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Advanced Energy Efficient Master/Slave Algorithm in Wireless Sensor Networks

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Abstract: ***The nodes in WSNs are densely deployed and lots of redundancy exists during the data gathering and sending perceived data straightforwardly to the base station, which leading to consumption of energy in nodes. Existing Clustering algorithms in WSN selects just one group head in the each cluster, where it devours more energy at Cluster head(CH) quickly and which condenses lifetime of the network incredibly. The paper proposes the Advanced and Energy Efficient Master/Slave algorithm to solve this problem. The algorithm reduces the energy consumption of each node by minimizing the direct communication of the nodes with the Base station or CHs by changing the hierarchy in WSN. The moto of the algorithm is to select one master Cluster Head and remaining slave CHs. The algorithm will select Master Cluster Head based on more residual energy, distance, and low packet drop; the remaining become Slave Cluster Heads. The simulation results prove that the Advanced and Energy Efficient Master/Slave algorithm improves throughput and packet delivery ratio(PDR) by decreasing the energy consumption.***

Keywords: Wireless Sensor Network(WSN), Cluster Head (CH), Cluster Selection, Clustering, Base Station (BS), lifetime, Sensor node , Multi-hopLEACH, Hi- LEACH, LEACH, CH-LEACH, C-LEACH V-LEACH, .

I. INTRODUCTION

The wireless sensor network is a collection of small size nodes, which are sensor devices. These tiny devices sense the data from the different areas of location and also useful to know the environmental condition based on collected data by those nodes [1]. The arising field of WSNs combines detecting, calculation, and correspondence by a single small device. When people comprehend the capacities of WSN, several applications spring into the brain. It appears clear blend of present-day innovation. It consolidates sensor, radio and CPU's into viable remote sensor arrange to detail comprehension of abilities and impediments of every equipment segment and detail comprehension of circulated framework hypothesis and present-day organizing innovations. The structure of WSN depends essentially on the application, and they should think of some as a factor, for example, nature, cost, application plan targets, and equipment and application imperatives. Momentum Wireless Sensor Networks sent ashore, underground, and submerged. Contingent upon the condition a sensor hub faces distinctive difficulties and limitations. A few sorts of remote sensor arranges are Terrestrial, Underground, Multi-media, Mobile, and the Underwater WSNs.

The lifetime of remote sensor systems lies in sending a substantial number of tiny sensor nodes gathered and designed themselves. In WSN, most applications are battery controlled, so it is tough to supplant the battery or revive the battery when hubs are sent. Another oblige that lessens the proficiency of hubs information excess dependent on this compel each bunch has the Cluster Head which total the information and transmits to base station hub. Many directing strategies are proposed to build the system lifetime and improve productive energy. HT protocol directing convention is an intriguing strategy to make the system's lifetime and improve proficient vitality. In the bunch-based system, the designs are parcel into littler groups.

This convention utilizes the idea of bunching and allotting the uncommon assignment to the sensor hub to the group leader of each bunch. Hierarchical routing directing is an effective system to decrease the energy utilization by doing the information conglomeration and combination with the end goal to lessen the quantity of transmission to Base Station. this audit paper, we characterize the distinctive Hierarchical routing conventions. The filter is the main Hierarchical routing steering convention for remote sensor systems. Drain upgrade the vitality utilization since the transmission just be finished by the group head instead of all CH. Numerous Hierarchical routing protocols dependent on the procedure or approach of LEACH. That Hierarchical routing convention of protocols influences multiple elements are thought about in this paper.

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II. LITERATURE ON ROUTING PROTOCOL LEACH.

A. Leach

Low-Energy Adaptive Clustering Hierarchy(LEACH) is the primary various leveled directing cluster-based protocol for remote sensor(wireless)systems. LEACH segment the system into the parts known as Cluster, and each group has a dedicated hub with the added benefits that is called Cluster head(CH) in charge of the building and performing TDMA schedule and sending gathered information from CH to Base-Station utilizing the CDMA. The task of the LEACH is broken into rounds. Drain is circulated is required worldwide learning of systems. To accomplish a structuring objective the key assignment performs by the LEACH are as per the following[2]:

1) Random selection of cluster Head and corresponding small sensors of the Clusters.
2) Worldwide correspondence decreased by its nearbypressure.
3) Confined co-appointment and control for bunchcreation and task.
4) Low energy media gets to control.
5) Application explicates information preparing.

LEACH has separated into two stages: that are Set Up stage and the Steady stage. In the Set-Up stage at first, the node turns into the bunch head with the likelihood p and sends the promotional message in the system. The standard hub picks their group head dependent on the quality of the information accepting and sending to the bunch head. The job of the bunch head continues turning among the hubs of the group to upgrade the system's time. The determination of the bunch head is relying upon the choice made by the hub arbitrarily created number somewhere in the range of 0 and 1. After group head area and producing the bunches of the system then next all the bunch head gives the TDMA calendar to its part hubs. In the Steady stage after bunch creation and TDMA allows every part hub information transmission to start. Part hubs send the data to the bunch head amid that designated transmission time remaining hub in the transmission time are side road until the point when the season of its turn for information transmission comes. The bunch head keeps on and accepting the information from the part hub and after getting information from part hubs group head totals the information and then sends to base station. After the specific time, the following round starts [1].

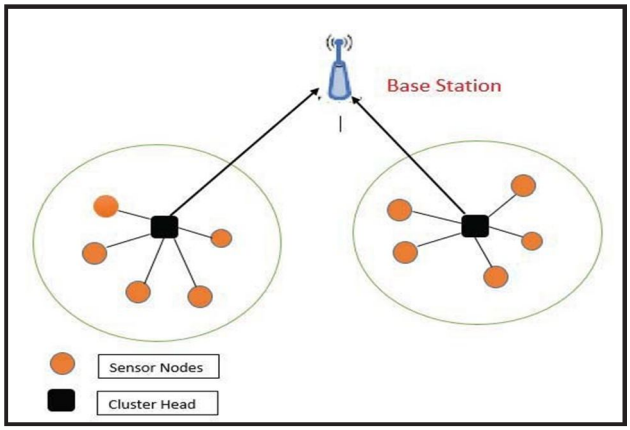

Fig. 1. Leach Protocol

B. Centralized LEACH (LEACH-C)

C-LEACH is ad extended form of customary LEACH. In this convention introductory setup stage is the same as the custom LEACH convention. The enduring stage is changing in the unified LEACH the sink sensor devices or base station knows the area of the sensor node and left lifetime of the tiny node. The node having enough vitality are qualified for taking an interest in the CH race process.

LEACH-C the sensor node with not exactly average vitality is barred in the determination of cluster head. The BS sends all information that a message of the ideal cluster head IDs. The tiny sensors which are having the same ID turned into the CH for that round and doing the same assignment all through the procedure.

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C. Multi-Hop LEACH

In the LEACH sensor, tiny devices are arbitrarily chosen as CH and the new group is occasionally reconfigured. After the group was framed part hub in bunch forward their data to their CH. CH at that point total all data accepting from the group and forward it to the Base Station. Subsequently, CHs which are a long way from the base station require more vitality contrast with the CHs which are close to base station. Thus, the fluctuation of the LEACH.

M-LEACH is proposed with the multi-trusting transmission of the information to the base station. In Multi-trusting or multi-hoping LEACH Set-Up stage is similar to the LEACH convention. Amid the information transmission, information transmits utilizing the multi-owner idea.

After information getting from the CH, CH aggregate the information and transmit information to its closer group head(CH), which transmits the information to its next jump and proceeds to the one CH which is closer to the Base Station. Since closer CH sends the totaled data to Base Station.

There is each other type of enhancement in M-LEACH in that shape tiny devices of sensor which are close to the Base Station are not transmit the information using the group head but rather they have specifically transmitted its information to the Base Station. What's more, the nodes which are at long distance from the Base Station they are sending the information through the CHs[5].

D. Hierarchical Tree-LEACH

Hierarchical Tree LEACH paper adjusted adaptation of LEACH is proposed known as HT-LEACH. In LEACH vitality utilization typical hubs got from information accumulation and information transmission to the Cluster Head. CH's vitality utilization gotten primarily from the information gathering, totaling information, and information transmission to Base Station. In which information transmission from the Cluster Head to the Base Station requires more vitality. In this convention Cluster development is the same as the LEACH however the end of this stage Cluster Heads are not specifically associated with the Base Station.

In - this convention one new stage is included known as Hierarchy Tree Routing arrangement: in which at the simple initial step closest and quickest separation from the BS is found. In the subsequent stage draw the circular segment from the Base Station with the range r(i) of the system, and after that isolate arranges into the n number of parts. Separation CHs into the n bunch as per the parts. In the Steady stage, a tiny sensor node begins to transmit its information while directing arrangement is finished. Presently joining of Clusters is done in the tree layer beginning of that is a base layer. Base layer CHs are joining its closer upper layer CHs and in the wake of joining of all layer from a similar way information collection done at each layer of the tree. The root sensor is one who just associated with the Base Station. Just root hub is transmitting collected data to Base Station. [7].

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E. Vice LEACH

In V-LEACH creator characterize the principle three terms Cluster Head which has control of accepting information from part of tiny sensor nodes, and transmit information to Base Station, Vice Cluster Head it is the sensor nodes which turned into a CH of the bunch when CH is passing on, Member sensor devices which are in charge of social occasion the information from condition and send it to the Cluster Head. In the LEACH CHs are getting the information from part hubs at that point total the data and afterward transmits to Base station climate it is closer or far from it. Thus, in light of that CHs require more vitality contrast with the part hubs so if CHs bite the dust prior then the part hubs at that point bunch of that CHs are futile. Information sends by part sensor devices of the cluster to that pass on Cluster Head are never reach to the base station so for that V-LEACH client the idea of the Vice LEACH.

In V-LEACH each group has one Cluster Head and one Vice Cluster Head sensor device when his life is over then-Vice Cluster Head takes the duties of CHs and proceed with the activity of that bunch and groups are noted futile information of that groups are additionally send using the Vice Cluster Head to the Base Station. [8].

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F. Q-LEACH

In LEACH because of the arbitrary generation of the CHs and non-uniform allocation of groups, energy-requiring in the systems are uneven, some hub may become up short on vitality before long contrast with alternate hubs in the system. In the Q (E-LEACH) entire system partition into CH based group of clusters and CHs are associated with a portal or gateway sensor device. Q-LEACH works with the concept of multi- hopping steering in which the door node plays an essential obligation to limit separate among source and goal hubs. Consequently, it leaves a constructive outcome over the idea of spare vitality and expanding the lifetime of the system however sensor nodes.

Q-LEACH first initializes the network parameter for the WSN node. The second step is to randomly place nodes in the network. In the third step make a cluster using the basic methodology of LEACH then elect CH for each cluster. The fourth step selects one node as a gateway node between the sink node and CHs. In the fifth step, it performs data transmission from cluster to base station or sinks node through gateway node. Repeat the same process for the remaining data. After completion of data transmission Q-LEACH increases the lifetime of the sensor node and provides better performance than the traditional LEACH [10].

G. P-LEACH

LEACH and PEGASIS are the two known routing protocols. LEACH works dynamically in WSN. PEGASIS protocol works the same as LEACH and improves the lifetime, improving the energy of sensor nodes manually.

P-Leach is the combination of LEACH and PEGASIS routing protocol. It uses the CH selection process from LEACH and the chaining process from the PEGASIS protocol.

In P-LEACH at the first step initializing the sensor node, base station, and the location of nodes. The second step is for the selection of CH. In the selection of CHs calculate the energy of every sensor node and the nodes which are having maximum energy become CH for their area. In the third step select the Leader from all CHs depends on the nearest gap of CH from BS and make a queue from one cluster head to next CH up to Leader CH and Leader CH at last directly connected to the base station. Do the same process until the data transfer is done.

Based on the difference of LEACH and PAGASIS P- LEACH works better regarding network lifetime improvement and energy consumption..

Table I. Comparision and Analysis of Literature of Cluster Based Routing Protocols

Protocols	Centralized Network	Distributed Network	Count of Hop	Selection of CH based on
LEACH.	No.	Yes.	Single hop.	Randomly.
CENTRALIZD LEACH.	Yes.	No.	Single hop.	residual energy.
MULTI-HOP LEACH.	No.	Yes.	Multi hop.	leftover energy and location.
HIERARCHL TREE LEACH.	No.	Yes.	Single hop.	distance from one cluster to another cluster.
VICE LEACH.	No.	Yes.	Single hop.	remaining energy.
Q- LEACH.	Yes.	No.	Multi hop.	In light of leftover energy and separation and degree, additionally Arbitrarily..
P- LEACH.	No.	Yes.	Single hop.	Node with max energy

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III. PROPOSED WORK

LEACH is a standout among most of the usable protocols in the wireless sensor network. Even the LEACH is viewed as the most important cluster-based directing methodology, it has a few disadvantages, for example, the probability of picking a less energy tiny node as CH, non-structure circulation of CHs, and so forth. To demonstrate such issues scientists have proposed a few arrangements and such late enhancements for LEACH are exhibited in this segment.
The Master/slave algorithm is proposed to overcome the energy consumption problem of LEACH, traditional cluster-head routing protocol, and its latest enhancement. in my proposed algorithm modifies LEACH routing during the establishment of cluster-head formation.

Proposed Algorithm

1) *Step 1:* Random choice of the cluster head (CH) in all the clusters in the network . (LEACH algorithm)
2) *Step 2:* Selection of the cluster head based on the parameters:
a) Distance (Centroidal algorithm)
b) Residual Energy
3) *Step 3:* Selection of MASTER-CH based on the parameters
a) Distances (centroidal algorithm)
b) Residual Energy
c) Packet Drop (Congestion Algorithm) remaining cluster heads (CHs) become the SLAVE-CH, SLAVE-CHs gather all the information from the nodes technology and sends to MASTER-CH using TDMA technology.
Finally, MASTER-CH sends the data to BS using CDMAtechnology.
4) *Step 4:* So, using this proposed algorithm we can enhance lifetime of network and residual energy of each node, improves throughput and packet delivery ratio(PDR) by decreasing the energy consumption.

A. *Working Process of Proposed Model*

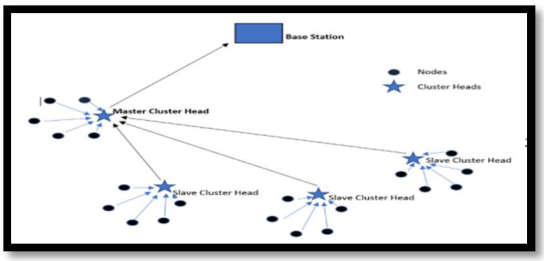

Fig. 2. Working process Proposed algorithm

IV. RESULT AND DISCUSSION

This simulation is done in the Network simulator-2, the tool provides an efficient way to compare the performance parameters of the Master/slave algorithm against that of the LEACH protocol. The random, 51-nodes network shown in Figure 3, among them one node is Base Station, and the remaining 50 nodes forms the 5 clusters with 10 nodes in each cluster. The figure 3 shows the random cluster head(CH) selection using the Existing LEACH algorithm.

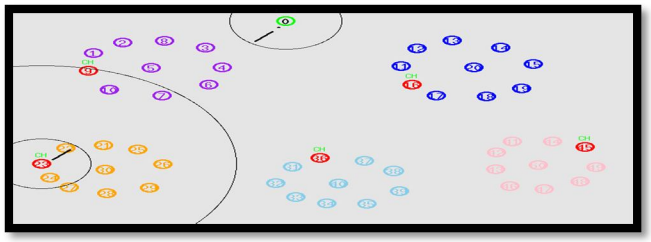

Fig.3 Cluster head selection Using LEACH algorithm.

This proposed algorithm follows the hierarchy of data transmitting from nodes to SLAVE-CH, SLAVE-CHs to MASTER-CH, and MASTER-CH to Base station as shown in the

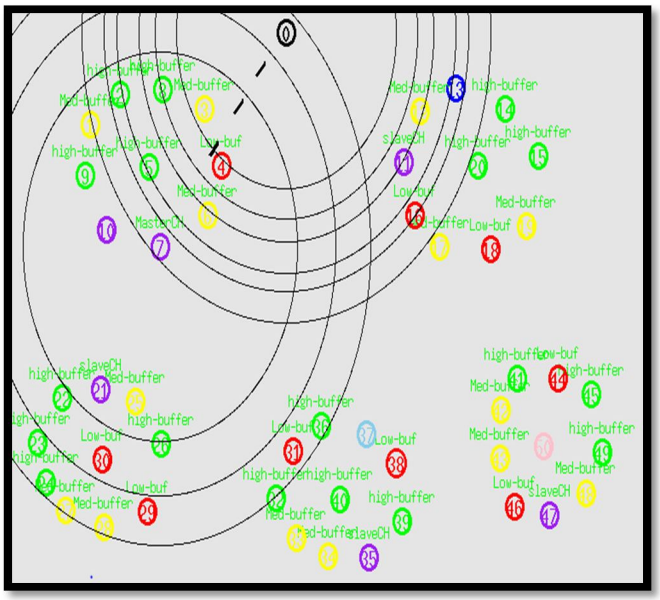

Fig.4 MASTER-CH selection using proposed algorithm

The Performance Evaluation of both the algorithms is done based on the following three parameters:

A. Residual Energy

The residual energy calculated using the equation (1),

$E_n = E_{initial} - E_{consumed}$ (1)

The comparison between the residual energy of the LEACH and Master/Slave Algorithm is show in the figure 5, Initial energy of the all the 50 nodes was 10 joules after the transmission for 70 seconds, the average residual energy is 2.82 joules for the LEACH algorithm, and 5.12 joules for the master/slave algorithm. The simulation shows that proposed algorithm is enhances the residual energy by 95.39 % when compared with the traditional LEACH.

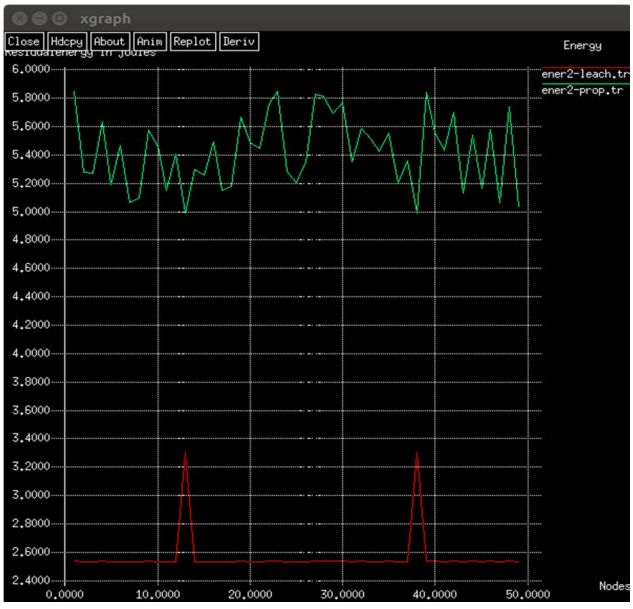

Fig. 5 Residual energy v/s nodes (Residual energy in each node).

B. Throughput

The maximum rate of creation or the most extreme rate at which something can be readied is known as throughput. The comparison between the throughput of the LEACH and Master/Slave Algorithm is show in the figure 6, Maximum Throughput of LEACH is 139 bits/s, and the proposed model is 496 bits/s. the simulation shows that the proposed algorithm has 3 times more throughput then traditional LEACH.

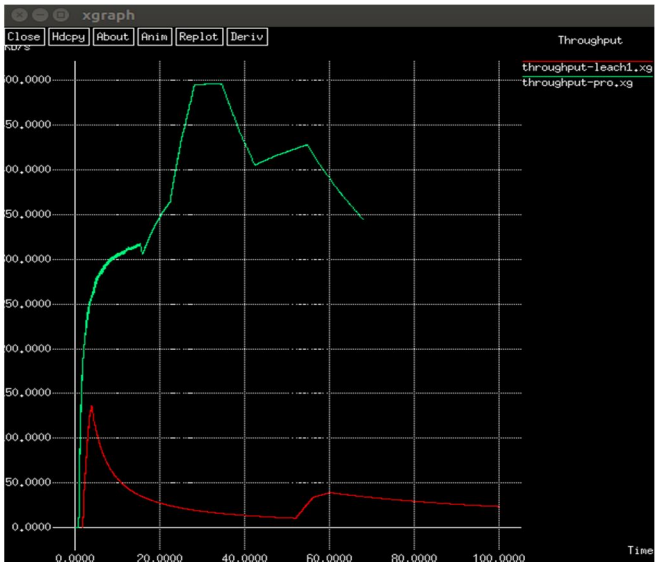

Fig. 6 Throughput (Kb/s vs time)

C. Packet Delivery Ratio(PDR)

The proportion between the quantity of packets effectively conveyed to the quantity of packets sent during the transmission know as Packet Delivery Ratio(PDR). The comparison between the Packet Delivery Ratio(PDR) of the LEACH and Master/Slave Algorithm is show in the figure 7, the maximum PDR of the proposed algorithm is 0.998827, and the maximum PDR of LEACH is 0.923577, so the simulation shows that PDR of the proposed is greater than the traditional LEACH.

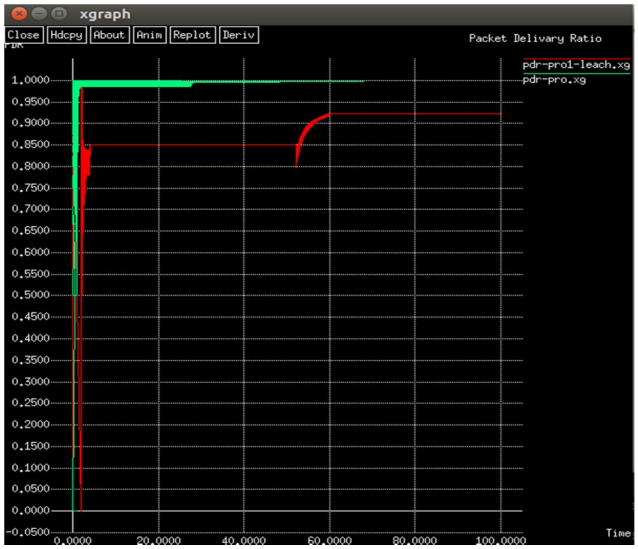

Fig. 7 PDR v/s time

V. CONCLUSION

This paper depicts that the proposed algorithm due to the hierarchical changes using master/slave method, enhances residual energy in the each node and by the simulation when we compare the proposed algorithm with the traditional LEACH, we come to know that proposed algorithm residual energy improved by 95.39 %, and 3 times more throughput and has more PDR. Which concludes that new proposed algorithm decreases the energy consumption and increases the network lifetime.

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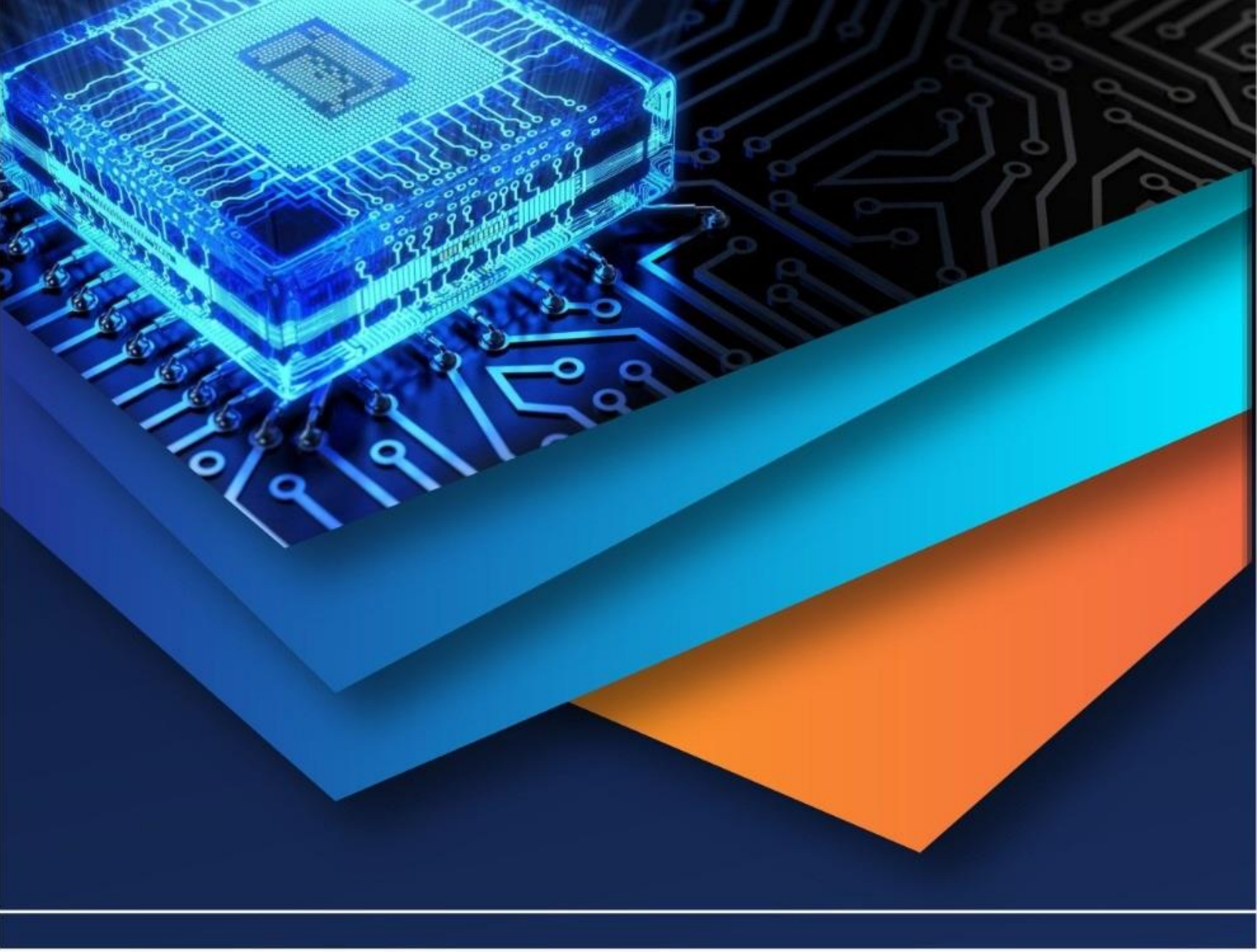

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