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Optimization of the operational state's routing for mobile wireless sensor networks

Khalid K. Almuzaini[1] · Shubham Joshi[2] · Stephen Ojo[3] · Mansi Aggarwal[4] · Preetam Suman[5] · Piyush Kumar Pareek[6] · Prashant Kumar Shukla[7]

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Abstract

High levels of node power in Mobile Wireless Sensor Networks (MWSN) can have an effect on the reliability of a number of different aspects of the service. Due to their inherently low energy efficiency, sensor nodes lose power with every bit of data they transmit. In order to accomplish any data transfer, however, the nodes must engage in cooperative communication. To aid optimal routing in mobile wireless sensor networks, researchers have developed a new method inspired by the work of bee colony optimizers. To enhance service in a mobile wireless sensor network, we present a cluster energy hop-based dynamic route selection (CEH-DRS) that takes into account individual production zones. In this case, sensor nodes can collect data and send it out to the network. They also help with the routing of data packets coming from various origin nodes. Finally, this study optimizes the system's route while still meeting the criterion of selecting the shortest way. This technique improves cluster selection by taking into account the state of affairs in the area and other characteristics (such as throughput, delay and packet delivery ratio). It is also discovered that the soft computing approaches accurately detect and select the best path, whereas the conventional methods cannot. The proposed CEH-DRS method improved network performance in a better way to achieve higher throughput than all approaches like optimized route cache protocol-ad hoc on-demand distance vector, fuzzy and bee colony optimization, selectively turning ON/OFF the sensors, hidden Markov model.

Keywords MAC · MSN · OSRP (optical signal and routing protocol) · WRP · PSO (particle swarm optimization) · CEH-DRS

1 Introduction

A wireless system that relies on a network of nodes to function makes use of radio waves to carry out its operations. When people think of a communications network, they usually picture a wireless one. Any system that successfully performs some pre-set functions via electromagnetic-wave transmission is considered a wireless system. The wireless cellular system has relied on a central supporting framework since the 1980s. Despite moving from one access point to another, users will never lose contact with the wireless network [1].

A number of routing strategies can be applied to mobile wireless sensor networks, however cluster-based routing has a far greater effect on meeting performance goals. The nodes of a cluster-based routing network forward data packets to a gateway so that the cluster as a whole can communicate with any destination that is not a member of the cluster [2].

Wireless sensor networks (WSNs) are a type of centralised network that represents a novel perspective in multi-hop remote systems administration. Sensor nodes come in both wired and wireless varieties. Sensor networks, cameras, the entrance, as well as an administration cluster are all parts of a wireless channel. The properties of sensor networks model are hubs can move around, capacity to distribute widely, sensor network power usage restrictions, node uniformity, capacity to handle transient faults, terminal diversity and so on. WSNs are becoming increasingly accepted in the industry and are expected to become a standard feature of the modern computing environment. These self-organizing and self-configuring

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Extended author information available on the last page of the article features are largely responsible for the success of this particularly designed system. In a WSN, each node serves as a sort of mini-router and host computer. Routing Tables are used by networks to choose the connection through which a message will be transmitted. All connections for that pathways are available are listed in a forwarding table. The routing protocol for every network is different and is kept in the router's Memory. For situations requiring immediate outdoor communication despite the lack of a pre-existing wireless network, such as hastily arranged business meetings, mine site operations, military operations, robot data collecting, and emergency natural disasters, an ad hoc wireless network (AWSN) is available. Due to the fact that the nodes in this network may be connected via a series of hops, we refer to it as a "Multi-Hop" Wireless Sensor Network [3]. OSRP, which was created for ATM systems, is an optically transport technology akin to PNNI (Stateful Firewall Interaction) as well as MPLS (Multiprotocol Label Mixing). Devices can communicate system information, including switching as well as connection statuses, over OSRP. Particle swarm optimization (PSO) is a computer technique used in machine learning that attempts to continuously enhance a population of solutions with respect to a specified qualitative measure.

The collection of mobile nodes (or routers) in a Mobile Wireless Sensor Network functions as the dynamic temporary network without the need for centralised administration and infrastructure network. Additionally called adaptive sequencing. It is a method where a router, in reaction to modifications in the state or structure of the network, inserts a different approach for every passenger in the forwarding table. The nodes shift around in different regions at will and arrange themselves in whatever way they see fit. This is why the wireless topology of the sensor network may undergo sudden and unexpected changes. The three primary types of routing algorithms are as follows: distance vector routing framework: these methods decide which number of hops is the optimal way to travel to a network device in a defined way. This network functions autonomously and may be linked to the wider web. Multi-hop, mobility, heterogeneity, bandwidth, and battery power limits are some of the most significant obstacles in the design of sensor routing protocols [4].

It has been thought about how wireless sensor networks could benefit from having mobile sink nodes that can move around and collect data from sensors scattered over the network. The sensor nodes provide their most current status updates and can be found in close proximity to one another. The members of the cluster then create a fuzzy-logic based inter-cluster routing mechanism to distribute the amassed messages [5].

In this paper, we offer a hidden Markov model-based (HMM) mobility management strategy for mobile wireless sensor networks (MWSN). Markov frameworks can be repaired sequence or changeable purchase, in addition to nonlinearities or uniform. A remedied number of previous states are used to forecast the greatest better indication in a fixed-order Markov prototype. This set number of prior provinces is referred to as the Markov model's sequence. Here, we use RSSI (Received Signal Strength Indication), Link Loss, and Expected Transmission Count to foretell a node's potential for movement (ETX). At first, we set up a prediction timer during which we record both the received signal strength indication (RSSI) and the link failure rate (Link Loss) [6]. The HMM-based predictions are activated when either the RSSI or the Link Loss decreases from their previous values. If not, the current timer will run out and a new one will be initiated.

When the energy factors are taken into account, it becomes clear that path hops cannot result in efficient execution. In order for two nodes to communicate in an environment devoid of infrastructure, the Sensor routing protocol is required. In the classroom, students may need to ask questions and get answers, while in the firehouse; firefighters must be able to communicate with one another quickly in an emergency. Because of the lack of fixed infrastructure and centralised administration, ad hoc networks consist of mobile hosts communicating with one another [7].

To add WSN standards to the Internet standard track, the WSN group was established. The WSN will be further refined and developed by this team. The ultimate goal is to create a WSN protocol that can handle numerous WSN routers and overcome all of the obstacles. Some of the difficulties in WSN include the limited wireless transmission range, packet losses owing to transmission defects, the concealed terminal problem, mobility—caused routing changes, and battery life. WSN has the potential to improve wireless connectivity in areas where there was previously no service or signal [8].

Numerous gateways link the WSN to the larger network. The performance of the mobile host could be enhanced even in a holistic setting by adjusting the switch gateway. If the upcoming process for the information is to some other edge gateway, an entry point, or an implementation, this exchange takes place via IoT networks, that guarantee that information sent through physical devices, including detectors, is recognized and comprehended by the following as well as successive stages in the robust network. As a result of using a network-layer metric for the overall measurement, the prediction of the mobile host has been shown to improve. The key properties of a WSN are its direct peer-to-peer communication, its dynamic multi-hop network structure, and its simple connection to access networks. The gateway connects the wireless sensor network's (WSN) multi-hop capability to the underlying wired network. The gateway network interface needs to be compatible with both traditional global routing and local ad hoc routing [9].

The Web server and a communication system extension via nodes are two primary motivations for the creation of Wireless Sensor Network. This feature enables the user to set up authentication on their sensor server network. An additional tool for keeping tabs on the nucleus mark language is the remote device Page (HTML). In order to alter the mode of the remote network and access the data, the user can switch the WSN function at any moment [10].

Node density energy in mobile wireless sensor systems (MWSN) can impact the dependability of a variety of various service-related elements. Sensor nodes waste electricity with each and every bit of information they broadcast because they are grossly inefficient energy consumers. Nevertheless, the networks need to work together in order to communicate in order to switch significant information. When there aren't enough people or money to set up permanent networks, the WSN might be set up for temporary use. A few instances would be the communication between moving vehicles and soldiers, activities like meetings and emergency search and rescue operations, and the like on the battlefield. The WSN can accommodate the rising need for on-the-go computation, which bodes well for the future.

1.1 IEEE 802.11 protocol

Standard Operating Procedure the IEEE 802 Standards Committee divides the Data-Link layer of the OSI model into two parts: the Logical Link Control (LLC) and the media access control. Despite its widespread use in many protocols, the International Standardization System (ISS) shown in Fig. 1 was designed as a model for Open Systems Integration (OSI) to standardise the layer in the stack. Developers of connecting hardware and communications applications benefit from the OSI model because: Make hardware and software interoperable with items from every other manufacturer to enable broad compatibility. Specify the components of the system that their solutions must support. Generally speaking, WiFi (802.11) functions at the physical level as well as the information connection level, which are the initial two levels of the OSI architecture. Layers 1–4 are regarded as the bottom levels & are mainly focused on information transfer. The top layers, layers 5–7, are where user information is located. As a result, every level has a certain responsibility to do. The 'passing it on' idea underlies this approach. The OSI reference model is the basis of this network's lower layers, where IEEE 802.11 operates according to the standards. In the sensor network model, operation of a specialised piece of hardware is not regulated. In the ISO paradigm, the Channels of their Body Media are Application, Presentation, Session, Transport, Network, and Data Connection [11]. To facilitate mobile connectivity, not all network access points adhere to the open systems interconnection (OSI) reference model's application, presentation, session, transport network, data link, physical, media access control (MAC), physical, 802.2 logical link control (local area network) specifications. Data transmission via a physical connection is facilitated by two ostensibly invisible layers called the media access control (MAC) and the logic connection control (LLC).

1.1.1 MAC layer

In the medium access control (MAC) layer, there are two access methods: point coordination and distributed coordination. The IEEE 802.11-based WLAN technology, encompassing Wi-Fi, uses the Properly Implement Functions (PCF) as an alternative mechanism to avoid conflicts. It is a carrier-sense multiplexed entry with obstacle detection (CSMA/CA) lower layer technology for medium identity management (MAC). In this approach, the coordinating component of a distributed network manages inter-process interaction and collaboration. It serves as the adhesive that holds the functions carried out by operations together as a totality. The additional process periodically spaces out beacon frequencies throughout the channel allocation duration. The duration among access points broadcasting beacon packets, that transmit network infrastructure and identifying details to everyone client terminals within a single WLAN, is characterized as an iteration step. The primary channel password protection (MAC) method used by the IEEE 802.11-based WLAN protocol is termed dispersed coordinating functional (DCF) (including Wi-Fi). DCF uses the multivariate exponentially timeout method with carrier-sense mutual authentication with obstacle detection (CSMA/CA). Information that allows routers to choose paths between any two nodes on a network is disseminated via the routers' inter-communication, as specified by the routing protocol. As each router gains new information about the network, it shares that information with the others. This method is useful for learning about the topology of a network. In a network, data packets are sent from one computer to another via a protocol that conforms to the standard established by the sensor nodes [12]. There are many different types of routing protocols, including Ad Hoc Directed View (AODV), Cluster Head Gateway Switch Routing (CGSR), Destination Sequenced Distance Vector (DSDV), Dynamic Source Routing (DSR), Optimized Link State Routing

Fig. 1 OSI and IEEE 802.11 model

Protocol (OLSR), Wireless Routing Protocol (WRP), Zone Routing Protocol (ZRP), etc.

2 Existing work done

Author suggested Sensor nodes in Wireless Sensor Networks have limited power, computational, bandwidth, and memory. These nodes can communicate with each other and a base station. Each node has a sensor for a specific task and is connected to the base station. The sensor includes a radio module for wireless data transmission, a microcontroller for processing, and a power supply for all components. Flat, hierarchical, and location-based routing techniques make up Wireless sensing networks. In flat routing systems, all nodes do the identical task and broadcast data to the Base station using flooding. Small-scale networks use flat topology [13]. Location-based routing protocols used real-time applications to transport data based on geographical positions. As a routing algorithm for secure networks, several networking experts consider EIGRP to be the ideal option since it provides the best proportion of performance, flexibility, and administrative simplicity. The position route planning (LRP) is a classic strategic-tactical-operational issue that takes into account a group of prospective infrastructure or a set of clients with a requirement. The key judgements in the LRP are (1) the multitude as well as available facilities to access, (2) the allotment of consumers to access infrastructure, and (3) the layout of pathways to deal with customers from every facility utilizing a fleet of automobiles.

Authors compared fuzzy and neuro-fuzzy cluster-based routing protocols for wireless sensor networks. Sensor node locations are not predetermined. Clustering in Wireless Sensor Networks extends the network's life. It has real-time apps. Wireless Sensor Networks save energy. Soft computing improves performance. Routing is data forwarding in network-layer routing and routing is two-fold. First, identify the data forwarding path; then, transfer the packet [14]. The delivered packet utilises a common metric to determine the best route.

Researchers discussed cognitive radio. By leveraging unused wireless spectrum, difficulties in wireless networks caused by limiting spectrum consumption can be solved. The difficulties are hardware architecture & Firmware, RF interference, WLAN security and protection from internal/external threats, physical object interference, besides incorrect antenna configuration. Cognitive radio allows unlicensed users to access licenced frequency bands while safeguarding network quality. By connecting Wireless Sensor Networks to Cognitive radio technologies, spectrum shortage can be alleviated in real-time. CMAPs (Compound muscle action potential) don't provide channel switching. When using many independent channels simultaneously, MMAC (Maintenance Management and Control file) procedures must be improved [15].

Authors tested hybrid trust models in wireless sensor networks. Wireless sensor networks face attacks and have energy, communication, and longevity limits. Bio-inspired trust models increase wireless sensor network security. Security flaws are quite likely in the absence of periodic reviews. If a breach occurred, this could damage the professional image among customers and suppliers as a result of your inadequate data security measures. Individual mistake accounts for more than 90% of invasions. Instances of this include spam messages, hasty decisions, using unsecure credentials, and so more. It's a network of affordable sensing nodes that can measure, compute, and communicate. They measure local environmental or other characteristics and communicate them to surrounding nodes. Wireless sensor networks include military, environmental, health, household, and industrial uses. Wireless sensor networks confront restricted functionality, power, node costs, environmental concerns, and topology management [16].

Authors discussed a trust-based bat-inspired WSN routing protocol. Mobile Ad-hoc Network has a decentralised, self-organized, dynamic topology. An effective Mobile Ad-hoc Network communication system deployment requires trust management and network cooperation information. The Trust-Based Bat-Inspired Routing protocol assesses the trust value of each source node's neighbour using the Trust Equation [17]. The destination side aggregates the individual trust values into a single value. High-trust nodes are used for better packet transport. Fuzzy logic evaluates the node's trust level to create the optimum routing option. The second contribution of Trust-Based Bat-Inspired Routing is barrier estimation.

EDehghan et al. (2017) used smartphones to collect data from wireless sensor networks in cities. Hundreds or thousands of nodes are randomly deployed in remote or dangerous regions. Nodes collect data from their surroundings. These nodes can collect information from these places that isn't otherwise obtainable. Each sensor node has a sensor, computation unit, memory, and a limited-range wireless communications device. Smartphones capture data from urban mobile sensor networks due to their portability and inclusion. Smartphones can collect and communicate wireless sensor network data to the central controller [8, 18].

Data gathering with smartphones creates delays owing to human mobility; however some applications may overlook this delay in wireless sensor networks. Authors suggested regulating wireless sensor networks' energy consumption to increase their lifetime [19, 20]. Wireless sensor networks manage energy to extend network life. For sensor networks in inaccessible locations, like outer planets or deep oceans, energy saving is critical. Recent advances in sensor node electronics, control, and communication allow researchers to examine more efficient approaches for low-cost, low-energy operation [21]. The neighbourhood clusters are generated based on the proximity of the nodes, and the ranking is based on an index comprising of energy remnant, distance to the base station, and local distances to other cluster nodes.

Researchers designed a routing strategy to conserve energy in a wireless sensor network. Three characteristics were evaluated while choosing the route: sensor energy in joules, traffic, and the distance in metres needed to send a packet from the source to the destination node. The volume of information that passes through a system at any particular time is referred to as congestion. Data usage or simply communication are several names for network activity. Fuzzy logic and ant colony optimization powered the routing protocol. Fuzzy logic was utilised to calculate the total node cost to the gateway by considering node traffic and energy. Ant colony optimization was utilised to discover the shortest route from source to destination sensor node [22]. Wireless sensor network routing techniques connect source and destination nodes. These routing methods break the network into manageable pieces and share information with its neighbours and then the entire network.

Authors studied huge networks. Wireless Sensor Networks has explored unique uses offered by large-scale networks of thousands of sensor nodes capable of receiving environmental information, processing it inefficiently, and transmitting it back to base locations for analysis. Wireless Sensor Networks are dynamic, adaptable, and distinctive networks grabbing researchers' interest. Wireless Sensor Networks use multi-path routing instead of static network architecture and constantly use Dynamic topology in real world applications of Neuro-computing, evolutionary computing, fuzzy logic computing, reinforcement learning, and swarm intelligence. Wireless Sensor Networks need better routing efficiency [23].

Soujanya et al. (2017) explored Wireless Sensor Networks' flexibility. These capture network information and send it to end users in a single hop or multiple hops. In a wireless sensor network, sensor nodes feature low-power wireless interfaces and a central processing unit to conserve energy, which is crucial because the power source cannot be restored. Trust management is the best way to defend wireless sensor networks from rogue nodes. Information gathering from every network endpoint is the responsibility of every member node. Whenever a session of information from every membership is obtained, the CH applies data acquisition before sending the panel towards the ground station. Installing security software on all network-connected machines is one of the initial lines of defence regarding malware as well as other infections [24]. This trust and reputation method finds malicious nodes, and the Artificial Bees Colony algorithm selects cluster heads. The sensor node's endurance will lengthen the life of wireless sensor networks, which will aid in locations where other kinds of communication are impossible. A package is a brief section of a communication in telecommunication. Transmissions are used to transport data via communications networks*, including the Ethernet. The machine or other device that accepts these messages then reassembles them. The wireless router buffers the message in its internal storage (card typically maintains many messages simultaneously in a memory area). An interruption is raised by the access point. A temporary connection buffers is allocated and set up by the interrupt service routine for the message. Information collected from the other stations is gathered by the cluster-head. Once another cluster-head is positioned among it or the central node, it sends the information it has acquired to that location. The Multi-hop LEACH method relays information to the base unit through a number of hops [25]. Information handling systems may include cluster network nodes. How to optimally use channel bandwidth to serve users is a key problem in network operation [27].

Authors presented Cluster-Based Energy Optimization in Duty-Cycled WSNs. Wireless network sensors may have multiple nodes. Each sensor node has sensing, computing, communication, and limited energy. Nodes communicate wirelessly. Wireless Sensor Networks are employed in many applications since they're flexible. It may operate independently in tough or risky situations where human apparition is impossible or difficult. Sensor longevity depends on their batteries, which cannot be replaced or recharged. Sensor networks require energy-efficient routing techniques. Clustering methods optimise routing protocol energy. Clustering helps Wireless Sensor Networks scale [26].

Anand Nayyar et al. (2017) published a comprehensive analysis of Ant Colony Optimization-based routing protocols for Wireless Sensor Networks to give researchers a better platform to work on protocol deficiencies to design an efficient routing protocol in the near future. Wireless Sensor Networks nodes can operate in any environment and network with other nodes to transmit data. They can be deployed in civil, military, environmental monitoring, surveillance, healthcare applications, industrial production, transportation, space technology, and more. Sensor nodes have limited transmission range, thus data and control packets must travel via multi-hop. Despite the different aims of sensor network applications, the WSN node collects, processes, and transmits data over radio to the sink node [3, 4].

Authors analysed wireless sensor network mobility issues in cyber-physical systems. The cyber-physical system is an intelligent system that integrates computational and physical components to perform monitoring and surveillance. The protocol doesn't employ control messages to broadcast node positions to neighbours. Using a virtual grid, sensor nodes identify Field locations. All nodes in the field are fixed save the sink node. GPS capability except for high-power nodes that act as cluster heads [28, 29]. GPS has become more accessible.

3 Objective of the research work

The objective of this research work is as follows:

- Cluster-based route detection based on efficient routing is the goal, and to do this, we will need to create a routing system that takes into account as many parameters as possible through the use of fuzzy and bee colony optimization.
- If we want our mobile wireless sensor network's route optimization time to be faster, we need give some thought to the sink node selection.
- The goal of this research is to predict and create a highly successful algorithm for routing that takes into account energy, fuzzification, and node mobility.
- The algorithm used to choose and optimise routes in a synchronised sleep–wake model should take into account the dynamic nature of the parameters under consideration.
- In order to increase throughput, it is recommended that the routing algorithm take into account a wide variety of network characteristics while selecting routes.
- In order to extend the life of the network as a whole, the routing algorithm must reduce network failures.
- In order to design effective route optimization and extend the network's lifetime, fewer nodes are required.

4 The projected work

How well a network functions is determined by a number of factors, including throughput, redundancy, and the routing of packets communicated. These three parts work together, and there are several threats to packets travelling across the network's channels. An individual, institution, organization, or state that engages in harmful activity or intends to do so. A person or organization that is not permitted to view or edit data, or that attempts to circumvent any security measures put in place to safeguard it. These modern adversaries engage in a wide variety of forms of traffic, including adjustment, deception, sink openings, and more. Scholars have proposed a wide variety of approaches, each with their own set of packet characteristics, to encompass the network packets generated by such occurrences. There are still a lot of things that aren't taken into account when trying to solve the problem of network threats. The routing approaches, for instance, take advantage of things like payload, title, leap count, and bounce addresses, but they don't account for the possibility of delay when carrying out change attacks. The method by which a route for traffic within, among, or across systems is called routing. In general, networking is carried out in a variety of systems, encompassing networked computers like the Web or circuit-switched channels like the publicly switching telecommunications system (PSTN). As a corollary, there are great deals of use-cases that just don't think about implementing cluster-based routing. Differentiating Route, Dynamic Route Selection, and Stream Construct Guess Are Discussed Here. Network infrastructure includes multiple-factor identification, robust credential schemes, and security patches. Cybersecurity's primary responsibility is to protect a systems and data against internet bullying and offenses such hacking. Techniques are utilized in dynamic routing to estimate numerous potential pathways and identify the optimal route for transport to follow through the system. It employs intermediate nodes procedures as well as shortest path procedures, two classes of sophisticated techniques. Although the proposed technique makes use of multiple highlights in the same way that previous methodologies have, a routing approach should occur in the various paths. A transportation circle is a typical issue with many different kinds of networks, digital computing channels. They develop whenever a routing algorithm fault appears, which causes the route to a certain target to create a loop among a set of units. Several steps, including Node Extraction, Cluster Head Detection, Node Energy Analysis, and Dynamic Route Selection, make up the proposed Cluster Energy Hop Based Dynamic Route Selection (CEH-DRS) method. Each phase has its own degree, which will be explained in further depth below.

4.1 Extraction of node features

At the phase of element extraction, the data packet received from the node's network interface port is processed. Considering the numerous advantages of connectivity, communication increases the risk of safety problems including data theft and privacy violations, harmful assaults like hackers and viruses. The main obstacles that an open wireless networking routing protocol encounters are station movement, financial constraints, error-prone route information, or concealed and revealed interface concerns. In the process of converting the packet into an IP packet, information formerly contained inside it, such as the node id, thickness details, neighbour address, neighbour details, and time to depart esteems, are stripped out. The extracted values are transformed into a vector by adding the aforementioned highlights and being directed to the network's subsequent step of analysis.

4.2 Localization of cluster leaders

With the help of information exchange between network nodes, it is possible to find evidence of the cluster head, thereby revealing an increase in traffic in a network. The highlights are being split, and the highlights that have been separated have neighbour addresses that the packet is being routed through. In a data model, traversing entails going over each component one by one. Every component of a database table is visited during traversal. A data structure component can be accessed by going to each member at least one. The combination of the received packet history and the current element vector allows for the identification of a remarkable traversal arrangement. Retrieving the ordered elements of a Binary Search Tree in increasing order is among the most well-liked applications of in-order traversing. As an approach, we can do the procedure backwards, beginning with the left sub-tree as well as finishing with the middle, to extract the elements in order of importance. In every routing setup, there exists a subset of nodes through which packets must pass on a frequent basis. In addition, the set of feasible paths to the service point are distinguished with the aid of network topology [30]. The node's status as a cluster leader is determined by its currently hosting succession, as well as its accessible path and its unique traversal route.

4.3 Node energy analysis and dynamic route selection

It uses node energy to dynamically determine the best path between two points. Any source-requested route delivery must be completed on time, typically with little leeway. Finding a route between two edges can be done by employing either a depth-first searching (DFS) or a breadth-first searching (BFS). In BFS (or DFS), employ the initial vertices as a resource and proceed as normal (or DFS). Report truth if the traverse finds the subsequent vertices; otherwise, give untrue. By filtering traffic going from unauthorized personnel, a router can aid in preventing unauthorised connection to a system. Moreover, firewalls can be set up to only let particular kinds of traffic, like email or internet vehicular. In this case, this characteristic of network packets is used to track out instances in which packets are being spoofed or otherwise manipulated by cluster nodes. In addition, the network recorded the duration of each packet's journey, the number of hops it took, and whether or not it was suspended normally. The production of Internet Protocol (IP) messages with an originating IP address with the intention of hiding the user's identification or mimicking other computational machine is referred as packet spoofing. It is otherwise called as IP spoofing. The future production of packets is estimated based on the existing traffic state [31] Fig. 2.

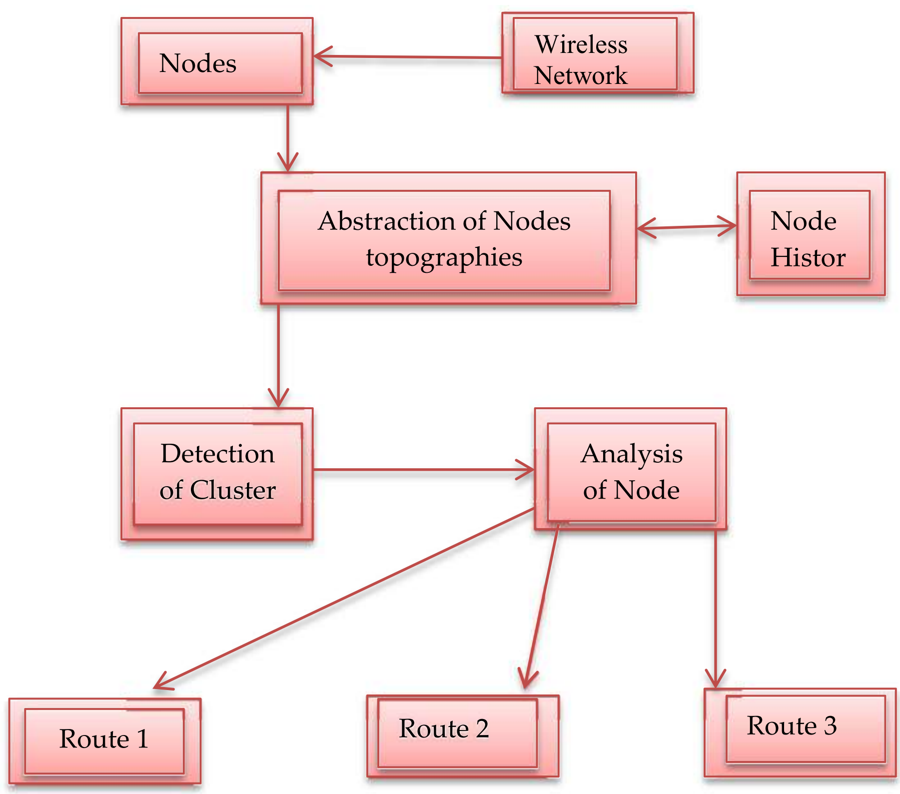
	Algorithm
Extraction of Node features	
1	Start
2	Counting of node
3	the data packet received from the node's network interface port is processed
4	information contained in the data pocket such as the node id, thickness details, neighbour address, neighbour details, and time to depart esteems, are stripped out
5	The extracted values are transformed into a vector
6	The extracted features directed to the network's subsequent step of analysis
Cluster Head Detection	
7	Abstraction of Nodes topographies
8	Identification of a remarkable traversal arrangement with the help of Node History and current element vector
Detection of Cluster Head Nodes	
9	Node Energy Analysis and Dynamic Route Selection
10	the network recorded the duration of each packet's journey and the number of hops of each route
11	The future production of packets is estimated based on the existing traffic state
12	End

This energy-based dynamic route selection strategy is implemented by the aforementioned algorithm to enable cluster head-based packet transmission across the network.

5 Result and discussion

Packet transmission data energy level consumption-based dynamic on selective node NS 2 starts cluster on mobile node performances. Through 100 iterations of the simulation, we validated the proposed approach of Cluster Energy Hop Based Dynamic Route Selection. Not only does the cluster-based strategy pinpoint the source of the risk, but it also pins down a transfer-off node design that lends support to the network's head node and allows for the use of many estimating strategies. This is the NS-2 network simulation

Fig. 2 The projected algorithm



output page, which shows results relative to the entire network.

The configurations of the simulated fields: 100 nodes spread out over an area of 1200 m*1200 m. Each node's starting conditions were completely made up. The Two-Ray Model of Radio Propagation. The utilized material in terms of the speed of illumination as well as the range d between the transmission partners are the sole factors that affect delay time. There is a comparison made between the proposed methods (Fuzzy and Bee Colony Optimization (FBCO), Selectively Turning ON/OFF the Sensors (STOS), and Hidden Markov Model (HMM)) and the existing technique (Optimized Route Cache Protocol-AODV (ORC-AODV)).

5.1 Throughput

The average throughput is calculated by looking at the number of packets successfully delivered to the destination at any given instant over the time period. It's the yardstick by which we evaluate the speed with which a node transmits data through a network [32]. Information is evaluated utilizing the transmission rate in seconds of bits to identify how quickly they are moved between different locations (bps). The greatest quantity of information that may be transmitted in a specific period of time is referred to as capacity. The equation for messaging services is $N * (N-1)/2$. It is a method of quantitatively demonstrating the significance of effective management administration on a program. People all share a strong intuition about this, and many individuals might concur that the bigger the enterprise, the harder it will be to communicate. The average throughput of a communication channel measures the proportion of attempted messages that are successfully delivered. Sending Time = File Size / Available Bandwidth (sec).

$$\text{Throughput} = \text{File Size}/\ \text{Transmission time (bps)} \tag{1}$$

Compare the data transfer times between the transmitter and the receiver in the current model to the ones shown in Table 1 above, and you'll see that the wireless sensor network offers significantly faster data transfer times.

Table 1 Throughput Investigation

Number of node	20	40	60	80	100
ORC-AODV in %	16	20	36	42	50
FBCO in %	19	26	40	47	57
STOS in %	23	38	47	66	73
HMM in %	40	47	63	80	87
CEH-DRS in %	45	55	79	83	93

In Fig. 3 we can see the throughput expressed as a percentage. The y-axis in this graph shows the percentage of throughput, while the x-axis shows the total number of nodes. The suggested system features a higher level of data transmission and a higher throughput than existing systems.

5.2 Average end-to-end delay

Time spent in route finding, retransmission, transfer, and propagation are all factored into the average end-to-end delay. One-way delayed (OWD), often referred as end-to-end latency, is the amount of time it takes a package to travel between origin to destination along a system. This phrase, which is frequently used in IP networking management, varies from round-trip duration (RTT) in that it only measures the journey from origin to target in a linear fashion. The typical latency, or total time taken from beginning to end, is calculated by adding all of these elapsed intervals together. The latency measures how long it takes a packet to travel from its origin to its final destination. The following formula can be used to get the total round-trip delay or latency:

$$\text{Average end to end delay D} = TR - TS \tag{2}$$

where TR is the receiving time of the packet and TS is the sent time of the packet.

The End-to-End Delay of the proposed framework is compared to that of the existing framework in Table 2. It measures the typical delay in data packet transmission between two points.

A graphical representation of the throughput can be seen in Fig. 4. The x-axis in this graph represents the total number of nodes, while the y-axis shows the percentage of throughput at each node. The proposed system outperforms all competing systems in terms of data delay ratio and incurs a minimal amount of data delay.

5.3 Delivery ratio

Data packets are considered successfully delivered if their Packet Delivery Ratio (PDR) is high. One of the most important metrics for measuring a network's performance is its packet delivery rate. The Packet Delivery Ratio (PDR) is the ratio of the total number of packets successfully delivered to all destinations to the total number of packets introduced into the system.

$$PDR = S1 \div S2 \tag{3}$$

We can think of S1 as the total number of packets received by each destination and S2 as the total number of packets sent out by each source.

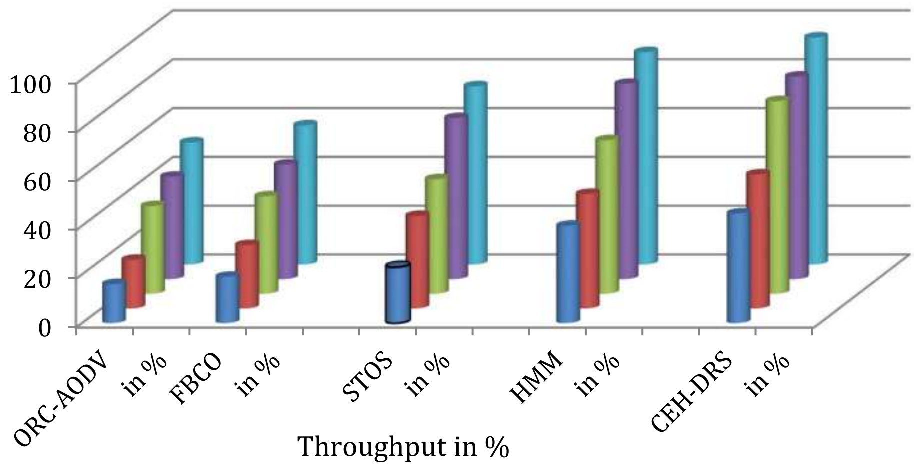


Fig. 3 Throughput analysis

Table 2 Average end-to-end delay analysis

Number of node	20	40	60	80	100
ORC-AODV in %	38	49	59	72	81
FBCO in %	36	48	57	67	79
STOS in %	33	47	53	64	77
HMM in %	31	44	47	61	57
CEH-DRS in %	24	41	40	58	47

Table 3 Packet delivery ratio analysis

Number of node	20	40	60	80	100
ORC-AODV in %	12	20	36	38	45
FBCO in %	14	22	40	45	57
STOS in %	20	36	47	63	75
HMM in %	23	40	50	70	83
CEH-DRS in %	30	33	54	73	95

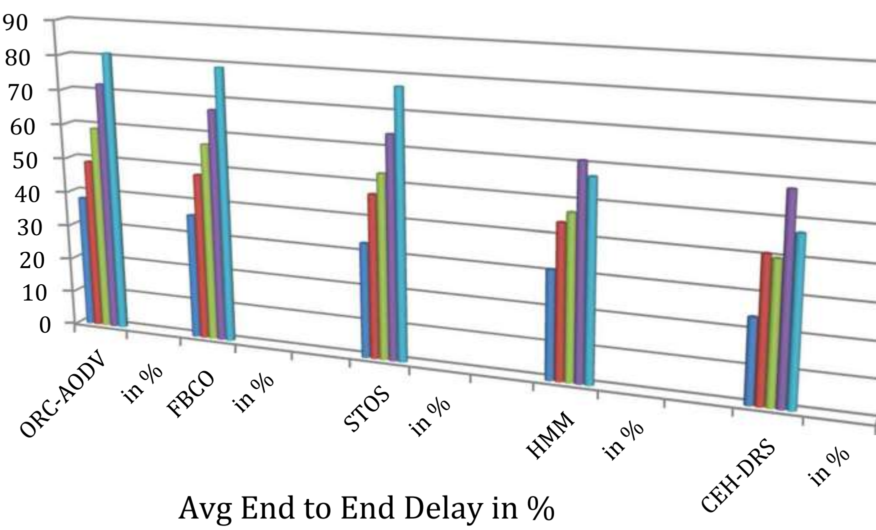


Fig. 4 Average end to end analysis

Analysing the proportion of successfully delivered packets relative to the total number of packets sent from the source to the destination node for a certain input size is shown in Table 3.

The suggested model is shown in Fig. 5; it improves the total throughput performance of a mobile wireless sensor network by 91%, increases the delivery ratio to 95%, and reduces latency by 89.98% compared to all other approaches in the network. All other methods in the system are compared to the suggested model, and it is shown to be superior.

6 Conclusion

The clustering technique should accomplish energy balance and energy savings limited by wireless sensor network design. Proposed approaches improve existing method

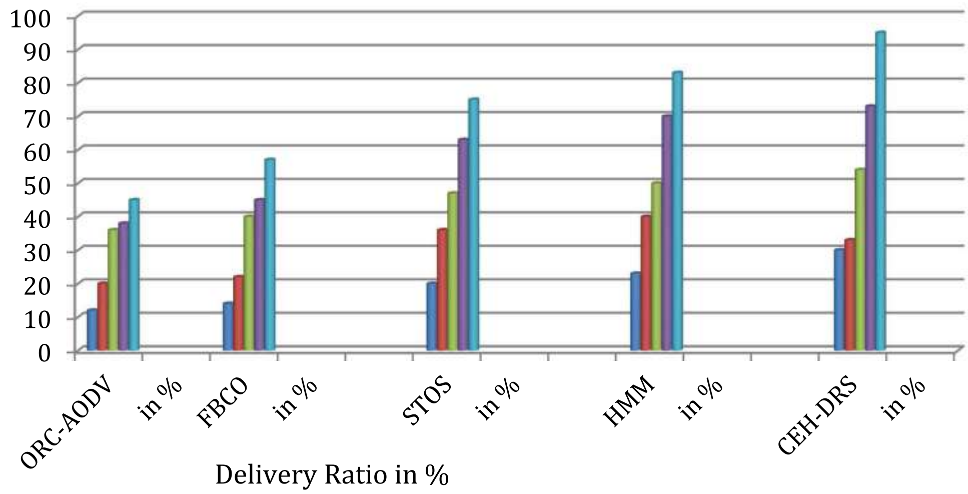


Fig. 5 Packet delivery ratio analysis

performance. This dissertation adds Fuzzy logic, evolutionary algorithms, and graph theory clustering techniques. The proposed algorithms incorporate WSN design restrictions and increase network longevity. Logic clustering creates redundant data. Logical clusters are nodes with non-overlapping coverage or sensing radius RS. Event-based monitoring is required in some applications. By activating these clusters one after another, the full Region of Interest (ROI) is sensed. CH or member nodes communicate data often. Due of MWSN's mobility, every node must be energy efficient to control power. Microcontrollers commonly limit network service access. Mainly Mobile network topology affects voice, video, and message sharing. This is done with a Medium Access Control (MAC) system, such as CSMA, FDMA, or CDMA (CDMA). Wireless source-to-sink data transmissions are unstable in all network systems. It uses multi-hop pathways. Mobile wireless sensor networks use time division and frequency division to cluster devices. Most MWSN clustering protocols are based from WSN MACs and focus on low-power, duty-cycled techniques. This technology improves network performance over small sensor nodes. All proposed solutions use minimum data delivery time. The proposed technique enhances Throughput 58% and End-to-End Delay 39%, according to cluster-based fuzzy and bee colony route optimization models. Because of its adaptability, resilience, scalability, and energy efficiency, this Wireless Sensor Network (WSN) clustering topology is the best. On anticipated RSSI, link loss rate, and ETX value, the moving node's mobility status throughput was 86% and detection accuracy was 68%. Cluster Head (CH) near BS may operate as a relay node for distant CH nodes, reducing cluster size. Detection Accuracy is 65%, Routing Overhead is 57%, and Time Complexity is 54%. The suggested and current algorithm network models are discussed.

6.1 Future work

Wireless network systems transfer more data from device to device. Mobile Wireless Sensor Network (MWSN) allows long-distance communication without wires. Event-driven apps only generate data when an event happens. Monitoring apps run continuously, while mapping apps are deployed. MWSN is a wireless sensor network with mobile nodes. MWSNs are more flexible than static wireless sensor networks. This app's monitoring and schedule commands are straightforward. Nodes for measuring light, heat, humidity, and temperature typically include a radio transceiver, battery, and microcontroller-powered sensors. This dissertation simulates cluster-based energy. This manuscript proposes another fuzzy distributed clustering approach for non-uniform sensor nodes. Heterogeneous networks can't use homogeneous strategies. Co-located sensor nodes should create a cluster around an event whenever it's detected. Clustering should be used with heterogeneous network approaches. Future WSN research will apply theoretical methodologies to real-time sensor network platforms. Future improvements to WSN clustering design, such as drone-operated devices, will include mobile clustering.

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Code availability Not applicable.

Declaration

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Ethical standard This article does not contain any studies with human participants performed by any of the authors.

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Khalid K. Almuzaini (Member, IEEE) is an Assistant Research Professor and the Director of the National Center for Cybersecurity Technologies at King Abdulaziz City for Science and Technology KACST). He received B.Sc. degree in Electrical Engineering from King Saudi University, Saudi Arabia, M.Sc. in Electrical Engineering from University of Southern California, USA, and Ph.D. in Electrical and Computer Engineering from University of Victoria, Canada. He worked for Saudi Basic Industries Corporation (SABIC) and Saudi Telecommunication Company (STC) before joining KACST. His interests cover Network Analysis, Wireless Sensor Networks, Cybersecurity, Data mining and Machine Learning. He published several conference and journal papers.

Shubham Joshi is a valued IEEE Senior Member (Membership No: 90656134, member since 2008). He has 15 years of experience in Teaching, Research and Consulting, He is an envisioned researcher and passionate to new era of creation. With the advent of novel platform for learning and development, I served to many aspirants, technology savvy people, working professionals and organizations. To Energies the world of opportunities in technology with passion, intelligence and innovation, he has served to the society to cater the best. Authored 50 + research papers, with citation of 300 (google scholar), h index 10; i-index-10, 20 + SCIE Indexed publications, 20 + Scopus publications, 1 International Book (Artificial Intelligence in Higher Education, Taylor and Francis, published in 2022), 15 + Patents, copyrights (India and International).

Stephen Ojo (Member, IEEE) is currently an Assistant Professor in the Department of Electrical and Computer Engineering, College of Engineering, Anderson University, Anderson South Carolina, United States of America. He received B.Sc (Honours) in Electrical and Electronics Engineering from the Federal University of Technology Akure Nigeria in 2014, M.Sc in Electrical and Electronics Engineering from Girne American University,Cyprus in 2017 and PhD in Information Systems in May 2021 from the same University. Before Joining Anderson University, he was a Lecturer at Girne American University Cyprus where he taught courses in distributed computing, advanced programming and Electric Circuits. Dr. Ojo also worked as a research scholar in Vodafone Telecommunication Company Cyprus where he developed a multiplicative based model for signal propagation in wireless networks. Dr. Ojo was awarded Mobil scholarship throughout his undergraduate program and also a full PhD scholarship. Dr. Ojo is presently a full time faculty at Anderson University, USA where he teaches courses in computer programming, electric circuits, machne learning and artificial intelligence in biomedical applications. He has authored and co-authored several peer-reviewed journals. His research interests are in wireless networks, machine learning for wireless mobile networks and machine learning and AI in biomedical devices.

Mansi Aggarwal , has done Bachelor of Technology in Information Technology from Uttar Pradesh Technical University, Uttar Pradesh and has done Masters of Technology in Computer Science and Engineering from Uttar Pradesh Technical university, Uttar Pradesh. Presently, She is pursuing PHD from Banasthali University, Rajasthan in the domain of "Block Chain Technology". She is working as Senior Assistant Professor at ABES Engineering College, Ghaziabad, Uttar Pradesh. She is having a total of 13 years of teaching and research experience. She is having a great knowledge of various programming languages and has a deep understanding of alogrithms. She has also contributed in the area of Software Engineering with intensive research about software maintainability of Object oriented languages. She is passionate about helping students and fellow researchers. She is working to come up with the ideas and innovations that could help the society in general.

Preetam Suman has completed his doctorate from Indian Institute of Information Technology, Allahabad. He has perused his M.Tech and B.tech degree from RGPV Bhopal. He has over eight years' experience in the field of academics. He has previously worked at UTD, RGPV, Bhopal, Integral University, Lucknow, and Jaipuria Institute of Management, Lucknow. Dr. Suman is currently working as Assistant Professor with VIT Bhopal University, Bhopal. He has visited foreign countries for research, like EPFL, Swtizerland, Naresuan University, Thailand, etc. His core areas of expertise include Medical Imaging, Big Data analytics, Cloud Computing, real-life applications of artificial intelligence and embedded systems. He was involved in a project related to implementing sensor networks in forests to save wildlife and development of technology to identify tumors in the brain using fMRI. His three projects were also accepted by DAAD RISE Germany. He has been nominated by various forums and associations in their committees. He has published more than forty papers in international journals and conferences and various seminars organized by professional bodies and industry associations worldwide. Dr. Preetam holds professional associations with IEEE Technical Committee, IEEE Young Professionals.

Piyush Kumar Pareek working as Professor and Head in Department of Artificial Intelligence and Machine Learning and IPR Cell of Nitte Meenakshi Institute of Technology Bengaluru.He has Experience of 12 + Years. He has Authored 10 + Text Books, 50 + Scopus Indexed Articles, 30 + Patents Granted, He has Special Issue in MDPI Electronics on Artificial Intelligence as Guest Editor and CRC Press Book Series as Editor in Artificial Intelligence.

Prashant Kumar Shukla received his Master of Engineering in Software Systems from RGPV, Bhopal, Madhya Pradesh in 2010 and Ph.D. (Computer Science & Engineering) in 2018 from Dr. K. N. Modi University, Rajasthan, India and currently holds an Associate Professorship (Research) in the Department of computer science and engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh from October 2021. His interests include Artificial Intelligence, Machine Learning, Deep Learning, Data Science, Computer Vision, Internet of Things (IOT) concerns.

Authors and Affiliations

Khalid K. Almuzaini[1] · Shubham Joshi[2] · Stephen Ojo[3] · Mansi Aggarwal[4] · Preetam Suman[5] · Piyush Kumar Pareek[6] · Prashant Kumar Shukla[7]

✉ Khalid K. Almuzaini
kmuzaini@kacst.edu.sa

✉ Prashant Kumar Shukla
prashant_ks46@outlook.com

[1] National Center for Cybersecurity Technologies (C4C), King Abdulaziz City for Science and Technology (KACST), Riyadh 11442, Saudi Arabia

[2] Department of Computer Engineering, SVKM'S NMIMS MPSTME, Shirpur Campus, Mumbai, Maharashtra 425405, India

[3] Electrical and Computer Engineering, College of Engineering, Springdale, 316 Boulevard , Anderson, SC 29621, USA

[4] Department of Information Technology, ABES Engineering College, Uttar Pradesh, Ghaziabad, India

[5] School of Computing Science and Engineering, VIT Bhopal University, Bhopal-Indore Highway Kothrikalan, Sehore, Madhya Pradesh 466114, India

[6] Department of Computer Science & Engineering, Nitte Meenakshi Institute of Technology, Bengaluru, Karnataka, India

[7] Department of Computer Science and Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh 522302, India