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NETWORK COVERAGE OPTIMIZATIONUSING ARTIFICIAL FISH SWARM ALGORITHM

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Abstract: The bulk of the earth's surface is expected to be covered by wireless sensor networks (WSN). In the Internet of Things era, the WSN is the principal data collecting framework. The research community has offered a number of solutions to deal with the energy efficient data collection paradigm in WSN. The standard DSR protocol is investigated in this study in order to improve the operating efficiency and service life of wireless sensor networks. This study proposes a clustering method based on the K-means algorithm. To maximize network coverage and reduce energy consumption while maintaining quality of service, a wireless sensor network coverage optimization solution based on an upgraded artificial fish swarm algorithm was proposed. A controlled experiment will also be carried out to assess the suggested algorithm's effectiveness and practical implications. The results show that the method suggested in this paper has some advantages over other methods and can be used as a theoretical foundation for future study in this field.

Index Terms -Wireless sensor network, coverage optimization, fish swarm algorithm, reverse learning, k – means clustering.

I. INTRODUCTION

Agriculture is the backbone of the Indian economy and around 70% of the population depends on this field to run their livelihood. From time immemorial agriculture has been a part of the human civilization. It has transformed the way humans survive. The economy of a particular area was indirectly dependent on agriculture, and was a major thrust behind the industrial revolution. Advancements in the field of science and technology led to increased yield. Applying electronic monitoring systems isone of the technologies for analyzing important conditions required for optimum growth of plants. The conditions can be listed as temperature, humidity, carbon dioxide, and soil moisture and soil pH. There are valuable data that could decide the plant life cycle.Efficient use of these parameters increases the output per plant and minimizes crop loss. The quantum of steps taken to monitor never ends here, more data collection in turn increases the accuracy and by leaving no stones unturned efficiency of harvest and output increases. Agricultural stations have developed novel methods for monitoring the data, and programs to help the farmer generate more output. Integrating various sensors that are rugged and capable of generating the hard data in real time can augmentfurther analysis. Currently geographical land use patterns, soil parameters are determined using satellites, and non-invasive techniques that are sophisticated and generate precise data in real time. Agricultural fields have taken shelter under the umbrella ofthese new age technologies. Real time monitoring systems have the advantage of being fast and time saving in the present context. Moreover, making it user friendly allows the agriculturist act swiftly and takes preventive measures. Designing Real time monitoring systems are a challenging task as it is not always possible to cover the entire domain of growth parameters owing to thedearth of sensor technologies, new emerging technologies like Ion selective field effect transistor (ISFET), Internet of things (IoT), Wi-Fi, mechanized harvesting, Robotic assistance are recent trends in the field of analysis of data. There are many advantages in developing microcontroller-based circuits and incorporating new sensor technologies into agricultural applications.

Microcontrollers and solid-state sensors can be found in many commercial, industrial, and consumer applications. Many sensors and auxiliary components (memory chips clocks, etc.) are designed to interface directly 2 with microcontrollers, simplifying circuit design and modification. A variety of programming languages are available, allowing the programmer to access sophisticated and complex features and create applications without having to learn each microcontroller's native assembly language. Components are very inexpensive, and can be obtained in most parts of the world via a number of suppliers.

II. Problem Statement

Some energy is lost during the data collection process from wireless sensor networks. Furthermore, current network protocols and network coverage methodologies are insufficient for efficiently lowering system energy consumption. In order to increase the operating efficiency and service life of wireless sensor networks, this paper analyses the traditional AODV protocol and highlights the merits and downsides.

III. Scope Of The Project

A feedback-based K-means clustering approach is presented. This technique primarily uses the multi-hop mechanism of cluster head and primary cluster head to collect, fuse, and transport information. The method combines the cluster head and primary cluster head information for each round based on node energy and location concentration weighting to reduce unnecessary energy usage. The fish school method is used in this research to reduce energy consumption by lowering the active state of a large number of nodes in a wireless sensor network.

IV. Literature Survey

[1]. PCA Technique and ARIMA Model

S. Diwakaran, B. Perumal et al. In the year of 2019**,** to reduce duplicate data transmission, a prediction model-based data collecting with PCA-based data reduction technique is given. This approach compresses the data greatly before sending it to the sink node. As a result, it uses a substantial quantity of energy. At the CH node, the ARIMA model is employed to define the data prediction model. This prediction model is given to the cluster's other nodes, which then predict the data according to the model. The accuracy of prediction is further tested, and it is proven that the predicted data received at the sink node is identical to the original data. This method, unlike other geographical and temporal-based methods, sends the data difference between the expected and actual data to decrease data transmissions.

[2]. Novel Energy Efficient Connected Coverage

J.Roselin, P.Latha et al. In the year of 2017, A unique energy efficient connected coverage method is presented to optimize the lifetime of WSNs, and it is confirmed using Greedy-CSC, CWGC, OCCH, and MCLCT from the literature. A rigorous scenario configuration is modelled to imitate the real-time environment. For sensor selection, the proposed EECC algorithm uses QoS parameters such as remaining energy, coverage, and connection, and formulates non-disjoint energy efficient connected covers for scheduling sensor operations. EECC rigorously avoids coverage redundancy at CPs through sensor selection and cover set formulation. To avoid needless traffic and early battery loss on detecting nodes, sensors are further categorized as sensing or relaying nodes. To create communication, the non-covering sensors are efficiently used as relay nodes. As a result, the EECC avoids early energy, coverage, and communication holes, extending the WSN's lifetime.

[3]. Genetic Algorithm

Suneet Kumar Guptaa et al. In the year of 2015,We have presented a GA-based strategy for locating the smallest number of viable sensor node placement locations in target-based wireless sensor networks that meet the sensor nodes' k-coverage and m-connectivity requirements. When all of the targets must be monitored by sensor nodes in close proximity, the need for such a system has been demonstrated. The linear programming formulation of the problem was first proposed. The suggested GA-based approach was then given, complete with appropriate chromosome presentation, fitness function derivation, selection, crossover, and mutation procedures. All of these processes have been explained with appropriate examples for ease of comprehension. We've demonstrated that the suggested technique is considerably more time efficient than other GA-based approaches. Using numerous WSN scenarios, the method has been extensively simulated by altering the number of alternative positions and target points. The results of the simulation are compared to current methods as well as a greedy approach. The results reveal that our method outperforms all other algorithms in terms of the number of alternative sites selected. The proposed work has a wide range of applications in huge companies, such as rigorously monitoring some designated target points, such as a potential fire zone.

[4]. Energy Effective Movement Algorithm

X. Gao, Z. Chen, F. Wu et al. In the year of 2017, the k-Sink Minimum Movement Target Coverage problem is a version of the target coverage problem in mobile sensor networks (k-MMTC). To address this issue, we offer the Energy Effective Movement Algorithm, a polynomial-time approximation scheme (PTAS) (EEMA). We offer D-EEMA, a distributed variant for large-scale networks. Experiments are also provided to verify the efficacy and efficiency of EEMA and D-EEMA. Overall, EEMA is the first PTAS to solve the target coverage problem with sensor movement scheduling.

[5]. Efficient k-Barrier Construction Mechanism

C. I.Weng, C. Y. Chang et al. In the year of 2018, the goal of this research is to offer a novel graph model (CA-Net) that simplifies the problem of k-barrier coverage while reducing computation complexity. Two decentralized techniques, BCA and

TOBA, are proposed to address the k-barrier coverage problem based on the built CA-Net. The BCA is a basic and straightforward method for determining the best-fit DBk on CA-Net. The TOBA may make full use of all of the sensors and do additional research on DB1. In addition, a backtracking (BT) policy is proposed to increase the BCA and TOBA's performance when they hit a dead-end situation. The suggested BES scheduling approach intends to make full use of all of the built DB1 in order to achieve energy balance and maximum lifetime. In terms of control overhead, number of DBk produced, number of sensors required, sensor usage, barrier construction efficiency, and network lifetime, the simulation study compares the offered techniques to the ideal solution MDP. When compared to the centralized MDP algorithm, simulation results suggest that the proposed decentralized TOBA technique with BT and BES policies has similar performance.

[6]. Whale Group Algorithm

Wireless sensor network coverage optimization based on whale group algorithm October 2018 - Lei Wang, Weihua Wu, Junyan Qi, and Zongpu Jia - Whales are mammals that grow in the ocean and have strong group communication ability and high IQ. Whale size is relatively large, and usually dominated by the community. In seawater, they can make a variety of melodious sounds, and the spread of a very wide range. Social whales use ultrasound to communicate with their peers to complete prey, migration and other activities. When a whale discovers food, it will sound to inform the whales about the amount of food and other information. As a result each whale receives a large amount of information from nearby whales and then opts to move to the nearest and most food-bearing spot. The predatory behavior of whales in this vocal communication inspired scholars to develop a new target optimization algorithm [23]. In this paper, we use the characteristics of optimization of whale swarm optimization algorithm and apply it in wireless sensor network coverage optimization.

[7]. The Grey Wolf Optimization Algorithm

A Novel Coverage Optimization Strategy Based on Grey Wolf Algorithm Optimized by Simulated Annealing for Wireless Sensor Networks - March 2021 - Yong Zhang - In recent years, a large number of scholars have paid more attention to grey wolf optimization algorithm (GWO). The grey wolf optimization algorithm is a new swarm intelligence algorithm proposed by Mirjalili et al. in 2014 [26, 27]. The grey wolf algorithm is inspired by the hunting behavior of wolves. It is an intelligent optimization algorithm that imitates the hierarchical system and hunting strategy in wolves. The grey wolf algorithm simulates the social class system of grey wolf and its predatory behavior and then uses the grey wolf's search, siege, and the hunting behaviors in the predation process to achieve the purpose of optimization [28]. The algorithm refers to the relationship between the natural grey wolf hunting division and the food distribution. It takes artificial wolf as the main body and adopts a collaborative path search structure based on responsibility division to abstract the engineering optimization solution process into the grey wolf hunting process. The algorithm has the advantages of simple model, fewer parameter settings, and better optimization performance. Therefore, the GWO algorithm is widely used in the multisensor training, the surface wave parameter optimization, cluster optimization, and other fields .

[8]. Grey Wolf Algorithm Optimized by Simulated Annealing

Although the GWO algorithm has received extensive attention, it also has some shortcomings, such as the slow convergence speed and the weak global search ability, etc., and in continuous iterations, the GWO algorithm is prone to falling into local optimality. In the process of optimizing the fitness function, the grey wolf swarm algorithm always approaches the maximum value. If the fitness function has a local extreme value, once it falls into the local optimum in the process of optimization, it cannot escape. The idea of simulated annealing can improve or eliminate this problem [31, 32]. Therefore, a grey wolf optimization algorithm optimized by simulated annealing (SA-GWO) is proposed in this paper. In the proposed algorithm, the SA-GWO algorithm is embedded in the end of the siege behavior of wolves and before the update of wolves to enhance the global optimization ability of the basic grey wolf algorithm and improve the convergence speed of the grey wolf algorithm

PROPOSED SYSTEM

Artificial fish eyesight and swimming step are two important variables in the fish school algorithm that have a big impact on the results. When the field of vision is large, the convergence speed is higher, but the algorithm accuracy is low, and the number of fish to be searched is large. The approach converges slowly in a small field of vision, but its accuracy is higher. As a result, both a large field of view and a short field of view have benefits and drawbacks. As a result, combining the two is critical in order to improve accuracy and speed convergence.

The maximum visual eld range, number of repeats, and congestion factor are listed first, followed by algorithm parameter settings, which primarily include fish school scale and step size. Create a group of fish. By defining parameters, several artificial fish are generated within a specific range. The number of iterations is then decided after the school of fish is initialised. The food concentration of artificial fish is calculated after initial purification, and the associated parameters are recorded on the bulletin board. The distribution of food concentrations and fish foraging behaviour were both simulated.

All fish must complete the process simulation, and we must decide whether to continue based on the local food concentration. Once the fake fish school has completed its matching behaviour, the bulletin board reports the best record. The food concentration is then compared to the initial value, and the current value is replaced on the bulletin board if the food concentration is higher. If the maximum number of iterations is reached, it will immediately stop and the bulletin board value will not be output. If the maximum number of iterations is not reached, iteration continues.

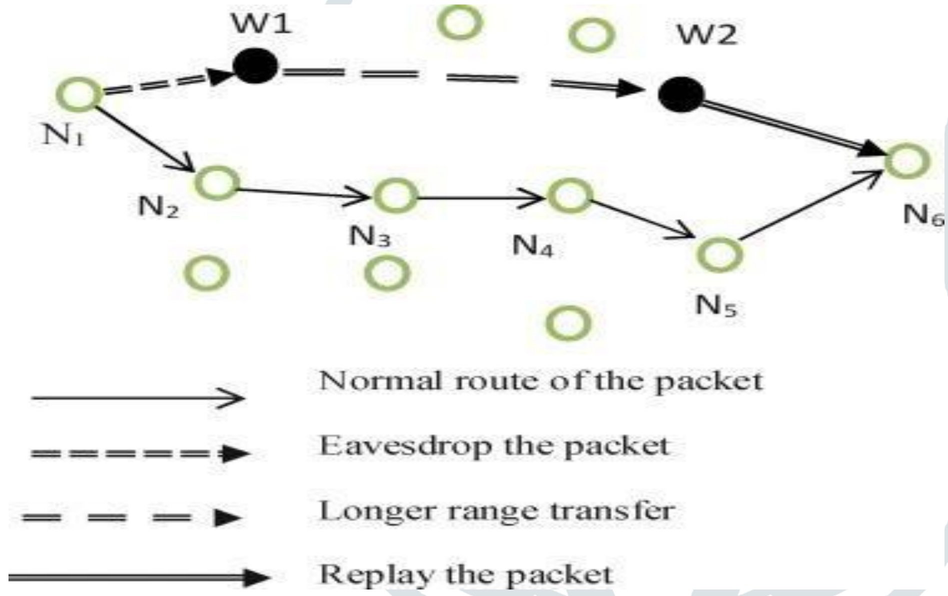
Using the artificial fish school approach, the wireless sensor network optimization problem may be converted into a reasonable target finding problem, removing the difficulty of being constrained to extreme values. After the model clusters and rear-ends again, the artificial fish and vits relevant F value are acquired, and the largest one with the matching artificial fish is chosen as the final result. The current F value is also compared to the F value on the bulletin board, with the greater of the two being published on the bulletin board.

According to the above analysis, the artificial fish is introduced to the dynamic field of view analysis in this study, which considerably boosts the convergence speed and speeds up the ideal solution query speed. However, the accuracy of this investigation did not outperform the fish school algorithm with a smaller field of vision. Although the results are similar to those obtained using the traditional fish school method, it has advantages in terms of convergence speed and run duration.

Iteration criteria are met when the judgement value obtained by the operation reaches the system's maximum value, at which point the median iteration is performed. The improvement concept in the research is to use a large field of view in the early stages of the algorithm to quickly find a rough solution, reduce convergence time, determine the target range, and gradually improve the iteration step, gradually reduce the field of view, and perform a fine target search until the optimal solution is found.

METHODOLOGY

Wireless Sensors Network Using ADOV Protocol

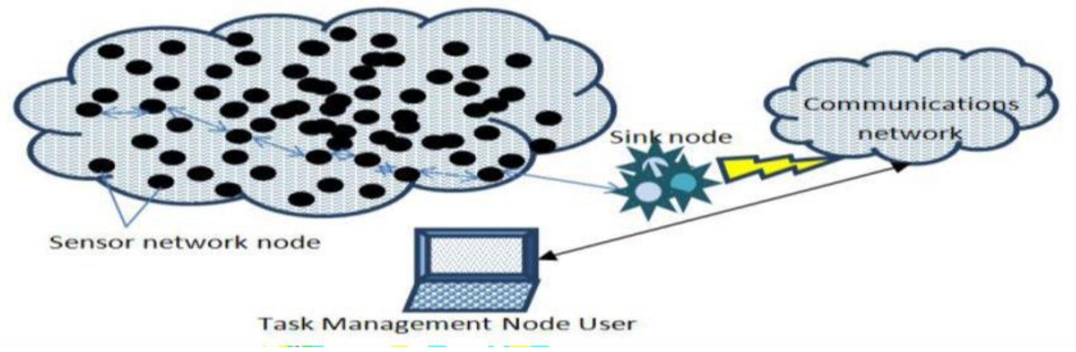


The AODV routing protocol is designed for wireless sensor networks, as seen in fig (WSN). The AODV routing protocol is a reactive routing protocol. It employs an on-demand approach to route discovery, in which a route is built only when it is requested by a source node for data packet transmission. Route discovery and route maintenance are the two core activities of AODV. To discover and manage routes, AODV uses Route REQuest (RREQ), Route REPly (RREP), and Route ERRor (RERR) messages. When a source node needs a route to a destination node for which it does not have one, it broadcasts an RREQ packet across the network.

The source IP address, destination IP address, source sequence number, destination sequence number, request ID, and hop count are all included in an RREQ packet. A node rejects a route request packet that contains the identical source address and request ID fields as previous route request packets. Otherwise, it will check to see if the destination address is already in its routing table. If that address is found, the destination sequence number in the table is compared to the destination in the routing table, and if the destination cannot be reached by that route, the destination sequence number is incremented and a route request is submitted. As a result, the route freshness is indicated by the destination sequence number.

When a link breakage in an active route is discovered during route maintenance, the node alerts thsource node by sending an RERR message. If there is still data to send, the source node will restart the route discovery process

WSN Node Model



When transferring data, the sensor network is mostly dependent on distance, which is not a linear connection. The functional relationship is often an exponential function relationship, and it can be divided into a free space model and a multi-channel transmission model based on the distance. Figure depicts the wireless sensor network node model.

Technologies Used

Network Stimulator in Ubuntu

NS is a network simulator based on events. MIT's Object Tool Command Language, OTcl (an obj oriented version of Tcl), is used as the command and configuration interface for an extensible simulation engine written in C++. The Tool Command Language, Tcl, was utilised as the configuration language in an earlier version of the simulator, ns version 1. Simulation programmes developed in Tcl for the ns version 1 simulator are still supported in the current version.

Network Animator

Nam, or Network Animator, is a tool for displaying network traces and real-world packet traces graphically. NS and nam can be combined to build a virtual network that can be manually or graphically analysed.

The NAM is a Tcl/TK-based animation programme. Viewing network simulation and real-world packet traces with this programme. We can execute processes such as topology layout, packet level animation, and many data inspection tools using this nam tool.

Fish Swarm Algorithm

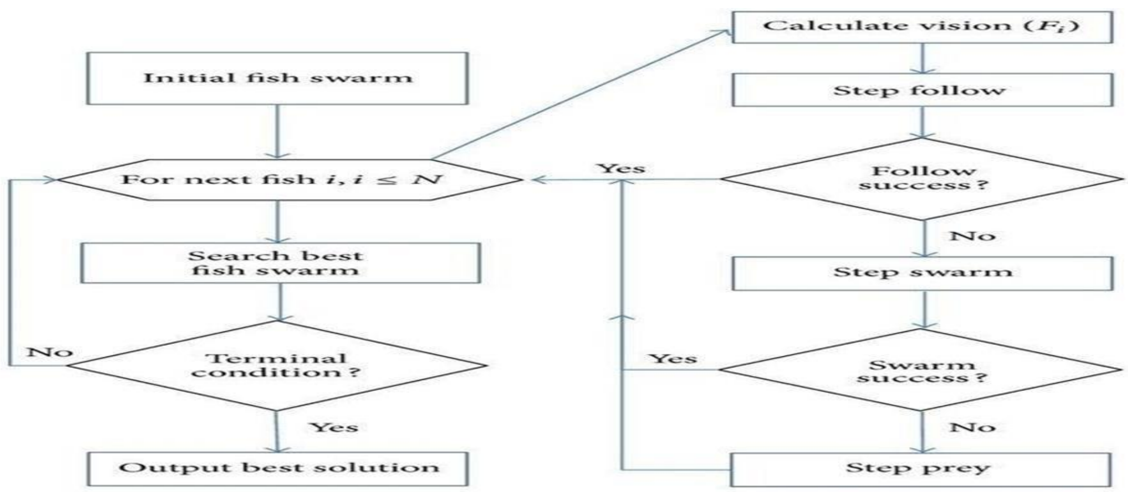
The application of the PSO method in binary coding is referred to as the fish swarm algorithm. Should be either 0 or 1 in binary coding. However, the results of may not be integer; the result of iteration can still be any number other than 0 and 1, thus the fuzzy function is used to make it 0 and 1.

The evaluation of criterion of network coverage

When building a wireless sensor network, one of the first questions to consider is how to best deploy the sensor nodes to maximise network coverage. By monitoring network coverage, the blind spots can be identified and the sensor node distribution improved. In general, the quality of sensing service is used to assess the coverage of wireless sensor networks.

Wireless sensor network coverage shows a sensor network's sensing service quality. The basic notion of network coverage will be discussed in this section, as well as the evaluation of the criterion, which will serve as the foundation for subsequent research and algorithm construction.

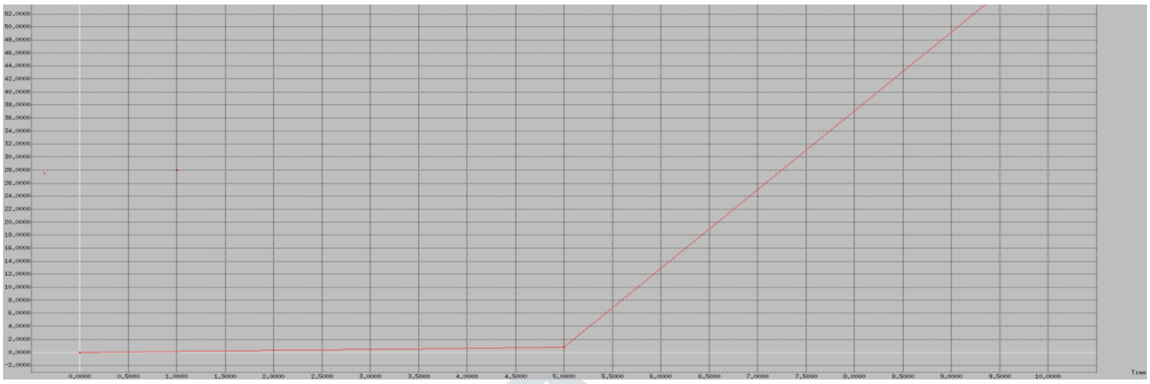
Use Case Diagram



Use-case diagrams depict a system's high-level functions and scope. The interactions between the system and its actors are also depicted in these diagrams. In use-case diagrams, the use cases and actors define what the system does and how the actors interact with it, but not how the system works internally.

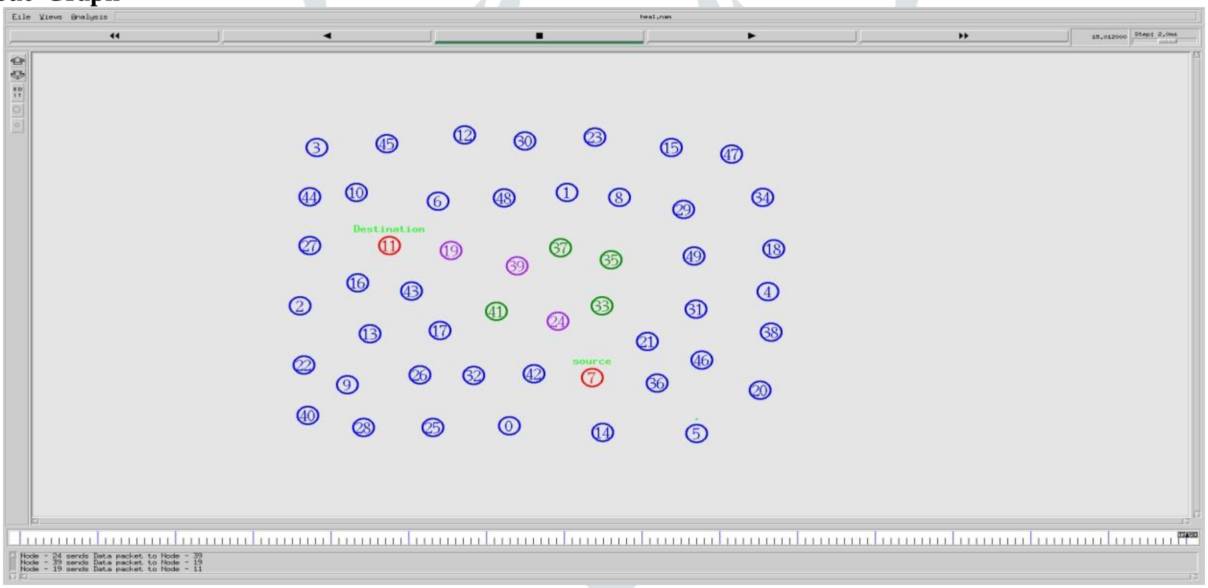
V. Experimental Results

With Graph



The accuracy node module frequency of the signals flowing through the nodes is shown in this graph. The graph will run until the nodes are separated in the drop value, which will stabilize the node's signals.

without Graph



The ultimate segregation of the nods in the network animation is shown in this diagram. Where the nodes have created a simple path from the source to the destination.

I. Conclusion and Future work

On this foundation, a clustering approach based on the K-means algorithm is proposed, with a scoring function added to the algorithm to dynamically adapt the system for stable operation and information transmission while reducing system energy consumption. Second, this article uses an artificial fish swarm technique to examine the nodes' operational state in light of network node consumption. Furthermore, under the premise of establishing the node distribution, the node consumption rate is reduced, the network coverage is not changed, and the convergence speed is increased without sacrificing accuracy, resulting in the achievement of the intended goals. A new artificial fish swarm technique for overcoming the coverage problem in wireless sensor networks is described in the article.

The study technique offers certain practical benefits, according to the experimental solution results, and it could be utilised to improve the F value on the bulletin board, with the greater of the two being published on the bulletin board. According to the above analysis, the artificial fish is introduced to the dynamic field of view analysis in this study, which considerably boosts the convergence speed and speeds up the ideal solution query speed. However, the accuracy of this investigation did not outperform the fish school algorithm with a smaller field of vision. Although the results are similar to those obtained using the traditional fish school method, it has advantages in terms of convergence speed and run duration.

Iteration criteria are met when the judgement value obtained by the operation reaches the system's maximum value, at which point the median iteration is performed. The improvement concept in the research is to use a large field of view in the early stages of the algorithm to quickly find a rough solution, reduce convergence time, determine the target range, and gradually improve the iteration step, gradually reduce the field of view, and perform a fine target search until the optimal solution is found.

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