

## Game Theory Based Security Approach in Wireless Sensor Network

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**Abstract**— Wireless sensor networks have gone through a lot of changes in recent years. Secrecy in data transmission and network standby time are a major concern in communication. Currently, DSR algorithm is used for transmission of data between nodes. The algorithm determines the path for data to be transmitted to the destination node. Once the path is determined, all data are transmitted through the path. This method of data transmission drains the battery of the nodes quickly when the nodes are stationary. All the data are transmitted in a single stretch through the data path selected. When someone gains access to this path, all the data can be collected, and the entire network is compromised. A theory is implemented for eliminating this game. The data path is selected such that the battery level of all the nodes is effectively used. The data are split and transmitted using more than one path for enhancing data security.

**Keywords**— Network Life Time, Data Encryption, Game Theory.

### I. INTRODUCTION

Wireless sensor network is implemented in all areas for collection of data. Data security and network lifetime are the vital parameters when it comes to selecting the algorithm for a particular application. DSR algorithm is currently used for transmission of data between the nodes. The algorithm works such that without any consideration to node's battery level the shortest path is selected to transmit data between the nodes. This is a major problem when the nodes are stationary. This is so because the shortest path in stationary nodes will be the same until a node in the middle goes off. This continued transmission will not efficiently use the energy level of all the nodes in the network. So, game theory is introduced for this purpose. An aloof, remote sensor arranges in the light of the Surface Acoustic Wave (SAW) resonators. The sensor hub comprises the SAW sensor that is little, light, solid, steady, delicate, remote and aloof, making the battery unnecessary, and its life-range is unending. The sink hub accumulates information from the sensor hubs, forms the information with clever calculations and transmits the required information to the system opportune outside. The essential structure and the acknowledgment of the inactive remote sensor system are expounded. The five fundamental qualities of the detached, remote sensor arranges are inactive sensor hubs, basic and little sensor hubs, sorted out sensor hubs, wise sink hubs, high security, great extendibility, with solid classification. Uniquely, the key methods in our examination, for example, coding and deciphering systems of the sensor hub, signal recurrence

estimation procedures of the sensor hub, keen flag preparing strategies, estimation blunder remuneration systems, and system security systems, from the subject matter of an extensive and through discussion. At last, we call attention to the issues at present and figure the application prospect and research heading later on [1].

Remote sensor organizes hubs arrangement enhancement issue is examined with the remote sensor hubs organization deciding its ability and lifetime. A heterogeneous remote sensor organizes hubs organization calculation taking into account the apparent likelihood show going for the heterogeneous remote sensor arrange hubs which are arbitrary conveyed is composed in this article. The apparent likelihood model is utilized to ascertain the apparent likelihood in the zone around the heterogeneous remote sensor hubs and change virtual drive calculation. The calculation moves the heterogeneous remote sensor hubs to the low saw likelihood range and accomplishes the greatest scope of the checking zone. The reproduction that comes about demonstrates the accomplishment of this organization calculation in the objective of the hubs sensible dissemination with enhancing the system scope impact and decreasing the hubs development removing and augmenting the lifetime of heterogeneous remote sensor arrange later [2].

### II. RELATED WORK

The proposed remote sensor framework, which comprises various leveled sensor organization and an application

system, empowers the use of pervasive processing. The progressive sensor organizes 1) a sensor system, where groups of sensor hubs impart using IEEE 802.15.4 to a sink hub 2) a hand-off system, comprising of Wideband Relay Nodes (WRNs). The WRNs go about as IEEE 802.11 b/g. The applications arrange utilizes the same radio channel as the hand-off system. This paper portrays the analyzes and re-enactments of the remote sensor framework. We suggest that IEEE 802.15.4 and IEEE 802.11 b/g utilize the same direct in the 2.4 GHz band, and, propose controlling activity of IEEE 802.11b/g later, changing IEEE 802.11 b/g MAC convention keeping in mind the end goal to forestall inter-channel impedance between IEEE 802.15.4 and IEEE 802.11 b/g. Our tests and re-enactments demonstrate the capability of two distinctive system frameworks working in the same recurrence channel: the progressive sensor arranges, and the application organizes [3].

The vitality of sensor hubs is a rare asset in remote sensor organizes. It is indispensable for reducing the vitality utilization to enhance the lifetime of remote sensor organizes. A capable approach to enhance lifetime is to segment sensor arrange into gatherings called bunch with high vitality hub going about as pioneer of the group called bunch head. Bunch head is in charge of overseeing intra-group and entomb group correspondence. The vitality level of group head at a given purpose of time decides the life of bunch and in this way entire sensor organizes. Disappointment in the bunch head conveys group correspondence to the end and may require re-grouping for getting sensor organizes back on track. These exercises include extra vitality use and, at last, have an extraordinary effect on the lifetime of the sensor system in the entirety. This paper proposes to have a group of bunch heads inside of the group of sensor hubs for adjusting the vitality utilization among the bunch heads. Given a minute, one bunch head goes about as ace of the given group and the ace ship is pivoted among group heads after the indicated number of adjusts of correspondence. This enhances the vitality use of sensor system, augments the system lifetime and makes the remote sensor organize blame tolerant to some degree [4].

Appropriate data deduction in remote sensor systems is of great significance for some true applications in which graphical display of a sent remote sensor system is the key. One basic issue confronted today is the way to take in the graphical model parameters of a sent sensor arrange as proficiently as could be expected under the circumstances since it is normally costly or even difficult to gather a lot of preparing information in a conveyed remote sensor organize given the asset limitations of modest remote bits. This paper endeavors to address this issue. We propose a novel portion based approach in graphical model learning for remote sensor systems to minimize the number of preparing tests of genuine sensor information required. We indicate the

proposed approach by reproductions utilizing true remote sensor organize information. Our outcomes demonstrate the probability of the proposed part based learning approach significantly diminishing the volume of preparing information required for building a Markov arbitrary field model of the sensor organize in contrast with the conventional learning approach without influencing the developed model's execution in conveyed data deduction [5].

Information security in remote sensor arranges incorporation of information validness, information privacy, and information accessibility. Giving attractive information security in remote sensor systems is a testing process since remote sensor arranges comprise a huge number of sensor hubs that are for the most part put in antagonistic or unattended situations which might be presented to a few assaults. Assaults incorporate Denial of administration assaults, due to hub trade off for example, particular sending assaults and report interruption assaults. The existing security outlines give just jump bounce security, and this jump bounces security functions admirably while expecting a uniform remote correspondence design. Hub to sink correspondence is the prevailing correspondence design in remote sensor systems and bounce jump security plan is not adequate in view of its presentation to a few assaults due to hub trade off. In the proposed work, mystery keys are bound to geographic areas and every hub store keys taking their area into account. This area mindful property confines the effect of traded off hubs without influencing end-end security. Secret keys are produced taking into account their area and utilizing RSA calculation encryption, while decoding is finished information classification. The proposed multifunctional key administration system guarantees both hub to-sink and hub-to-hub validation along the report sending courses. Additionally, the proposed information conveyance approach ensures effective in transit false information sifting and is exceptionally hearty against DoS assaults. The assessment shows that the proposed plan is profoundly strong against an expanding number of traded off hubs and compelling in vitality investment funds [6].

Remote sensor systems are another sort of organized frameworks, described by seriously obliged computational and vitality assets, and a specially appointed operational environment. Since sensor systems may collaborate with delicate information and work in threatening unattended situations, it is basic that these security concerns be tended to form the earliest starting point of the framework outline. Be that as it may, security in sensor arranges postures diverse difficulties than conventional system security due to natural asset and processing requirements. There is presently huge research potential in the field of remote sensor arrange security. In this paper, we present a message expansion issue which can be settled by an information interface layer security design called dasiaCipher-content Stealing

methods for remote sensor arrangements. Customary security conventions have a tendency to be traditionalist in their security ensures, regularly including 16-32 bytes of overhead. With little recollections, powerless processors, restricted vitality, and 30-byte parcels, sensor arrangements cannot manage the cost of this extravagance. TinySec addresses these amazing asset imperatives with a cautious outline. We investigate the tradeoffs among various cryptographic primitives and utilize the innate sensor organize impediments further bolstering our good fortune while picking parameters for locating a sweet spot for security, parcel overhead, and asset necessities [7].

The measure of information transmission has turned into a critical issue in WSN. The innovation of compressive detecting (CS) in sensor organizes new thought for information gathering and target restriction as research regions in sensor arrangements. Compressive Sensing (CS) minimizes the quantity of information transmissions and adjusts the movement stack all through systems. After all, by utilizing immaculate compressive detecting, the aggregate number of transmissions for information gathering is still high. Cross breed strategy for Compressive Sensing (CS) is utilized for minimizing the quality of transmission in sensor organizes. Further to give information pressure in WSN a light weight Enhanced Lossless Entropy Compression (LEC) calculation is utilized for abridging the size of information in the Sensor Network. Security is the significant issue in the Sensor Network and identity SET-IBS convention is utilized for making the information secure and for efficient transmission. It is a light weight calculation which consumes less vitality while scrambling and unscrambling the information. This encryption takes less vitality and it is useful to make the WSN proficient along these lines. In this anticipate the fundamental center is on the improvement of vitality as far as lightweight security and pressure procedures which diminish the multifaceted nature of Wireless Sensor Network the Advance SET-IBS convention for encoding the information on the sensor hub is proposed [8].

Remote sensor organizes (WSN) comprises independent sensor hubs appended to one or base stations. One of the primary objectives of remote sensor systems is to convey dependable data starting with one hub then onto the next hub in a system. As Wireless sensor organizes keep on developing, they get to be helpless against assaults and consequently the requirement for powerful security instruments. Distinguishing proof of suitable cryptography for remote sensor systems is a vital test due to restriction in vitality, calculation ability and capacity assets of the sensor hubs. In this paper we have executed Encryption calculation AES (Advanced Encryption Standard) to give adequate levels of security to ensuring the secrecy of the information in the WSN arrange [9].

Remote Sensor Networks have been a noteworthy region in the exploration of Security Authentication and the Data Access Control. This paper exhibits a conveyed information meant to control conspire fine-grained get to control over sensor information which is safe against solid assaults, for example, sensor trade off and client plotting. Here another security component is proposed in the characterized grouping construction which incorporates base station, bunch heads, and the sensor hubs. The information is transmitted utilizing the group head rather than direct transmission from individual sensor hubs to the base station and in this way, the vitality rationed for the sensor hubs are abundantly decreased preparing for long time information transmission. Disseminated Cluster Heads and Base station are composed utilizing the NS2 Simulation Environment. The proposed conspire misuses an Advanced Encryption Standard (AES) with CCMP (CBC-MAC), which ad libs, adjusts and balances out the WSNs as for both execution and security necessities. This paper gives understanding and change to acknowledge circulated fine-grained information get to control in grouped environment and the symmetric encoded systems utilizing AES with CCMP [10].

### III. METHODOLOGY

Game theory is used for selecting the optimal path for data transmission. This optimal path is determined by the battery level of all nodes in the network. Data security is also addressed in the game theory. The optimal path is selected ensuring collection of the battery level of all nodes, and the data is transmitted through nodes that have more energy in the network. This method improves the network life of the entire network. To enhance data security, the data's are not only transmitted by a single path. Instead, the entire data block is split into blocks. More than one data path is determined, and each block is transmitted through a different data path. If a hacker gains access to a particular data path, only the block of data is accessible. By monitoring the unusual activity in the network traffic, the compromised nature or otherwise of the node can be determined. The network life time and data security are enhanced through the use of the game theory.

### IV. RESULTS AND DISCUSSION

The algorithm is implemented in network simulator (ns2) for validating the effects of the game theory. Initially the nodes are created as shown in Figure 1.

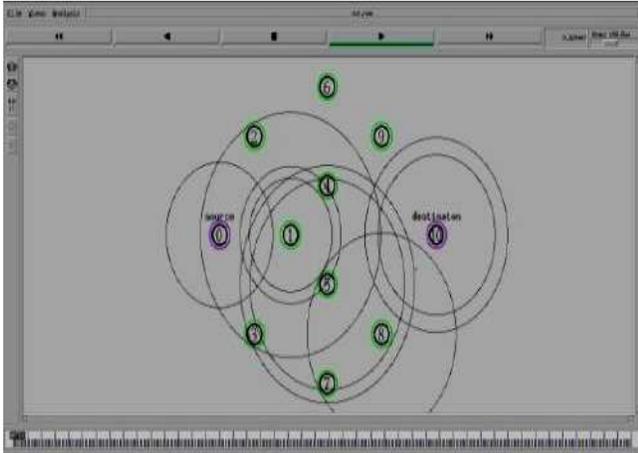


Figure 1. Node creation

The data transmission is started between nodes. The optimal data paths are selected, and each block of data is transmitted between nodes. The throughput and network life time of the entire network are increased through implementation of this algorithm compared to the network which works on DSR algorithm.

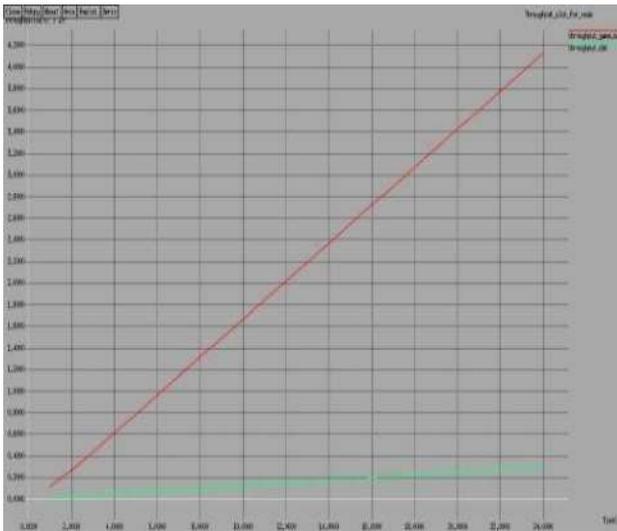


Figure 2. Throughput

Figure 2 shows the comparison of throughput between the networks working on the different algorithm.

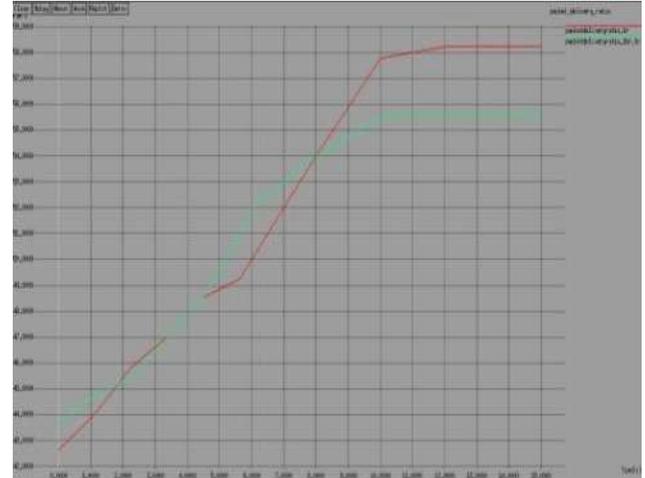


Figure 3. Packet Delivery Ratio

The packet delivery ratio of the network working under game theory algorithm is more than that compared to network working under DSR algorithm.

## V. CONCLUSION

The main conclusions of the study may be presented in the above discussion clearly shows that game theory algorithm utilizes the energy in the network effectively more than DSR algorithm. Secrecy in data transmission is also more compared to DSR algorithm. The proposed method is implemented on ns2 to validate our claim.

## REFERENCES

- [1] Xiangwen Zhang; Fei-Yue Wang "Key Technologies of Passive Wireless Sensor Networks Based on Surface Acoustic Wave Resonators". Networking, Sensing and Control, IEEE International Conference (ICNSC) on 6-8 April 2008, pp. 1253 – 1258.
- [2] Shi-Wei Li; Dong-Qian Ma; Qiang-Yi Li ; Ju-Wei Zhang; X. Zhang "Nodes deployment algorithm based on perceived probability of heterogeneous wireless network". International Conference on Advanced Mechatronic Systems (ICAMEchS), 25 – 27 Sept. 2013 pp: 374 – 378.
- [3] Keisuke Nakatsuka, Kenzo Nakamura, Yuichi Hirata, Takeshi Hattori "A Proposal of the Co-existence MAC of IEEE 802.11b/g and 802.15.4 used for The Wireless Sensor Network" 5<sup>th</sup> IEEE Conference on EXCO, Daegu, Korea October 22-25, 2006.
- [4] Vaibhav V. Deshpande; Arvind R. Bhagat Patil "Energy efficient clustering in Wireless Sensor Network using Cluster of Cluster heads", Wireless and Optical Communication Networks (WOCN), 2013, Tenth International IEEE Conference on 26 – 28 July 2013, pp: 1 – 5.
- [5] Wei. Zhao; Yao. Liang "Kernel-based Markov random fields learning for wireless sensor networks", Local Computer Networks (LCN) IEEE 36<sup>th</sup> Conference on 4 -7 Oct 2011, pp: 155 – 158.

- [6] M. Jeyalakshmi “*Location aware end-end data security using Mac for secured wireless sensor networks*”. International Conference on Advances in Engineering, Science, and Management (ICAESM), 2012.
- [7] Md. Anisur Rahman, Mitu Kumar Debnath “*An energy-efficient data security system for Wireless Sensor Network*”, 11<sup>th</sup> International IEEE Conference on Computer and Information Technology, (ICCIT) 24 – 27 Dec. 2008, pp: 381 – 386.
- [8] Akshay S. Nagdive, Piyush K. Ingole “*An implementation of energy efficient data compression & security mechanism in clustered Wireless Sensor Network*”, International IEEE Conference on Advances in Computer Engineering and Applications (ICACEA), 19 – 20 March 2015, pp: 375 – 380.
- [9] M. Panda “*Data Security in Wireless Sensor Networks via AES algorithm*”. IEEE 9th International Conference on Intelligent Systems and Control (ISCO), 9 – 10 Jan. 2015, pp: 1 – 5.
- [10] R. Velayutham, J. Mary Suganya “*Security Authentication through AES and fine-grained distributed Data Access Control using Clustering in Wireless Sensor Networks*”. Third International Conference on Computing Communication and Networking Technologies, 26 – 28 July 2012, pp: 1- 6.

### Authors Profile

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# A NOVEL GAME THEORY SCHEME TO EGEST LARCENY IN COCKROACH TOPOLOGY WIRELESS SENSOR NETWORK

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## ABSTRACT

Wireless Sensor Network (WSN) deploys for remote monitoring applications namely healthcare monitoring, finance and military. The nature of WSN in certain application makes it impossible to inspect and repair the nodes physically at certain times. In such cases, an unwanted user can associate to the node and retrieve crucial information. Moreover, conventional routing mechanism include Dynamic Source Routing (DSR) scheme to transmit data to destination. In DST routing scheme the whole data shift from one node to other node. The routing mechanism pose a disadvantage when network deal with confidential data. We propose, a Game theory routing scheme to forward data to destination with secrecy. The objective is to transmit data to destination under compromised node condition, without sacrificing network parameters namely throughput, network lifetime, end to end delay and packet delivery ratio. The proposed routing scheme is simulated and the same implement in hardware for comparative analysis and validation.

**Keywords:** wireless sensor networks, game theory, energy efficient, DSR.

## 1. INTRODUCTION

Wireless sensor network is more beneficial compared to wired networks in terms of coverage region, mobility and installation cost. Wireless sensor network can save cost up to 90% compared to wired networks. Recent trends in IOT (Internet of Things) show improved demand for wireless devices due to its mobility and ease of use. Wireless sensor network employ for applications such as remote health care monitoring, military and financial applications. In such applications, data security is crucial and all data's in transmission medium should be kept confidential. Researchers devise new routing scheme and cryptographic techniques to improve data secrecy in transmission medium. Often, the objective attain by sacrificing network parameters such as throughput, end-to-end delay and energy consumption. In particular, conventional routing scheme such as Dynamic Source Routing (DSR) routing scheme forwards whole data from one node to other node until the data reaches destination.

The DSR routing scheme increases data latency and decreases efficiency [1]. Furthermore, Collection Tree Protocol (CTP) gathers information from all the nodes in the network. The CTP algorithm has load-balancing problem due to selection of parent node with optimum link quality. The CTP algorithm raises delay in the network [2].

The Back Collection Protocol (BCP) creates more delay compared to CTP. In BCP protocol the data forward only after computation of link weightage. The weightage computation for each packet leads to more delay in network [3]. The delay incur due to computation, minimize with SPIN routing method. In SPIN method, node forwards data only to nodes interested in data. Moreover, the sender node sends ADV descriptor about the data to surrounding nodes. Receiver nodes on receiving the descriptor, request for the data from the sender node [4]. The process increases network traffic. Directed diffusion routing scheme reduces network traffic

by collecting sensor data from nodes on demand. The sensor data comprises of attribute values. The sink node with the data pair, queries the sensor nodes. The sink node lifetime drain proportionally to number of sensor nodes [5]. However, clustering hierarchy with LEACH improves network lifetime of sink nodes. In LEACH the nodes in a cluster take turns as cluster head. The random rotation of node as cluster head improves energy balancing in network. The selection of cluster head decide by node at intervals without communication with other nodes to minimize overhead [6]. In addition, TEEN protocol (Threshold Sensitive Energy Efficient Sensor Network Protocol) built with hierarchical cluster architecture. In TEEN protocol, nodes closet to each other form clusters. The clusters form up to coverage region of base station. The cluster head has two threshold namely hard threshold and soft threshold for data transfer [7].

## 2. RELATED WORK

SDF (Semi-Directional Flooding) based AODV (Ad hoc On-Demand Distance Vector) routing algorithm reduce route overhead in network. The route overheads in network reduce by semi directional flooding. The flooding mechanism has no knowledge of location of nodes in network [8]. Oppcode use opportunistic flooding method. The flooding method involves nodes transmitting multiple data packets to other nodes instead of single packet. Moreover, the flooding concept improves transmission overhead and data reliability [9]. The coarse industrial environment affects reliable data communication in wireless sensor network. The reliable data communication establish with CDRRP (critical data reliable routing protocol). The protocol route data with respect to constraints namely deadline time and data type. Selection of appropriate relay node to transfer data depends on the parameters. Moreover, relay nodes fast forward critical data in network compared to normal data [10]. Dynamic Clustering approach improves energy efficiency in cluster



based wireless sensor network. In cluster based, network the nodes in the network take turns to become cluster head. The rotation of cluster head balances energy consumption of nodes in network. The combination of clustering and multi hop routing protocol forms JCR protocol. The JCR protocol enhances network lifetime by limiting hops in neighboring nodes [11]. Data from sensors employed in industries have time validity. The data from the sensors should reach control centre within a specified time interval. The data forwarded by node depends on deadline time and distance to the end node. Moreover the real time routing protocol improve packet reception before deadline [12]. Data transmission by scheduling process implement in wireless sensor network. The scheduling methods improve data reliability and delivering data before deadline [13]. A routing protocol based on two hop neighbor information delivers data to forwarding nodes in network. The approach improves end to end data reception while improving network lifetime [14]. The QOS routing protocol selects paths, which minimizes energy consumption. Moreover, genetic algorithm in combination with QOS routing determine appropriate path for data forwarding. The approach improves network life time over all nodes in network [15]. The above-described routing schemes rely on entire data packet transmission from one node to the adjacent node in routing path. The routing path use repeatedly till energy of all nodes utilize completely. Furthermore, in data critical applications such as banking and military if any one of the node in transmission medium is compromised then all data flowing in the routing path is at risk. Hence, a game theory routing scheme implement to improve data security and occurrence of first dead node in network. Furthermore, the routing scheme utilizes energy of all nodes in the network uniformly unlike conventional DSR routing protocol.

### 3. METHODOLOGY

The influence of wireless technologies is growing faster than ever before with improvements in fast processing controllers and improved coverage region of wireless modules amidst noise. The energy efficiency and data security play a vital role in wireless sensor network especially in applications such as health care and finance. We propose, a bio inspired cockroach topology and game theory routing scheme to secure data transmission and improve network lifetime. In conventional topologies the data's are transferred completely from source to destination through interconnected nodes. If a hacker gain access to one of interconnected nodes the entire data in network is compromised. In addition, the complete data transfer between nodes reduces battery of node considerably. The Proposed algorithm working explains with node scenario as in Figure-1. The network model considered node frame with parameters is tabulated in Table-1.

**Table-1.** Simulation parameter.

Parameter	Description
Wireless Channel Propagation	channel type
Propagation/Two Ray Ground Network Interface	radio-propagation model
Phy/Wireless Phy	network interface type
Mac/802_11	MAC type
Queue/DropTail / PriQueue	interface queue type
Queue length	500 bits
Number of Nodes	50
Link layer type	LL
Antenna model	Antenna / Omni Antenna
Max packet in if q	50
Number of mobile nodes	71
Routing protocol	DSR
X dimension of topography	1000
Y dimension of topography	1000
Time of simulation end	45.0s
initial energy	100J
packet size	100 bits

#### 3.1 Algorithm

- Step 1:** Create source and destination nodes.  
**Step 2:** Route data's between source and destination nodes by game theory.  
**Step 3:** Main transmitter node (n0) transmits send signal to nodes closer (n2, n3) to it.  
**Step 4:** Up on reception of acknowledgement signal from nodes n2, n3 main transmitter node splits entire data into to half.  
**Step 5:** First half of data is sent to node n2. The second half of data sent to node n3.  
**Step 6:** The nodes n2 and n3 looks for nodes closer to it to transfer data. The process repeats itself until the data reaches destination.  
**Step 7:** The data accumulates at the destination node n9.  
**Step 8:** The destination node combines all data to form original data.

#### 3.2 Pseudo code

Transmitter side

- Sender node scan for neighbor node.
- If more than one neighbor node detect  
Split data evenly based on number of node  
Transfer data packets
- else  
send complete packet to neighbor node.

**Receiver side**

- check destination ID of received packet
- if destination id == node id  
collect data packet and start process
- else  
merge all the received packet
- if duplicate packet == True  
drop packet.

**Route identification**

- Multipath DSR routing protocol is used
- If more than one routing path is found  
Apply game parameters
- Else  
Check for alternate path.

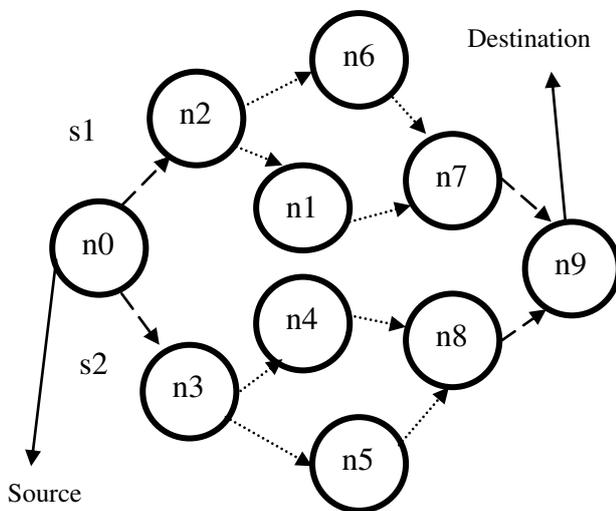


Figure-1. Cockroach Topology.

In Cockroach topology as in Figure-1 the entire data 's' are split into fragments 's1' and 's2' by the source node. The source node then transmit receive request signal to nodes n2 and n3. If node n0 receives acknowledgement from n2 and n3 then the node n0 splits the data 's' into 's1', 's2' and transfers data to nodes n2 and n3 (as in figure). The node n2 further splits the data and transfers data to nodes 'n6' and 'n1' as shown in figure. The process repeats itself till the nodes reach the destination node 'n10'. In destination node the data fragments converge to form entire data. The routing mechanism maintains data security under compromised node scenario. The routing mechanism consumes entire network energy uniformly unlike conventional routing schemes. In conventional routing schemes the data path is fixed. The fixed data path energy drains quickly compared to other nodes in network.

**3.3 Network simulation tool**

Subsequent to the installation of NS2, it is used for evaluate and simulate work apart from other tools used. The Network Simulator is an Object Oriented Simulator, and it can be written in C++ language. The development of NS2 codes are done by using both OTcl

(Object oriented extension of Tool Command Language) and C++. Trace Graph is an essential part for displaying a result, so we plot a graph to show a various result comparison with packets, throughput, delivery ratio, network delay and energy efficiency etc. The results are achieved by using Xgraph tool. The proposed and existing methods are compared through the graphs generated. The network is designed using a Network Simulator (ns2) and parameters like throughput, packet loss ratio, packet delivery ratio, an end to end delay are calculated.

The proposed routing scheme implement in NS-2 (Network Simulator) to evaluate game theory routing scheme effectiveness. The network performance evaluate in terms of network parameters namely, throughput, network life time, packet delivery ratio and end to end delay. The nodes in network simulate with DSR scheme and proposed Game theory routing scheme. Figure-2 shows the comparison of throughput for DSR and Game theory routing scheme. It is observed from graph, the through put of game theory linearly high compared to DSR algorithm. The packet delivery ratio express in terms of Kbps.

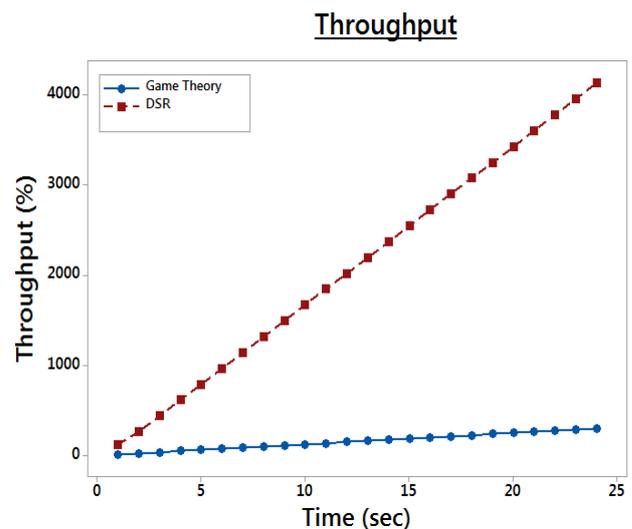


Figure-2. Throughput.

Packet delivery ratio defined as ratio of packets successfully delivered to destination with respect to number of data transmitted.

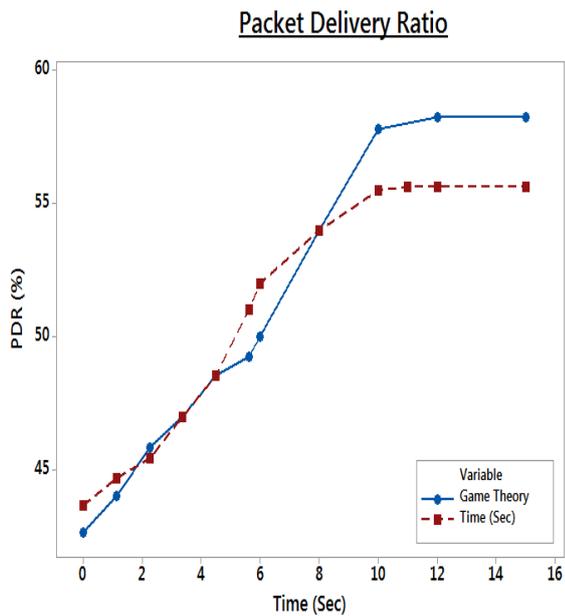


Figure-3. Packet delivery ratios.

Figure-3 shows the comparison of packet delivery ratio for Game theory routing and DSR routing. The graph plot with number of packets on y-axis and time on x-axis. The number of packets transmission starts from the origin. As the time increases the number of data transmitted also increases. The packet delivery ratio for Game theory routing scheme is comparatively high compared to DSR routing scheme.

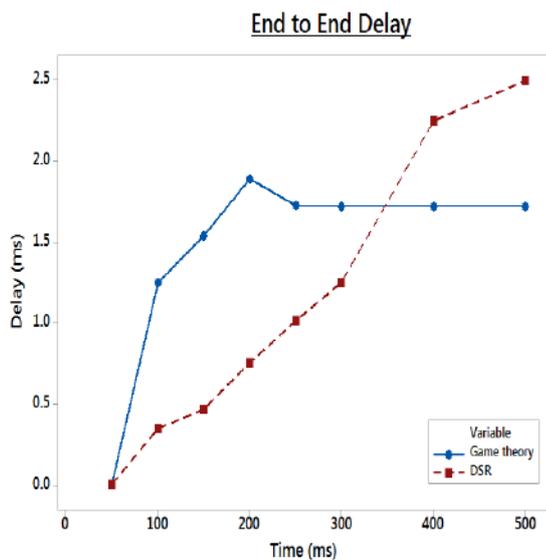


Figure-4. End to end delays.

The Figure-4 show end to end delay defines by time consumed for data to travel from source to destination. The figure show end to end delay for game theory and DSR routing scheme. The graph is conclusive evidence that end to end delay for Game theory routing scheme is low compared to DSR routing scheme.

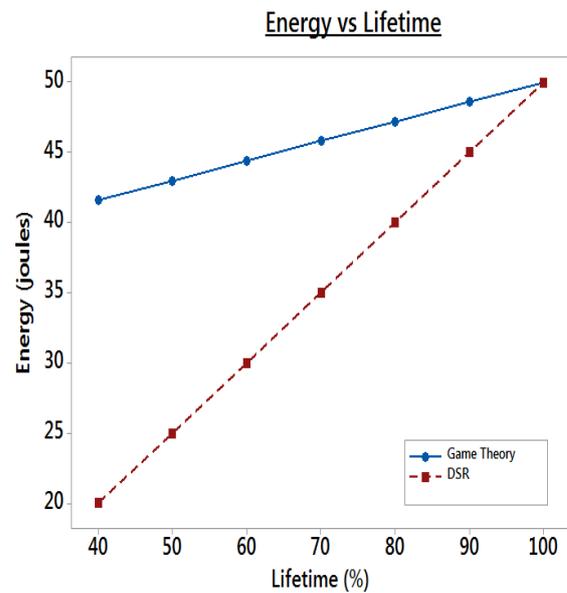


Figure-5. Life time of network.

The Figure-5 shows the lifetime of network and energy consumption. The graph plotted with available energy in node.

### 3.4 Hardware implementation

The Game theory routing scheme implement in hardware to validate proposed system effectiveness. The nodes in network include PIC microcontroller and tarang zigbee module. The nodes are powered by non-rechargeable battery. The nodes are powered by non-rechargeable battery. The microcontroller in each node performs routing mechanism. The tarang zigbee module transfers data from microcontroller in wireless medium. The data from PIC microcontroller sent to tarang zigbee module by serial interface. Figure-6 shows hardware description of a node.

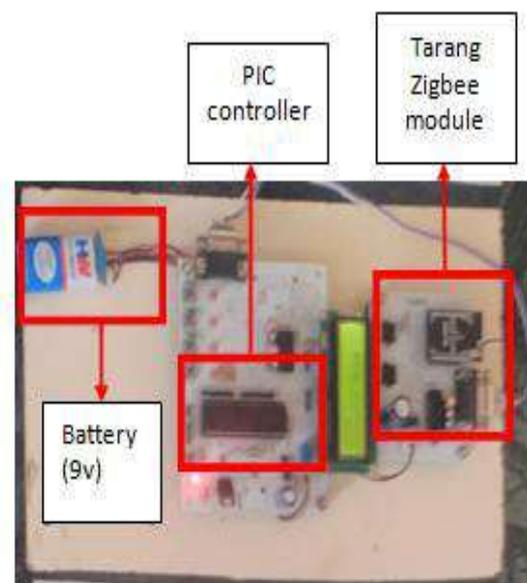


Figure-6. Hardware description of a node.



The game theory routing mechanism implement in hardware to validate proposed system effectiveness. The performance of game theory evaluate in terms of throughput, network life time, packet delivery ratio and end to end delay. The hardware results lag the simulation results by a slender margin. Figure-7 shows the implemented hardware.

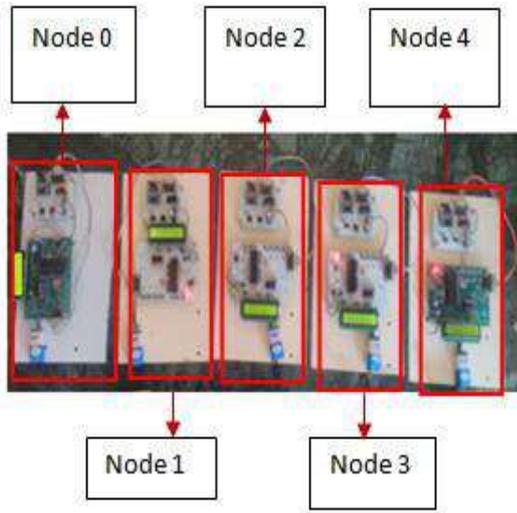


Figure-7. Hardware implementation.

manually connected to an external controller to receive data. The data from node 5 varied each time a data frame received form node0. The data had variations without pattern at the compromised node. Moreover, the data routing and splitting vary dynamically with change in location of nodes.

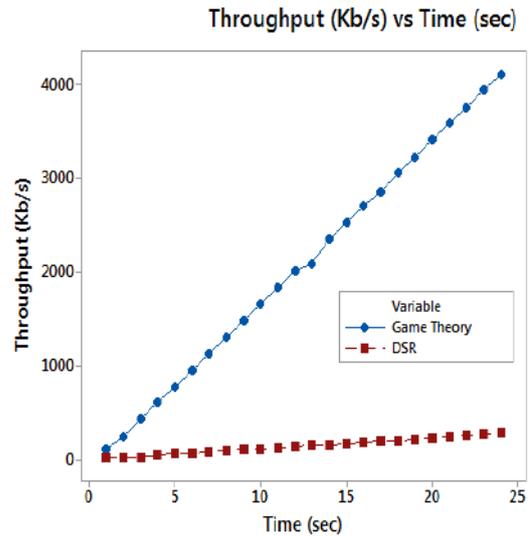


Figure-8. Throughput.

Table-2. Power consumption and time.

Node	Battery level		Tx power consumed (mv)	Data reception time (ms)
	Before Tx (volt)	After Tx (volt)		
n0	9	8.31	0.699	-
n2	9	8.63	0.376	10
n3	9	8.66	0.348	9.76
n6	9	8.81	0.19	17.82
n1	9	8.759	0.241	17.51
n4	9	8.754	0.246	16.82
n5	9	8.782	0.218	16.54
n7	9	8.579	0.421	19.81
n8	9	8.614	0.386	19.24
n9	9	8.156	0.844	26

In Table-2 shows the power consumption and time at which the data is received by nodes. In the initial stage node, n0 consumes more power due to large data. The data transfers to node n2 and n3. The nodes process half the data compared to node n0. The nodes show similar power consumption with minimal variations. The data split further for nodes n6 and n1. The analysis shows power consumption varies with respect to quantity of data being handled. To validate proposed system effectiveness under node compromised condition, one of nodes n5 was

Figure-8 show throughput of network implemented on hardware. The comparative analysis of algorithm shows, increased throughput for game theory algorithm. The throughput increases linearly with slight deviations. The deviations occur due to data parsing by the nodes.

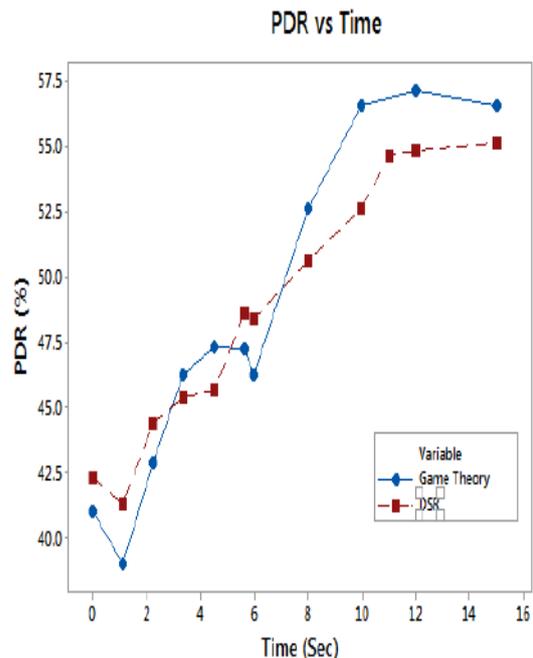


Figure-9. Packet delivery ratio.



The node data reception time vary with respect to routing scheme and surrounding environment.

$$\lambda = P_{on} \lambda_j \tag{1}$$

$\lambda$  denotes data reception rate. The arrival of data is given by  $\lambda_j$ . The probability of data reception of node is given by  $P_{on}$ . The data reception rate for Game theory algorithm is given by equation.

$$C_{aj}^{r2} = c_{aj}^2 + k\lambda_j \tag{2}$$

$$P_{on} = \frac{\beta}{\alpha + \beta} \tag{3}$$

$$k = \frac{\alpha(v_{on}\alpha^2 + v_{off}\beta^2)}{(\alpha + \beta)^2} \tag{4}$$

Game theory has improved packet delivery ratio as shown in figure 9 with oodles variations. The packet delivery dips at one point since the node takes more time interval to dissever the data. The data then route through nodes to reach the destination.

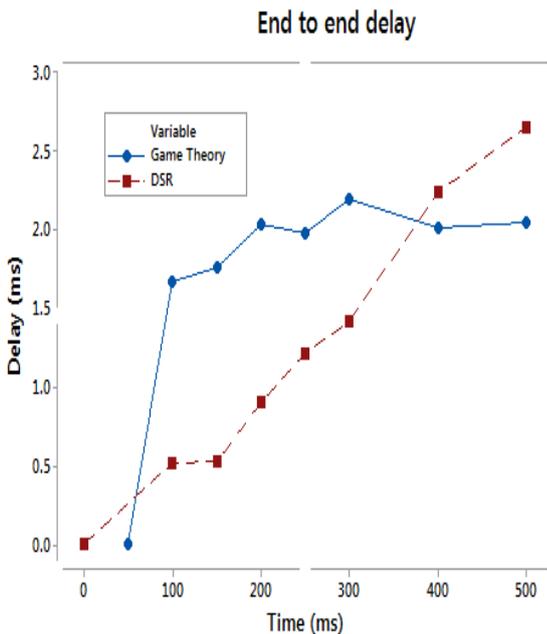


Figure-10. End to end delay.

$$\text{Min} \sum_{i=1}^n \|\tilde{n}_i - n_i\| \tag{5}$$

Where  $n_i$  is position of nodes  $\|\tilde{n}_i - n_i\|$  represents distance between nodes. Compared to the simulation results in figure 10 and figure 11 the end-to-end

delay is increased. The delay is increased due to increased controller execution time.

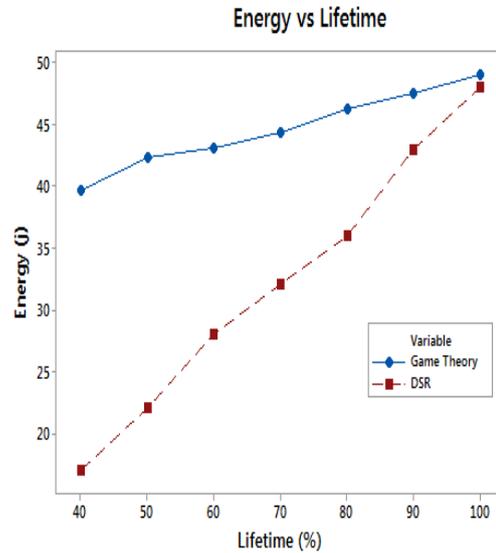


Figure-11. Network life time.

Let battery power of node represent by  $P_i, i = 1, \dots, N$ . Where,

$i$  - Initial energy

$D_{Rt}$  - Data Routed by the nodes. The lifetime of the network determined by,

$$P_1 = P_1 - K \|\tilde{v}_1 - V_1\| D_{Rt} \cdot D_{rec} \|\tilde{v}_2 - \tilde{V}_1\|^2 \tag{1}$$

$$P_i = P_i - K \|\tilde{v}_i - V_i\| - D_{Rt} \cdot D_r \left[ \|\tilde{v}_{i+1} - \tilde{v}_i\|^2 + \|\tilde{v}_i - \tilde{v}_{i-1}\|^2 \right] \tag{2}$$

$$P_N = P_N - K \|\tilde{v}_N - V_N\| - D_{Rt} \cdot D_r \|\tilde{v}_N - V_{N-1}\|^2 \tag{3}$$

Energy consumption of node due to data transmission is given by

$$P_i \geq 0, i = 1, \dots, N \tag{9}$$

The node placement for optimal data routing is used to improve the network lifetime. The

$$\text{Max} = \sum_{i=1}^n \tilde{p}_i \text{ subject to constraints 1 to 4.}$$

Network lifetime improve with game theory routing as shown in figure 6.16. Relative analysis of lifetime for hardware and simulation shows minimal reduction in network lifetime when implement in hardware.

#### 4. CONCLUSIONS

In this work, data security in wireless sensor network under compromised node condition with game theory routing scheme is addressed. In addition, a relative analysis of game theory routing mechanism and state of the art DSR routing mechanism simulate in NS-2



environment and the same implement in hardware to validate proposed routing scheme effectiveness. The relative analysis show game theory routing scheme is immune to data hacking under compromised node condition. The compromised node induces with an external node physically connected to a node in the network. The analysis show Game theory routing is immune to data theft and outperforms DSR routing in terms of throughput, packet delivery ratio, network lifetime and end to end delay.

## REFERENCES

- [1] W. Si, M. Hashemi, I. Warszawski, M. Laifenfeld, D. Starobinski and A. Trachtenberg. 2013. TeaCP: A Toolkit for evaluation and analysis of collection protocols in Wireless Sensor Networks. 2013 IEEE Int. Conf. Microwaves, Commun. Antennas Electron. Syst. COMCAS 2013, 4537(c): 1-14.
- [2] R. Laufer, T. Salonidis, H. Lundgren and P. Le Guyadec. 2014. A Cross-Layer Backpressure Architecture for Wireless Multihop Networks. IEEE/Acmtransactions Netw. 22(2): 363-376.
- [3] W. R. Heinzelman, J. Kulik and H. Balakrishnan. 1999. Adaptive protocols for information dissemination in wireless sensor networks. Proc. 5th Annu. ACM/IEEE Int. Conf. Mob. Comput. Netw. - MobiCom '99, pp. 174-185.
- [4] C. Intanagonwiwat, R. Govindan, D. Estrin, J. Heidemann and F. Silva. 2003. Directed diffusion for wireless sensor networking. IEEE/ACM Trans. Netw. 11(1): 2-16.
- [5] H. Y. Kong. 2010. Energy efficient cooperative LEACH protocol for wireless sensor networks. J. Commun. Networks. 12(4): 358-365.
- [6] A. Manjeshwar and D. P. Agrawal. 2001. TEEN: A Routing Protocol for Enhanced Efficiency in Wireless Sensor Networks. Proc. 15<sup>th</sup> Int. Parallel Distrib. Process. Symp. 0(C): 2009-2015.
- [7] Y. Yu, R. Govindan and D. Estrin. 2001. Geographical and Energy Aware Routing : a recursive data dissemination protocol for wireless sensor networks. Tech. Rep. ucla/csd-tr-01-0023, UCLA Comput. Sci. Dep.
- [8] S. H. Kim, P. K. Chong and D. Kim. 2014. A Location-Free Semi-Directional-Flooding Technique for On-Demand Routing in Low-Rate Wireless Mesh Networks. 25(12): 3066-3075.
- [9] X. Shen *et al.* 2015. Oppcode: Correlated opportunistic coding for energy-efficient flooding in wireless sensor networks. IEEE Trans. Ind. Informatics. 11(6): 1631-1642.
- [10] M. Kumar, R. Tripathi and S. Tiwari. 2016. Critical data real-time routing in industrial wireless sensor networks. IET Wirel. Sens. Syst. 6(4): 144-150.
- [11] Z. Xu, L. Chen, C. Chen and X. Guan. 2015. Joint clustering and routing design for reliable and efficient data collection in large-scale wireless sensor networks. IEEE Internet Things J. 4662(c): 1-1.
- [12] Z. Lu, Y. Wang, L. Yang, L. Li and F. Wang. 2008. A Reliable Routing for Industrial Wireless Sensor Networks. pp. 2008-2011.
- [13] W. Pottner, H. Seidel and J. Brown. 2014. Constructing schedules for time-critical data delivery in wireless sensor networks. ACM Trans. Sens. Networks. V(212): 1-31.
- [14] M. Kumar, R. Tripathi, and S. Tiwari. 2013. Two-hop information based gradient routing in industrial Wireless Sensor Networks. 2013 4th Int. Conf. Comput. Commun. Technol. 4(2): 228-232.
- [15] A. Pourkabirian and A. Toroghi Haghghat. 2007. Energy-aware, delay-constrained routing in wireless sensor networks through genetic algorithm. 2007 15th Int. Conf. Software, Telecommn. Comput. Networks. pp. 1-5.

# A secure dynamic adaptive routing technique using game theory in wireless sensor network

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## Abstract

A Wireless Sensor Network (WSNs) is popular developing the field in industrial and other major markets. Wireless data security is the central theme in the WSNs application where security of transmitted data is more concerned. Due to the significant concentration of energy efficiency and performance analysis in WSN, providing secured communication is a challenging issue. To overcome this interdependent problem Game theory can be used. Game theory is applied here to select different routes to transfer the data from source to destination. The performance of the WSNs can be increased by providing security for transmitted data. The graph for throughput, end to end delay, delivery, and packet loss ratio are generated using NS2 simulation tool.

**Keywords:** DSR; Energy Efficient; Game theory; NS2; Wireless Sensor Networks.

## 1. Introduction

A Wireless Sensor Networks (WSNs) is the combination of sensor nodes networked together to collect and process the sensed values and transmit the collected results to the base station through wireless transmitters. Each sensor nodes consists of four important segments. They are the sensor unit, the power supply unit, the processing unit and the transceiver unit. These sensor nodes broadcast the sensed values to other nodes to route the information to the base station or else for their analysis. Wireless Sensor Networks (WSNs) nodes mostly comprise primary sensors that measure light, pressure, sound and other parameters of placed environment. The nodes are powered with small batteries. Since Wireless Sensor Networks (WSNs) are placed in sensing field, replacing of power source manually is difficult and expensive. Due to this limited power source, energy efficiency plays a significant role in Wireless Sensor Networks (WSNs).

In Wireless Sensor Networks (WSNs), many security protocols have been proposed to overcome the security threats, but there are still limitations to overcome the security related problems. Traditional cryptographic methods hold a bigger encryption technique that affects the memory conception, battery conception and inhibit the performance of network

Communication Wireless sensor networks have limited network lifetime and hence network protocols used in it must focus on improving the performance of the system.

Every node present in a network plays a dual role. The first consists of sensing the environment and transfer of the sensed value to the base station or the sink node. The second is to continue its life to the extent possible. This naturally creates a robust environment enabling maintenance of energy efficiency and secured communication in major criteria. So designing the network protocol is very important. Here we introduce the Game theory for overcoming security threats and energy maintenance in wireless sensor networks.

## 2. Related work

Wireless Sensor Networks (WSNs) are used in many important areas like military surveillance and forest fire control. They use multi-hop routing to transfer the data efficiently to the sink node or base station. Identity theft is avoided by implementing multi-hop information in routing data and provide maximum protection against identity deception. Authentication of trusty nodes is highly important in major applications like military surveillance and industrial Wireless Sensor Networks (WSNs). Provision of secured communication is the central theme of research in Wireless Sensor Networks (WSNs). Trust-aware routing protocols available currently are not more efficient to obviate theft of transmitted data. The cryptography techniques used in this affects the performance of networks, energy efficiency or any relevant factors. Fuzzy logic is implemented for overcoming this problem and to perform trusting operation in Wireless Sensor Networks routing. This is along with Bio inspired Energy Efficiency cluster protocol for determination of the threshold values meant for locating the trust worthiness of a node. A table has been generated, and the trust values of each node are compared with the threshold value. If the value is high, the node is saved as a trusted node and added to the table or else, the node is considered as an untrusted node and not placed in the routing table. This helps us to avoid black hole and flooding attacks. [1].

Most of the Wireless Sensor Networks (WSNs) applications are battery powered. Energy management has a vital role to play in view of the low volume of the available power. Many types of research are proposed monitoring and control of the energy management for Wireless Sensor Networks (WSNs). The energy aware framework designed now a day is not efficient as they are designed on the basis of the software environment. The requirements and challenges provided by software environment are not complicated when compared to real-time issues. So most of the

energy monitoring frameworks produce small results when implemented in real time environment. Here we introduce the multi-channel Energy Measurement device, Energy Data Management software and testing nodes. These together generate, the energy management issues in test bed node in real time environment and produce results. These measurements help researchers to get a clear of the required efficient protocol using the results of our test bed. [2].

A combined network with Wireless Sensor Networks and cloud computing has been produced for overcoming the issues relating to storage, real time processing and challenges in battery or node size and characteristics or Wireless Sensor Networks nodes. This combination solves the problems mentioned above but still generates an issue in the security of data in cloud storage. To overcome this problem pub/sub framework is implemented. This structure provides the maximum level of safety for the data stored in the cloud storage. By sharing the process between the cloud and Wireless Sensor Networks (WSNs), it increases the performance and speed of the network. [3]

Wireless Sensor Networks (WSNs) constitute a fast growing technology. Many research studies are now a foot one the subjects of getting elongated network life time and bringing down energy consumption. Energy efficient protocols play a significant role in increasing network lifetime. Here we introduce Linear Cluster Handling Technique (LCH) for maintaining the energy efficiency in multi-static sink nodes in Wireless Sensor Networks (WSNs). The system is divided into four regions, placing four static sink nodes at all corners for efficient collection of data from the network nodes. Distributed Energy Efficient Clustering with Linear Cluster Handling (DEEC-LCH) is used to maintain energy efficient routing protocol in the network. The energy efficiency of this technique is monitored in the software environment. Another method named Threshold Sensitive Energy Efficient with Linear Cluster Handling (TEEN-LCH) is also implemented in three static sink nodes scenario. The combined performance of these two techniques is analyzed for network lifetime, throughput and net energy consumption. [4]

Homogeneous Wireless Sensor Networks (HWSNs) is one of the major fields in WSNs. It deals with the hardware configuration that possess limited resource and processing capacity. The hardware environment possesses unique characteristics for focus on higher security in applications. Additional light weight security models have been proposed for overcoming security threats. These are based on a specific hardware attack. Here we introduce a clustering based key management scheme. Our security system develops a higher efficient security method compared to disjointed clusters. These clusters are made to combine by the randomly selected nodes. This provides analysis for both nodes connectivity and the safety from capture attack. [5]

Wireless Sensor Networks (WSNs) find many applications, in military, natural, and well-being related zones. These applications regularly incorporate the checking of accurate data, for example, for development in the war zone or the area of staff in a building. Security is essential in Wireless Sensor Networks (WSNs). Then again, Wireless Sensor Networks (WSNs) experience the ill effects of numerous imperatives, including low calculation ability, little memory, restricted vitality assets, powerlessness to real catch, and the utilization of shaky remote correspondence channels. These limitations fuse a challenge to security in Wireless Sensor Networks (WSNs). The authors have, in this paper, made an attempt to investigate safety issues in Wireless Sensor Network. Initially, the imperatives, security prerequisites and attacks with their comparing countermeasures in Wireless Sensor Networks (WSNs) are clarified. Singular sensor hubs are liable to trade off security. An attacker can infuse false reports into the systems using traded off hubs. Besides, a foe can make a Gray gap by traded off hubs. If these two sorts of attacks happen simultaneously in a system, a percentage of the current strategies neglect to safeguard against those attacks. The Ad-hoc On Demand Distance (AODV) Vector plan for recognizing Gray-Hole assault and Statistical En-Route Filtering is utilized for locating false report. El-

liptic curve cryptography is employed for improvement of the security level. [6]

Energy efficiency and fault tolerance play a vital role in WSNs. When the nodes communicate with the node far away, it spends considerable energy to transfer the data to the receiver node. Communication distance requires to be minimized for overcoming this problem as also that of loss of energy for the routing data. Node failure is inevitable despite the monitoring of energy consumption. A node in Wireless Sensor Networks (WSNs) can malfunction or get hacked by an attacker. So the transmitting node can tend to transmit data to longer distance. This leads to loss of network lifetime. Energy hole aware efficient communication is introduced for overcoming this problem. This methods solves the energy hole problem and increases energy efficiency. [7]

SAERP: An Energy Efficiency Real-time Routing Protocol in Wireless Sensor Networks (WSNs) is widely used for sensor communication. In this paper the dynamic network sustenance for critical issues such as bandwidth operation, a control system is discussed. A Simultaneous Attentive Energy Routing Protocol (SAERP) is used for improvement of the dynamic network sustenance [8].

Wireless Sensor Networks (WSNs) is widely used for monitoring environmental conditions. Since Wireless Sensor Networks (WSNs) operate in an open environment, they are prone to security threats. The cryptographic method does not suffer from any limitation due to the nature of Wireless Sensor Networks. A novel algorithm has been used in this paper for prevention of node compromise, and internal attack from the compromised node, using the multi-hop and single sinker. The algorithm is based on the proposed algorithm was implemented on an actual test bed to support the claim [9].

Improved Energy Efficiency Semi-Static Routing (EESSR) algorithm using sink mobility for Wireless Sensor Networks (WSNs) ubiquitous wireless sensor network devices are battery powered, and so network lifetime and energy management is an important issue. One way to improve the network lifetime is the use of Energy Efficiency Semi-Static Clustering (EESSC) protocol is used to form node clusters. In this paper developed Energy Efficiency Semi-Static Routing is proposed which is simulated, and the results are compared with EESSC and LEACH based on individual network constraints such as network lifetime and middle node death. Experimental results show that the proposed method is better than EESSC and LEACH [10].

### 3. Problem of the statement

Energy efficiency and performance analysis in wireless sensor network is a challenging issue for providing secured communication in sensor network. To overcome this problem the researchers used the Game theory approach.

### 4. Motivation

Game theory is a new concept suggested for wireless sensor networks can be improved by providing data security for transmitted data and ensuring energy efficiency. This theory is applied for the partitioning of data and then selecting the different routes to transfer data from source to destination. It is also possible for uniform utilisation of energy resource in the sensor node.

### 5. Methodology

Electronics and wireless technologies are fast growing techs of Wireless Sensor Networks (WSNs). The proposed work stimulates the concept of data security and energy efficiency in Wireless Sensor Networks (WSNs) applications. A new concept named the game theory in Wireless Sensor Networks for providing data security and ensuring energy efficiency. In addition to Game Theory, Dynamic Source Routing (DSR) protocol is implementing to

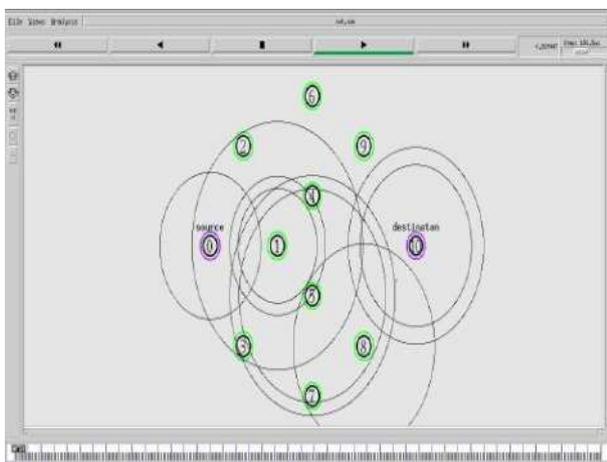
transmit the data from sender to destination nodes. Dynamic Source Routing is used for establishment of the route between the sender node and receiver node and producing a table of paths through which the data can be successfully transmitted to the sink node. The Game theory can change the paths alternatively to the sink node. The path is not constant and so no one can predict the actual path of the data is transmitted in the network. Along with the different path selection, we also split the packets into multiple pieces and transmit each portion in one direction. So the load for transmission is reduced the data will get fused and split several times while passing through the network. At the destination node, the split data are collected and combined to generate a complete data. This method has the capability of providing maximum security for the transmitted data. An attacker can never collect all the pieces of encoded data to get complete information about the transmitted data. DSR protocol ensures an effective communication link and mitigating packet loss. When the network is big, the process will be more complicated and so the security for the data increases. Reduction in transmission energy is possible as a result of low-energy packet size network lifetime can also increase.

**5.1. Algorithm**

- Step1: Create source and destination nodes.
- Step2: Route between the source and destination nodes are tabled using DSR protocol.
- Step3: Count number of possible routes in every hop in the network.
- Step4: The data packets are split into some available routes.
- Step5: The data was transmitted to next layer or hops.
- Step6: Check for destination in the next hop if destination present sends packets to the destination node else split the collected data packets to make ready for next hop.
- Step7: Collect and merge the data packets obtained from past hops and split the received data for next hop.
- Step8: Continue the steps of splitting and merging of data in several hops until finding the destination node.

**5.2. Network simulation tool**

Subsequent to the installation of NS2, it is used for evaluate and simulate work apart from other tools used. The Network Simulator is an Object Oriented Simulator, and it can be written in C++ language. The development of NS2 codes are done by using both OTcl (Object oriented extension of Tool Command Language) and C++. Trace Graph is an essential part for displaying a result, so we plot a graph to show a various result comparison with packets, throughput, delivery ratio, network delay and energy efficiency etc. The results are achieved by using Xgraph tool. The proposed and existing methods are compared through the graphs generated.



**Fig. 1:** NS2 Node Arrangement.

The network is designed using a Network Simulator (ns2) and parameters like throughput, packet loss ratio, packet delivery ratio, an end to end delay are calculated. The above Fig. 1 shows the node positions of source, destination and relay nodes of our network.

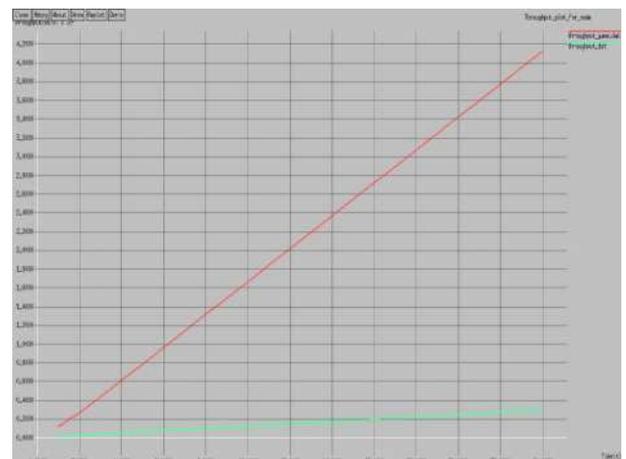
**6. Results and discussion**

The method we proposed here was implemented over Network Simulator platform with following parameters. The NS2 parameters are shown below.

**Table 1:** Simulation Parameter

Parameter	Description
Channel/Wireless Channel	:# channel type
Propagation/2Way Ground	:# radio-propagation model
Phy/Wireless Phy	:# network interface type
Mac/802_11	:# MAC type
Queue/DropTail / PriQueue	:# interface queue type
Queue length	; 500 bits
Number of Nodes	; 16
LL	:# link layer type
Omni Antenna	:# antenna model
50	:# max packet in if q
71	:# number of mobile nodes
DSR	:# routing protocol
100	:# X dimension of topography
100	:# Y dimension of topography
45.0s	:# time of simulation end
100J	; initial energy
100 bits	;packet size

The present study work involves implementing by using DSR routing protocols. The performance of DSR routing protocol is evaluated for observance the network speed and maintaining the routing information is maintain at mobile nodes. There are 71 mobile nodes were used in this simulation work. The other parameters like MAC type, interface queue type, and link layer type are analyzing the data packet and handover to the successor. In sensor networks, the radio propagation model decides whether mobile nodes with given distance and their power of transmission. By default it implements through Omni antenna model to gain all direction. It will be propagated from one place to another place in the simulation model. It predicts the behavior of propagation for all similar links under constraint. So, we can easily achieve the loss of path and effective coverage area of a transmitter by using this model. The initial energy of node is 100j (Joule) with the packet size 100 bits and the queue length is 500 bits. The simulation time ends at 45 seconds and X-Y-dimension of topography are used for creating the graph representation with dimension (100X100). The outcome of the simulation is an output trace file that can be used to do data processing such as throughput, end-to-end delay, etc. It can also visualize the simulation with a program called Network Animator.



**Fig. 2:** Throughput.

Fig.2 shows a comparison of throughput for the network created. The red line represents game theory, and the blue line is the existing system without game theory. The data rate is more in proposed method than the existing.



Fig. 3: Packet Delivery Ratios.

Fig.3 shows the Packet delivery ratio that indicates the successful transmission of packets between the sender and the receiver. The ratio of game theory is high when compared to the existing system. Our method attains the maximum delivery ratio in the short time when compared to existing work.

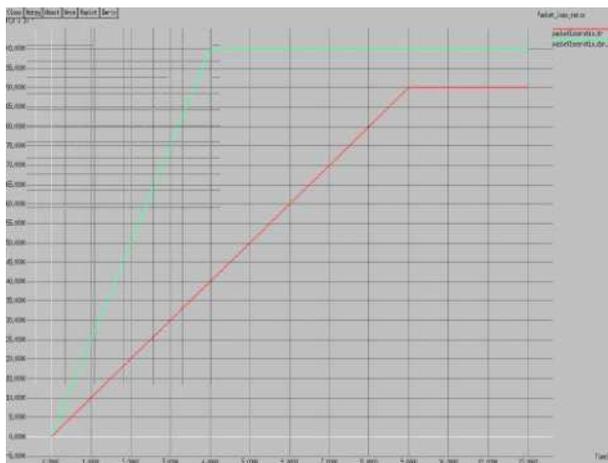


Fig. 4: End to End Delays.

The above Fig. 4 shows the end to end delay in the network. Here the delay in communication between the nodes is reduced when using the game theory. The weightage of data transmission gets reduced consequent on the splitting of data. The reduction is so perpendicular as to ensure reduction in the delay between data transmission through the game theory.

## 7. Conclusion

This research work provides a detailed view of the Game theory over Wireless Sensor Networks (WSNs) for producing energy efficient and secured protocol. The result generated by our method is compared with the typical Dynamic Source Routing (DSR) network, and it is proved that the Game theory plays the major role in the security of transmitted data's in the network. The combination of Dynamic Source Routing (DSR) and Game theory provides more security than other ethical methods followed in Wireless Sensor Networks (WSNs).

## References

- [1] S. Renubala, K.S.Dhanalakshmi, "Trust based Secure Routing Protocol using Fuzzy Logic in Wireless Sensor Networks", *Computational Intelligence and Computing Research (ICCIC)*, 2014 IEEE International Conference on 18-20 Dec. 2014. <https://doi.org/10.1109/ICCIC.2014.7238435>.
- [2] N. Zhu, I. O. Connor, U. De Lyon, N. De Lyon, and I. N. L. Umar, "Energy Measurements and Evaluations on High Data Rate and Ultra Low Power WSN Node", 2013.
- [3] G. Yue, Y. Xie, and H. Wen, "The security issue of WSN based on cloud computing for smart grid," *Information Technology*, vol. 12, no. 22, pp. 6702–6709, 2013. <https://doi.org/10.3923/ijtj.2013.6702.6709>.
- [4] M. Sajid, K. Khan, U. Qasim, Z. A. Khan, S. Tariq, and N. Javaid, "A New Linear Cluster Handling (LCH) Technique Towards Energy Efficiency in Linear WSNs," 2015 IEEE 29th International Conference on Advance Information Networking and Applications (AINA), vol. 7, pp. 389–393, 2015.
- [5] M. Rezaeirad, M. Orooji, S. Mazloom, D. Perkins, and M. Bayoumi, "A novel clustering paradigm for key pre-distribution: Toward a better security in homogenous WSNs," 2013 IEEE 10th Consumer Communication Networking Conference (CCNC), pp. 308–316, 2013. <https://doi.org/10.1109/CCNC.2013.6488463>.
- [6] S. M. Sakharkar, R. S. Mangrulkar, and M. Atique, "A survey: A secure routing method for detecting false reports and gray-hole attacks along with Elliptic Curve Cryptography in wireless sensor networks," 2014 IEEE Students' Conference Electrical Electronic Computer Science, pp. 1–5, 2014.
- [7] Q. Zhao and Y. Nakamoto, "Routing Algorithms for Preventing Energy Holes and Improving Fault Tolerance in Wireless Sensor Networks," *Proc. 2nd International Symposium on Network Computing*, pp. 278–283, 2014. <https://doi.org/10.1109/CANDAR.2014.18>.
- [8] K. Y. S. B and S. S. Tyagi, "SAERP: An Energy Efficiency Real-time Routing Protocol in Wireless Sensor Networks," pp. 249–254, 2014.
- [9] M. R. Ahmed and D. Sharma, "Protecting wireless sensor networks from internal attacks based on uncertain decisions," 2013 IEEE Wireless Communication Network Conference, pp. 1854–1859, 2013.
- [10] Deepali and Padmavati, "Improved energy efficiency semi static routing algorithm using sink mobility for WSNs," 2014 Recent Advance Engineering and Computational Sciences (RAECS).pp. 1–5, 2014.

## A STUDY ON INVESTMENT PREFERENCES AND PURPOSE OF INVESTMENTS AMONG THE RURAL AREA INVESTORS IN KRISHNAGIRI DISTRICT

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### Abstract

Investment is the commitment of funds which have been saved from current consumption with the hope that benefits will be received in future. The objectives of this study are to assess the preference and purpose of investment of rural investor in Krishnagiri District. Descriptive research design is used to describe the characteristic of group of target population such as age, gender, area of residence etc., therefore this study have been framed by the following descriptive research design. Sample framing is essential segment of any research report and this study is conducted with convenience sampling under the non-probability sampling method. There are two types of data namely primary data and secondary data, the primary data are those collected from 110 rural investors with help of interview websites and text books. All the data codes are tabulated with help of the appropriate statistical tools as well as percentage analysis t-test, and one way – ANOVA. There is a significant difference between the monthly income of the respondent with regard to the purpose of investment among the rural investors.

**Keywords:** Investment, Rural Investors

### Introduction

No one can thrive in the world without money. Money means currency coins (or) cheques or any other forms which are generally acceptable either as a medium of exchange or in the settlement of debts. Keeping wealth is a important obligation of every human being to perform. India needs very high rate investment since the investment will play a big part in economic growth. First investment into a firm will lead to expansion, investment into technology which can lead to higher economic growth and increase aggregate demand in the economy. This will be because of increasing productivity in the firm as well as and increasing GDP for the country. Saving and investment in the rural economy appears to be in monetized and non monetized forms. This could be attributed to the subsistent nature of the economy. This further implies that for any meaningful investment to be obtained, a sound saving mobilization has to be pursued. Saving and investment are only different aspects of the same phenomenon. Saving has been defined as personal disposable income minus personal consumption expenditure and to overcome the problem in future they have to invest their money. Investment is the commitment of funds which have been saved from current consumption with the hope that benefits will be received in future and thus it is a reward for waiting for money. The objectives of this study is to assess the preference and purpose of investment of rural investor in Krishnagiri District. This study determines the Investors' preference in rural areas and therefore suggests policy recommendations based on the findings of the study.

### Investment Avenues

Today there are large number of Investment avenues which are available to the public. Some of them are marketable, liquid, non - marketable, highly risky, and others are almost risk less. A people has to choose proper avenue depending their specific needs, risk preference, and return expected from the findings, the following different investment avenues are considered as follows: Bank fixed deposit, Insurance products, Postal savings, Shares, Bonds, Debenture, Mutual fund, Gold/ Silver, Real Estate, Other

### Literature Review

Obamuyi (2013) tried to reveal the socio-economic factors influencing investment decisions of investors in the Nigerian capital market through a modified questionnaire developed by Al-Tamimi (2005). By employing independent t-test, analysis of variance and *post-hoc* tests, past performance of the company's stock, expected stock split/capital increases/bonus, dividend policy, expected corporate earnings and get-richquick were found to be the most influential factors on investment decisions of investors in Nigeria. When taking investment decisions, non-economic factors such as religions, rumors, loyalty to the company's products/services, and opinions of members of the family were found to be insignificant among investors.

Lothi (2014) examined the impact of financial literacy, high experience, use of accounting information, importance of analyzing financial statements and age on the investment decision of any individual by applying a survey in Karachi, Pakistan. By using SPSS, correlation analysis was performed in order to determine the relation between the aforementioned variables. According to empirical results, financial literacy and accounting information were considered to be significant factors in lowering information asymmetry and allowing investors to invest in risky instruments. Additionally it was verified that investors' preference for risky investments decreases, as age and experience increase. Puneet Bhushan & Yashu Mehra (2013) concluded that women are more conservative and takes less risk and significant gender differences exist in investment preferences for health insurance, fixed deposits and market investments among employees. V.R.Patavola & K.Chandrasekhar (2013) highlights that certain factors of salaried employees like education level, awareness about the current financial system, age of investors etc. make significant impact while deciding the investment avenues. Dr. Ananthapadmanabha Achar (2012) studied on –Saving and Investment Behaviour of Teachers - An empirical study. In the ultimate analysis individual characteristics of teachers such as age, gender, marital status, and lifestyle determined the savings and investment behaviour of teaching community in the study region. In a more or less similar manner, their family characteristics such as monthly family income, stage of family life cycle, and upbringing status emerged as determinants of their savings and investment behaviour.

#### Need for the Study

1. The study reveals the relationship between the economic condition of the investor and their preference towards different modes of investment.
2. Day by day there is growing demand for wealth management function. It includes the understanding of investors preferences and requirements.

#### Statement of the Problem

Investment related variable include, influence of investment decision, sources of investment, percentage of income invested. Sources of information about investment & preference of investment, proportion of income invested in various investments. Indian saving market has been expanding over the period and there is a steady increase of house hold savings. More over general profile of investors in changing in tune with time. But they lag in various spheres of investment such as awareness and preferences of investment so, an attempt has been made by the researcher to identify the factors influencing investor behavior to evaluate the level of awareness among investors.

#### Objectives of the Study

To analyse investment preferences and purpose of investments among the rural area investors in Krishnagiri District

#### Hypothesis of the Study

There is no significant difference between socio - economic profiles such as gender, age group, educational qualification, occupation, monthly income, monthly household expenses with regard to purpose of investment among the rural area investors.

#### Methodology

Descriptive research design is used to describe the characteristic of group of target population such as age, gender, area of residence etc., therefore this study have been framed by following descriptive research design. Sample framing is essential segment of any research report and this study is conducted with convenience sampling under the non-probability sampling method. There are two types of data namely primary data and secondary data, the primary data are those collected from 110 rural investors with help of interview schedule in the study area of Krishnagiri District. Secondary data are those are collected from reputed journals respective websites and text books. All the data code are tabulated with the help of appropriate statistical tools as well as percentage analysis t-test, and one way - ANOVA.

#### Limitations of the Study

1. The Present Study is covered in and around the rural areas of Krishnagiri District
2. The present study has covered only 110 respondents only. It may or may not be able to match with the population.

Table 1: Socio Economic Profile of the respondents

Variables	Characteristics	
	No. of Respondents	Percentage
Gender	Male	53
	Female	57
	Total	110
Educational Qualification	Illustrates	12
	Up to School Level	41
	Under Graduate	11
	Post Graduate	30
	Others	16
	Total	110

Age Group	Government Employee		
	Private Employee		
	Professional	8	7.3
	Farmers	32	29.1
	Businessman	6	5.5
	Others	32	29.1
Monthly Income	Total	12	10.9
	Young age	20	18.2
	Middle age	110	100.0
Monthly household Expenses	Old age	27	24.5
	Total	49	44.5
	Low income	34	30.9
	Medium Income	110	100.0
Inferences	High Income	28	25.5
	Total	47	42.7
	Low Expenses	35	31.8
	Medium Expenses	110	100.0
	High Expenses	33	30.0
Sources: Primary Data	Total	45	40.9
		32	29.1
		110	100.0

Sources: Primary Data

**Inferences**

The above table 1 (a) shows that 51.8 per cent of the respondents are female and 48.2 per cent of the respondents are male. It clearly shows that the majority 51.8% of the respondents are female. The above table 4.1 (b) shows that 37.3 per cent of the respondents are School level, 27.3 per cent of respondent are Post graduate, and 14.5 per cent of the respondents are others, 10.9 per cent of the respondents are illiterate, 10 per cent of the respondents are under graduate. It clearly stated that majority 37.3 per cent of the respondents are at school level. The above table 4.1 (c) shows that 29.1 per cent of the respondents are Private employee as well as Farmers, 18.2 per cent of the respondents are Others, 10.9 per cent of the respondents are Businessman, 7.3 per cent respondents are government employees, 5.5 per cent of the respondents are professional. It clearly shows that the majority 29.1 per cent of the respondents are private employee and farmers. The above table 4.1 (d) shows that 44.5 per cent of the respondents are middle age group, 30.9 per cent of respondents are old age group, 24.5 per cent of the respondents are young age group. It is clearly indicates that majority 44.5 per cent of the respondents are middle age group. The above table 4.1 (e) shows that 42.7 per cent of the respondents income are medium 31.8 per cent of the respondents income are high, 25.5 per cent of the respondents income are low. It clearly shows that the majority 42.7 per cent of the respondents are of Medium Income. The above table 4.1 (f) shows that 40.9 per cent of the respondent's monthly household expenses are medium , 30.0 per cent of the respondent's monthly household are low, 29.1 per cent of the respondents monthly household expenses are high. It clearly shows that majority 40.9 per cent of the respondent's monthly household expenses are medium.

**Table 2: Nature of investment presently held by the rural investors**

Sources: Primary data

S. No	Nature of Investments	No. of Investments	Percentage
1.	Bank fixed Deposit	53	20.61
2.	Insurance Product	31	12.06
3.	Postal Savings	42	16.34
4.	Shares	1	0.38
5.	Bonds	1	0.38
6.	Debenture	0	0
7.	Mutual Fund	2	0.77
8.	Gold/Silver	60	23.34
9.	Real Estate	21	8.17
10.	Agricultural Fund	35	13.61
11.	Others	11	4.28
		257	

The above table shows that 23.34 per cent of the investor invest their money in gold/silver, 20.61 per cent of the investor invest their money in bank fixed deposit, 16.34 per cent of the investor invest their money in postal savings, 13.61 per cent of the investor invest their money in agricultural fund, 12.06 per cent of the investor invest their money in insurance product, 8.17 per cent of the investor invest their money in real estate investment, 4.28 per cent of the investor invest their money in other investment, 0.77 per cent of the investor invest their money in mutual fund investment, 0.38 per cent of the investor

invest their money in both shares and bonds, there is no investment made by debenture.

**Classification of the respondents based on gender and purpose of investment among the rural investors**

H<sub>0</sub>: There is no significant difference between male and female respondents with regard to purpose of investment among the rural investors

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**Table 3: Respondents based on Gender and Purpose of Investment**  
Sources: Primary Data

Gender	N	Mean	Std. Deviation	t-value	P-Value
Male	53	29.74	4.230	0.884	0.379
Female	57	29.07	3.664		
Total	110				

**Inference**

Table 3 indicates that P value is 0.379. Since P value is more than 0.05, the null hypothesis is accepted at 5% level of significance. Hence it is concluded that there is no significant difference between male and female respondents with regard to purpose of investment among the rural investors.

**Classification of the respondents based on age group and purpose of investment among the rural investors**

$H_0$ : There is no significant difference between age group of the respondents with regard to purpose of investment among the rural investors

**Table 4: Respondents based on Age Group and Purpose of Investment**  
Sources: Primary Data

Age Group	N	Mean	Std. Deviation	F-Value	P- value
Young age	27	29.74	2.596	0.279	0.757
Middle age	49	29.47	4.263		
Old age	34	29.00	4.397		
Total	110	29.39	3.942		

**Inference**

Table 4 identifies that p value is 0.757. Since P value is more than 0.05, the null hypothesis is accepted at 5% level of significance. Hence it is concluded that there no significant difference between age group of the respondents with regard to purpose of investment among the rural investors.

**Classification of the respondents based on Occupation and purpose of investment among the rural investors**

$H_0$ : There is no significant difference between occupation of the respondents with regard to purpose of investment among the rural investors

**Table 5: Respondents based on Occupation and Purpose of Investment**

Occupation	N	Mean	Std. Deviation	F-Value	P- value
Government Employee	8	29.50	4.567	2.003	0.084
Private Employee	32	29.28	3.362		
Professional	6	29.50	2.881		
Farmers	32	28.00	4.450		
Businessman	12	31.83	3.589		
Others	20	30.25	3.640		
Total	110	29.39	3.942		

Sources: Primary Data

**Inference**

This table 5 indicates that P value is 0.084. Since P value is less than 0.05, the null hypothesis is accepted at 5% level of significance. Hence it is concluded that there is no significant difference between occupation of the respondents with regard to purpose of investment among the rural investors.

**Classification of the respondents based on Monthly income and purpose of investment among the rural investors**

$H_0$ : There is no significant difference between Income of the respondents with regard to purpose of investment among the rural investors

**Table 6: Respondents based on Monthly Income and Purpose of Investment**

Monthly Income	N	Mean	Std. Deviation	F-Value	P- value
Low income	28	29.64	3.466	3.213	0.044
Medium Income	47	28.38	3.937		
High Income	35	30.54	4.061		
Total	110	29.39	3.942		

Sources: Primary Data

**Inference**

This table 6 revealed that P value is 0.044. Since P value is less than 0.05, the null hypothesis is rejected at 5% level of significance. Hence it is concluded that there is a significant difference between monthly income of the respondent with regard to purpose of investment among the rural investors.

**Classification of the Respondents based on Educational Qualification and purpose of Investment among the rural investors**

$H_0$ : There is no significant difference between Educational qualifications of the respondents with regard to purpose of investment among the rural investors.

Table 7: Respondents based on Education Qualification and Purpose of Investment

Educational Qualification	N	Mean	Std. Deviation	F -Value	P- value
Illustrates	12	30.42	4.926	0.435	0.783
Up to School Level	41	29.15	4.004		
Under Graduate	11	30.09	3.239		
Post Graduate	30	28.93	3.028		
Others	16	29.62	5.084		
Total	110	29.39	3.942		

Sources: Primary Data

**Inference**

This table 7 revealed that P value is 0.783. Since P value is more than 0.05, the null hypothesis is accepted at 5% level of significant. Hence concluded that there is no significant difference among the rural investors

between educational qualification of the respondents with regard to purpose of investment among the rural investors

**Findings of the Study**

1. There is no significant difference between male and female respondents with regard to purpose of investment among the rural investors.
2. There no significant difference between age group of the respondents with regard to purpose of investment among the rural investors.
3. There is no significant difference between occupation of the respondents with regard to purpose of investment among the rural investors.
4. There is a significant difference between monthly income of the respondent with regard to purpose of investment among the rural investors.
5. There is no significant difference between educational qualification of the respondents with regard to purpose of investment among the rural investors

**Recommendations and Conclusion of the Study**

The concluding part of the research report explores the better understanding about the purpose of investment among the rural area investors. Most of the rural investors invest their money in gold/silver, followed by bank fixed deposit and postal investment because of the rural investors familiar with those investment avenues. Hence the rural area investor is not familiar with the following investment avenues such as debenture, shares and bonds. Therefore the investment avenues should concentrate the rural investors to offer more schemes for them. In the terms of monthly income the rural investors are not aware of the purpose of investments since this study is limited to rural area investors, it way also extended to state level. This study only limited to rural area investors besides it may extend State level. It could be also made a comparative study among the rural and urban area investors.

**References**

1. N. Geetha, Dr. M. Ramesh (2011). "A Study on People's Preferences in Investment Behaviour" IJEMR – November 2011-Vol 1 Issue 6
2. Dr. K. Kalidoss , E. Jenmarakkini "A Study On The Investment Pattern Of Rural Investors With Special Reference To Nagapattinam District " International Journal of Management Focus | ISSN : 2250 - 2971 July – Sep '2012
3. Lodhi, S. (2014)," Factors influencing individual investor behaviour: "An empirical study of city Karachi, Journal of Business and Management, 16(2), 68-76. International Journal of Economics and Financial Issues, Vol. 5. Issue 2. 2015. <http://www.econjournals.com>
4. Obamuyi, T.M. (2013), "Factors influencing investment decisions in capital market: A study of individual investors in Nigeria". Organizations and Markets in Emerging Economies, 4(7), 141-161. International Journal of Economics and Financial Issues, Vol. 5. Issue 2. 2015. <http://www.econjournals.com>
5. Bhushan, P. & Medury, Y. (2013). Gender Differences in Investment Behaviour among Employees. Asian Journal of Research in Business Economics and Management, 3 (12), 147-157.
6. Palanivelu, V.R. & Chandrakumar, K. (2013). A Study on Preferred Investment Avenues among Salaried Peoples with Reference to Namakkal Taluk, Tamil Nadu, India. IBEA, International Conference on Business, Economics, and Accounting.
7. Dr. Anantha Padhmanabha Achar (2012) "Savings and Investment Behaviour of Teachers" - An Empirical Study, IJPSS – August 2012. Vol. 2, Issue- 8. ISSN: 2249-5894.

# Trustful Traffic Management with Adaptive PSO Path Selection Policy in VANET

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**Abstract**— A novel Identity-based Batch Verification Scheme in Vehicular ad hoc network (VANET) can outstandingly improve the traffic safety and effectiveness. The basic idea is to allow vehicles to send traffic message to roadside units (RSUs) or other vehicles. Vehicles have to be prohibited from some attacks on their privacy and misuse of their private data. For this reason, the security and privacy protection issues are important prerequisites for VANET. The Novel identity-based batch verification scheme was newly future to make VANET more secure and efficient for practical use. The current IBV system exist some security risks. To set up an improved scheme that can satisfy the security and isolation desired by vehicles. The proposed NIBV scheme provides the verifiable security in the casual Mysql model. In addition, the batch confirmation of the proposed scheme needs only effectual approach for VSNs to achieve confirmation, reliability, and authority. However, when the number of signatures received by a Roadside Unit (RSU) becomes bulky, a scalability problem appear immediately, where the RSU could be difficult to consecutively verify each received signature within 300 ms period according to the current committed short range communications broadcast protocol. To introduce a new identity-based batch verification scheme for transportation between vehicles and RSUs, in which an RSU can confirm abundant received signatures at the same instance such that the total verification time can be drastically reduced.

**Index Terms**— Authenticity, novel batch verification, Privacy, Vehicular ad-hoc network.

## I. INTRODUCTION

VANETs are a subgroup of mobile ad-hoc networks. The main difference is that the mobile routers construction the network are vehicles like cars or trucks and their movement is controlled by factors like road route, surrounding traffic and traffic system. It is a feasible supposition that the members of VANETs can connect to fixed networks like the Internet occasionally, at least at usual service intervals. A main goal of VANETs is to enhance road safety. In VANET they have three important entities like trusted authority, road side unit, on board unit. In trusted authority (TA) schedule the route to the vehicle. The TA can communicate via a road side unit (RSU). In RSU is a communication between the TA and OBU. In OBU to commune with roadside units (RSUs) situated at roadside or street intersection. Vehicles can also use OBUs to commune with each other. VANET can be classifying into

two types: vehicle-to-infrastructure (V2I) communication or inter-vehicle (V2V) communication. The basic use of VANET is that OBUs at regular intervals transmit information on their nearby states. The information like current time, position, direction, speed and traffic events are passed to other nearby vehicles and RSUs. For example, the traffic actions could be accident location, brake light warning, change lane/merge traffic warning, emergency vehicle warning, etc. Other vehicles may modify their travelling routers and RSUs may inform the traffic control centre to alter traffic lights for avoiding possible traffic jamming. VANET offers a variety of services and profit to users, and thus deserve deployment efforts. The wonderful benefits expected from vehicular communications and the enormous number of vehicles, it is clear that vehicular communications are probable to become the most relevant understanding of mobile ad hoc networks. The appropriate integration of on-board units and position devices, such as GPS receivers along with communiqué capabilities, opens marvelous business opportunities, but also raises alarming research challenges.

The protection of communication exchange acting a key task in VANET applications. The message from OBUs has to be identity-authenticated and integrity-checked before it can be trust on. Otherwise, an opponent can change the information or even masquerade as other vehicles to transmit the wrong information. The wrong information probably makes some bad situation. For example, the information of incorrect traffic flow may reason the traffic control centre to make wrong decision. The traffic light of the heavy side always stay red and the other side stay green. In addition, an opponent may portray an ambulance to require the traffic light to help with her/him and break the driving right of other users.

A driver may not wish for others to know her/his travelling routes by tracing information sent by OBU. Or else, it is hard to draw users to link the network. So, an nameless communication is needed. On the opposing, traceability is also necessary where a vehicle's real identity should be able to be exposed by a trust authority for legal responsibility issue when crimes or accidents happen. For example, a driver who sent out false information causing an accident should not be clever to escape by using a nameless identity. In other words, vehicles in VANET need the provisional privacy.

Our main aid in the paper is given as follows: Specified the security issues of avoiding incorrect information and the

contradictory goals of isolation and traceability. The proposed new identity based batch verification scheme can be used in both V2I and V2V communications. The new IBV scheme can endure our future threats such as the identity privacy violation, fake and anti-traceability attacks. Compare to the preceding schemes, the future new IBV scheme is efficient in computational cost of confirmation delay. It is since the process of batch verification needs only a small stable number of pairing and point increase computations. In new identity batch verification scheme can improving the security using efficient algorithm like symmetric encryption algorithm and new identity based batch verification algorithm.

## II. RELATED WORKS

In 2015, Shiang-FengTzeng, Shi-Jinn Horng [1] proposed a scheme to point out that the present IBV scheme survive some security risks. To introduce an improved scheme that can satisfy the security and privacy needed by vehicles. The IBV scheme provides the demonstrable security in the random oracle model. Lee and Lai [2] described the two weakness of *et al.*'s IBV scheme. First, Zhang *et al.*'s IBV system is susceptible on the replay attack. An opponent may replicate a false condition, such as traffic squash, by collect and store the vehicle messages and signatures in the matching condition. In 2013, Shi-Jinn Horng, Shiang-FengTzeng [3], SPECS provided software based key to satisfy the solitude requirement and gave inferior message slide and more successful rate than earlier result in the message verification phase. To find out that SPECS is vulnerable to imitation attack. SPECS have a pour such that a spiteful vehicle can force random vehicles to broadcast fake messages to other vehicles. In 2008, Zhang *et al* [4] proposed an identity-based batch verification system for V2I and V2V infrastructure in VANET. They adopt a one-time identity-based signature, which eliminate the confirmation and broadcast costs of certificate for public key. It reduces the general verification delay of a lot of message signatures. In 2007, Raya and Hubaux [5] proposed a scheme to conceal the real identities of users by nameless certificates. The conservative public key infrastructure is adopt as the security base to achieve both message verification and integrity. The main problem is that each vehicle loads a large storage capability to save a number of key pairs and the matching certificates, and incur the high cost of message verification.

## III. PRELIMINARIES

### A. SYSTEM MODEL

The structure model consists of four entities like trust authority, application servers, roadside units and on-board units (OBUs) install on vehicles. A two-layer vehicular network model was address in recent research .The top layer is a trusted authority and application servers. TA and application servers converse with RSUs through secure

channel, the transport layer security protocol, by wired relations. The lower layer is embrace of vehicles and RSUs. The communiqué amongst them is based on the dedicated short range communications protocol. The VANET security standard, every vehicle has its own public/private key pairs distributed by TA. Before messages are transmit, vehicles contain to sign the messages with their private keys to assurance the honesty of messages. Delivery the safety related or non-traffic related message, each RSU or vehicle is accountable for verify their signatures of messages.

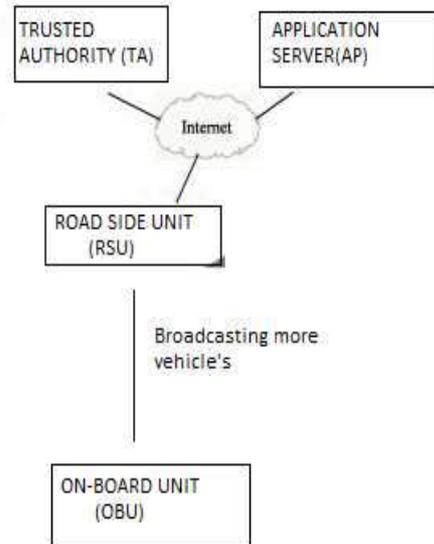


FIG 1: The System Model

1) TA is totally confidential by everybody and it is motorized with enough calculation and storage ability. The laid off TA are installing to keep away from being a bottleneck or a solitary point of failure.2) TA is the only can decide the vehicle's real individuality but not by other vehicles or RSU.

3) TA and RSUs converse via a secure fixed network.

4) RSUs are not confidential. As they are located down road side, they can be simply co-operation. They are inquisitive about vehicle's seclusion.

5) Tamper-proof devices on vehicles are supposed to be believable and its information is for no reason to been reveal. The WAVE standard, every OBU is capable with a hardware security module , which is a tamper-resistant module used to accumulate the security resources The HSM in each OBU is accountable for drama all the cryptographic process such as signing messages, keys update. It is hard for lawful OBUs to take out their private keys from their tamper-proof devices. The system has its individual clock for make accurate timestamp and is clever to sprint on its individual battery. TA, RSUs and OBUs have approximately coordinated clocks.

### B. ADVERSARY MODEL

All participating RSUs and OBUs are not believable and the communication channel is not protected. An opponent is able to performing the following without the novel IBV scheme.

1) An opponent may adjust or repeat existing messages, even an opponent may disperse or mimic any rightful vehicle to produce incorrect information into the scheme to influence

the behavior of other users or damage the transportation of VANET.

2) An opponent may draw the real identity of any vehicle and can disclose the vehicle's real identity by analyzing many messages sent by it.

#### IV. PROPOSED SYSTEM

(1)TheOBU of the vehicle broadcast or distribute traffic information to RSU or nearby vehicles. (2)RSU verify the traffic information and send to the TA. (3)TA schedules the route of the vehicles, which route is traffic free and shortest. (4)To applying a dynamic routing algorithm find shortest energetic routers without traffic. (5)Energy level should be increased in vehicular networks during that time of providing high security. (6)To apply a novel identity based batch verification algorithm deducts the hacking packets and also find, which vehicle can be create it. To compromise the particular hacking vehicles master keys. (7)To apply a novel identity based batch verification scheme provide high security and high performance for vehicular networks.

(8)Compare to existing system, High Security can be provided. RSU extend network range. (9)In novel identity based batch verification scheme easily identify the changed information and difficult to access the information without signature key. (10)TA easily fined the duplicate information and provides high performance in novel IBV scheme. (11)Advanced symmetric key algorithm can be used to novel identity based batch verification. (12)Novel identity based batch verification algorithm can be used to improving a security of a VANET and also improving a speed and performance.

#### V. PERFORMANCE EVALUATION

The computation delay is the mainly important issue, which affect the worth of traffic linked messages. To describe the time charge of the cryptographic linked operations necessary in each signing and verification by the novel IBV scheme and other batch verification schemes.

In fig.2 is comparison between computations delay and verify a signing message. A previous IBV schemes they have more delay for verifying a message. Previous IBV scheme have a delay of 9.6 in verification and 0.6 in sign message.

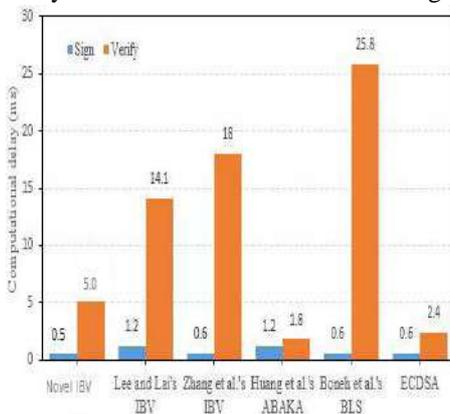


FIG 2: Comparison of computational delay to verify and signing message

To proposed a novel IBV scheme having a 5.0 in verification delay and 0.5 in signing a message.

Fig. 3 indicates the connection between the transmission

overhead and the number of messages received by an RSU in 10 seconds. As the number of messages increases, the transmission overhead increases linearly. The transmission overhead of the novel IBV system

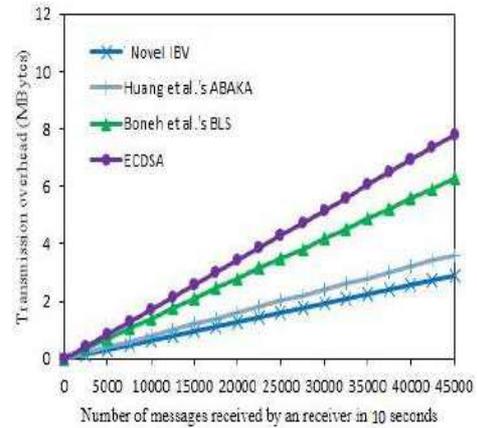


FIG 3: Transmission overhead with number of message received

is least among the four schemes. Here, 45,000 correspond to the number of messages transmitted by 150 vehicles in 10 seconds. The previous IBV systems they have transmitted by 150 vehicles in 30 seconds.

#### VI. CONCLUSION

To proposed an efficient identity-based batch verification (NIBV) scheme for vehicle-to-infrastructure and inter-vehicle communications in vehicular ad hoc network (VANET). The batch-based verification for multiple message signatures is more efficient than one-by-one single verification when the receiver has to confirm a large number of messages In particular; the batch verification process of the proposed NIBV scheme needs only a constant number of pairing and point multiplication computations, independent of the number of message signatures. The proposed NIBV scheme is secure against existential forgery in the random oracle model under the computational Diffie-Hellman problem. In the performance analysis, we have evaluated the proposed NIBV scheme with other batch verification schemes in terms of computation delay and transmission overhead. Moreover, we verify the efficiency and practicality of the proposed scheme by the simulation analysis. Simulation results show that both the average message delay and message loss rate of the proposed IBV scheme are less than those of the existing schemes.

#### VII. FUTURE WORK

In the future work, we will continue our efforts to enhance the features of IBV scheme for VANET, such as recognizing illegal signatures. When attackers send some invalid messages, the batch verification may lose its efficacy. This problem commonly accompanies other batch-based verification schemes. Therefore, thwarting the invalid signature problem is a challenging and a topic for study in our future research.

REFERENCES

- [1] Shiang-FengTzeng, Shi-Jinn Horng, "Enhancing security and privacy scheme for identity based batch verification scheme in VANET," IEEE Transaction on Vehicular technology, 2015.
- [2] C. C. Lee and Y. M. Lai, "Toward a secure batch verification with group testing for VANET," Wireless Networks, vol. 19, no. 6, pp. 1441-1449, 2013.
- [3] Shi-Jinn Horng, Shiang-FengTzeng, "b-SPECS+: Batch Verification for Secure Pseudonymous Authentication in VANET", information forensics and security, vol. 8, no. 11, November 2013.
- [4] C. Zhang, R. Lu, X. Lin, P. H. Ho, and X. Shen, "An efficient identity-based batch verification scheme for vehicular sensor networks," in Proceedings of the 27th IEEE International Conference on Computer Communications (INFOCOM'08), pp. 816-824, 2008.
- [5] M. Raya and J. P. Hubaux, "Securing vehicular ad hoc networks," Journal of Computer Security – Special Issue Security Ad Hoc Sensor Networks, vol. 15, no. 1, pp. 39-68, 2007.

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# Correlates of Job Stress and Job Involvement among the Employees of Private Industries Limited, Tiruchirapalli District

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## Abstract

The term 'Job Involvement' is an indicator of how much an employee is involved in his/her job. For an organization, it is important that all its employees are highly involved in their jobs, that is, they should have high level of job involvement. Job involvement appears to be a construct that follows directly from the way individuals are affected by their immediate work environment and interpersonal relationships. Job stress comes in different forms and affects the mind and body in different ways. Major stress comes from having too much or not enough work or doing work that doesn't satisfy the person. Conflicts with the boss, coworkers, or customers are other major causes of stress. Psychological strain is often due to the culture and management style adopted within an organization. The main aim of the study is to study the correlation of Job Stress and Job Involvement among the Employees at Private Sectors in Tiruchirappalli District. In this study the researcher attempts to describe the various characteristics of job involvement and job stress and to measure its associates with the related socio-demographic variable and hence the researcher has adopted descriptive research design. The researcher adopted simple random sampling method to collect the samples. The universe of the study is 210 and out of which 157 were selected as respondents using lottery method. The researcher adopted standardized scale developed by Linkers (1998) to evaluate the stress level and to measure the level of job involvement, the researcher used the standardized tool developed by Agarval (1972). The data was analyzed and the finding reveals that more than half 51.6 percent of the respondents have low level of job involvement and less than half 48.4 percent of the respondents have high level of Job Involvement. The overall Job stress more than half 57.3 percent of the respondents have low level of job stress and less than half 42.7 percent of the respondents have high level of Job stress. The researcher suggest that Management has to involve the union at the highest levels as an equal partner from planning, through implementation, and evaluation of employee Involvement. In order to reduce the stress the management need to arrange work properly, and improve or simplify the work process to avoid long hours of monotonous and repetitive work.

**Keywords:** Job Involvement, Job Stress, Job Autonomy, Job Motivation, Job Commitment

## 1. Introduction

### 1.1 Stress

The term "stress" was first used by psychologist Hans Selye. He later broadened and popularized the concept to include the response of the body to any demand. In Selye's terminology, "stress" refers to a condition, and "stressor" to the internal reaction causing stress. The word is originated from Latin word "STRINGERE" means force and presser.

Job stress comes in different forms and affects your mind and body in different ways. Small things can make you feel stressed, such as a copy machine that never seems to work when you need it or phones that won't quit ringing. Major stress comes from having too much or not enough work or doing work that doesn't satisfy you. Conflicts with your boss, coworkers, or customers are other major causes of stress.

Psychological strain is often due to the culture and management style adopted within an organization. The factors relating to organizational structure and climate that are stressors include hierarchical, bureaucratic structures that allow employees little participation in decisions affecting their work; lack of adequate communication between managerial and non-managerial levels; cynicism regarding leadership and attempts by employees to further their own interest at the expense of others.

### 1.2 Job Involvement

The term 'Job Involvement' is an indicator of how much an employee is involved in his/her job. For an organization, it is important that all its employees are highly involved in their jobs, that is, they should have high level of job involvement. Conceptually, job involvement is an employee's work related attitude which is reflected in his/her enthusiasm, zeal and interest while performing his/her job.

Research on job involvement is comparatively recent and mostly based on extensive contributions of empirically oriented psychologists. It appears that the term 'job involvement' is still in quest of a distinct identity, as there is a problem of semantics. A number of other terms are used by people to convey the same meaning as

'job involvement', such as, attachment to work, central life interest, commitment towards work, intrinsic motivation, ego involvement, morale etc., Paullay, Alliger & Stone Romero (1994) also supports this notion that there are numerous terms such as work alienation, work involvement, job commitment, work commitment etc., that have been used by the researchers to describe attitude or orientation towards one's job; and this leads to considerable confusion in precisely defining the term.

In the opinion of Lodahl & Kenjer (1965), who developed the most celebrated and widely used measure of job involvement, this primary work attitude - job involvement affects people for whom his/her job constitutes the most important portion of life.

Thus, we can conceptualize job involvement as "the degree to which a person identifies psychologically with his/her work or the importance of work in his total self-image. So, in a way, job involvement refers to the internalization of values about the goodness of work or the importance of work in the total worth of the person, and thereby it provides an insight about the ease with which the person can be further socialized by the organization, in the organization. So, job Involvement is a cognitive belief state reflecting the degree of psychological identification with one's job (Lawler (III) & Hall, 1970; Rabinowitz & Hall, 1977)

Supporting the same notion, Agarwala (1978), who has done pioneering research for developing the scale to measure job involvement in Indian context, refers to this construct of job involvement as an individual's willingness to invest himself/herself in their job activities perceived to be meaningful. In his opinion, person who is highly involved in his job is sure to demonstrate a strong desire to be at work, would be willing to exert himself/herself to cope with the demands of the job, consider the work activities as self-rewarding etc. So, job involvement can be considered as an indicator for determining the individual's commitment towards his/her own work/job.

## 2. Review of Literature

**Manisha Jain, Prashant Mishra and Saroj Kothari (2002)** made a study titled Type A/B behavior pattern and occupation as predictors of occupational role stress to understand the effect of Type A/B behavior pattern among doctors and engineers. It is clear from findings that engineers experienced higher occupational role stress than doctors, and Type A personalities experienced higher occupational role stress than Type B personalities.

**Khalid A. (2012)** in his research titled —Role of Supportive Leadership as a Moderator between Job Stress and Job Performance, have found that, there is a direct relationship between stress and job performance in any organization. To improve the performance of an individual in an organization an employee should receive good support from their leaders. Therefore, a supportive leader can improve the performance of an employee even at unfavorable situations.

**Dhanesha (2013)** made a study on A Psychological Study o Job Involvement among B.S.N.L Employees. The sample was consisted of 480 employees of Rajkot district. The Job Involvement Scale was used to measure involvement of the employees. The conclusions drawn were as follows: (1) There is a significant mean differences between education of employees with reference to their job involvement. (2) There is no significant mean differences between types of job of employees with reference to their job involvement.

**G.Kalpna and K. Gunasundari (2016)** made a study on Job Involvement of Bank Employees in Private Sector Banks with Reference to Tirupur District. The study revealed that there is a no significant difference in the level of job involvement among the employees of different age groups and there is no significant difference in the level of job involvement among the married and the unmarried employees at 0.05 level of significance. The study also that there is no significant difference in the level of job involvement among the under graduate and the post graduate employees that demographic variables, namely gender and level of management do influence the job involvement of bank employees

## 3. Research Methodology

Stress is a reality of our everyday life. Stress is a factor that everyone has to contend with on a daily basis in the work and non-work sphere of life. Employees stress is growing concern for organizations today. Job involvement is an indicator of how much an employee is involved in his / her job. When an employee encounters stress in his job, eventually he lacks involvement in performing his / her job. Job stress leads to lack of commitment which affects the performance of an individual, which leads to decrease in job involvement, productivity gets reduced, management pressure is increased and it makes people ill in many ways. Hence this research focus on how Job Involvement and Job Stress Correlates among the Employees at Private Sectors in Tiruchirappalli District. In this study the researcher attempts to describe the various characteristics of job involvement and job stress and to measure its associates with the related socio-demographic variable and hence the researcher has adopted descriptive research design. The researcher adopted simple random sampling method to collect the samples. The universe of the study is 210 and out of which 157 were selected as respondents using lottery method. The researcher adopted standardized scale developed by Linkers (1998) to evaluate the stress level and to measure the level of job involvement, the researcher used the standardized tool developed by

Agarval (1972). The data was analyzed using SPSS.

**4. Findings**

It is found in the study that little more than half 50.3 percent of the respondents were from rural background where as the remaining little less than half 49.7 percent of the respondents were from the urban background. Among the employees more than half 59.9 percent of the respondents were married and while the remaining less than half 40.1 percent of the respondents were unmarried and majority 64.3 percent of the respondents were from joint family and while the remaining one third 35.7 percent of the respondents were from Nuclear Family. While analyzing education more than one third 40.1 percent of the respondents have completed their technical studies (ITI), less than one fourth 22.3 percent of the respondents have completed higher secondary school and below, considerable 15.3 percent of the respondents have completed their Diploma or Engineering studies, considerable 14.6 percent of the respondents have completed high school level studies or below and less than one tenth 7.6 percent of the respondents have completed their graduation.

While analyzing the job involvement, It is inferred that in the dimension of Job Analysis more than half 64.3 percent of the respondents have low level of Job Analysis whereas the remaining little more than one third 35.7 percent of the respondents have high level of Job Analysis. It is observed that in the dimension of Job Interest little more than half 51.6 percent of the respondents have low level of job Interest and less than half 48.4 percent have high level of Job Interest. It is found that in the dimension of Job autonomy little more than half 51 percent of the respondents have low level of job autonomy and little less than half 49 percent of the respondents have high level of Job autonomy. It is perceived that in the dimension of Job motivation more than half 57.3 percent of the respondents have low level of job motivation and less than half 42.7 percent of the respondents have high level of Job motivation. It is found that in the dimension of Job commitment majority 63.7 percent of the respondents have low level of job commitment and little more than one third 36.3 percent of the respondents have high level of Job commitment. It is understood that in the overall Job Involvement little more than half 51.6 percent of the respondents have low level of job involvement and less than half 48.4 percent of the respondents have high level of Job Involvement.

While we examine the stress level, it is observed that in the dimension of Individual stressors more than half 52.9 percent of the respondents have low level of individual stress and less than half 47.1 percent of the respondents have high level of individual stress. It is perceived that in the dimension of Group stressors little more than half 51.6 percent of the respondents have low level of group stress and less than half 48.4 percent of the respondents have high level of group stress. It is understood that in the dimension of Organizational stressors more than half 54.1 percent of the respondents have low level of organizational stress and less than half 45.9 percent of the respondents have high level of organizational stress. It is observed that in the overall Job stress more than half 57.3 percent of the respondents have low level of job stress and less than half 42.7 percent of the respondents have high level of Job stress.

**4.1 Major Findings**

**TABLE 1**

**‘Z’ TEST BETWEEN THE DOMICILES OF THE RESPONDENTS WITH THE JOB INVOLVEMENT AND JOB STRESS**

Dimension	Place of Living	N	Mean	Standard Deviation	Std. Error Mean	Statistical Inference
Overall Job Involvement	Urban	78	97.2436	13.1615	1.4902	Z = .271 P > 0.05 Not Significant
	Rural	79	96.7342	10.2753	1.1560	
Over all Job Stress	Urban	78	88.6026	14.6361	1.6572	Z = 2.794 P < 0.05 <b>Significant</b>
	Rural	79	82.6076	12.1522	1.3672	

From the above table using ‘Z’ Test, it is found that there is no significant difference between the respondent’s place of living and Job Involvement. While analyzing the stress there is a significant difference between the respondent’s place of living and job stress.

**TABLE 2**  
**‘Z’ TEST BETWEEN THE MARITAL STATUSES WITH THE DIMENSIONS OF JOB INVOLVEMENT AND WORK STRESS**

Dimension	Marital Status	N	Mean	Standard Deviation	Std. Error Mean	Statistical Inference
Overall Job Involvement	Married	94	98.308	11.9596	1.233	Z = 1.730 P > 0.05 Not Significant
	Single	63	95.015	11.2687	1.419	
Over all Stress	Married	94	86.6915	14.52179	1.49781	Z = 1.234 P > 0.05 Not Significant
	Single	63	83.9365	12.39520	1.56165	

From the above table using ‘Z’ Test it is found that there is no significant difference between the respondent’s marital status and Job Involvement and work stress.

**TABLE 3**  
**‘Z’ TEST BETWEEN THE TYPES OF FAMILY WITH THE DIMENSIONS OF JOB INVOLVEMENT AND WORK STRESS**

Dimension	Types of Family	N	Mean	Standard Deviation	Std. Error Mean	Statistical Inference
Overall Job Involvement	Nuclear Family	101	96.5842	11.77308	1.1714	Z = -.575 P > 0.05 Not Significant
	Joint Family	56	97.7143	11.81480	1.5788	
Over all Stress	Nuclear Family	101	85.4257	14.9414	1.4867	Z = -.196 P < 0.05 <b>Significant</b>
	Joint Family	56	85.8750	11.3555	1.5174	

From the above table using Z - Test it is found that there is no significant difference between the respondent’s types of family and job involvement and there is a significant difference among respondent’s types of family and job stress.

**TABLE 4**  
**ONE WAY ANALYSIS OF VARIANCE AMONG THE RESPONDENTS EDUCATIONAL QUALIFICATION WITH THE DIMENSIONS OF JOB INVOLVEMENT**

DIMENSION	VARIABLES	SUM OF SQUARES	DF	MEAN	MEAN SQUARE	STATISTICAL INFERENCE
Overall Job Involvement	Between Groups	3172.28	4	G1=107.304 G2=96.7714 G3=93.8730 G4=95.0000 G5= 98.1667	793.071	F = 6.547 p < 0.01 <b>Highly Significant</b>
	Within Groups	18411.6	152		121.130	
Over all Stress	Between Groups	6685.44	4	G1=99.2609 G2=88.3143 G3=81.2698 G4=79.3333 G5=86.5833	1671.36	F = 11.17 p < 0.05 <b>Highly Significant</b>
	Within Groups	22738.6	152		149.596	

G1=10<sup>th</sup>std and below G2=12<sup>th</sup>std and below G3=ITI G4=DME/BE G5=Graduates

From the above table using One Way Anovait is found that there is a highly significant variance among the respondent’s educational qualification and overall Job Involvement and Work stress.

**5. Discussion**

While analyzing the data it is found that employees from urban area seemed to have more job involvement than employees from rural area. In the level of stress it is observed that the employees from urban area had more stress than employees from rural area. It may be because of the personal responsibility and family commitments. It is observed that married employees had more job involvement than unmarried employees. Married employees seem to have more stress than unmarried employees. It may be that once they are married they become responsible and concentrate on the job and get involved. Sometimes if they are not able to achieve their expectations it is natural to go through stress in the job.

Employees living in a Joint family had more Job involvement than employees from nuclear families. It may be that respondents from joint family have understood the family commitments and wants to contribute to the family by getting involved in work and proving himself or herself. Employees from joint family as well as

nuclear family seem to have more or less same level of job stress.

There is a significant variance among the respondent's educational qualification and Job Involvement. There is a significant variance among the respondent's educational qualification and job stress. Based on the educational qualification the work role also changes and more is expected from the educated person. Due to this the educated get more involved and when they are not able to complete or fulfill the requirements they get into stress.

## 6. Suggestion

- Provide training to cope up with stress and relaxation techniques
- Provide good work ambient and provide basic facilities
- More role clarity helps to do the job
- Train the experienced staff members to be like mentors and counselors so that they help the other employees
- Conduct more employee engagement activities
- Get the employees into decision making process – participatory model
- Strengthen the feedback system and concentrate on welfare measures.

## 7. Conclusion

This research study aimed at finding the correlation between the job stress and job involvement among the employees of private sectors at Tiruchirapalli. It revealed in the finding the influence of domiciles of the respondents, marital statuses of the respondents, educational qualification of the respondents on the level of job stress and the level of job involvement.

Job stress needs to be addressed and the efforts have to be done by employee as well as the organization. In order to increase the job involvement of the employees the organization has to get them involved in the decision making process and increase employee engagement activities.

Sharing of responsibility, proper rewards and recognition, proper working conditions, proper pay, clear cut role definition, active role of the unions and work committees would help the organization to reduce job stress and increase the job involvement. When job involvement increases in an organization it is bound to be a successful one with less job stress. So job involvement and reducing the job stress has to be addressed simultaneously by the organizations in order to be a successful industry.

## References

- Agarwala, U. N. (1978) Measuring job involvement in India. *Indian Journal of Industrial Relations*, 4, pp219-31
- Ahmad, A. & Ansari, S.A.(2002). Effect of income and job tenure on job involvement. A study of Craftsman. *Journal of Community Guidance and Research*.17(3),pp-271-275.
- DeepaAnandhaPriya, (2013) "A Study on Job Stress of Women Employees in IT and ITES Industries, Tamilnadu" *Asia Pacific Journal of Research*, Vol.1, Issue.7, pp. 10 – 17
- Dhanesha, M. H. (2013). A Psychological Study of Job Involvement Among B.S.N.L. Employees. *Paripex - Indian Journal Of Research*, 2(4), 9-10.
- Kalpana, G. (2016). A Study on Job Involvement of Bank Employees in Private Sector Banks with Reference to Tirupur District. *Global Journal For Research Analysis*, 5(2), 237-239.
- Khalid, (2012) Role of Supportive Leadership as a Moderator between Job Stress and Job Performance, *Information Management and Business Review*, 4(9), 487-495
- Lodahl, T.M. &Kejner, M. (1965). The definition and measurement of job involvement. *Journal of Applied Psychology*, 49, 24-33.
- Paullay, I., Alliger, G., and Stone-Romero, E. (1994). Construct validation of two instruments designed to measure job involvement and work centrality. *Journal of Applied Psychology*, 79, 224-8.
- Rabinowitz, S. & Hall, D.T. (1977) . *Organizational Research on Job Involvement*. *Psychological Bulletin* , 84, 265- 288.
- Rabinowitz, S. , Hall , D.T. &Goodale, N.G. (1977) . *Job Scope and Individual Differences as Predictor s o f Job - Involvement: Independent or Interactive*. *Academy of Management Journal*, 20 , 273-281 .
- Selye, H. *The stress of life* (rev. ed.). New York: McGraw-Hill. 1984.

## Portrayal of Post Modern Myth in John Barth's *Chimera*

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### Abstract

The present paper concentrates on the Portrayal of Post Modern Myth in John Barth's *Chimera*. It aims to exhibit how the writer recycled myth in his creation through the reconstruction of this concept, consisting importantly in demythologization, revealing its central ridiculous situation and literary reprocessing. In order to understand the multi facet application of myths in *Chimera*, the article analyzes the subject from different aspects. Subsequently offering some preliminary remarks concerning the traditional history and meaning of myth, the first part of the article turns on to tracing Barth's partiality as well as argumentative with distinct philosophical views and literary theories as far as the sort of myth is discussed. The second part of this paper is concerned to the dissection of the understanding of myth in order to storytelling, understood especially in the nature of existence and epistemological conditions.

### Introduction

The term 'Mythos' derived from Greek. The word 'Myth' signifies any story or plot, whether true or false. Most of the myths involve rituals – prescribed forms of sacred ceremonial but social anthropologists disagree as to rituals generated myths or myths generated rituals. If the central character is a man rather than a supernatural being, the story is not called myth but legend. A mythology in which no longer believes in any religion. The word has also explained to signify the supernatural tales which are intentionally used by their authors. Many writers have also stated that fuse mythology, whether heredity or made up is important to literature. James Joyce's *Ulysses*, Eliot's *The Waste Land*, O'Neill's *Mourning Becomes Electra*, John Barth's *The Sot-Weed Factor* and *Chimera* and many other authors have thoughtfully produced their works in the form of ancient myths, Now Myth is one of the most famous

terms in contemporary literature, In addition to myth, is firmly imagined place in which a work of art appears in Faulkner's myth of yoknapatawpha country' and 'the mythical worlds of *Moby Dick*.

Myth can be considered as religious belief, primary archetype, structural lexical model, mode of cognition, political promulgation. We could rethink to its Greek origin: myth is the foremost a narrative story since, and then at the consequence of every myth lays a tale. According to Edmund Leach Mythology involves both of the East and the West, mythic stories around Man and Gods and then concentrating on the reciprocal relations between the two worlds. (quoted in Warrick 75). In this context, Mythopoeia is an instrument for grand sense, perception, and interpretation of the surrounding reality. In the minds of artists, myths have known as multiple transformations their literary traditions were changing along with cultural, philosophical, political and social changes.

But it was no other span than postmodernism that interchanged myth into a bunch of contradictory definitions. Thus in this regard, myth gained the degree of literal meaning of the fundamental concept of post-modern philosophy. Miserably, it is impossible to find the whole idea of myth related postmodern texts, let alone to show all the dimension of myth portray by postmodern writers in such a creative writing. As a result, it will be confined to defendable the most important of them, John Barth's fiction *Chimera*(1972) explained by other dignified postmodernists such as Thomas Pynchon, Donald Barthelme or Kurt Vonnegut remarks to mythology can be beheld as a peripheral affection, restructure and revising of myths constructs the core of Barth's literary work.

Since Barth's mythical works are dealt with highly sensitive, at times bound on misunderstanding because of the collection of formal experiments. Most often focused at disturbance and dissolution of narrative formula, literary critics aim to approach Barthian depiction of myths in a somewhat unique manner. Barth's mythopoeia involves holistic approach, formally, co-existences of binaries and which encircles more precise post-modern to be more precise which encircles, co-existences of binaries and inappropriate. Therefore in this chapter will analyze to show how John Barth delivers and regenerate myth in his writing by controverting this ' Bizarre' and unrealistic, as Robert Graves puts it gently in his prologue to *The Greek Myths* (1992:11) Since Barth's close study incarnated by Genie in Dunyazad in *Chimera*. This fiction states straightly while annotating on stories:"

the quality of art, which if it could not ...save us the revulsion of living and dying, at least retained, reviewed, spread out and fertilized our spirits along the way".(*Chimera*, 17)

In order to understand the multi-access of mythology in John Barth's *Chimera* will scrutinize this subject from distinguished perspectives. This chapter is based on the author's kinship as well as controversy with the typical philosophical tendency and literary theories, which can be described in *Chimera*. The aim of the section is to reveal both external source of Barthian myth and its internal references within the fiction. The meaning of myth, analyses chiefly relating to storytelling so as to come out with the postmodern perception of human existence, established by one of the most popular American storytellers.

In the second part of Barth's *Chimera* finds on the mythological sketch of the twentieth century, let us deliberate for a while at those who prepared this sketch for future generation. Obviously, two famous writers of modernism Carl Jung Swiss Psychiatrist and Joseph Campbell American mythologist established the most extreme theory of myths, contributing psychology, linguistics, and literature into a new sphere. As a result of these writers, an absurd folk tales and legends were now supplied with depth meaning since, conforming to the modern approach, they delivered a fragment of universal truths and knowledge. According to Jung myths are "original preconscious psyche, automatic articulation about unconscious psychic events" (Graves 1992:21-22). On another hand, Campbell rather on human pre-consciousness attracted

more on the impressions controlling effectively all kinds of narratives, which he named "Monomyths" (a simple concept of Levi- Strauss's 'mytheme'). There are some differences in these theories; Jung and Campbell arose a mainstream movement references to myths a quality of mythical experiences, locating it on the point of the intrinsic and abstract, which is outlying from Barth's approach towards myths.

In the third part of his fiction, the author briefly gives us, with his self-aesthetic view on how myths should be treated. Barth asserts his readers that myths themselves one amidst another concept poetic mixture of our simple psychic experience and so situation always to daily experience, to create realistic stories which mark always to mythic form is in his opinion to share the wrong end of the mythological stick, on the other hand outstanding such fictions may be in another consideration. He is better to take the forms of myths directly (*Chimera*, 199). By this central reason why the most salient features of *Chimera* applies to modify, which deals mainly in discovering the model of hero -hood. Consequently, we are expounded with two demigods from Greek mythology Perseus and Bellerophon, not in the pinnacle of their lives, but living through a difficult mid -life dilemma. The former criticizes about his marriage with Andromeda, which is his mental and physical strength. He said that he has been twenty kilos bulky and bored inflexible. He felt repressed and repository. Eventually, he is frustrated by "forty and too tired" (*Chimera*, 71). Barth obviously focuses on the end of the mythological stick, rejecting formal patterns in favor of everyday reality.

The critic, Jerry Powell exhibits most interestingly to this discussion, making distinguish between Barth's and Grave's theory of mythology. According to Powell, Barth looks to be given towards Graves theory of myth, looked as "reduction to the narrative record of ritual mockery". This is clearly what the author of *Chimera* exclaims "poetic infusion of our ordinary knowledge"(Powell 1976:76). The model of a hero is rejected by "a warm human being, off his substructure", who is simply a man with a story to narrate "(*Chimera*, 70). Furthermore, this is personal, not a collective or combined, a story upon which nobody should involve as if it were a figure to follow, chiefly if we accept the fact that the alleged hero is lost and baffled in his mythic life.

Barth narrates the two mythic heroes, Perseus and Bellerophon at the main point of their lives, both are bygone the lives of their magnificence and glory. At first, Perseus fails his battle for rebirth because he carefully grasps to the heroic figure. Dispirited, tired and bored with his life, he analyses to recur the delightful deeds of his youth. This intrinsic excursion to do so stems not very much from variety but rather from an attraction to discover the pattern, the important to his story. And he declares for the pattern guides him disposition, direct into Lake Triton, above which he once perfectly operated with Medusa's head. His failure is created by the refusal of Athene's advice. This type of research in the second activity must be opposite to his first one: on the other hand, direct instead of not straight (*Chimera*, 94-95). if a man forty and more, he cannot do like a youth. So far Perseus is

unused by Barth and allowed a second chance. On the contrary falling in the lake, he detects himself caught to by the kindhearted Calyxa, a faithful student of mythology. He becomes his pupil caretaker, beloved, and teacher. The images of Calyxa temple display twist in Perseus heroic profession. Finally, he thinks that in order to alive, he must move outside the pattern, exchange it and the modifying circumstances, instantly, as Medusa, or New Medusa is created to live by Athene, Perseus sets to meet her again and accept his earlier fault. She is in affection with him, once she actually secured him from drowning in the lake. If he really accepts her feelings, he will be awarded immortally instead of demoralized with new benefited consciousness of the artifice of the pattern, which was lower than a hateful device contrived by King Polydectes with regard to disposes of Perseus , he looks Medusa, kisses her and agrees placed in the heavens to settle with his beloved Literary critics among them Paul Vickery and Bronwen Whitehead accept that Perseus correction, which affects to excel the pattern and going beyond transforming the strong structure of the story. It is the clear manifestation of the pattern towards myths.

Barthian theory of "Mythemes", accepted as literary characters, is more even noticeable in Perseid's twin sister, Bellerophoniad. However, Bellerophon's story is a slight change o Perseid, highlighting while domain of ghosts, reiterates and assimilates (a wife of a royal header, an over, a supernatural being to kill, a duplicitous plot objected to the hero and an idealistic journey replaying the past). It should convey him similar

statements, Bellerophon's myth enhances a mere imitation of his role exemplary Perseus. It tries to maintain the Pattern at all cost, Bellerophon fails everything including his own personality as the god asserts that: "By paralleling perfectly the Pattern of the Mythic Heroism, Bellerophon become a classical imitation of the mythic hero"(Chimera, 299). In an almost unconscious repetition of his past (or the pattern f the mythic story) he culminates in being himself and reverses into "the comic comparison of Perseus ... without self – consciousness"(Powell 1976: 62).

### Myth as post modern philosophy

In this process of myth is Barth's allegory for fiction, story and literature in common, myth –maker equals story teller. And in post modern perception, "to narrate a story" more often than not is at same time moving the entertaining dimension of a story into the backdrop. Internally, *Chimera* acts the same form. In Perseid and Bellerophoniad both conception and summation of myths seem to be the only way of understanding of human beings, imperfect and confusing as it is. This is why Perseus, likewise his less fortune follower, goes to replay the story of his life just so as to free himself from the attack and confusion delivered by the absence of knowledge of who he is and what the meaning of his life is . his second adventure for hero hood comes a query for understanding and meaning, like he defines to Calyxa descriptively: on that account this infinite repetition of my story: as both hero and author, so to assert, I hope to defeat with understanding my adjust chapter as it were by exploring my labeled past, and thus noted, proceed clear to the future's book"

(*Chimera*, 80-81). Though description our life, Barth pretend to say, we imagine ourselves a different, and only like this can we study anything about the nature of life in the world. This is what the writer calls "Mythotherapy", a word seeming in his earlier fiction entitled *The End of the Road*. In a point of view, its hero, Jacob Horner, shows the same depression of mid-life dilemma as our two mythic heroes and his physician cures his epistemological crisis with the above remarked mythotherapy. As Barth asserts that not only are we the heroes of our own life tales but also we're the ones who accept the story, and other people transfer nature of minor characters. But since no one's life as a rule is consistently one story with a plot, we are always believing just the type of hero we are, therefore just the role of minor characters that other people are accepted to play. This kind of role playing is myth making. (*The End of the Road*, 337)

### **Conclusion**

From the deep discussion of Barth's *Chimera*, we can freely evaluate that his analysis of myth is new and contrary and, above all, highly complicated. In his fiction,

he invariably escapes explicit directions, parting far from the traditional forbearing of mythopoeia. Although *Chimera* truly seems to accompany the utmost deformity of myth, then extending it to the limits of understanding, it is also ridiculing, disproving and mistreated its literary, traditional and philosophical foundations, which peculiarly enough appears in myth's inevitable restoration.

With regard to refresh this rigid form, Barth achieves involved on the pages of *Chimera* argument with the modernist and the structural method toward myth, the ones truly responsible for its significative failure. Hence, through the use of Perseus and Bellerophon myths are appearing them as the tale of a fake and a true hero. Barth demolishes the concept of forms, devices and designs, exposing the misconception behind fatiguing to follow structures at all and pursuing structures the highly enigmatic, unreality and openly, at all times utterly confused world. For such a world, Barth assumes to assert, many meaning or sense is able to come out from disorder rather than order. In this subject, myth already agitated and altered, works as a skillful example of post modern philosophy.

### **Reference:**

1. Barth, John. "The literature of exhaustion" New York: *The Atlantic* publications (220: 29-34). 1967
2. Barth, John. *The End of the Road*. London: Granada Publishing. 1981.
3. Barth, John. *Giles Goat-Boy*. New York: Anchor Books. 1987.
4. Barth, John. *Lost in the Funhouse*. New York: Anchor Books. 1988.
5. Barth, John. *Chimera*. London: Quartet Books. 1997.
6. Graves, Robert. *The Greek Myths*. London: Penguin Books. 1992.
7. Lindsay, Alan. *Death in the FUN house*. New York: Peter Lang. 1995.

8. Powell, Jerry. "John Barth's *Chimera*: A creative response to the literature of exhaustion". *Critique: Studies in Contemporary Fiction* (18/2: 59-72). 1976.
9. Roemer, Marjorie Godlin. "The paradigmatic mind: John Barth's *Letters*". *Twentieth Century Literature* (33/1: 38-50).1987.
10. Vickery, John B. "The functions of myth in John Barth's *Chimera*". *Modern Fiction Studies* (38/2: 427-435).1992.
11. Warrick, Patricia. "The circuitous journey of consciousness in Barth's *Chimera*". *Critique: Studies in Contemporary Fiction* (18/2: 73-85).1976

RESEARCH CHRONICLER

## SIBEDE Approach For Total Graph of Path And Cycle Graphs

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**Abstract:** Let  $G(V(G), E(G))$  be a graph with  $n$  vertices is said to be Binary Equivalent Decimal Edge Graceful Labeling (BEDE) graph if the vertices are assigned distinct numbers from  $0, 1, 2, \dots, (n-1)$  such that the labels induced on edges by the values obtained using binary equivalent decimal coding of end vertices for each edge which are distinct. A graph  $G$  is said to be Strong Incident Binary Equivalent Decimal Edge Graceful Labeling (SIBEDE) if the vertices of  $G$  are labeled with distinct positive integers from  $0, 1, 2, \dots, (n-1)$  such that the label induced on the edges by Binary equivalent decimal coding are distinct from the vertex labeling. This paper is concerned with the SIBEDE approach of total graph of path and cycle.

**Key words:** BEDE • Binary • Graceful • IBEDE • Incident • Labeling • SIBEDE • Total graph

### INTRODUCTION

Graph Labeling is a most vital area of Research in Graph theory. A Labeling of graph is where the vertices or edges or both are assigned real values by following some specific rule. Labeling plays an important role in Communication network addressing the system to determine optimal circuit design, Data base management, crystallographic etc. . Open problems in Labeling graph are discussed on Graph labeling by J.A. Gallian (2015) can be found in [1]. To any Graph  $G$  there corresponds a  $v \times e$  matrix called incident matrix of  $G$  [2]. Let us denote the vertices of  $G$  by  $v_1, v_2, \dots, v_n$  and edges by  $e_1, e_2, \dots, e_m$ . Then the incident matrix of  $G$  is the matrix  $B(G) = [b_{ij}]$  where  $b_{ij}$  is the number of times that  $v_i$  and  $e_j$  are incident. The Total Graph  $T(G)$  [3] [4] of graph  $G$  is a graph with vertex set  $V(G) \cup E(G)$  and two vertices  $x, y$  in  $T(G)$  are adjacent if either (i)  $x, y$  are in  $V(G)$  and  $x$  is adjacent to  $y$  in  $G$  or (ii)  $x, y$  are in  $E(G)$  and  $x, y$  are adjacent in  $G$  or (iii)  $x$  is in  $V(G)$ ,  $y$  is in  $E(G)$  and  $x, y$  are incident in  $G$ .

### Strong Binary Equivalent Decimal Edge Graceful Labeling

### Strong Incident Binary Equivalent Decimal Edge Graceful Labeling

**Definition:** A graph  $G = (V(G), E(G))$  be a graph with  $n$

vertices is said to be Incident Binary Equivalent Decimal Edge (IBEDE) Graceful labeling [5], if there corresponds a  $V \times E$  matrix called incident matrix and  $f$  is a bijective mapping from vertices to the set of integers  $\{0, 1, 2, \dots, (n-1)\}$  such that the induced map  $f$  from edge set to integers which is defined as;

$$f: V(G) \rightarrow \{0, 1, 2, \dots, (n-1)\}$$

$f: E(G) \rightarrow \{1, 2, 3, 4, 5, \dots, m\}$  ( $m$  is finite) such that the edges are labeled with the values obtained from binary equivalent decimal coding. It is also equivalent to  $e_k = (i, j) = 2^{n-i-1} + 2^{n-j-1}$  where  $k = \{1, 2, 3, \dots, q\}$  and  $i, j$  are finite positive integer labeled for end vertices of  $e_k$ ,  $n$  is the number of vertices in  $G$ .

**Definition:** A graph  $G = (V(G), E(G))$  be a graph with  $n$  vertices is said to be Strong Incident Binary Equivalent Decimal Edge Graceful Labeling (SIBEDE) [6], if the vertices of  $G$  are labeled with distinct positive integers from  $0, 1, 2, \dots, (n-1)$  such that the label induced on the edges by Binary equivalent decimal coding are distinct from the vertex labeling.

### Example

(i) consider Total Graph  $T(P_n)$  (for  $n$  odd)

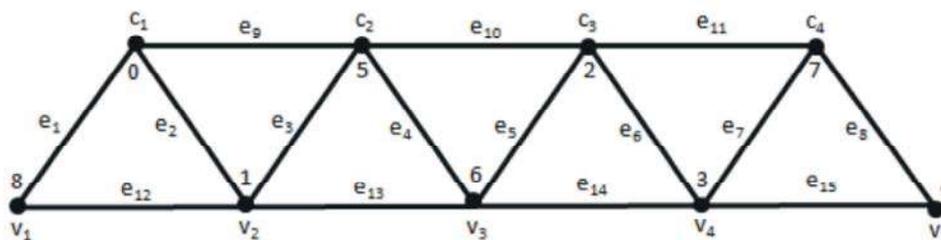


Fig. 1: Total Graph  $T(P_5)$   
Binary Equivalent Decimal Edge Labeling for Total Graph  $T(P_5)$

	0	1	2	3	4	5	6	7	8	
$e_1$	1	0	0	0	0	0	0	0	1	257
$e_2$	1	1	0	0	0	0	0	0	0	384
$e_3$	0	1	0	0	0	1	0	0	0	136
$e_4$	0	0	0	0	0	1	1	0	0	12
$e_5$	0	0	1	0	0	0	1	0	0	68
$e_6$	0	0	1	1	0	0	0	0	0	96
$e_7$	0	0	0	1	0	0	0	1	0	34
$e_8$	0	0	0	0	1	0	0	1	0	18
$e_9$	1	0	0	0	0	1	0	0	0	264
$e_{10}$	0	0	1	0	0	1	0	0	0	72
$e_{11}$	0	0	1	0	0	0	0	1	0	66
$e_{12}$	0	1	0	0	0	0	0	0	1	129
$e_{13}$	0	1	0	0	0	0	1	0	0	132
$e_{14}$	0	0	0	1	0	0	1	0	0	36
$e_{15}$	0	0	0	1	1	0	0	0	0	48

(ii) consider Total Graph  $T(P_6)$  (for n even)

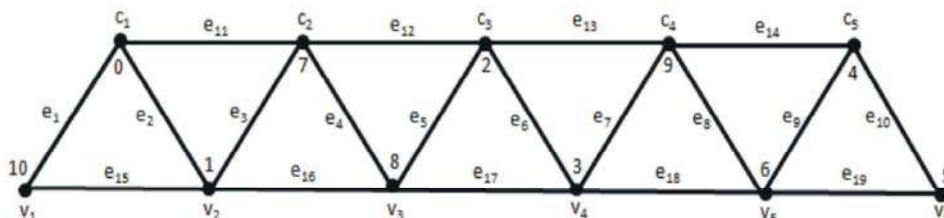


Fig. 2: Total Graph  $T(P_6)$   
Binary Equivalent Decimal Edge Labeling for Total Graph  $T(P_6)$

	0	1	2	3	4	5	6	7	8	9	10	
$e_1$	1	0	0	0	0	0	0	0	0	0	1	1025
$e_2$	1	1	0	0	0	0	0	0	0	0	0	1536
$e_3$	0	1	0	0	0	0	0	1	0	0	0	520
$e_4$	0	0	0	0	0	0	0	1	1	0	0	12
$e_5$	0	0	1	0	0	0	0	0	1	0	0	260
$e_6$	0	0	1	1	0	0	0	0	0	0	0	384
$e_7$	0	0	0	1	0	0	0	0	0	1	0	130
$e_8$	0	0	0	0	0	0	1	0	0	1	0	18
$e_9$	0	0	0	0	1	0	1	0	0	0	0	80
$e_{10}$	0	0	0	0	1	1	0	0	0	0	0	96
$e_{11}$	1	0	0	0	0	0	0	1	0	0	0	1032
$e_{12}$	0	0	1	0	0	0	0	1	0	0	0	264
$e_{13}$	0	0	1	0	0	0	0	0	0	1	0	258
$e_{14}$	0	0	0	0	1	0	0	0	0	1	0	66
$e_{15}$	0	1	0	0	0	0	0	0	0	0	1	513
$e_{16}$	0	1	0	0	0	0	0	0	1	0	0	516
$e_{17}$	0	0	0	1	0	0	0	0	1	0	0	132
$e_{18}$	0	0	0	1	0	0	1	0	0	0	0	144
$e_{19}$	0	0	0	0	0	1	1	0	0	0	0	48

**Theorem**

For all  $n \geq 3$  the Total Graph  $T(P_n)$  of a path graph  $P_n$  with  $n$  points is SIBEDE graceful labeling graph.

**Proof:**

Let  $V = \{v_1, v_2, v_3, \dots, v_n, c_1, c_2, \dots, c_{(n-1)}\}$  be the vertex set and  $E = E_1 \cup E_2 \cup E_3 \cup E_4$  be the edge sets of Total graph  $T(P_n)$  where

$$E_1 = v_i v_{i+1}, 1 \leq i \leq (n-1), E_2 = c_i v_i, 1 \leq i \leq (n-1), E_3 = c_i v_{i+1}, 1 \leq i \leq (n-1),$$

$$E_4 = c_i c_{i+1}, 1 \leq i \leq (n-2)$$

Let the total number of vertices of total graph  $T(P_n)$  be  $(2n-1)$ .

Define a bijective mapping  $f: V(T(P_n)) \rightarrow \{0, 1, 2, \dots, 2(2n-1)\}$

Case (i)  $n$  is Odd

$$f(v_i) = 2n - i - 1 \text{ for } i = 1, 3, 5, \dots, n$$

$$f(v_i) = i - 1 \text{ for } i = 2, 4, \dots, (n-1)$$

$$f(c_2) = n$$

$$f(c_{j+2}) = f(c_j) + 2 \text{ for } j = 2, 4, \dots, (n-1)$$

$$f(c_j) = j - 1, \text{ for } j = 1, 3, \dots, (n-2)$$

Case (ii)  $n$  is Even

$$f(v_i) = 2n - i - 1 \text{ for } i = 1, 3, 5, \dots, (n-1)$$

$$f(v_i) = i - 1 \text{ for } i = 2, 4, \dots, n$$

$$f(c_j) = n - 1 + j \text{ for } j = 2, 4, \dots, (n-2)$$

$$f(c_j) = j - 1, \text{ for } j = 1, 3, \dots, (n-1)$$

Now we define an induced function  $f^*: E(T(P_n)) \rightarrow \{1, 2, \dots, m\}$  ( $m$  is finite) such that the edges are labeled with the values obtained from binary equivalent decimal coding or using  $e_k = (i, j) = 2^{2n-i-2} + 2^{2n-j-2}$  where  $k = \{1, 2, 3, \dots, (4n-5)\}$  and  $i, j$  are finite positive integers labeled for the edge  $e_k$ . Hence the induced map  $f^*$  gives the distinct labels for edges which is distinct from vertex labeling. So the Total Graph  $T(P_n)$  of a path graph  $P_n$  is SIBEDE graceful labeling graph.

**Example 2:**

(I) Consider the Total Graph  $T(C_5)$  (for  $n$  odd)

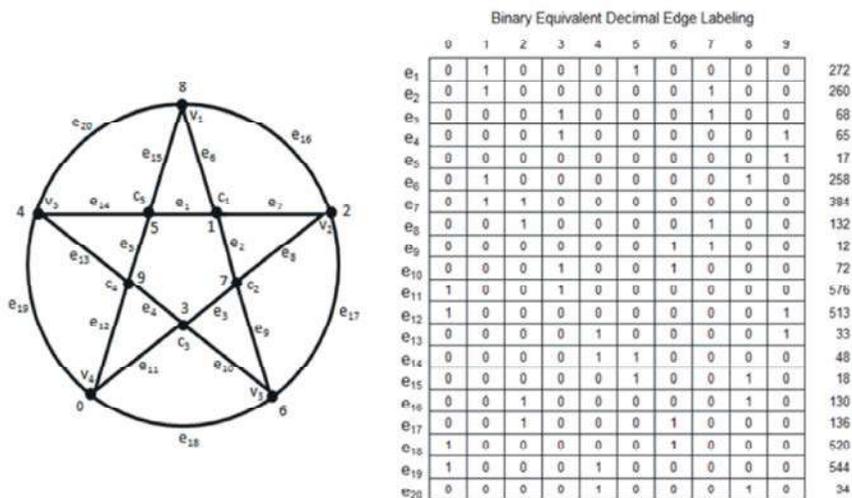


Fig. 3: Total Graph  $T(C_5)$

(ii) Consider the Total Graph  $T(C_6)$  (for  $n$  even)

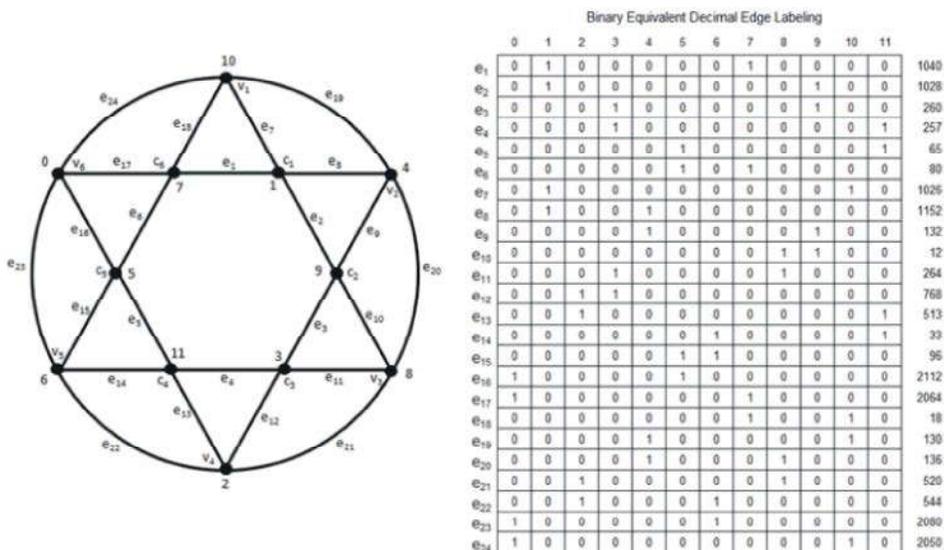


Fig. 4: Total Graph  $T(C_6)$

**Theorem**

For  $n \geq 5$  the Total Graph  $T(C_n)$  of Cycle graph  $C_n$  with  $n$  points is SIBEDE graceful Labeling Graph.

**Proof:**

Let  $V = \{v_1, v_2, v_3, \dots, v_n, c_1, c_2, \dots, c_{(n-1)}\}$  be the vertex set and  $E = E_1 \cup E_2 \cup E_3 \cup E_4 \cup E_5$  be the edge sets of Total graph  $T(C_n)$  where

$$E_1 = c_i v_{i+1}, 1 \leq i \leq n, E_2 = c_i v_i, 1 \leq i \leq (n-1), E_3 = c_i c_{i+1}, 1 \leq i \leq (n-1),$$

$$E_4 = v_i v_{i+1}, 1 \leq i \leq (n-1) \text{ and } E_5 = c_n v_1, c_n c_1, v_n v_1.$$

Let the total number of vertices of total graph  $T(C_n)$  be  $2n$ . Define a bijective mapping  $f: V(T(C_n)) \rightarrow \{0, 1, 2, \dots, (2n-1)\}$

Case (i)  $n$  is Odd

$$\begin{aligned} f(v_1) &= 2(n-1) \\ f(v_i) &= f(v_{i-2}) - 2 \text{ for } i = 3, 5, \dots, n \\ f(v_i) &= n-1-i \text{ for } i = 2, 4, \dots, (n-1) \\ f(c_j) &= j \text{ for } j = 1, 3, \dots, n \\ f(c_j) &= n+j \text{ for } j = 2, 4, \dots, (n-1) \end{aligned}$$

Case (ii)  $n$  is Even

$$\begin{aligned} f(v_1) &= 2(n-1) \\ f(v_i) &= f(v_{i-2}) - 2 \text{ for } i = 3, 5, \dots, n-1 \\ f(v_i) &= n-i \text{ for } i = 2, 4, \dots, n \\ f(c_j) &= j \text{ for } j = 1, 3, \dots, (n-1) \\ f(c_j) &= n+j+1 \text{ for } j = 2, 4, \dots, (n-2) \\ f(c_n) &= n+1 \end{aligned}$$

Now we define an induced function  $f: E(T(C_n)) \rightarrow \{1,2,\dots,m\}$  ( $m$  is finite) such that the edges are labeled with the values obtained from binary equivalent decimal coding or using  $e_k = (i,j) = 2^{2n-i-1} + 2^{2n-j-1}$  where  $k = \{1,2,3,\dots,4n\}$  and  $i,j$  are finite positive integers labeled for the edge  $e_k$ .

Hence the induced map  $f$  gives the distinct labels for edges which is distinct from vertex labeling.

So the Total Graph  $T(C_n)$  of Cycle graph  $C_n$  is SIBEDE graceful Labeling Graph.

**Proposition:** Total graph  $T(C_3)$  and  $T(C_4)$  are not SIBEDE graceful graphs since degree of each vertex is 4.

**Proposition:** Every total graph  $T(C_n)$  is SIBEDE graceful graphs only if the degree of each vertex is less than 'n'

**Observation:**

- Total Graph  $T(P_n)$  of Path  $P_n$  is planar. (It is explained in Example 1)
- Total Graph  $T(C_n)$  of Cycle  $C_n$  is planar. (It is explained in Example 2)
- Total Graph of connected graph need not be planar. (It is explained in Example 3)

**Example 3:**

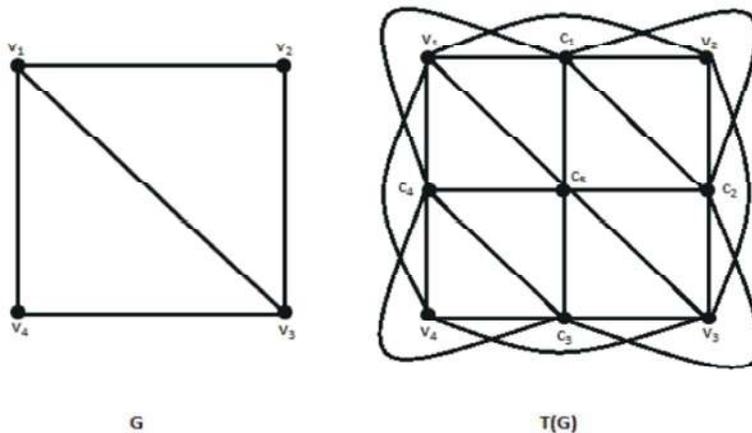


Fig. 5: Connected Graph G

**CONCLUSION**

In this Paper the Total graph of path and cycle are proved as strong Incident Binary Equivalent Decimal Edge (SIBEDE) graceful labeling and the Planarity of total graph of path and cycle are discussed.

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**REFERENCES**

1. Gallian, J.A., 2015. A Dynamic Survey of Graph Labeling, The Electronic journal of Combinatorics.
2. Bondy, J.A. and U.S.R. Murty, 1976. Graph Theory with Applications, London Macmillan.
3. Michalak, D., 1983. On Middle and total graphs with coarseness number equal 1; Lecture. Notes in Mathematics, Volume 1018: Graph Theory, Springer-Verlag, Berlin, pp: 139-150.
4. Kavitha, K. and N.G. David, 2012. Dominator Chromatic Number of Middle and total Graphs" in International Journal of Computer Applications (0975 - 8887), pp: 49.
5. Rajeswari, V. and K. Thiagarajan, 2016. Study on Binary Equivalent Decimal Edge Graceful Labeling in Proceedings of International conference on Emerging Techniques in Engineering, Science and Management (ICETESM2016), pp: 29-33.

6. Rajeswari, V. and K. Thiagarajan, 2016. Study on Strong Binary Equivalent Decimal Edge Graceful Labeling in Proceedings of International conference on Emerging Techniques in Engineering, Science and Management (ICETESM2016) pp: 186-192.
7. Frank Harray, Graph Theory, Narosa Publishing House pvt.ltd- ISBN 978-81-85015-55-2.