iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** X **Month of publication:** October 2021

DOI: https://doi.org/10.22214/ijraset.2021.38555

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue X Oct 2021- Available at www.ijraset.com

Secure and Energy Efficient Data Transaction in WSN through SSCHS Routing Protocol

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Abstract: ***Wireless sensor networks are widely used due to its usage and advantages because it can utilize in mission critical tasks. One of the major issues in WSN is reliable data delivery without any loss and to increase network lifetime by utilizing energy efficient process. The objective of this work is to increase network lifetime at the same time ensuring high packet delivery ratio. Clustering is one of the best methods to increase network lifetime, however election process of cluster head will consume energy and reduces network performance. Therefore in proposed work, energy efficient cluster based routing protocol has been implemented which includes residual energy and distance as major parameter to form cluster. Cluster head selection will be a static process, once cluster is formed cluster head will be selected through election process after transaction the residual energy in CH will be checked with the threshold value and same CH will again act as head this reduces cluster formation and election process. In addition to provide secure data transaction MD5 algorithm has been implemented. Attack based data loss is also reduced and concentrated in proposed work to achieve objective of this work.***

Keywords: (SSCHS) Secure static cluster head selection, network lifetime, cluster, MD5 and Static cluster head.

I. INTRODUCTION

WSN's have turned into an indispensable piece of assorted applications like ecological observing, military observation, and medication by giving plausible correspondence, dependable examination, and performing applications. WSN's are made out of countless sensor hubs which are thickly conveyed and remotely imparted to send and get natural data. The wireless sensor network is a type of ad hoc networks, in it, the sensed data transferred to the sink or base station in multi-hop routing method through several sensors. Ad-hoc network has neither specific infrastructure nor centralization as in traditional network, also it is subject to topology change in the event of node move, node death or new node joins.

Figure 1 explains basic components of WSN. The collection of sensor nodes create a network here the gathered information is transmitted to base station and connected to internet. The user who needs information can get the data through query. To achieve secure and efficient data transaction energy efficient routing algorithm is needed. Hence clustering is one of the efficient methods in achieving minimum energy consumption for data transaction.

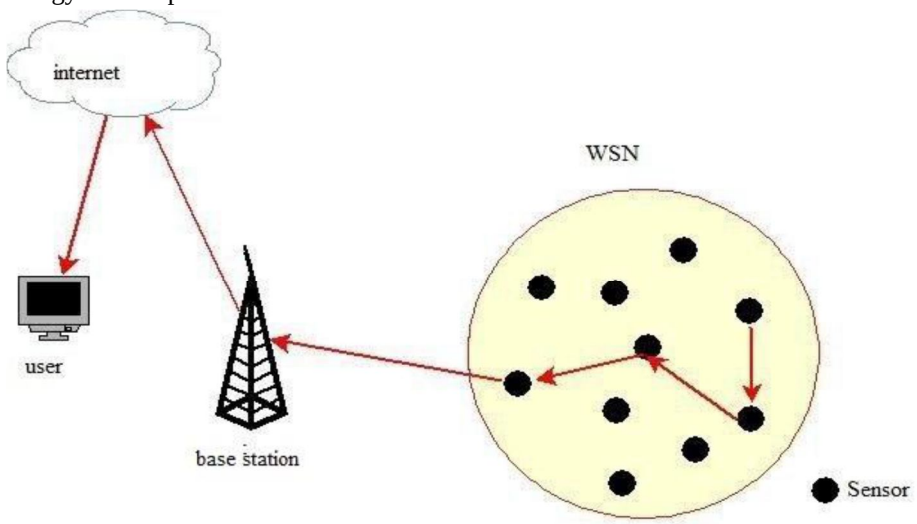

Figure 1: Basic components of WSN

A. *Clustering*

Clustering is a basic mission in Wireless Sensor Networks for energy effectiveness and network constancy. Grouping in remote sensor networks is notable and being used for quite a while. Presently clustering over appropriated techniques is being advancing for managing the issues like network lifetime and energy. Clustering in sensor hubs is vital to tackle numerous issues like adaptability, energy and lifetime issues of sensor organizations. Clustering algorithm inaugurates the communication among its nearby domain and forward data to the remaining nodes in the network through forwarding nodes (gateway nodes). A gathering of nodes structure a bunch and the neighbourhood collaborations between group individuals are controlled through a cluster head (CH). Cluster members generally communicate with the group head and the gathered information are accumulated and melded by the cluster head to moderate energy. The group heads can likewise shape another layer of clusters among themselves prior to arriving at the sink.

B. *Need of security in WSN*

Security is needed in WSN for ensuring reliable data delivery during data transaction. However various encryption algorithms provide high level security at the same time it will consume more amount of energy for it. It will automatically reduce lifetime of the network. Hence an algorithm should be implemented which should provide high security with less energy consumption is represented as light weight encryption algorithm.

C. *Objective Of Our Work*

1) To reduce energy consumption in network to increase network lifetime and to enhance performance of the network.
2) To obtain minimum energy consumption clustering is used.
3) In heterogeneous network energy of nodes will vary which is not predictable in that kind of network efficient routing protocol is needed.
4) To avoid data loss during transaction held by attackers secure data transaction using optimal encryption algorithm is implemented.

II. LITERATURE SURVEY

Yun-Sheng Yen (2010) depicts remote sensor networks become another approach to get data from an intriguing region. There are numerous broad utilizations of remote sensor organizations, for example, climate checking, reconnaissance, foe following, and so forth Since the accessible energy of sensor hubs are restricted and difficult to reestablish, energy management is basic for hubs and organization lifetime in remote sensor organizations. This paper propose another strategy to further develop ACPM and tackle the issue of separated hubs and to draw out their lifetime. After group development, the segregated hubs steadily upgrade their transmission range till tracking down a contiguous bunch to interface. Besides, in the wake of gathering all information inside a group, a bunch head hub will dole out the most impressive part hub in the bunch to advance the information to the base station. Reenactment results show that this methodology successfully preserves energy for disengaged hubs.

E. Brilliant Julie and S. Tamil Selvi (2016) depict Energy utilization in WSN is a huge issue in networks for further developing organization lifetime. It is fundamental to foster an energy mindful bunching convention in WSN to lessen energy utilization for expanding network lifetime. In this paper, a neuro-fluffy energy mindful bunching plan (NFEACS) is proposed to shape ideal and energy mindful groups. NFEACS comprises of two sections: fluffy subsystem and neural organization framework that accomplished energy proficiency in shaping bunches and group heads in WSN. NFEACS utilized neural organization that gives compelling preparing set identified with energy and got signal strength, everything being equal, to gauge the normal energy for speculative group heads. Sensor hubs with higher energy are prepared with focus area of base station to choose energy mindful bunch heads. Fluffy guideline is utilized in fluffy rationale part that contributions to frame bunches. NFEACS is intended for WSN taking care of portability of hub.

Swetha R et.al (2018), depicts Wireless Sensor Network the current group based strategy might bring about expanded organization works. WSNs are spatially circulated self-ruling sensors to screen physical or natural conditions, like temperature, sound, pressure, and so forth Sensor organizations can contain hundreds or thousands of detecting hubs. The advancement of remote sensor networks was inspired by military applications like front line observation; Networks are utilized in numerous mechanical and applications, like modern cycle and control, machine wellbeing checking.

Manish Kumar Singh et.al (2019), examines there is a quick advancement in the space of WSN. For modest remote correspondence, hundreds or thousands of sensor hubs and a base station (sink) have shaped another organization that is known as a remote sensor organization. Hubs and Base station are set in huge region.

This paper depicts a compact prologue to WSNs engineering, potential geographies and estimation of actual boundaries through crossbow apparatus. A while later, the paper features the sorts of WSN and its applications.

Tanveer Zia and Albert Zomaya (2016), presents inborn constraints in remote sensor organizations, security is an essential issue. While research in WSN security is advancing at colossal speed, no exhaustive record records the security issues and the danger models which present special dangers to the remote sensor organizations. This paper have put forth an attempt to record all the realized security issues in remote sensor organizations and have given the examination heading towards countermeasures against the dangers presented by these issues.

Mahfuzulhoq Chowdhury and Md Fazlul Kader (2013), portrays remote sensor organizations (WSNs) have as of late pulled in a ton important to the analysts. Restricted computational limit and force utilization are two significant difficulties to guarantee security in WSNs. As of late, safer correspondence or information conglomeration methods have found. Thus, knowledge of the momentum research in WSN security will help scientists enormously. In this paper, security related issues and difficulties in WSNs are explored. Here it recognizes the security dangers and audit proposed security systems for WSNs. Additionally, it gives a concise conversation on the future examination course in WSN security.

III. PROPOSED METHODOLOGY

To enable secure and reliable data delivery from source to destination an energy efficient algorithm is needed. More number of research work was implemented and attained its maximum performance. Single path, multipath algorithms were available which ensure reliable data delivery. One of the best methods to achieve maximum performance is clustering. Clustering will reduce energy consumption and transfer data from source to destination without any loss. However cluster completely focuses on energy consumption parameter. From the analysis of survey it concludes that clustering has many advantages the issue faced is frequent formation of cluster hence focus should be concentrated on this area to enhance performance of the network.

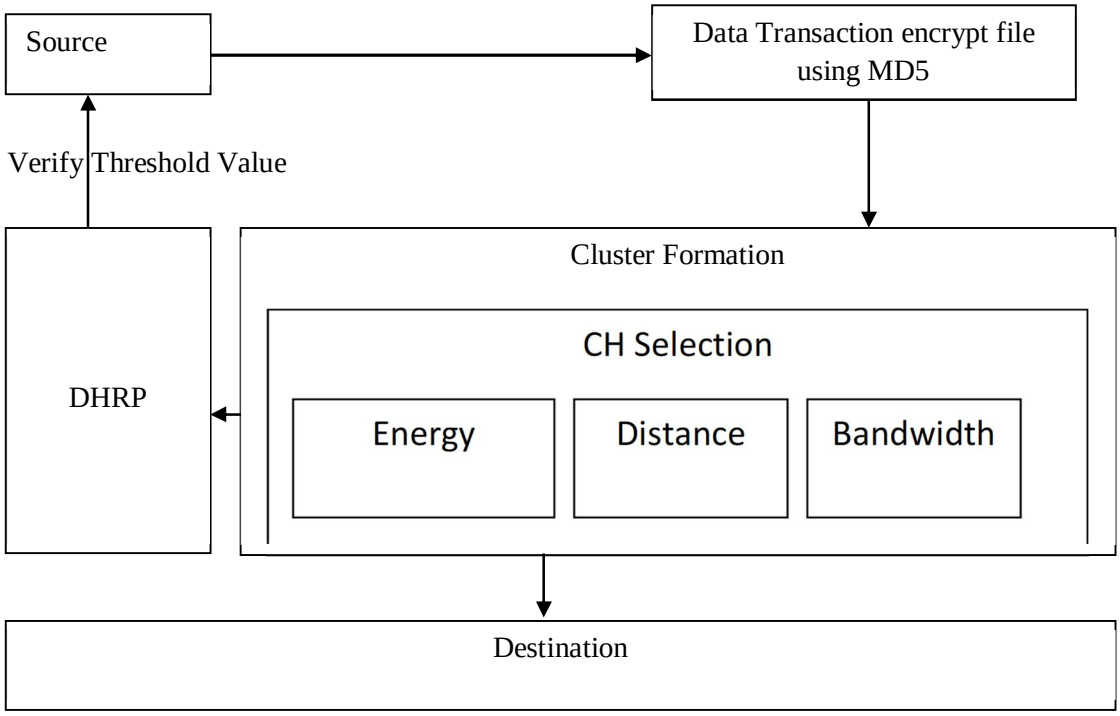

Figure 2: work flow of proposed system

Figure 2 explains the entire work flow of proposed system. Source is the starting point of data transaction once packet are selected for transaction for security purpose MD5 algorithm is used to encrypt the file to secure from attackers during transaction. Cluster based routing algorithm is implemented in this paper which includes the parameters such as energy, distance and bandwidth. Cluster is formed based on distance and head is selected based on energy level in node. Based on cluster formed initial data transaction is inaugurated is considered to be round one DHRP (Dynamic hierarchy round trip policy). Once data transaction is completed destination is reached the residual energy in CH is verified with fixed threshold limit and if it is high the same cluster is utilized otherwise again cluster formation will be implemented.

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A. Energy Aware Distributed Clustering

An energy efficient clustering algorithm is utilized widely in network to identify unexpected events in WSN's. Based on the movement of targeting nodes clustering algorithm creates optimal clusters to improve energy efficiency. It frequently creates clusters through competition among the nodes which are ready to involve in clustering and in the process of cluster head selection. After the data transaction cluster will destroys once it senses the nodes gets leaving the clustering.

The whole process is divided into three phases: information gathering phase, whose duration is T1; cluster forming phase, whose duration is T2; cluster head election phase, whose duration is T3.

1) *Information Gathering Phase:* T_1 is the phase's duration, during which each node sends out a Node Msg with two values: one is the node id, and the other is the remaining energy of this node within radio range r. At the same time, it receives Node Msg signals from its neighbour nodes, and each node S_i uses the formula below to determine the average residual energy E_{ia} of its neighbours.

$$E_{ia} = \frac{1}{d} \sum_{j-1}^{d} E_{jr} \quad \text{.....(1)}$$

Where E_{jr} is the residual energy of S_j, one of S_i's neighbours, and d is the total number of S_i's neighbours. We provide the following algorithm for calculating the waiting time for broadcasting Head Msg messages for each node.

$$t_i = \{\frac{E_{ia}}{E_{ir}} T2V_r \qquad R_{ir} \geq R_{ia}$$

$$T2V_r \qquad E_{ir} \leq E_{ia}$$

Where, ti denotes the waiting time of S_i, and E_{ir} is the residual energy of S_i, V_r in the formula is a real value uniformly distributed in [0.9, 1] which is introduced to reduce the probability that two nodes send Head Msg s at the same time.

2) *Cluster Forming Phase:* T1 represents the cluster formation process which includes request message to form clusters which considers distance and energy level of the nodes in local region. T2 is the cluster creation phase that conducted based on Energy Aware Distributed Clustering (EADC) algorithm. Here non cluster head prefers nearby cluster head and forward join Msg that should have ID and remaining energy in that particular node. Once cluster head receives the message it will create node schedule list that includes schedule Msg for cluster members. This schedule list consist of when that particular node will receive message therefore it indicates when the node should be in listening mode and when it should move to sleep mode for reduce energy consumption. based on this criteria clusters are created with the parameter distance and residual energy.
3) *Cluster Head Election Phase:* At the point when T1 has terminated, EADC starts the cluster head contest stage whose span is T2. In this stage, if node S_i gets no Head Msg when timer t_i lapses, it communicates the Head Msg inside radio reach Rc to publicize that it will be a cluster head. Or the consequences will be severe, it gives up the competition.

B. MD5 Algorithm

MD5 is most widely utilized cryptography hash function it creates a 128 bit message based on the data given as input which is visually expressed in 32 digits hexadecimal number. The input size may vary but the output hashes of MD5 is unique which is represented in below figure.

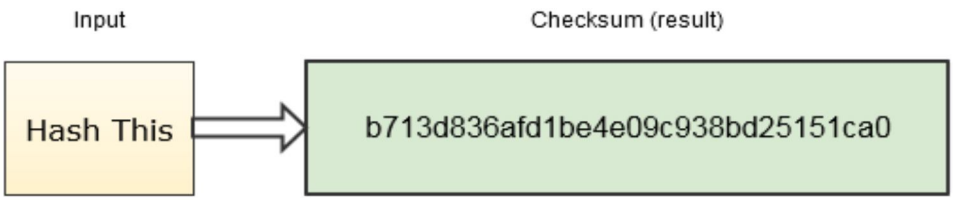

Figure 3: Hexadecimal representation of input by md5

MD5 is utilized to assure that the forwarded document is transmitted securely without any privacy issues. For example when we download a file from the server it might be corrupted, virus attacked or it may have some loss of data due to connection issues. One of the best methods to verify the uploaded and downloaded file are same from both server and client side is encrypting the file through MD5 when both the hash matches then it confirms that particular file is perfect and original without any change in it. It is also used in database to store passwords as hash instead of the original input.

MD5 makes a 128bit message digest from information input. The yield should be interesting from other message digests. Envision a b-bits message to process. To process this message we need to follow 5 stages. Teacher Rivest utilized the initial two stages to set up the info message for absorption by attaching and cushioning its pieces. In the third and fourth step he utilized a couple of aide capacities which incorporates four word cradles and four assistant capacities which are pre-instated.

IV. RESULT AND DISCUSSION

In this section, the proposed work and its results are discussed clearly. This work is compared with different algorithms and its results are shown and described clearly in this section. The performance analysis parameters are described as follows. The simulations were performed on NS-2, and two scenarios were chosen. Analysis of simulation results using NS2 shows improvement in throughput, delay, PDR, and energy as shown in the following figures. Here, based on 100 nodes our proposed work result has been compared with two different algorithms. Time and number of packets are represented in x axis and y axis respectively. This session briefly explains proposed method achieves better results.

Simulation parameters

Parameter	Value
Coverage area	1500m×1500m
Mac layer protocol	IEEE 802.11
No.of nodes	100
Packet size	512 bytes
Routing protocol	SSCHS

A. Energy Consumption

Below represented graph describes energy consumption of SSCHS approach compared to existing methods. Hence proposed approach focuses on security and minimum energy consumption thereby to increase performance. Due to efficient path selection and sleep and a wake approach minimum energy was consumed.

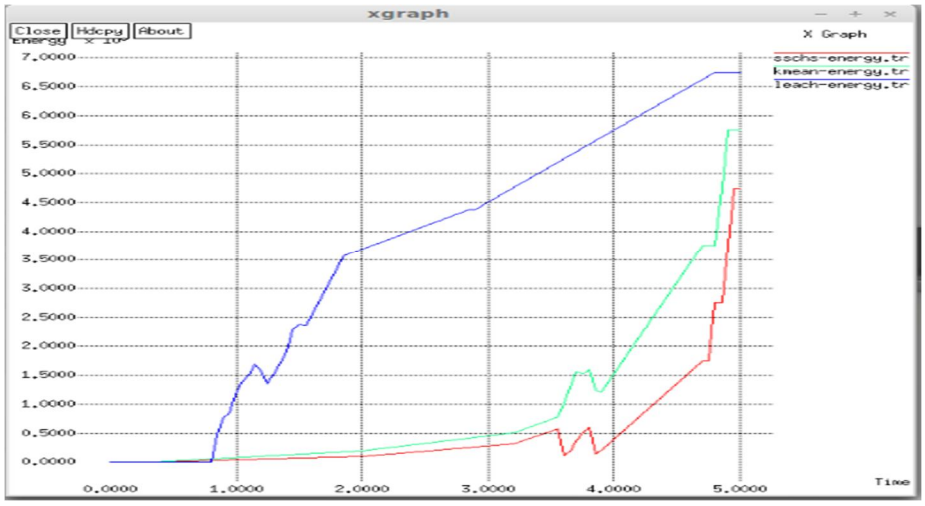

Figure 4: Energy consumption comparison

Figure 4, graph shows energy consumption of proposed algorithm with existing algorithms with number of nodes as 100. Here X axis indicates time and Y axis indicates energy consumption here the co-ordination of X and Y axis represent packets transaction. In the graph red colour represents proposed algorithm, green colour represents K Means algorithm and blue colour represents Leach algorithm. Above graph shows proposed method consumes minimum energy compared to other algorithms.

B. Packet Delivery Ratio (PDR)

PDR is described as the ratio of the packets obtained by the receiver to the total number of packets including the packets which are dropped during transmission. Based on packet transaction the number of packets delivered within a particular time is calculated in different scenarios. The above figure 5, graph shows packet delivery ratios when number of nodes are 100. Compared to other algorithm SSCHS achieves high packet delivery. Here X axis represents time and Y axis represents packet delivery ratio.

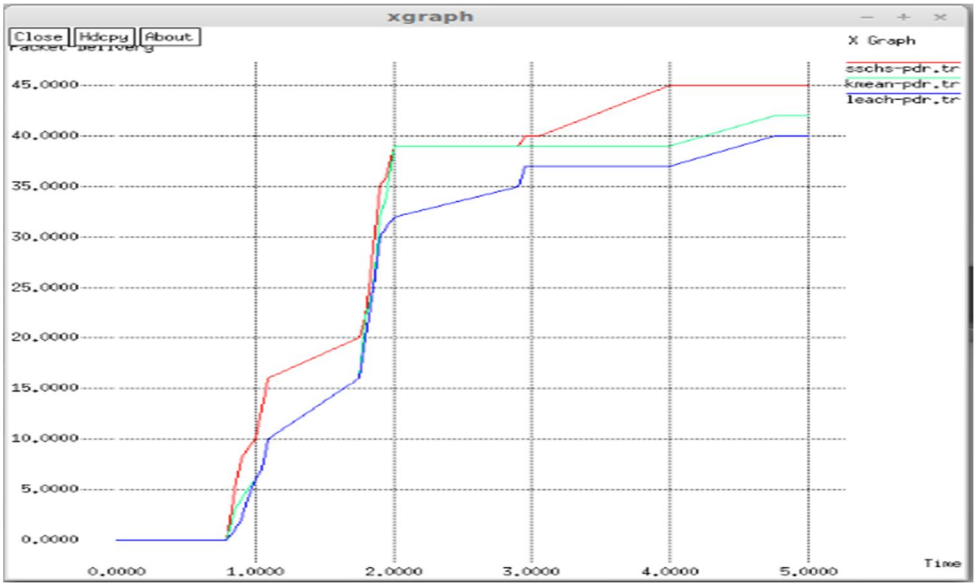

Figure 5: packet delivery ratio

C. Throughput

Throughput measures how many packets arrive at their destinations successfully. For the most part, throughput capacity is measured in bits per second, but it can also be measured in data per second. Packet arrival is key to high-performance service within a network.

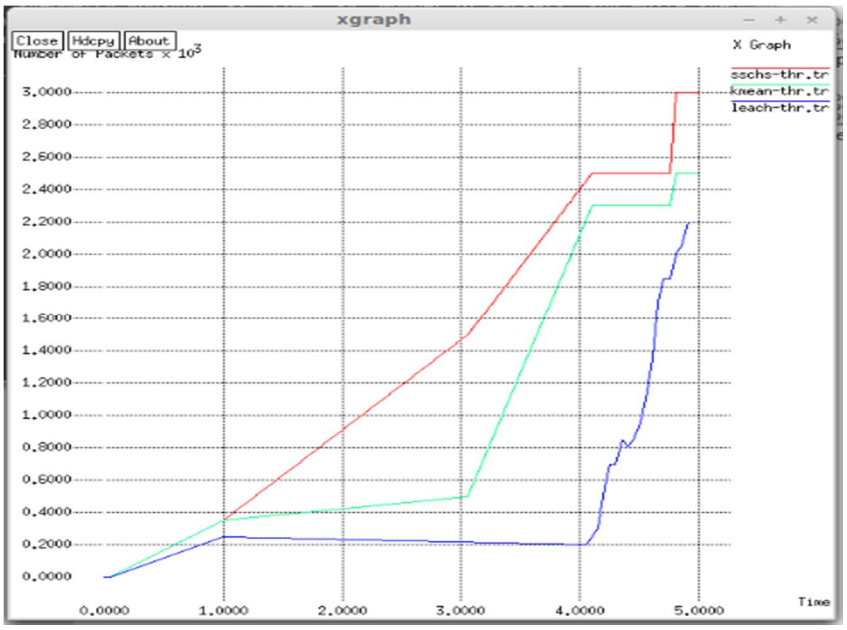

Figure 6: Throughput based on 100 nodes

In general throughput should be achieved higher in the above figure 6 graph X axis indicates time and Y axis indicates number of packets. Compared to other algorithms proposed method achieves better throughput when number of nodes are 100.

D. End to end Delay

End-to-end delay or one-way delay (OWD) alludes to the time taken for a parcel to be communicated across an organization from source to objective. It is a typical term in IP network checking, and contrasts from full circle time (RTT) in that solitary way the one way from source to objective is estimated.

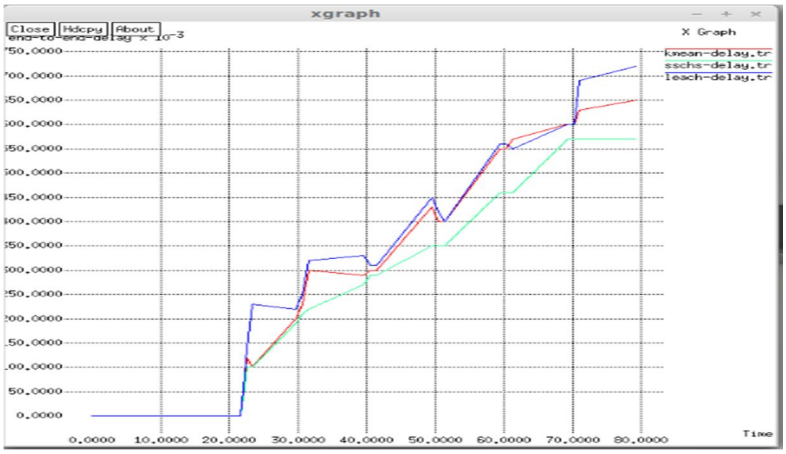

Figure 7: End to end delay based on 100 nodes

The above figure 7, graph indicates end to end delay in data transaction and this scenario is experimented based on 100 nodes. In end to end delay the green colour indicates proposed work which clearly shows data delivered to receiver end with minimum delay compared to other algorithms.

V. CONCLUSION

In Wireless Sensor Network, more number of research works has been going on to improve the network performance. Most important factor to be considered in network is energy consumption and secures data transaction. To obtain secure data transaction cryptography is one of the best methods used to achieve this. In proposed method MD5 algorithm is used this has been chosen among various cryptography algorithm. In clustering, during data transmission cluster will be formed and data transmitted once transaction is completed for other transaction again clusters should form. Hence this clustering and CH selection need energy which leads to network lifetime reduction. Considering this issue in proposed work static cluster head approach is implemented in energy aware clustering algorithm. Once data transmitted initially the residual energy in the CH is verified with the threshold limit if it is more or equal same cluster will be utilized for further transaction instead of creation of new cluster formation. From proposed work it is clearly shows that proposed method achieves better result in data delivery and energy consumption.

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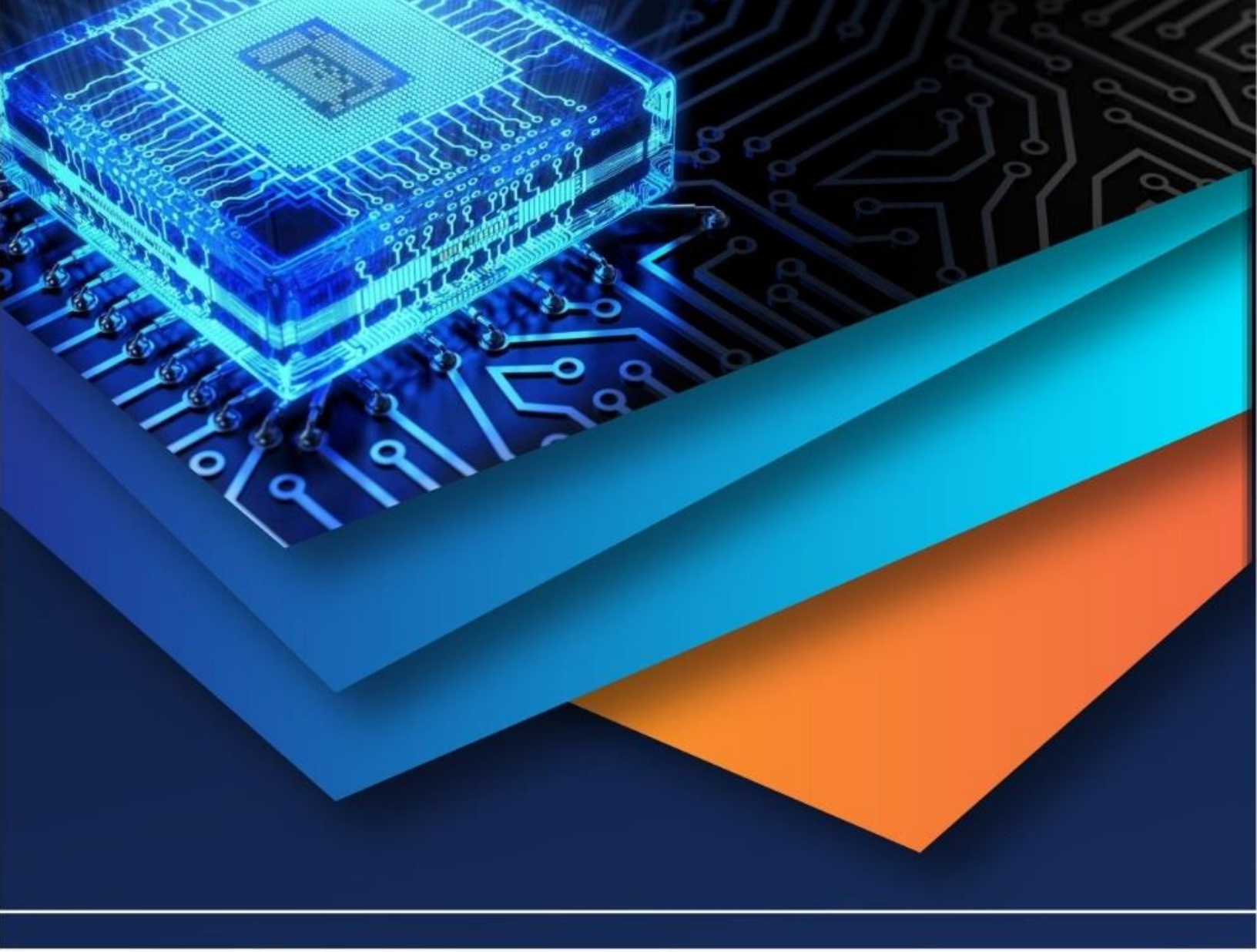

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