iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** XI **Month of publication:** November 2020

DOI: https://doi.org/10.22214/ijraset.2020.32121

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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 8 Issue XI Nov 2020- Available at www.ijraset.com

Fuzzy based Routing with Optimization for Improving Performance in WSN

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Abstract: ***This work proposes detection and prevention of attack in WSN network with improvement using Fuzzy Logic. It also provides network lifetime improvement using Tabu optimization in network. Black hole attack can cause decrease in energy as well as the network lifetime. Tabu Search is a meta-heuristic that guides a local heuristic search procedure to explore the solution space beyond local optimality. In rechargeable Wireless Sensor Networks (WSNs), a key concern is the max flow or data rate at one or more sinks. In this work, it helps to provide optimal cost in network using tabu algorithm. The main objective is to maximize the flow with improvement in network lifetime and optimize the network cost. The results of max flow vs degree of nodes and max flow vs no. of nodes are presented.***
Keywords: WSN, Fuzzy Logic, Tabu Optimization, Routing in Network etc.

I. INTRODUCTION

Remote systems are made out of self-ruling hubs that are self-guided with no framework. Along these lines, specially appointed systems have a unique topology to such an extent that hubs can without much of a stretch join or leave the system whenever. They have numerous potential applications, particularly, in military and salvage territories. Remote sensor systems (WSNs) are made out of countless fixed or portable sensor hubs dependent on the method of self-association and multi-bounce to comprise remote systems. It can cooperatively accumulate, process, and transmit the data of saw objects inside the geological zone secured by systems, and inevitably, give the data to the terminal client [1].

A sensor hub is made out of four segments: a sensor module, a processor module, a remote correspondence module, and a force flexibly module. The sensor module, which is comprised of sensor and simple to computerized converter, gathers data inside the observing region and changes over the gathered data to advanced signs. Processor module is answerable for controlling and planning the activity of sensor hubs, putting away just as handling the information gathered without anyone else or sent by different hubs. Remote correspondence module is answerable for correspondence with other sensor hubs to trade control data just as get and send the gathered information. Force module gives the necessary vitality to the sensor hubs. WSNs are frequently conveyed in extreme condition or territories where it isn't available for human. Sensor hubs might be uncovered in the outside, experiencing sun introduction or downpour, and system support is amazingly troublesome [2].

When a WSN is conveyed, its lifetime ought to be to the extent that this would be possible given the at first gave measure of vitality. In addition, the hubs of WSNs are little and battery-controlled, which prompts numerous issues. Vitality effectiveness is a basic issue in WSNs because of the restricted limit of the sensor hubs batteries. Uneven vitality utilization lessens the system lifetime to a huge degree. The fundamental reason for the WSN is to spread the data from focuses to sink. The vitality of the correspondence way will run out soon because of the high system traffic choosing a similar way. Lifetime of WSN is a basic boundary for surveying the presentation of steering conventions. In this manner, planning a powerful steering strategy to control vitality cost is significant for drawing out the system lifetime [3].

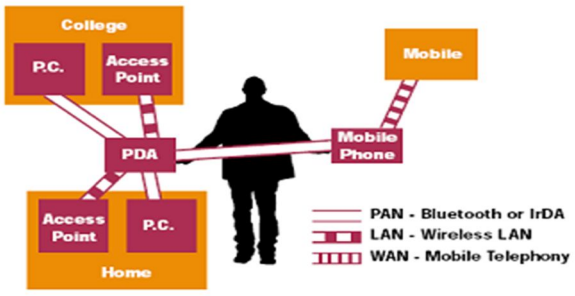


Fig 1: Wireless Used in Different Environments [3]

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Fig 1 shows the employments of remote framework in various applications. As remote impromptu systems do not have a foundation, they are presented to a great deal of assaults. One of these assaults is the Black Hole assault. Operating at a profit Hole assault, a malevolent hub assimilates all information parcels in itself, like an opening which sucks in everything in. Along these lines, all parcels in the system are dropped [4].

From study, it had examined the novel issue of updating a subset of sensor hubs with the point of amplifying the stream rate at least one sinks. The issue is demonstrated as a MILP. We propose three novel arrangements that can be utilized to redesign sensor hubs in enormous scale WSNs. The outcomes demonstrated that the presentation of Path and LagOP are near that of Tabu. In any case, both Path and LagOP have an a lot littler running time than Tabu. In another work, the impacts of the portable sink in the majority of the vitality proficient conventions have been overlooked [5].

The remainder of the paper's association is as per the following; Section II examines the WSN Routing protocols in brief. Section III presents the proposed work related to system. Section IV provides the proposed results of system. Section V presents the conclusion and its future scope.

II. WSN ROUTING PROTOCOLS

The steering conventions in WSNs are separated into three classes. In the first place, direct correspondence (DC), which is the least complex convention, where sensor hubs send information straightforwardly to the BS. The subsequent classification includes Minimum Transmission Energy (MTE) conventions, where hubs course information to the base station through transitional hubs, every hub going about as a switch for different hubs. The third and maybe most fascinating classification are comprised of grouping conventions [6].

A. Cluster-based Wireless Sensor Networks

In WSN, a portion of the issues are exceptionally basic and unpredictable, for example, vitality effective activity, inactivity, channel debate and the executives. Specifically, in enormous scope sensor organizes, the hubs that dwell far away from the BS either need to depend on huge number of middles of the road hubs or utilize high transmission capacity to advance their detected information. Different calculations propose answers for the above issue, which depends on the decay of the whole system into littler gatherings called groups. All in all, neighbouring hubs are gathered into a similar group and a bunch head as deals with each group. The bunch head goes about as a neighbourhood base-station and it is answerable for gathering the detected information from the part hubs of that group [7].

B. Unequal Clustering Algorithms

The sensor hubs closer to the base station expend more vitality, in light of the fact that the system traffic increments as we draw near to the base station. In this manner, the hubs closer to the base station immediately come up short on battery. So as to adjust vitality utilization over the system, inconsistent bunching approach is presented. This methodology depends on diminishing the group sizes as we draw near to the base station [8].

C. LEACH Clustering Protocol

In this segment, we depict LEACH (Low-Energy Adaptive Clustering Hierarchy) convention proposed by Heintzelman. Filter is a notable group head political race approach that establishes a reason for some different methodologies as expressed in. It is the main critical convention that plans to limit the general vitality utilized in information gathering activities in remote sensor systems [9].

In LEACH, bunch head political race is done occasionally to empower randomized pivot of group heads. Each round comprises of two stages, to be specific set-up stage and consistent state stage. In set-up stage, bunch heads are chosen and groups are shaped. In consistent state stage, information moves to the base station are performed through the bunched organize. A specific sensor hub chooses whether it will end up being a bunch head or not by creating an irregular number somewhere in the range of 0 and 1.

D. CHEF Clustering Protocol

In this area, we portray CHEF (Cluster-Head Election with Fuzzy) convention proposed by Kim et al. The inspiration driving this convention is that utilizing fluffy rationale can lessen gathering information and ascertaining overheads. Along these lines, the lifetime of the sensor system can be drawn out. This bunching convention is expected to beat the huge deformities of LEACH, which are brought about by its unadulterated probabilistic qualities. Bunch heads created by LEACH might be excessively near one another and they might be situated at the edges of the WSN. To beat these imperfections, CHEF considers two boundaries which are the lingering vitality of every sensor hub and the neighbourhood separation [10].

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The ideal limit P_{opt} for CHEF is characterized in.

Popt= α · P (1)

P speaks to the ideal level of bunch heads. α is a consistent worth which speaks to the proportion of the possibility for group head. The ideal estimation of P for a specific WSN is presented in. The ideal P can be determined by utilizing Equation

$$P = \frac{\sqrt{n}}{\sqrt{2\pi}} \cdot \frac{\sqrt{Efs}}{Emp} \cdot \frac{\sqrt{A}}{(0.765 \times \sqrt{A} \times 0.5)2} \cdot \frac{1}{n} (2)$$

III. PROPOSED WORK

This work provides the concept of fuzzy logic based routing in WSN. It also provides the optimization of network by Tabu search for improvement in network lifetime of system. First, it list the assumptions that we make about the network model:

1) Sensor nodes are deployed randomly.
2) All sensor nodes and the base station are stationary after deployment phase.
3) Nodes have the capability of adjusting the transmission power according to the distance of the receiver nodes.
4) The distance between nodes can be computed based on the received signal strength.
5) Therefore, there is no need for sensor nodes to know their exact locations.

A. Fault Detection in Network

This sort of dark opening assault has an inward malignant hub which fits in the middle of the courses of given source and goal. When it finds the opportunity this malevolent hub make itself a functioning information course component. At this stage it is currently equipped for leading assault with the beginning of information transmission. This is an inside assault since hub itself has a place with the information course. Inside assault is progressively defenseless against protect against in light of trouble in distinguishing the inner acting up hub. Outer assaults physically remain outside of the system and deny access to organize traffic or making clog in arrange or by upsetting the whole system.

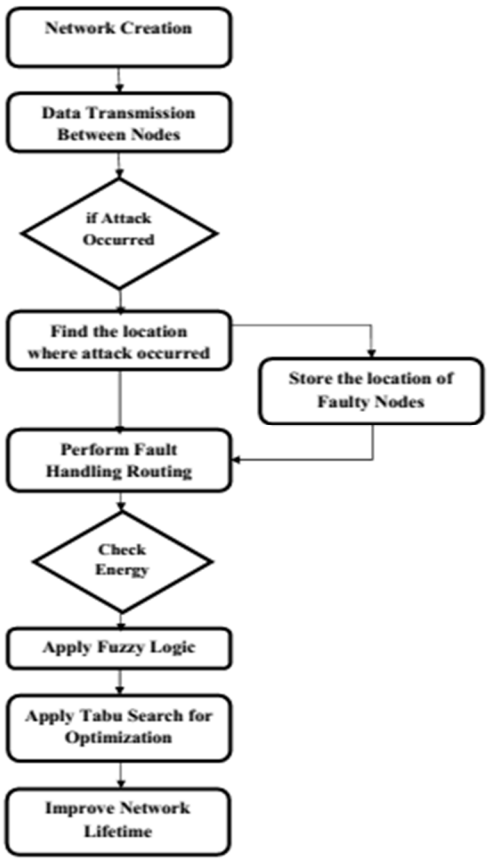


Fig 2: Proposed System Model

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B. Use of Fuzzy Logic

The Fuzzy Logic (FL) is a mathematical discipline invented to express approximate human reasoning. Contrary to the classical set theory which enable elements to belong or not to a set, FL allows a measure of imprecision or uncertainly which is marked by the use of linguistic variables like most, many, frequently through rules within a set called fuzzy set [9].

There are two essential feathery justification enlistment systems: Mamdani form and Sugeno compose. Of these Mamdani fleecy inferring structure is used. As showed up in Figure, the Mamdani sort of cushioned method of reasoning controller contains four essential parts, two of which perform changes. The fuzzifier performs estimations of the data factors input signals, certified components. In a customary cushioned method of reasoning controller, the amount of support limits and the conditions of these are from the outset directed by the customer. The membership function Fa of an element x for a crisp set A is defined as follows:

$$Fa(x) = \{0,1\}$$

Therefore, if x belongs to the set A, for any element x of universe of discourse X, membership function Fa(x) is equal to 1, and if x is not a member of set A, then it is equal to 0. Once the linguistic variables and values are defined, the rules of the fuzzy system can be formulated. These rules map the fuzzy inputs to fuzzy outputs. Fuzzy rules, or IF-THEN rules, are statement(s) that consists of three parts: antecedent, fuzzy proposition and consequence(s). One antecedent may contain more than one of the (AND) or (OR) operators.

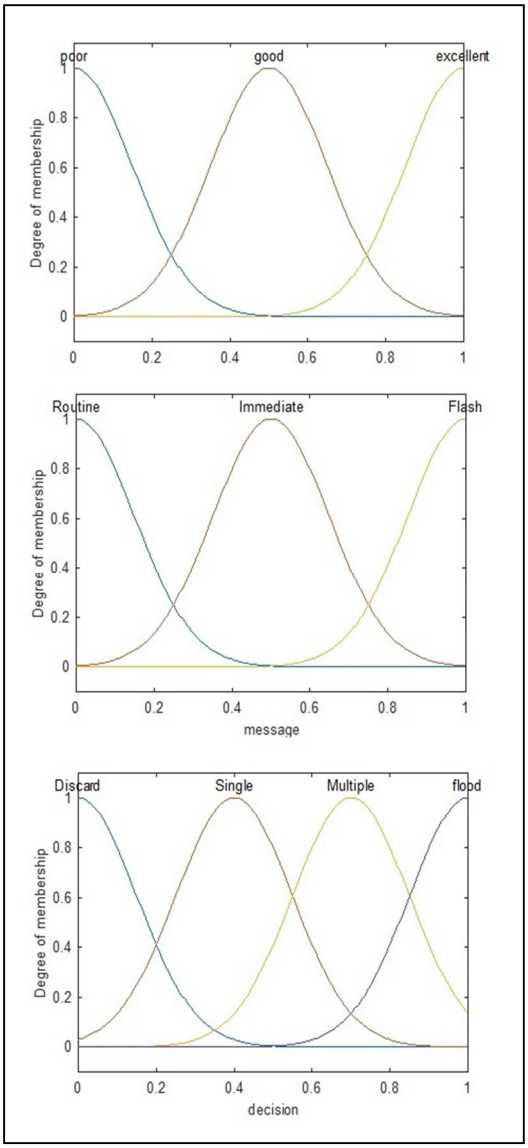


Fig 3: Proposed Membership Functions in Fuzzy Logic

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C. Optimization of Network

Tabu search is an adaptable interest strategy, using the best improvement neighbourhood look for as the central fixing. By allowing fleeting course of action corruption, tabu interest avoids the chase system being gotten into the local perfect. Two segments, the passing memory and long stretch memory, can be associated with screen attributes of as of late visited plans and guide the tabu request process.

IV. RESULTS & DISCUSSION

This work presents the concept of use of fuzzy logic in WSN network for improvement of routing with optimization of network. The dispersal essentialness in correspondence technique is the central factors we need to constrain. Moreover, the amount of center points can factor into the objective work. Less CHs bring about increasingly important imperativeness adequacy and higher CHs use more essentialness as CHs channel more power than non-bunch heads. Following are the use results for the circumstance. In this work, take the circumstance for 50 nodes as showed up in fig 4 and following result will exhibit the information about the situation of sensor center points in a zone.

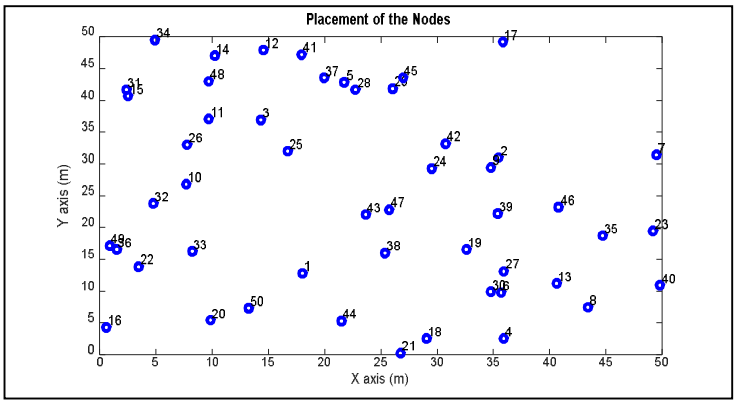


Fig 4: Network Placement with 50 Nodes

Here we take the 50*50 m^2 area for deployment of sensor nodes. But we can change it easily for large number of nodes. Then it provides shortest path routing by sender to receiver (shown in fig 5). After this, there is some attack occurred in network that causes loss of data transfer in network. There is a head CH provided as shown in fig 6.

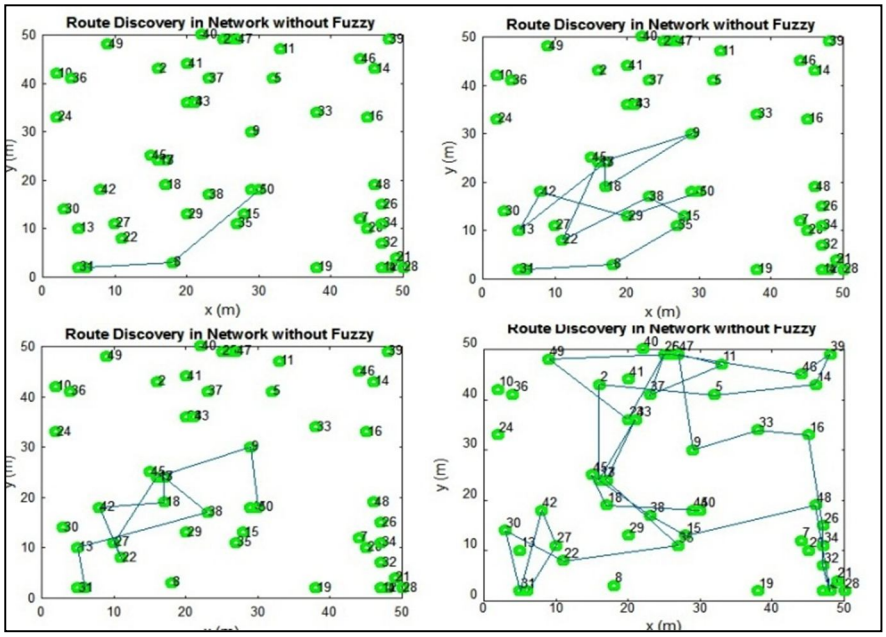


Fig 5: Attack Handling Routing in Network without Fuzzy Logic

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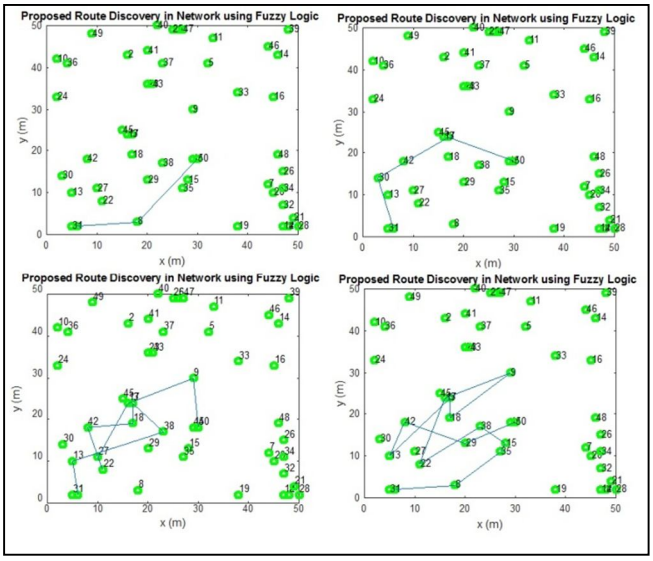


Fig 6: Attack Handling Routing in Network with Fuzzy Logic

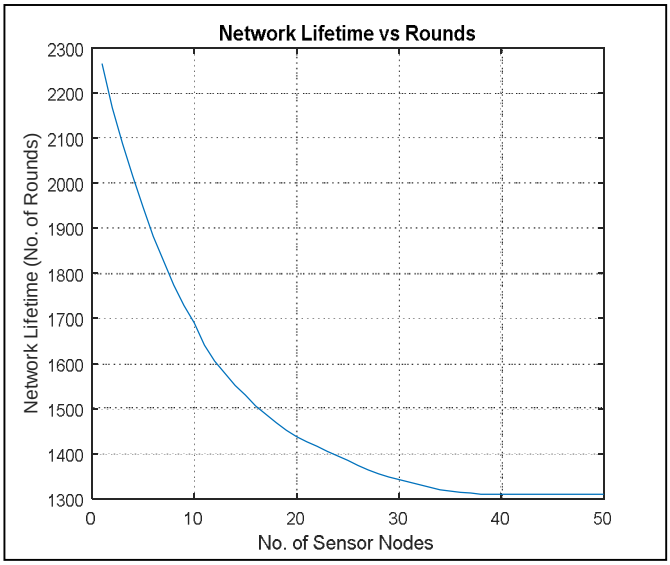


Fig 7: Network Lifetime Performance with Sensor Nodes

The results of without and with fuzzy logic based routing is shown in Fig 5 & 6 respectively. The fuzzy based routing shows better improvement in data transfer with minimum loss of energy. It provides 99% average energy remaining after fuzzy logic output. Table 1 shows the network lifetime performance of actual and proposed system and proposed result shows better as compared to actual results.

Iterations	Actual Lifetime	Proposed Lifetime
1	1600	2207
10	1550	1657
20	1500	1408
30	1450	1305
40	1400	1274
50	1350	1273

Table 1: Network Lifetime of System (For 50 Nodes)

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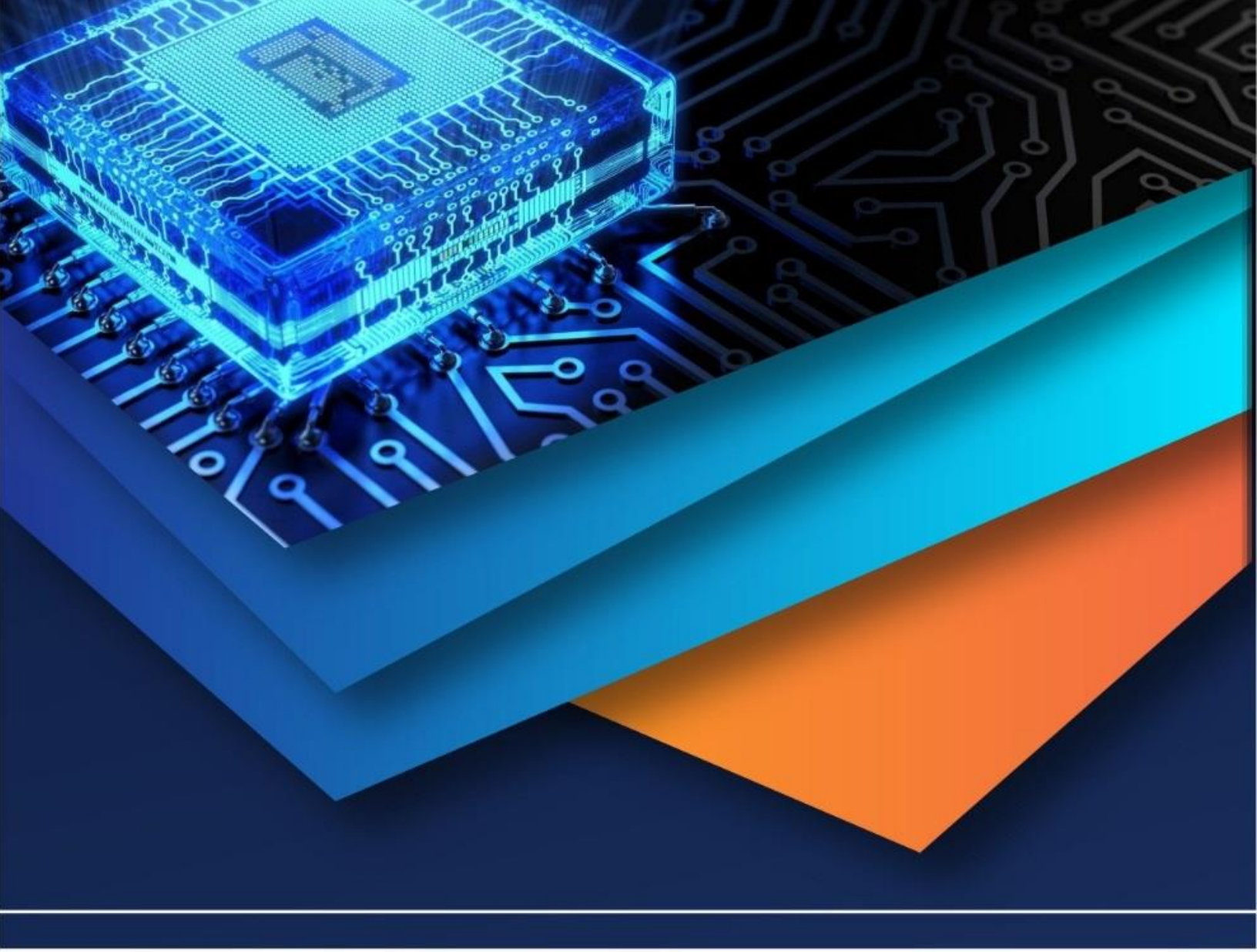
V. CONCLUSION

This work presents the concept of improvement in network lifetime by fuzzy logic with optimization in WSN. The use of fuzzy logic helps to improve energy of nodes by optimal routing in network. In this work, the main concern is the attack on nodes by any means that decrease the strength of network and also its efficiency. This work presents a scenario on detection and prevention of black hole attack on nodes that helps to improve energy as well as the network lifetime. In rechargeable Wireless Sensor Networks (WSNs), a key concern is the max flow or data rate at one or more sinks. In this work, it helps to provide optimal cost in network using tabu algorithm. The main objective is to maximize the flow rate at one or more sinks and optimize the network cost. The results of max flow vs degree of nodes and max flow vs no. of nodes are presented and prove better as compared to existing one. The network lifetime is improved with the help of optimization of network by use of Tabu Search. All proposed results are better as compared to actual results.

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