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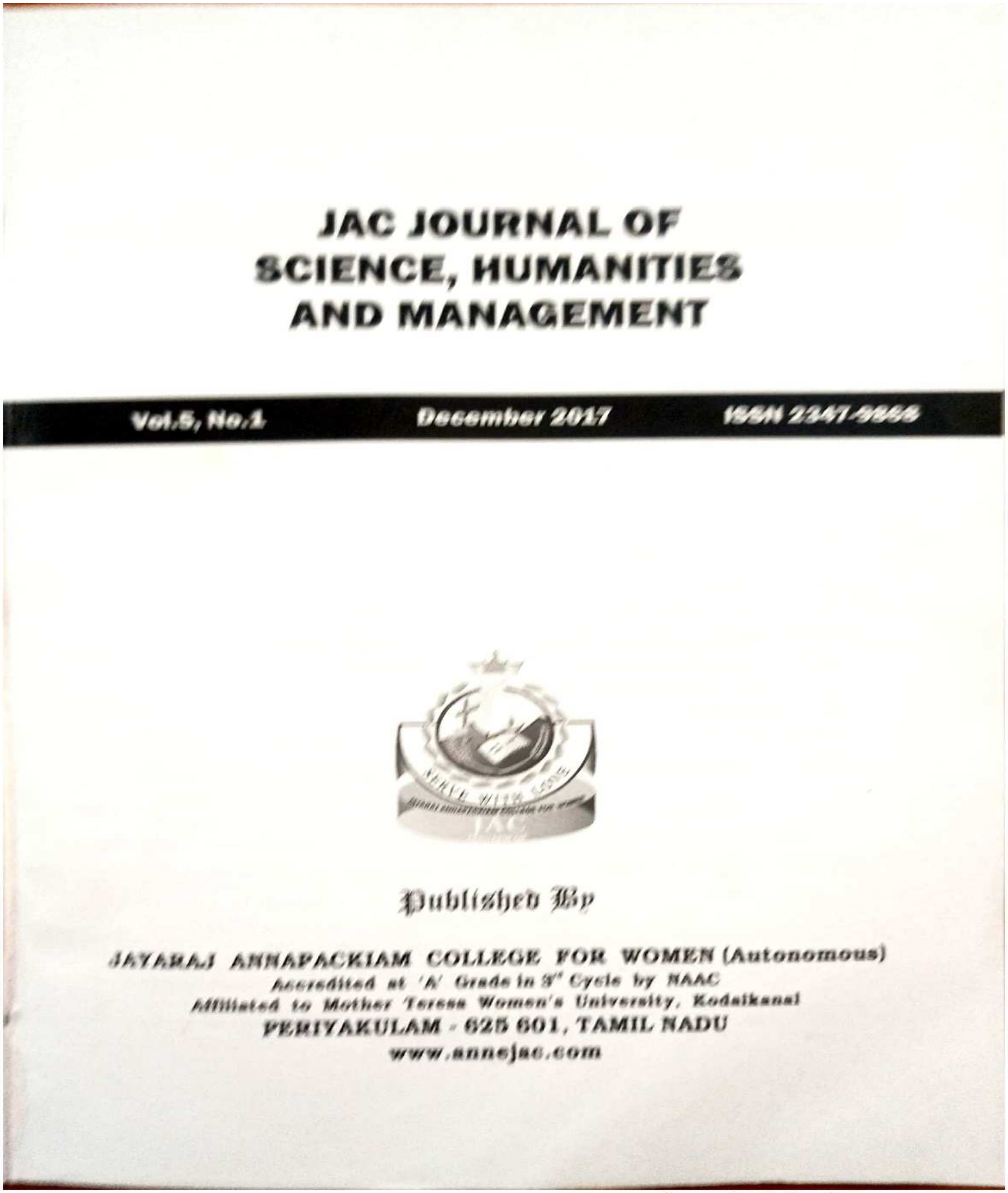

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CONTENTS

Green synthesis and characterization of silver nanoparticles from *Manilkara zapota* leaf extract

Thenmozhi[1] R., Antony lisa[1] J., Jayanthi priya[1] K., Gowri[1] K. and Karthikadevi A[2]
[1]Department of Chemistry, [2]Department of Physics
Sakthi College of Arts and Science for Women, Oddanchathram,
Tamilnadu, India-624618

Abstract

The aim of the present work is to investigate the green synthesis of silver nanoparticles from Manilkara zapota leaves extract. The absorption of MZAg UV-Vis spectroscopy. The functional groups are analysed by Fourier transform infrared spectroscopy. The ability of new compounds to act as hydrogen donors or free radical scavengers was tested by conducting a series of in vitro antioxidant assays. The MZAg was characterized surface morphology by scanning electron microscopy, Elemental constitution by Energy dispersive X-Ray diffraction. X-Ray diffraction studies were used to analyse the surface of the nature of the green synthesis of silver nano particles of MZAg.

1. Introduction

The Nanoworld deals with tiny objects which are nanometric in size at least in one dimension. The science of nanomaterials deals with their generation and properties and the phenomena exhibited by them because of their small size [1]. Nano-objects can be spherical, wiry, and tubular (or) sheet like. Nanotechnology is the study of matter on an atomic and molecular scale. One billionth (or) 10^{-9}m. The carbon-carbon bond length is in the range of 0.12-0.15 nm and the DNA double helix has a diameter of 2nm and bacteria will be around 200nm. So partials of nanometer size are called nanopartical [2]. Nanomaterials have been the subject of enormous interest. More importantly, Ag NPs are highly antimicrobial due to their antiseptic properties against several species of bacteria, including the common kitchen microbe. As such, Ag NPs have caught the attention of many researchers, especially because of their activity (3).

2. Materials and methods

2.1. Preparation of *Manilkarazapota* Leaf extract by boiling method

Mailkara zapota fresh and healthy leaves were collected locally and rinsed thoroughly first with tap water followed by distilled water to remove all the dust and unwanted visible particles cut into small pieces. The *Manilkara zapota* leaves weighed 50g and added 200 ml of distilled water boiled for 15 minutes at 80c in heating mental. The leaves extract was allowed to cool at room temperature and then filter using Whattmann filter paper No. 1 [4].

2.2. Synthesis of silver nanoparticles (AgSC)

For the synthesis of silver nanoparticles 1mM aqueous solution of silver nitrate ($AgNO_3$) was prepared. To 10 ml of SC leaf extract, 90 ml of the prepared silver nitrate solution mixed and kept for 24 hrs. Then the residue dried in oven at 80°C. The MZAg nanoparticles taken in a beaker washed to attain neutral pH then dried in oven (4) for further use. AgMZ was characterized by FTIR, SEM, EDAX, XRD, UV-visible spectrometer, particle analyzer antimicrobial activity and antioxidant property[2].

3. Result and discussion

3.1. UV-Vis spectroscopy

The addition of *Manilkarazapota* leaf extract to silver nitrate ($AgNO_3$) solution resulted in color change of the solution from transparent to brown due to the production of silver nanoparticles. The color changes arise from the excitation of surface Plasmon vibrations with the silver nanoparticles (**Figure 1**) .The silver nanoparticles produced a peak centered near 420 nm. UV–vis absorbance of the reaction mixture was taken from 0 till 2 min. It was observed that the absorbance peak was centered near 420 nm, indicating the reduction of silver nitrate into silver nanoparticles. It was also observed that the reduction of silver ions into silver nanoparticles started at the start of reaction and reduction was completed at almost 2 min at room temperature, indicating rapid biosynthesis of silver nanoparticles.

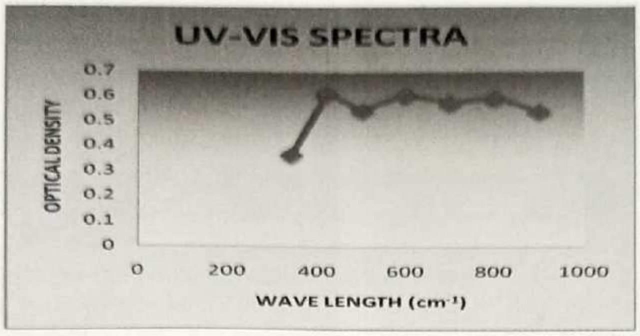

Figure 1: UV-Vis spetra of *Manilkarazapota*leafs extract

3.2 Scanning Electron Microscopy Analysis

The Scanning Electron Microscopy has been employed to characterization the size, shape and morphologies of formed silver nanoparticles. The SEM images of various magnification samples are shown in (Figure 2,3,4 &5). From the images, it is evident that the morphology of silver nanoparticles is nearly spherical the average particle size range analyzed from the SEM. Usually biosynthesized silver nanoparticles are covered by bimolecular. In figure, small silver nanoparticles are seen attached to the surface of very large bimolecular. The SEM images of the AgNPs are shown in Figures. It is seen that AgNPs of different shapes were obtained in case of the *Manilkarazapota* leaf extracts from being used as capping agents.

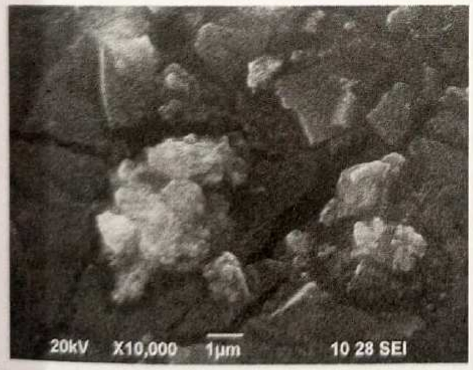

Fig 2: SEM analysis of *MZAg* in100,00nm

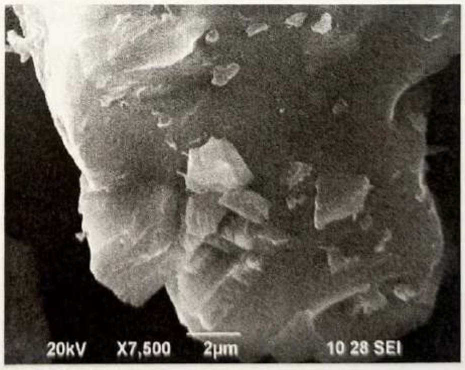

Fig 3: SEM analysis of *MZAg*7,500nm

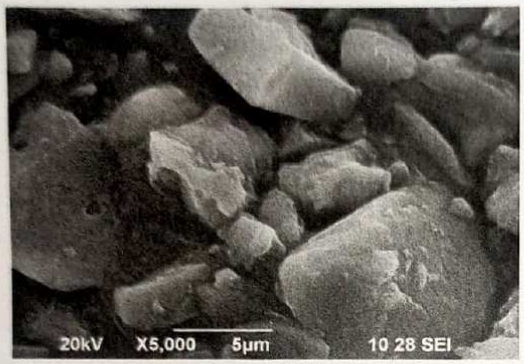

Fig 4: SEM analysis of MZAg in 5,000nm

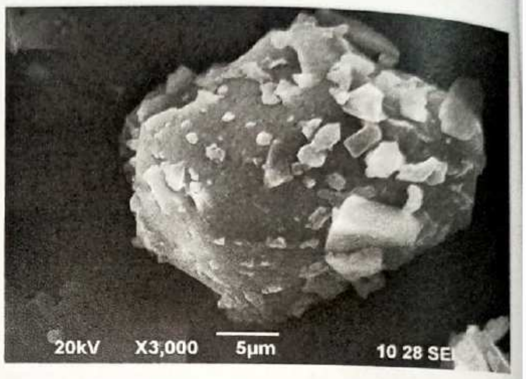

Fig 5: SEM analysis of MZAg in 3,000nm

3.4. Fourier Transform Infrared Spectroscopy

The FT-IR spectrum **Figure 6** obtained for *Manilkarazapota* leaf extract displays a number of absorption peaks, reflecting its complex nature. Strong absorption peaks at 3436.33 cm^{-1} result from stretching of the -NH band of amino groups or is indicative of bonded -OH hydroxyl group. The peaks at 1614.49 and cm^{-1} indicate the fingerprint region of CO, C-O, and O-H groups. The intense band at 1043 cm^{-1} could be assigned to the C-N stretching vibrations of aliphatic amines. The FT-IR spectrum also shows bands at 1448.60 cm^{-1} identified as amide I and amide II which arise due to carbonyl (C=O) and amine (–NH) stretching vibrations in the amide linkages of the proteins, respectively. The absorption band at 599.89 cm^{-1} could be attributed to ethylene scissoring vibrations from the proteins. FT-IR study indicates that the carboxyl (–C=O), hydroxyl (–OH), and amine (N-H) groups in carob leaf extract are mainly involved in reduction of Ag^{+} ions to Ag^{0} nanoparticles. The FT-IR spectroscopic study also confirmed that the protein present in *Manilkarazapota* leaf extract acts as a reducing agent and stabilizer for the silver nanoparticles and prevents aggiomeration.

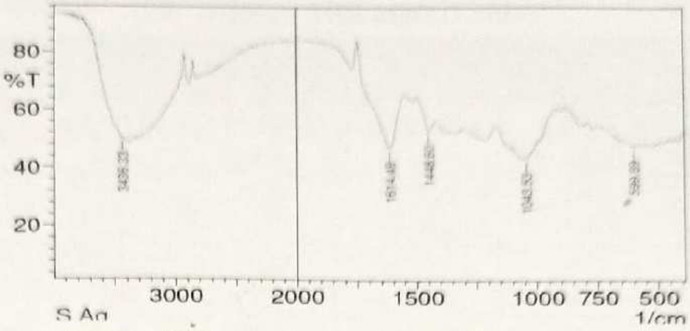

Fig 6: FTIR spectrum of *Manilkarazapota*

3.5. Energy Dispersive X-ray Spectroscopy Analysis:

The additional support of reduction of Ag+ ions to elemental silver, as confirmed by EDX Analysis, showed a peak at 3 keVin the silver region, which confirms the presence of Elemental silver as shown Figure 7 and Table 1. The optical absorption is typical for the absorption of metallic silver nano crystals due to Surface Plasmon Resonance. Its characterization capabilities are due in large part to the fundamental principle that each element has a unique atomic structure allowing unique set of peack on its X-ray spectrum. The EDX spectra also confirm the formation of Ag nanoparticles. The spectra show peaks only for Ag that shows the high purity of synthesized Ag nanoparticles.

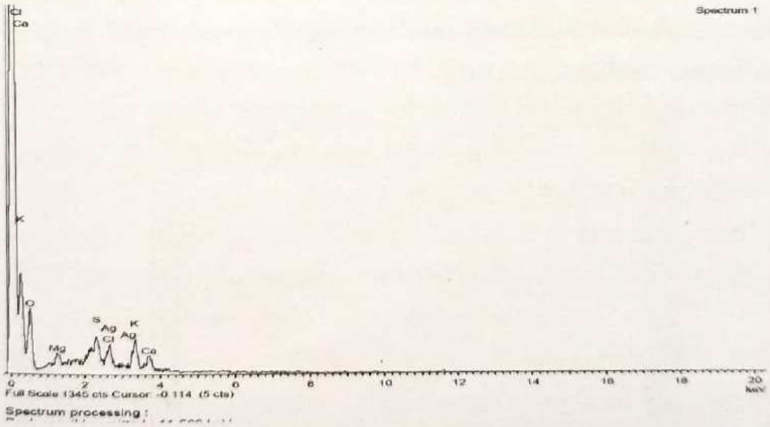

Fig 7: EDX spectra of *Manilkarazapota* silverNanoparticles

Table 1: Data EDX spectra

Element conc.	App corn.	Intensity sigma	Weight%	Weight%	Atomic%
OK	9.12	0.7472	68.46	5.17	83.37
MgK	0.46	0.6513	3.36	0.97	3.17
SK	0.81	0.9573	4.73	1.04	2.88
CK	0.82	0.8106	5.711	1.14	3.14
KK	1.68	1.0362	9.08	1.59	4.52
CaK	0.79	0.9238	4.77	0.99	2.32
AgL	0.46	0.7885	3.29	1.66	0.59
Total			100		100

3.6. X-Ray refractory diffraction:

Analysis through X-ray diffraction was carried out to confirm the crystalline nature of the silver nanoparticles. A comparison of our XRD spectrum with the standard confirmed that the silver particles formed in our experiments were in the form of nanocrystals, as evidenced by the peaks at 2θ values of corresponding to 38.5^{0}, 22^{0}, 26.5^{0}, 44.5^{0}, 29.5^{0}, 77.5^{0} and 64.5^{0} clearly *Mnilkarazapota* show that the silver nanoparticles formed by the reaction of Ag ions by the extract are crystalline in nature. The unassigned peaks at $2\theta = 38.2°$, 32.4°, and 44.4°, 64.6^{0}, 71.10 denoted by in are thought to be related to crystalline and amorphous organic phases. It was found that the average size from XRD data Figure 8, illustrate that the AgNPs synthesized by our green method were nanocrystalline in nature.

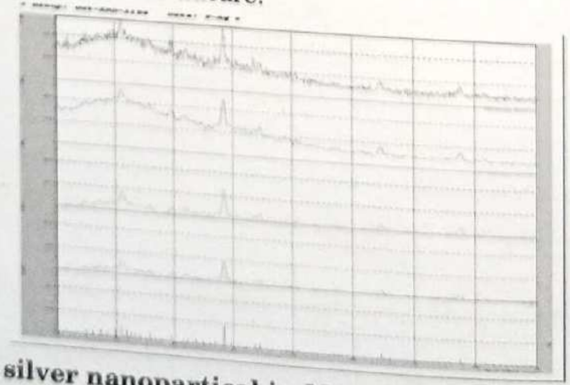

Fig 8. XRD silver nanopartical in *Manilkarazapota* leaf extracts

3.7. Antioxidant activity

Usually free radicals are generated in many bioorganic redox processes and they induce oxidative damage in various components of the body (lipids, proteins and DNA) and they have been implicated in chronic diseases such as cancer, hypertension, parkinson disease, alzheimer, cardiac infarction, atherosclerosis, rheumatism, cataracts etc.(5,6) Efforts to counteract the damage caused by the free radicals are gaining acceptance as an origin for novel therapeutic approaches and the field of preventive medicine is experiencing an upsurge of interest in medically useful antioxidants.

The DPPH radical has been widely used to test the ability of compounds as free radical scavengers or hydrogen donors to evaluate the antioxidant activity. Hydrogen peroxide itself is not very reactive but sometimes it is toxic to cell because it may give rise to hydroxyl radicals in the cells.(7) The free radical scavenger action is very important, especially in the case of superoxide anion, since it prevents or attenuates the formation of peroxynitrite and hydroxyl radical. The overproduction of peroxynitrite and hydroxyl radical consists of a very important feature regarding tissue damage mechanisms during pathological processes. Nitric oxide or reactive nitrogen species (RNS) are responsible for altering the structural and functional behaviour of many cellular components. The scavenging of RNS may help to arrest the chain reactions initiated by excess generation of NO that are detrimental to the human health. Among all the free radicals, hydroxyl radical is a major product arising from the high-energy ionization of water, whose most important biological source is Haber–Weiss and Fenton reaction, involving superoxide anion, hydrogen peroxide and transition metals (8). This is the most aggressive oxidant known and therefore the most dangerous oxygen metabolite, which is capable of attacking any biological molecule and lead to tissue damage, therefore the elimination of this radical is one of the major role of antioxidant administration (9,10).

Hence, we carried out experiments to investigate the free radical scavenging ability of the new compounds against a panel of free radicals, with a hope to develop potential antioxidants and therapeutic reagents. The IC_{50} value of the compound (Table 2) obtained from different types of assay experiments strongly supports that the new compound possess significant antioxidant activities, which are much better than that of the standard antioxidants Vitamin C and BHT.

Table 2: Antioxidant activity of the new compounds and Vitamin C against various radicals

Compounds	*IC$_{50}$(μM)[a]			
	DPPH$^{\cdot}$	NO$^{\cdot}$	H_2O_2	OH$^{\cdot}$
MZAg	> 500	31.29 ± 0.23	131.05± 0.48	5.63 ± 0.25
Vitamin C	147.6 ± 4.2	215.8 ± 2.7	238.5 ± 3.6	232.8 ± 1.9
BHT	86.2 ± 1.8	154.3 ± 2.4	149.8 ± 4.3	163.4 ± 0.7

[a] : fifty percent inhibitory concentration of the test compounds against free radicals

Antioxidants exert their effect by different mechanisms such as scavenging or inhibiting free radicals by the donation of an electron or proton (H^+). Out of the four radical species chosen to examine, the hydroxyl radical scavenging power of the tested compound was excellent (5.63 ± 0.25 μM), and the DPPD radical scavenging ability was the least (>500 μM). The new compound MZAg outperformed the activity corresponding to the scavenging of nitric oxide radical, hydroxyl radical and hydrogen peroxide moleculewith vitamin C and BHT.

4. Conclusion

In summary, the synthesized Ag nanoparticales using *Manilkara zapota* leaves extracts. Specifically, we describe an environmentally friendly one-step method to synthesize noble nanoparticles without usage of any special capping agents at room temperature. This green approach may find various medicinal as well as technological application.

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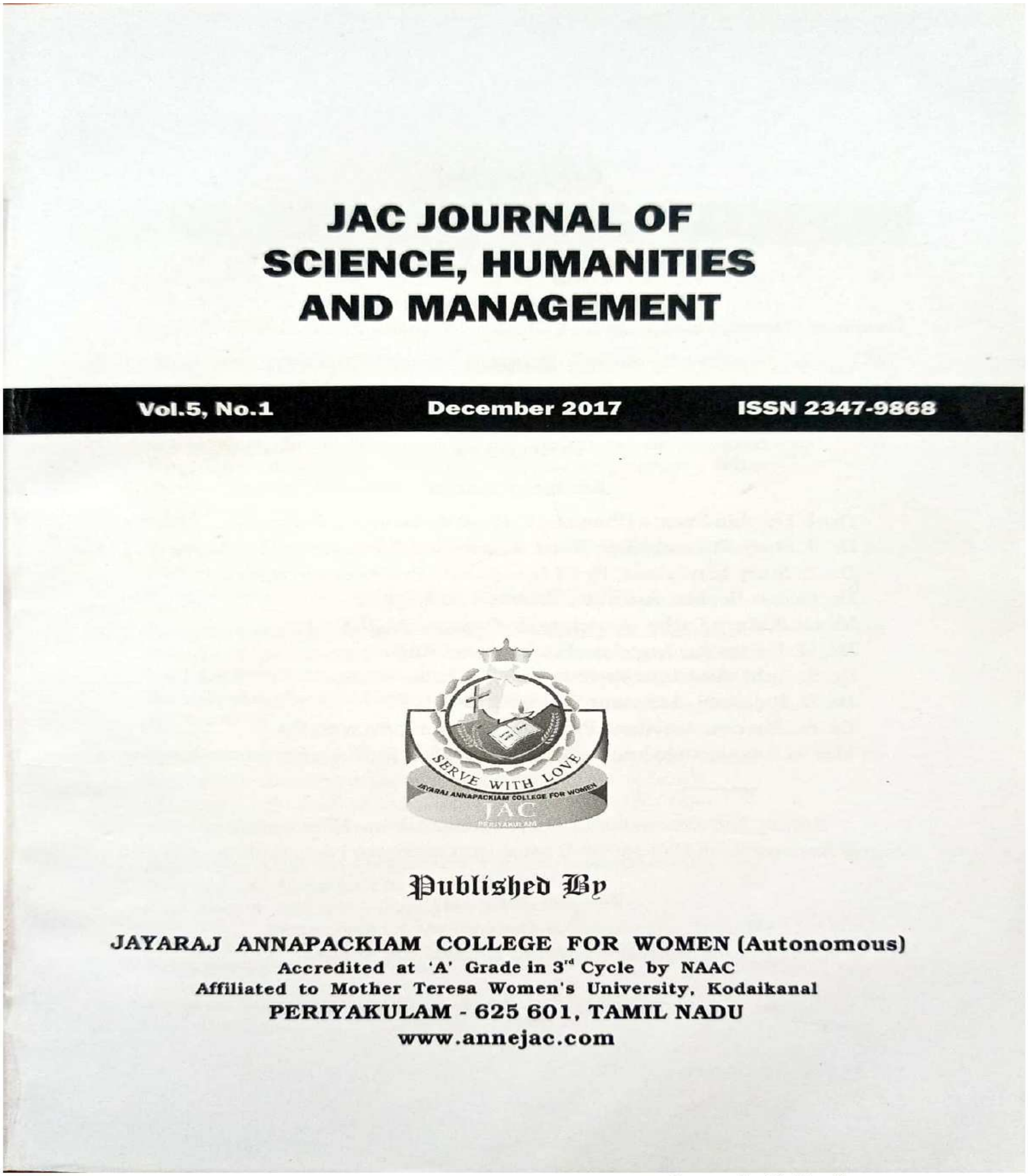

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CONTENTS

Inhibitive action of Pippali Dye-Zn^{2+} system of carbon steel in Sea water

Johnsirani[1] V.*, Sathiyabama J.[2] and Hemalatha[1] M.
[1]*PG and Research Department of Chemistry, Sakthi College of Arts and Science for Women, Oddanchatram-624624, Tamil Nadu, India.*
[2]*PG and Research Department of Chemistry, GTN Arts College, Dindigul – 624005, Tamil Nadu, India.*
Email:johnsirani15@gmail.com

Abstract

The inhibition efficiency (IE) of Pippali Dye- (PD) Zn^{2+} *system in controlling corrosion of carbon steel has been evaluated by weight loss method. Weight loss study reveals that the formulation consisting of 10 mL of PD and 25 ppm of* Zn^{2+} *has 92% inhibition efficiency in controlling corrosion of carbon steel immersed in sea water. Polarization study reveals that this system functions as mixed type inhibitor. AC impedance spectra reveal that a protective film is formed on the metal surface. The FTIR spectra reveal that the protective film consists of* Fe^{2+}*-PD complex. This is further confirmed by UV-visible spectra and fluorescence spectra.*

Key words: *Corrosion, Sea water, Carbon Steel, Inhibitors, Pippali Dye.*

1. Introduction

Corrosivity of metals used as construction materials are of important consideration for marine constructions planning. Corrosion at marine areas occurs as a consequence of metals in contact with seawater blown by the wind that will cling to the metal surfaces. Fine sprinkling of seawater containing chloride is very corrosive to the metals. The corrosion is more rapid if the metals are dipped in sea-water. Metals such as copper and iron, which are important for modern man's life tend to corrode. Corrosion of the metals as a result of fine sprinkling of seawater cause permanent reduction in the metal quality, which is not only materially disadvantageous, but could also create conditions which might cause disasters and loss economically. Plants are sources of naturally occurring compounds, some with complex molecular structures and having different chemical, biological, and physical properties. The naturally occurring compounds are mostly used because they are environmentally acceptable, cost effective, and have abundant availability. These advantages are the reason for use of extracts of plants and their products as corrosion inhibitors for metals and alloys under different environment [1-5]. The present work is undertaken: To evaluate the inhibition efficiency (IE) of Pippali Dye (PD)-Zn^{2+} system in controlling corrosion of carbon steel immersed in sea water in the absence and presence of Zn^{2+} by weight loss method. To study the mechanism of corrosion inhibition by polarization study. To analyse the protective film by FTIR spectra, UV-visible spectra and fluorescence spectra. To propose the mechanism of corrosion inhibition based on the above results.

2. Materials and Methods

2.1 Preparation of plant extract

10 gm of Pippali (Piper longum L.) powder was weighed and boiled with double distilled water. The grey dye Pippali was filtered to remove suspended impurities and made up to 100 mL. The Pippali dye (PD) was used as corrosion inhibitor in the present study.

2.2 Preparation of Specimen

Carbon steel specimens (0.02 6% S, 0.06% P, 0.4% Mn, 0.1% C and rest iron) of the dimensions 1.0 x 4.0 x 0.2 cm were polished to a mirror finish, degreased with trichloroethylene and used for the weight-loss method and surface examination studies.

2.3 Weight – Loss Method

Carbon steel specimens were immersed in 100 mL of the medium containing various concentrations of the inhibitor in the absence and presence of Zn^{2+} for 1 day. The weights of the specimens before and after immersion were determined using a balance Shimadzu AY62 model. The corrosion IE was then calculated using the equation.

$$IE = 100\left(1 - \frac{W_2}{W_1}\right) \qquad (1)$$

W_1 - weight loss value in the absence of inhibitor; W_2 - weight loss value in the presence of inhibitor Corrosion rate (CR, in mm/year) was calculated using the formula

$$CR = 87.6\frac{W}{DAT} \qquad (2)$$

D = density of specimen g cm^{-3}; A = area of specimen in square cm
T = exposure time in hours; W = weight in milligrams

2.4 Potentiodynamic Polarization Study

Polarization studies were carried out in a CHI- electrochemical work station with impedance model 660A. It was provided with iR compensation facility. A three electrode cell assembly is used. The working electrode was carbon steel. A saturated calomel electrode (SCE) was the reference electrode. Platinum was the counter electrode. From polarization study, corrosion parameters such as corrosion potential (E_{corr}), corrosion current (I_{corr}), Tafel slopes anodic = b_a and Cathodic = b_c were calculated and linear polarization study (LPR) was done. The scan rate (V/s) was 0.01. Hold time at (E_{fcs}) was zero and quiet time (s) was two.

2.5 Fourier transforms infrared spectra

These spectra were recorded in a Perkin-Elmer-1600 spectrophotometer using KBr pellet. The FTIR spectrum of the protective film was recorded by carefully removing the film, mixing it with KBr and making the pellet.

2.6 UV-visible spectra and fluorescence spectra

The possibility of the formation of iron-inhibitor complex in solution was examined by mixing the respective solutions and recording their UV-Visible absorption spectra using Analytic Jena SpecordS-100, UV-Visible spectrophotometer.

3. Results and Discussion

3.1. Analysis of the results of the weight loss method

The calculated inhibition efficiencies (IE) of Pippali dye in controlling the corrosion of carbon steel immersed in sea water both in the absence and presence of zinc ion have been tabulated in **Table 3.1.1.**The calculated values indicate the ability of Pippali dye to be a good corrosion inhibitor. The inhibition efficiency is found to be enhanced in the presence of zinc ion. The formulation consisting of 10mL of PD and 25 ppm of Zn^{2+} offers 92% inhibition efficiency. That is, mixture of inhibitors shows better IE than the individual inhibitors [6- 10].

Table 3.1.1. The corrosion inhibition efficiencies and the corresponding corrosion rates (millimetre per year) of PD – Zn^{2+} system.

PD (mL)	With out Zn^{2+} (ppm)		25 Zn^{2+} (ppm)	
	IE (%)	CR (mm/y)	IE (%)	CR (mm/y)
0	-	0.1576	16	0.1323
2	50	0.0788	70	0.0472
4	53	0.0740	75	0.0394
6	55	0.0709	85	0.0236
8	60	0.0709	89	0.0173
10	63	0.0583	92	0.0126

3.2. Analysis of results of potentiodynamic polarization study for the PD-Zn^{2+} system

Polarization study has been used to detect the formation of protective film on the metal surface during corrosion inhibition process. The potentiodynamic polarization curves obtained for carbon steel in sea water without and with inhibitors (10 mL of PD + 25 ppm Zn^{2+}) are shown in Fig.3.2.1. The cathodic branch represents the oxygen reduction reaction, while the anodic branch represents the iron dissolution reaction. The electrochemical parameters such as corrosion potential (E_{corr}), corrosion current (I_{corr}), Tafelsolpes (b_a and b_c), linear polarization resistance (LPR) are given in Table 3.2.2.When carbon steel is immersed in sea water, the corrosion potentials is -816 mV vs. SCE. The inhibitor system shifts the corrosion potential to -815 mV vs SCE. The corrosion potential shift is very small. This suggests that the PD-Zn^{2+} formulation functions as a mixed inhibitor controlling the anodic reaction and cathodic reaction, to the same extent. The corrosion current value and LPR value for sea water are 6.354×10^{-6} A/cm^2 and 6.500×10^3 ohm cm^2. In the presence of the inhibitors, the corrosion current value has decreased to 5.848×10^{-6} A/cm^2, and the LPR value is increased to 6.988×10^3 ohm cm^2. This indicates that a protective film is formed on the metal surface, LPR value increases and corrosion current value decreases [11-14].

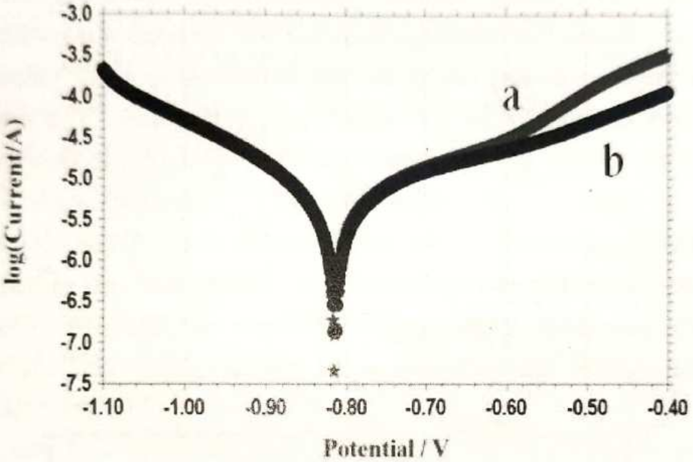


Fig. 3.2.1 Polarization curves of carbon steel immersed in various test solutions (a) Sea water (b) Sea water containing 10 mL of PD and 25 ppm of Zn^{2+}

Table 3.2.2 Corrosion parameter of carbon steel immersed in sea water in the absence and presence of inhibitor system (PD-Zn^{2+}) obtained from polarization method

PD mL	Zn^{2+} ppm	E_{corr} mVvs SCE	I_{corr} A/cm^2	b_a mV/dec	b_c mV/dec	LPR ohm cm^2
0	0	-816	6.354×10^6	239	157	6.500×10^3
10	25	-815	5.848×10^6	239	154	6.988×10^3

3.3 Analysis of AC impedance spectra

Nyquist representation of carbon steel in sea water in the absence and presence of the inhibitor system are shown in Fig. 3.3.2. AC impedance spectra have been used to detect the formation of film on the metal surface [15-16]. If a protective film is formed, the charge transfers resistance (R_t) increases and double layer capacitance (C_{dl}) value decreases. It is clear from the plots that the impedance response of carbon steel was significantly changed after addition of the inhibitors. The impedance diagrams obtained almost have a semicircular appearance. This indicates that the corrosion of carbon steel in aqueous solution is mainly controlled by a charge transfer process. The deviation from the perfect semicircle shape is due to the frequency dispersion of interfacial impedance. This anomalous behavior is generally due to the non-homogeneity of the metal surface arising from surface roughness or interfacial phenomena. The impedance parameters, namely charge transfer resistance (R_t) and double layer capacitance (C_{dl}) are given in Table 3.3.3.When carbon steel is immersed in sea water, R_t value is 101.10 ohm cm^2 and C_{dl} value is 5.0445×10^{-8} F/cm^2. When the inhibitors are added to sea water, $R_t$value increases from 101.10 ohm cm^2 to 121.04 ohm cm^2 and the C_{dl} decreases from 5.0445×10^{-8} F/cm^2 to 4.213×10^{-8} F/cm^2. This suggests that a protective film is formed on the surface of the metal[17].

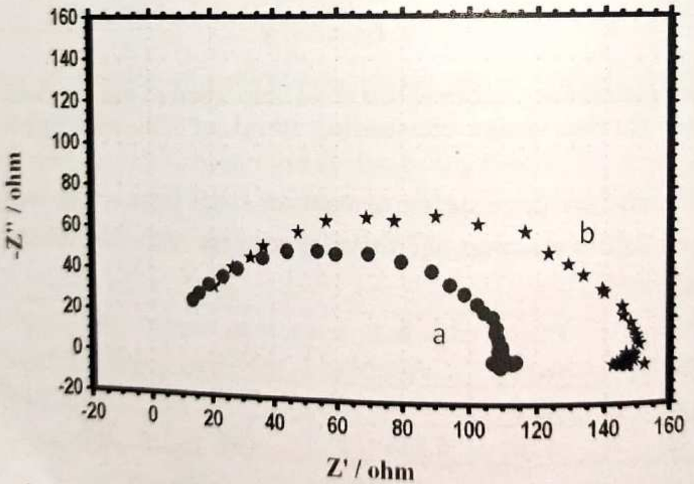


Fig. 3.3.2 Ac impedance spectra of carbon steel immersed in various test solutions (a) Sea water (b) Sea water containing 10 mL of PD and 25 ppm of Zn^{2+}

Table 3.3.3 Impedance parameters of carbon steel in sea water in the absence and presence of inhibitor system (PD-Zn^{2+}) obtained by AC impedance method

PD(mL)	Zn^{2+}ppm	R_t Ohm cm²	C_{dl} F/cm²
0	0	101.10	5.0445×10^{-8}
10	25	121.04	4.213×10^{-8}

3.4. Analysis of the UV–Visible absorption spectra and fluorescence spectra

UV-Visible absorption spectra and fluorescence spectra are used to confirm the protective film formed on the metal surface [18 &19]. UV-Visible absorption spectrum of an aqueous solution of (PD) is shown in Fig.3.4.2a. Peak appears at 320 nm. The corresponding emission spectrum (λ_{ex} = 320 nm) is shown in Fig.3.4.2 a. Peaks appear at 327nm and 433nm.

Fe^{2+} -PD complex in solution was freshly prepared by mixing PD solution and Fe^{2+} ion ($FeSO_4 . 7H_2O + H_2O$). Its UV-Visible absorption spectrum is shown in Fig.3.4.3a. Peak appears at 316nm. The corresponding emission spectrum (λ_{ex} = 316nm) is shown in Fig.3.4.3b. Peaks appear at 322 nm and 429 nm. These peaks correspond to Fe^{2+} -PD complex.

The emission spectrum (λ_{ex}= 316 nm) of the film formed on the carbon steel metal surface after immersion in the solution containing 25 ppm of Zn^{2+} and 10 mL of PD is shown in Fig.3.4.4 c. Peaks appears at 324 nm and 431nm. These peaks correspond to Fe^{2+}-PD complex. Thus fluorescence spectral study leads to the conclusion that protective film consists of Fe^{2+}-PD complex formed on the metal surface.

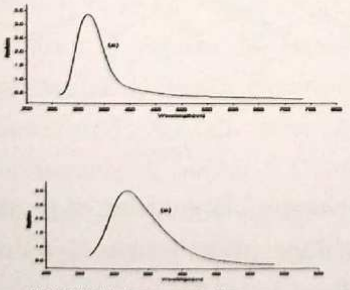


Fig.3.4.4 UV-Visible absorption spectra of solutions
a) PD b) PD+Fe^{2+}

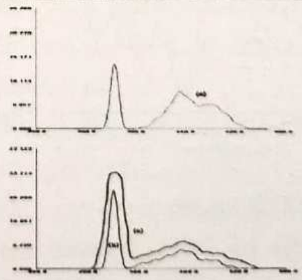
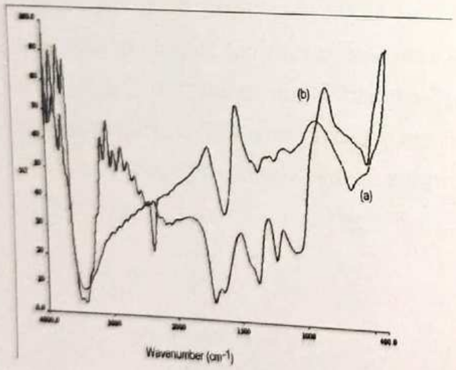


Fig 3.4.3 Fluorescence Spectra
(a) PD Solution
(b) PD+Fe^{2+} Solution
(c) Film Formed on metal surface after immersion in solution containing sea water +10ml of PD and 25ppm of Zn^{2+}

3.5 Analysis of FTIR spectra

The main constituent of Pippali dye is Piperine. The grey colour of the extract is due to Piperine [31]. The structure of Piperine is shown in Scheme 1 [20]. The Pippali dye extract was evaporated to dryness to get a solid mass. Its FTIR spectrum of the solid mass is shown in Fig 3.5.5a.The –OH stretching frequency appears at 3418cm^{-1}. The C=O stretching frequency appears at 1710cm^{-1}. Thus, Pippali dye was characterized by IR spectroscopy [21]. The FTIR spectrum of the protective film formed on the surface of the metal after immersed in the solution containing 25 ppm of Zn^{2+} and 10mL of PD shown in Fig3.5.5b. It is found that the -OH has shifted from 3418 cm^{-1} to 3437 cm^{-1}. The C=O stretching frequency has decreased from 1710cm^{-1} to 1630cm^{-1}. It was inferred that PD has coordinated with Fe^{2+} through the phenolic oxygen and carbonyl oxygen, resulting in the formation of the Fe^{2+}-PD complex on the anodic sites of the metal surface. The peak at 1367cm^{-1} is due to Zn-O band. The peak at 3437cm^{-1} is due to –OH stretching. Hence it is confirmed that $Zn(OH)_2$ is formed on the cathodic sites of the metal surfacehg. Thus, the FTIR spectral study leads to the conclusion that the protective film consists of the Fe^{2+}- PD complex and $Zn(OH)_2$.



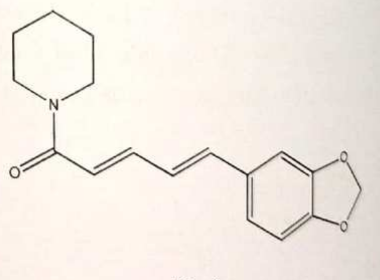

Piperine

Fig.3.5.5 FTIR spectra

Scheme:1. **Structure of piperine**

a) Pure PD b) Film formed on metal surface after immersion in sea water containing 10mL of PD – 25 ppm Zn^{2+}

4. Conclusion

In order to explain the corrosion inhibition of carbon steel immersed in sea water containing PD (10 mL)-Zn^{2+} (25 ppm), the following mechanism may be proposed. When the formulation consists of PD (10 mL) - Zn^{2+} (25 ppm) in sea water there is formation of Zn^{2+} -Piperine complex in solution.When carbon steel is immersed in this solution Piperine -Zn^{2+} complex diffuses from the bulk of the solution towards the metal surface. Piperine -Zn^{2+} complex is converted into - Fe^{2+} complex on the anodic sites of the metal surface with the release of Zn^{2+} ion. Zn^{2+}-Piperine + Fe $\rightarrow$ Fe^{2+}- Piperine+ Zn^{2+}. The released Zn^{2+} combines with OH^- to form $Zn(OH)_2$ on the cathodic sites of the metal surface. $Zn^{2+} + 2OH^- \rightarrow Zn(OH)_2\downarrow$ Thus the protective film consists of Piperine-Fe^{2+} complex and $Zn(OH)_2$.

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SD Closed set, SD Open set and its Properties

S.Divya Priya[1], K. Amutha[2],
M.Phil Scholar, Dept. of Mathematics, SCAS, Dgl, Tamil Nadu, India[1]
Associate Professor, Dept. of Mathematics, SCAS, Dgl, Tamil Nadu, India[2]

ABSTRACT: In this paper, we introduce and investigate the notation of SD closed set and SD open sets by utilizing generalized closed sets and regular b-closed set. We obtain fundamental properties of SD closed set and SD closed set and discuss the relationships between SD closed set and SD open set and other related sets.

KEY WORDS: SD closed set, SD open set.

I. INTRODUCTION

The notion of regular b-closed (briefly rb-closed) sets is introduced and studied recently by Nagaveni and Narmadha [1],[2]. Regular open sets and b-open sets have been introduced and investigated by Stone [3] and Andrijevi`c [4], respectively. Levine [5] (resp. Bhattacharya and Lahiri [6], Palaniappan and Rao [7], Arya and Nour [8], Maki et al [9], Maki et al [10],[11]) introduced and investigated generalized closed sets (resp. semi-generalized closed sets, regular generalized closed sets, generalized semi-closed sets, generalized preclosed sets, generalized α-closed sets and α-generalized closed sets). Al-Omari and Noorani [12] investigated the class of generalized b-closed sets and obtained some of its fundamental properties. We introduce and study the concepts of rb-open sets and rb-closed spaces. Throughout this paper, a space means a topological space on which no separation axioms are assumed unless otherwise mentioned. For a subset A of a space (X,τ), Cl(A) and Int(A) denote the closure of A and interior of A, respectively. X -A or A^c denotes the complement of A in X . The concept of generalized closed sets plays a significant role in topology. There are many research papers which deal with different types of generalized closed sets. Bhattacharya and Lahiri [6] introduced sg-closed sets in topological spaces. Arya and Nour [8] introduced gs-closed sets in topological spaces. Sheik John [14] introduced w -closed sets in topological spaces. Ravi and Ganesan [15] introduced $\ddot{g}$ -closed sets in topological spaces. Quite Recently, Ravi et. al. [16] have introduced ≈g-closed sets in topological spaces. In this paper we introduce a new class of sets namely sd-closed sets in topological spaces and study their basic properties.

II. PRELIMINARIES

Definition: 2.1 A subset A of a space (X,τ) is called

(i) Semi-open set [18] if $A \subseteq Cl(Int(A))$

(ii) preopen set [19] if $A \subseteq Int(Cl(A))$

(iii) α-open set [20] if $A \subseteq Int(Cl(Int(A)))$

(iv) semi-preopen set [21] if $A \subseteq Cl(Int(Cl(A)))$

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Definition: 2.2 A subset A of a space (X,τ) is called

(i) a generalized semi-preclosed (briefly gsp-closed) set [17] if $spCl(A)\subseteq U$ whenever $A\subseteq U$ and U is open in (X,τ) . The complement of gsp-closed set is called gsp-open set;

(ii) $\ddot{g}$ -closed set [15] if $Cl(A)\subseteq U$ whenever $A\subseteq U$ and U is sg-open in (X,τ). The complement of g -closed set is called $\ddot{g}$ -open set;

(iii) a A-closed set [16] if $Cl(A)\subseteq U$ whenever $A\subseteq U$ and U is $\ddot{g}$ -open in (X,τ). The complement of A-closed set is called A-open set;

(iv) a B-closed set [16] if $scl(A)\subseteq U$ whenever $A\subseteq U$ and U is A-open in (X,τ) . The complement of B-closed set is called B-open set;

(v) a $\approx$g-closed set [16] if $cl(A)\subseteq U$ whenever $A\subseteq U$ and U is B-open in (X,τ). The complement of $\approx$g-closed set is called $\approx$g-open set.

Definition 2.3: A subset A of a space X is said to be regular closed [3] if A = Cl (Int (A)). The complement of regular closed set is called regular open set;

Definition 2.4: A subset A of a space X is said to be b-closed [4] if Int (Cl (A)) ∩ Cl (Int (A)) □ A. The complement of b-closed set is called b-open set;

Definition 2.5: A subset A of a space X is said to be

1. generalized semi-closed (briefly gs-closed) [8] if scl (A) $\subseteq$ U whenever A $\subseteq$ U and U is open in X, The complement of gs-closed set is called gs-open set;

2. semi-generalized closed (briefly sg-closed) [6] if scl (A) $\subseteq$ U whenever A $\subseteq$ U and U is semi-open in X, The complement of sg-closed set is called sg-open set;

3. regular-generalized closed (briefly rg-closed) [7] if Cl (A) $\subseteq$ U whenever A $\subseteq$ U and U is regular-open in X, The complement of rg-closed set is called rg-open set;

4. generalized pre-closed (briefly gp-closed) [9] if pcl (A) $\subseteq$U whenever A $\subseteq$ U and U is open in X, The complement of gp-closed set is called gp-open set;

5. generalized α-closed (briefly gα-closed) [10] if αcl (A) $\subseteq$U whenever A$\subseteq$ U and U is α-open in X, The complement of gα -closed set is called gα -open set;

6. α-generalized closed (briefly αg-closed) [11] if αcl (A) $\subseteq$ U whenever A$\subseteq$ U and U is open in X, The complement of αg -closed set is called αg -open set;

7. generalized b-closed (briefly gb-closed) [12] if bcl (A) □ U whenever A □ U and U is open in X, The complement of gb -closed set is called gb- open set;

8. δ-generalized closed (briefly δg-closed) [13] if δcl (A) □ U whenever A □ U and U is open in X. The complement of δg -closed set is called δg -open set;

Definition 2.6: A generalized closed (briefly g-closed) set [5] if cl(A) $\subseteq$ U whenever A $\subseteq$ U and U is open in (X, τ). The complement of g-closed set is called g-open set.

Definition 2.7: A subset A of a space X is said to be regular b-closed (briefly rb-closed) [2] if rcl (A) □ U whenever A □ U and U is b-open in X. The complement of regular b-closed set is called regular b-open set.

3. SD Closed set

Definition 3.1: A Set A is said to be SD closed set if

(i)A is generalized closed set[22] and (ii) A is regular b-closed[23]

Example:3.1

Let X = {a,b,c}, τ = {ϕ,X,{b}}, τ^c = {ϕ,X,{a,c}} and U=X.

SD closed set = {{a},{b},{c},{a,b},{b,c},{c,a},ϕ,X}.

Proposition:3.1 Let (X, τ) be a topological space. Prove that if A is regular closed set then A is SD closed set in X. Converse is need not be true. (U=X).

Proof: Let A be a regular closed then A=Cl(Int(A)).

$\Rightarrow$ A is regular b-closed set. … (1)

Since every regular closed set is regular b-closed and also Every regular closed set is regular open set.

Now Every regular open is open. Therefore Int (A) = A.

A = Cl(Int(A)) = Cl(A).

$\Rightarrow$ Cl(A) = A.

$\Rightarrow$ Cl(A) $\subseteq$ A whenever A $\subseteq$ U and U is open in X.

Then A is generalized closed (g-closed). … (2)

From (1) and (2) A is SD closed set.

Converse :

Example:

Let X = {a,b,c}, $\tau = \{\phi, X, \{b\}\}$, $\tau^c = \{\phi, X, \{a,c\}\}$ and $U = X$

(i) Regular closed set = $\{\{a\},\{b,c\},\phi,X\}$

(ii) SD closed set = $\{\{a\},\{b\},\{c\},\{a,b\},\{b,c\},\{c,a\},\phi,X\}$

Here the element $\{c,a\}$ is in SD closed set but not in regular closed set.

Lemma: Let (X, τ) be a topological space. Prove that regular closed set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.2 Let (X,τ) be a topological space. Prove that b-closed set is SD closed set in X. Converse is need not be true. (U=X)

Proof: Let A be b-closed set then $Int\,(Cl\,(A)) \cap Cl\,(Int\,(A)) \subset A$.

Since Every b-closed set is a subset of regular b-closed set, A is regular b-closed set. … (1)

we know that $Int(A) \subseteq A \subseteq Cl(A)$

$\Rightarrow Int(A) \subseteq Cl(A)$

$\Rightarrow Cl(Int(A)) \subseteq Cl(Cl(A)) \subseteq Cl(A) \subseteq A$

$\Rightarrow Cl(A) \subseteq A$

$\Rightarrow Cl(A) \subseteq U$ since $A \subset U$

$\Rightarrow Cl(A) \subseteq U$ whenever $A \subset U$ and U is open in X.

Therefore A is g-closed set. … (2)

From (1) and (2) A is SD closed set.

Converse:

Example:

Let X = {a,b,c}, $\tau = \{\ \phi, X, \{a,b\}\}$, $\tau^c = \{\ \phi, X, \{c\}\}$ and $U = X$

(i) b - closed set = $\{\{a,c\},\{b,c\},\{a\},\{c\},\{b\},\phi,X\}$

(ii) SD closed set = $\{\{a\},\{b\},\{c\},\{a,b\},\{b,c\},\{c,a\},\phi,X\}$

Here the element $\{a,b\}$ is in SD closed set but not in b-closed set.

Lemma: Let (X, τ) be a topological space. Prove that b-closed set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.3 Let (X,τ) be a topological space. Prove that generalized semi closed set (gs-closed) is SD closed set in X. Converse is need not be true. (U=X)

Example:

Let X = {a,b,c}, $\tau = \{\ \phi, X, \{b\}, \{b.c\}\}$, $\tau^c = \{\ \phi, X, \{a\}, \{a,c\}\}$ and $U = X$

(i) gs - closed set = $\{\{a,c\},\{a\},\phi,X\}$

(ii) SD closed set = $\{\{a\},\{b\},\{c\},\{a,b\},\{b,c\},\{c,a\},\phi,X\}$

Here the element $\{b\}$ is in SD closed set but not in gs-closed set.

Lemma: Let (X, τ) be a topological space. Prove that gs-closed set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.4 Let (X,τ) be a topological space. Prove that generalized semi open set (gs open) is SD closed set in X. Converse is need not be true. (U=X)

Example:

Let X = {a,b,c}, $\tau = \{\ \phi, X, \{b\}, \{b.c\}, \{a,b\}\}$, $\tau^c = \{\ \phi, X, \{a\}, \{c\}, \{a,c\}\}$ and $U = X$

(i) gs - open set = $\{\{a,b\},\{b\},\{b,c\},\phi,X\}$

(ii) SD closed set = $\{\{a\},\{b\},\{c\},\{a,b\},\{b,c\},\{c,a\},\phi,X\}$

Here the element $\{b\}$ is in both SD closed set and gs-open set. The element $\{c\}$ is in SD closed set but not in gs-open set.

Lemma: Let (X, τ) be a topological space. Prove that gs-open set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.5 Let (X,τ) be a topological space. Prove that semi open set is SD closed set in X. Converse is need not be true. (U=X)

Example:

Let X = {a,b,c}, $\tau = \{\ \phi, X, \{b\}, \{a.c\}\}$, $\tau^c = \{\ \phi, X, \{b\}, \{a,c\}\}$ and $U = X$

(i) semi open set = $\{\{b\},\{a,c\},\phi,X\}$

(ii) SD closed set = $\{\{a\},\{b\},\{c\},\{a,b\},\{b,c\},\{c,a\},\phi,X\}$

Here the element $\{b\}$ is in both SD closed set and semi open set. The element $\{c\}$ is in SD closed set but not in semi open set.

Lemma: Let (X, τ) be a topological space. Prove that semi open set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.6 Let (X,τ) be a topological space. Prove that semi closed set is SD closed set in X. Converse is need not be true. (U=X)

Example:

Let X = {a,b,c}, $\tau = \{\ \phi, X, \{a\}, \{b\}, \{a.b\}\}$, $\tau^c = \{\ \phi, X, \{c\}, \{a,c\}, \{b,c\}\}$ and $U = X$

(i) semi closed set = $\{\{c\},\{a,c\},\{b,c\},\phi,X\}$

(ii) SD closed set = $\{\{a\},\{b\},\{c\},\{a,b\},\{b,c\},\{c,a\},\phi,X\}$

Here the element $\{c\}$ is in both SD closed set and semi closed set. The element $\{a\}$ is in SD closed set but not in semi closed set.

Lemma: Let (X, τ) be a topological space. Prove that semi closed set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.7 Let (X,τ) be a topological space. Prove that semi generalized closed (sg-closed) set is SD closed set in X. Converse is need not be true. (U=X)

Example:

Let X = {a,b,c}, $\tau = \{\ \phi, X, \{a\},\{c\},\{a,c\},\{a.b\}\}$, $\tau^c = \{\ \phi, X, \{b\},\{c\},\{a,b\},\{b,c\}\}$ and $U = X$

(i) sg-closed set = $\{\{b\},\{c\},\{a,b\},\{b,c\},\phi,X\}$

(ii) SD closed set = $\{\{a\},\{b\},\{c\},\{a,b\},\{b,c\},\{c,a\},\phi,X\}$

Here the element $\{c\}$ is in both SD closed set and sg-closed set. The element $\{a,c\}$ is in SD closed set but not in sg-closed set.

Lemma: Let (X, τ) be a topological space. Prove that sg-closed set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.8 Let (X,τ) be a topological space. Prove that semi generalized open (sg-open) set is SD closed set in X. Converse is need not be true. (U=X)

Example:

Let X = {a,b,c}, $\tau = \{\ \phi, X, \{b\},\{c\},\{a.c\},\{b,c\}\}$, $\tau^c = \{\ \phi, X, \{a\},\{b\},\{a,c\},\{a,b\}\}$ and $U = X$

(i) sg-open set = $\{\{b\},\{c\},\{a,c\},\phi,X\}$

(ii) SD closed set = $\{\{a\},\{b\},\{c\},\{a,b\},\{b,c\},\{c,a\},\phi,X\}$

Here the element $\{c\}$ is in both SD closed set and sg-open set. The element $\{a\}$ is in SD closed set but not in sg-open set.

Lemma: Let (X, τ) be a topological space. Prove that sg-open set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.9 Let (X,τ) be a topological space. Prove that generalized pre closed (gp-closed) set is SD closed set in X. Converse is need not be true. (U=X)

Example:

Let X = {a,b,c}, $\tau = \{\ \phi, X, \{b\}, \{c\}, \{b,c\}, \{a,c\}\}$, $\tau^c = \{\phi, X, \{a\}, \{b\}, \{a,c\}, \{a,b\}\}$ and $U = X$

(i) gp-closed set = $\{\{b\}, \{a,c\}, \{a,b\}, \phi, X\}$

(ii) SD closed set = $\{\{a\}, \{b\}, \{c\}, \{a,b\}, \{b,c\}, \{c,a\}, \phi, X\}$

Here the element $\{b\}$ is in both SD closed set and gp-closed set. The element $\{b,c\}$ is in SD closed set but not in gp-closed set.

Lemma: Let (X, τ) be a topological space. Prove that gp-closed set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.10 Let (X, τ) be a topological space. Prove that generalized pre open (gp-open) set is SD closed set in X. Converse is need not be true. (U=X)

Example:

Let X = {a,b,c}, $\tau = \{\ \phi, X, \{b\}, \{c\}, \{b,c\}, \{a,c\}\}$, $\tau^c = \{\phi, X, \{a\}, \{b\}, \{a,c\}, \{a,b\}\}$ and $U = X$

(i) gp-open set = $\{\{b\}, \{c\}, \{a,b\}, \{b,c\}, \phi, X\}$

(ii) SD closed set = $\{\{a\}, \{b\}, \{c\}, \{a,b\}, \{b,c\}, \{c,a\}, \phi, X\}$

Here the element $\{a,b\}$ is in both SD closed set and gp-open set. The element $\{a\}$ is in SD closed set but not in gp-open set.

Lemma: Let (X, τ) be a topological space. Prove that gp-open set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.11 Let (X, τ) be a topological space. Prove that pre open set is SD closed set in X. Converse is need not be true. (U=X)

Example:

Let X = {a,b,c}, $\tau = \{\ \phi, X, \{b\}\}$, $\tau^c = \{\phi, X, \{a,c\}\}$ and $U = X$

(i) Pre open set = $\{\{a\}, \{b\}, \{a,b\}, \{b,c\}, \phi, X\}$

(ii) SD closed set = $\{\{a\}, \{b\}, \{c\}, \{a,b\}, \{b,c\}, \{c,a\}, \phi, X\}$

Here the element $\{a,b\}$ is in both SD closed set and pre open set. The element $\{c\}$ is in SD closed set but not in pre open set.

Lemma: Let (X, τ) be a topological space. Prove that pre open set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.12 Let (X,τ) be a topological space. Prove that pre closed set is SD closed set in X. Converse is need not be true. (U=X)

Example:

Let X = {a,b,c}, $\tau = \{ \phi, X, \{b\}, \{b,c\}\}$, $\tau^c = \{\phi, X, \{a\}, \{a,c\}\}$ and $U = X$

(i) pre closed set = $\{\{a\},\{c\},\{a,c\},\phi,X\}$

(ii) SD closed set = $\{\{a\},\{b\},\{c\},\{a,b\},\{b,c\},\{c,a\},\phi,X\}$

Here the element $\{a\}$ is in both SD closed set and pre closed set. The element $\{b,c\}$ is in SD closed set but not in pre closed set.

Lemma: Let (X, τ) be a topological space. Prove that pre closed set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.13 Let (X,τ) be a topological space. Prove that generalized α-closed (gα-closed) set is SD closed set in X. Converse is need not be true. (U=X)

Example:

Let X = {a,b,c}, $\tau = \{ \phi, X, \{a,b\}\}$, $\tau^c = \{\phi, X, \{c\}\}$ and $U = X$

(i) gα-closed set = $\{\{c\},\phi,X\}$

(ii) SD closed set = $\{\{a\},\{b\},\{c\},\{a,b\},\{b,c\},\{c,a\},\phi,X\}$

Here the element $\{c\}$ is in both SD closed set and gα-closed set. The element $\{b,c\}$ is in SD closed set but not in gα-closed set.

Lemma: Let (X, τ) be a topological space. Prove that gα-closed set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.14 Let (X,τ) be a topological space. Prove that α-open set is SD closed set in X. Converse is need not be true. (U=X)

Example:

Let X = {a,b,c}, $\tau = \{ \phi, X, \{b\}, \{b,c\}\}$, $\tau^c = \{\phi, X, \{a\}, \{a,c\}\}$ and $U = X$

(i) α-open set = $\{\{b\},\{a,b\},\{b,c\},\phi,X\}$

(ii) SD closed set = $\{\{a\},\{b\},\{c\},\{a,b\},\{b,c\},\{c,a\},\phi,X\}$

Here the element $\{b\}$ is in both SD closed set and α-open set. The element $\{b,c\}$ is in SD closed set but not in α-open set.

Lemma: Let (X, τ) be a topological space. Prove that α-open set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.15 Let (X,τ) be a topological space. Prove that α-closed set is SD closed set in X. Converse is need not be true. (U=X)

Example:

Let X = {a,b,c}, $\tau = \{\ \phi, X, \{b\}, \{a,b\}, \{b,c\}\}$, $\tau^c = \{\phi, X, \{a\}, \{c\}, \{a,c\}\}$ and $U = X$

(i) α-closed set = $\{\{a\}, \{c\}, \{a,c\}, \phi, X\}$

(ii) SD closed set = $\{\{a\}, \{b\}, \{c\}, \{a,b\}, \{b,c\}, \{c,a\}, \phi, X\}$

Here the element $\{c\}$ is in both SD closed set and α-closed set. The element $\{a,b\}$ is in SD closed set but not in α-closed set.

Lemma: Let (X, τ) be a topological space. Prove that α-closed set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.16 Let (X,τ) be a topological space. Prove that α-generalized closed (αg-closed) set is SD closed set in X. Converse is need not be true. (U=X)

Example:

Let X = {a,b,c}, $\tau = \{\ \phi, X, \{a\}, \{b\}, \{a,b\}\}$, $\tau^c = \{\phi, X, \{b,c\}, \{a,c\}, \{c\}\}$ and $U = X$

(i) αg-closed set = $\{\{c\}, \{b,c\}, \{a,c\}, \phi, X\}$

(ii) SD closed set = $\{\{a\}, \{b\}, \{c\}, \{a,b\}, \{b,c\}, \{c,a\}, \phi, X\}$

Here the element $\{c\}$ is in both SD closed set and αg-closed set. The element $\{a,b\}$ is in SD closed set but not in αg-closed set.

Lemma: Let (X, τ) be a topological space. Prove that αg-closed set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.17 Let (X,τ) be a topological space. Prove that α-generalized open (αg-open) set is SD closed set in X. Converse is need not be true. (U=X)

Example:

Let X = {a,b,c}, $\tau = \{\ \phi, X, \{a\}, \{c\}, \{a,b\}, \{a,c\}\}$, $\tau^c = \{\phi, X, \{b\}, \{c\}, \{a,b\}, \{b,c\}\}$ and $U = X$

(i) αg-open set = $\{\{a\}, \{c\}, \{a,b\}, \{a,c\}, \phi, X\}$

(ii) SD closed set = $\{\{a\}, \{b\}, \{c\}, \{a,b\}, \{b,c\}, \{c,a\}, \phi, X\}$

Here the element $\{a\}$ is in both SD closed set and αg-open set. The element $\{b\}$ is in SD closed set but not in αg-open set.

Lemma: Let (X, τ) be a topological space. Prove that αg-open set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.18 Let (X,τ) be a topological space. Prove that generalized b-closed (gb closed) set is SD closed set in X. Converse is need not be true. (U=X)

Proof: Let A be a gb closed set then $bcl(A)\subset U$ whenever $A\subset U$ and U is open in X.

$\Rightarrow bcl(A)\subset U$

$\Rightarrow cl(A)\subset U$

$\Rightarrow$ A is g-closed set. … (1)

Since every regular closed set is b-closed set.

$\Rightarrow rcl(A)\subset bcl(A)\subset U$

$\Rightarrow rcl(A)\subset U$ whenever $A\subset U$ and U is open in X.

$\Rightarrow$ A is regular b-closed set. … (2)

From (1) and (2) A is SD closed set.

Converse:

Example:

Let X = {a,b,c}, $\tau=\{\ \phi,X,\{b\},\{c\},\{a,c\},\{b,c\}\}$, $\tau^c=\{\phi,X,\{a\},\{b\},\{a,b\},\{a,c\}\}$ and $U=X$

(i) gb-closed set = $\{\{a\},\{c\},\{a,c\},\phi,X\}$

(ii) SD closed set = $\{\{a\},\{b\},\{c\},\{a,b\},\{b,c\},\{c,a\},\phi,X\}$

Here the element $\{c\}$ is in both SD closed set and gb-closed set. The element $\{a,b\}$ is in SD closed set but not in gb-closed set.

Lemma: Let (X, τ) be a topological space. Prove that gb-closed set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.19 Let (X,τ) be the topological space. Prove that semi pre open (sp open) set is a SD closed set in X. converse is need not to be true. (U=X)

Example:

Let X = {a,b,c}, $\tau=\{\ \phi,X,\{b\},\{b,c\}\}$, $\tau^c=\{\phi,X,\{a\},\{a,c\}\}$ and $U=X$

(i) sp open set = $\{\{b\},\{a,b\},\{b,c\},\phi,X\}$

(ii) SD closed set = $\{\{a\},\{b\},\{c\},\{a,b\},\{b,c\},\{c,a\},\phi,X\}$

Here the element $\{b\}$ is in both SD closed set and sp open set. The element $\{a\}$ is in SD closed set but not in sp open set.

Lemma: Let (X, τ) be a topological space. Prove that semi pre open set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.20 Let (X,τ) be the topological space. Prove that semi pre closed (sp closed) set is a SD closed set in X. converse is need not to be true. (U=X)

Proof: Let A be a semi pre closed set.

Since every semi pre closed set is generalized semi pre closed set (gsp closed)

$\Rightarrow$ A is gsp closed set

Since every gsp closed set is b-closed set then by proposition 3.2.

Hence A is SD closed set in X.

Converse:

Example:

Let X = {a,b,c}, $\tau = \{\ \phi, X, \{b\},\{c\},\{a,b\},\{b,c\}\}$, $\tau^c = \{\phi, X,\{a\},\{c\},\{a,b\},\{a,c\}\}$ and $U = X$

(i) sp closed set = $\{\{a\},\{c\},\{a,b\},\{a,c\},\phi,X\}$

(ii) SD closed set = $\{\{a\},\{b\},\{c\},\{a,b\},\{b,c\},\{c,a\},\phi,X\}$

Here the element $\{b\}$ is in SD closed set but not in sp closed set.

Lemma: Let (X, τ) be a topological space. Prove that semi pre closed set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.21 Let (X,τ) be a topological space. Prove that generalized semi pre closed (gsp-closed) set is a SD closed in X. Converse is need not to be true (U=X)

Example:

Let X = {a,b,c}, $\tau = \{\ \phi, X, \{b\}\}$, $\tau^c = \{\phi, X,\{a,c\}\}$ and U=X

(i) gsp-closed set - $\{\{a\},\{c\},\{a,c\},\{b,c\},\phi,X\}$

(ii) SD closed set = $\{\{a\},\{b\},\{c\},\{a,b\},\{b,c\},\{c,a\},\phi,X\}$

Here the element $\{a\}$ is in both SD closed set and gsp-closed set. The element $\{a,b\}$ is in SD closed set but not in gsp-closed set.

Lemma: Let (X, τ) be a topological space. Prove that gsp-closed set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.22 Let (X,τ) be a topological space. Prove that generalized semi pre open (gsp-open) set is a SD closed in X. Converse is need not to be true (U=X)

Example:

Let X = {a,b,c}, $\tau = \{ \phi, X, \{a,b\}\}$, $\tau^c = \{\phi, X, \{c\}\}$ and U=X

(i) gsp-open set - $\{\{a\},\{b\},\{a,b\},\{b,c\},\{c,a\},\phi,X\}$

(ii) SD closed set = $\{\{a\},\{b\},\{c\},\{a,b\},\{b,c\},\{c,a\},\phi,X\}$

Here the element $\{a\}$ is in both SD closed set and gsp-open set. The element $\{c\}$ is in SD closed set but not in gsp-open set.

Lemma: Let (X, τ) be a topological space. Prove that gsp-open set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.23 Let (X,τ) be a topological space. Prove that B-closed set is a SD closed in X. Converse is need not to be true. (U=X)

Example:

Let X = {a,b,c}, $\tau = \{ \phi, X, \{a,b\}\}$, $\tau^c = \{\phi, X, \{c\}\}$ and U=X

(i) B-closed set - $\{\{c\},\phi,X\}$

(ii) SD closed set = $\{\{a\},\{b\},\{c\},\{a,b\},\{b,c\},\{c,a\},\phi,X\}$

Here the element $\{c\}$ is in both SD closed set and B-closed set. The element $\{a,b\}$ is in SD closed set but not in B-closed set.

Lemma: Let (X, τ) be a topological space. Prove that B-closed set is SD open set in X. Converse is need not be true. (U=X)

Proposition: 3.24 Let (X,τ) be a topological space. Prove that B-open set is a SD closed in X. Converse is need not to be true. (U=X)

Example:

Let X = {a,b,c}, $\tau = \{ \phi, X, \{b\}, \{b,c\}\}$, $\tau^c = \{\phi, X, \{a\}, \{a,c\}\}$ and U=X

(i) B-open set - $\{\{b\}, \{b,c\}, \phi, X\}$

(ii) SD closed set = $\{\{a\}, \{b\}, \{c\}, \{a,b\}, \{b,c\}, \{c,a\}, \phi, X\}$

Here the element $\{b,c\}$ is in both SD closed set and B-open set. The element $\{a\}$ is in SD closed set but not in B-open set.

Lemma: Let (X, τ) be a topological space. Prove that B-open set is SD open set in X. Converse is need not be true. (U=X)

IV. PROPERTIES OF SD CLOSED SETS

Let (X, τ) be a topological space. Let A and B be the SD closed set,

1. Int(SD closed set) $\neq$ Cl(SD closed set)
2. Int(SD closed set) $\subseteq$ Cl(SD closed set)
3. $A \cap B = \rho(A)$
4. $A \cup B = \rho(A)$
5. $A \cup B = A \cap B$
6. $(A \cap B)^C = \phi$
7. $(A \cup B)^C = \phi$
8. $(A \cap B)^C = (A \cup B)^C$
9. $(A \cap B)^C = A^C \cup B^C$
10. $(A \cup B)^C = A^C \cap B^C$

Remark: The above properties are true for SD open sets.

V.CONCLUSION

The following sets are subset of SD closed set and SD open set

1. regular closed set, 2.b closed set, 3.gs closed set, 4.gs open, 5.semi open set, 6.semi closed set, 7.sg closed set, 8.sg open set, 9.gp closed set, 10.gp open set, 11.pre open set, 12. pre closed set, 13.gα closed set, 14.α-open set, 15.α-closed set, 16.αg closed set, 17.αg open set, 18.gb closed set, 19.sp open set, 20.sp closed set, 21.gsp closed set, 22.gsp open set, 23.B-closed set, 24.B-open set.

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δmk-Closed Set and δmk-Open Set in Topological Spaces

M.Kaleeswari[1], K. Amutha[2],

M.Phil Scholar, Dept. of Mathematics, SCAS, Dgl, Tamil Nadu, India[1]

Associate Professor, Dept. of Mathematics, SCAS, Dgl, Tamil Nadu, India[2]

ABSTRACT: In this paper, we introduce and investigate the notation of δmk-closed set and δmk-open set.We obtain fundamental properties of δmk-closed set, δmk-open set and discuss the relation between δmk-closed set,δmk-open set and other related sets.

KEYWORDS: δmk-closed set,δmk-open set.

I.INTRODUCTION

The concept of generalized closed sets introduced by Levine [1] plays a significant role in general topology. After the introduction of generalized closedsets many research papers were published which deal with different types of generalized closed sets. Y. Gnanambal [2] introduced the concept of gpr-closed set and investigated its basic properties. H. Maki et al. [3] defined the concept of gp-closed set in topological spaces and established results related to it. These concepts motivated us to define a new class of sets called the delta generalized pre-closed sets. Throughout this paper, (X,τ) (or simply X) represents topological space on which no separation axioms are assumed unless explicitly stated. For a subset A of a space (X,τ) , we denote the closure of A ,the interior of A and complement of A as Cl(A),int(A) and A^c respectively. The modified forms of generalized closed sets and $\hat{g}$-closed sets were studied by K.Balachandran, P. Sundaram and H. Maki [4]. In 2008, S. Jafari, T. Noiri, N. Rajesh and M.L. Thivagar [5] introduced the concept of $\hat{g}$ -closed sets and their properties. In this paper, we introduce new classes of sets called $\hat{g}$-closed sets for topological spaces.

II.PRELIMINARIES

2.1. A subset A of a topological space X is called,
pre-open [6] if $A \subseteq \operatorname{int}(cl(A))$ and Pre-closed if $cl(\operatorname{int}(A)) \subseteq A$ $cl(\operatorname{int}(A))$.

2.2. A subset A of a topological space X is called,
$\alpha - open$ [7] if $A \subseteq \operatorname{int}(cl(\operatorname{int}(A[\,))$ and $\alpha - closed$ if $cl(\operatorname{int}(cl(A))) \subseteq A$.

2.3. A subset A of a topological space X is called,
$b - open$ [8] if $A \subseteq cl(\operatorname{int}(A)) \cup \operatorname{int}(cl(A))$ and $b - closed$ if $cl(\operatorname{int}(A)) \cap \operatorname{int}(cl(A)) \subseteq A$.

2.4. A subset A of a topological space X is called,
$regular - open$ [9] if $A = cl(\operatorname{int}(A))$ and $regular - closed$ if $A = cl(\operatorname{int}(A))$.

2.5. A subset A of a topological space X is called,
$semi - open$ [10] if $A \subseteq cl(\operatorname{int}(A))$ and $semi - closed$ if $\operatorname{int}(cl(A)) \subseteq A$.

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2.6 . A subset A of a topological space X is called,
Semi preopen [11] if $A \subseteq cl(\operatorname{int}(cl(A)))$ and semi preclosed if $\operatorname{int}(cl(\operatorname{int}(A))) \subseteq A$.

2.7. A subset A of a topological space X is called,
$\delta - closed$ [12] if $A = cl_{\delta}(A)$ where $cl_{\delta}(A) = \{x \in X : \operatorname{int}(cl(U)) \cap A \neq \Phi, U \in \tau$ and $x \in U\}$. The Complement of δ-closed is δ-open.

2.8 . Let (x, τ) be a topological space and $A \subseteq X$.
The pre-interior of A, denoted by pint(A), is the union of all preopen subsets of A.
The pre-closure of A, denoted by Pcl(A), is the intersection of all preclosed sets containing A.

2.9. A subset A of a topological space X is called ,
Generalized closed (briefly,g-closed) [1] if $cl(A) \subseteq G$ whenever $A \subseteq G$ and G is open in X. The complement of g-closed is g-open.

2.10. A subset A of a topological space X is called ,
Generalized $\alpha - closed$ (briefly, $g\alpha - closed$)[113] if $\alpha cl(A) \subseteq G$ whenever $A \subseteq G$ and G is $\alpha - open$ in X. The complement of gα-closed is gα-open.

2.11. A subset A of a topological space X is called ,
$\alpha - generalized$ closed $(briefly, \alpha g - closed)$[14] if $\alpha cl(A) \subseteq G$ whenever $A \subseteq G$ and G is Open in X. The complement of αg-closed is αg-open.

2.12. A subset A of a topological space X is called ,
Generalized pre-closed $(briefly, gp - closed)$[15] if $pcl(A) \subseteq G$ whenever $A \subseteq G$ and G is Open in X. The complement of gp-closed is gp-open.

2.13. A subset A of a topological space X is called ,
Generalized preregular closed $(brieflygpr - closed)$[2] if $pcl(A) \subseteq G$ whenever $A \subseteq G$ and G is regular Open in X. The complement of gpr-closed is gpr-open.

2.14. A subset A of a topological space X is called ,
$\delta -$ generalized closed $(briefly, \delta g - closed)$[16] if $\delta cl(A) \subseteq G$ whenever $A \subseteq G$ and G is Open in X. The complement of δg-closed is δg-open.

2.15. A subset A of a topological space X is called ,
Pregeneralized closed $(briefly, pg - closed)$[3] if $pcl(A) \subseteq G$ whenever $A \subseteq G$ and G is preopen in X. The complement of pg-closed is pg-open

2.16. A subset A of a topological space X is called,
Generalized semi-preclosed $(briefly, gsp - closed)$ [17] if $spcl(A) \subseteq G$ whenever $A \subseteq G$ and G is Open in X. The complement of gsp-closed is gsp-open.

2.17. A subset A of a topological space X is called,
Pre semi closed [18] if $spcl(A) \subseteq U$ whenever $A \subseteq G$ and G is $g - open$ in X. The complement of Pre semi closed is Pre semi open.

2.18. A subset A of a topological space X is called a delta generalized pre-closed (briefly, δgp-closed) [19] set if $pcl(A) \subseteq G$ whenever $A \subseteq G$ and G is δ-open in X. The complement of δgp-closed is δgb-open.

The family of all δgp-closed sets in a topological space X is denoted by δGPC(X).

Example:2.1
Let X={a,b,c},τ={ϕ,x,{a},{b},{a,b}} τ^c ={ϕ,x,{b},{ac},{bc}} then δGPC(X)={ϕ,x,{c},{a,c},{b,c}}.

2.19. Let $(X,\tau\ )$ be a topological space. A subset $A \subseteq X$ is said to be $\hat{g}$-closed set[20] if $cl(A\ ) \subseteq G$ whenever $A \subseteq G$ and G is semi o-pen in X. The complement of $\hat{g}$-closed is $\hat{g}$-open.

Example:2.2

Let X={a,b,c}, τ={ϕ,x. {a},{a,c}} and τ^c ={ϕ,x, {b},{b,c}}then $\hat{g}$={ϕ,x, {a},{b},{c},{a,b},{a,c},{b,c}}.

III.ΔMK-CLOSED SET

Definition:3.1

.Let $(X,\tau\ )$ be a topological space. A subset $A \subseteq X$ is said to be $\delta mk-closed$ set if

(i) δgp-closed,

(ii) $\hat{g}$-closed.

The complement of $\delta mk-closed$ is δmk-open.

Example:3.1

Let $X=\{a,b,c\ \}$, τ={ϕ,x, {b},{c},{bc}} and τ^c ={ϕ,x,{a},{ac},{ab}}then $\delta mk-closed$ ={ϕ,x,{a},{ab},{ac}}.

Theorem:3.1

Let (x,τ) be a Topological Space. Prove that Every closed set is $\delta mk-closed$ set in X.

But not conversely. (U=X)

Proof:

Let A be a Closed set.

then Cl(A)=A,

Take $A \subseteq \cup$ and U is semiopen in X.

Then Cl(A) $\subseteq U$

∴ A is $\hat{g}$-closed. Every Semi open is δ-open in X. Therefore U is δ-open in X.

Cl(A)$\subseteq$Pcl(A) and A is $\hat{g}$-closed.

Therefore A is Preclosed in X.

Therefore A is $\delta mk-closed$ set.

Example:3.2

Let X={a,b,c}, τ={ϕ,x, {b},{bc}} ,τ^c={ϕ,x,{a},{ac}.

δmk-closed set ={ϕ,x,{a},{c},{a,c}}, Preclosed={ϕ,x,{a},{c},{{a,c}},

$\hat{g}$-closed={ϕ,x,{a},{b},{c},{a,b},{a,c},{b,c}}. The elements {a},{a,c} are in closed, Preclosed, $\hat{g}$-closed and δmk-closed.

Therefore closed set is δmk-closed set.

The converse of the above theorem is not true.

Example:3.3

Let X={a,b,c}, τ={{c},{a,b},ϕ,X} and τ^c ={{c},{a,b},ϕ,X}.

δmk-closed set={ϕ,x,{a},{b},{c},{a,b},{a,c},{b,c}}

closed set={ϕ,x,{c},{a,c}}. The element {a} is in δmk-closed but not in closed set

Therorem3.2.

Let (x,τ) be a Topological Space. Prove that Every open set is δmk-open set in X.(U=X). But not conversely.

Exapmle:3.4

Let X={a,b,c}, τ={ϕ,x,{b},{bc}} ,τ^c={ϕ,x,{a},{ac}}.

δmk-open set={ϕ,x,{b,c},{a,b},{b}}

The element {a,b}€ δmk-open set but not in open set.

Theroem:3.3

Let (x,τ) be a Topological Space. Prove that Regular Closed Set is $\delta mk-closed$ set in X. But not conversely. (U=X)

Proof:

Let A be a Regular Closed set in X.

Then A=Cl(Int(A)).

And also A is Regular open in X.

Therefore Int(A)=A

$\Rightarrow$ A=Cl(Int(A))=Cl(A)

$\Rightarrow$ A=Cl(A)

Take $A \subseteq \cup$ and U is semiopen in X.

Then Cl(A) $\subseteq U$

$\therefore$ A is $\hat{g}$-closed.

Every Semi open is δ-open in X. Therefore U is δ-open in X.

Cl(A)$\subseteq$Pcl(A) $\subseteq$ A$\subseteq$ U

A is $\hat{g}$-closed.

Therefore A is δ-generalized preclosed in X.

Therefore A is $\delta mk-closed$ set in X.

Example:3.5

Let X={a,b,c}, τ ={ϕ,x,{c},{b},{b,c}{a,c}} and τ^c={ϕ,x,{a,c},{a,b},{a}{b}},

Regular closed={ϕ,x,{a,c},{b}}, Regular open={ϕ,x,{a,c},{b}} and δmk-closed set= {ϕ,x,{a,c},{a,b},{a}{b}}.

Here Regular closed set = Regular open set

The converse of the above theorem need not to be true.

In the above example, element {a} in δmk-closed set but not in Regular Closed Set.

Theorem 3.4

Let (x,τ) be a Topological Space. Prove that Regular Open Set is δmk-open set in X.(U=X). But not conversely.

Example:3.6

Let X={a,b,c}, τ ={ϕ,x,{c},{b},{b,c}{a,b}} and τ^c={ϕ,x,{a,c},{a,b},{a}{c}},

Regular open={ϕ,x,{a,b},{c}} and δmk-Open set= {ϕ,x,{b,c},{a,b},{c}{b}}.

The element {b} is in δmk-Open set but not in Regular open.

Theroem:3.5

Let (x,τ) be a Topological Space. Prove that δmk-closed Set is Semi closed set in X.

But not conversely. (U=X)

Proof:

Let A be a δmk- Closed set in X.

Then A is $\hat{g}$ closed and δ-generalized preclosed.

$\Rightarrow Cl(A) \subseteq U$ and $Pcl(A) \subseteq U$ whenever $A \subseteq U$ and U is Semiopen and δ-open in X.

$\Rightarrow Cl(A) \subseteq Pcl(A) \subseteq U$

$\Rightarrow$ Cl(A)$\subseteq U$

Every δ-open set is open set in X.

Int(cl(A) $\subseteq$int U =U

$\Rightarrow$ Int(Cl(A) $\subseteq$U

$\Rightarrow$ Int(Cl(A) $\subseteq$A . since A$\subseteq$ U

Therefore A is Semi closed in X.

The converse of the above theorem need not to be true.

Example:3.7

Let X={a,b,c}, τ={ϕ,x,{b},{c},{b,c}} and τ^c ={ϕ,x,{a},{a,c},{a,b}},Semi closed={ϕ,x,{a},{b}{c},{a,b},{a,c}} and δmk-closed set={{ϕ,x,{a},{a,b}{a,c}}.

The elements{b},{c} in Semi closed set but not in δmk- closed set.

Theroem:3.6

Let (x,τ) be a Topological Space. Prove that δmk-open Set is Semi open set in X.

But not conversely. (U=X)

Example:3.8

Let X={a,b,c}, τ={ϕ,x,{b},{c},{b,c}} and τ^c ={ϕ,x,{a},{a,c},{a,b}},Semi Open={ϕ,x,{b}{c},{a,b},{a,c},{b,c}} and δmk-Open set={{ϕ,x,{b},{c}{b,c}}.

The elements{a,c} in Semi open set but not in δmk- open set.

Theorem:3.7

Let (x,τ) be a Topological Space. Prove that Every δmk-closed set is generalized closed set. But not conversely.(U=X)

Proof:

Let A be a δmk-closed set in X.

Then A is $\hat{g}$ closed and δ-generalized preclosed.

$\Rightarrow$ Cl(A) $\subseteq$U and Pcl(A) $\subseteq$U Whenever A$\subseteq$U and U is semiopen and δ-open in X.

$\Rightarrow$ Cl(A) $\subseteq$Pcl(A) $\subseteq$U

$\Rightarrow$ Cl(A)$\subseteq U$

Every δ-open set is open set in X.

Then A$\subseteq$ U and U is open in X.

Therefore Cl(A) $\subseteq$U Whenever A$\subseteq$U and U is open in X.

Hence A is generalized closed.

The converse of the above theorem need not to be true.

Example:3.9

Let X={a,b,c}, τ={ϕ,x,{b},{bc}} and τ^c ={ϕ,x,{a},{ac}}, generalized closed={ϕ,x,{a},{b},{c},{a,b},{a,c},{bc}} and δmk-closed set={ϕ,x,{a},{c},{a,c}}

The element {b,c} is in generalized closed set but not in δmk-closed set.

Theorem:3.8

Let (x,τ) be a Topological Space. Prove that Every δmk-open set is generalized open set. But not conversely.(U=X).

Example:3.10

Let X={a,b,c}, τ={ϕ,x,{a},{b},{a,b},{bc}} and τ^c ={ϕ,x,{a},{c},{ac},{b,c}}, generalized Open={ϕ,x,{a},{b},{c},{a,b},{a,c},{bc}} and δmk-Open set={ϕ,x,{a},{b},{b,c},{a,b}}

The element {c} is in generalized open set but not in δmk-open set.

Properties:

If A and B are δmk-closed sets, then

1. A$\cap$B$\subseteq$A$\cup$B

2. $(A \cup B)^c = A^c \cup \mathrm{B}^c$
3. $A^c \cap \mathrm{B}^c = A \cap \mathrm{B}^c$

The above properties are true for δmk-Open set.

IV.CONCLUSION

1.The following sets are subset of δmk-closed set

(i)α-closed, (ii)Regular closed, (iii)gα-closed, (iv)αg-closed

2. .The following sets are subset of δmk-open set

(i)α- open, (ii)Regular open, (iii)gα- open, (iv)αg- open.

3. δmk-closed set is subset of the following sets

(i)Semi closed, (ii)Semi preclosed, (iii)g-closed, (iv)gsp-closed, (v)pre semiclosed.

4. δmk-open set is subset of the following sets

(i)Semi open, (ii)Semi preopen, (iii)g-open, (iv)gsp-open, (v)pre semiopen.

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SK Open set and SK Closed set in Topological Spaces

K.Kaleeswari[1], K. Amutha[2]
M.Phil Scholar, Dept. of Mathematics, SCAS, Dgl, Tamil Nadu, India[1]
Associate Professor, Dept. of Mathematics, SCAS, Dgl, Tamil Nadu, India[2]

ABSTRACT: In this paper, we introduce and investigate the notation of SK open set and SK closed set. We obtain fundamental properties of SK open set and SK closed set and discuss the relation between SK open set and SK closed set and other related sets.

KEYWORDS: SK open set, SK closed set.

I. INTRODUCTION

Levine [1] introduced generalized closed sets in topology as a generalization of closed sets. This concept was found to be useful and many results in general topology were improved. Many researchers like Arya et al [2], Balachandran et al [3], Bhattarcharya et al [4], Arockiarani et al [5], Gnanambal [6] Malghan [7], Nagaveni [8] and Palaniappan et al [9] have worked on generalized closed sets. In this paper, the notion of sg-interior is defined and some of its basic properties are investigated. Also we introduce the idea of sg-closure in topological spaces using the notions of sg-closed sets and obtain some related results. Throughout the paper, X and Y denote the topological spaces (X,τ) and (X,σ) respectively and on which no separation axioms are assumed unless otherwise explicitly stated. In 1937, regular open sets were introduced and used to define the semi-regularization space of a topological space. Throughout this paper,(X,τ) and (Y,σ) stand for topological spaces with no separation axioms assumed unless otherwise stated. For a subset A of X, the closure of A and the interior of A will be denoted by cl(A) and int(A), respectively. Stone [10] defined a subset A of a space X to be a regular open if $A = \operatorname{int}(cl(A))$. Norman Levine [11] defined a subset A of a space X to be a semi-open if $A \subseteq cl(\operatorname{int}(A))$, or equivalently, a set A of a space X will be termed semi- open if and only if there exists an open set U such that $U \subset A \subset cl(U)$. Mashhour *et al.* [12] defined a subset A of a space X to be a preopen if $A \subset \operatorname{int}(cl(A))$. Njastad [13] defined a subset A of a space X to be an α-open if $A \subseteq \operatorname{int}(cl(\operatorname{int}(A)))$. The complement of a semi-open (resp., regular open) set is said to be semi-closed [14] (resp., regular closed). The intersection of all semi-closed sets of X containing A is called the semi-closure [15] of A. The union of semi-open sets of X contained in A is called the semi-interior of A. Joseph and Kwack [16] introduced the concept of θ-semi open sets using semi-open sets to improve the notion of S-closed spaces. Also Joseph and Kwack [16] introduced that a subset A of a space X is called θ-semi-open if for each $x \in A$, there exists a semi-open set G such that $x \in G \subset cl(G \subset A)$. It is well-known that, a space X is called TI if to each pair of distinct points x, y of X, there exists a pair of open sets, one containing x but not y and the other containing y but not x, as well as is TI if and only if for any point $x \in X$, the singleton set $\{x\}$ is closed. A space X is regular if for each $x \in X$ and each open set G containing x, there exists an open set H such that $x \subset H \subset cl(H) \subset G.N.K$. Ahmed [17] defined a topological space (X,τ) to be s^{**}-normal if and only if for every semi-closed set F and every semi-open set G containing F, there exists an open set H such that $F \subset H \subset cl(H) \subset G$. In 1968, Velicko [18], defined the concepts of δ-open and θ-open as, a subset A of a space

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X is called δ-open (resp., θ-open) if for each $x \in A$, there exists an open set G such that $x \in G \subset \operatorname{int}(cl(G)) \subset A$ (resp., $x \in G \subset cl(G) \subset A$). Di Maio and Noiri [19] introduced that a subset A of a space X is called semi- θ -open if for each $x \in A$, there exists a semi-open set G such that $x \in G \subset scl(G) \subset A$. The family of all open (resp., semi-open, α-open, pre-open, θ-semi-open, semi-θ-open, θ-open, δ-open, regular open, semi-closed and regular closed) subsets of a topological space (X,τ) are denoted by τ (resp., $SO(X)$, $\alpha O(X)$, $pO(X)$, $\theta SO(X)$, $S\theta O(X)$, $\theta O(X)$, $\delta O(X)$, $RO(X)$, $SC(X)$ and $RC(X)$).

II. PRELIMINARIES

Definition :2.1 A subset A of a space X is called
(i) A **preopen** set if $A \subseteq \operatorname{int}(cl(A))$ and a **preclosed** if $cl(\operatorname{int}(A)) \subseteq A$.
(ii) A **regular open set** if $A = \operatorname{int}(cl(A))$ and **regular closed set** if $A = cl(\operatorname{int}(A))$.
(iii) A **semi open set** if $A \subseteq cl(\operatorname{int}(A))$ and **semi closed set** if $\operatorname{int}(cl(A)) \subseteq A$.

Definition 2.2: A subset A of a space X is called
(i) **g-closed set**[1] if $cl(A) \subseteq U$ whenever $A \subseteq U$ and U is open in X . The complement of g-closed set is g-open set.
(ii) **semi generalized closed set** [4] (sg-closed) if $scl(A) \subseteq U$ whenever $A \subseteq U$ and U is semi open in X. The complement of sg-closed set is sg-open set.
(iii) **generalized preclosed set** [7] (gp-closed) if $cl\operatorname{int}(A) \subseteq U$ whenever $A \subseteq U$ and U is open in X. The complement of gp-closed set is gp-open set.

Definition 2.3: Let X be a topological space and let $x \in X$. A subset N of X is said to be sg -neighbourhood of x if there exists a sg -open set G such that $x \in G \subset N$.

Definition 2.4: A subset A of a space X is called Bc-open if for each $x \in A \in BO(X)$,there exists a closed set F such that $x \in F \subset A$. The family of all Bc-open subsets of a topological space (X,τ) is denoted by $BcO(X,\tau)$ or (Briefly. $BcO(X)$). The complement of Bc-open set is called Bc-closed set.

Definition 2.5:[20] A subset A of a space X is called b-open if $A \subseteq \operatorname{int}(cl(A)) \cup cl(\operatorname{int}(A))$. The family of all b-open subsets of a topological space (X,τ) is denoted by $BO(X,\tau)$ or (Briefly $BO(X)$). The complement of b-open set is called b-closed set.

Definition 2.6: Let A be a subset of X. A point $x \in A$ is said to be sg-interior point of A is a sg-neighbourhood of x. The set of all sg-interior points of A is called the sg-interior of A and is denoted by sg-int(A).

Definition 2.7: Let A be a subset of a space X. We define the sg-closure of A to be the intersection of all sg-closed sets containing A. In symbols, $sg - cl(A) = \cap\{F : A \subset F \in sgc(X)\}$.

III. SK OPEN SET

Definition 3.1: A set A is said to be SK open set if
(i) A is BcO(X)[22] and
(ii) A is Sg-open[21].

Example 3.1: Let $X = \{a,b,c\}$ with topology $\tau = \{\phi, X, \{a\}, \{b\}, \{a,b\}\}$,
$\tau^c = \{\phi, X, \{c\}, \{a,c\}, \{b,c\}\}$ and U=X. Then SK open set $= \{\phi, X, \{a,b\}, \{a,c\}\}$.

Theorem 3.1: Let (X,τ) be a topological space. Prove that if A is SK open set then A is regular open set in X.(U=X)

Proof: Let A be SK open set in X.
Then A is BcO(X) and Sg-open in X.
$F \subset A$ where F is closed (By the definition of BcO(X)).
(ie) $Cl(F) = F \subset A$.
$\Rightarrow Cl(F) \subset A.$
$\Rightarrow \text{int}(cl(F)) \subseteq \text{int}(A) = A.$ since A is open
$\Rightarrow \text{int}(cl(F)) \subseteq A.$
$\Rightarrow \text{int}(cl(A)) \subseteq A.$ since $F \subset A$ ……….(1)
$A \subseteq Cl(A)$.
$\text{int}(A) \subseteq \text{int}(cl(A))$.
$A \subseteq \text{int}(cl(A))$ …………(2)
From (1) and (2)
$A = \text{int}(cl(A))$
$\therefore$ A is regular open.
Converse of the above theorem is also true.

Example 3.2: Let $X = \{a, b, c\}$, $\tau = \{\varphi, X, \{a\}, \{c\}, \{a, c\}, \{b, c\}\}$ and $\tau^c = \{\phi, X, \{b\}, \{a\}, \{a, b\}, \{b, c\}\}$ and U = X . Then SK open set = $\{\phi, X, \{a\}, \{b, c\}\}$, regular open = $\{\varphi, X, \{a\}, \{b, c\}\}$ and regular closed= $\{\varphi, X, \{a\}, \{b, c\}\}$.
The elements {a},{b,c} are in SK open set and in regular open.
Also the above example said regular open = regular closed.

Theorem 3.2: Let (X,τ) be a topological space . Prove that if A is SK open set then A is regular closed in X.

Proof: From the theorem3.1 and example3.1 obviously proved.

Theorem 3.3: Let (X,τ) be a topological space. Prove that if A is SK closed set then A is regular open and regular closed in X.

Example 3.3: Let $X = \{a, b, c\}, \tau = \{\varphi, X, \{a\}, \{c\}, \{a, c\}, \{b, c\}\}$ and $\tau^c = \{\phi, X, \{b\}, \{a\}, \{a, b\}, \{b, c\}\}$ and U = X. Then SK closed set = $\{\phi, X, \{a\}, \{b, c\}\}$, regular open = $\{\varphi, X, \{a\}, \{b, c\}\}$ and regular closed= $\{\varphi, X, \{a\}, \{b, c\}\}$.
Hence regular open = regular closed.

Theorem 3.4: Let (X,τ) be a topological space. Prove that if A is SK open set then A is semiclosed in X. Converse is need not be true.(U=X)

Proof: Let A be SK open set in X.
Then A is BcO(X) and sg open in X.
$F \subset A$ Since A is Bc open
$cl(F) = F$ Since F is closed by the definition of BcO(X)
$cl(F) = F \subset A$
$\Rightarrow cl(F) \subset A$
$\text{int}(cl(F)) \subset \text{int}(A)$
$\Rightarrow \text{int}(cl(F)) \subset A$ Since A is Bc open
$\Rightarrow \text{int}(cl(A)) \subset A$
Hence A is semi closed.

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Converse,

Example:3.4 Let $X=\{a,b,c\}$, $\tau=\{\phi, X,\{a\},\{b\},\{a,b\},\{b,c\}\}$,
τ^c=$\{\phi, X,\{a\},\{c\},\{a,b\},\{b,c\}\}$ and U = X

(i) Semi closed set = $\{\phi, X,\{a\},\{c\},\{a,c\},\{b,c\}\}$

(ii) SK open set = $\{\phi, X,\{a\},\{a,b\},\{b,c\}\}$

Here the element {a} is in semi closed set but not in SK open set.

Theorem 3.5: Let (X,τ) be a topological space. Prove that every SK open set is semi open set in X. Converse is need not be true.(U =X)

Example 3.5: Let $X=\{a,b,c\}$ with topology $\tau=\{\phi, X,\{b\},\{c\},\{b,c\},\{a,c\}\}$
$\tau^c=\{\phi, X,\{a\},\{b\},\{a,b\},\{a,c\}\}$ and U = X

(i) SK open set =$\{\phi, X,\{b\},\{a,c\}\}$and

(ii) semi open set =.$\{\phi, X,\{b\},\{c\},\{a,c\},\{b,c\}\}$

Here the element {b} is in both SK open set and semi open set and the element {c} is in semi open set but not in SK open set.

Theorem 3.6: Let (X,τ) be a topological space. Prove that if A is SK open set then A is semi generalized closed set (sg-closed) in X. Converse is need not be true.(U =X)

Proof: Let A be SK open set in X.
Then A is BcO(X) and sg open in X.
$F\subset A$
$cl(F)\subset A$ Since F is closed
$\Rightarrow scl(F)\subset A$ Since every closed set is semi closed
$\Rightarrow scl(A)\subset U$ Since $A\subset U$, U is semi open
Since A is sg open.
$\therefore$ A is sg closed.

Converse,

Example:3.6 Let $X=\{a,b,c\}$, $\tau=\{\phi, X,\{b\},\{c\},\{a,b\},\{b,c\}\}$,
τ^c= $\{\phi, X,\{a\},\{c\},\{a,b\},\{a,c\}\}$ and U = X

(i) SK open set = $\{\phi, X,\{c\},\{a,b\}\}$

(ii) sg closed set = $\{\phi, X,\{a\},\{c\},\{a,c\},\{a,b\}\}$

Here the element {a,c} is in sg closed set but not in SK open set.

Theorem 3.7: Let (X,τ) be a topological space. Prove that every SK closed set is semi generalized open (sg-open) in X. Converse is need not be true.(U =X)

Example 3.7: Let $X=\{a,b,c\}$, $\tau=\{\phi, X,\{b\},\{c\},\{a,b\},\{b,c\}\}$,
τ^c= $\{\phi, X,\{a\},\{c\},\{a,b\},\{a,c\}\}$ and U = X

(i) SK closed set = $\{\phi, X,\{c\},\{a,b\}\}$

(ii) sg open set = $\{\phi, X,\{b\},\{c\},\{a,b\},\{b,c\}\}$

Here the element {c} is in both SK closed set and sg open set and {b,c} is in sg open set but not in SK closed set.

Theorem 3.8: Let (X,τ) be a topological space. Prove that if A is SK open set then A is pre open set in X. Converse is need not be true.(U =X)

Proof: Let A be SK open set in X.
Then A is BcO(X) and sg open in X.

$F \subset A$
$cl(F) \subset cl(A)$
$F \subset cl(A)$
$\Rightarrow A \subset cl(A)$
$\Rightarrow \operatorname{int}(A) \subset \operatorname{int}(cl(A))$ Since int(A) = A
$\Rightarrow A \subset \operatorname{int}(cl(A))$
Hence the result.

Converse,

Example:3.8 Let $X = \{a,b,c\}$, $\tau = \{\phi, X, \{c\}, \{a,b\}\}$, $\tau^c = \{\phi, X, \{c\}, \{a,b\}\}$ and U = X

(i) SK open set $= \{\phi, X, \{c\}, \{a,b\}\}$
(ii) Pre open set $= \{\phi, X, \{a\}, \{b\}, \{c\}, \{a,b\}, \{a,c\}, \{b,c\}\}$

Here the element {c} is in both SK open set and pre open set. The element {a} is in pre open but not in SK open set.

Theorem 3.9: Let (X,τ) be a topological space. Prove that if A is SK closed set then A is pre open set in X. Converse is need not be true.(U =X)

Example 3.9 Let $X = \{a,b,c\}$, $\tau = \{\phi, X, \{a\}, \{c\}, \{a,c\}, \{b,c\}\}$,$\tau^c = \{\phi, X, \{a\}, \{b\}, \{a,b\}, \{b,c\}\}$ and U = X

(i) SK closed set $= \{\phi, X, \{a\}, \{b,c\}\}$
(ii) Pre open set $= \{\phi, X, \{a\}, \{c\}, \{a,c\}, \{b,c\}\}$

Here the element {a} is in both SK closed set and pre open set. The element {c} is in pre open but not in SK closed set.

Theorem 3.10: Let (X,τ) be a topological space. Prove that if A is SK open set then A is generalized preclosed set (g-preclosed) in X. Converse is need not be true.(U =X)

Example 3.10 Let $X = \{a,b,c\}$, $\tau = \{\phi, X, \{a\}, \{c\}, \{a,c\}, \{a,b\}\}$, $\tau^c = \{\phi, X, \{b\}, \{c\}, \{a,b\}, \{b,c\}\}$ and U = X

(i) SK open set $= \{\phi, X, \{c\}, \{a,b\}\}$
(ii) g-preclosed set $= \{\phi, X, \{a\}, \{b\}, \{c\}, \{a,b\}, \{a,c\}, \{b,c\}\}$

Here the element {c} is in both SK open set and g-preclosed set. The element {a} is in g-preclosed but not in SK open set.

Theorem 3.11: Let (X,τ) be a topological space. Prove that if A is SK closed set then A is generalized preclosed set (g-preclosed) in X. Converse is need not be true.(U =X)

Example:3.11 Let $X = \{a,b,c\}$, $\tau = \{\phi, X, \{a\}, \{b\}, \{a,b\}, \{b,c\}\}$, $\tau^c = \{\phi, X, \{a\}, \{c\}, \{a,b\}, \{b,c\}\}$ and U = X

(i) g-preclosed $= \{\phi, X, \{a\}, \{b\}, \{c\}, \{a,b\}, \{a,c\}, \{b,c\}\}$
(ii) SK closed set $= \{\phi, X, \{a\}, \{c\}, \{b,c\}\}$

Here the element {a} is in both SK closed set and g-preclosed set. The element {b} is in g-preclosed but not in SK closed set.

IV. PROPERTIES OF SK OPEN SETS

Let (X,τ) be a topological space. Let A and B be the SK open sets,

(i) $A \cup B \supset A \cap B$
(ii) $(A \cup B)^c = A^c \cup B^c$

(iii) $(A \cap B)^c = A^c \cap B^c$

The above properties are true for SK closed sets.

V. CONCLUSION

1. SK open set is subset of the following sets
(i) Semi open,(ii) Pre open (iii) g-open (iv) g-preopen
2. SK closed set is subset of the following sets
(i) Semi closed (ii) Pre closed (iii) g-closed (iv) g-preclosed

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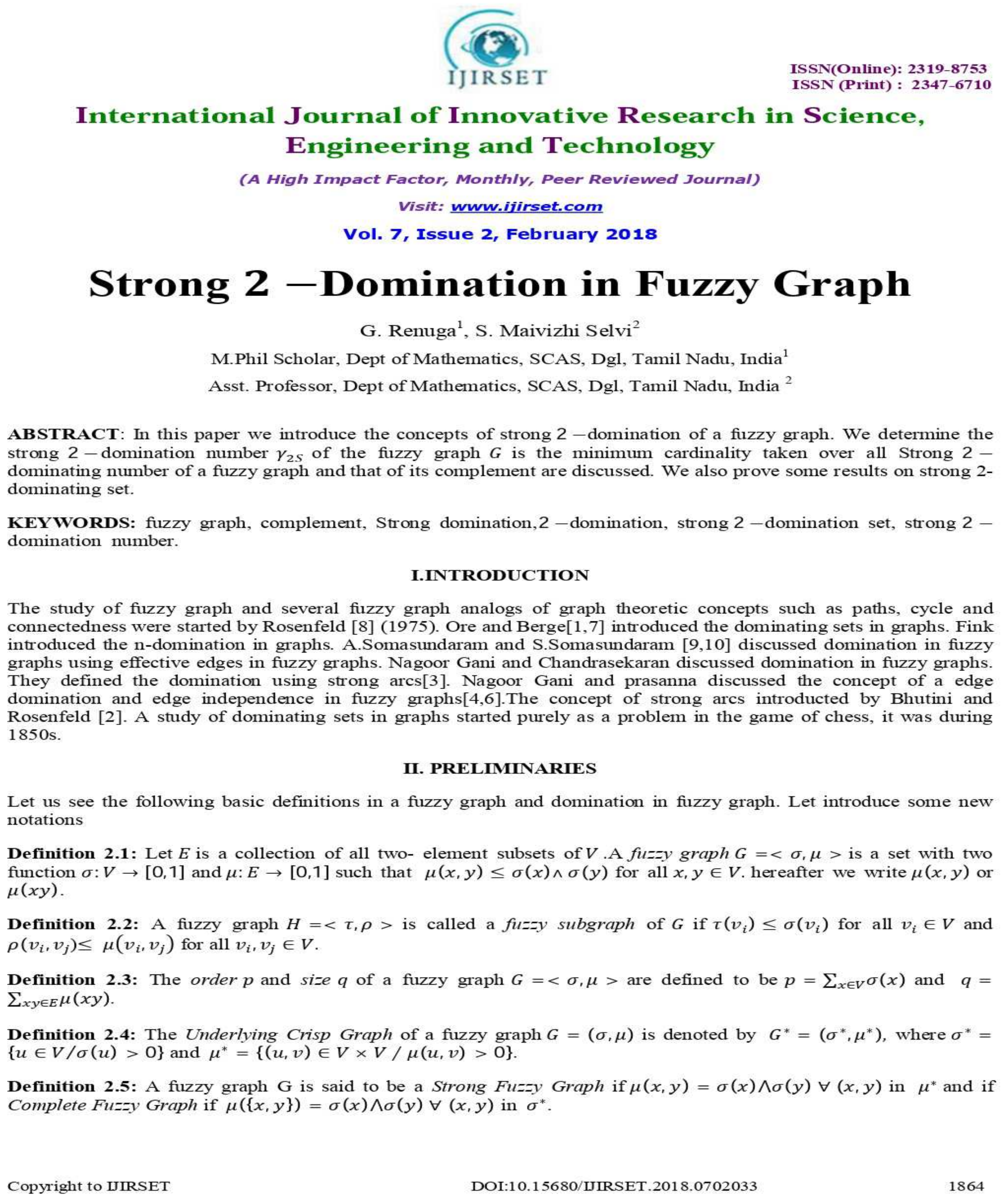

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Strong 2 −Domination in Fuzzy Graph

G. Renuga[1], S. Maivizhi Selvi[2]

M.Phil Scholar, Dept of Mathematics, SCAS, Dgl, Tamil Nadu, India[1]

Asst. Professor, Dept of Mathematics, SCAS, Dgl, Tamil Nadu, India [2]

ABSTRACT: In this paper we introduce the concepts of strong 2 −domination of a fuzzy graph. We determine the strong 2 −domination number γ_{2S} of the fuzzy graph G is the minimum cardinality taken over all Strong 2 − dominating number of a fuzzy graph and that of its complement are discussed. We also prove some results on strong 2-dominating set.

KEYWORDS: fuzzy graph, complement, Strong domination,2 −domination, strong 2 −domination set, strong 2 − domination number.

I.INTRODUCTION

The study of fuzzy graph and several fuzzy graph analogs of graph theoretic concepts such as paths, cycle and connectedness were started by Rosenfeld [8] (1975). Ore and Berge[1,7] introduced the dominating sets in graphs. Fink introduced the n-domination in graphs. A.Somasundaram and S.Somasundaram [9,10] discussed domination in fuzzy graphs using effective edges in fuzzy graphs. Nagoor Gani and Chandrasekaran discussed domination in fuzzy graphs. They defined the domination using strong arcs[3]. Nagoor Gani and prasanna discussed the concept of a edge domination and edge independence in fuzzy graphs[4,6].The concept of strong arcs introducted by Bhutini and Rosenfeld [2]. A study of dominating sets in graphs started purely as a problem in the game of chess, it was during 1850s.

II. PRELIMINARIES

Let us see the following basic definitions in a fuzzy graph and domination in fuzzy graph. Let introduce some new notations

Definition 2.1: Let E is a collection of all two- element subsets of V .A *fuzzy graph* $G =< \sigma, \mu >$ is a set with two function $\sigma: V \to [0,1]$ and $\mu: E \to [0,1]$ such that $\mu(x, y) \leq \sigma(x) \wedge \sigma(y)$ for all $x, y \in V$. hereafter we write $\mu(x, y)$ or $\mu(xy)$.

Definition 2.2: A fuzzy graph $H =< \tau, \rho >$ is called a *fuzzy subgraph* of G if $\tau(v_i) \leq \sigma(v_i)$ for all $v_i \in V$ and $\rho(v_i, v_j) \leq \mu(v_i, v_j)$ for all $v_i, v_j \in V$.

Definition 2.3: The *order* p and *size* q of a fuzzy graph $G =< \sigma, \mu >$ are defined to be $p = \sum_{x \in V} \sigma(x)$ and $q = \sum_{xy \in E} \mu(xy)$.

Definition 2.4: The *Underlying Crisp Graph* of a fuzzy graph $G = (\sigma, \mu)$ is denoted by $G^* = (\sigma^*, \mu^*)$, where $\sigma^* = \{u \in V / \sigma(u) > 0\}$ and $\mu^* = \{(u, v) \in V \times V \ / \ \mu(u, v) > 0\}$.

Definition 2.5: A fuzzy graph G is said to be a *Strong Fuzzy Graph* if $\mu(x, y) = \sigma(x) \Lambda \sigma(y) \ \forall \ (x, y)$ in μ^* and if *Complete Fuzzy Graph* if $\mu(\{x, y\}) = \sigma(x) \Lambda \sigma(y) \ \forall \ (x, y)$ in σ^*.

Definition 2.6: Let $G = (\sigma,\mu)$ be a fuzzy graph on V and S subset of V. Then the *scalar cardinality* of S is defined to be $\sum_{v\in s}\sigma(v)$ and it is denoted by $|S|$. Let p denotes the scalar cardinality of V, also called the order of G.

Definition 2.7: The *Complement* of a fuzzy graph G denoted by $\overline{G}$ is defined to be $\overline{G} = (\sigma,\overline{\mu})$ where $\overline{\mu}(xy) = \sigma(x)\wedge\sigma(y) - \mu(xy)$.

Definition 2.8: An arc (u, v) of a fuzzy graph is called an *effective* arc if $\mu(x,y) = \sigma(x)\wedge\sigma(y)$. Then x and y are called effective neighbors. The set of all effective neighbors of u is called effective neighborhood of x is denoted by $EN(x)$.

Definition 2.9: Let $G = (\sigma,\gamma)$ be a fuzzy graph on V.Let$x, y \in V$. We say that $x\ dominates\ y$ in G if $\mu(x,y) = \sigma(x)\wedge\sigma(y)$. A subset S of V is called a *dominating set* in G if for every $v \notin S$, there exists $u \in S$ such that $u$dominates v. The minimum fuzzy cardinality of a dominating set in G is called the *domination number* of G and is denoted by $\gamma(G)$ or γ.

Definition 2.10: A set D of nodes of G is a *strong domination set* of G if every node $V(G) - D$ is a strong neighbor of some node in D.

Definition 2.11: The weight of a strong dominating set D is defined as $W(D) = \sum_{u\in D}\mu(x,y)$, where $\mu(x,y)$is the membership values (weight) of the strong arcs incident on u.The *strong domination number* of a fuzzy graph G is defined as the minimum weight of strong dominating sets of G and it is denoted by $\gamma_S(G)$ or γ_S.

Definition 2.12: A subset D of V is called a *2–domination* set on G if for every node $v \in V - D$ there exist atleast two strong neighbors in D.

Definition 2.13: The 2 –*domination number* of a fuzzy graph G denoted by $\gamma_2(G)$, is the minimum cardinality of a 2 –dominating set of G.

III. STRONG 2 − DOMINATION IN FUZZY GRAPHS

In this section, we defined strong 2-domination set and strong 2-domination number of a fuzzy graph with suitable examples.

Definition 3.1: A set D of nodes of G is a strong dominating set and subset D of V is called 2 − dominating set of G if for every node $v \in V(G) - D$ is a two strong neighbor of some node in D is called *Strong* 2 –*domination in fuzzy graph.*

Example 3.2:

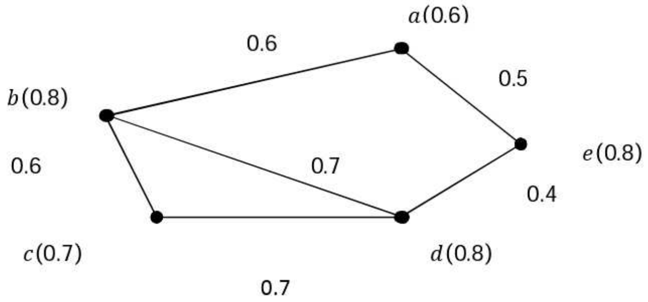

Fig. 1

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Definition 3.3: The *Strong* $2-$*domination number* of a fuzzy graph G is defined as the minimum cardinality of a Strong $2-$ dominating set of G. The strong $2-$domination is denoted by $\gamma_{2S}(G)$ or γ_{2S}

Example 3.4:

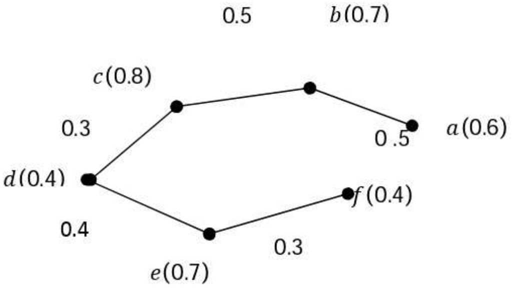

Fig. 2

$\{b,e\}$ is strong $2-$ dominating set of a fuzzy graph G. $\gamma_{2S}(G) = 2$.

Theorem 3.5: For any fuzzy graph $G:(V,\sigma,\mu)$, $\gamma_{2S} + \overline{\gamma_{2S}} < 2p$ where $\overline{\gamma_{2S}}$ is the strong $2-$ domination number of $\overline{G}$ and equality holds if and only if $0 < \mu(x,y) < \sigma(x)\Lambda\sigma(y)$ for all $x,y \in V$.

Proof: Since $\gamma_{2S} < p$ and $\overline{\gamma_{2S}} < p$($p$ is a scalar cardinality). If and only if , $0 < \mu(x,y) < \sigma(x)\Lambda\sigma(y)$ and $0 < \overline{\mu}(x,y) < \sigma(x)\Lambda\sigma(y) \Rightarrow \mu(x,y) > 0$,

$\gamma_{2S} + \overline{\gamma_{2S}} < 2p$ if and only if $0 < \mu(x,y) < \sigma(x)\Lambda\sigma(y)$.

Theorem 3.6[3]: Every non-trivial connected fuzzy graph G has a strong $2-$ dominating set D whose complement $V-D$ is also a strong $2-$ dominating set.

Proof: Let G be a strong $2-$ dominating graph.Strong $2-$ dominating set of G is $\{e,c\}$ ……………….(1). Let $\overline{G}$ be a strong $2-$ dominating graph. Strong $2-$ dominating set of $\overline{G}$ is $\{e,c\}$ ………………..(2)

From (1) and (2) Every non-trivial connected fuzzy graph G has a strong $2-$ dominating set D whose complement $V-D$ is also a strong $2-$ dominating set..Hence the proof.

Theorem 3.7[3]: Let G be a fuzzy graph without isolated nodes. If D is a minimal strong $2-$ dominating set, then $V-D$ is a strong $2-$dominating set

Proof: Let d be any vertex in D.Since G has no isolated vertices, there is a vertex $c \in N(d)$.there is a vertex $c \in V-D$. Thus, every element of D is strong $2-$dominated by element $V-D$.

Theorem 3.8: For any fuzzy graph $G:(V,\sigma,\mu)$ without isolated nodes $\gamma_{2S} \leq \frac{p}{2}$

Proof: Let D be a minimal strong 2-domination set of G. Then $V-D$ is a Strong $2-$ dominating set of G. therefore $\gamma_{2S} + \gamma_{2S} \leq p$, $2\gamma_{2S} \leq p$. $\Rightarrow$ $\gamma_{2S} \leq \frac{p}{2}$.

Remark 3.1: let G be a fuzzy graph such that both G and $\overline{G}$ have no isolated nodes, then $\gamma_{2S} + \overline{\gamma_{2S}} \leq p$ further equality holds if and only if $\gamma_{2S} = \overline{\gamma_{2S}} = \frac{p}{2}$

Theorem 3.9: Every Strong $2-$ dominating set of a fuzzy graph G is a domination set of G.

Proof : Let D be a strong $2-$ dominating set of the fuzzy graph G. then every node $V-D$ has two strong neighbours in D. That is for every node $v \in V-D$, there exist minimum two nodes in D and both dominates v. Every node in $V-D$ is dominated by strong two nodes in D. Thus D is a dominating set of G.

Remark 3.2: If G is a fuzzy graph then $\gamma_{2S}(G) > \gamma(G)$.

IV.CONCLUSION

The concept of domination in graph in very rich both in theoretical developments and applications. In this paper the concept of strong 2-domination has been modified for fuzzy graphs .we defined strong $2-$domination set and strong $2-$ domination number in fuzzy graphs. Further we proved the theorems based on strong $2-$ domination of fuzzy graph.

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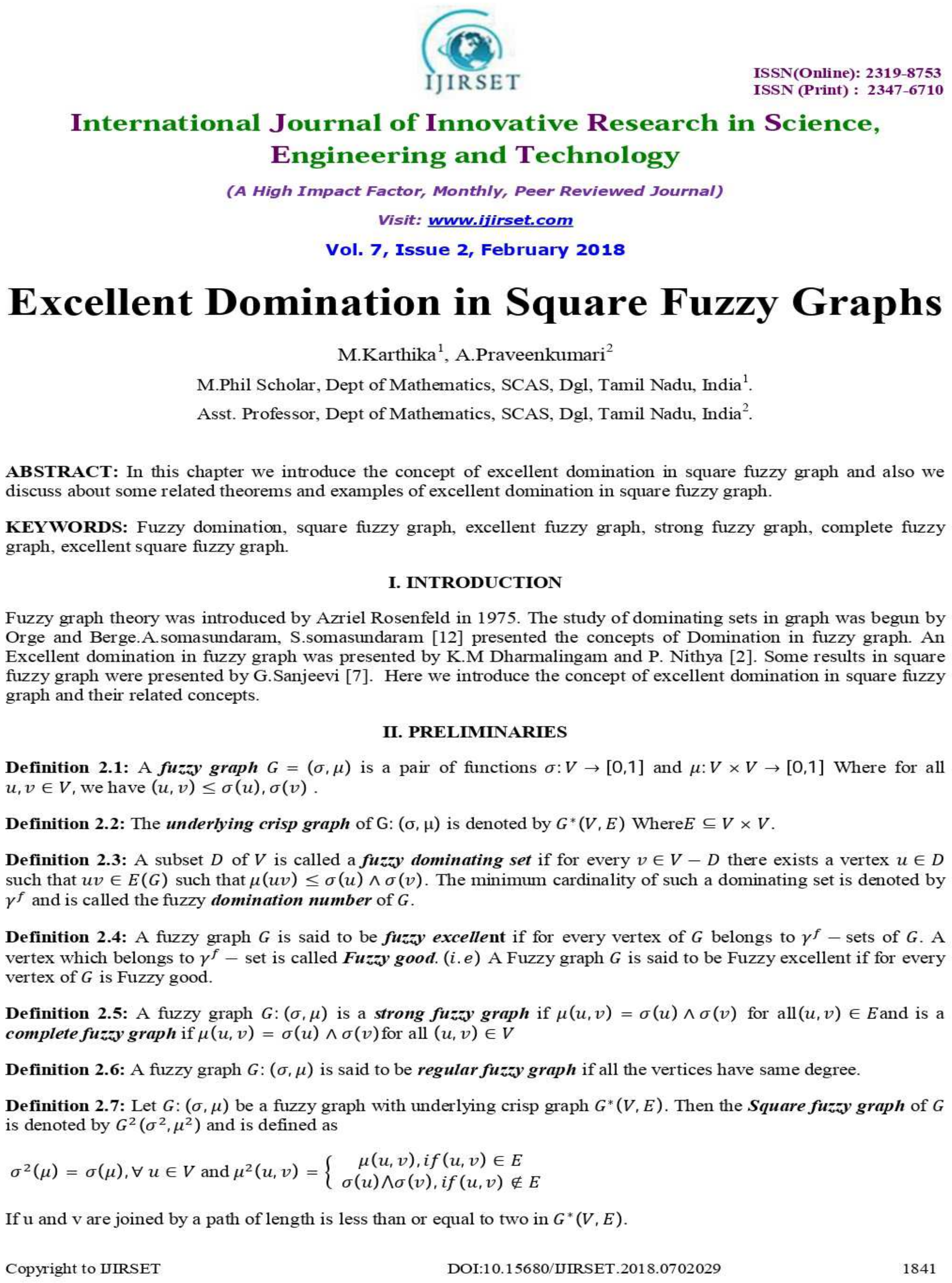

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Excellent Domination in Square Fuzzy Graphs

M.Karthika[1], A.Praveenkumari[2]

M.Phil Scholar, Dept of Mathematics, SCAS, Dgl, Tamil Nadu, India[1].

Asst. Professor, Dept of Mathematics, SCAS, Dgl, Tamil Nadu, India[2].

ABSTRACT: In this chapter we introduce the concept of excellent domination in square fuzzy graph and also we discuss about some related theorems and examples of excellent domination in square fuzzy graph.

KEYWORDS: Fuzzy domination, square fuzzy graph, excellent fuzzy graph, strong fuzzy graph, complete fuzzy graph, excellent square fuzzy graph.

I. INTRODUCTION

Fuzzy graph theory was introduced by Azriel Rosenfeld in 1975. The study of dominating sets in graph was begun by Orge and Berge.A.somasundaram, S.somasundaram [12] presented the concepts of Domination in fuzzy graph. An Excellent domination in fuzzy graph was presented by K.M Dharmalingam and P. Nithya [2]. Some results in square fuzzy graph were presented by G.Sanjeevi [7]. Here we introduce the concept of excellent domination in square fuzzy graph and their related concepts.

II. PRELIMINARIES

Definition 2.1: A ***fuzzy graph*** $G = (\sigma, \mu)$ is a pair of functions $\sigma: V \to [0,1]$ and $\mu: V \times V \to [0,1]$ Where for all $u, v \in V$, we have $(u, v) \leq \sigma(u), \sigma(v)$.

Definition 2.2: The ***underlying crisp graph*** of G: (σ, μ) is denoted by $G^*(V, E)$ Where$E \subseteq V \times V$.

Definition 2.3: A subset D of V is called a ***fuzzy dominating set*** if for every $v \in V - D$ there exists a vertex $u \in D$ such that $uv \in E(G)$ such that $\mu(uv) \leq \sigma(u) \wedge \sigma(v)$. The minimum cardinality of such a dominating set is denoted by γ^f and is called the fuzzy ***domination number*** of G.

Definition 2.4: A fuzzy graph G is said to be ***fuzzy excellent*** if for every vertex of G belongs to $\gamma^f -$ sets of G. A vertex which belongs to $\gamma^f -$ set is called ***Fuzzy good***. $(i.e)$ A Fuzzy graph G is said to be Fuzzy excellent if for every vertex of G is Fuzzy good.

Definition 2.5: A fuzzy graph $G: (\sigma, \mu)$ is a ***strong fuzzy graph*** if $\mu(u, v) = \sigma(u) \wedge \sigma(v)$ for all$(u, v) \in E$and is a ***complete fuzzy graph*** if $\mu(u, v) = \sigma(u) \wedge \sigma(v)$for all $(u, v) \in V$

Definition 2.6: A fuzzy graph $G: (\sigma, \mu)$ is said to be ***regular fuzzy graph*** if all the vertices have same degree.

Definition 2.7: Let $G: (\sigma, \mu)$ be a fuzzy graph with underlying crisp graph $G^*(V, E)$. Then the ***Square fuzzy graph*** of G is denoted by $G^2(\sigma^2, \mu^2)$ and is defined as

$$\sigma^2(\mu) = \sigma(\mu), \forall\, u \in V \text{ and } \mu^2(u, v) = \begin{cases} \mu(u, v), if\,(u, v) \in E \\ \sigma(u) \wedge \sigma(v), if\,(u, v) \notin E \end{cases}$$

If u and v are joined by a path of length is less than or equal to two in $G^*(V, E)$.

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Definition 2.8: A ***homomorphism*** of fuzzy graph $G:(\sigma,\mu)$ and $G':(\sigma',\mu')$ with underlying crisp graphs $G^*(V,E)$ and $G^{*'}(V',E')$ respectively is a bijective map $h: V \to V'$ which satisfies $\sigma(x) = \sigma'(h(x)), \forall x \in V$ and $\mu(x,y) \le \mu'(h(x),h(y)), \forall x,y \in V$.

Definition 2.9: A ***weak isomorphism*** $h: G \to G'$is a homomorphism such that the map $h: V \to V'$ is bijective and satisfies $\sigma(x) = \sigma'(h(x)) \forall x \in V$.

Definition 2.10: If $\gamma^{uf}(G,u) = \gamma^f(G)$ then u is ***fuzzy level vertex*** of G

Definition 2.11: An edge (u,v) of fuzzy graph $G:(\sigma,\mu)$ is called an ***effective edge*** [5] if $\mu(u,v) = \sigma(u) \wedge \sigma(v)$.

Definition 2.12: A dominating set S of a fuzzy graph $G:(\sigma,\mu)$ is said to be a ***minimal dominating set*** if no proper subset of S is a dominating set of G.

III. EXCELLENT DOMINATION IN SQUARE FUZZY GRAPH

Definition 3.1: A square fuzzy graph $G^2(\sigma^2,\mu^2)$ is said to be an ***Excellent square fuzzy graph*** if for every vertex of G^2 belongs to γ^f sets of G^2, and is denoted by $G_E^2(\sigma^2,\mu^2)$.

Example 3.1:

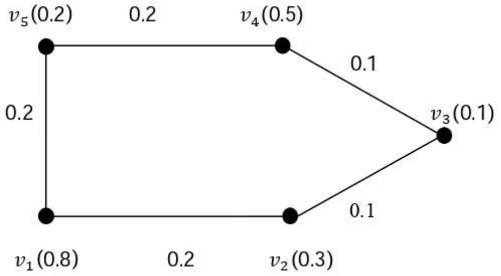

Fig 1: Fuzzy Graph $G(\sigma,\mu)$

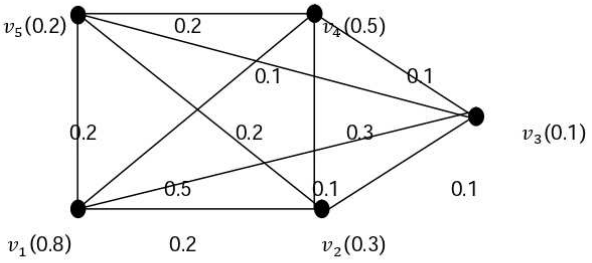

Fig 2: Square fuzzy graph $G^2(\sigma^2,\mu^2)$

γ^f Sets of G^2 are $\{v_1\},\{v_2\},\{v_3\},\{v_4\},\{v_5\}$

$\therefore G^2(\sigma^2,\mu^2)$ is a $G_E^2(\sigma^2,\mu^2)$

Theorem 3.1: Let $G(\sigma,\mu)$ be a strong fuzzy graph and $G^*(V,E)$ is cycle of length $n \le 5$. Then the square fuzzy graph $G^2(\sigma^2,\mu^2)$ is a complete and is an excellent square fuzzy graph.

Proof: Given $G(\sigma,\mu)$ be a strong fuzzy graph and $G^*(V,E)$ is cycle of length $n \le 5$. Since G is a strong fuzzy graph if $(u,v) \in V$.

Then $\mu(u,v) = \sigma(u) \wedge \sigma(v)$ in G^2 also.

Since $G^*(V,E)$ is cycle of length $n \le 5$ if u and v are non adjacent than there is a path of length 2.

$\therefore \mu(u,v) = \sigma(u) \wedge \sigma(v)$ inG^2, if $(u,v) \notin E$.

$\therefore$ Any two points are joined by an effective edge. $\therefore G^2(\sigma^2,\mu^2)$ is a complete fuzzy graph. Since $G^2$is a complete, then every vertex of G^2belongs to γ^f sets of G^2. $\therefore G^2$ is an excellent square fuzzy graph.

Theorem 3.2: If $G(\sigma,\mu)$ is a fuzzy graph with underlying crisp graph $G^*(V,E)$ being complete then G and G^2 are same also G and $G^2$are excellent square fuzzy graph.

Proof: $G^*(V,E)$ being complete every pair of vertices in V are adjacent in G^*. $i.e$) For every u,v in V,(u,v) is in $E \Rightarrow \mu(u,v) > 0 \ \forall u,v$ in V.

$\therefore \mu^2(u,v) = \mu(u,v) \ \forall u,v$ in V.

$\therefore G^2(\sigma^2,\mu^2) = G(\sigma,\mu)$.

$\therefore G$ and G^2 are same. Since G and G^2 are complete. Then each vertex of G and $G^2$are a minimum dominating set. Hence G and $G^2$are excellent square fuzzy graph.

Theorem 3.3: Let G_E^2 be an excellent square fuzzy graph and a dominating set D of G_E^2 is a minimal dominating set if and only if for each $d \in D$ one of the following two conditions holds.

1. $N(d) \cap D = \emptyset$.

2. There is a vertex $c \in V \backslash D$ such that $N(c) \cap D = \{d\}$.

Proof: Given D be a minimal dominating set in G_E^2 , and $d \in D$. Then $D_d - D\{d\}$ is not a dominating set in G_E^2 , hence there exists $x \in V \backslash D_d$ such that x is not dominated by any element of D_d. If $x = d$ we get $N(d) \cap D = \emptyset$ and if $x \neq d$ we get $N(c) \cap D = \{d\}$.The converse is obvious.

Theorem 3.4: Let $G(\sigma,\mu)$ be a fuzzy graph and G_E^2 (σ^2,μ^2) be its excellent square fuzzy graph. Then

$(i) O(G) = O(G_E^2)$ [$i.e.$ Order of G = Order of G_E^2]

(ii) Size of $G \le$ Size of G_E^2

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Proof: Given $G(\sigma,\mu)$ be a fuzzy graph and $G_E^2\ (\sigma^2,\mu^2)$ be its excellent square fuzzy graph.(i)Since $G$and G_E^2 has same point set with their respective weights.

$\therefore$ Order of $G = \sum\sigma(u)$,

Order of $G_E^2 = \sum\sigma^2(u) = \sum\sigma(u)$,

$\therefore O(G) = O(G_E^2)$.

(ii) If (u,v) be an edge in $G(\sigma,\mu)$then (u,v) is also be an edge in $G_E^2\ (\sigma^2,\mu^2)$. If u and v are at a distance 2 in $G^*(V,E)$ then they are made adjacent in $G_E^2\ (\sigma^2,\mu^2)$. $\therefore$The number of edges is more in $G_E^2\ (\sigma^2,\mu^2)$.

Hence Size of $G \leq$ Size of G_E^2.

Results 3.4.1: 1. A fuzzy graph G is weak isomorphic to the excellent square fuzzy graph G_E^2 .

2. [9] For any excellent square fuzzy graph $G_E^2\ (\sigma^2,\mu^2)$. $\gamma^f(G_E^2) \leq \gamma^f(G)$.

3. An excellent square fuzzy graph of a regular fuzzy graph needs not be regular.

Theorem 3. 5: If $G_E^2\ (\sigma^2,\mu^2)$ is complete then any vertex of G_E^2 is a fuzzy level vertex.

Proof: Let $G_E^2\ (\sigma^2,\mu^2)$ be a complete excellent square fuzzy graph. Since G_E^2 is complete then every pair of vertices are adjacent. Since each vertex of G_E^2 are minimum dominating set

$\therefore \gamma^f\ (G_E^2) = 1$.

Now remove any vertex $\{u\}$ of G_E^2 and their incident edges. We get $G_E^2 - \{u\}$ is complete. Since $G_E^2 - \{u\}$ complete then each vertex of $G_E^2 - \{u\}$ is a minimum dominating set.

$\therefore \gamma^{uf}\,(G_E^2,u) = 1$,

$\therefore \gamma^f\ (G_E^2) = \gamma^{uf}(G_E^2,u)$

$\therefore \{u\}$ is a fuzzy level vertex.

Since any vertex of G_E^2 is a fuzzy level vertex.

IV. CONCLUSION

In this paper we have define the concept of excellent domination in square fuzzy graph and derive the related theorems to this concept.

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Connected Edge Perfect Domination in Fuzzy Graphs

P. Karpagam[1], V. Revathi[2]

M.Phil Scholar, Dept of Mathematics, SCAS, Dgl, Tamil Nadu, India [1]

Asst. Professor, Dept of Mathematics, SCAS, Dgl, Tamil Nadu, India [2]

ABSTRACT: In this paper we introduce the concept of connected edge perfect domination and connected edge domination in fuzzy graph. We determine the connected edge perfect domination number for standard theorems and some examples. Finally the connected edge perfect domination set and number for a connected fuzzy graph is obtained.

KEYWORDS: Fuzzy graph, Dominating set, Edge domination, Edge domination number, Effective edge, Connected edge domination, Perfect dominating set, Connected edge perfect domination, Connected edge perfect domination number.

I. INTRODUCTION

An interesting application in voting situation using the concept of domination. The study of dominating sets in graphs was begun by Ore and Berge, the domination number, independent domination number are introduced by Cockayne and Hedetniemi. A. Somasundram and S. Somasundram discussed domination in fuzzy graphs. V.R. Kulli and D.K. Patwari discussed the total edge domination number of graph. Nagoor Gani and Chandrasekaran discussed domination in fuzzy graph using strong arcs. We also discuss domination, independent domination and perfect domination in fuzzy graph using strong arcs. In this paper we introduce the connected edge perfect domination in fuzzy graph, the connected edge perfect domination number, and give some important results.

II. PRELIMINARIES

Definition 2.1: A ***fuzzy graph*** $G = (\sigma, \mu)$ is a set with two functions, $\sigma: V \to [0,1]$ and $\mu: E \to [0,1]$ such that $\mu(xy) \leq \sigma(x) \Lambda \sigma(y) \forall x, y \in V$. Let $\sigma: V \to [0,1]$ be a fuzzy subset of V then the ***complete fuzzy graph*** on σ is defined on $G = (\sigma, \mu)$ where $\mu(xy) = \sigma(x) \Lambda \sigma(y)$ for all $xy \in E$ and is denoted by K_σ. The ***complement of a fuzzy graph*** G denoted by $\bar{G} = (\sigma, \bar{\mu})$ where $\bar{\mu}(xy) = \sigma(x) \Lambda \sigma(y) - \mu(xy)$.

Definition 2.2: Let $G = (\sigma, \mu)$ be a fuzzy graph on V. Let $x, y \in V$. We say that x dominated y in G if $\mu(xy) = \sigma(x) \Lambda \sigma(y)$. A subset S of V is called a ***dominating set*** in G if for every $v \notin S$, there exists $u \in S$ such that u dominates v. The minimum fuzzy cardinality of a dominating set in G is called the ***domination number*** of G and is denoted by $\gamma(G)$ or γ.

Definition 2.3: Let $G = (\sigma, \mu)$ be a fuzzy graph on V and $S \subseteq V$. Then the ***fuzzy cardinality*** of S is defined to be $\sum_{v \in S} \sigma(v)$. Let $G = (\sigma, \mu)$ be a fuzzy graph on V and $D \subseteq E$. Then the ***fuzzy edge cardinality*** of D is defined to be $\sum_{e \in D} \mu(e)$.

Definition 2.4: Let $G = (\sigma, \mu)$ be a fuzzy graph on (V, X). A subset S of X is said to be an ***edge domination set*** in G if for every in $X - S$ is adjacent to atleast one effective edge in S. The minimum fuzzy cardinality of an edge dominating set in G is called the ***edge domination number*** of G and is denoted by $\gamma'(G)$ or γ'. An edge $e = xy$ of a fuzzy graph is called an ***effective edge*** if $\mu(xy) = \sigma(x)\Lambda\sigma(y)$.

Definition 2.5: Let $G = (\sigma, \mu)$ be a fuzzy graph on (V, X), an edge dominating set F of a fuzzy graph G is ***connected edge dominating set*** with $\langle F \rangle$ is connected. The ***connected edge domination number*** $\gamma_{c'}(G)$ or $\gamma_{c'}$ is the minimum fuzzy cardinality of connected edge dominating set.

Definition 2.6: Let G be a fuzzy graph without isolated edges. A subset D of E is said to be a ***total edge dominating set*** if every edge in E is dominated by an edge in D. The minimum fuzzy cardinality of a total edge dominating set is called the ***total edge domination number*** of G and is denoted by $\gamma_{t'}(G)$.

Definition 2.7: An edge dominating set X of a fuzzy graph G is said to be a ***perfect edge dominating set*** if every edge of $E - X$ is adjacent to exactly one edge in X. The perfect edge dominating set X of a fuzzy graph G is said to be a ***minimal perfect edge dominating set*** if for each $uv \in X, X - \{u, v\}$ is not a perfect edge dominating set. The cardinality of a minimum perfect edge dominating set is called as ***perfect edge domination number*** and is denoted by $\gamma_{pf}'(G)$.

III. CONNECTED EDGE PERFECT DOMINATION IN FUZZY GRAPH

Definition 3.1: Let $G = (\sigma, \mu)$ be a fuzzy graph on (V, X), an edge dominating set F of a fuzzy graph G is ***connected edge perfect dominating set*** with $\langle F \rangle$ is connected.

The ***connected edge perfect domination number*** $\gamma_{cep'}(G)$ or $\gamma_{cep'}$ is the minimum fuzzy cardinality of connected edge perfect dominating set.

Example 3.1:

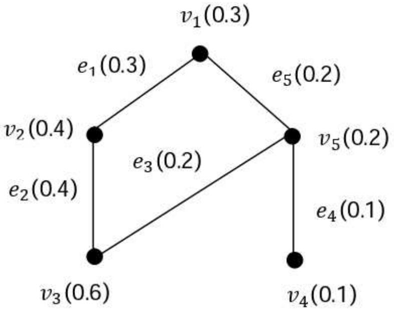

Fig. 1

$\{e_1, e_5\}$ is a connected edge perfect dominating set.

Connected edge perfect domination number $\gamma_{cep'}(G) = 0.5$

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Theorem 3.1: [4] For any fuzzy graph $\frac{q}{\Delta_{cep}'(G)+1} \geq \gamma_{cep}'(G)$

Proof: Let S be connected edge perfect edge domination set of G.

Since $|S|\Delta_{cep}'(G) \leq \sum_{e\in S} d_E(e)$

$$= \sum_{e\in S}|N(e)|$$

$$\leq |\cup_{e\in S} N(e)|$$

$$\leq |E - S|$$

$$\leq q - |S|$$

$$|S|\Delta_{cep}'(G) + |S| \leq q$$

Thus $\frac{q}{\Delta_{cep}'(G)+1} \geq \gamma_{cep}'(G)$.

Theorem 3.2: A connected edge perfect dominating set D is minimal if and only if for each edge $e \in D$, one of the following two conditions holds.

I. $N(e) \cap D = \emptyset$

II. There exists an edge $q \in E - D$ such that $N(q) \cap D = \{e\}$ and q is an effective edge.

Proof: Let D be a minimal connected edge perfect dominating set and $e \in D$. Then $D_e = D - \{e\}$ is not an connected edge perfect dominating set. Hence there exists $q \in E - D_e$ such that q is not dominated by any element of D_e. If $q = e$ we get (I) and if $q \neq e$ we get (II).

Conversely,

Let I. $N(e) \cap D = \emptyset$ II. There exists an edge $q \in E - D$ such that $N(q) \cap D = \{e\}$ and q is an effective edge. To prove that D is a minimal connected edge perfect dominating set. Suppose that $\in E - D_e$, then q is not dominated by any element of D_e. Now $D_e = D - \{e\}$ is not a connected edge perfect dominating set. Hence D is a minimal connected edge perfect dominating set.

Theorem 3.3: [4] Let G be a connected fuzzy graph and let S be a minimal connected edge perfect dominating set of G. Then $E - S$ is also a minimal connected edge perfect dominating set of G.

Proof: Let S be a minimal connected edge perfect dominating set of G. Suppose that $E - S$ is not a connected edge perfect dominating set. Then there exists a edge $E - S$ such that e is not a dominated by any edge in $E - S$. Since G is connected, e is a strong neighbor of atleast one edge in $S - \{e\}$. Then $S - \{e\}$ is a dominating set which is a contradiction. Thus every edge in S is a strong neighbor of atleast one edge in $E - S$. Hence $E - S$ is also a connected edge perfect dominating set.

Result 3.3: [4] For any fuzzy graph G without isolated edges $\gamma_{cep}' \leq \frac{E}{2}$.

Given that G be any fuzzy graph without isolated edges. To prove that $\gamma_{cep}' \leq \frac{E}{2}$. If any graph without isolated edges has two disjoint connected edge perfect dominating set. Then $\gamma_{cep}' \leq \frac{E}{2}$.

For the connected edge perfect domination in fuzzy graph given in fig. 2

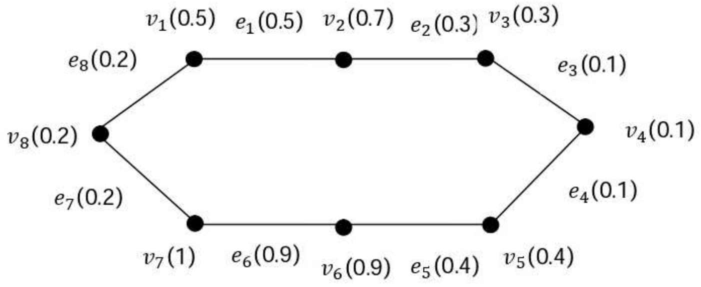

Fig. 2

The connected edge perfect domination number $\gamma_{cep}' = 0.6, E = 2.7$ and $\frac{E}{2} = 1.35$.

Hence $\gamma_{cep}' \le \frac{E}{2}$.

Theorem 3.4: For any fuzzy graph $\frac{X}{\Delta_{cep}'(G)} \ge \gamma_{cep}'(G)$.

Proof: Let S be a connected edge perfect dominating set with minimum number of fuzzy edge cardinality. Then every edge in S is adjacent to atleast $\Delta_{cep}'(G)$ fuzzy edge cardinality. Therefore $|S|\Delta_{cep}'(G) \le X$. Hence $\frac{X}{\Delta_{cep}'(G)} \ge \gamma_{cep}'(G)$.

Theorem 3.5: [3] Every complete fuzzy graph G is a connected edge perfect dominating set with $n = 3$.

Proof: Let G be a complete fuzzy graph. Therefore every arc in G is strong arc. (ie) every edge e, $E - S$ is incident to exactly one edge of the dominating set S in G. Hence S is a connected edge perfect dominating set with $n = 3$. Therefore, every complete fuzzy graph G is a connected edge perfect dominating set with $n = 3$.

Theorem 3.6: [4] If a fuzzy graph G has no isolated edges then $\gamma_{cep}'(G) \le \gamma_{tcep}'$.

Proof: Let G be any fuzzy graph without isolated edges. To prove that $\gamma_{cep}'(G) \le \gamma_{tcep}'$. By the definition, clearly every minimal connected edge perfect dominating set which is less than or equal to minimal total connected edge perfect dominating set. Hence $\gamma_{cep}'(G) \le \gamma_{tcep}'$.

Theorem 3.7: [6] If G be any fuzzy graph without isolated edges then $\delta_{cep}(G) \le \frac{2q}{p} \le \Delta_{cep}(G)$

Proof: Let G be connected edge perfect domination in fuzzy graph. Let $E(G) = \{e_1, e_2, e_3, e_4\}$. We have $\delta_{cep}(G) \le degE_i(G) \le \Delta_{cep}(G)$

Hence $p\delta_{cep}(G) \le \sum_{i=1}^{4} degE_i(G) \le p\Delta_{cep}(G)$.

$p\delta_{cep}(G) \le 2q \le p\Delta_{cep}(G)$.

$\delta_{cep}(G) \le \frac{2q}{p}$.

IV. CONCLUSION

The concept of domination in graphs is very rich both in the theoretical developments and applications. More than thirty domination parameters have been investigated by different authors, and in this paper we have introduced, the concepts of connected edge perfect domination and minimal connected edge perfect domination in fuzzy graph by using connected edge domination in fuzzy graph.

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Fuzzy Multiple Split Domination Number

A. Shanmuga Rathinam[1], Ms.V. Revathi[2],

M.Phil Scholar, Dept. of Mathematics, SCAS, Dgl, Tamil Nadu, India[1]

Asst Professor, Dept. of Mathematics, SCAS, Dgl, Tamil Nadu, India[2]

ABSTRACT: In this paper we introduced the concepts of fuzzy multiple split domination number. We determine the number $\gamma_{ms}(G)$ of a fuzzy multiple split domination number and obtain the definitions and theorems.

KEYWORD: Graph, Fuzzy Graph, Domination set, Multiple domination set, Split dominating set, Split domination number.

I. INTRODUCTION

The study of dominating sets in graphs was begun by ore and berge, the domination number is introduced by cockayne and Hedetniemi, Rosenfeld introduced the notion of fuzzy graph and several fuzzy analogs of graph theoretic concepts such as paths, cycle and connectedness. A. Somasundaram and S. Somasundaram discussed domination in fuzzy graph. A. Nagoor Gani and V. T. Chandarasekaran discussed domination in fuzzy graph. We also discussed the domination number of the fuzzy digraph, fuzzy k-dominating set, fuzzy k-domination number, fuzzy multiple domination. Then the concept of split domination was introduced by V. R. Kulli and B. Janakiram discussed about the split domination number by using this finally about the fuzzy multiple split domination number $\gamma_{ms}(G)$.

II. PRELIMINARIES

Definition 2.1: A fuzzy graph $G = (\sigma, \mu)$ is a set with two functions $\sigma: V \to [0,1]$ and $\mu: E \to [0,1]$ such that $\mu(\{x,y\}) \leq \sigma(x) \wedge \sigma(y)$ for all $x, y \in V$. Then we write $\mu(xy)$ for $\mu(\{x,y\})$.

Definition 2.2: Let $G = (\sigma, \mu)$ be a fuzzy graph on V and $V_1 \subseteq V$. Define σ_1 on V_1 by $\sigma_1(x) = \sigma(x)$ for all $x \in V_1$ and μ_1 on the collection E_1 of two element subsets of V_1 by $\mu_1(x,y) = \mu(xy)$ for all $x, y \in V_1$. Then (σ_1, μ_1) is called the fuzzy sub grapg of G induced by V_1 and is denote by $\langle V_1 \rangle$.

Definition 2.3: Let $G = (\sigma, \mu)$ be a fuzzy graph on $V$and $S \subseteq V$. Then the fuzzy cardinality of S is defined to be $\sum_{v \in S} \sigma(v)$.

Definition 2.4: A subset D of V is said to be a ***dominating set*** of G if every vertex in $V - D$ is adjacent to a vertex in D.

Definition 2.5: The ***domination number*** $\boldsymbol{\gamma(G)}$ of G is the minimum cardinality of a dominating set.

Definition 2.6: Let $G = (V, \sigma, \mu)$ b a fuzzy graph. Then $D \subseteq V$ is said to be ***fuzzy dominating set*** of G if for every $v \in V - D$ there exists u in D such that $\mu(v, v) = \sigma(u) \wedge \sigma(v)$.

Definition 2.7: The minimum fuzzy cardinality of a fuzzy dominating set is called the ***fuzzy domination number*** of G and is denoted by $\gamma_f(G)$.

Definition 2.8: A fuzzy dominating set D of a fuzzy graph G is called ***multiple dominating set*** of G if for each vertex in $V - D$ be dominated by multiple vertices in D.

Definition 2.9: A split dominating set D of graph G is called a ***split dominating set***, if the induced sub graph $\langle V - D \rangle$ is disconnected.

Definition 2.10: The ***split domination number*** $\boldsymbol{\gamma_s(G)}$ of G is the minimum cardinality of the split dominating set.

III. FUZZY MULTIPLE SPLIT DOMINATION NUMBER

Definition 3.1: A fuzzy dominating set D of a fuzzy graph G is called ***multiple split domination number*** of G if for each vertex in $V-D$ be dominated by multiple vertices in D and $\gamma_{ms}(G)$ is the minimum cardinality of the split dominating set.

Example: The fuzzy multiple split domination number of given fuzzy graph (Fig.4) is $D=\{v_2,v_4,v_5\}$, $V-D=\{v_1,v_3\}$

The cardinality of a fuzzy multiple split domination number is 3.

The fuzzy multiple split domination number $\gamma_{ms}(G)=3$ and $\{v_2,v_4,v_5\}$ is a set of cut vertices.

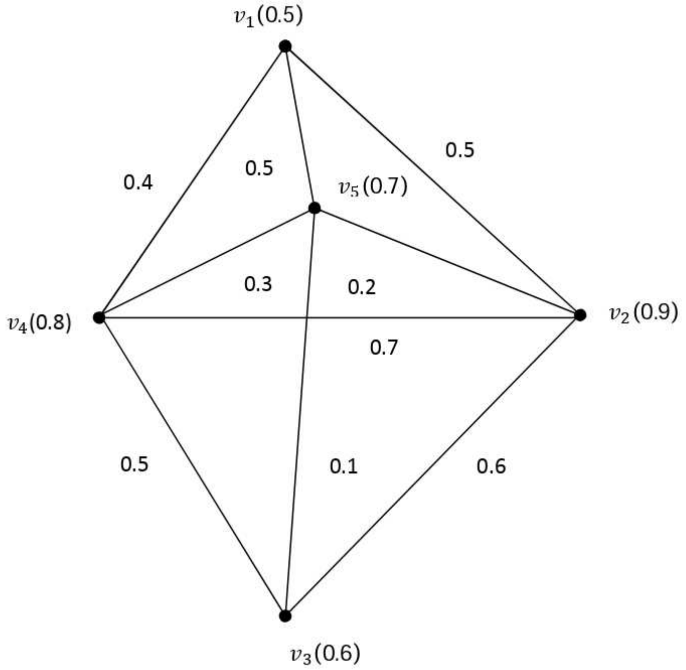

Fig. 1

Theorem 3.1: If D is a fuzzy γ_{ms}- set of a fuzzy graph G, then at least one vertex in $V-D$ is not dominated by multiple vertices in D and is not a set of cut vertices.

Proof: Let D be a fuzzy multiple split dominating set in G. Assume that, every vertex in $V-D$ is dominated by multiple vertices in D and is a set of cut vertices. Let u$\in V-D$ and let v and w be two cut vertices in D with multiple vertices which dominates u. By our assumption, every vertex in $V-D$ is dominated by at least one cut vertices in $D-\{v,w\}$. The set $D^1=D-\{v,w\}\cup\{u\}$ is fuzzy multiple split domination number $\gamma_{ms}(G)$. But, $|D^1|\le|D|$ contradict the assumption that D is a fuzzy multiple split domination number.

Corollary 3.1: If the fuzzy graph G has no cut vertices and no multiple vertices in D, then $\gamma_{ms}(G)\ge 2$.

Remark 3.1: Converse of **corollary 3.1** need not be true as one can see from the fuzzy graph G given in **Fig. 2**. Here $\gamma_{ms}(G) = 4$ and $\{v_5, v_6, v_7, v_8\}$ is a set of cut vertices and has multiple vertices in D.

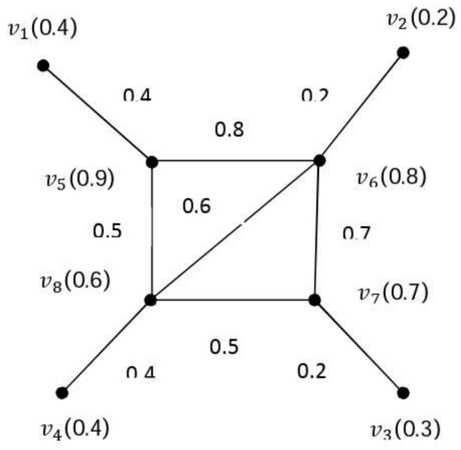

Fig. 2

Theorem 3.2: Let v be a vertex in a fuzzy graph G with degree k and $\langle N(v)\rangle$ disconnected. Then $\gamma_{ms}(G) \leq p - k$.
Proof: Since v is of degree k and $\langle N(v)\rangle$ disconnected. $V - N(v)$ is a fuzzy multiple split domination number $\gamma_{ms}(G)$. Therefore $|V - N(v)| \geq \gamma_{ms}(G)$.
Theorem 3.3: Let S be a γ_{ms}- set of a fuzzy graph G. If $V - S$ is a fuzzy multiple split domination number of $\gamma_{ms}(G)$, then $\gamma_{ms}(G) \leq p/2$.
Proof: Since $V - S$ is a multiple split domination number in a fuzzy graph G. $|V - S| \geq \gamma_{ms}(G)$.
Remark 3.2: The converse of the above **Theorem 3.3** need not be true and the same can be seen from the fuzzy graph given in **Fig. 3** In this fuzzy graph, $S = \{v_1, v_4\}$ is a γ_{ms}- set with $\gamma_{ms} < p/2$. But, $V - S = \{v_2, v_3, v_5\}$ is not a fuzzy multiple split domination number $\gamma_{ms}(G)$.

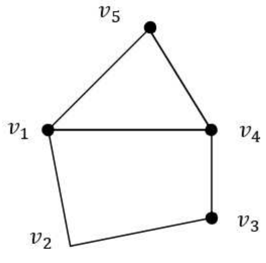

Fig. 3

Theorem 3.4: If a dominating set S of fuzzy graph is also a fuzzy multiple split domination number, then there exists two vertices v_1, v_2 in $V - S$ such that $d(v_1, v_2) \geq 2$.
Proof: If not, assume that for any two vertices v_1, v_2 in $V - S$, $d(v_1, v_2) = 1$. Then $\langle V - S \rangle$ is connected which is a contradiction to S is a fuzzy multiple split domination number γ_{ms}(G).

IV. CONCLUSTION

The concept of domination in graphs is very rich both in the theoretical developments and applications. More than thirty domination parameters have been investigated by different authors, and in this paper we have introduced, the concepts of fuzzy multiple split domination number by using fuzzy multiple domination and Split domination number in graphs.

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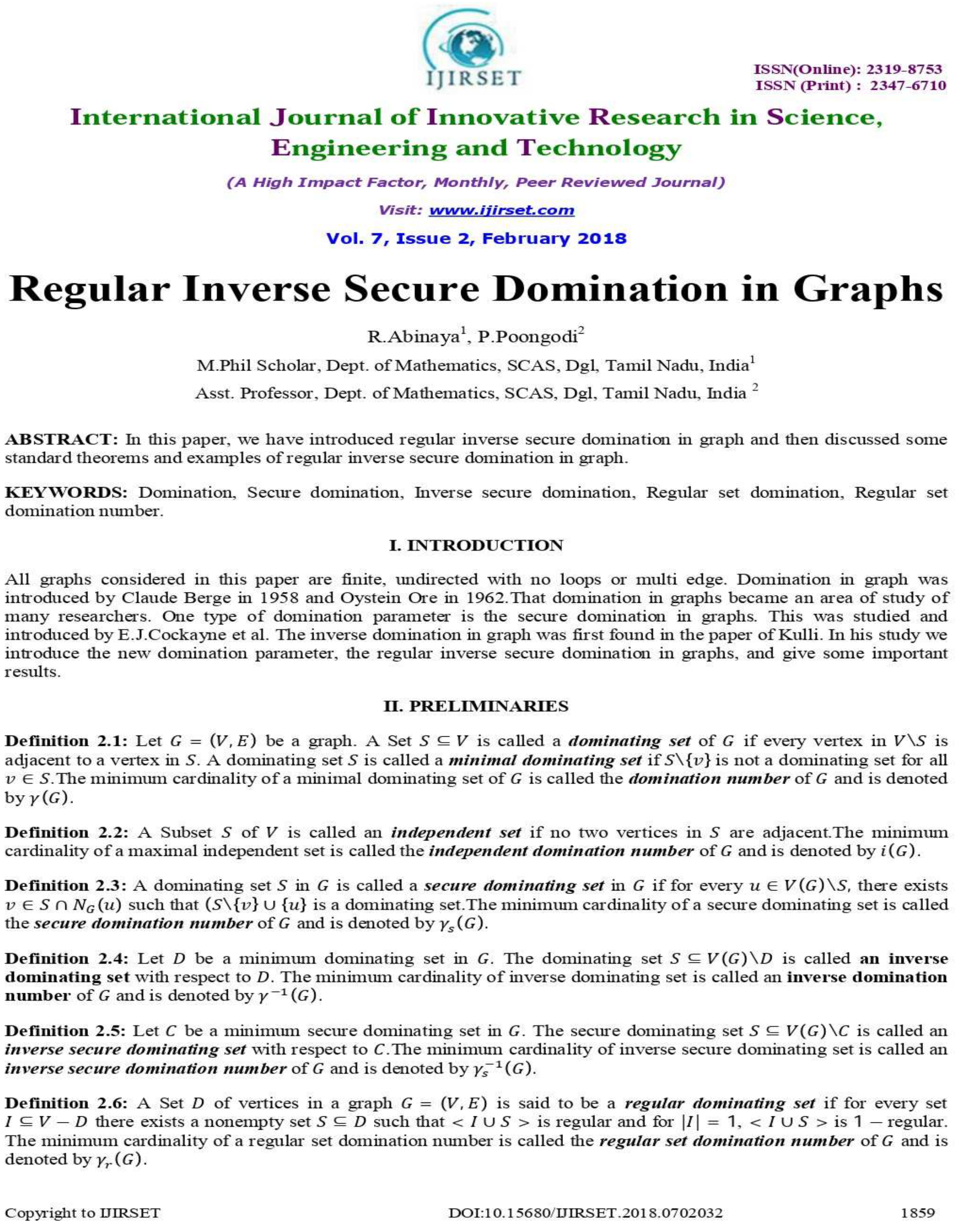

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Regular Inverse Secure Domination in Graphs

R.Abinaya[1], P.Poongodi[2]

M.Phil Scholar, Dept. of Mathematics, SCAS, Dgl, Tamil Nadu, India[1]

Asst. Professor, Dept. of Mathematics, SCAS, Dgl, Tamil Nadu, India [2]

ABSTRACT: In this paper, we have introduced regular inverse secure domination in graph and then discussed some standard theorems and examples of regular inverse secure domination in graph.

KEYWORDS: Domination, Secure domination, Inverse secure domination, Regular set domination, Regular set domination number.

I. INTRODUCTION

All graphs considered in this paper are finite, undirected with no loops or multi edge. Domination in graph was introduced by Claude Berge in 1958 and Oystein Ore in 1962.That domination in graphs became an area of study of many researchers. One type of domination parameter is the secure domination in graphs. This was studied and introduced by E.J.Cockayne et al. The inverse domination in graph was first found in the paper of Kulli. In his study we introduce the new domination parameter, the regular inverse secure domination in graphs, and give some important results.

II. PRELIMINARIES

Definition 2.1: Let $G = (V, E)$ be a graph. A Set $S \subseteq V$ is called a ***dominating set*** of G if every vertex in $V\setminus S$ is adjacent to a vertex in S. A dominating set S is called a ***minimal dominating set*** if $S\setminus\{v\}$ is not a dominating set for all $v \in S$.The minimum cardinality of a minimal dominating set of G is called the ***domination number*** of G and is denoted by $\gamma(G)$.

Definition 2.2: A Subset S of V is called an ***independent set*** if no two vertices in S are adjacent.The minimum cardinality of a maximal independent set is called the ***independent domination number*** of G and is denoted by $i(G)$.

Definition 2.3: A dominating set S in G is called a ***secure dominating set*** in G if for every $u \in V(G)\setminus S$, there exists $v \in S \cap N_G(u)$ such that $(S\setminus\{v\} \cup \{u\})$ is a dominating set.The minimum cardinality of a secure dominating set is called the ***secure domination number*** of G and is denoted by $\gamma_s(G)$.

Definition 2.4: Let D be a minimum dominating set in G. The dominating set $S \subseteq V(G)\setminus D$ is called **an inverse dominating set** with respect to D. The minimum cardinality of inverse dominating set is called an **inverse domination number** of G and is denoted by $\gamma^{-1}(G)$.

Definition 2.5: Let C be a minimum secure dominating set in G. The secure dominating set $S \subseteq V(G)\setminus C$ is called an ***inverse secure dominating set*** with respect to C.The minimum cardinality of inverse secure dominating set is called an ***inverse secure domination number*** of G and is denoted by $\gamma_s^{-1}(G)$.

Definition 2.6: A Set D of vertices in a graph $G = (V, E)$ is said to be a ***regular dominating set*** if for every set $I \subseteq V - D$ there exists a nonempty set $S \subseteq D$ such that $< I \cup S >$ is regular and for $|I| = 1$, $< I \cup S >$ is $1 -$ regular. The minimum cardinality of a regular set domination number is called the ***regular set domination number*** of G and is denoted by $\gamma_r(G)$.

Definition 2.7: Let S be a subset of $V(G)$ and $v \in S$. Then the **private neighborhood** of v with respect to S set $Pn[v,S] = \{w \in V(G): N[w] \cap S = \{v\}$.

Definition 2.8: A dominating set D of a graph G is **a maximal dominating set** if $V - D$ is not a dominating set of G. Maximal domination number $\gamma_m(G)$ of G is the minimum cardinality of a maximal dominating set.

III. REGULAR INVERSE SECURE DOMINATION IN GRAPHS

Definition 3.1: An inverse secure dominating set D is said to be ***regular inverse secure dominating set*** if for every $I \subseteq V - D$ there exists a non empty set $S \subseteq D$ such that $< I \cup S >$ is regular. The minimum cardinality of a regular inverse secure dominating set is called the ***regular inverse secure domination number***.

Example 3.1:

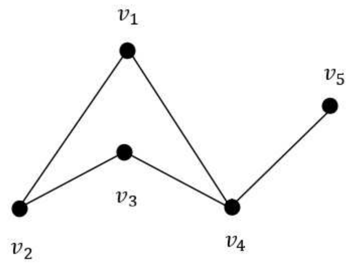

Fig. 1

$\{v_2, v_3, v_5\}$ is a regular inverse secure dominating set.

Theorem 3.1: **[4]** Let G be a graph with no isolated vertex. If $S \subseteq V(G)$ is a regular inverse secure dominating set then $V(G)\backslash S$ is also a regular inverse secure dominating set.

Proof: Let G be a graph with no isolated vertex and $S \subseteq V(G)$ is a regular inverse secure dominating set. To prove that $V(G)\backslash S$ is also a regular inverse secure dominating set. Let there exists a regular inverse secure dominating set in some graph G. Since the regular inverse secure dominating set of any graph G of order n cannot be $V(G)$. It follows that $\gamma_{rs}^{-1}(G) \neq n$ and hence $\gamma_{rs}^{-1}(G) < n$. Since $\gamma_{rs}^{-1}(G)$ does not always exists in a connected nontrivial graph G, we denote by G_s^{-1} be a family of all graphs with regular inverse secure dominating set. From this, we get $V(G)\backslash S$ is also a regular inverse secure dominating set.

Result 3.1: Let G be a connected graph of order $n \geq 4$.Then

(i) $1 \leq \gamma_{rs}^{-1}(G) < n$
(ii) $\gamma(G) \leq \gamma_{rs}^{-1}(G) \leq \gamma_s^{-1}(G)$

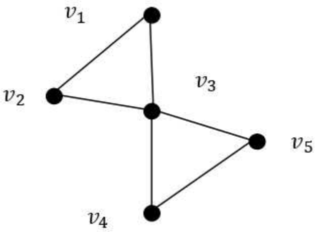

Fig. 2

(i) Dominating Set $= \{v_3\}, \{v_2, v_4\}, \{v_1, v_3\}, \{v_2, v_3\}, \{v_5, v_3\}$

Minimum cardinality of the regular inverse dominating set is denoted by $\gamma_{rs}^{-1}(G)$

$\gamma_{rs}^{-1}(G) = 2$ and $n = 5$

$$1 \leq 2 < 5$$

$$\text{Hence } 1 \leq \gamma_{rs}^{-1}(G) < n$$

(ii) Minimum cardinality of the dominating set is called the domination number $\gamma(G)$

$$\gamma(G) = 1$$

Minimum cardinality of the regular inverse dominating set is denoted by $\gamma_{rs}^{-1}(G)$

$$\gamma_{rs}^{-1}(G) = 2$$

Minimum cardinality of the secure dominating set is denoted by $\gamma_s^{-1}(G)$

$$\gamma_{rs}^{-1}(G) = 2$$

$$1 \leq 2 \leq 2$$

$$\gamma(G) \leq \gamma_{rs}^{-1}(G) \leq \gamma_s^{-1}(G)$$

Theorem 3.2: **[9]** For any graph G, $\gamma_{rs}^{-1}(G) = 1$ if and only if $G = K_n$.

Proof: Let $\gamma_{rs}^{-1}(G) = 1$

To prove that, $G = K_n$. Let $D = \{v\}$ be a regular inverse secure dominating set of G. Suppose there exists two nonadjacent vertices $u, w \in V - D$. Then $< \{u, w, v\} >$ is not regular, which is a contradiction. Hence every two vertices in $V - D$ are adjacent. Hence G is complete.

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Conversely,

Let G be a complete graph. To prove that, $\gamma_{rs}^{-1}(G) = 1$. We know that, "Let G be a connected non trivial graph of order n. Then $\gamma_{rs}^{-1}(G) = 1$ if and only if $G = K_n$." Every complete graph is a connected non trivial graph. Hence G is connected. Hence $\gamma_{rs}^{-1}(G) = 1$

Theorem 3.3: [9] Let G be a connected non complete graph of order $n \geq 4$, if $\gamma_{rs}^{-1}(G) = 2$ then $\gamma_{rs}(G) = 2$.

Proof: Let G be a connected non complete graph of order $n \geq 4$ and $\gamma_{rs}^{-1}(G) = 2$. To prove that, $\gamma_{rs}(G) = 2$. Suppose that $\gamma_s^{-1}(G) = 2$. "Let G be a connected nontrivial graph of order $n \geq 4$. Then $\gamma_{rs}(G) \leq \gamma_{rs}^{-1}(G)$". Since $\gamma_{rs}(G) \leq \gamma_{rs}^{-1}(G) = 2$. It follows that, $\gamma_{rs}(G) = 1$ *or* $\gamma_{rs}(G) = 2$. If $\gamma_{rs}(G) = 1$ then $G = K_n$ Which is a contradiction. Hence $\gamma_{rs}(G) = 2$

Theorem 3.4: For any graph G, $\gamma_{rs}^{-1}(G) \leq n - \Delta(G)$

Proof: Let u be a vertex of maximum degree Δ. Let $D = V - N(u)$. Then $|D| = n - \Delta(G)$ and $v \in D$. Consider a maximal regular inverse secure dominating set S in $< D >$ containing v. Then S is the regular inverse secure dominating set of $< D >$. Since v dominates $N(v)$, S dominate $N(v)$. S is the regular inverse secure dominating set of G.

$|S| \leq |D| = n - \Delta(G)$, $\quad \gamma_{rs}^{-1}(G) \leq n - \Delta(G)$

Corollary 3.4: For any graph G $\gamma_{rs}^{-1}(G) \leq n - k(G)$

Proof: $\gamma_{rs}^{-1}(G) \leq n - \Delta(G)$, $\gamma_{rs}^{-1}(G) \leq n - \delta(G)$

Since $\delta(G) \leq \Delta(G)$

$\gamma_{rs}^{-1}(G) \leq n - k(G)$, $[k(G) \leq \delta(G)]$.

$\gamma_{rs}^{-1}(G) \leq n - k(G)$.

Theorem 3.5: [11] Let G be a regular graph with $diam(G) \leq 3$ then any regular inverse secure dominating set D of G is a set dominating set of G, where $diam(G)$ is the diameter of G.

Proof: Let G be a graph, with $diam(G) \leq 3$. To prove that, Any regular inverse secure dominating set D of G is a dominating set. Clearly, G is connected. Suppose there exists two non adjacent vertices $u, v \in V - D$ such that every $u - v$ path in G contains a vertex of $V - D$. Then there exists a vertex $w \in V - D$ adjacent to u *or* v, say u. Thus for the set $I = V - D - \{v\}$ there exists no nonempty set $S \subseteq D$ such that $< I \cup S >$ is regular, a contradiction. Hence there exists a nonempty set $S \subseteq D$ such that $< \{u, v\} \cup S >$ is connected. This implies that D is a set dominating set.

Theorem 3.6: [11] If u and v are two vertices adjacent to same cut vertex, then there is a γ_{rs}^{-1} set of G containing v.

Proof: Let D be a γ_{rs}^{-1} set of G. Suppose $u, v \in V - D$. Then there exists a vertex $w \in D$ not adjacent to any vertex of $V - D$. This implies that $D - \{w\} \cup \{v\}$ is a γ_{rs}^{-1} set of G.

IV. CONCLUSION

In this paper we have introduced the concept of regular inverse secure domination in graphs by using the concept of secure domination in graphs, inverse secure domination in graphs and regular domination in graphs.

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IRIS Crypts for Human Recognition System

L.PONNARASI [#1] and S.YOGA [*2]

[#] *Full Time Research Scholar, Department of Computer Science, Sakthi College Of Arts and Science College For Women, oddanchatram, India*

[*] *Assistant Professor, Department of Computer Science, Sakthi College Of Arts and Science For Women, oddanchatram, India*

***Abstract*— In a variety of applications, the iris is a secure biometric feature that has been extensively employed for human recognition. Though, exploitation of iris recognition is forensic applications has not been informed. A most important cause is being deficient in of human friendly approaches for comparing with iris. Additionally to endorse the utilization of iris recognition in forensics, the resemblance between irises be supposed to made visualizable and understandable. In recent times, a system was proposed, known as "a human-in-the-loop iris recognition system" which was based on detecting and matching iris crypts. Structuring on this system, a new approach for detecting and matching iris crypts automatically is proposed in this work. This detection method is capable to capture iris crypts of different sizes. This matching method is considered to handle possible topological modifications in the detection of the similar crypt in diverse images.**

***Index Terms*— Iris recognition, forensics, human-in-the-loop, eye pathology, ophthalmic disease, iridotomies, conjunctivitis, visible feature, corneal Oedema.**

I. INTRODUCTION

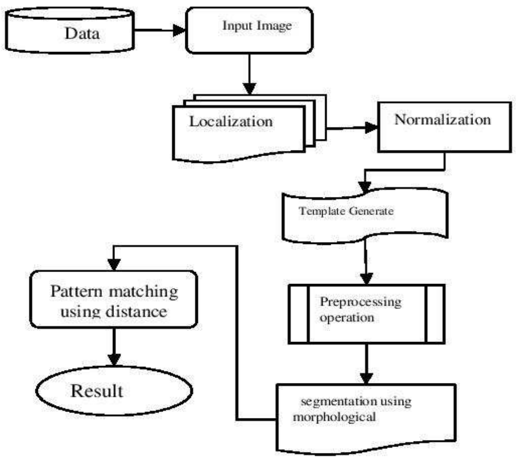
In recent times, iris recognition is fetching one of the most vital biometrics employed in recognition when imaging can be performed at distances below two meters. This significance is because of its high reliability for individual identification. Human iris has enormous mathematical advantage that its pattern inconsistency among different persons is tremendous, since iris patterns acquire a high degree of randomness. Additionally, iris is extremely stable over time. Because the idea of automated iris recognition was developed in 1987, several researchers worked meanwhile that time and they developed different dominant methods. Those methods were based on the texture variations of the iris and can be separated into different techniques e.g. phase-based methods, texture analysis, and intensity variations etc.., Nowadays most of the systems is used and they required unambiguous user collaboration, demanding that the user is placed properly to attain a quality image. These systems give acoustic response to the user to make certain that they are properly situated for image acquisition. In the United Kingdom, the Iris Recognition Immigration System (IRIS) is an intended system that appropriates travelers to authorize through border control stations at various airports rapidly, confirming their identification employing automated roadblocks. CANPASS in Canada is a related program to grant regular travele to speedily proceed through security verification at airports.

II. LITERATURE SURVEY

In last decade discussed that biometric established on the physical and behavioral features were commonly followed and were employed to recognize person uniquely in a usual and instinctive way. Biometric qualities were distinctive to the individual. Among biometric qualities e.g. face, signature, thumb etc. Iris biometric was the nearly trustworthy authentication method. Mostly commercial iris biometric systems work in a unnatural background. Iris images captured in the unnatural background have enough entropy to differentiate individual from some other. This iris recognition system depicted good recognition rate except Performance of the system degrades in noisy environment. They presented the analysis of iris recognition in fewer inhibited background. The author discussed challenges also.

Methodology of Iris recognition

There was a short of human friendly techniques for iris comparison. Therefore it had not been described in forensics applications. They required capturing iris of human and resemblances between the irises are captured. In recent times Human-in-the-loop system had been developed based on matching and detection of iris crypts. Their detection was capable to capture crypts of different sizes and capable to identified every type of topological changes. Currently iris recognition existed in Aadhar card projects. The developed method of this model was to allow for additional correctness in detecting rate and to implement in student verifications coming out for high level government oriented Examinations.



A. *Morphological operation:*

Morphological image processing is a set of non-linear operations associated with the shape or morphology of traits in an image. Allowing morphological operations trust only on the proportional sequence of pixel values, even not on their numerical values, and consequently or particularly appropriate to the processing of binary images. Morphological operations can also be employed to grayscale images like their light transfer functions are indefinite and thus their complete pixel values are of no or small attention. Morphological techniques investigate an image with a small shape or pattern predicted as a structuring element. The structuring element is located at all probable locations in the image and comparison is done with the consequent neighborhood of pixels. Few operations test whether the element "fits" contained by the neighborhood, whereas others test whether it "hits" or intersects the neighborhood.

Binary Image:

A digital image is a binary image that holds just two probable values for each pixel. Though any two colors can be used for binary Image, usually two colors black and white are used for a binary image. For the object(s) in the image the color used is the foreground color whereas the rest of the image is the background color. This is frequently referred to as "bi-tonal" in the document-scanning industry. Binary images are termed as bi-level or two-level.

This intends that each pixel is stored as a single bit such as 0 or 1. The names frequently used for this concept are black-and-white, B&W, monochrome or monochromatic, but possibly will choose any images that contain just one sample per pixel, e.g. grayscale images. The operations are segmentation, thresholding, and dithering. Few input/output devices can only handle bi-level images or as laser printers, fax machines, and bi-level computer displays etc. As a bitmap a binary image can be stored in memory. A 640×480 image needs 37.5 KB of storage. Fax machine and document management solutions normally use this format due to the small size of the image files. With simple run-length compression approaches most of the binary images also compress well.

III. REVIEW OF LITERATURE

According to Deepa, V.Priyanka and J.Pradeepa [2], Iris was a biometric feature used for human recognition in a variety of applications. There was a short of human friendly techniques for iris comparison. Therefore it had not been described in forensics applications. They required capturing iris of human and resemblances between the irises are captured. In recent times Human-in-the-loop sys8Their detection was capable to capture crypts of different sizes and capable to identified every type of topological changes. Currently iris recognition existed in Aadhar card projects. The developed method of this model was to allow for additional correctness in detecting rate and to implement in student verifications coming out for high level government oriented Examinations.

Mrigana walia, Dr. Shaily Jain [3] explained that based on particular features of an individual, the biometric system identified a person automatically. There had been lots of evolutions of biometric systems particularly for identification using biometrics. Generally, iris recognition employed the technique of computer vision and image processing. These methods comprised dissimilar phases as image segmentation, feature extraction, image recognition and image normalization. The sound measure, Iris Biometry had been suggested. In the iris partitioning pace, localization of the iris region in the image was completed. For numerous algorithms and presuming near-frontal illustration of the people, the iris limitations were shown as two circles. The inner circle was the boundary between the people and iris whereas the outer circle was the limbic boundary between the iris and the sclera. After that the normalization phase changed sectioned image into the rectangular block to check the elimination of dimensional incompatibilities present. The feature extraction pace converted the peculiar iris image texture into standard bit vector code. The proportional matching phase figured the distance between converted codes and gave the rate of recognition for the systems. Biometrics was globally applicable in lot of areas as limited access to assured facilities and Labs, verification of secured financial transfers, protection from welfare frauds and immigration inspection although inflicting other countries. An iris recognition system was suggested here holding four paces. The first is, image segmentation that was achieved using Canny Edge Detector then iris Circular Hough transformation (CHT) was second pace to localize the people and iris regions. The third pace sectioned iris was normalized and features were extracted using standard symlet wavelet 4. Finally the last pace, the comparison of iris code was performed. After the comparison with existing system, a high recognition rate was found while the false acceptance ratio FAR and false rejection ratio FRR values found continued low for this proposed system.

According to Proença H et. al. [4] the iris was considered as one of the most valuable qualities for biometric recognition and the dispersion of countrywide iris-based recognition systems was about to happen. Nevertheless, presently distributed systems trusted on intense imaging restraints to capture near infrared images with adequate excellence. In addition, all of the publicly offered iris image databases comprised data correspondent to this type of imaging constraints and thus are completely desirable to measure methods thought to function on these types of surroundings. The main objective of this work was to announce the availability of the university of beria interior UBIRIS.v2 database, a multisession iris images database which singularly comprised data captured in the visible wavelength, at-a-distance (between four and eight meters) and on on-the-move. This database was freely presented for researchers related to visible wavelength iris recognition and was helpful in getting at the feasibility and specializing the constraints of such biometric recognition.

Mustafa M.et.al. [5], Iris recognition was the main exact pattern of biometric identification. The robustness of iris recognition got from the distinctive uniqueness of the human iris texture like it was steady throughout the human life, and the environmental consequences couldn't easily alter its shape. In most iris recognition systems, ideal image acquisition terms were presumed. These terms comprised a near infrared (NIR) light source to divulge the patent iris texture with look and gaze restraints and close distance from the capturing device. Though, modern progresses on iris recognition have developed dissimilar methods to work iris images captured in unrestrained surroundings. These surroundings contain a visible wavelength (VW) light source, on the move and over distance from the capturing device. This research stated the most used iris databases and depicted their imaging framework along with all characteristics of iris images in each database.

Shaik Touseef Ahmad and Sandesh Kumar [6] discussed that ordinal evaluations had been presented as an efficient feature illustration model for iris and palmprint recognition. Nevertheless, ordinal measures were a common concept of image analysis and many variants with distinct parameter settings, e.g. location, scale, orientation, etc. could be derived to construct an enormous feature space. This work developed a new optimization formulation for ordinal feature selection with flourishing applications to both iris and palmprint recognition. The aimed function of the developed feature selection method had two parts, i.e., misclassification error of intra and interclass matching samples and weighted sparsity of ordinal feature forms. Consequently, the feature selection intended to accomplish an exact and sparse illustration of ordinal measures. Along with, the optimization subjected to a number of linear inequality restraints, that needed all intra and interclass matching pairs were well classified with a large periphery. Ordinal feature selection was invented as a linear programming (LP) problem so that a solution could be effectively achieved even on a large-scale feature pool and training database. Wide experimental outcomes presented that the developed LP formulation was beneficial over existing feature selection methods, e.g. mRMR, ReliefF, Boosting, and Lasso for biometric recognition, reporting state of-the-art accuracy on CASIA and PolyU databases etc.

According to Vineetha John Tharakan and Shaikh Fairooz [7], reliable authorization and authentication had turn out to be a part of life for numerous routine applications. Most of the authentication systems obtained was not much flexible. Thus, biometric identification methods were rapidly getting ordinary in security and access control applications. This work generally focused on allowing for higher and strict security in military backgrounds for the access of nuclear weapons and their research sites by using the more exact and reliable of the biometric technologies that was the palmprint recognition and iris recognition. The modified work was to represent an effective feature illustration model for palmprint and iris recognition using the concept based on ordinal measures and it presented a palmprint and iris recognition using ordinal features. It is to provide all intra and interclass matching pairs well separated with a large periphery. Sequentially to acquire efficient feature set for palm print recognition was performed by firstly, sectioning the hand and then the palm print region was extracted. The tangent based approach was used for the segmentation. In the same manner, the effective feature set for iris recognition was obtained. The texture features e.g. scale, orientation and salient texture primitives of iris patterns diverge from region to region. Firstly, segmentation was performed and exception of the occlusion regions in the iris images and marking the regions using mask in iris matching. Ordinal features were then extracted and hamming distance based matching was done. High efficiency was to be accomplished still on a large-scale feature pool and training database.

Priya.J and A.Alad Manoj Peter [8] discussed that the pattern of the human body was well fitted to be employed to access control and provided security in biometric person identification technique. For following two primary functions security system was used: to verify or identify users. This work concentrated on a strong methodology for Capturing, matching and verifying for human recognition with feature extraction from iris and palm print of single person. These features of an input image were compared with those of a database image to found matching scores. Based on the accuracy at the time of matching process the outcome was yielded as the person was authorized or not. It was suitable to modify a feature analysis method which was perfectly both discriminating and robust for iris and palm print biometrics.

C Suresh kumar and Jagadisha N [9] demonstrated that personal identity authentication through comparison of high level features of iris was very effective. The success of a biometric recognition system depends heavily on its feature representation model for biometric patterns. Accomplishing sensitivity to inter-class differences and at the same time robustness against intra-class variations is very difficult. Many biometric representation schemes have been reported but the above issue remains to be resolved. This paper introduces iris recognition using high level features in an attempt to resolve this issue. Huge feature space can be derived with different parameter settings such as distance, location, scale, orientation and number. Feature selection aimed at accurate and sparse representation of ordinal measures. This paper provides separation between inter classes and intra class robustness. High level features of iris provide simple and fast recognition through small feature set using ordinal feature representation.

Manisha Sam Sunder and Arun Ross [10] discussed that most of the iris recognition systems used the global and local texture information of the iris sequentially to recognize individuals. In this work, they inquired the use of macro-features that were seeable on the anterior surface of RGB images of the iris for matching and retrieval. These macro-features matched to structures e.g. moles, freckles, nevi, melanoma, etc. and might not be illustrated in all iris images. Gave an image of a macro feature, the goal is to found if it could be used to successfully retrieved the linked iris from the database. To formulate this issue, they used features extracted by the Scale-Invariant Feature Transform (SIFT) to illustrate and match macro-features. Experiments using a subset of 770 distinct irides from the Miles Research Iris Database proposed the prospects of using macro-features for iris characterization and retrieval.

According to Dr.S. Prasath and A.Selvakumar [11]

Iris recognition developed into a very significant research area focused on how to extract and recognize iris images. Iris recognition was a broadly used biometric application for security and identification security iris was being used for recognition of humans. A variety of method had been suggested for iris recognition and every approach had benefits and disadvantages. The complexities in procedure were affected performance of existing system made insufficient. In this work they illustrated iris recognition feature vector to evaluate the threshold value individually and stored in feature database. The feature was generated and matching was performed by Manhattan distance classifier was employed to measures a distance between two images. The experimental outcome demonstrated that developed method offered better recognition rate when compared with the existing methods e.g. Local Binary Pattern, Local Ternary Pattern etc.

Shweta Malvi and P.M.Agarkar [12] explained that biometric authentication had been received broad concentration over the preceding decade with increasing needs in automated personal identification. Among many biometrics approaches, iris recognition was one of the most predicting approaches due to its high reliability for personal identification. Their work illustrated the literature survey of Iris Recognition Systems, different types of databases and complex patterns of the iris texture. Conventional Iris Recognition System followed six steps, Image Acquisition, Preprocessing, Feature Extraction, Iris Coding, Matching and Result Generation. Matching would be performed by using various databases as UBIRIS, CASIA , MMU2 etc.

Nozomi Hayashi and Akira Taguchi [13] introduced a new technique to extract the features of space domain from iris image, which used gray scale morphological filtering. It was well known that the skeleton which illustrated the features of images was extracted from binary images by morphological filtering. The skeleton of gray scale images could be also extracted by gray-scale morphological filtering. Sequentially to extract the features of the iris, they employed the gray scale morphological filtering to the iris image and acquired the skeleton. The binary skeleton which was considered as the iris code was obtained by thresholding. The Hamming distance was used for classification of iris codes.

Samanpreet Kaur and Mandeep Singh [14] explained That iris recognition was a category of the biometrics technologies based on the physiological characteristics of human body, compared with the feature recognition based on the fingerprint, palm print, face and sound etc, the iris had some benefits e.g. uniqueness, stability, high recognition rate, and non infringing etc. The iris recognition comprised of iris localization, normalization, encoding and comparison. Iris recognition was an automated method of biometric identification that utilized mathematical pattern-recognition approaches. In this work they have demonstrated a review on various methods in iris recognition.

According to Manisha M. Khaladkar, Sanjay R. Ganorkar [15], the iris had been suggested like a reliable intends of biometric identification. The significance of the iris like a distinct identifier was predicated on the hypothesis that the iris was stable all over a person's life. Also, the requirement for security systems going up, Iris recognition was issuing as one of the crucial approaches of biometrics-based identification systems. Iris biometry had been developed as a sound measure of personal identification. Iris biometry had been developed as a sound measure of personal identification. This project generally explicated comparison of the developed algorithm with the existing algorithms for Iris recognition. In modified approach, image preprocessing was done using Daugman's Integro-differential operator. The extracted iris part was then normalized using Daugman's rubber sheet model pursued by extracting the iris portion of the eye image employing Haar transform. At last two Iris Codes were compared to achieve the Hamming Distance which was a fractional measure of the distinction. The outcomes accomplished with this algorithm were of highest accuracy while the false rejection ratio (FRR) and false acceptance ratio (FAR) were lowest compared to existing algorithms.

Suganthy M. and P. Ramamoorthy [16] explained about Principal Component Analysis (PCA) was employed for preprocessing, in which the removal of redundant and unwanted data was performed.Applications e.g. Median Filtering and Adaptive thresholding were employed for handling the variations in lighting and noise. Features were extracted using Wavelet Packet Transform (WPT). At last matching was done using k-nearest neighbor KNN. The developed method was better than the earlier technique and was proved by the outcome of different parameters. The testing of the suggested algorithm was performed using CASIA iris database (V1.0) and (V3.0).

Geetanjali Sharma and Neerav Mehan [17] explained that biometric features based system provided an automated recognition for a person based on unique features of an individual. Iris recognition was considered as the most reliable and accurate automated recognition system like it was a safe body part and did not vary with time. This work illustrated a new technique for iris based recognition system based on median filter and compared it with other existing technique based on Gaussian filters.The outcomes demonstrated that the developed method is better than the previous ones. Correctness of the developed method was 99.07%.

According to Himanshi Budhiraja et. al. [18] this work demonstrated analysis on fusion strategies for personal identification utilizing fingerprints and iris biometrics. The aim of this work was to inquire whether the integration of fingerprint and iris biometrics could attain performance that might not be possible employing a single biometric approach. Biometrics contained methods for uniquely recognizing humans based on one or more intrinsic physical or behavioral. Multimodal biometric identification was based on iris and fingerprint biometrics, both performed better in the comparison to other available features because of their accuracy, reliability and simplicity. The fusion of multiple biometrics assisted to diminish the system error rates. Fusion methods involved processing biometric modalities in order to anticipation of an acceptable match was accomplished. The outcomes of this work affirmed that a multimodal biometric can overcome some of the restrictions of a single biometric consequential in a significant performance enhancement.

Govindharaj et. al. [19] discussed that biometric methods based on iris images were conceived to accomplish very high accuracy, and there had been an explosion of interest in biometrics. In this work, they employed the Scale Invariant Feature Transformation (SIFT) for recognition of iris. On comparison with traditional iris recognition systems, the SIFT methods did not trust on the transformation of the iris pattern to polar coordinates,appropriating less inhibited image acquisition considerations. The feature points used the SIFT method to extract feature points in scale space and perform matching based on the texture information.

Joaquim de Mira Jr. and Joceli Mayer [20] illustrated a new technique based on morphological operators for application of biometric identification of someone's by segmentation and analysis of the iris. Algorithms based on morphological operators were proposed to segment the iris region from the eye image and also to highlight selected iris patterns. The extracted features were utilized to demonstrate and portray the iris. Sequentially to appropriately extract the preferred patterns, an algorithm was developed to generate skeletons with distinct paths between end-points and nodes. The depiction found by the morphological processing was stored for identification intentions. To demonstrate the efficiency of the morphological technique some outcomes were delivered. The developed method was derived to illustrate low storage requirements and low complexity implementation.

A. Access control methods in IRIS

In computer sight, the process of partitioning a digital image into multiple segments is called Image segmentation. The aim of segmentation is to make simpler and modify the illustration of an image into incredible that is additionally consequential and simpler to examine. Image segmentation is normally utilized to place objects and boundaries (lines, curves, etc.) in images. More accurately, image segmentation is the process of putting a label to each pixel in an image as pixels with The same label allocate convinced distinctiveness.

The outcome of image segmentation is a collection of segments that cooperatively deal with the whole image, or a collection of contours extracted from the image. Each of the pixels in a region is similar concerning few qualities or computed property e.g. color, intensity, or texture etc. Adjacent regions are extensively dissimilar regarding the same characteristic(s) as employed to a stack of images, usually in medical imaging, the consequential contours after image segmentation can be utilized to construct 3D renovation with the aid of interpolation algorithms such as marching cubes.

IV. SUMMARY

A novel method for detecting and matching iris crypts for the human-in-the-loop iris biometric system is introduced. The presented method develops predicting outcomes on the three tested datasets, in-house dataset, ICE2005, and CASIA-Iris-Interval. On Comparison with the existing method, this proposed method enhances the iris recognition performance by minimum 22% on the position one hit rate in the circumstance of human identification and by minimum 51% on the equal error rate in provisions of subject verification.

It is noticed that the three datasets under estimation were gathered using dissimilar facilities among diverse population groups. The constraints applied in this method were skilled on a different small set of homemade data. The generalization and usefulness of this method on varied image data can be presented. Additionally, to the extent that, this work is so distant the just estimation of a human-interpretable iris features matching method by using the public datasets (ICE2005 and CASIA-Iris-Interval), that provides a lead contrast with existing methods for example Daugman's framework.

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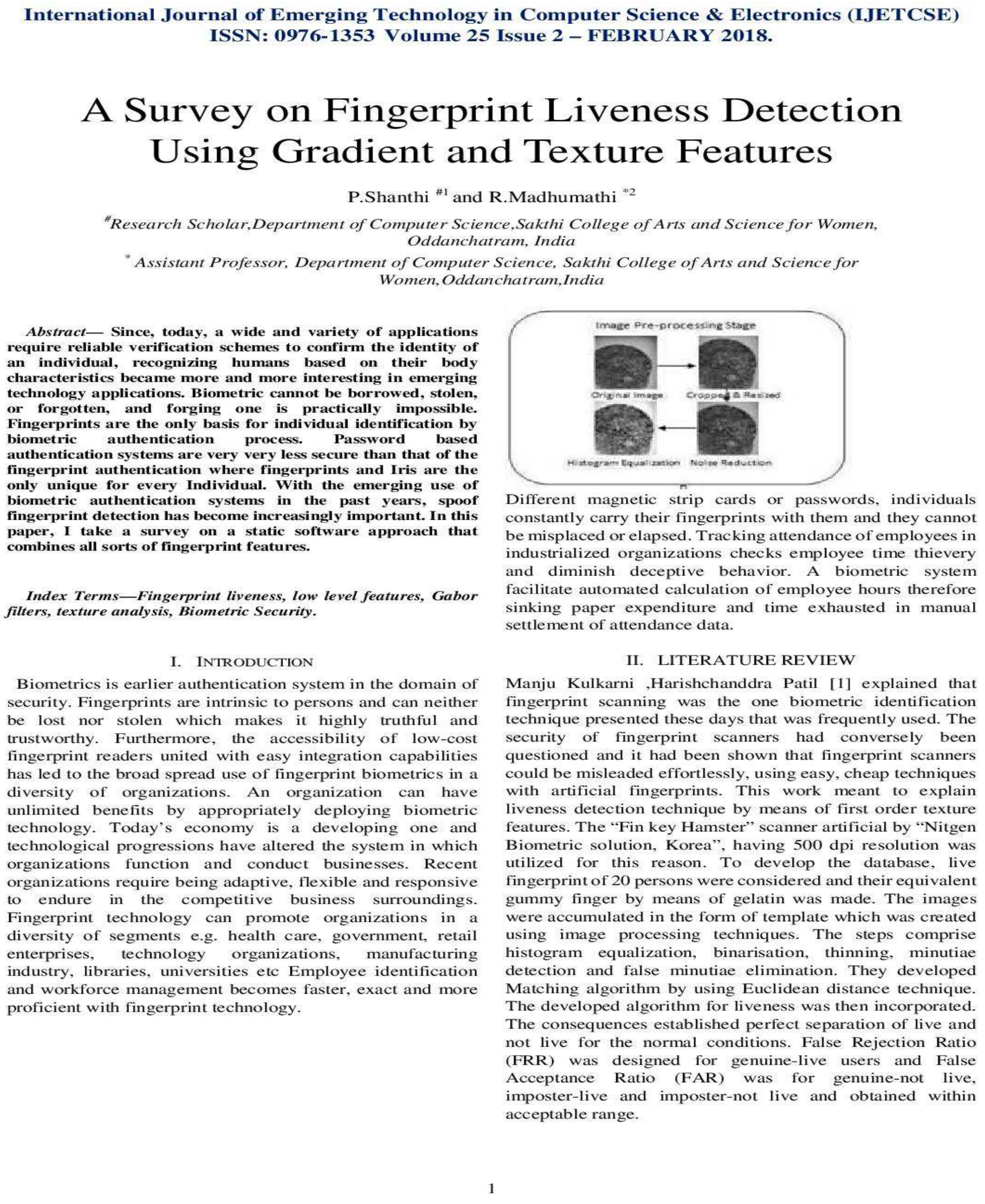
R. Madhumathi, Assistant Professor of Computer Science	International Journal of Emerging Technology in Computer Science & Electronics		A Survey on Fingerprint Liveness detection using Gradient and Texture Features			International 0976-1353	February 2018



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A Survey on Fingerprint Liveness Detection Using Gradient and Texture Features

P.Shanthi [#1] and R.Madhumathi [*2]

[#] Research Scholar,Department of Computer Science,Sakthi College of Arts and Science for Women, Oddanchatram, India

[*] Assistant Professor, Department of Computer Science, Sakthi College of Arts and Science for Women,Oddanchatram,India

***Abstract*— Since, today, a wide and variety of applications require reliable verification schemes to confirm the identity of an individual, recognizing humans based on their body characteristics became more and more interesting in emerging technology applications. Biometric cannot be borrowed, stolen, or forgotten, and forging one is practically impossible. Fingerprints are the only basis for individual identification by biometric authentication process. Password based authentication systems are very very less secure than that of the fingerprint authentication where fingerprints and Iris are the only unique for every Individual. With the emerging use of biometric authentication systems in the past years, spoof fingerprint detection has become increasingly important. In this paper, I take a survey on a static software approach that combines all sorts of fingerprint features.**

***Index Terms*—Fingerprint liveness, low level features, Gabor filters, texture analysis, Biometric Security.**

I. INTRODUCTION

Biometrics is earlier authentication system in the domain of security. Fingerprints are intrinsic to persons and can neither be lost nor stolen which makes it highly truthful and trustworthy. Furthermore, the accessibility of low-cost fingerprint readers united with easy integration capabilities has led to the broad spread use of fingerprint biometrics in a diversity of organizations. An organization can have unlimited benefits by appropriately deploying biometric technology. Today's economy is a developing one and technological progressions have altered the system in which organizations function and conduct businesses. Recent organizations require being adaptive, flexible and responsive to endure in the competitive business surroundings. Fingerprint technology can promote organizations in a diversity of segments e.g. health care, government, retail enterprises, technology organizations, manufacturing industry, libraries, universities etc Employee identification and workforce management becomes faster, exact and more proficient with fingerprint technology. Different magnetic strip cards or passwords, individuals constantly carry their fingerprints with them and they cannot be misplaced or elapsed. Tracking attendance of employees in industrialized organizations checks employee time thievery and diminish deceptive behavior. A biometric system facilitate automated calculation of employee hours therefore sinking paper expenditure and time exhausted in manual settlement of attendance data.

II. LITERATURE REVIEW

Manju Kulkarni ,Harishchanddra Patil [1] explained that fingerprint scanning was the one biometric identification technique presented these days that was frequently used. The security of fingerprint scanners had conversely been questioned and it had been shown that fingerprint scanners could be misleaded effortlessly, using easy, cheap techniques with artificial fingerprints. This work meant to explain liveness detection technique by means of first order texture features. The "Fin key Hamster" scanner artificial by "Nitgen Biometric solution, Korea", having 500 dpi resolution was utilized for this reason. To develop the database, live fingerprint of 20 persons were considered and their equivalent gummy finger by means of gelatin was made. The images were accumulated in the form of template which was created using image processing techniques. The steps comprise histogram equalization, binarisation, thinning, minutiae detection and false minutiae elimination. They developed Matching algorithm by using Euclidean distance technique. The developed algorithm for liveness was then incorporated. The consequences established perfect separation of live and not live for the normal conditions. False Rejection Ratio (FRR) was designed for genuine-live users and False Acceptance Ratio (FAR) was for genuine-not live, imposter-live and imposter-not live and obtained within acceptable range.

Ana F. Sequeira and Jaime S. Cardoso [2] suggested that, fingerprint liveness detection methods had been developed as an attempt to overcome the vulnerability of fingerprint biometric systems to spoofing attacks. Traditional approaches had quite optimistic about the behavior of the intruder assuming the use of a previously known material. This assumption was led to the use of supervised techniques to estimate the performance of the methods, using both live and spoof samples to train the predictive models and evaluate each type of fake samples individually. In addition to, the background was often included in the sample representation, completely distorting the decision process. Therefore, they proposed that an automatic segmentation step be supposed to perform to isolate the fingerprint from the background and truly decided on the liveness of the fingerprint and not on the characteristics of the background. Also, they argued that one couldn't aim to model the fake samples completely since the material used by the intruder was unknown beforehand. They approached the design by modeling the distribution of the live samples and predicting as fake the samples very unlikely according to that model. The experiments compare the performance of the supervised approaches with the semi-supervised ones that rely solely on the live samples. The results obtained differ from the ones obtained by the more standard approaches which reinforced their conviction that the results in the literature were misleadingly estimating the true vulnerability of the biometric system.

Sajida Parveen et. al. [3] described that in recent years, facial biometric systems received increased deployment in various applications such as surveillance, access control and forensic investigations. However, one of the limitations of face recognition system was the high possibility of the system being deceived or spoofed by non-real faces such as photograph, video clips or dummy faces. In order to identify the spoofing attacks on such biometric systems, face liveness detection approaches had been developed. Thus, the current approach was to integrate liveness detection within facial biometrics by using life sign indicators of individual features. This article presented a review of state-of-the-art techniques in face liveness detection, which were classified into two groups, namely intrusive and non-intrusive approaches. Here, each technique was discussed in terms of its implementation, strengths and limitations, as well as indications on possible future research directions that can be studied.

Emanuela Marasco and Arun Ross [4] discussed that several issues related to the vulnerability of fingerprint recognition systems to attacks had been highlighted in the biometrics literature. One such vulnerability involved the use of artificial fingers, where materials such as play-doh, silicone, and gelatin were inscribed with fingerprint ridges. Researchers have demonstrated that some commercial fingerprint recognition systems could be deceived when these artificial fingers were placed on the sensor, i.e., the system successfully processed the ensuing fingerprint images thereby allowing an adversary to spoof the fingerprints of another individual. However, at the same time, several countermeasures that discriminated between live fingerprints and spoof artifacts have been proposed. While some of these anti-spoofing schemes were hardware-based, several software-based approaches had been proposed as well. Here, they reviewed the literature and presented the state-of-the-art in fingerprint anti-spoofing.

Y. Chung and M. Yung [5] explained that recent studies had shown that the conventional fingerprint recognition systems were vulnerable to fake attacks, and there were many existing systems that needed to update their anti-spoofing capability inexpensively. They proposed an image quality-based fake detection method to address this problem. Three effective fake/live quality measures, spectral band energy, middle ridge line and middle valley line, are extracted firstly, and then, these features were fused and tested on a fake/live dataset using SVM and QDA classifiers. Experimental results demonstrated that the proposed method was promising in increasing the security of the existing fingerprint authentication system by only updating the software.

III. METHODOLOGY

A. *Image Acquisition:*

Image acquisition in image processing can be widely defined as the action of retrieving an image from a few sources, generally a hardware-based source, thus it can be accepted during whatever processes require to come about later.

Performing image acquisition in image processing is all the time, the primary step in the workflow sequence because, exclusive of an image, no processing is achievable. The image that is attained is entirely unprocessed and is the result of whatever hardware was used to produce it, which can be very significant in some areas to have a reliable baseline from which to work.

B. *Preprocessing:*

The objective of pre-processing is an enhancement of the image data that contains unnecessary distortions or improves some image features significant for additional processing. We improved the quality of the image by first cropping the fingerprint region in the image and median filtering is afterward applied on the cropped images devoid of diminishing the sharpness of the input image. To end with, histogram equalization is carried out to advance the compare of the image by expanding the intensity range over the entire cropped image. The output achieved after this stage is an image with a condensed noise and enhanced description of the ridge structure.

C. *Feature Extraction:*

In fingerprint authentication systems, the image is generally captured from various subjects by using the dissimilar scanners. Hence, fingerprint images are usually obtained to be of dissimilar scales and rotations. In definite circumstances, the fingerprint images are partly captured caused by human errors. Sequentially to acquire features that are invariant to these troubles, various features use which capture properties of live fingerprint images. We decide to employ SURF as it is invariant to enlightenment, scale and rotation. SURF is also utilized because of its brief descriptor length. Although SURF is invariant to object orientation and scale transformation, it is not invariant to geometric transformations. Therefore, sequentially to recompense the restrictions of SURF, PHOG descriptors are used to extract local shape information to achieve more distinguishable features. Additionally, Gabor wavelet features are also integrated for texture analysis.

D. Classification:

The classification procedure is done over the extracted features. Here, main innovation is the acceptance of SVM and Random Forest. RF and SVM classifier is applied over the features and the classification is done.

IV. CONCLUSION

An efficient dynamic score level integration module is developed to unite the outcome from the two individual classifiers. Experiments are carried out on two most commonly used databases from LivDet competition 2011 and 2013. In detail comparison is done with the current state of the art, and the winner of LivDet 2011 and 2013 fingerprint liveness detection competition. ACE rate of 2.27% in comparison to the 12.87% of the 2013 LivDet competition winner is an important concert gain.

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P. Alaguthai, Assistant Professor of Computer Science	International Journal of Emerging Technology in Computer Science and Electronics		A Literature review on Video Content Sharing with Security using Time-domain Attribute			International 0976-1353	February 2018

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A Literature review on Video Content Sharing with Security using Time-domain Attribute

S.Sangeetha [#1] and P.Alaguthai [*2]

[#] *Full Time Research Scholar, Department Of Computer Science, Sakthi College Of Arts and Science for Women, Oddanchatram, India.*

[*] *Assistant Professor, Department Of Computer Science, Sakthi College Of Arts and Science for Women, Oddanchatram, India.*

***Abstract*— Internet is gaining more and more popular now a days, so there is need to provide security for everything on internet. One of the most important concepts where we need to provide higher security is in communication between sender and receiver. Due to security threats the requirement of the secure transmission of the data is also increased the reason for developing the Data Hiding is the easy access of images, documents confidential data by the hackers who always monitor the system. Data hiding is the process of secretly embedding information inside a source without changing its content and meaning there is numerous techniques which hides the data. This paper aims to implement data hiding in compressed video. Like data hiding in images and raw video which operates on the images themselves in the spatial or transformed domain which are vulnerable to steganalysis. The sender first uses the stenographic application for encrypting the secret message. For this encryption, the sender uses text document in which the data is written and the image as a carrier file in which the secret message or text document to be hidden. The sender sends the carrier file and text document to the encryption phase for data embedding, in which the text document is embedded into the image file.In encryption phase, the data is embedded into carrier file which was protected with the password now the carrier file acts as an input for the decryption phase. The image in which data is hidden i.e. the carrier file is sent to the receiver using a transmission medium. E.g. Web or e-mail. The receiver receives the carrier file and places the image in the decryption phase. Now the carrier file acts as an input for the decryption phase. The image in which data is hidden the carrier image is sent to the receiver using a transmission medium. E.g. Web or e-mail. The receiver receives the carrier file and places the image in the decryption phase.**

Index Terms*— *Streaming media, Access Control, Time domain analysis, Encryption, Video Content Sharing.

I. INTRODUCTION

With the rapid development of communication technologies and mobile devices, video applications (e.g., video chat, video conference, movies, short sight, etc.) have become more and more popular in our daily life.

Meanwhile, the demands on video quality and user experience have also been increasing significantly in many video applications, such as Ultra-high definition (UHD) live streaming, 3D movies, instant high definition (HD) video messages and so on. The ever-increasing demands pose great challenges on video processing, coding, presentation as well as communication, especially when the resources of media devices (e.g., bandwidth, power and computation) are limited.

Cloud computing, due to its flexible,scalable and economic resources, is a natural fit for storing, processing and sharing multimedia contents.

A. *Video Processing*

Video processing is a method to convert a video into digital form and perform some operations on it, in order to get an enhanced video or to extract some useful information from it. It is a type of signal dispensation in which input is video, like video frame or photograph and output may be image or characteristics associated with that image. Usually video Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them.

It is among rapidly growing technologies today, with its applications in various aspects of a business. Video Processing forms core research area within engineering and computer science disciplines too.

B. *Steganography Image Analyses*

There are currently three effective methods in applying Image Steganography: LSB Substitution, Blocking, and Palette Modification1. LSB (Least Significant Bit).

Substitution is the process of modifying the least significant bit of the pixels of the carrier image. Blocking works by breaking up an image into blocks and using Discrete Cosine Transforms (DCT).

Each block is broken into 64 DCT coefficients that approximate luminance and color the values of which are modified for hiding messages. Palette Modification replaces the unused colors within an image‘s color palette with colors that represent the hidden message. I have chosen to implement LSB Substitution in my project because of its ubiquity among carrier formats and message types.

With LSB Substitution I could easily change from Image Steganography to Video Steganography and hide a zip archive Instead of a text message. LSB Substitution lends itself to become a very powerful Steganography method with few limitations.

LSB Substitution works by iterating through the pixels of an image and extracting the ARGB values. It then separates the color channels and gets the least significant bit. Meanwhile, it also iterates through the characters of the message setting the bit to its corresponding binary value3.

II. METHODOLOGIES USED FOR INTRUSION DETECTION SYSTEM

A. System Model

We consider a multi-authority access control system for cloud storage, as described in Fig.1. There are five types of entities in the system: the data owners (owners), the cloud server (server), the data consumers (users), the attribute authorities (AAs) and a certificate authority (CA). The owners define the access policies and encrypt their data under the policies before hosting them in the cloud. The server stores the owners' data and provides data access service to users. Each attribute authority is a trusted entity that is responsible for setting, revoking and updating user's attributes within its Administration domain. The CA is a fully trusted entity which is responsible for issuing a global *UID* for each user and AID system.

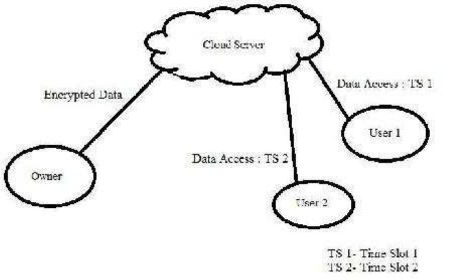


Fig 1 System Model of Multi-authority Access Control in Cloud Storage

B. Security Model

The security key has provided by two attribute 1.By Time 2.By passkey. In time a manual or automatic time as keyword is used so that the security over the time attribute is increased. In second a secret symmetric passkey is used to encrypt and decrypt the content.

C. Secret Video Selection

Here the secret video to be hidden is selected and the secret key with time is used for encryption, after that encryption details are shown below in that box. The reason why time and key used in same box is to increase the complexity for intruders (hackers) If the key or password is wrong the pop-up box of wrong passkey will not be shown, it is to confuse the intruders So that the intruder will have no knowledge of whets going on the entire process, so hacking of data is not possible.

After that selection the videos are partitioned into frames and encrypted, then later in next process the merging of that frames using LSB technique will occur. The least significant bit has the self-reversible embedding, so the correct frame.

D. ADVANTAGES

Merging of secret video with sample video make complications to intruders.

Time taken for decryption is less than that of encryption.

Self reversible embedding makes the extraction process easier.

III. SYSTEM ARCHITECTURE

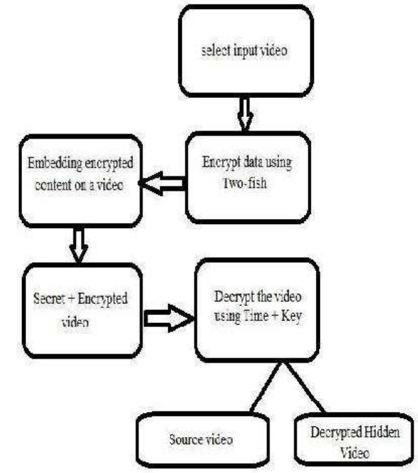


Fig 2 System Architecture

A. Secret Video Selection

In this module,the processing of secret video takes place after the selection of video.

B. FRAMES PARTITION

SELF REVERSIBLE EMBEDDING - followed by video encryption.

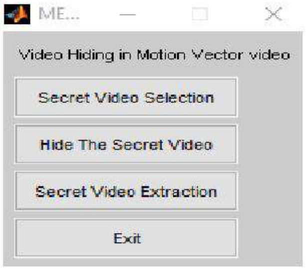


Fig 3 Video Hiding Menu

C. FRAME PARTITION

The selected secret video is partitioned into several frames and after that encryption of data with secret key takes place.

D. SELF REVERSIBLE EMBEDDING

The goal of self-reversible embedding is to embed the encrypted video frames into the sample video.

E. Data Encryption

In cryptography, Two fish is a symmetric key block cipher with a block size of 128 bits and key sizes up to 256 bits. It was one of the five finalists of the Advanced Encryption Standard contest, but it was not selected for standardization.

Two fish is related to the earlier block cipher Blowfish. It uses 16 rounds to produce the encrypted video.

Enter The Key With Time: das1:20

Encrypted Details: 50 216 130 213 41 98 211 98 109 176 89 173 158 226 19 207 53 78 125 127

Fig 4 Secret Video Selection

F. *Embedding Process*

In the data embedding phase, some parameters are embedded into a small number of encrypted pixels, and the LSB of the other encrypted pixels are compressed to create a space for accommodating the additional data and the original data at the positions occupied by the parameters.

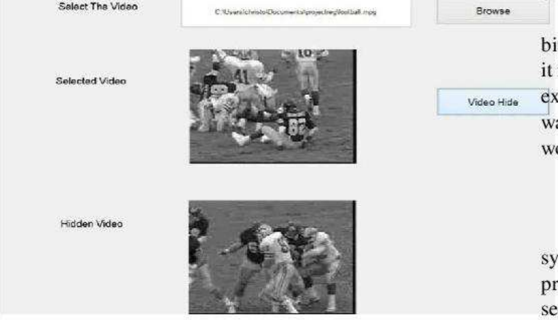
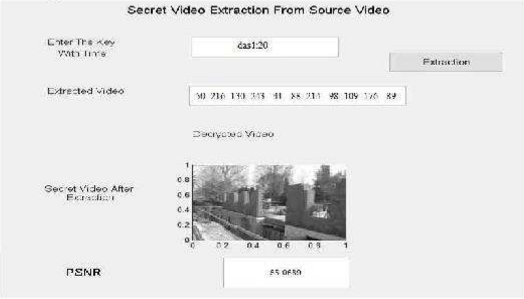


Fig 5 Hiding Secret video in Source Video

G. *Data Extraction and Video Restoration*

In this module,after providing the correct key the secret video gets extracted from sample video.



Enter The Key With Time: das1:20

Extracted Video: 50 216 130 213 41 88 211 98 109 176 89

PSNR: 55.0680

Fig 6 Secret Video Extraction from Source Video

H. *Peak Signal-To-Noise Ratio (PSNR)*

The mean squared error (MSE) for our practical purpose allows us to compare the true‖ pixel values of our original image to our degraded image. The MSE represents the average of the squares of the "errors" between our actual image and our noisy image. The error is the amount by which the values of the original image differ from the degraded image. The proposal is that the higher the PSNR, the better degraded image has been reconstructed to match the original image and the better the reconstructive algorithm.

This would occur because we wish to minimize the MSE between images with respect the maximum signal value of the image. For color images, the MSE is taken over all pixels values of each individual channel and is averaged with the number of color channels. Another option may be to simply perform the PSNR over a converted luminance or greyscale channel as the eye is generally four times more susceptible to luminance changes as opposed to changes in chrominance.

This approximation is left up to the experimenter. Data Embedding Procedure The encrypted message to be hidden is converted into its ASCII equivalent character and subsequently into binary digit. For an example if the character is an encrypted character of the message then as ASCII value for is 116 and binary value for it is 1110100.As image comprises of pixel contribution from red, green and blue components and each pixel has numbers from the color components (for 24-bit bitmap image each of red, green and blue pixel has 8 bit).

At 8 bit of the color number, if we change least significant bits, our visual system cannot detect changes in pixel and thus it is possible to replace message bits with image pixel bit. For example if we consider the pixel value 10111011, and we want to store the information in the least significant bit, at the worst situation the pixel changes to 10111010.

IV. CONCLUSION

A reversible steganographic algorithm using texture synthesis. Given an original source texture, our scheme can produce a large steganographic synthetic texture concealing secret messages. We believe our proposed scheme offers substantial benefits and provides an opportunity to extend steganographic applications. Another possible study would be to combine other steganography approaches to increase the embedding capacities.

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TOTAL COLORING REGULAR DOMINATION in FUZZY GRAPH

M. Nithyakalyani*
S. Tharani**

Abstract

In this paper we discuss the concept of total coloring Regular domination in fuzzy graph. We determine the chromatic number χ^{rf} for a Regular domination fuzzy graph G_k, with fuzzy set of vertices and fuzzy set of edges in terms of family of fuzzy sets.

Keywords:

Regular fuzzy graph,
Domination in fuzzy graph,
Regular domination in fuzzy graph,
Fuzzy total coloring,
Chromatic Number.

Author correspondence:

P.G Head and Assistant Professor*, M.Phil Scholar**
Department of Mathematics,
Sakthi College of Arts and Science for Women,
(Affiliated to Mother Teresa Women's University, Kodaikanal),
Oddanchatram – 624619,Dindigul(Dt), Tamilnadu,India.

I.INTRODUCTION

As a advancement fuzzy coloring of a fuzzy graph was defined by authors Eslahchi and Onagh in 2004, and later developed by them as fuzzy vertex coloring [1] in 2006. This fuzzy vertex coloring was extended to fuzzy total coloring in terms of family of fuzzy sets by Lavanya. S and Sattanathan.R [2]. On Regular Fuzzy Graphs was defined by the authors A. Nagoor Gani and K. Radha[3].

In this paper we discuss on k −fuzzy total coloring of a Regular domination fuzzy graph by taking fuzzy sets of vertices and edges. In section 2 we review the basic definitions of fuzzy sets and other basic definitions of fuzzy graphs. In section 3 we introduce the definition of total coloring and chromatic number regular domination in fuzzy graph and their example and theorem.

II. PRELIMINARYS

Definition: 2.1

Let V be a finite nonempty set. The triple $G = (V, \sigma, \mu)$ is called a *fuzzy graph* on V where σ and μ are fuzzy sets on V and E, respectively, such that $\mu(uv) \le \sigma(u) \wedge \sigma(v)$ for all $u, v \in V$ and $uv \in E$. For fuzzy graph $G = (V, \sigma, \mu)$ the elements V and E are called set of vertices and set of edges of G respectively.

Definition: 2.2

Two vertices u and v in G are called *adjacent*if $(1/2)[\sigma(u) \wedge \sigma(v)] \le \mu(uv)$.

Definition: 2.3

Two edges $v_i v_j$ and $v_i v_k$ are said to be *incident* if $2\{\mu(v_i v_j) \wedge \mu(v_i v)\} \le \sigma(v_i)$ for $i = 1,2, \dots \dots |v|$ and $1 \le j, k \le |v|$.

Definition: 2.4

Let G:(σ,μ) be a fuzzy graph. The *degree* of a vertex $u$is $d_G(u) = \sum_{u \neq v} \mu(uv)$. Since $\mu(uv) > 0$ for $uv \in E$ and $\mu(uv) = 0$for $uv \notin E$, this is equivalent to $d_G(u) = \sum_{uv \in E} \mu(uv)$. The minimum degree of G is $\delta(G) = \wedge\{d(v)/v \in V\}$. The maximum degree of G is $\Delta(G) = \vee\{d(v)/v \in V\}$.

Definition: 2.5

Let $G = (V, E)$ be a graph. A subset S of V is called a *dominating set* in G is every vertex in $V \backslash S$ is adjacent to some vertex in S.

Definition: 2.6

A fuzzy graph $G = (V, \sigma, \mu)$ is called a *completefuzzy graph* if $(uv) = \sigma(u) \wedge \sigma(v)$ for all $u, v \in V$ and $uv \in E$.

Definition: 2.7

An assignment of colours to the vertices of a graph so that no two adjacent vertices get the same colour is called a *colouring* of the graph.

Definition: 2.8

The *chromatic number* $\chi(G)$ of a graph Gs is the minimum number of colours needed to colour.

Definition: 2.9

Let $G = (\sigma, \mu)$ be a fuzzy graph on V. Let $x, y \in V$. We say that x dominates y in Gif $\mu(xy) = \sigma(x) \wedge \sigma(y)$. A subset S of V is called a *dominating set* in G if for every $v \notin S$, there exists $u \in S$ such that u dominates v.

Definition: 2.10

The minimum fuzzy cardinality of a dominating set in G is called the *domination number* of G and is denoted by
$\gamma(G)$or γ.

Definition: 2.11

Let $G: (\sigma, \mu)$ be a fuzzy graph on $G^*: (V, E)$. If $d_G(v) = k$ for all $v \in V$, (i.e) if each vertex has same degree k, then G is said to be a *regular fuzzy graph of degree k or a k −regular fuzzy graph.*

Definition: 2.12

Let $G: (\sigma, \mu)$ be a fuzzy graph on G^*. The total degree of a vertex $u \in V$ is defined by $td_G(u) = \sum_{u \neq v} \mu(uv) + \sigma(u) = \sum_{uv \in E} \mu(uv) + \sigma(u) = d_G(u) + \sigma(u)$. If each vertex of G has same total degree k, then G is said to be a *totally regular fuzzy graph of total degree k or k −totally regular fuzzy graph.*

Definition: 2.13

A family $\Gamma = \{\gamma_1, \ldots\ldots, \gamma_k\}$ of fuzzy sets on V is called a k *−fuzzy coloring* of $G = (V, \sigma, \mu)$ if

(a) $\vee\, \Gamma = \sigma$,

(b) $\gamma_i \wedge \gamma_j = 0$,

(c) for every strong edge xy of G, $min\{\gamma_i(x), \gamma_i(y)\} = 0$ $(1 \le i \le k)$.

Definition: 2.14

A family $\Gamma = \{\gamma_1, \gamma_2, \ldots\ldots \gamma_k\}$ of fuzzy sets on $V \cup E$ is called a k −fuzzy total coloring of $G = (V, \sigma, \mu)$ if

(a) $max_i\, \gamma_i(v) = \sigma(v)$ for all $v \in V$ and $max_i\, \gamma_i(uv) = \mu(uv)$ for all edge $uv \in E$,

(b) $\gamma_i \wedge \gamma_j = 0$,

(c) For every adjacent vertices u, v of $\min\left\{\gamma_i(u), \gamma_i(v)\right\} = 0$ and for every incident edges $\min\{\gamma_i(v_j v_k) / v_j v_k$ are set of incident edges from the vertex v_j ,$j =$ 1,2, … $|v|$ }.

Definition: 2.15

The least value of k for which G has a k −fuzzy total coloring, denoted by $\chi_T(G)$, is called the *fuzzy total chromatic number* of G.

III TOTAL COLORING REGULAR DOMINATION IN FUZZY GRAPH

We extend the definition of total coloring regular domination in fuzzy graph in the definition given below. Since we deal with regular domination fuzzy graph for which $d_G(v) = k$, the definition can be stated as follows.

Definition: 3.1

Let $G:(V,\sigma,\mu)$ be a fuzzy graph and S be a subset of V. Then a family $\Gamma = \{\gamma_1, \gamma_2, \ldots\ldots \gamma_k\}$ of fuzzy sets $V \cup E$ is called a *total coloring Regular domination in fuzzy graph* if,

(a) All the vertices in S has the same degree, [3]
(b) Every vertex in $V - S$ is adjacent to some vertex in S, [4]
(c) $\vee \gamma_i(v) = \sigma(v)$ for all $u, v \in V$, [2]
(d) $\gamma_i \wedge \gamma_j = 0$,
(e) For every adjacent vertices u, v of $\min\left\{\gamma_i(u), \gamma_i(v)\right\} = 0$ and for every incident edges uv on vertex $u \in V$ of G, $\wedge\left\{\gamma_i(uv)\right\} = 0$.

Definition: 3.2

The least value of k for which G has a total coloring regular domination in fuzzy graph, denoted by $\chi_T^{rf}(G)$ is called the fuzzy total chromatic number of G [6].

Example: 3.3

Consider the fig-1, a regular domination fuzzy graph $G_k = (V, \sigma, \mu)$ with vertex set $V = \{v_1, v_2, v_3, v_4, v_5, v_6\}$ and edge set $E = \{v_i v_j / ij = 12, 16, 23, 34, 45, 56\}$ the membership functions are defined as follows:

$$\sigma(v_i) = \begin{cases} 0.2, \, for \; i = 1 \\ 0.7, \, for \; i = 2 \\ 0.5, \, for \; i = 3 \\ 0.4, \, for \; i = 4 \\ 0.6, \, for \; i = 5 \\ 0.3, \, for \; i = 6 \end{cases}$$

$$\mu(v_i v_j) = \begin{cases} 0.2, \, for \; ij = 12. \\ 0.5, \, for \; ij = 23. \\ 0.1, \, for \; ij = 16, 34. \\ 0.4, \, for \; ij = 45. \\ 0.3, \, for \; ij = 56. \end{cases}$$

We see that the membership functions satisfy the definition of regular domination fuzzy graph. In fig-1 $S = \{v_2, v_5\}$ is a dominating set.

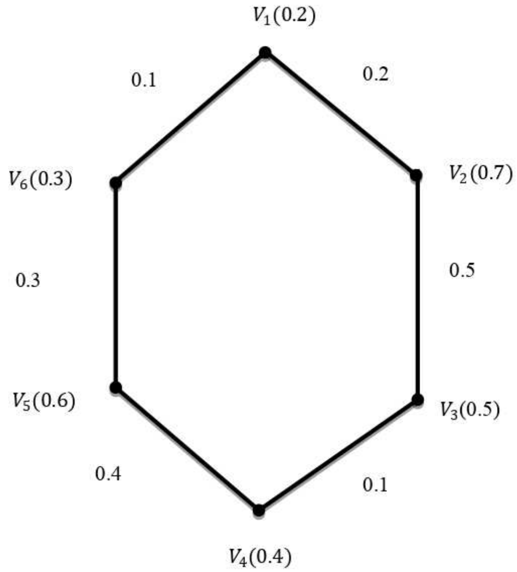

Figure-1

Let $\Gamma = \{\gamma_1, \gamma_2\}$ be a family of fuzzy sets defined on $V \cup E$as follows:

$$\gamma_1(V_i) = \begin{cases} 0.2, i = 1 \\ 0.5, i = 3 \\ 0.6, i = 5 \\ 0, \text{ otherwise} \end{cases} \qquad \gamma_1(v_i v_j) = \begin{cases} 0.2, \ ij = 12 \\ 0.1, \ ij = 34 \\ 0.3, \ ij = 56 \\ 0, \text{ otherwise} \end{cases}$$

$$\gamma_2(v_i) = \begin{cases} 0.7, \ i = 2 \\ 0.4, \ i = 4 \\ 0.3, \ i = 6 \\ 0, \text{ otherwise} \end{cases} \qquad \gamma_2(v_i v_j) = \begin{cases} 0.5, \ ij = 23 \\ 0.4, \ ij = 45 \\ 0.1, \ ij = 16 \\ 0, \text{ otherwise} \end{cases}$$

Hence the family $\Gamma=\{\gamma_1, \gamma_2\}$ satisfies our definition of total coloring regular domination in fuzzy graph. From the table given below, we can see the values γ_1, γ_2 clearly. Hence in this case the total chromatic number $\chi_T^{rf}(G)$is 2.

Table-1

Vertices and Edges	γ_1	γ_2	max
1	0.2	0	0.2
2	0	0.7	0.7
3	0.5	0	0.5
4	0	0.4	0.4
5	0.6	0	0.6
6	0	0.3	0.3
12	0.2	0	0.2
16	0	0.1	0.1
23	0	0.5	0.5
34	0.1	0	0.1
45	0	0.4	0.4
56	0.3	0	0.3

Threoem: 3.4

For a Regular Domination in fuzzy graph $G:(V,\sigma,\mu)$then $\chi(G)=\chi^{rf}(G)$.

Proof:

Let $G=(V,\sigma,\mu)$ be a regular domination in fuzzy graph on n vertices, $\{u_1, u_2, \dots. u_n\}$.

Let $\chi^{rf}(G)=k$.

$\Leftrightarrow \Gamma=\{\gamma_1, \dots \dots, \gamma_k\}$is a $k-$fuzzy coloring and let C_j be the color assigned to vertices in $\gamma_j{}^*$, $j = 1,2, \dots. k$.

$\Leftrightarrow \{\gamma_1, \dots \dots, \gamma_k\}$is a family of fuzzy sets where,

$\gamma_j(u_i)=\{(u_j, \sigma(u_j)) \cup (u_i, \sigma(u_i))/\mu(u_i, u_j) = 0, i \neq j\}$which follows from (iii) and (v) of definition (3.1).

Also $\bigcup_{j=1}^{k} \gamma_j{}^* = V$ and $\gamma_i{}^* \cap \gamma_j{}^* = \phi$, $i \neq j$ which follows from (iv) of definition (3.1).

$\Leftrightarrow \gamma_j{}^*$ is an independent set of vertices and edges,((i.e) no two vertices in $\gamma_j{}^*$ are adjacent and no two edges in $\gamma_j{}^*$ are incident) for each $j = 1,2, \dots \dots k$.

$\Leftrightarrow \chi(G^*) = k$, G^* is the underlying crisp graph of G.

Now,

$\Leftrightarrow \chi(G^*) = \chi(G_t) = k$ where $t = \min\{\alpha / \alpha \in L\}$.

Since, $\chi(G) = \max\{(\chi_\alpha / \alpha \in L$ where $\chi_\alpha = \chi(G_\alpha)$.

Therefore, $\chi(G_\alpha) = k$,

$\max\left\{\chi_\alpha / \alpha \in L\right\} = k$.

$\Leftrightarrow \chi(G) = k$.

Hence the proof.

V. CONCLUSIONS

The concept of $k-$fuzzy total coloring and chromatic number of a fuzzy graph are analized. In this paper the total coloring and chromatic number regular domination in fuzzy graph are introduced and determined the example and theorem.

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DOMINATION IN FUZZY PLANAR GRAPH

M. Nithya Kalyani*
S. Manonmani**

Abstract

Fuzzy Planar Graph is an important subclass of fuzzy graph. In this paper we introduced the concept "Domination in Strong and Isomorphic Fuzzy Planar Graph". It is combination of domination and fuzzy planar graph. We discussed in this paper various properties like domination in fuzzy planar graph (γ_{FP}), domination in strong fuzzy planar graph (γ_{SFP}), domination in isomorphic fuzzy planar graph (γ_{IFP}), domination in fuzzy planar graph with planarity.

Keywords:

Fuzzy graph,
Fuzzy planar graph,
Domination in fuzzy planar graph,
Domination in strong fuzzy planar graph,

Author correspondence:

P.G Head and Assistant Professor*, M.Phil Scholar**.
Department of Mathematics,
Sakthi College of Arts and Science for Womens,
(Affiliated to Mother Teresa Women's University, Kodaikanal.)
Oddanchatram-624619, Dindigul(Dt), Tamilnadu, India.

I. INTRODUCTION

Graph Fuzzy graph and Planar graph are the sub-class of graph theory. Combination of these two graph is called "Fuzzy Planar Graph". One of the fastest growing areas within graph theory is the study of domination.

We discussed the concept of dominating graph were introduced by V.R. Kulli and Bidarhalli Janakiraman[3]. We used the Concept Of Fuzzy Planar Graph with using planarity value is introduced by Sovan Samantha, Anita Pal, Madhumangal Pal [6] and Domination in

Fuzzy Graph is introduced by A.Somasundaram and S.Somasundaram [4]. In this paper we introduced the concept of Domination In Strong, Isomorphic Fuzzy Planar Graph.

II. PRELIMINARIES

Definition: 2.1

A ***finite graph*** is a graph $G = (V, E)$ such that V and E are called vertices and edges finite sets.

Definition: 2.2

An ***infinite graph*** is one with an infinite set or edges or both. Most commonly in graph theory, it is implied that the graphs discussed are finite.

Definition: 2.3 If more than one edge joining two vertices is allowed, the resulting object is a ***multigraph***[1]. Edges joining the same vertices are called ***multiple lines***.

Definition: 2.4

A drawing of a geometric representation of a graph on any surface such that no edges intersect is called ***embedding***.

Definition: 2.5

A graph G is ***planar*** [1] if it can be drawn in the plane with its edges only intersecting at vertices of G. So the graph is ***non-planar*** if it cannot be drawn without crossings.

Definition: 2.6

A $\boldsymbol{fuzzy\ set\ A}$ [2] on a universal set X is characterized by a mapping $m: X \to [0,1]$, which is called the membership function. A fuzzy set is denoted by $A = (X, m)$.

Definition: 2.7

A $\boldsymbol{fuzzy\ graph}$ [2] $G = (V, \sigma, \mu)$ is a non-empty set V together with a pair of function $\sigma: V \to [0,1]$ and $\mu: V \times V \to [0,1]$ such that for all $x, y \in V$, $\mu(x, y) \leq \sigma(x) \wedge \sigma(y)$ Where $\sigma(x)$ and $\mu(x, y)$ represent the membership values of the vertex x and of the edge (x, y) in G respectively.

Definition: 2.8

The fuzzy graph $G - (V, \sigma, \mu)$, an edge (x, y) is called $\boldsymbol{strong}$ [5] if $\frac{1}{2}\{\sigma(x) \wedge \sigma(y)\} \leq \mu(x, y)$ and weak otherwise.

Definition: 2.9

The ***order p*** [4] and ***size q*** [4] of a fuzzy graph $G = (\sigma, \mu)$ are defined to be $p = \sum_{x \in V} \sigma(x)$ and $q = \sum_{x,y \in E} \mu(xy)$.

Definition: 2.10

$N(x) = \{y \in V \mid \mu(xy) = \sigma(x) \wedge \sigma(y)\}$ is called the ***neighborhood of x*** and $N[x] = N(x) \cup \{x\}$ is called the ***closed neighborhood of x***[4].

Definition: 2.11

If an edge (x, y) of a fuzzy graph satisfies the condition $\mu(x, y) = \sigma(x) \wedge \sigma(y)$, then this edge is called ***effective edge*** [6].

Definition: 2.12

Two vertices are said to be ***effective adjacent*** [6] if they are the end vertices of the same effective edge.

Definition: 2.13

The ***minimum neighborhood degree*** is denoted by δ_N and ***maximum neighborhood degree*** is denoted by Δ_N

Definition: 2.14

A ***homomorphism*** [6] between fuzzy graph G and G' is a map $h: S \to S'$ which satisfies $\sigma(x) \leq \sigma'(h(x))$ for all $x \in S$ and $\mu(x, y) \leq \mu'(h(x), h(y))$ for all $x, y \in S$ where S is set of vertices of G and S' is that of G'.

Definition: 2.15

An ***isomorphism*** [6] between fuzzy graph is a bijective homomorphism $h: S \to S'$ which satisfies $\sigma(x) = \sigma'\big(h(x)\big)$ for all $x \in S$ and $\mu(x, y) = \mu'(h(x), h(y))$ for all $x, y \in S$.

Definition: 2.16

Let *G be a* ***fuzzy planar graph*** with planarity value f**,** [6] where

$f = \frac{1}{1+\{I_{P_1}+I_{P_2}+\cdots+I_{P_n}\}}$. The range of f is $0 < f \leq 1$.

Here, $P_1, P_2, \ldots . P_n$ be the points intersections between the edges.

In a graph $G = (V, \sigma, E)$, E contains two edges $\mu(a, b)$ and $\mu(c, d)$, which are intersected at a point P.

Strength of the fuzzy edge $I_{(a,b)} = \frac{\mu(a,b)}{\{\sigma(a)^\wedge\sigma(b)\}}$.

The intersecting point at P is $I_P = \frac{I_{(a,b)}+I_{(c,d)}}{2}$.

Results: 2.17

- If there is **no point of intersection** for a geometrical representation of a fuzzy planar graph, then **its fuzzy planarity value is 1**.
- If $\mu(w, x) = 1$ (or near to 1) and $\mu(y, z) = 0$ (near to 0), then we say that the fuzzy graph has no crossing. Then the crossing will not be important for planarity.
- If $\mu(w, x) = 1$ (or near to 1) and $\mu(y, z) = 1$ (near to 1), then the crossing will be important for planarity.
  - Strong fuzzy planar graph if f is greater than or equal 0.5.
  - Otherwise weak.

Definition: 2.18

Let $G = (V, E)$ be a graph. A set $D \subseteq V$ is a $\boldsymbol{dominating\ set}$ [3] of G if every vertex in $V \backslash D$ is adjacent to some vertex in D.

Definition: 2.19

The $\boldsymbol{dominating\ set\ \gamma(G)}$ [3] of G is the minimum cardinality of a dominating set.

Definition: 2.20

A dominating set D is a $\boldsymbol{minimal\ dominating\ set}$ [3] if no proper subset $D^{'} \subset D$ is a dominating set of G.

Definition: 2.21

Let $G = (V, \sigma, \mu)$ be a fuzzy graph on V. Let $x, y \in V$, if x dominates y in G if $\mu(x, y) = \sigma(x)^\wedge\sigma(y)$. A subset D of V is called a $\boldsymbol{dominating\ set}$ [4] in G if for every $v \notin D$, there exists $u \in D$ such that *u* dominates *v.*

Definition: 2.22

The minimum fuzzy cardinality of a dominating set in G is called the ***dominating number*** [4] of G and is denoted by $\gamma(G)$ or γ..

Definition: 2.23

Let G be a fuzzy graph without isolated vertices. A subset D of V is said to be a ***total dominating set***[4] if every vertex in V is dominated by a vertex in D.

The ***total domination number*** of G is denoted by γ_t.

III. DOMINATION IN FUZZY PLANAR GRAPH

Definition: 3.1

If a graph G is said to be ***domination in fuzzy planar graph*** if

- $G = (V, \sigma, \mu)$ be a fuzzy planar graph with planarity value f
- Let $x, y \in V$, x dominates y in G then $\mu(x, y) \leq \sigma(x)^\wedge\sigma(y)$
- A subset D of V is called a dominating set in G if for every $y \notin D$, there exist $x \in D$ such that x dominates y.
- The minimum fuzzy cardinality of a dominating set in G is called the dominating number of G and is denoted by γ_{FP}.

Example 3.2

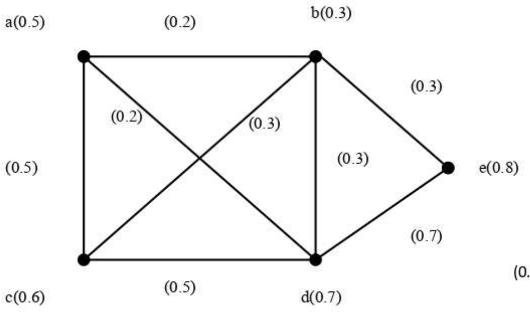

Fig 1. Fuzzy planar graph G_1 with intersection

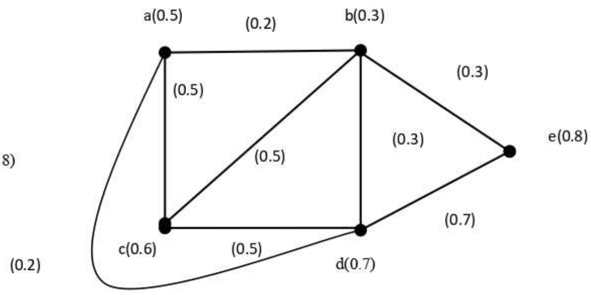

Fig 2. Fuzzy planar graph G_2without intersection

G_1 and $G_2$are the same fuzzy planar graph. Planarity value = 0.588

Dominating set = {c,e}, {a,e},{b}, {d}

Minimum dominating number $\gamma_{FP} = 1$

Definition: 3.3

If a graph G is said to *be domination* ***in strong fuzzy planar graph*** if

- $G = (V, \sigma, \mu)$ be a fuzzy planar graph with planarity value *f* greater than 0.5
- A subset D of V is called a dominating set in G if for every $y \notin D$, there exist $x \in D$ such that x dominates y.
- The minimum fuzzy cardinality of a dominating set in G is called the dominating number of G and is denoted by γ_{SFP}.

Definition: 3.4

If a graph $G_1$and G_2 is said to be *domination in* ***isomorphic fuzzy planar graph*** if

- $G_1$and G_2 be an isomorphic fuzzy planar graph
- The minimum fuzzy cardinality of a dominating set in G is called the dominating number of G and is denoted by γ_{IFP}.

Theorem: 3.5

For fuzzy planar graph, $p - q \leq \gamma_{FP} \leq p - \delta_E$. Where γ_{FP} be the minimum dominating number in fuzzy planar graph and *p, q* and δ_E are the order, size and minimum effective incident degree of G respectively.

Proof:

Let G be a fuzzy planar . D be a dominating set and γ_{FP} be a minimum dominating number in G.

Then the scalar cardinality of V-D is γ_{FP} and the scalar cardinality of $V \times V$ is $p - q$.

$$p - q \leq \gamma_{FP} \quad \text{……………………I}$$

Let *x* be the vertex with minimum effective incident degree δ_E. Clearly $V - \{x\}$ is a dominating set and

$$\gamma_{FP} \leq p - \delta_E \quad \text{……………………II}$$

From I and II

$$p - q \leq \gamma_{FP} \leq p - \delta_E.$$

Remark: 3.6

If all the vertices having the same membership value, then $p - q \leq \gamma_{FP} \leq p - \Delta_E$

Theorem: 3.7

Every dominating fuzzy planar graph (with the condition $\mu(x, y) = \sigma(x)^\wedge\sigma(y)$) is the strong fuzzy planar graph according to calculating its strength.

Proof:

Let G be a fuzzy planar graph. Then *x* dominates *y* if $\mu(x, y) = \sigma(x)^\wedge\sigma(y)$.

Hence the membership value of edge will be equal to the membership value of minimum vertex. Then the strength of an edge will be 1.

Strength $I_{(x,y)} = \frac{\mu(x,y)}{\sigma(x)^\wedge\sigma(y)}$

A fuzzy planar graph is strong fuzzy planar graph if the planarity is greater than 0.5.

Then the strength of a strong fuzzy planar graph is 1, then the planarity will be 0.5.

Hence every dominating fuzzy planar graph is the strong fuzzy planar graph.

Theorem: 3.8

Let G be a strong fuzzy planar graph with the minimum dominating set γ_{SFP}.

Then $\gamma_{SFP} \geq p - \Delta_N$.

Proof:

Let G be a strong fuzzy planar graph with the minimum dominating set γ_{SFP}. Let *v* be a vertex such that $dN(v) = \Delta_N$.

Then $V \backslash N(v)$ is a dominating set of G.

Hence $\gamma_{SFP} \geq p - \Delta_N$.

Theorem: 3.9

For any fuzzy planar graph G, total dominating set of a fuzzy planar graph $\gamma_{tFP} = p$ if and only if every vertex of G has a unique neighbor.

Proof:

Let G be a fuzzy planar graph with unique neighbor.

If every vertex of G has unique neighbor then D is the only total dominating set of G.

So that $\gamma_{tFP} = p$.

Conversely, suppose $\gamma_{tFP} = p$.

If there exists a vertex *v* with two neighbors *x* and *y* then, $V - \{x\}$ is a total dominating set of G.

So that $\gamma_{tFP} < p$ which is contradiction.

Hence every vertex of fuzzy planar graph has unique neighbor.

Theorem: 3.10

Let G_1 and G_2 be the two isomorphic fuzzy planar graph with the minimum dominating set γ_{IPF_1} and γ_{IPF_2}. Let f_1 and f_2 be the fuzzy planarity values. Then

a) $\gamma_{IFP_1} = \gamma_{IFP_2}$
b) $f_1 = f_2$

Proof:

Let $G_1$and G_2 be the isomorphic fuzzy planar graph.

i.e $G_1$is isomorphic to G_2.

Now isomorphism preserves size, weight of the edges and vertex of a fuzzy planar graph.

Hence, weight of the edges and vertex of G_1 and G_2 will be same.

Then we can draw G_1 and G_2 are similarly.

Hence, $\gamma_{IFP_1} = \gamma_{IFP_2}$ and $f_1 = f_2$.

VII. CONCLUSION

This study described the domination in fuzzy planar graph (γ_{FP}), domination in strong fuzzy planar graph (γ_{SFP}), domination in isomorphic fuzzy planar graph (γ_{IFP}). Using the concept of finding the strength of an edge, we defined the strong fuzzy planar. We defined the relationship between maximum neighborhood degree and γ_{SFP}. Then we introduced the relation between the fuzzy planar graph with the planarity and domination in isomorphic fuzzy planar graph.

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A SURVEY ON VARIOUS TECHNIQUES OF FREQUENT ITEMSET MINING

M.GEETHA[1], S.KAVITHA[2]
[1]Full Time Research Scholar,[2]Head and Associate Professor, Department of Computer Science,Sakthi college of Arts and Science For Women, oddanchatram, India

Abstract:The Paper is to address some issues based on the traditional FIM which may discover a large amount of frequent but low-value item sets and lose the information on valuable item sets having low selling frequencies. Hence, it cannot satisfy the requirement of users who desire to discover item sets with high utilities such as high profits. Here, is an attempt to enhance the existing framework for top-k high utility itemset mining, and propose a new enhanced model of Mining of High Utility Itemsets using Faster High-Utility itemset miner with Negative unit profits. We are aware that in the data mining field, the high utility mining is a recent trend of the domain. The task completes the identification of more profitable itemsets which we call and represent it as high utility itemsets in the large transactional databases. In recent more algorithms are introduced for this propose, but many did not considered the point of negative unit profits. The existing works are also considered only positive unit profits. But, we know that the current transactional databases will have both positive and negative unit profits. To compute high utility itemsets with both positive and negative unit profits is a more costly and so we need to design the proposed model more efficient and cost effective. Considering the existing pitfalls, we proposed the reinforced model with FHN (Faster High-Utility itemset miner with Negative unit profits). The proposed model incorporates both positive and negative unit profits and thus the objective of efficient high utility mining will be achieved.

Keyword - Frequent Itemset mining, Closed High Utility Itemset , Utility mining

I. INTRODUCTION

Data Mining consists mining huge amount of data using different mining techniques to derive useful and important information i.e. discovery of knowledge. Organizations use such knowledge for based on their related purposes. Frequent Itemset Mining (FIM) is a modern technique for market basket analysis i.e. discovery of itemsets that customer purchase together frequently. Present problem of FIM model that it generates high volume of frequent itemsets and avoids low selling frequencies. Generated itemsets may have low revenues and less frequent itemsets may generate high revenue. FIM treats every item with same importance, profit and weight and it assumes an item can be either present or absent i.e. binary representation of itemsets in transaction. To recover from this problem, utility mining concept is emerged. A utility of an itesmset is measured in cost, weight, quantity, profit etc. If the utility of an itemset is greater than user-specified minimum utility threshold then it is said to be highutilityitemset otherwise it is considered as a low utility itemset. High utility mining has wide application. HUI may use to find large amount of high utility itemsets causes difficulty to the user for result analysis. It also needs more memory and processing time to be less efficient. To reduce cost and mining task and to provide good results in FIM we introduce Freeset, Non derivable sets, Closed Itemsets.

II. LITERATURE SURVEY

This section depicts the existing works studied by other researchers related to the Frequent Itemset Mining. Vincent E. Teseng et al discussed about the closed frequent itemset mining concepts. They depicted a lossless data model for High Utility Itemset mining. They suggested three algorithms, namely, AprioriCH (Apriori-based algorithm for mining High utility closed itemsets), AprioriHC-D (AprioriHC algorithm with Discarding unpromising and isolated items) and CHUD (Closed High Utility Itemset Discovery) to find this representation. In addition to, they have suggested another model Derive All High Utility Itemsets which extracts the data without the help of source database. Though, the models were efficient, it failed to support larger number of candidate's subsets. ChowdhuryFarhan Ahmed and Syed Khairuzzaman discussed about on incremental and interactive data mining. They suggested three tree structures for efficiently performing incremental and interactive HUP (High Utility Pattern) mining, and to reduce the calculations in case of changing a minimum threshold was or updating a database. These three structures were named as, Incremental HUP Lexicographic Tree (IHUPL Tree, was arranged according to an item's lexicographic order and without any restructuring operation it can capture the incremental data), and second one was IHUP Transaction Frequency Tree (IHUPTF-Tree, the construction and handling was simple, very easy and according to their transaction frequency the tree items were arranged in this).). To avoid the problem of level wise candidate generation, they used pattern growth approach. Vincent S. Tseng and Philip S. Yu explained about High utility itemsets mining. They introduced two algorithms namely, utility pattern growth (UP-Growth) and UP-Growth+. These algorithms having the advantage over tree-based data structure, which was utility pattern tree (UP-Tree). According to the authors that the Tree based data structures used to store the candidate itemsets. So for mining high utility itemsets from transaction databases, they introduced two efficient algorithms named UP-Growth and UP-Growth+. The main use of these two algorithms was to improve the run time, when database contains lots of long transactions. According to Chun-Jung Chu and Tyne Liang [4], the negative utility values could be there. By considering the database, they found that the decisive necessities of temporal and spatial efficiency for mining high utility itemsets with negative item values. Then they suggested one method was HUINIV (Negative values for utilities if itemsets were considered). By using this modified method, they explained that Mining for negative item values was also utility mining and achieved the High scalability in dealing with large databases. Hua-Fu Li, et al [5] suggested two efficient one pass algorithms based on BIT vector, the developed algorithms named as MHUI-BIT and MHUITID for mining high utility itemset. They introduced these two approaches to find out high-utility itemsets with negative item profits from data streams within a transaction sensitive sliding window. The main focus of these approaches was to improve the efficiency of mining high utility itemsets. Sen Su, ShengzhiXu, et al [6] developed a differentially private FIM algorithm. The base of this algorithm was FP-growth algorithm that was referred to as PFP-growth. The PFP-growth algorithm consists of two phases were preprocessing phase and a mining phase. A novel smart splitting method was proposed to transform the database, the preprocessing phase needs to be performed only once for a given database. In mining phase, transaction splitting was introduced to offset the information loss. In addition, to original database; they developed a run-time estimation method to estimate the actual support of itemsets. During formal privacy analysis, they showed the PFP-growth algorithm was differentially private.

III METHODOLOGIES

a) List Utility-Structure

This phase discuss about the utility-list structure and relevant properties. This method developed the List Uitlity-Items. The detailed description of utility-lists, in the TKO Base and TKO algorithms, here each item (set) is linked with a utility-list. For creating the utility-lists of items the database will scan twice. This created utility-lists of items called as initial utility-lists. According to the above discussion the database is scanned two times. So, the TWU and utility values of items are computed in the first database scan. At the time of scan the second database, in each transaction items are sorted in order of TWU values and for every item, the utility-list is created. In each transaction the items are set in ascending sequence of TWU values. There is one or more tuples contained by utility-list of an item (set) X. In a transaction Tr, the information of X represented by each tuple. Each tuple has three fields illustrated as Tid, iutil and rutil. Every field has its specification, Tid contains the identifier of Tr and iutil contains the utility of X in Tr. The remaining utility of X in Tr is contained by rutil.

b) Frequent Itemset Mining

A non-empty set of items can be defined as an itemset. Any itemset containing k distinct items is known as a k-itemset, means the collection of one or more items in a supermarket transaction E.g.{Milk, Bread, Diaper}. The itemsets that appear frequently in the communication are termed as frequent itemsets. The main objective of frequent itemset mining is to find out all the itemsets in a transaction dataset. There are many tasks available in data mining e.g. mining association rules, long patterns, emerging patterns, and dependency rules in the terms of theory and practice. Frequent itemset mining plays a crucial role in data mining. In the field of telecommunications, census analysis and text analysis also FIM is playing supportive and more helpful role.

C) Top-k Pattern Mining

This phase is about to develop the Top-k Pattern Mining. According to many studies, there are several methods have been proposed to mine different kinds of top-k patterns, like as top-k frequent itemsets, top-k frequent closed itemsets, top-k closed sequential patterns, top-k association rules, top-k sequential rules, top-k correlation patterns, and top-k cosine, etc that differentiate each top-k pattern mining algorithm is the type of patterns determined, as well as the data structures and explore approaches that are engaged. For example, some algorithms use a rule expansion approach for finding patterns, while others rely on a pattern-growth search using structures such as FP-Tree. In terms of memory and execution time the selection of data structures and search strategy influence the efficiency of a top-k pattern mining algorithm. Though, the above algorithms find top-k patterns according to traditional measures instead of the utility measure. As an outcome, it may fail to mark patterns yielding high utility

IV CONCLUSION

In this paper, an in-depth analysis of few algorithms is done which made a significant contribution to the search of improving the efficiency of frequent itemset mining. We have reviewed various techniques of generating HUIs amongst them Closed High Utility Mining proved better and efficient. But conducting all these processes, organizations have to carry the storage and computation overhead.

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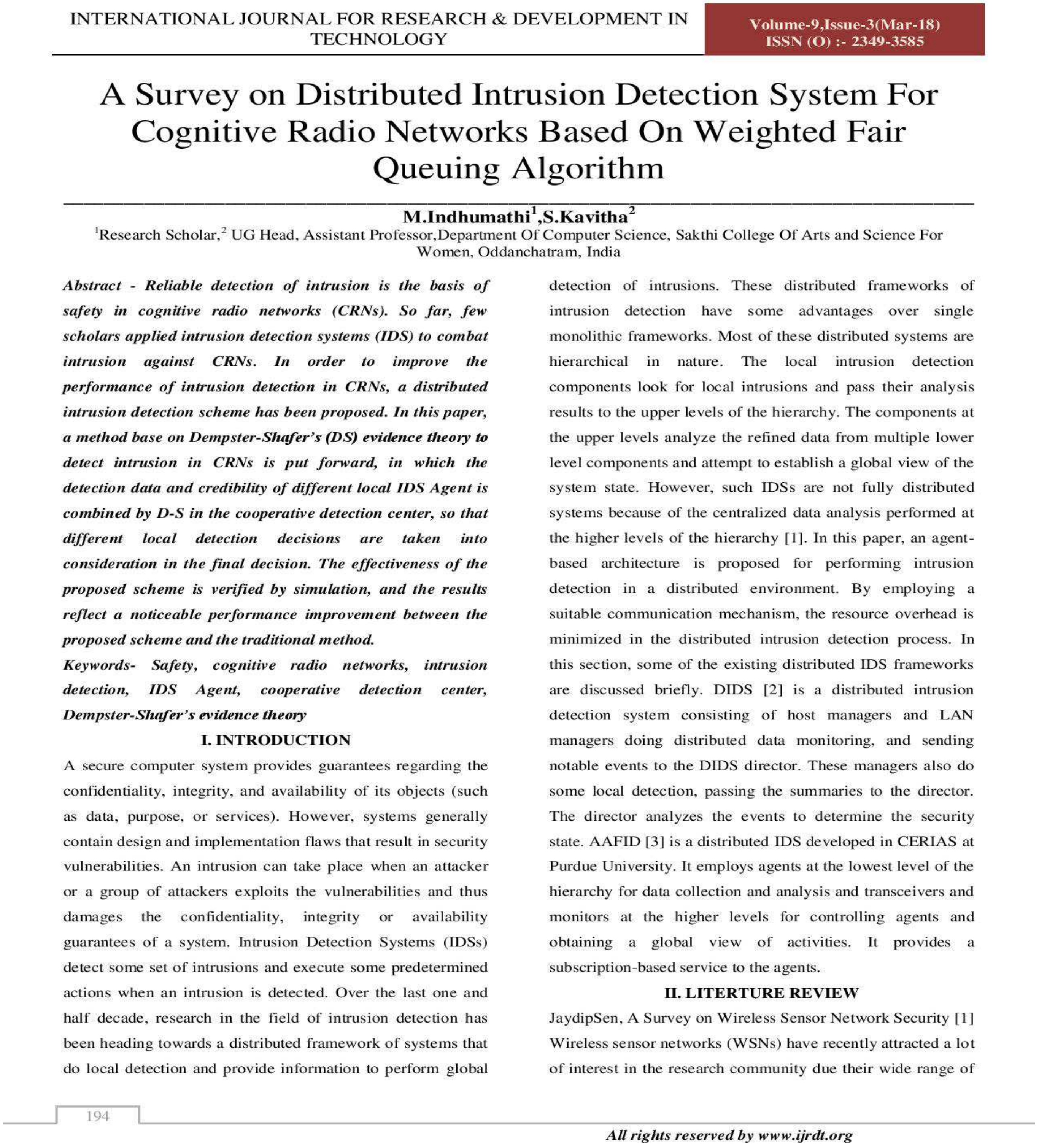

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A Survey on Distributed Intrusion Detection System For Cognitive Radio Networks Based On Weighted Fair Queuing Algorithm

M.Indhumathi[1],S.Kavitha[2]
[1]Research Scholar,[2] UG Head, Assistant Professor,Department Of Computer Science, Sakthi College Of Arts and Science For Women, Oddanchatram, India

Abstract - Reliable detection of intrusion is the basis of safety in cognitive radio networks (CRNs). So far, few scholars applied intrusion detection systems (IDS) to combat intrusion against CRNs. In order to improve the performance of intrusion detection in CRNs, a distributed intrusion detection scheme has been proposed. In this paper, a method base on Dempster-Shafer's (DS) evidence theory to detect intrusion in CRNs is put forward, in which the detection data and credibility of different local IDS Agent is combined by D-S in the cooperative detection center, so that different local detection decisions are taken into consideration in the final decision. The effectiveness of the proposed scheme is verified by simulation, and the results reflect a noticeable performance improvement between the proposed scheme and the traditional method.

Keywords- Safety, cognitive radio networks, intrusion detection, IDS Agent, cooperative detection center, Dempster-Shafer's evidence theory

I. INTRODUCTION

A secure computer system provides guarantees regarding the confidentiality, integrity, and availability of its objects (such as data, purpose, or services). However, systems generally contain design and implementation flaws that result in security vulnerabilities. An intrusion can take place when an attacker or a group of attackers exploits the vulnerabilities and thus damages the confidentiality, integrity or availability guarantees of a system. Intrusion Detection Systems (IDSs) detect some set of intrusions and execute some predetermined actions when an intrusion is detected. Over the last one and half decade, research in the field of intrusion detection has been heading towards a distributed framework of systems that do local detection and provide information to perform global detection of intrusions. These distributed frameworks of intrusion detection have some advantages over single monolithic frameworks. Most of these distributed systems are hierarchical in nature. The local intrusion detection components look for local intrusions and pass their analysis results to the upper levels of the hierarchy. The components at the upper levels analyze the refined data from multiple lower level components and attempt to establish a global view of the system state. However, such IDSs are not fully distributed systems because of the centralized data analysis performed at the higher levels of the hierarchy [1]. In this paper, an agent-based architecture is proposed for performing intrusion detection in a distributed environment. By employing a suitable communication mechanism, the resource overhead is minimized in the distributed intrusion detection process. In this section, some of the existing distributed IDS frameworks are discussed briefly. DIDS [2] is a distributed intrusion detection system consisting of host managers and LAN managers doing distributed data monitoring, and sending notable events to the DIDS director. These managers also do some local detection, passing the summaries to the director. The director analyzes the events to determine the security state. AAFID [3] is a distributed IDS developed in CERIAS at Purdue University. It employs agents at the lowest level of the hierarchy for data collection and analysis and transceivers and monitors at the higher levels for controlling agents and obtaining a global view of activities. It provides a subscription-based service to the agents.

II. LITERTURE REVIEW

JaydipSen, A Survey on Wireless Sensor Network Security [1] Wireless sensor networks (WSNs) have recently attracted a lot of interest in the research community due their wide range of applications. Due to distributed nature of these networks and their deployment in remote areas, these networks are vulnerable to numerous security threats that can adversely affect their proper functioning. This problem is more critical if the network is deployed for some mission-critical applications such as in a tactical battlefield. Random failure of nodes is also very likely in real-life deployment scenarios. Due to resource constraints in the sensor nodes, traditional security mechanisms with large overhead of computation and communication are infeasible in WSNs. Security in sensor networks is, therefore, a particularly challenging task. This paper discusses the current state of the art in security mechanisms for WSNs. various types of attacks are discussed and their countermeasures presented. A brief discussion on the future direction of research in WSN security is also included. In addition to traditional security issues like secure routing and secure data aggregation, security mechanisms deployed in WSNs also should involve collaborations among the nodes due to the decentralized nature of the networks and absence of any infrastructure. In real-world WSNs, the nodes cannot be assumed to be trustworthy apriori. Researchers have therefore, focused on building a sensor trust model to solve the problems which are beyond the capabilities of traditional cryptographic mechanisms. In this chapter, we present a survey of the security issues in WSNs. First we outline the constraints of WSNs, security requirements in these networks, and various possible attacks and the corresponding countermeasures. Then a holistic view of the security issues is presented. These issues are classified into six categories: cryptography, key management, secure routing, secure data aggregation, intrusion detection and trust management. The advantages and disadvantages of various security protocols are discussed, compared and evaluated. Some open research issues in each of these areas are also discussed. S.Ganesh, Efficient and Secure Routing Protocol for Wireless Sensor Networks through SNR based Dynamic Clustering Mechanisms [2] Advances in Wireless Sensor Network Technology (WSN) have provided the availability of small and low-cost sensor with capability of sensing various types of physical and environmental conditions, data processing and wireless communication. In WSN, the sensor nodes have a limited transmission range, and their processing and storage capabilities as well as their energy resources are limited. Triple Umpiring System (TUS) has already been proved its better performance on Wireless Sensor Networks. Clustering technique provides an effective way to prolong the lifetime of WSN. In this paper, we modified the Ad hoc on demand Distance Vector Routing (AODV) by incorporating Signal to Noise Ratio (SNR) based dynamic clustering. The proposed scheme Efficient and Secure Routing Protocol for Wireless Sensor Networks through SNR based dynamic Clustering mechanisms (ESRPSDC) can partition the nodes into clusters and select the Cluster Head (CH) among the nodes based on the energy and Non Cluster Head (NCH) nodes join with a specific CH based on SNR Values. Error recovery has been implemented during Inter cluster routing itself in order to avoid end-to-end error recovery. Security has been achieved by isolating the malicious nodes using sink based routing pattern analysis. Extensive investigation studies using Global Mobile Simulator (GloMoSim) showed that this Hybrid ESRP significantly improves the Energy efficiency and Packet Reception Rate (PRR) compared to SNR unaware routing algorithms like Low Energy Aware Adaptive Clustering Hierarchy (LEACH) and Power-Efficient Gathering in Sensor Information Systems (PEGASIS). Sensor Network Wireless is widely considered as one of the most important technologies for the twenty-first century. The sensing electronics measure ambient conditions related to the environment surrounding the sensors and transform them in to an electrical signal. In many WSN applications, the deployment of sensor nodes is performed in an ad-hoc fashion without careful planning and engineering. In the past few years, an intensive research that addresses the potential of collaboration among sensors in data gathering and processing and in the coordination and management of the sensing activities were conducted. However, sensor nodes are constrained in energy supply and bandwidth. Energy conservation is critical in Wireless Sensor Networks. Replacing or recharging batteries is not an option for sensors deployed in hostile environments. Generally, communication electronics in the sensor utilizes most energy. Stability is one of the major concerns in advancement of Wireless Sensor Networks (WSN). A number of applications of WSN require guaranteed sensing, coverage and connectivity throughout its operational period. Death of the first node might cause instability in the network. Therefore, all of the sensor nodes in the network must be alive to achieve the goal during that period. One of the major obstacles to ensure these phenomena is unbalanced energy consumption rate. Numerous techniques were proposed to improve energy consumption rate such as clustering, efficient routing, and data aggregation

III. METHODOLOGY

1. Security Agents

1.1. Misuse Detection Agent

As we previously mentioned, each security agent consists of two tiers. The lower tier comprises of the process that handles the misuse detection within our network. Snort [6] has been chosen as the misuse IDS software for our system. Snort is a libpcap-based [7] software that can be used as a sniffer, packet logger or network intrusion detection system. In our case, we used Snort as a misuse intrusion detection tool. The detection of malicious packets is based on known attack signatures. Snort is able to detect a variety of attacks such as DoS/DDoS attacks, Portscans, HTTP, DNS, SMTP, IMAP, POP3 attacks and Virus/Worm attacks. Alerts generated from Snort are passed to the upper tier of our agent. The upper tier of the Misuse Detection Agent receives alert messages from the lower tier and stores them for a defined period of time in a buffer. For every different case of attack, that is, source IP address and port, target IP address and port and known attack signature, the upper tier process uses a unique alert identification. Rate limiting is achieved independently for different types of attacks, sending the alert message only once in the specified period of time. Agent's upper tier process is also responsible for sending the heartbeat messages to the Central IDS Node informing that the misuse IDS system is operational. The messages sent to the Central IDS Node are formatted using the extended signed IDMEF format. In addition, the upper tier process listens for commands from the Central IDS Node. It receives parameters for the rate limiting of alert messages, configuration for the Snort process and new attack signatures.

1.2. Anomaly Detection Agent

For the lower tier of the Anomaly Detection Agent we developed a prototype anomaly detection tool [8] that currently focuses on DoS Attacks. The prototype tool consists of two main modules: the collector and the detector. The collector module is responsible for asynchronously receiving flow data from the Netflow-enabled [9] router; information is analyzed, mean values and adaptive thresholds are calculated and stored in a local data structure. The tool extracts and stores packet and flow counters per destination IP address, as well as total counters and mean values for each pair of input-output interfaces. The detector process is responsible for calculating the metrics for the interface pairs stored by the collector, and comparing the results to detection thresholds. It is periodically activated, implements extensive logging of detection events and generates notifications with security alerts which are sent to the upper tier.The upper tier process receives the alerts and sends them to the Central IDS Node using the signedIDMEF Format. Moreover, the Central IDS Node adjusts Anomaly Detection Agent's parameters (metrics and thresholds for the DoS attack detection algorithm).

1.3. SNMP Query Agent

As the other two agents, the SNMP Query Agent is comprised of two tiers. The lower tier process is a custom SNMP client that performs SNMP queries at the routers of the network. Values like CPU and memory usage, active and inactive flows are polled from routers at specific intervals. The upper tier accepts the values from the SNMP queries and forwards them to the Central IDS Node after formatting them using the signed-IDMEF data model. The upper tier process is also responsible for sending heartbeat messages to inform the Central IDS Node that the SNMP client is operational. Instructions from the Central IDS Node are sent to the SNMP Query Agent, giving information about the router and the SNMP objects to be polled.

2. Intrusion Detection System

Intrusion detection mechanism can detect malicious behavior on the network and identify malicious users. So Intrusion detection mechanism can protect the reliability of the network, especially it is more important in distributed cognitive radio network which absenting center facilities. The traditional intrusion detection system (IDS) was proposed by Denning in 1987. It is composed of main body, object, audit record, activity profile and exception record and activity rules. A more detailed description of IDES is given as follows.

There are six main parts in the IDS model [12].

1) Subject: Active initiator in the system operation, the entity that moves on the target system, such as the process of the computer operating system, the service connection of the network and so on.

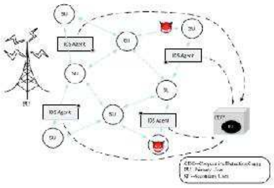

Fig.1. System of Distribute Intrusion Detection in CRNs

2) Object: Resources that are managed by the system-- files, devices, commands, for example.

3) Audit Records: when a subject operates on an object, such as user registration, command execution, and file access, data will be produced by the target system.

4) Activity Profile: Preserve the information about the normal activity, and the specific implementation depends on the detection method.

5) Anomaly Record: Used to indicate the occurrence of an abnormal event. The format is <Event, Time-Stamp, Profile>

6) Activity rule: An action that should be taken when an audit record, update profile, an exception record, detect relate anomalies to some suspected intrusions or abnormal behavior is produced.

Actually, the Denning model is can be described as a rule based pattern matching system. After generating an audit record, it will match against the profiles. Then type information will determine the rule to report anomalies detection. It's largely system-in-dependent for the rules and profile structures to establish profile templates. Not all of the IDS can be fully consistent with the model.

IV.CONCLUSION

I propose distributed IDS for CRNs based on evidence theory. Aim to get more accurate final detection result making at CDC, we apply D-S theory of evidence to combine different detection data and credibility from every IDS Agents. Simulations presented show that the proposed system performs more excellent than the traditional Weighted Fair Queuing (WFQ) Combination algorithm.

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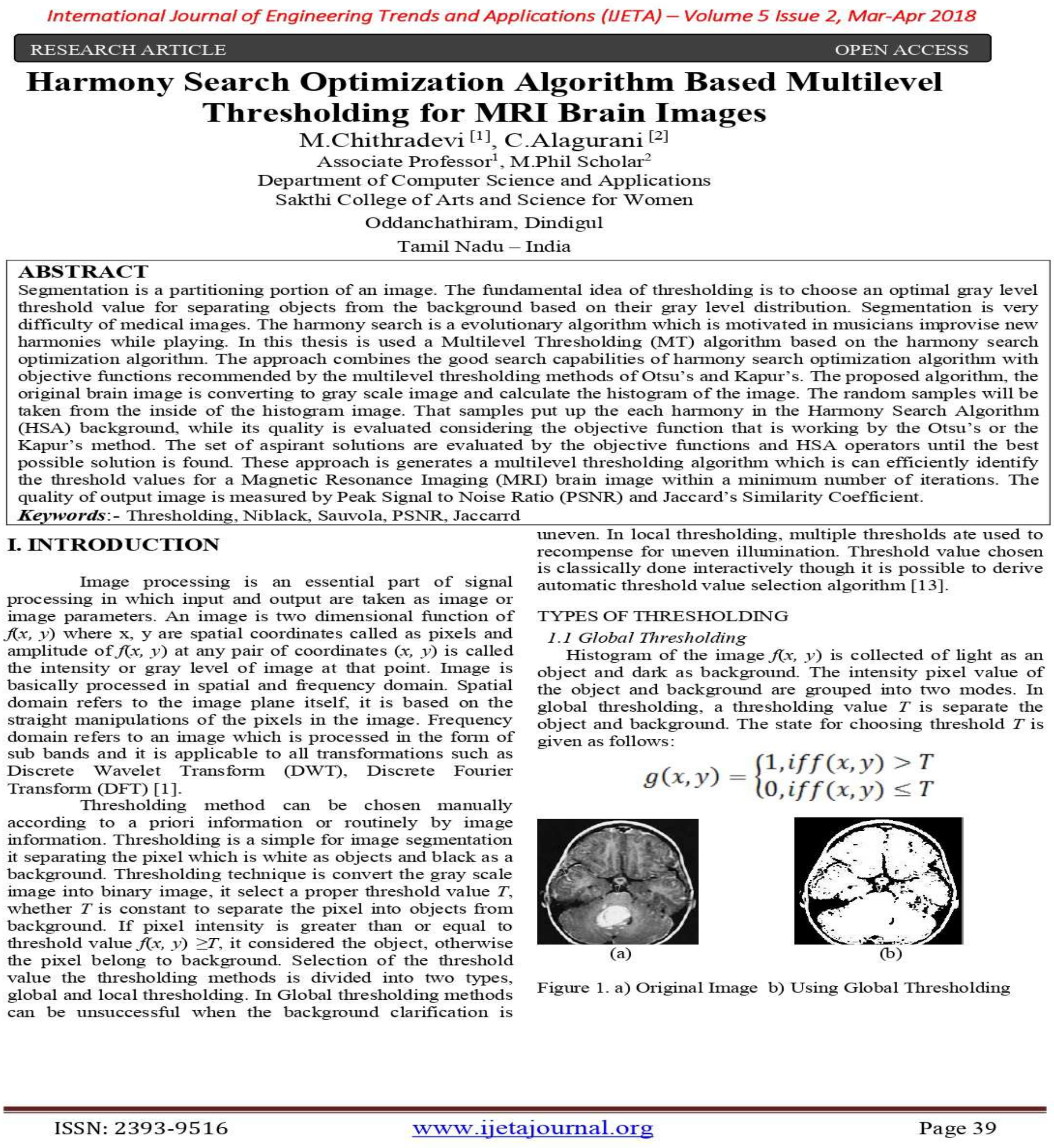

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Harmony Search Optimization Algorithm Based Multilevel Thresholding for MRI Brain Images

M.Chithradevi [1], C.Alagurani [2]
Associate Professor[1], M.Phil Scholar[2]
Department of Computer Science and Applications
Sakthi College of Arts and Science for Women
Oddanchathiram, Dindigul
Tamil Nadu – India

ABSTRACT

Segmentation is a partitioning portion of an image. The fundamental idea of thresholding is to choose an optimal gray level threshold value for separating objects from the background based on their gray level distribution. Segmentation is very difficulty of medical images. The harmony search is a evolutionary algorithm which is motivated in musicians improvise new harmonies while playing. In this thesis is used a Multilevel Thresholding (MT) algorithm based on the harmony search optimization algorithm. The approach combines the good search capabilities of harmony search optimization algorithm with objective functions recommended by the multilevel thresholding methods of Otsu's and Kapur's. The proposed algorithm, the original brain image is converting to gray scale image and calculate the histogram of the image. The random samples will be taken from the inside of the histogram image. That samples put up the each harmony in the Harmony Search Algorithm (HSA) background, while its quality is evaluated considering the objective function that is working by the Otsu's or the Kapur's method. The set of aspirant solutions are evaluated by the objective functions and HSA operators until the best possible solution is found. These approach is generates a multilevel thresholding algorithm which is can efficiently identify the threshold values for a Magnetic Resonance Imaging (MRI) brain image within a minimum number of iterations. The quality of output image is measured by Peak Signal to Noise Ratio (PSNR) and Jaccard's Similarity Coefficient.

Keywords:- Thresholding, Niblack, Sauvola, PSNR, Jaccarrd

I. INTRODUCTION

Image processing is an essential part of signal processing in which input and output are taken as image or image parameters. An image is two dimensional function of $f(x, y)$ where x, y are spatial coordinates called as pixels and amplitude of $f(x, y)$ at any pair of coordinates (x, y) is called the intensity or gray level of image at that point. Image is basically processed in spatial and frequency domain. Spatial domain refers to the image plane itself, it is based on the straight manipulations of the pixels in the image. Frequency domain refers to an image which is processed in the form of sub bands and it is applicable to all transformations such as Discrete Wavelet Transform (DWT), Discrete Fourier Transform (DFT) [1].

Thresholding method can be chosen manually according to a priori information or routinely by image information. Thresholding is a simple for image segmentation it separating the pixel which is white as objects and black as a background. Thresholding technique is convert the gray scale image into binary image, it select a proper threshold value T, whether T is constant to separate the pixel into objects from background. If pixel intensity is greater than or equal to threshold value $f(x, y) \geq T$, it considered the object, otherwise the pixel belong to background. Selection of the threshold value the thresholding methods is divided into two types, global and local thresholding. In Global thresholding methods can be unsuccessful when the background clarification is uneven. In local thresholding, multiple thresholds ate used to recompense for uneven illumination. Threshold value chosen is classically done interactively though it is possible to derive automatic threshold value selection algorithm [13].

TYPES OF THRESHOLDING

1.1 Global Thresholding

Histogram of the image $f(x, y)$ is collected of light as an object and dark as background. The intensity pixel value of the object and background are grouped into two modes. In global thresholding, a thresholding value T is separate the object and background. The state for choosing threshold T is given as follows:

$$g(x,y) = \begin{cases} 1, iff(x,y) > T \\ 0, iff(x,y) \leq T \end{cases}$$

(a) (b)

Figure 1. a) Original Image b) Using Global Thresholding

1.2 OTSU THRESHOLDING METHOD

The Otsu thresholding method, is a differentiate analysis method. The threshold operation is regarded as the splitting of the pixels of an image into two classes *D0* and *D1* (e.g., objects and background) at gray-level *t*, i.e., $D0 = \{0,1,2,\dots,t\}$ and $D1 = \{t+1, t+2, \dots, L-1\}$. As stated in, let σ_w^2 , σ_w^2 and σ_T^2 be the within the class variance, between-class variance, and the total variance, respectively. An optimal threshold can be resolute by minimizing one of the following (equivalent) condition functions with admiration to *t* [17]:

$$\lambda = \frac{\sigma_B^2}{\sigma_W^2}, \eta = \frac{\sigma_B^2}{\sigma_T^2}, \kappa = \frac{\sigma_T^2}{\sigma_W^2}$$

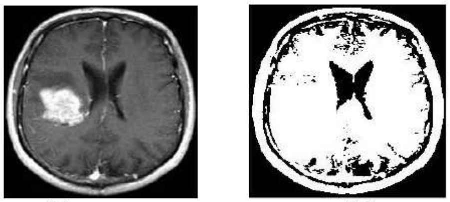

(a) (b)

Figure 2.3. a) Original Image b) Using Otsu Technique

1.3 RIDLER CALVARD TECHNIQUE

The Ridler and Calvard algorithm uses an iterative clustering approach. First step compute the threshold value (e.g. mean image intensity).Pixels above and below the threshold are assigned to the object and background classes correspondingly. Then the mean of pixels in the object class is computed as μ_F and for the background as μ_B. Using these two mean values, an improved threshold T_1 is computed as [19]:

$$T_1 = \frac{\mu_S + \mu_F}{2}$$

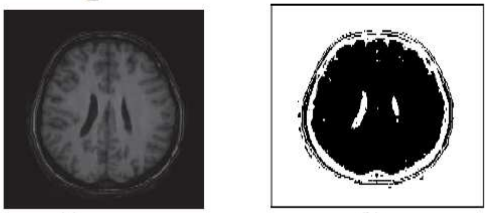

(a) (b)

Figure 2.a) Original Image b) Using Ridler Calvard Technique

A. Local Thresholding

Global thresholding method is not appropriate solution whenever the background clarification is uneven. In local thresholding technique, appropriate solution for background illumination is uneven. The threshold value *T* depending upon gray levels of *f*(*x*, *y*) and some local image properties of adjacent pixels such as mean or variance.

The threshold technique with a locally varying threshold function *T*(*x*, *y*) is given by

$$g(x,y) = \begin{cases} 1 \; if \; f(x,y) \geq T(x,y) \\ 0 \; if \; f(x,y) < T(x,y) \end{cases}$$

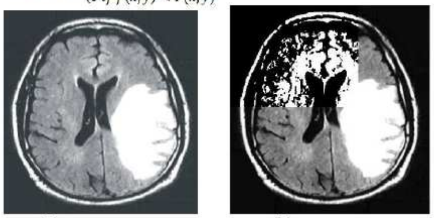

(a) (b)

Figure 3. a) Original Image b) Using Local Thresholding

1.4 BERNSEN'S TECHNIQUE

Bernsen's technique is developed by Bernsen's, it is local thresholding technique. Local threshold value is computed through local contrast. The local threshold value for each pixel (*x*, *y*) is computed by the relation.

$$T(x,y) = \frac{Imax + Imin}{2}$$

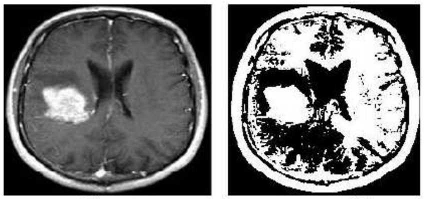
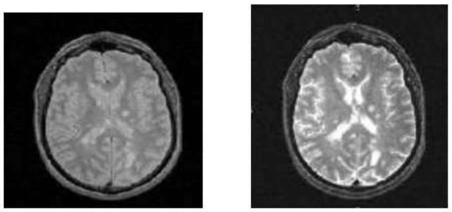

(a) (b)

Figure 4. a) Original Image b) Using Bernsen's Technique

1.5 LAAB (Local Adaptive Automatic Binarization)

Local adaptive automatic binarization is proposed by T.R Singh et al. It is converting to gray scale image into binary image routinely without using any threshold value *T* by adapting the pixel contained by local region surroundings. In this algorithm is an automatic binarization with local adaptation. Local mean of *m*(*x*, *y*) of pixel intensity value and local region is help for local adaption because is carried out within a local window size of *w* ×*w*. The automatic binarization is designed as:

$$b(x,y) = \frac{|1-2v| - (1-2v)}{2|1-2v|}$$

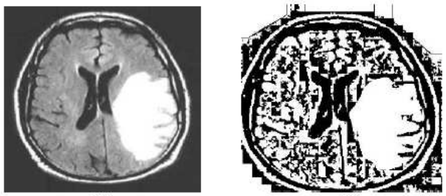


(a) (b)

Fig. 5 a) Original Image b) Using LAAB Technique

B. Adaptive Thresholding

Adaptive thresholding technique is used to when the images are captured under without lightning situation and it is necessary to segment a lighter foreground from its background or when gray level value not constant of the background and object disparity varies within an image. This method allows the threshold value T to change based on the gradually unreliable function of location in the image or on local neighboring hood information. Threshold T based on the spatial coordinated (x, y) pixels [16].



(a) (b)

Fig. 6 a) Original Image b) Using Adaptive Thresholding

II. PROPOSED TECHNIQUES

2.1 INITIALIZE THE PARAMETERS OF HSA

In step 1, HSA parameters are initialized as follows [23]:

1. Harmony memory size (HMS) is the number of solutions that are stored in the Harmony Memory. Harmony Memory Size is related to the population size in genetic algorithms.

2. Harmony Memory Considering Rate (HMCR) is used during the improvisation procedure to choose whether the variables of the solution must take the value of any one in Harmony Memory. HMCR takes a value in the range [0, 1]. It is similar to the crossover rate in genetic algorithms. For example, if Harmony Memory Considering Rate (HMCR) is 0.9 it meaning that the probability of choosing the value of the variable from HM is 90%; even as the probability of selecting a value randomly as of the domain of the variable is 10%, i.e. (1 – HMCR). In case, the region of the variable refers to all the feasible shift patterns that Harmony Search Algorithm (HSA) can select from. Choosing a random value for the variable at probability of (1 – HMCR) is related to the mutation operation in genetic algorithms.

3. Pitch Adjusting Rate (PAR) is also used during the improvisation procedure to make a decision whether the variable of the solution must be distorted to a neighbor value. Pitch Adjusting Rate takes a value in the range [0, 1]. The amount of transform is determined by the bandwidth to shift the solution from one neighbor to another. The value of the bandwidth is arbitrarily select from its domain, and used to modify one shift pattern for a nurse. For case, if PAR is 0.3 it meaning the probability of altering the variable value is 30%; whilst 70%, i.e. (1 – PAR), is the probability of maintenance the variable without any change. PAR is related to a local search algorithm which agrees only improving solutions.

4. The maximum Number of Improvisations (NI) in the search corresponding number of iterations in HSA.

In this process, it investigates the appropriate values for Harmony Search Algorithm parameters including HMS, HMCR, PAR and NI.

2.2 Between—Class Variance (OTSU'S METHOD)

Otsu's is a nonparametric technique for thresholding it proposed by Otsu that segment image measure based on the employs the maximum variance value of the different classes [24]. It is captivating the intensity levels L as of a gray scale image or from every component of a RGB (red, green, and blue) image, the intensity values probability distribution is calculated as follows:

$$Ph_i^c = \frac{h_i^c}{NP}, \sum_{i=1}^{NP} Ph_i^c = 1, c = \begin{cases} 1,2,3 \ \ if \ \ RGB\, Image \\ 1 \ if Gray\, scale\, Image \end{cases} \qquad \cdots (3.6)$$

Where i is a definite intensity level $(0 \le i \le L - 1)$, c is the constituent of the image. In c is depends on if the image is gray scale or RGB whereas the total number of pixels in the image is denoted as the Number Improvisation. h_i^c (histogram) of the image is the number of pixels that respective to the i intensity level in c. The histogram is normalized contained by a probability distribution Ph_i^c. Bi-level is the simplest segmentation of two classes are defined as:

$$C_1 = \frac{Ph_1^c}{\omega_0^c(th)}, \ldots, \frac{Ph_{th}^c}{\omega_0^c(th)} \quad and \quad C_2 = \frac{Ph_{th+1}^c}{\omega_1^c(th)}, \ldots, \frac{Ph_L^c}{\omega_1^c(th)}, \qquad \cdots (3.7)$$

Where C_1 and C_2 classes are probability distributions, of $\omega_0(th)$ and $\omega_1(th)$ as it is given by Eq. (3.8).

$$\omega_0^c(th) = \sum_{i=1}^{th} Ph_{i,}^c \qquad \omega_1^c(th) = \sum_{i=th+1}^{L} Ph_i^c \qquad \cdots (3.8)$$

In μ_0^c and μ_1^c that define the classes and It is necessary to compute mean levels using Eq. (3.9). Once individual's values are calculated, the Otsu variance between classes σ^{2^c} is calculated using Eq. (3.10) as follows:

$$\mu_0^c = \sum_{i=1}^{th} \frac{iPh_i^c}{\omega_0^c(th)}, \qquad \mu_1^c = \sum_{i=th+1}^{L} \frac{iPh_i^c}{\omega_1^c(th)}$$

$$\sigma^{2^c} = \sigma_1^c + \sigma_2^c$$

Observe that for both equations, Eqs. (3.9) and (3.10), *c* depends on the type of image. In Eq. (3.10) the number two is part of the Otsu´s variance operator and does znot characterize on proponent in the mathematical logic. Likewise σ_1^c and σ_2^c in Eq. (3.10) are the variances of C_1 and C_2 classes are distinct as:

$$\sigma_1^c = \omega_0^c(\mu_0^c + \mu_T^c)^2, \sigma_2^c = \omega_1^c(\mu_1^c + \mu_T^c)^2,$$

Where $\mu_T^c = \omega_0^c\mu_0^c + \omega_1^c\mu_1^c$ and $\omega_0^c + \omega_1^c = 1$. Depends on the values σ_1^c and σ_2^c, Eq.(3.12) given the objective function.

$$J(th) = \max\left(\sigma^{2^c}(th)\right), \; 0 \leq th \leq L - 1, \qquad \cdots (3.12)$$

Where $\sigma^{2^c}(th)$ is the Otsu´s variance for a given threshold (*th*) value. Hence, the optimization difficulty is compact to determine the intensity level (*th*) that maximizes Eq. (3.12).

Otsu's method is functional for a single module of an image. In such case RGB images, it is required to single module images needs to separation in the image. The bi-level thresholding is described the extensive of multiple thresholds. Original image separate the possible *k* classes and calculate the *k* variances and their corresponding elements is based on the k thresholds using Eq. (3.5). The objective function *J*(*th*) in Eq. (3.12) can thus be rewritten for multiple thresholds as follows:

$$J(TH) = \max\left(\sigma^{2^c}(\mathrm{TH})\right), \quad 0 \leq \mathrm{th_i} \leq \mathrm{L} - 1\,, \quad \mathrm{i} = 1{,}2, \ldots \ldots, \mathrm{k} \quad \cdots (3.13)$$

Here $TH = [th_1, th_2, \ldots, th_{k-1}]$, is a vector have multiple thresholds and the variances are calculated throughout Eq. (3.14) as follows.

$$\sigma^{2^c} = \sum_{i=1}^{k} \sigma_i^c = \sum_{i=1}^{k} \omega_i^c\,(\mu_i^c - \mu_T^c)^2,$$

Here, it represents and definite class, ω_i^c and μ_j^c are correspondingly the probability of incidence and the mean of a class. In multilevel threshold, such values are obtained as: $\cdots (3.9)$

$$\omega_0^c(th) = \sum_{i=1}^{th1} Ph_i^c \qquad \cdots (3.10)$$

$$\omega_1^c(th) = \sum_{i=th_1+1}^{th2} Ph_i^c$$

$$\vdots \qquad \vdots$$

$$\omega_{k-1}^c(th) = \sum_{i=th_k+1}^{L} Ph_i^c \qquad \cdots (3.11)$$

and, for the mean values:

$$\mu_0^c = \sum_{i=1}^{th_1} \frac{iPh_i^c}{\omega_0^c(th_1)}$$

$$\mu_1^c = \sum_{i=th_1+1}^{th_2} \frac{iPh_i^c}{\omega_0^c(th_2)} \qquad \cdots (3.16)$$

$$\vdots \qquad \vdots$$

$$\mu_{k-1}^c = \sum_{i=th_1+1}^{L} \frac{iPh_i^c}{\omega_k^c(th_k)}$$

Like a bi-level thresholding, for the Multilevel Threshold using the Otsu's method *c* corresponds to the image works, RGB *c* = 1, 2, 3 and gray scale *c* = 1.

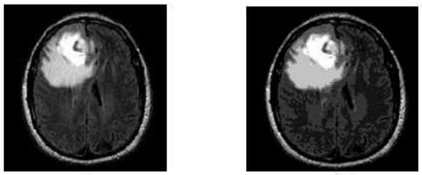

(a) (b)

Fig. 7 a) Original Image b) Using Otsu's Method

2.3 Entropy Criterion Method (KAPUR'S METHOD)

Kapur method is proposed by Kapur et al. It is another nonparametric method that is used to establish the optimal threshold values. Kapur method is based on the entropy criterion and probability distribution of the histogram image. That this kapur method to get the optimal threshold value *th* that it is maximum of the overall entropy. Density and separability of entropy measured by among classes. In this logic, when entropy has the highest value the optimal *th* value properly separates the classes. The objective function kapur's method is distinct as [24]:

$$J(th) = H_1^c + H_2^c,\quad c = \begin{cases} 1,2,3 \text{ if } RGB\ Image \\ 1 \text{ if } Gray\ scale\ Image \end{cases} \quad \cdots(3.17)$$

Where the H_1 and H_2 are defined as the entropies is computed by the following model:

$$H_1^c = \sum_{i=1}^{th} \frac{Ph_i^c}{\omega_0^c} \ln\left(\frac{Ph_i^c}{\omega_0^c}\right), H_2^c = \sum_{i=th+1}^{L} \frac{Ph_i^c}{\omega_1^c} \ln\left(\frac{Ph_i^c}{1}\right), \quad \cdots(3.18)$$

In probability distribution of the intensity levels Ph_i^c which is obtained using Eq.(3.6). $\omega_0(th)$ and $\omega_1(th)$ are probability distributions for C_1 and C_2 classes. $ln(\cdot)$ stands for the natural logarithm. Like to the Otsu's method, the entropy-based approach can be extensive for multiple threshold values; for such a case, it is important to divide the image into k classes using the related number of thresholds. Under such situation the new objective function is distinct as:

$$J(TH) = max\left(\sum_{i=1}^{k} H_i^c\right), c = \begin{cases} 1,2,3 \text{ if } RGB\ Image \\ 1 \text{ if } Gray\ Scale\ Image \end{cases} \quad \cdots(3.19)$$

Where $TH = [th_1, th_2, \ldots, th_{k-1}]$, is a vector that contains the multiple thresholding values. Every entropy is calculated individually with its relevant *th* value, so Eq. (3.20) is extended for k entropies.

$$H_1^c = \sum_{i=1}^{th_1} \frac{Ph_i^c}{\omega_0^c} \ln\left(\frac{Ph_i^c}{\omega_0^c}\right),$$
$$H_2^c = \sum_{i=th_1+1}^{th_2} \frac{Ph_i^c}{\omega_1^c} \ln\left(\frac{Ph_i^c}{\omega_1^c}\right), \quad \cdots(3.20)$$
$$H_k^c = \sum_{i=th_k+1}^{L} \frac{Ph_i^c}{\omega_{k-1}^c} \ln\left(\frac{Ph_i^c}{\omega_{k-1}^c}\right)$$

The $(\omega_0^c, \omega_1^c, \ldots, \omega_{k-1}^c)$ is the values of the probability happening of the k classes are obtained using Eq. (3.15) and the probability distribution Ph_i^c with Eq. (3.9). To conclude, it is important to use Eq. (3.5) to divide the pixels into the related classes.

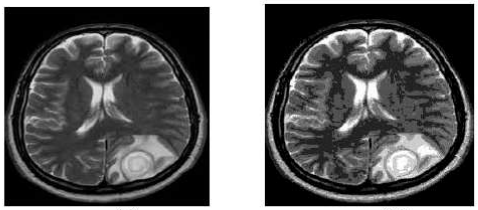
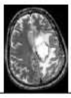
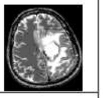
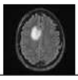
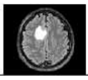
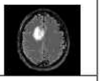
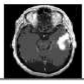
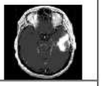
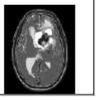
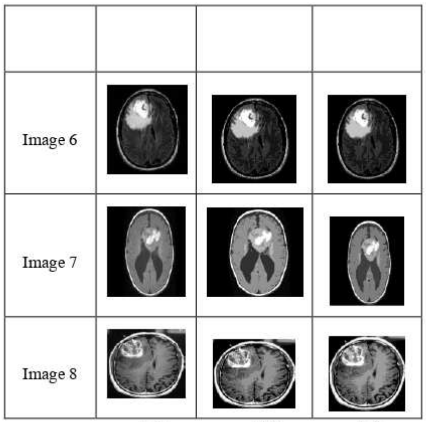

(a) (b)

Figure 3.2. a) Original Image b) Using Kapur's Method

III. RESULT AND DISCUSSION

Images	**Original image**	**Using Otsu**	***Using Kapur***
Image 1			
Image 2			
Image 3			
Image 4			
Image 5			



(a) (b) (c)

Fig. 8 a)Original Image b) Using Otsu's with HSMA c) Using Kapur's with HSMA

Table 1
Result after applying the Harmony Search Optimization Algorithm using Otsu's function to the MRI brain image

Images	K	Threshold value	PSNR	Jaccard	Time
Image 1	6	23 60 90 123 169 219	59.06	0.20	8.9
Image 2	6	24 66 103 134 171 216	59.16	0.20	10.77
Image 3	6	23 48 75 97 117 169	58.49	0.50	15.97
Image 4	6	28 68 99 136 177 220	61.23	0.10	19.01
Image 5	6	12 37 68 101 146 208	59.75	0.04	11.41
Image 6	6	19 46 76 120 169 220	63.99	0.43	12.82
Image 7	6	7 38 82 112 141 196	59.16	0.07	11.77
Image 8	6	29 61 94 123 162 215	58.45	0.19	12.51

Table 2
Result after applying the Harmony Search Optimization Algorithm using Kapur's function to the MRI brain image

Images	k	Threshold value	PSNR	Jaccard	Time
Image 1	6	59 90 118 155 201 224	59.23	0.25	7.05
Image 2	6	17 48 80 125 168 210	59.27	0.22	10.41
Image 3	6	33 78 114 144 178 213	61.15	0.52	14.68
Image 4	6	12 50 99 137 175 214	62.02	0.14	12.95
Image 5	6	30 71 107 138 169 202	59.93	0.32	9.63
Image 6	6	49 74 108 143 179 215	65.64	0.56	6.01
Image 7	6	22 54 106 138 172 214	59.63	0.22	8.56
Image 8	6	33 64 94 125 158 205	58.48	0.21	8.31

IV. CONCLUSIONS

In this paper, multilevel thresholding based on the Harmony search optimization algorithm is used. Harmony Search Optimization Algorithm use some objective functions that can be proposed by the multilevel thresholding methods of Otsu's and Kapur's thresholding methods. Otsu's and Kapur's Multithresholding technique to gives the multi thresholding value for MRI brain images. The performance of these two methods is compared using Jaccard's Similarity Coefficient and Peak Signal to Noise Ratio for MRI brain images. The Experimental result shows the Kapur method produces the better results than the Otsu thresholding method. Kapur method is gives the better result for MRI brain images.

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AUTHOR PROFILE

C.Alagurani doing M.phil computerscience in Sakthi Arts and science–Mother Theresa Womens University,Tamilnadu and done in Master of Computer Application Pannaikadu Veerammal Paramasivam college Tamilnadu.Her research area include image processing

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DATA SECURITY IN NETWORK FLOW USING OBFUSCATION TECHNIQUE

S.Kalaiselvi[1], S.Yoga[2]

[1] Research Scholar, Department of Computer Science, Sakthi College of Arts and Science for Women, Oddanchatram, India
[2] Assistant Professor, Department of Computer Science, Sakthi College of Arts and Science for Women, Oddanchatram, India

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Abstract - *An application encompasses network modeling and simulation, recognition of privacy assaults, and formalization of research results. Indeed, existing techniques for network flow sanitization are vulnerable to different kinds of attacks, and solutions proposed for micro data anonymity cannot be directly applied to network traces. In our previous research, we proposed an obfuscation technique for network flows, providing formal confidentiality guarantees under realistic assumptions about the adversary's knowledge. Put forward an obfuscation technique that leads to confidential guarantee of IP address thus securing the sensitive data. In this paper, we identify the threats posed by the incremental release of network flows and by using SHA3 algorithm we formally prove the achieved confidentiality guarantees. For this operation, a fingerprint is created which is based on the configuration of the system. We group hosts based on the fingerprint and obfuscated address and secure the IP address during the release of incremental network flows. Then, the process of grouping is done using the generated signature. Group intimation is done and the set of IP addresses and signature are compared and the requested signature is send as response. All this processes occur with an intermediate router. Only, the obfuscated signature will be visible to the hacker.*

***Key Words*: Security, Incremental release, Obfuscation, Code Security, Code obfuscation techniques, Privacy**

1. INTRODUCTION

Obfuscation is the obscuring of intended meaning in communication, making the message confusing, will fully ambiguous, or harder to understand. It may be intentional or unintentional (although the former is usually connected) and may result from circumlocution (yielding wordiness) or from use of jargon or even argot (yielding economy of words but excluding outsiders from the communicative value). Unintended obfuscation in expository writing is usually a natural trait of early drafts in the writing process, when the composition is not yet advanced, and it can be improved with critical thinking and revising, either by the writer or by another person with sufficient reading comprehension and editing skills. Similarly, Internet flows may reveal personal communications among specific individuals, such as e-mail exchanges and chat sessions among them. On the other hand, those datasets may also help an adversary to perform security attacks. For instance, observing the traffic of a target network, an adversary could identify possible bottlenecks to be exploited for denial-of-service (DoS) attacks. For these reasons, several techniques were proposed to sanitize network flows while preserving their utility. Early techniques (e.g., Crypto-PAn) were based on the substitution of the real IP addresses with pseudo-IDs. However, that method proved to be vulnerable to different kinds of attacks, based on the knowledge of network characteristics, or on the capacity to inject bogus flows in the monitored network. More recently, several techniques have been proposed to avoid the re-identification of IP addresses, based on the perturbation of other fields of the flows. However, those techniques do not provide any formal confidentiality guarantee, and it has been recently shown that they are prone to different kinds of attacks. In our previous work, we have presented -obfuscation, an obfuscation technique for network flows, which provides formal confidentiality guarantees under realistic assumptions about the adversary's knowledge, while preserving the utility of released data. In that work, we assumed a single release of the whole dataset of flows. However, the incremental release of network flows represents a clear practical advantage. For instance, suppose that an organization wishes to share a month of network flows. Without the incremental release, it would be necessary to wait until the end of the month to start releasing the dataset. Through incremental releases, the organization could provide a more time sharing of network flows choosing a per-week or even a per-day schedule. Moreover, the incremental release provides important technical advantages. Indeed, the computational costs and the memory requirements for obfuscating a large dataset could be strongly reduced by partitioning the dataset in smaller subsets and by running the obfuscation process independently on each subset. Each IP-group contains at least different IP addresses that appear in. Formally, for each group-ID appearing in a flow, there exists a set of at least IP addresses appearing in a flow in such that, for each group-ID. *p2*: Each flow is fp-indistinguishable in a set of at least flows in originated by distinct IP addresses belonging to the same IP-group.is undefined if the above properties cannot be satisfied—i.e., if involves less than different IP addresses(it is impossible to enforce *p1*) or if contains less than flows(it is impossible to enforce *p2*). An extensive experimental evaluation of the algorithm for incremental (K,j) obfuscation, carried out with billions of real flows generated by the border router of a commercial autonomous system. We made experiments on traffic diversity, statistical analysis of flow fields, and network flow analysis. Our results show that our technique preserves the data quality in both the single and the incremental release. Early techniques for network flow obfuscation were based on the encryption of source and destination IP addresses. However, those techniques proved to be ineffective since an adversary might be able to re-identify message source and destination by other values of network flows. Early techniques were based on the substitution of the real IP addresses with pseudo-IDs more recently several techniques have been proposed to avoid the re-identification of IP addresses, based on the perturbation of other fields of the flows. However, those techniques do not provide any formal confidentiality guarantee. The existing work has assumed a single release of the whole dataset of flows. However, the incremental release of network flows represents a clear practical advantage. In this project to partition hosts in homogeneous groups by Fingerprint based group creation algorithm, we use system details: OS, RAM, Processor, User, IP address. For each host, we built the fingerprint vector by computing on the whole set of flows generated by that host, the mean and standard deviation of each considered feature. Using fingerprint the data will be send to router. Router sends that fingerprint to Host Identity. If finger print is matching in any group then host ID send the data to that fingerprint.

2. METHODOLOGY

To identify the threats posed by the incremental release of network flows and by using SHA-3 algorithm and formally prove the achieved confidentiality guarantees. In order to evaluate the effectiveness of our grouping method, To measure the homogeneity of hosts of the same group according to their fingerprint vectors. In this paper we perform the obfuscation for incremental network flows. We illustrate the confidentiality threats and data quality issues involved in the incremental release of network flows. Furthermore, we show how our defense algorithm can be extended to overcome these issues. We also prove the confidentiality guarantees of our defense, as well as the computational complexity of the extended algorithm.

A. Fingerprint based Group creation

Fingerprint creation is based on OS, RAM, Processor, Username and IP address on each node. Creating fingerprint for each nodes and mapping the nodes. Nodes having similar fingerprint values are grouped together. The goal of our fingerprint-based IP-groups creation method is to enforce property obfuscation while preserving the quality of obfuscated data. In order to reach this goal, IP-groups are created by grouping together IPs whose hosts have a similar fingerprint (i.e., they originate similar flows).

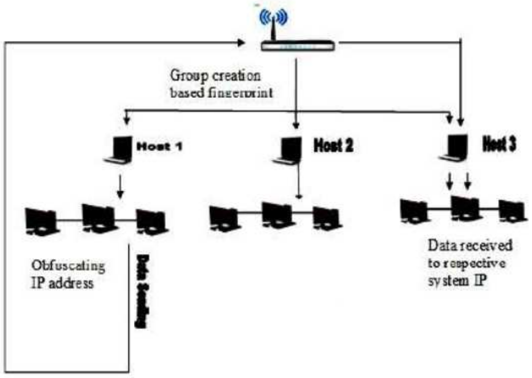

Figure 1: Fingerprint based group creation

B. Creating Group Identity and Group Intimation

To identify the group, we create a group ID for each group based on the count and relevant score values obtained by the obfuscated IP address and the 32-bit fingerprint values. These fingerprint values are in the form of vectors. Group information is sent to all the nodes and the node which matches the group information sent responds to that host and the data is sent to that corresponding nodes. Markov models are used to create groups of hosts having similar network behavior. In order to enforce anonymity, the real IP address of each network flow is substituted by its group ID being released. This group ID is a unique value and hence it eliminates the redundant or duplicate value of real IP addresses. However, there is neither experimental evidence nor a formal guarantee that, with this statistically driven approach, an adversary applying available domain knowledge cannot re-identify hosts by their fingerprint.

C. Obfuscation of sensitive data in network flows

In network flow a sensitive data is transmitted from source and destination, here we obfuscate the source and destination IP address as a fingerprint. Using fingerprint we transmit a data from source to router. Router sends the data to the entire host IDs. In every host, the host ID is obtained by many-to-many mapping the fingerprint in respective group. Data is sent to the nodes having similar fingerprint. The quality of the data is not compromised.

3. ARCHITECTURE

In general, the fact that two specific hosts A and B exchanged some message may be considered confidential information. Since IP address uniquely identifies its host, we assume that confidential information in network flows as source and destination address along with the obfuscated address and fingerprint values. Even if we remove this confidentiality information from the network flows there is no violation of privacy and security of the data that is been sent through the flows. Removal of only the IP address may disrupt the utility of the data, but when real IP address is mapped with the obfuscated IP address and the fingerprint generated there will never be any disruption in the transfer and utility of the data. Hence the performance in incremental network flows is higher than the performance of single release of network flows. The main advantage of incremental network flow is manages the single release network flows by initially creating nodes based on networks they reside on. The network confidentiality threats are managed here and data quality issues are neglected here.

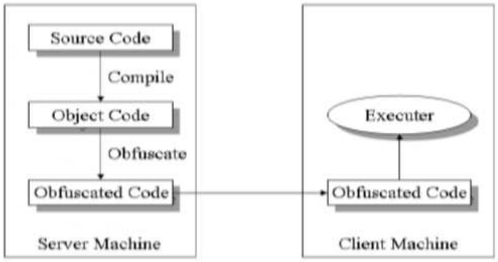

Figure 2: Processing of inputs

A. Network Flow Obfuscation

Since every network flow involves IP address of the sender and receiver nodes, we provide a secure transmission by obfuscating the IP address. This obfuscation is performed by mapping the fingerprint value, the real IP address and configurations of every host in the router. The result of this obfuscation is a 32 bit value which is a combination of text and numerical values. Parameters of this obfuscation involves OS, RAM, Processor, Username and real IP address of each node so the values of each node varies and results in unique obfuscated value which will be very difficult for the intruder to hack and get the data from the incremental release of network flows.

B. Fingerprinting

Fingerprinting is matching the flow field's values to the characteristics of the target environment (OS, RAM, Processor, distance, range and architecture). The typical values of network flows are types of service, number of bytes, and number of packets per flow. The initial fingerprint obtained is a 128 bit alpha-numeric value which is then compressed to 32 bit value using the SHA3 algorithm. Our algorithm enforces a further level of protection.

Merging of each group in which the group having the closest Hilbert index, such that the union of the two groups satisfies. The set of merged groups is returned, as well as the updated set of IP-groups. This processes using the following algorithm

```
Input: L:original set of network flows; fp-QI: set of fingerprint quasi- identifiers;
k:minimum group size; j:minimum number of fp-indistinguishabale flows
Output: L*:set of obfuscated network flows
Obfuscate ( L, fp-QI, k,j ) begin
IP-groups G:=Group Creation(L,fp-QI,k)
if G={A} s.t |A|< K then retuen 0
L:= SubstituteIPs(L,G)
L*:=0
foreach IP-group Ga E G
La:= Getflows (L,GA)
La*:=Bucketsize (La,fp-QI,j)
L*=L* U La*
end
return L*
end
```

4. CONCLUSIONS

To addressed the challenging research issue of network flow obfuscation. This technique provides formal protection guarantees under realistic assumptions about the adversary's knowledge. A proposed a novel defense algorithm to enforce obfuscation to incremental releases, and SHA-3 proved the confidentiality guarantees. All network flow is maintained in one path and making high confidential for source and destination IP addresses. We have formally proved the confidentiality guarantees provided by the new extended algorithm.

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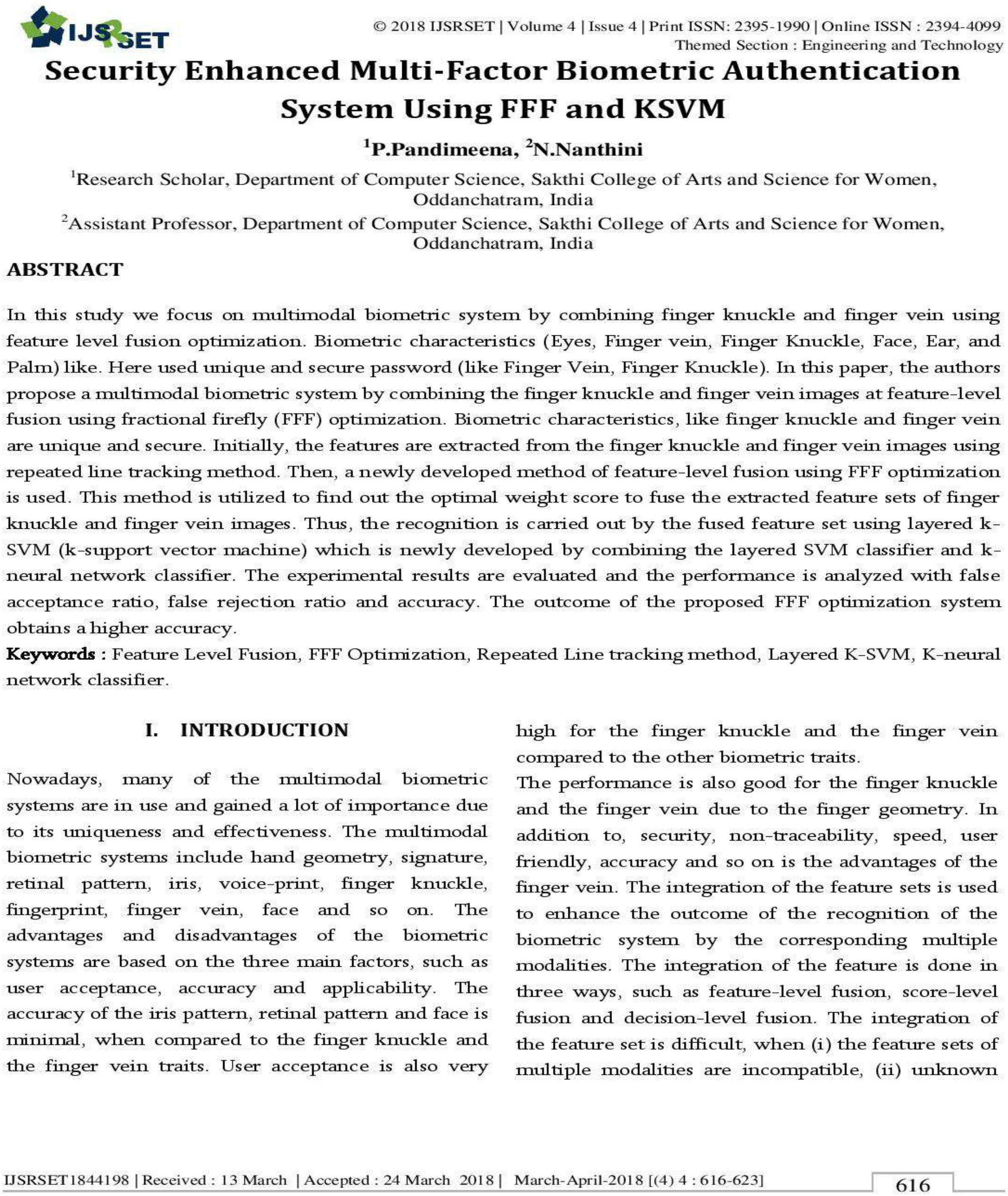

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Security Enhanced Multi-Factor Biometric Authentication System Using FFF and KSVM

[1]P.Pandimeena, [2]N.Nanthini

[1]Research Scholar, Department of Computer Science, Sakthi College of Arts and Science for Women, Oddanchatram, India

[2]Assistant Professor, Department of Computer Science, Sakthi College of Arts and Science for Women, Oddanchatram, India

ABSTRACT

In this study we focus on multimodal biometric system by combining finger knuckle and finger vein using feature level fusion optimization. Biometric characteristics (Eyes, Finger vein, Finger Knuckle, Face, Ear, and Palm) like. Here used unique and secure password (like Finger Vein, Finger Knuckle). In this paper, the authors propose a multimodal biometric system by combining the finger knuckle and finger vein images at feature-level fusion using fractional firefly (FFF) optimization. Biometric characteristics, like finger knuckle and finger vein are unique and secure. Initially, the features are extracted from the finger knuckle and finger vein images using repeated line tracking method. Then, a newly developed method of feature-level fusion using FFF optimization is used. This method is utilized to find out the optimal weight score to fuse the extracted feature sets of finger knuckle and finger vein images. Thus, the recognition is carried out by the fused feature set using layered k-SVM (k-support vector machine) which is newly developed by combining the layered SVM classifier and k-neural network classifier. The experimental results are evaluated and the performance is analyzed with false acceptance ratio, false rejection ratio and accuracy. The outcome of the proposed FFF optimization system obtains a higher accuracy.

Keywords : Feature Level Fusion, FFF Optimization, Repeated Line tracking method, Layered K-SVM, K-neural network classifier.

I. INTRODUCTION

Nowadays, many of the multimodal biometric systems are in use and gained a lot of importance due to its uniqueness and effectiveness. The multimodal biometric systems include hand geometry, signature, retinal pattern, iris, voice-print, finger knuckle, fingerprint, finger vein, face and so on. The advantages and disadvantages of the biometric systems are based on the three main factors, such as user acceptance, accuracy and applicability. The accuracy of the iris pattern, retinal pattern and face is minimal, when compared to the finger knuckle and the finger vein traits. User acceptance is also very high for the finger knuckle and the finger vein compared to the other biometric traits.

The performance is also good for the finger knuckle and the finger vein due to the finger geometry. In addition to, security, non-traceability, speed, user friendly, accuracy and so on is the advantages of the finger vein. The integration of the feature sets is used to enhance the outcome of the recognition of the biometric system by the corresponding multiple modalities. The integration of the feature is done in three ways, such as feature-level fusion, score-level fusion and decision-level fusion. The integration of the feature set is difficult, when (i) the feature sets of multiple modalities are incompatible, (ii) unknown

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relationship between the feature space of multiple modalities and, (iii) curse of dimensionality problem. Commonly, three level fusion before and after matching criteria are used for fusing the features. In score-level fusion, the integration of feature vector is done with the matching score output of the individual matches, and then, the feature vectors are accepted or rejected by an information

- Combining the fractional theory and firefly algorithm as fractional firefly (FFF) optimisation algorithm for feature-level fusion based on the finger knuckle and finger vein images.
- FFF optimisation algorithm is proposed to find out the optimal weight score level for the feature-level fusion. Thus, this optimisation is used to fuse the feature set of both finger knuckle and vein image by the weight score level.
- A new classifier called, k-SVM (k-support vector machine) is developed for the recognition of person by combining the k-NN (k-neural network) classifier and SVM classifier.

1.1 Challenges

On the basis of the literature review conducted, multimodal recognition have been actively studied with various machine learning techniques but for the unsurpassed recognition, the feature-level fusion-based recognition is the fine choice considering the matching score-level as well as the decision-level fusion. The developing of multimodal recognition techniques using feature-level fusion have not been studied much in the literature even though it contains more advantages than the score- and decision-level fusion. In feature-level fusion, the concatenation of the feature vector with reasonable accessibility is an important challenge in the biometric recognition system. Even if the features of the multimodalities are not compatible, the concatenation must be appropriate for the recognition.

Furthermore, fusion of the feature with the ultimate robust recognition is crucial challenge considerable in the multimodal biometric recognition system. While using feature-level fusion, the biometric recognition system must not degrade along with the quality of the feature sets. Proper processing over the feature must be employed for the thriving function of the recognition system. Another important challenge with respect to feature-level fusion is to develop the reliable recognition system. The fusion level must be selected in a way improving the recognition accuracy of the recognition system without degrading the system performance.

1.2 New FFF optimisation

A novel optimisation method is proposed for feature-level fusion using FFF optimisation, which comprises fractional theory and firefly algorithm. In the firefly algorithm, variation of light intensity and the formulation of attractiveness are the two significant issues. It is a meta heuristic algorithm for global optimisation, which is inspired by flashing behaviour of firefly insects. For simplicity, assume that the attractiveness of a firefly is determined by its brightness or light intensity, which in turn is associated with the encoded objective function. The brighter one will attract the other; so the less bright one is moved towards the brighter one. In the simplest case, for the optimisation problems, the brightness I of a firefly at a particular location x can be chosen as $I(x) \alpha f(x)$. In this paper, the fireflies are initialised randomly. For the next iteration, the fireflies are newly generated by finding the movement of firefly with another firefly, which is expressed using the fractional theory. The fractional theory can be rather interesting for filtering and edge detection and also enhance the quality of images. When differential and integral calculus plays a significant role in mathematics, experts investigated the computation of non-integer order derivatives and integrals. Thus, the integration of firefly optimisation and fractional theory is used here to calculate the appropriate value for α and β.

1.3 Deep Learning

In this paper, we do not focus on custom-tailored solutions. Instead, inspired by the recent success of Deep Learning in several vision tasks, and by the ability of the technique to leverage data, we focus on two general-purpose approaches to build image-based anti-spoofing systems with convolutional networks for several attack types in three biometric modalities, namely iris, face, and fingerprint. The first technique that we explore is hyper parameter optimization of network architectures that we hence forth call architecture optimization, while the second lies at the core of convolutional networks and consists of learning filter weights via the well-known back-propagation algorithm, here in after referred to as filter optimization. Fig. 1 illustrates how such techniques are used. The architecture optimization (AO) approach is presented on the left and is highlighted in blue while the filter optimization (FO) approach is presented on the right and is highlighted in red.

II. ARCHITECTURE OPTIMIZATION (AO)

AO is used to search for good architectures of convolutional networks in a given spoofing detection problem and uses convolutional filters whose weights are set at random in order to make the optimization practical. This approach assumes little a priori knowledge about the problem, and is an area of research in deep learning that has been successful in showing that the architecture of convolutional networks, by themselves, is of extreme importance to performance. In fact, the only knowledge AO assumes about the problem is that it is approachable from a computer vision perspective. FO is carried out with back-propagation in a predefined network architecture. This is a long standing approach for building convolutional networks that has recently enabled significant strides in computer vision, specially because of an understanding of the learning process, and the availability of plenty of data and process in power. Network architecture in this context is usually determined by previous knowledge of related problems.

In general, we expect AO to adapt the architecture to the problem in hand and FO to model important stimuli for discriminating fake and real biometric samples. We evaluate AO and FO not only in separate, but also in combination, i.e., architectures learned with AO are used for FO as well as previously known good performing architectures are used with random filters. This explains the crossing dotted lines in the design flow of Fig 1. As our experiments show, the benefits of evaluating AO and FO apart and later combining them to build anti-spoofing systems are twofold. First, it enables us to have a better comprehension of the interplay between these approaches, something that has been largely underexplored in the literature of convolutional networks. Second, it allows us to build systems with outstanding performance in all nine publicly available benchmarks considered in this work.

III. FILTER OPTIMIZATION (FQ)

The first three of such benchmarks consist of spoofing attempts for iris recognition systems, Biosec, Warsaw, and MobBIOfake. Replay-Attack and 3DMAD are the benchmarks considered for faces, while Biometrika, Cross Match, Italdata, and Swipe are the fingerprint benchmarks here considered, all them recently used in the 2013 Fingerprint Liveness Detection Competition (LivDet'13). Results outperform state-of-the-art counterparts in eight of the nine cases and observe a balance in terms of performance between AO and FO, with one performing better than the other depending on the sample size and problem difficulty. In some cases, we also show that when both approaches are combined, we can obtain performance levels that neither one can obtain by itself. Moreover, by observing the behaviour of AO and FO, we take advantage of domain knowledge to propose a single new convolutional architecture that push performance in five problems even further, sometimes by a large margin, as in Cross Match (68.80%v.98.23%). The experimental results strongly indicate that convolutional networks can be readily used for robust spoofing detection. Indeed, we believe that data-driven solutions based on deep representations might be a valuable direction to this field of research, allowing the construction of systems with little effort even to image-based attack types yet to come. We organized the remainder of this work into five sections. Section II presents previous anti-spoofing systems for the three biometric modalities covered in this paper, while Section III presents the considered benchmarks. Section IV describes the methodology adopted for architecture optimization (AO) and filter optimization (FO) while Section V presents experiments, results, and comparisons with state-of-the-art methods.

IV. PROBLEM OF THE STATEMENT

Recognition or identification of human is very challenging problem in today's world. Here, the major challenge is to identify the human through finger knuckle and finger vein images. Let us assume that the input database of A having N persons and every person n1 have Q number of finger knuckles and finger veins.

$$A\text{€}n1; \{1\leq 1\leq N\}$$

$$n1=\{qk;\ 1\leq k\leq Q\}$$

Here, every person corresponding to qk is indicated as image Rij (knuckle image) and Sij (vein image) which are then utilized to recognize the person. The main problem considered here is to recognize N person separately through their finger knuckle and finger vein images.

V. METHODOLOGY

This research aims to developing a system for acquiring images of finger veins and processing them using MATLAB for the purpose of authentication. It includes designing of hardware for image acquisition, coding the matching algorithm for processing the finger vein pattern and training and testing of algorithm module. Typical Finger vein recognition system consists of image acquisition module, image preprocessing, feature extraction, and matching.

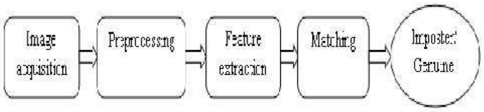


Figure-1: Authentication process

(i) Image acquisition: Finger Vein patterns can be viewed through an image sensor sensitive to infrared light. Infrared light passing through the tissues of the human body is blocked by hemoglobin. As hemoglobin exists densely in blood vessels, infrared light passing through veins appears as dark shadow lines in the captured image.

(ii) Pre-processing: The first step of the proposed multimodal biometric recognition is pre-processing which makes the input training images better suitable for the subsequent steps. The important processes such as, normalization, filtering and resizing are carried out under pre-processing steps. Once the input images are read out, it undergoes the normalization steps to convert the range of pixels within the particular range. The, median filtering is applied to smooth the input images which makes the input images much visible. Also, this process is helpful for the feature extraction to easily identify the vein parts. Then, resizing is performed to convert all the input images into fixed size through interpolation scheme.

Preprocessing step includes image segmentation in which captured image is divided into multiple parts. Each of the pixels in a segment will be similar with respect to some properties, such as color, texture or intensity. The aim of segmentation is to change the representation of an image into something that is easier to analyze. Image segmentation is used to locate objects and boundaries in an image. Segmentation is the process by which we are assigning a label to every pixel in an image. Pixels sharing the same label will have certain similar visual characteristics.

5.1 Vein and Knuckle Print Extraction Using Repeated Line Tracking

In this method, the extraction of finger knuckle and vein print using a repeated line method is discussed. The line tracking operation starts at any pixel in the source image. We defined the current pixel position in an image as the current tracking point and this point is moved from pixel to pixel along the dark line direction in the finger knuckle and finger vein images. Thus, the method of feature extraction from the image is described as follows. F i, j is the intensity of the pixel i, j in the finger knuckle image. Similarly, F m, n is the intensity of the pixel m, n in the finger vein image. Zf_k and Zf_v are the set of pixels in the finger knuckle and finger vein images, respectively. S_1 is considered as the locus space. Thus, the knuckle and vein print are extracted by the following four steps:

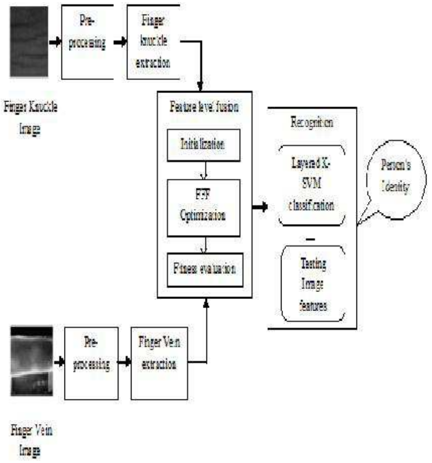


Figure-2: System Overview

The finger vein image features are extracted using wavelet transform and line detection. Wavelet transform is a mathematical function which divides a function into its different frequency components .Wavelet transform analyzes each individual component with a resolution that matches its scale. HAAR wavelet transform multiplies a function against the HAAR wavelet with various shifts and stretches. HAAR transform is easy to implement and is able to analyze the local features. These characteristics make HAAR wavelets applicable for Finger vein recognition algorithm. At last, matching with database is a final decision making step to get a result from the finger vein recognition algorithm. In the matching stage two types of errors are considered

- FAR (False Acceptance Rate)
- FRR (False Rejection Rate)
- EER (Equal Error Rate)

(i) FAR (FALSE ACCEPTANCE RATE)

FRR is the rate of occurrence of a scenario in which two fingerprints from same finger fails to match (the matching score is below the threshold) while

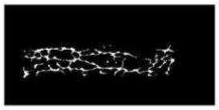
(ii) FRR (FLASE REJECTION RATE)

FAR is the rate of occurrence of a scenario in which two fingerprints from different fingers will match (matching score is greater than the threshold).

(iii) EER (EQUAL ERROR RATE)

EER is the error rate at which the FAR equals the FRR and is therefore, suitable for measuring the overall performance of biometric recognition system. Sample image and its feature extracted image are shown below.

Sample finger vein image.



Feature extracted image

Figure-3: Feature extracted image

In the verification stage, newly captured finger vein image is applied to preprocessing stages, and at last vein image is replaced with the feature extracted image. Finally that extracted image is sent to an authentication stage. This stage will match the newly feature extracted image with the database image, after matching it will create a match score of each finger vein images in the database. Depending on the match score authentication is carried out. This project implements a highly secured authentication system based on using finger vein recognition.

5.2 Feature-level fusion by FFF optimisation

Fusion at the feature level is least explored even though they are expected to provide better recognition results and much easier to compute. The matching score-level and decision-level supplies less information to be exploited for personnel authentication than the feature-extraction level. Also, the feature-level fusion carries much richer information about the raw biometric data than the matching score or decision level. This is the driving force for the proposed scheme.

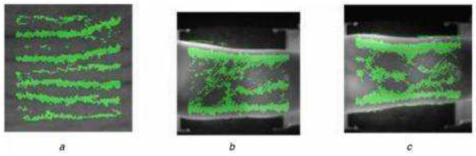


Fig.4 Vein extracted image

5.3 Recognition using layered k-SVM classifier

The extracted features of finger knuckle and finger vein are fused by the FFF optimisation. Then, the classification is performed using layered k-SVM classifier. Here, SVM classifier and k-NN classifier are combined to perform binary classification and then, N − 1 k-SVM classifiers are connected serially to perform multi-level classification. Here, SVM classifier is a binary classifier which is classified by either 0 or 1. Similarly, k-NN classifier is popular technique for data classification based on the neighbours of the input test data. The reason of selecting the k-NN classifier is that it can perform better for multi-classification because the classification is purely based on the distance between the training data and test sample. Also, SVM is preferably chosen here because of the good performance for the high dimensional data. In proposed work, we used an N number of persons for biometric recognition. Thus, recognition is done by the layered k-SVM classifier which consists of N − 1 number of classifiers.

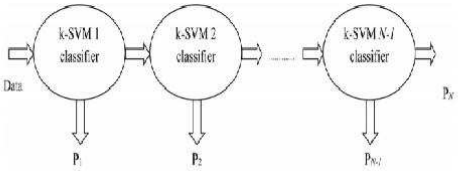
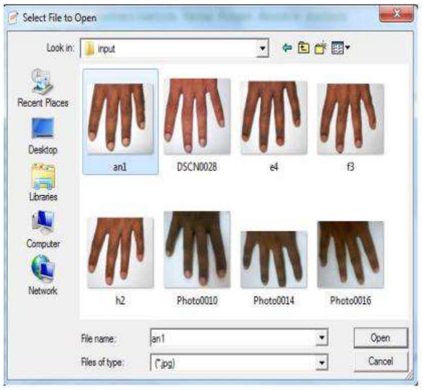


Figure-5: Architecture of layered k-SVM classifier

VI. RESULTS AND DISCUSSION

6.1 Registration Process

Select input images for registering training data, these users can only access the accounts.



File name: an1
Files of type: (*.jpg)

Figure-2: Registration process

6.2 Binary Image

After that selection the user hand converted into binary images.

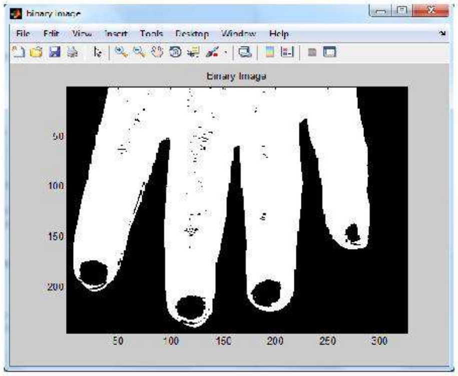


Figure-3: Binary image

6.3 Canny Edge Detection

Binary images are converted into contours images and also calculate the distance peak values from the given images, after that canny edge detection the registered finger knuckle are extracted from the training image.

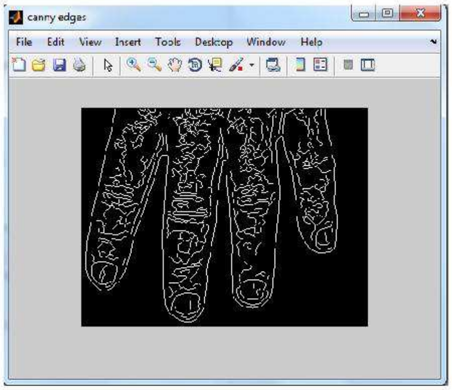


Figure-4: Canny edge detection

6.4 Knuckle Extraction

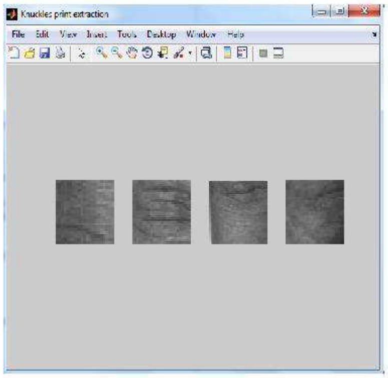
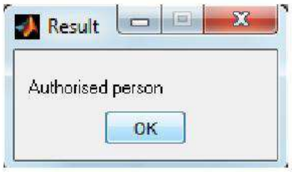


Figure-5: Knuckle extraction

Training images extracted details are stored in temporary database, given user finger as a test user finger which is processed using above methods after that getting extracted value is compared to the training data values, then only get the result user is authorized or not.

6.5 Authorization Process

Whether the results are verified using predefined training details.



Authorised person

Figure-5: Authorization process

6.6 Finger Vein Extraction Process

Represents the finger vein extracted image. Training images extracted details are stored in temporary database. Then only get the result user is authorized or not.

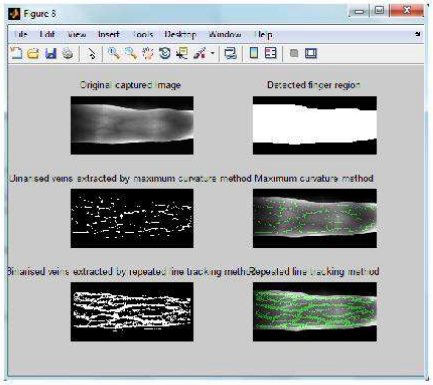


Figure-6: Finger vein extraction process

VII. CONCLUSION AND SCOPE OF FUTURE WORK

Conclusion

In this paper, a multimodal biometric recognition system based on the finger knuckle and finger vein was proposed. An important aspect of the proposed system was the development of FFF optimisation for feature-level fusion. After input images were pre-processed, the FKP was extracted from the knuckle image and vein was extracted from finger vein images using the repeated line tracking method. Then, the features were extracted from the finger knuckle and vein by applying the grid operation to the image. Subsequently, the proposed system was fused the obtained feature set with the help of weight score level, which was obtained by feature-level fusion using FFF optimisation method. Then, recognition was performed by the fused feature set using layered k-SVM classifier. The proposed system was evaluated with the existing systems and the performance was analyzed by the metrics, FAR, FRR, EER and accuracy. From the outcome, we found that the accuracy was obtained for the proposed method. In future, the proposed method can be extended to develop the different objective functions to find the optimal weight score.

Future Work

In our future work, we intend to evaluate such datasets using the proposed approaches here and also consider other biometric modalities such as palm, vein, and gait. Finally, it is important to take all the results discussed here in with a grain of salt. We are not presenting the final word in spoofing detection. In fact, there is important additional research that could finally take this research another step forward. We envision the application of deep learning representations on top of pre-processed image feature.

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An Analytical Study on the Medical Image Compression Techniques

[1]I.Sahaya Kirija [2]N.Nanthini
[1] *Full Time Research Scholar, Department Of Computer Science,*
Sakthi College Of Arts and Science for Women, Oddanchatram, India
[*] *Assistant Professor, Department Of Computer Science,*
Sakthi College Of Arts and Science for women, Oddanchatram, India

***Abstract*:An region of interesting compression algorithm of still image is introduced. The algorithm that is based on embedded block coding with optimized truncation (EBCOT) encodes the interested region of the image. According to the character of image edge, an improved canny edge detection algorithm is proposed before the wavelet transform, without the participation of automatic extraction of artificial region-of-interest (ROI) by using the dilation and erosion operation in morphology. The ROI coding algorithms is analysed. ROI information can be encoded with high priority at the same time by con structing a weighted function, giving reasonable weight for ROI code block, and reducing the wavelet coefficients effect on the context region of the ROI code block. The proposed method improves the quality of the reconstructed image of ROI. Experiments show that the reconstructed ROI image quality is significantly improved under low bit rate or high, and the reconstructed image background region (BG) quality can be also improved.**

Index Terms: ROI, Region Of interest, Embedded Block Coding

I.INTRODUCTION

Medical imaging is an evolving and growing area of research and development both in academia as well as in industry. It involves interdisciplinary research and development encompassing diverse domains. New techniques and directions are being proposed in the literature every day. The medical equipment's of today's modern era are creating huge number of high resolution images that are used by medical practitioners during analysis and diagnosis. These images while are revolutionizing the healthcare industry creates the problem of storage and transmission. For example, an image of size 512 x 512 pixels created by CT (Computed Tomography) requires about 1/4 MB of storage space, thus stressing the need for image compression algorithms. Image compression is the process of eliminating redundant data in an image in a fashion that minimizes the storage space requirement while maintaining the quality of the image. The algorithms used for this purpose are categorized as lossy and lossless, out of which lossless techniques are more popular in the medical domain. The reason behind this popularity is the need for recovering the decompressed image which is exactly the same as the original image. As healthcare professionals require accurate and clear picture, lossless techniques are not frequently used. Owing to the great demand for high compression ratio while maintaining high image quality, recently, Region of Interest (ROI) techniques have become acknowledged in medical compression. The main advantage of using ROI-based compression techniques is that it combines the usage of both lossy and lossless techniques to compress images. Here, an image is initially segmented into two regions, interested and not-interested regions. It is assumed that the Interested Region (IR) consist of the most important part that has diagnostic/medicinal important, while the Not-Interested Region (NIR) has data that are not considered vital for diagnosis purposes. During Compression, a lossless technique is used for IR while a lossy technique is used on NIR. The method used for determining the ROI in medical images is still an active research area. The method used can be either manual or automatic, both with the same aim of achieving optimal compression balance between lossy and lossless regions.

II. RELATED WORK

ROI Based Image Compression

Lossy compression techniques give better compression results with the accuracy compromised, they are used only for non crucial regions of the image. The crucial regions are compressed using lossless compression techniques. This increases the efficiency of process by retaining the accuracy of crucial region alone and the rest of the region is not given much importance on accuracy. For the industrial weld radiographic images, the modified Tsallis entropy expression gives the threshold value. Based on this threshold value, the image is divided into ROI and non-ROI. The ROI contains the details about weld part and non-ROI contains details about the rest of the part. Similarly for the medical radiographic image, the ROI contains details about bone or other diagnostically important parts (Gokturk., 2001). The non-ROI contains details about background of the image or rest of the parts.Generally, Huffman coding is used since it is lossless coding algorithm. It has many advantages like it uses small code words for high probability elements and the converse for the lesser probable elements. Applying Huffman coding in the digital image segmented using modified Tsallis entropy thresholding method satisfies the previously mentioned criteria. It compresses the region of interest effectively since the segmentation of image converts the pixels intensity at region of interest to white (1) while the other pixels into black (0). The ROI in the actualimage is identified by retaining the values of the pixel for which the values are 1 in the segmented image. The values of all other pixel are made as zero. The entire image obtained after this process is compressed using the Huffman compression.These steps constitute the compression part which completes by transmitting the compressed image to the required destination. Along with the compressed image the corresponding dictionary and some other important details like the size of image data at various stages that will be used for decompression or extraction. The transmission of compressed image has advantages like reduced bandwidth requirements, high speed and therefore low time. Also, security is increased since the compressed data is not meaningful if viewed by any third party without properdecoder. The other side receives these details and reconstructs the image using the same Huffman coding and the dictionary. The resulting image is of the same details at the region of interest i.e. crucial regions but varies at other non-crucial areas.

III.METHODOLOGY

Automatic image segmentation techniques can be classified into four categories, namely, (1) Clustering Methods, (2) Thresholding Methods, (3) Edge-Detection Methods, and (4) Region-Based Methods.

1. Clustering Methods

Clustering is a process whereby a data set (pixels) is replaced by cluster; pixels may belong together because of the same color, texture etc. There are two natural algorithms for clustering: divisive clustering and agglomerative clustering. The difficulty in using either of the methods directly is that there are lots of pixels in an image. Also, the methods are not explicit about the objective function that is being optimized. An alternative approach is to write down an objective function and then build an algorithm. The K-means algorithm is an iterative technique that is used to partition an image into K clusters, where each pixel in the image is assigned to the cluster that minimizes the variance between the pixel and the cluster center and is based on pixel color, intensity, texture, and location, or a weighted combination of these factors. This algorithm is guaranteed to converge, but it may not return the optimal solution. The quality of the solution depends on the initial set of clusters and the value of K .

2. Thresholding Methods

Thresholding is the operation of converting a multilevel image into a binary image i.e., it assigns the value of 0 (background) or 1 (objects or foreground) to each pixel of an image based on a comparison with some threshold value T (intensity or color value). When T is constant, the approach is called global thresholding; otherwise, it is called local thresholding. Global thresholding methods can fail when the background illumination is uneven. Multiple thresholds are used to compensate for uneven illumination. Threshold selection is typically done interactively.

3. Edge Detection Methods

Edge detection methods locate the pixels in the image that correspond to the edges of the objects seen in the image. The result is a binary image with the detected edge pixels. Common algorithms used are Sobel, Prewitt, Robert, Canny and Laplacian operators. These algorithms are suitable for images that are simple and noise free; and will often produce missing edges, or extra edges on complex and noisy images.

4. Region-Based Methods

The goal of region-based segmentation is to use image characteristics to map individual pixels in an input image to sets of pixels called regions that might correspond to an object or a meaningful part of one. The various techniques are: Local techniques, Global techniques and Splitting and merging techniques. The effectiveness of region growing algorithms depends on the application area and the input image. If the image is sufficiently simple, simple local techniques can be effective. However, on difficult scenes, even the most sophisticated techniques may not produce a satisfactory segmentation. Edge-based techniques are based on the assumption that pixel values change rapidly at the edge between two regions Operators such as Sobel or Roberts operators can be used to detect the edges. And some post procedures such as edge tracking, gap filling can be used to generate closed curves. Regionbased techniques are based on the assumption that adjacent pixels in the same region should be consistent in some properties. Namely, they may have similar characteristic such as grey value, color value or texture. The deformable models are based on curves or surfaces defined within an image that moves due to the influence of certain forces. And the global optimization approaches use a global criterion when segmenting the image.

IV. CONCLUSION

In this paper, a various methods of palm selection andextraction of ROI are discussed. ROI segmentation of palm is to automatically and reliably segment a small region from the captured palm image, it is very important step of palm print recognition because it greatly influences the accuracy and processing speed of the system. All various methods of extraction of ROI are useful by considering various constraints provide very good and accurate results.

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