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Improved Energy and Communication for Underwater Wireless Sensor Network Based Location Estimation

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Abstract: The area of underwater wireless sensor networks (UWSNs) is garnering an increasing attention from researchers due to its broad potential for exploring and harnessing oceanic sources of interest. Because of the need for real-time remote data monitoring, underwater acoustic sensor networks (UASNs) have become a popular choice. The restricted availability and non-rechargeability of energy resources, as well as the relative inaccessibility of deployed sensor nodes for energy replenishment, forced the development of many energy optimization approaches un the UASN. Clustering is an example of a technology that improves system scalability while also lowering energy consumption. Due to the unstable underwater environment, coverage and connectivity are two important features that determine the proper detection and communication of events of interest in UWSN. A sensor network consists of several nodes that are low in cost and have a battery with low capacity. In wireless sensor networks, knowing the position of a specific device in the network is a critical challenge. Many wireless systems require location information from mobile nodes.
Keywords: MAC, Communication cost, IDV-Hop algorithm, Localization, Ranging error, unconstrained optimization, Wireless sensor network, Distributed Least Square

I. INTRODUCTION

A wireless sensor network is a group of sensor nodes that work together to form a network. As indicated in Figure 1, each sensor node is made up of numerous elements. A sensor node is usually a tiny electronic device equipped with a battery for an energy source. It has sensors that sense temperature, sound, vibration, pressure, humidity, and motion in the environment. A wireless transceiver is fitted for two way communications with other sensors. It is a comprehensive discipline which has great research and practical value. With the rapid advancement of information technology and integrated circuit technology, as well as the increasing attention of governments to smart city, smart planet, wireless sensor network has developed rapidly. It has a long history of usage in environmental monitoring and data collection, resource exploration, disaster prevention and other related fields [1].

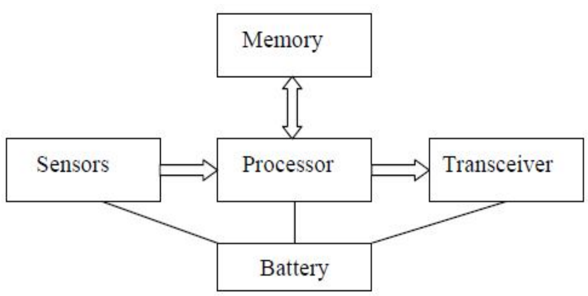

Figure.1 Sensor Node Structure

Recently, many localization algorithms have been proposed for WSNs. These can be classified into two types: range-based and range-free. For localization, range-based methods require absolute point-to-point distance or orientation information between neighbor nodes. These approaches provide improved localization precision, but they necessitate additional hardware for distance or orientation measurements, making them prohibitively expensive for large-scale sensor networks. Range-free techniques, on the other hand, do not rely on distance or orientation information to locate nodes. They need only network connectivity information for localization of nodes. Although range-free algorithms provide cost-effective localization, their results are less precise than range-based algorithms. [1]

Wireless sensor networks (WSNs) are often made up of a large number of randomly placed nodes that communicate with one another and collect data about the environment. In many applications, knowing the position of the sensor that detected an event is needed.[3]

Distributed sensor networks have already been applied for years, but wireless sensor networks [1] have recently been focused on. The rapid growth of wireless sensor networks paved the way for the creation of low-cost, low-power, and multifunctional sensor devices that combine sensing, processing, and communication functions. In sensor networks, determining a sensor's location is crucial. In sensor networks, there are various different methods for estimating location. There are several ways to categorise localization. Based on the communication between nodes, localization strategies can be split into two groups: - centralized localization techniques, - and decentralized localization techniques.

II. LITERATURE SURVEY

Zhenghao XI et. al.(1) “Underwater Wireless Sensor Networks, MAC Protocol, and Location Algorithm Research” in this author is proposed an underwater multi-channel MAC protocol with fusion positioning. The underwater multi-channel MAC protocol architecture is examined for the fairness challenge and the triple concealed terminal problem. Based on a single transceiver and underwater positioning information, an underwater multichannel MAC protocol is designed. By delaying the transmission of CTS packets for a period of time, the fairness problem is alleviated; by listening to the channel usage statement sent by other nodes and monitoring the usage of the data sub channel, the correct channel selection and utilization information is obtained, and the triple hidden terminal problem is solved. The back-off mechanism of the control sub channel is analyzed by the discrete Markov chain model, and the network throughput calculation expression is given based on this. Finally, the performance analysis and simulation of the proposed protocol are carried out. The results show that the handshake mechanism proposed in this paper can effectively improve the fairness index and effectively improve the throughput of the network. However, due to the slow speed of sound travel, a long propagation delay is an issue. Because of the unique characteristics of the underwater acoustic channel, numerous technologies and solutions developed for terrestrial wireless networks cannot be easily adapted to underwater networks. The MAC protocol and location algorithm of wireless sensor networks are investigated by this author. In this author introduces the typical underwater MAC protocol, and analyzes the centralized positioning algorithm and distributed positioning algorithm in detail for the existing underwater positioning algorithm.

Rodolfo W. L. Coutinho et. al. (2)" Underwater Sensor Networks: Geographic and Opportunistic Routing" In this author proposed and evaluated the GEDAR routing protocol to improve the data routing in underwater sensor networks. GEDAR is a simple and scalable geographic routing protocol that takes advantage of the broadcast communication medium to greedily and opportunistically forward data packets to sea surface sonobuoys. GEDAR also includes a novel depth adjustment-based topology control method for moving void nodes to new depths in order to bypass communication voids. The results of our simulations revealed that geographic routing protocols based on node position are more efficient than pressure routing strategies. Furthermore, opportunistic routing was found to be critical for network performance, regardless of the number of transmissions required to deliver the packet. The use of node depth adjustment to cope with communication void regions improved significantly the network performance. GEDAR efficiently reduces the percentage of nodes in communication void regions to 58 percent for medium density scenarios as compared with GUF and reduces these nodes to approximately 44 percent as compared with GOR. Consequently, When compared to existing underwater routing protocols, GEDAR enhances network performance in many circumstances of network density and traffic load.

Boyu Diao et. al.(3)"Depth-Based Routing for Underwater Sensor Networks: Improving Energy and Time Efficiency" In this paper, the author focuses on increasing the energy and time efficiency of depth-based routing protocols, proposing two new protocols,EE-DBR and D-DBR. Author creatively employ underwater ToA ranging technique toDBR protocols. Taking full advantage of ToA ranging technique, EE-DBR significantly reduces energy consumption from multipath forwarding redundancy by at most 81.5% while it keeps a high success packet delivery ratio (average 88.8%), and D-DBR reduces end-to-end delay by at most 36.2% while it keeps an average success packet delivery ratio of 98.3% which is even better than DBR. In energy-sensitive scenarios, like long-time marine data sampling, EE-DBR is a better choice. In time-sensitive scenarios, like marine rescue, DDBR provides a better performance.

Volkan Rodoplu et. al.(4) "An Energy-Efficient MAC Protocol for Underwater Wireless Acoustic Networks" The authors offer a distributed, scalable, and energy-efficient MAC technique that works despite the underwater acoustic medium's long, unknown propagation delays. This protocol can be utilised in applications that require delay tolerance, such as underwater ecological sensor networks with energy-constrained nodes. In contrast to ALOHA, MACA, and MACAW protocols, the author's proposed protocol focuses on energy rather than bandwidth usage as the primary performance parameter. When the average number of 1-hop neighbours is 5, and the duty cycle is 0.004, our suggested MAC technique consumes just 3% of the transmit energy due to collisions in a realistic underwater sensor network scenario. This scalable, distributed MAC protocol has the potential to be used as a model for developing energy-efficient MAC protocols for future underwater sensor networks.

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III. METHOD

Location estimation is tuff task in UWSN. It is 3d space where node is move X,Y and z direction. Here is communication of node and its continuity is very difficult. Location estimation of node is major efforts to optimized communication and energy in wireless sensor network. The DV-bounce (remove vector-jump) limitation calculation was proposed by Niculescu. It is a reasonable answer for typical hubs having few neighbor grapples. As appeared in Figure 2, in spite of the fact that the conventional hub Nx has no neighbor stays, Nx will utilize the DV-bounce algorithmic program for localization. This is regularly one among the ordinary agents of sans range restriction algorithmic program. Its fundamental arrangement is that the space between the obscure hubs and furthermore the reference hubs is communicated by the stock of normal bounce remove and furthermore the jump check. The essential thought is: the hub itself just trade data with its adjoining hubs, the separation between the obscure hubs and the grapple hubs is spoken to by the result of system normal Hop remove and the most limited way between two hubs, and utilizations trilateral estimation to get the hub area data. This equation needs a few hubs have GPS situating instrumentation, diverse hubs decides their own position steady with grapple hub (utilizing GPS situating or manual preparing of the hubs already, their genuine area is known) and thusly the correspondence data between the hubs. The hubs don't might want have separate period or Angle feminine cycle work; furthermore don't might want additional area or Angle estimation instrumentation. Subsequently DV-Hop recipe is one in everything about premier wide connected equation inside the monstrous hub self-limitation calculations for remote gadget organizes.

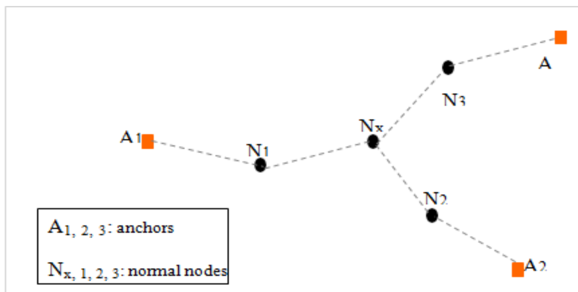

Figure 2 Example of Network Topology

The algorithm implementation is comprised of three steps.

1) *Step 1:* Ascertain the negligible jumps between obscure hubs and each stay hub. Signal hubs communicate their area data bundle to the neighbor, which included hopping segment of the field, and the esteem is introduced to 0. Accepting hub records the base bounce tally of every hub, while overlooking the bigger jump assemble from a similar grapple hub, at that point the hop number is added 1 and transmitted to neighbor nodes.
2) *Step 2:* Figure the genuine separation between obscure nodes and the stay nodes. Each stay nodes evaluates the real normal jump separate utilizing equation (3.1), as indicated by the area data and the bounce check of the other anchor nodes .

$$HopSize_i = \frac{\sum_{i \neq j} \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2}}{\sum_{i \neq j} h_j} \qquad (1)$$

Among them: (xi, yi), (xj, yj) hj is the hop account between anchor node I and anchor node j I j); area unit the coordinates of the anchor node I j. Anchor nodes broadcast the typical hop distance that use the grouping with a live field to the network. Unknown nodes, that solely record the primary received average hop distance and transmit the data to neighbor nodes. The unknown nodes then calculate the space to each anchor node based on the hop account records.

3) *Step 3:* Calculate the coordinates of nodes that aren't known. The unknown nodes use trilateration or the most chance estimation technique to calculate their coordinates, in accordance with the records of hop distance to each anchor node. The unknown nodes use the trilateral worth or the most chance estimation technique to calculate their coordinates. When the distances which are from all the anchor nodes to the unknown node P, we can use formula (3.2) to calculate:

$$\begin{cases} (x_i - x_j)^2 + (y_i - y_j)^2 = d_1^2 \\ . \\ . \\ . \\ (x_n - x)^2 + (y_n - y)^2 = d_n^2 \end{cases} \qquad (2)$$

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Meanwhile, formula (2) can be expressed as:

$$\begin{cases} x_1^2 - x_n^2 + 2(x_1 - x_n)x + y_1^2 - y_n^2 \\ -2(y_1 - y_n)y = d_1^2 - d_n^2 \\ . \\ . \\ . \\ x_{n-1}^2 - x_n^2 + 2(x_{n-1} - x_n)x + y_{n-1}^2 - y_n^2 \\ -2(y_{n-1} - y_n)y = d_{n-1}^2 - d_n^2 \end{cases} \qquad (3)$$

Formula (3) means the linear equation for:

$$AX = B \qquad (4)$$

Among them:

$$A = \begin{bmatrix} 2(x_1 - x_n) & 2(y_1 - y_n) \\ . & \\ . & \\ . & \\ 2(x_{n-1} - x_n) & 2(y_{n-1} - y_n) \end{bmatrix}$$

$$B = \begin{bmatrix} x_1^2 - x_n^2 + y_1^2 - y_n^2 + d_n^2 - d_1^2 \\ . \\ . \\ . \\ x_{n-1}^2 - x_n^2 + y_{n-1}^2 - y_n^2 + d_n^2 - d_n^2 \end{bmatrix}$$

$$X = \begin{bmatrix} x \\ y \end{bmatrix}$$

We can get the directions of the obscure hub P through utilizing the standard least mean difference estimation technique to recipe (5):

$$X = \left(A^T A\right)^{-1} A^T b \qquad (5)$$

IV. RESULT

A sensor node (often called mote) is practically a device in the wireless network that is capable of data processing, information gathering and establishing communication with the other nodes in the network. Wireless localization techniques [6] are used to give the positions of the mobile nodes considering the known location information. Many sensor network applications necessitate knowledge about physical sensor placements.

A. In section Different Scenario of Network

I. Compare result based on anchor node

No. of Anchor node	DV-Hop	IDV-Hop (Proposed Work)
10	.22	0.003
15	.11	0.004
20	.11	0.0038
25	.10	0.0031
30	.082	0.0046
35	.076	0.0014
40	.079	0.0069

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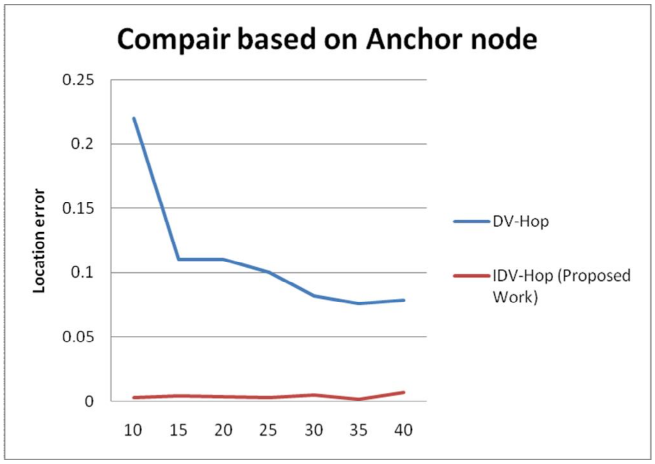

Figure.3.: Compare result based on anchor node

II. COMPARE RESULT BASED ON RANGE

No. of Anchor node	DV-Hop	Improve DV-Hop (Proposed Work)
20	.137	0.0174
25	.62	0.0059
30	.5	0.0065
35	.42	0.0028
40	.34	0.0041
50	.21	0.0030

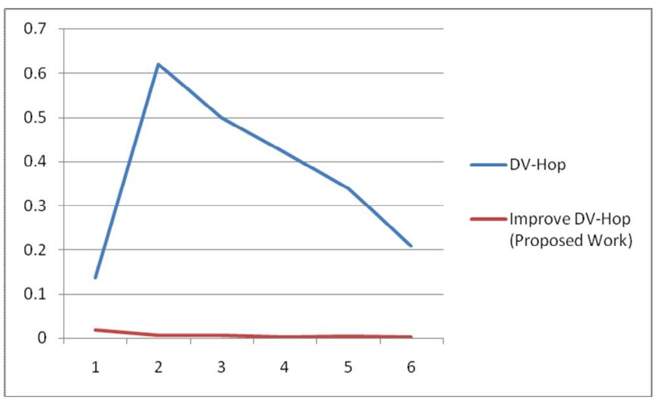

Figure.4.: Compare result based on Range

III. Compare result based on Node

No. of Anchor node	DV-Hop	Improve DV-Hop (Proposed Work)
50	.21	0.0066
100	.1	0.0066
150	.087	0.0052
200	.085	0.0036
250	.082	0.0024
300	.080	0.0020

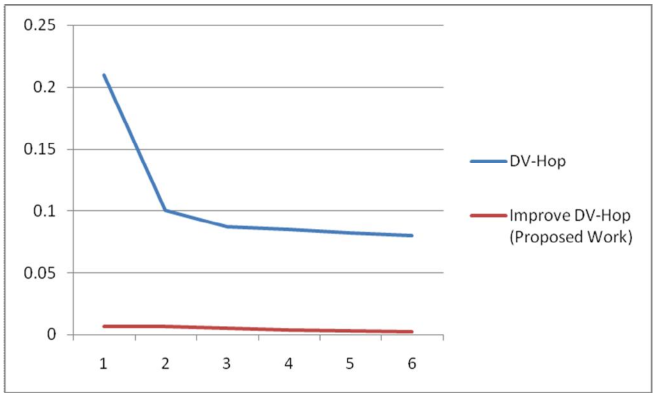

Figure.5.: Compare result based on node

Table I,II,III and figure 3,4 5 is compare result of different scenario of wirless senser network. For wireless sensor network fault localization and network lifetime improvement, an improved DV-Hop algorithm using distributed least square method was developed. The graphical results are shown below:

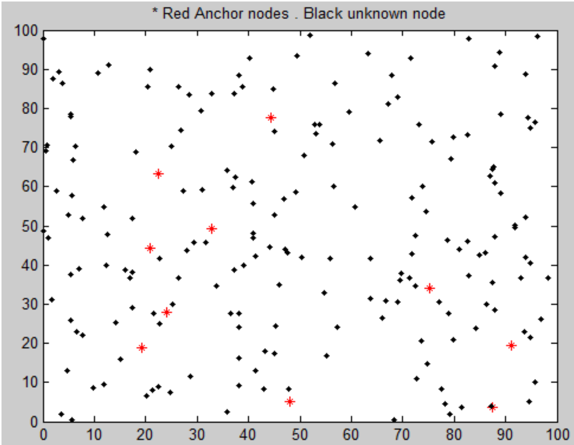

Figure.6. Localization of Node

Figure 6 shows localization of node. In this show red color node is anchor node and black colour node is unknown node. We have used 200 nodes in proposed architecture.

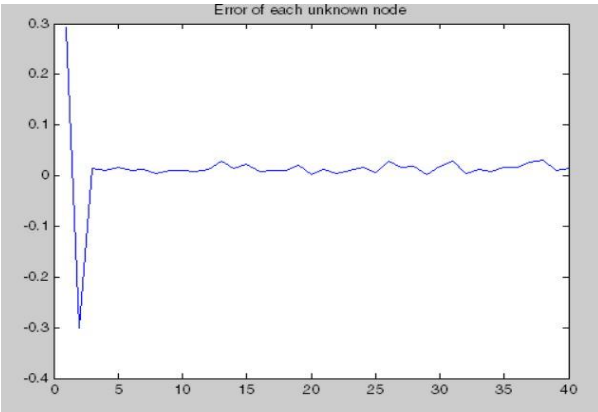

Figure 7. Error of each unknown node

Figure 7 shows Error of each unknown node.

V. CONCLUSION

In this paper proposed IDV-Hop algorithm to reduce localization error. Because no position information is useless in a wireless sensor network, the node localization problem is one of the most widely used and highly respected wireless sensor network support technologies. In proposed improved DV-HOP algorithm with distributed least square error method for analyze the localization error and improve the network communication and energy. The suggested study aims to increase the accuracy of wireless sensor network localization while also increasing energy economy. In the research analyze every node location and error and estimate, compare to the previous work based on anchor node, node and range. Basic evaluation parameter is node deployment and then distance between node and error estimation with anchor node.

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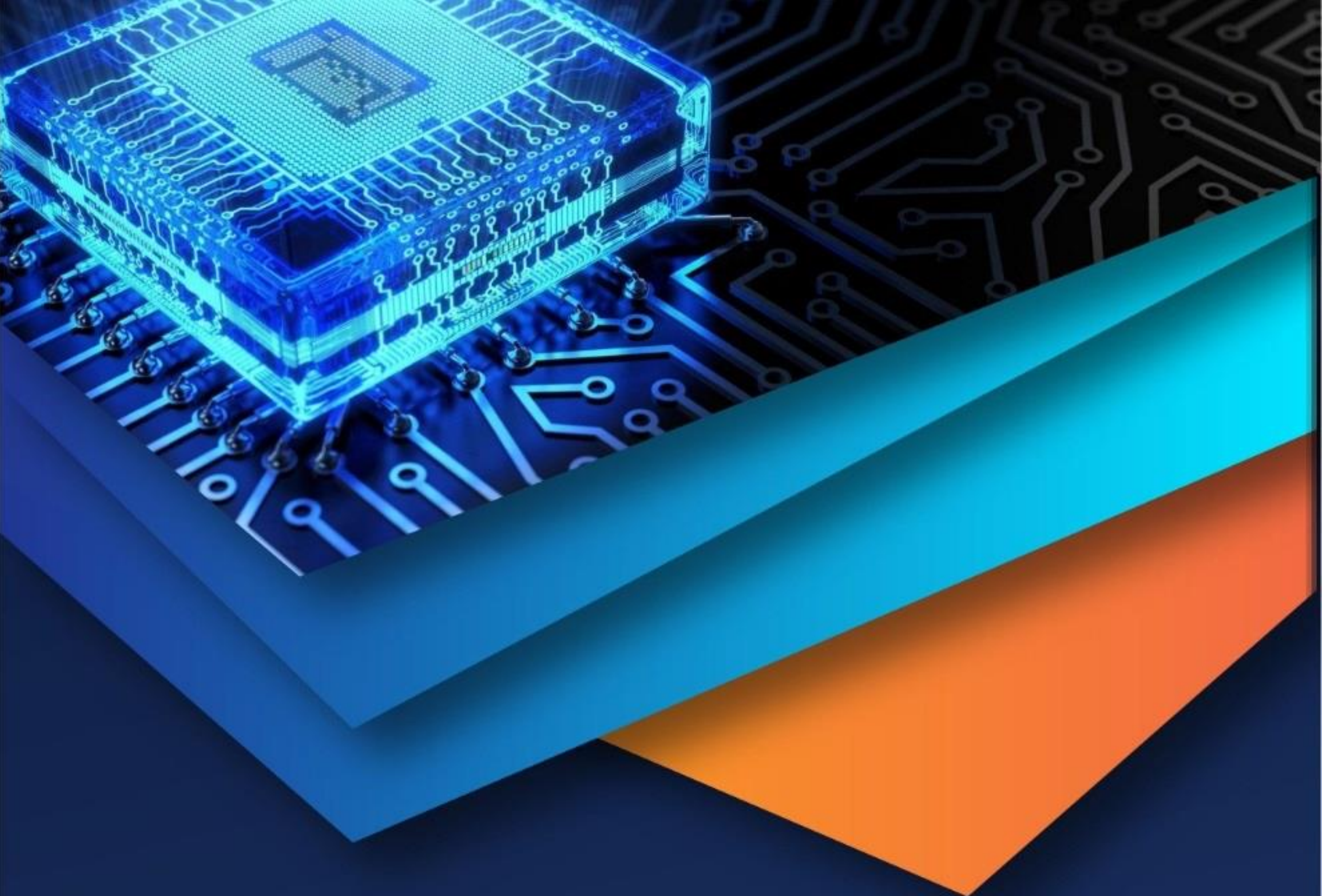

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