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Fuzzy Base Enhanced LEACH IN WSN

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***Abstract*— Wireless sensor networks (WSN) are highly distributed networks of autonomous small, lightweight sensors (nodes) in large numbers to monitor physical or environmental conditions by the measurement of, temperature, vibration, pressure, motion or pollutants, sound, and to cooperatively pass their data through the network to a main location (often called a sink). In designing WSN routing protocol, enhancing energy efficiency and extending the lifetime of WSNs are the most important challenges for researchers. In LEACH protocol each sensor nodes elects itself as a cluster head based on the probability model. Every sensor node will become cluster head in every cycle to evenly distribute the work loads. Main problem of LEACH protocol is it only depends on the probability model to elect the cluster head and therefore it is possible that no cluster heads or too many are selected in a single round. Moreover, selected cluster heads may be located near to each other or even near to the edge of the networks which leads to inefficient energy distribution. From the above discussion, we conclude that the focus of almost researches is to conserve energy at its maximum level. Our proposed model is also an improvement in the leach algorithm.**

***Keywords*— WSN, LEACH, Fuzzy, energy, probability**

I. INTRODUCTION

WIRELESS Sensor Network (WSN) [1] consists of one or more sinks and large number of sensor nodes scattered in an area. With the integration of information sensing, computation and wireless communication, sensor nodes can sense the physical phenomenon, (pre-) process the “raw” information, share the processed information with neighboring nodes, and report information to the sink. The downstream traffic from the sink to the sensor nodes usually is a one-to-many multicast. The upstream

traffic from sensor nodes to the sink is a many-to-one communication.

II. MAIN ISSUE IN WSN

A. Energy Considerations

During the creation of an infrastructure, process of setting up the routes is greatly influenced by energy considerations. By the transmission power of a wireless radio is proportional to distance squared or even higher order in the presence of obstacles, multi-hop routing will consume less energy than direct communication. Anyhow, multi-hop routing introduces significant overhead for topology management and medium access control [2]. The direct routing would perform well enough if all the nodes were very close to the sink. Almost the time sensors are scattered randomly over an area of interest and multi-hop routing becomes unavoidable

III. ENERGY EFFICIENCY IN WIRELESS SENSOR NETWORK

Energy-efficiency is an important issue in WSN, because battery resources are limited. Mechanisms that conserve energy resources are highly desirable, as they have a direct impact on network lifetime. Network lifetime is in general defined as the time interval the network is able to perform the sensing functions and to transmit data to the sink. During the network lifetime, some nodes may become unavailable (e.g. physical damage, lack of power resources) or additional nodes might be deployed. A frequently used mechanism is to schedule the sensor node activity such that to allow redundant nodes to enter the sleep mode as often and for as long as possible. However, approaches mainly focus on finding some energy efficient path, designing better turn on/off schedules, forming energy efficient clusters, and so on, but none of them has examined the energy efficiency from the view of data itself, i.e., to adapt the data sampling rate to

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the data dynamics and keep lazy when data consistency is maintained.

IV. ROUTING PROTOCOL LEACH IN WSN

LEACH [3] stands for Low-Energy Adaptive Clustering Hierarchy and is one of the first hierarchical protocols. When the node in the network fails or its battery stops working then LEACH protocol is used in the network. Leach is self-organizing, adaptive clustering protocol in which sensor nodes will organize themselves into local clusters and cluster members elect cluster head (CH) to avoid excessive energy consumption and incorporate data aggregation which reduces the amount of messages sent to the base station to increase the lifetime of the network. Therefore this algorithm has an effect on energy saving.

Cluster head is responsible for collecting data from its cluster members. To reduce inter cluster and intra cluster collisions, LEACH uses a TDMA/code-division multiple access (CDMA) [4]. The decision whether a node elevates to cluster head is made dynamically at a time interval. However, data collection is performed periodically. Therefore, the LEACH protocol is mainly used for constant tracking by the sensor networks. When the node becomes cluster head for the current round, then each elected cluster head broadcasts information to rest of the nodes in the network. To balance the energy dissipation of nodes, the cluster heads change randomly over time [5].

A. *DIRECT V. MINIMUM TRANSMISSION*

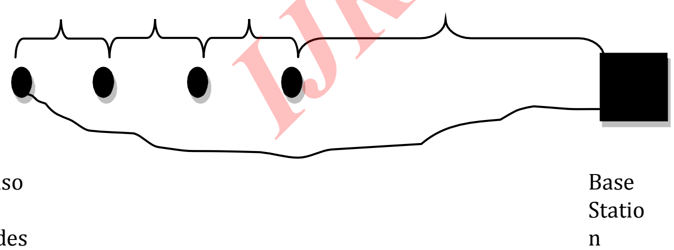

Fig 1: (a) shows the direct transmission (b) Minimum Transmission Energy

The amount of energy used in figure (a) can be modeled by this formula:

- $e_{amp}k(3d_1 + d_2)^2$

Whereas the amount of energy used in figure (b) uses this formula:

- $e_{amp}k(3d_1^2 + d_2^2)$

B. *THE AMOUNT OF ENERGY DEPLETION*

This is the formula for the amount of energy depletion by data transfer:

The energy being dissipated to run the transmitter: $E_{elec} = 50nJ/bit$

The energy dissipation of the transmission amplifier: $\varepsilon_{amp} = 100pJ/bit/m^2$.

Transmission costs: $E_{TX}(k,d) = E_{elec}\, k + \varepsilon_{amp}\, k d^{\lambda}$

Receiving Costs: $E_{RX}(k) = E_{elec}\, k$

Where k is the length of the message in bits.

D is distance between nodes and

λ represents the path loss exponent ($\lambda \geq 2$).

C. *STOCHASTIC THRESHOLD ALGORITHM*

In each round, each node independently generates the random number between 0 and 1. If the generated number is less than the threshold value T(n) which defines by (1), the node ills self elect to become the cluster head for the current round.

Cluster-heads can be chosen stochastically (randomly based) on this algorithm:

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$$T(n) = \begin{cases} \dfrac{p}{1 - p \times \left(r \bmod \frac{1}{p}\right)}, & \text{if } n \in G \\ 0, & \text{otherwise} \end{cases} \qquad (1)$$

r is the round which already ended;

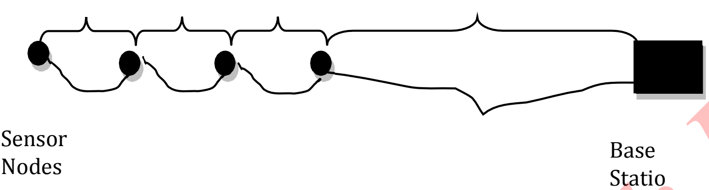
p is the proportion of the nodes to cluster heads;

G is a set of nodes which have never been cluster head in the last 1/p rounds.

If n < T(n), then that node becomes a cluster-head.

D. *DETERMINISTIC THRESHOLD ALGORITHM*

1. A modified version of this protocol is known as LEACH-C (or LEACH Centralized).
2. This version has a deterministic threshold algorithm [6], which takes into account the amount of energy



in the node…

$$T(n)_{new} = \frac{P}{1 - P \times (r \bmod P^{-1})} \frac{E_{n\_current}}{E_{n\_max}}$$

Where En_current is the current amount of energy and

En_max is the initial amount of energy

E. *DIFFERENCE BETWEEN THE STOCHASTIC AND DETERMINISTIC*

- The goal of these protocol is to increase the life of the network
- The changes between the LEACH stochastic algorithm and the LEACH-C deterministic algorithm alone is proven to increase the FND (First Node Dies) lifetime by 30% and the HND (Half Node Dies) lifetime by 20%.

F. *DRAWBACK OF LEACH*

1. LEACH depends on only the probability model to elect the cluster head, elected cluster head may be very close to each other.
2. In each round the number of the cluster head is dynamic and it cannot guarantee the data stream received at the base station [7].
3. Cluster head will appear in the edge of the network or in the place where the node density is very low.

V. PROPOSED WORK

The performance of the LEACH protocol depends on the cluster head. So the election of the cluster head is the crucial task. The proposed work uses a fuzzy logic controller for the selection of Cluster head. The cluster head must have the energy greater than the average energy. The distance of the cluster head from the base station should be kept low as distance increases the energy consumption increases. The cluster head must be surrounded by other nodes so that the data can be easily forwarded and collected. Depending upon these factors the proposed work selects the cluster head on the basis of these factors.

1. Residual Energy

2. Node centrality

3. Node Density

4. Distance

These factors are taken as input for fuzzy logic controller as the fuzzy logic controller is used to elect the cluster head. Following Figure shows the fuzzy logic controller. Various components of fuzzy logic controller are described below.

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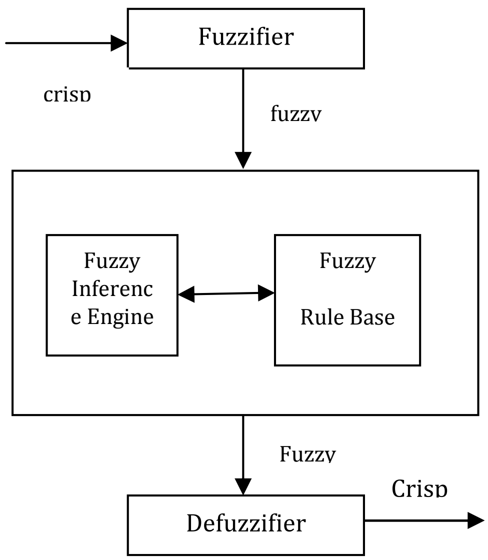

Fig 2: Fuzzy Inference System Architecture

- Fuzzfier: It translates crisp inputs into fuzzy values. It transforms the system inputs, which are crisp numbers, into fuzzy sets. This is done by applying a fuzzification function.
- Fuzzy Inference Engine: It applies reasoning to compute fuzzy outputs.
- Defuzzyfier: Translates fuzzy outputs into crisp values.
- Fuzzy Rule Base: Defines rules and membership functions.

In fuzzifier, inputs with crisp value change into a fuzzy set and results are transferred to defuzzifier through fuzzy inference engine and fuzzy rules base. Defuzzifier changes a fuzzy set to crisp value. These four parameter can give the output on the basis of the fuzzy rule base.This output decide the cluster head. The proper Cluster head Selection leads to the Proper clustering and the energy efficient operation. Following table shows the fuzzy rule base, the mapping of input with output. As total input are 4 with each having 3 possibilities so the total number of rules in rule base are 3*3*3*3=81 as given in the table.

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Sr No.	Residual Energy	Density	Node Centrality	Distance from Base station	Probability
1	Low	Sparsely	Close	Close	Medium
2	Low	Sparsely	Close	Adequate	Lower Medium
3	Low	Sparsely	Close	Far	Little Weak
4	Low	Sparsely	Adequate	Close	Lower Medium
5	Low	Sparsely	Adequate	Adequate	Little Weak
6	Low	Sparsely	Adequate	Far	Weak
7	Low	Sparsely	Far	Close	Little Weak
8	Low	Sparsely	Far	Adequate	Weak
9	Low	Sparsely	Far	Far	Very Weak
10	Low	Medium	Close	Close	Higher Medium
11	Low	Medium	Close	Adequate	Medium
12	Low	Medium	Close	Far	Weak
13	Low	Medium	Adequate	Close	Medium
14	Low	Medium	Adequate	Adequate	Lower Medium
15	Low	Medium	Adequate	Far	Little Weak
16	Low	Medium	Far	Close	Little Weak
17	Low	Medium	Far	Adequate	Lower Medium
18	Low	Medium	Far	Far	Weak
19	Low	Densely	Close	Close	Little Strong
20	Low	Densely	Close	Adequate	Higher Medium
21	Low	Densely	Close	Far	Little Weak
22	Low	Densely	Adequate	Close	Higher Medium
23	Low	Densely	Adequate	Adequate	Medium
24	Low	Densely	Adequate	Far	Weak
25	Low	Densely	Far	Close	Lower Medium
26	Low	Densely	Far	Adequate	Medium
27	Low	Densely	Far	Far	Little Weak
28	Medium	Sparsely	Close	Close	Higher Medium

29	Medium	Sparsely	Close	Adequate	Medium
30	Medium	Sparsely	Close	Far	Lower Medium
31	Medium	Sparsely	Adequate	Close	Medium
32	Medium	Sparsely	Adequate	Adequate	Lower Medium
33	Medium	Sparsely	Adequate	Far	Little Weak
34	Medium	Sparsely	Far	Close	Lower Medium
35	Medium	Sparsely	Far	Adequate	Little Weak
36	Medium	Sparsely	Far	Far	Weak
37	Medium	Medium	Close	Close	Little Strong
38	Medium	Medium	Close	Adequate	Higher Medium
39	Medium	Medium	Close	Far	Little Weak
40	Medium	Medium	Adequate	Close	Higher Medium
41	Medium	Medium	Adequate	Adequate	Medium
42	Medium	Medium	Adequate	Far	Lower Medium
43	Medium	Medium	Far	Close	Lower Medium
44	Medium	Medium	Far	Adequate	Medium
45	Medium	Medium	Far	Far	Little Weak
46	Medium	Densely	Close	Close	Strong
47	Medium	Densely	Close	Adequate	Lower Strong
48	Medium	Densely	Close	Far	Lower Medium
49	Medium	Densely	Adequate	Close	Strong
50	Medium	Densely	Adequate	Adequate	Higher Medium
51	Medium	Densely	Adequate	Far	Little Weak
52	Medium	Densely	Far	Close	Medium
53	Medium	Densely	Far	Adequate	Higher Medium
54	Medium	Densely	Far	Far	Lower Medium
55	High	Sparsely	Close	Close	Strong
56	High	Sparsely	Close	Adequate	Higher Medium
57	High	Sparsely	Close	Far	Medium
58	High	Sparsely	Adequate	Close	Higher Medium

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59	High	Sparsel y	Adequat e	Adequat e	Medium
60	High	Sparsel y	Adequat e	Far	Lower Medium
61	High	Sparsel y	Far	Close	Medium
62	High	Sparsel y	Far	Adequat e	Lower Medium
63	High	Sparsel y	Far	Far	Little Weak
64	High	Mediu m	Close	Close	Strong
65	High	Mediu m	Close	Adequat e	Little Strong
66	High	Mediu m	Close	Far	Lower Medium
67	High	Mediu m	Adequat e	Close	Little Strong
68	High	Mediu m	Adequat e	Adequat e	Higher Medium
69	High	Mediu m	Adequat e	Far	Medium
70	High	Mediu m	Far	Close	Medium
71	High	Mediu m	Far	Adequat e	Higher Medium
72	High	Mediu m	Far	Far	Lower Medium
73	High	Densel y	Close	Close	Very Strong
74	High	Densel y	Close	Adequat e	Strong
75	High	Densel y	Close	Far	Medium
76	High	Densel y	Adequat e	Close	Very Strong
77	High	Densel y	Adequat e	Adequat e	Strong
78	High	Densel y	Adequat e	Far	Lower Medium
79	High	Densel y	Far	Close	Higher Medium
80	High	Densel y	Far	Adequat e	Strong
81	High	Densel y	Far	Far	Medium

A. *Simulation*

The simulation is done on NS2[8] tool by modifying the LEACH protocol. We have changed the condition to select the cluster head so the changes is done in the method decide cluster-head available in file ns-leach.tcl. A new condition is introduced i.e. if the energy is greater than the average energy of node only then the node can be cluster head. Then the protocol is analyzed by varying number of nodes. The results for existing and modified LEACH for various parameters like energy consumption, end 2 end delay and throughput are shown in following tables

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TABLE 1 RESULT ANALYSIS OF PROPOSED LEACH

No of Nodes	**Through put(kbps)**	**Energy(J)**	**End 2 End delay(ms)**	**No of alive Nodes**
25	20833.20	0.6965	216.912	25
50	37449.65	1.85	298.302	50
75	57155.97	2.74	298.334	4
100	77649.68	4.63	330.660	4

TABLE 2 RESULT ANALYSIS OF EXISTING LEACH

No of Nodes	**Through put(kbps)**	**Energy(J)**	**End 2 End delay(ms)**	**No of alive Nodes**
25	20833.20	0.6965	216.912	25
50	37449.65	1.85	298.302	50
75	57155.97	2.74	298.334	4
100	77649.68	4.63	330.660	4

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The tabular analysis for the performance of the existing and proposed protocol shows that the performance of the proposed protocol is better than the performance of existing protocol; as the end 2 end delay is reduced by 0.112% and the energy consumption is reduced by 0.288% while the throughput is enhanced by 0.063%. The analysis is done on various networks having the different number of nodes as already shown in the table 2 and table 3. It means the proposed protocol performs well even for the large-scale network as well as for small-scale network

1. VI. Conclusion

The paper elected the cluster head on the basis of the fuzzy controller. The fuzzy controller gets residual energy, node centrality, node density and distance from BS as input and output the cluster head on the basis of fuzzy database. The simulation shows that proper cluster head selection leads to less energy consumption i.e. increase in network life time. In future work, movement can be provided to the sink node to balance the load and sub clustering can be done if the cluster is at large distance from the base station.

References

1. [1] I. F. Akyildiz, W. Su, Y. Sankara subramaniam and E. Cayirci, “Wireless sensor networks: A survey,” Computer Networks J., vol. 38, pp. 393-422, 2002.

2. [2]I.F. Akyildiz, W. Su, Y. Sankarasubramaniam, E.Cayirci, “Wireless sensor networks: a survey” IEEE Commu.Mag., vol.40, no. 8, pp. 102-104, Aug. 2002.

3. [3] Ankita Joshi &Lakshmi Priya.M, “A Survey of Hierarchical Routing Protocols in Wireless Sensor Network”, MES Journal of Technology and Management, pp. 67 – 71.

4. [4] Kiran Kumar, T. V. U., & Karthik, B. (2013). Improving Network Life Time using Static Cluster Routing for Wireless Sensor Networks. Indian Journal of Science & Technology, 6.

5. [5] Kemal Akkaya and Mohamed Younis, (2005) “A Survey on Routing Protocols for Wireless Sensor Networks”, Ad Hoc Networks, pp. 325-349.

6. [6] Mitra, R., & Biswas, A. Enhanced Clusterhead Selection Algorithm Using LEACH Protocol for Wireless Sensor Networks. International Journal Of Computational Engineering Research/ISSN, 2250-3005.

7. [7] Siew, Z. W., Bono, A., Yoong, H. P., Yeo, K. B., & Teo, K. T. K. (2012). Cluster Formation of Wireless Sensor Nodes using Adaptive Particle Swarm Optimisation.

8. [8] The Network Simulator Wiki. [Online]. Available: http://nsnam.isi.edu/nsnam/ index.php/

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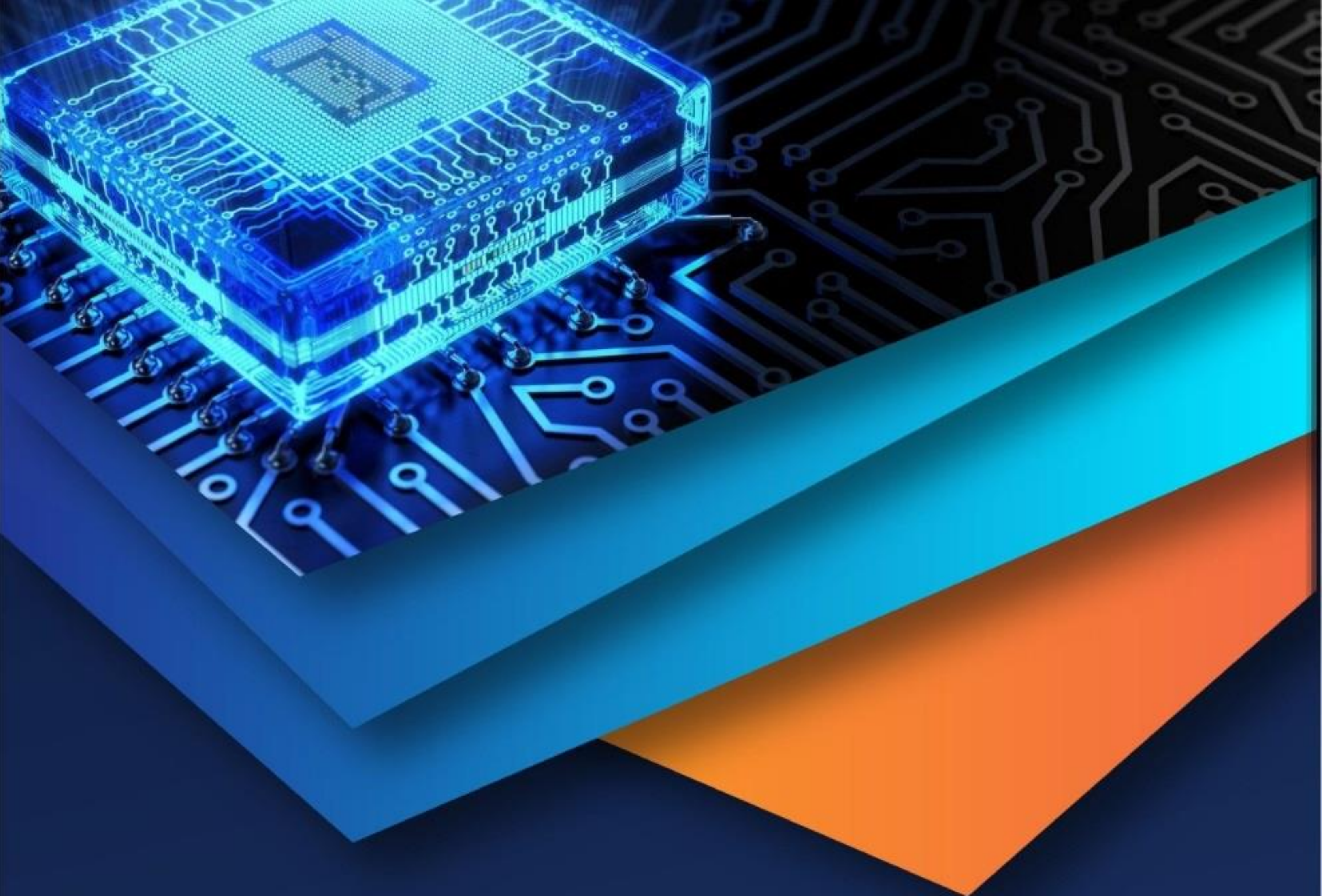

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