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Cuckoo Search Based Energy Efficient Routing Protocol in WSN

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Abstract: ***Wireless sensor network (WSN) may be a collection of an outsized number of small nodes which acts as routers also. These nodes carry very limited power source which is non-rechargeable and non-replaceable which makes a huge issue in energy consumption. There have been many interests in building and deploying sensor networks during a wide range of application including battlefield surveillance, smart home environments, habitat exploration of animals and vehicle tracking. Energy conservation could also be a vital issue for prolonging the lifetime of the network. Because the sensor nodes act like routers also, the determination of routing technique plays a key role in controlling the consumption of energy. To obtain this objective, this paper introduces an Energy Efficient and Shortest-Path Routing Protocol based on cuckoo search to assist WSN in order to increase the lifespan of the network and effectively extending the battery power and decreasing the network overhead and thereby ensures high packet delivery ratio with minimal delay.***

Keywords: Cuckoo Search, Energy Aware Routing, Wireless Senor Networks, Energy Efficient Routing.

I. INTRODUCTION

Wireless sensor networks are often defined as a self-configured and infrastructure less wireless network. Wireless Sensor Network contains many thousands of low-cost sensor nodes. A sensor node hasconstraints like storage, energy, limited processing and transmitting capability. The sensor node monitors the physical and environmental conditions, like temperature, pressure, motion, fire, humidity and lots of more. This sensor nodes co-operatively pass their data through the network to main location or sink where the data are observed and analyzed.So, it becomes a strenuous task to exchange or recharge the battery. The sensor node senses the environment as well as forwards the data to the base station or sink. A base station may be a resource-rich device having unlimited power, communication and storage capability.It is going to be static node or a mobile node supported on the applications and scenarios. It can communicate with the sensor nodes, to gather the data and sends to the user via existing communication system or the web. Because the sensor network operates in an energy constraint environment, the network often requires an energy-efficient routing protocol to boost the lifetime of the network.The research has conducted on the data collection among sensors and routing the data in recent years. WSN is applicable for tracking, surveillance, monitoring, healthcare, disaster relief, event detection, biodiversity mapping, intelligent building, facility management, preventive maintenance, etc. Generally, sensor nodes are deployed in an unattended and hostile environment for monitoring wild forest, battlefield, chemical plants, nuclear reactors then so on.

II. RELATED WORKS

Hsiang-Hung Liu,Jia-Jang Su,Cheng-Chau [7]Proposed an Energy- Efficient straight-Line routing protocol in 2017.In this paper they propose a wireless sensor network (WSN) is its limited sensor node energy resource; this necessitates an energy-efficient routing protocol that maximizes the system performance. Rumor routing could also be a classic random-walk routing protocol that, unfortunately not scalable and should end in spiral paths. We consider that the shortest distance between two points could also be a straight line and that two straight lines in a plane are likely to be intersect and develop for WSNs an improved protocol called straight-line routing (SLR), during which we construct a straight path using two-hop information without the help of geographic information. SLR reduces the energy consumption of sensornodes in WSNs. We propose enhanced schemes to spice up the performance and conserve more energy with extensive simulation results, demonstrate the effectiveness of those SLR schemes as compared with rumour routing.

Yinghui Zhang,XiaoluZhang,Shuang Ning, Jing Gao, Yang Liu [10]Proposed an Energy-Efficient Multilevel Heterogeneous Routing Protocol for Wireless Sensor Networks in 2019.In this paper they propose an enhanced balanced energy efficient network-integrated super-heterogeneous (E-BEENISH) routing protocol, by analysing communication energy consumption of the clusters and an outsized range of energy levels in heterogeneous WSNs. E-BEENISH is predicted on weighted election probabilities of each and every node to become a cluster head consistent with the help of remaining energy and therefore the distance from the sink to the node. Moreover, the impact of the heterogeneity of nodes is due to energy. By studying the sensitivity of our stable election protocol, we can conclude the heterogeneity parameters by capturing the energy imbalance with the network and find that the E-BEENISH yields the longer stability region for the acceptable weight of energy and distance.

Our results show by simulation that the E-BEENISH can improve system lifetime by an order of magnitude compared to obtained using current clustering protocols, which is crucial for several applications.

Chuan Xu,ZhengyingXiong, Guofeng Zhao, Shui Yu[5]Proposed an Energy-Efficient Region Source Routing Protocol for Lifetime Maximization in WSN in 2019.In this paper they proposed a unique energy efficient region source routing protocol to maximize the network lifetime of the WSN. In ER-SR, a distributed energy region algorithm is proposed in order to select the nodes with high residual energy within the network as source routing node dynamically. Then, the source routing nodes calculate the optimal source routing path for each and every common node, which in turns enables the partial nodes to participate in the routing process and balances the energy consumption. Furthermore, to attenuate the energy consumption of data transmission, we proposed an efficient distance-based ant colony optimization algorithm to obtain the global optimal transmission path for each and every node. Simulation results demonstrate that ER-SR exhibits higher energy efficiency and has moderate performance improvements on network lifetime, packet delivery ratio, and delivery delay when compared with other routing protocols in WSNs. Since sensor nodes are driven with limited power batteries, it is quite difficult to extend network lifetime. So as to attain reliable data transmission in WSNs, energy efficient routing protocol could be a crucial issue in extending the network lifetime.

Baidaa Hamza Khudayer, Mohammed Anbar, Sabri M. Hanshi, Tat-Chee Wan[2]Proposed an Efficient Route Discovery and Link Failure Detection Mechanisms for Source Routing Protocol in Mobile Ad-Hoc Networks in 2020.This paper proposes a enhance on-demand source routing protocols by combining two mechanisms, a zone-based route discovery mechanism (ZRDM) and a link failure prediction mechanism (LFPM). ZRDM aims to control the flooding of route requests. LFPM aims to avoid route breakages due to node mobility. The performance of the proposed mechanisms was calculated using network simulator 3 in terms of normalized routing load, average end-to-end delay, and packet delivery ratio. Node mobility can cause rapid topology changes within the network; which cause frequent link breakages thus produces additional overhead and hence disruptions is created in the established connections. The disruption events significantly affect network performance, which results in increased delay and control overhead also reduces the packet delivery ratio. On-demand routing protocols was developed to save lots of bandwidth by minimizing the utilization of control messages throughout the network. A route to a destination is merely searched when it is required by the upper protocol layers.Reactive routing protocols are often categorized into two classes: hop-by-hop routing and source-based routing. Moreover, the frequent link breakages due to node mobility events affect the network performance, which increases the demand for an efficient link failure prediction. The experimental results showthe proposed mechanisms outperform well-known mechanisms like dynamic source routing (DSR) protocol, reliable DSR, and zone- based DSR and segment-based DSR.

An He, Jun Long, Jinhuan Zhang[1] Proposed an Energy-Efficient Multi-Ring-Based Routing Scheme for WSNs in 2019This paper proposes schemes not only minimize the dimensions of receiving and sending data packets, but also reduce the maximum energy consumption of nodes for prolong network lifetime. Furthermore, it could balance energy consumption within the network and increase energy efficiency of the nodes by exploiting the remaining energy of peripheral nodes. Data aggregation is a basic solution to decrease energy consumption by reducing the transmitting data within the WSNs. Although there are enormous energy-efficient data routing algorithms developed to gather data, the highly correlation of sensed data in WSNs is not fully considered in many existing studies. So, tons and tons of redundant data is transmitted to the sink, which increases the energy cost in the WSNs. The accuracy of the proposed scheme is proved by theory analysis. Simulations are implemented to gauge the efficiency of the proposed scheme. The simulation results show in extended lifetime of the network and the energy efficiency. Comparing with data aggregation scheme centralized sink (DACS), the lifetime is often increased by 190% and the energy utilization is increased by 200% which additionally, maximize the optimal transmission radius of network lifetime.

III. PROPOSED SYSTEM

In the existing systembecause of the relatively enormous number of sensor nodes, it is impossible to create a global addressing scheme for the deployment of an outsized number of sensor nodes and thus overhead of ID maintenance is high. Sensor nodes are constrained in terms of energy, processing, and storage capacities. Position awareness of sensor nodes is very important since data collection is generally based on the location. Data collected based on common phenomena, so that there is high probability of data redundancy.Energy conservation is a vital issue for prolonging the lifetime of the network. Because the sensor nodes still act as a router and also determinates the routing technique which plays a key role in controlling the consumption of energy.

To achieve this objective, this paper introduces an Energy Efficient and Shortest-Path Routing Protocol based on cuckoo search to guide WSN in order to extend the lifespan of the network effectively using the battery power and decreasing the network overhead and thereby ensures high packet delivery ratio with minimal delay.

A. Block Diagram

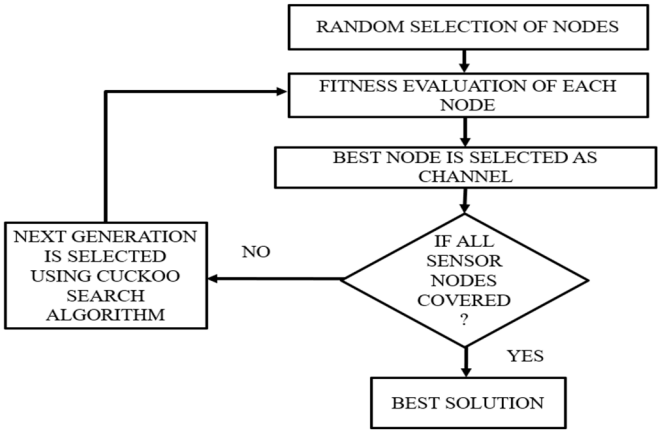

Figure: 1 Block diagram of the proposed system

In operation research, cuckoo is an optimization algorithm developed by Xin-she Yang and Suash Deb in 2009. It was inspired by the obligate brood parasitism of cuckoo species by laying their eggs in the nests of other host birds. Some host birds can directly involve in conflict with the intruding cuckoos. For example, if a host bird identity the eggs are not their own, then it will either throw these unknown eggs away or simply change its nest and build a new nest somewhere. Some cuckoo species such as the New World brood-parasitic Tapera have evolved in a way that female parasitic cuckoos are often very specialized within the mimicry in colours and pattern of the eggs of a couple of chosen host species.Cuckoo search idealized such breeding behaviour, and thus can be applied for various optimization problems. Cuckoo search (CS) uses the following representations.

Each egg in a nest is called solution and a cuckoo's egg represents a new solution. The main aim is to use the new and potentially better solutions (cuckoos) to replace a bad solution in the nests. In the simple terms, each nest has one egg. The algorithm can be extended in more complicated cases in which each nest has multiple eggs representing a set of solutions. CS is based on three idealized rules:

1) Each cuckoo lay one egg at a time and dumps its egg in a randomly chosen nest
2) The best nests with high quality of eggs are selected to the next generation.
3) The number of host nests available in group is fixed and the egg laid by a cuckoo is discovered. In this case, the host bird can throw the egg away in the nest, and can build a completely new nest. In addition, Yang and Deb discovered the random-walk style search which is better than Levy flights rather than simple random walk.
4) Finally, at the top of this framework, in the control plane, cuckoo search algorithm is introduced to correlate the energy and increase the packet delivery ratio.

B. Energy Aware Routing

Designing energy-aware routing protocol can reduce energy consumption in WSNs. Energy saving protocols are used to minimize the overall energy consumed by a sensor node, while energy balancing protocols attempt to distribute the consumption of energy throughout the network.

They are two type of Phases:

1) Setup Phase

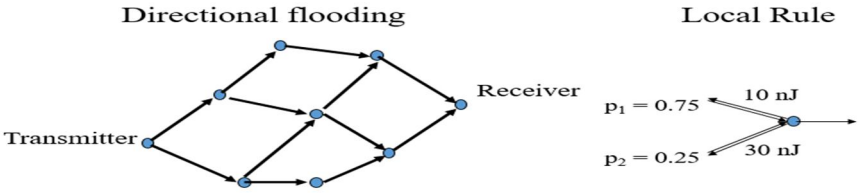

Figure:2 setup phase

2) Data Communication Phase

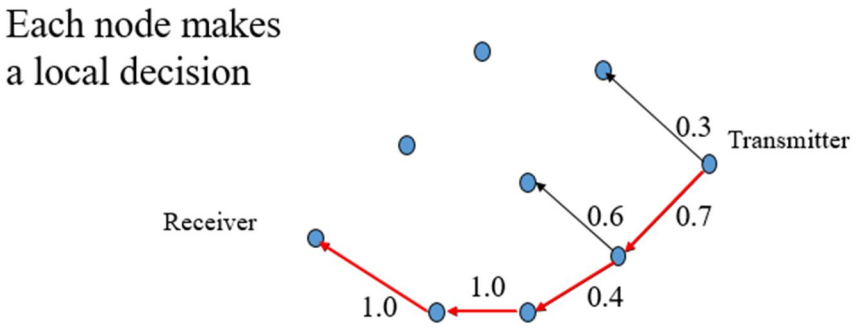

Figure:3 Data Communication phase

IV. SOFTWARE DISCRIPTION

A. Network Simulator

A network simulator is software which predicts the behavior of a computer network. Since communication networks became too complex for traditional methods to supply an accurate understanding of system behavior, network simulators are used. In simulators, the computer network is modelled with devices, links, applications etc. and the network performance is reported properly. Simulators come with support for the most popular technologies and networks in use today trends like 5G, Internet of Things (IOT), Wireless LANs, mobile ad hoc networks, wireless sensor networks, vehicular ad hoc networks, cognitive radio networks etc. The behavior of the network, the various applications and services supports are observed in a test lab; various attributes of the environment can also be modified in a controlled manner to access the network or protocols behavior under different conditions

B. Simulations

Most of the commercial simulators are GUI driven and some network simulators are CLI driven. The network model or configuration describes the network like nodes, routers, switches, links etc and the events like data transmissions, packet error etc. The output results include network level metrics, link metrics, device metrics etc. Further, drill down in terms of simulations trace files. Trace files and detects every log packet, every event that occurred in the simulation and are used for analysis. Most network simulators use discrete event simulation, in which list of pending events are stored, and those events are processed later in order, with some events triggering future events such as the arrival of a packet at one node triggering the event of the arrival of that packet at a downstream node of the network.

C. Network Emulation

Network emulation allows users to introduce real devices and applications to a test network (simulated) that alters packet flow in such a way as to mimic the behavior of a live network. Live traffic can travel through the simulator and be affected by objects within the simulation.The typical methodology is to send real packets from a live application to the emulation server (where the virtual network is simulated). The real packet is modulated into a simulation packet. The simulation packet again demodulated into a real packet after experiencing effects like loss, errors, delay, jitter etc., thereby transferring these network effects into the real packet. Thus, the real packet flowed through a real network but in reality, it flowed through the simulated network.Emulation is widely used in the design stage for evaluating communication networks prior to deployment.

V. RESULT AND DISCUSSION

A. Module Implementation

Wireless Sensor Networks (WSN) in hardware**,** we deal exemplary with the implementation of the well-known average consensus algorithm. By formulating the algorithm into nesC, a derivative, it is possible to enrich the knowledge of the algorithm with practical information, specific to embedded devices such as nodes. We created a simple mechanism of a time scheduled access to share the wireless channel among the nodes and guarantee a collision free environment, in which our implementation is tested.

B. Simulation Model And Parameters

To better understand the difference between the routing algorithms in our experiment, we evaluated each algorithm using the same two typical applications of WSNs mentioned at the beginning of our introduction: data collection and target tracking. For simplicity, we consider data collection in a static network, while target tracking takes place in a dynamic network. In each scenario, the nodes are all equipped with the same radio device and transmission power, resulting in symmetric links between them, and they are unaware about their location coordinates. In the data collection application, all sensor nodes are randomly deployed to monitor a static event source, collect the relevant sensor data, and then transfer them to the sink node periodically. All nodes, including the sink node, are fixed and the topology of the network does not change in any significant way. In the target tracking application, a sensor node in the vicinity of a moving target generates a sequence of events. As the target moves out of the range of that node, the node stops generating the events and another node takes over. Here, we assume that the source node moves randomly in the monitored area. Hence, paths may break and need to be replaced by new paths so that the event information can be delivered. In both static and dynamic scenarios, there is one sink node, and its location is fixed.

C. Output Of The Proposed System

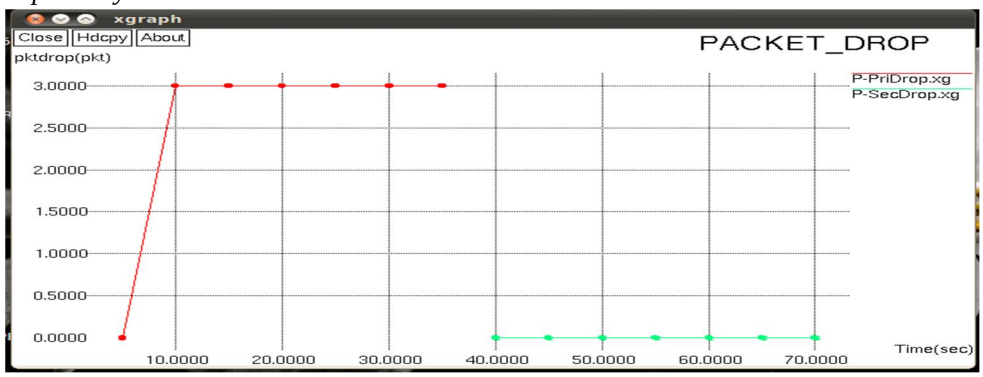

Figure: 2Comparison of Packet Drop with existing and proposed system

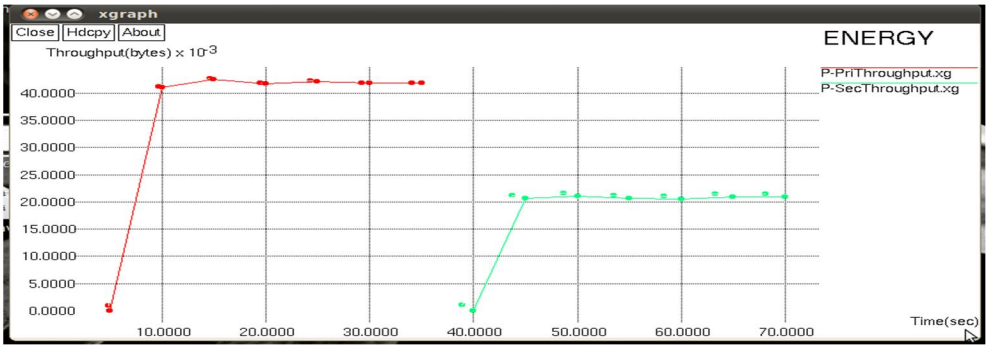

Figure: 3 Optimization of Packet Energy

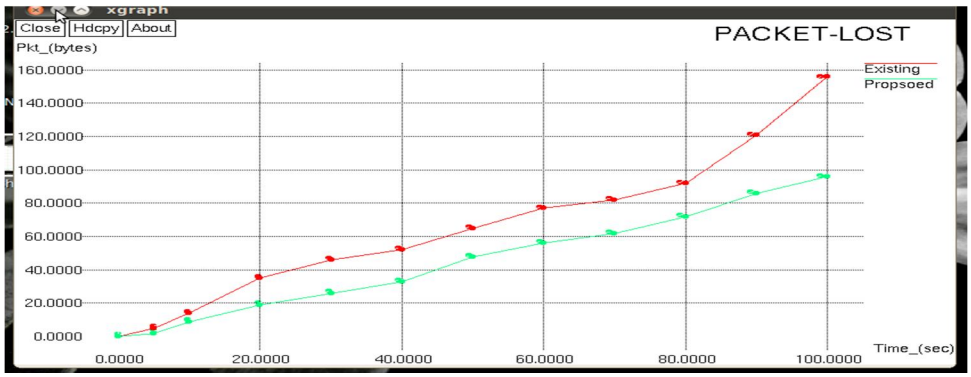

Figure: 4Optimization of Packet Loss

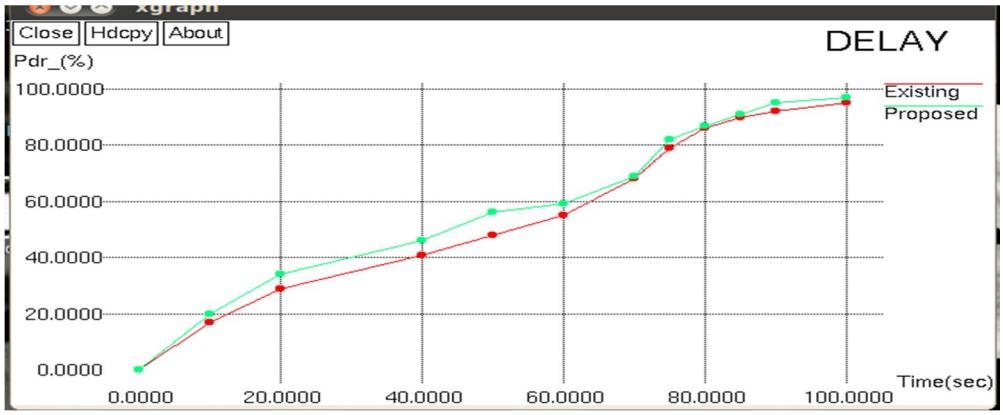

Figure:5Optimization of Packet delay

VI. CONCLUSION

Cuckoo search optimization, its working rule and its various application areas are described. This Paper also focuses on the Cuckoo feeding behavior, Levy Flight mechanism. Simplicity is an important advantage of this algorithm.The simulation results indicate that the algorithm proposed in the paper can reduce the WSNs energy consumption efficiently by introducing the sleep, listenand active modes of operation in WSNs and hence extend network lifetime**.**

In this project the packet drop in existing system is 45% reduced in proposed system and energy utilized and loss of energy is minimized. The packet lost in existing system is 85% reduced in this system by providing alternate node and path to reach the destination. The time taken for packet to reach the destination is reduced.

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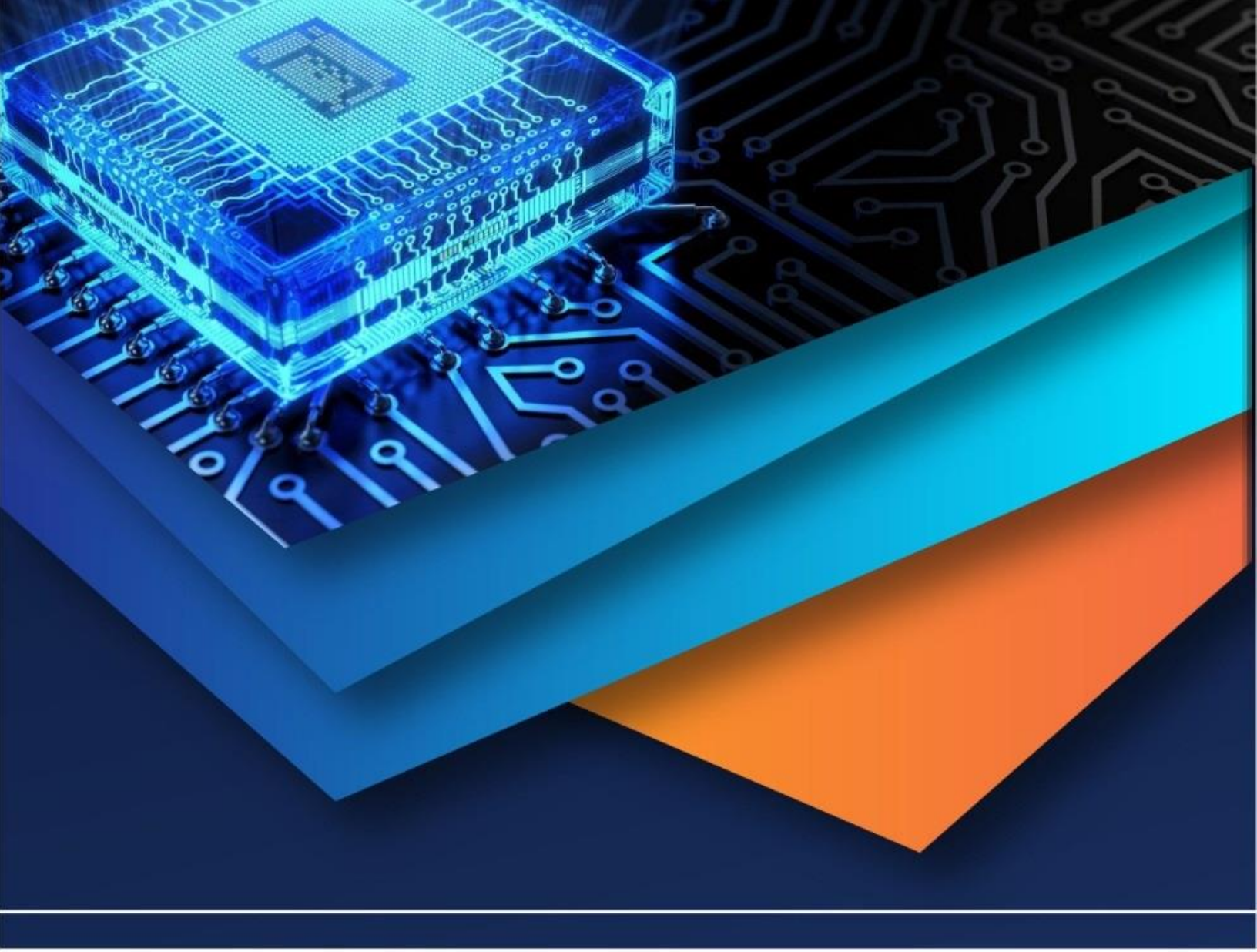

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