Maximum Coverage Range Based Sensor Node Selection Approach to Optimize in WSN

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Abstract— Wireless sensor network (WSN) is a network of sensor nodes with wireless link. The sensor nodes in WSN sense the data from surrounding, process on sensed data and send the sensed data to sink node. All the functions execute by sensor nodes consume energy. So, the Energy saving is the important challenge in the wireless sensor network. This paper concentrates on the energy optimization of the WSN. The Minimum Hop Maximum Range routing (MHMR) algorithm is proposed to reduce the energy consumption of the sensor nodes in the WSNs. The proposed algorithm provides a least energy cost minimum hop path over the sensor network between the target or source node and sink node to increase the lifetime of WSN and reduce the delay in data transmission. MATLAB software or tool is used to design the WSN model and to implement the proposed algorithm. The results show the efficiency of the proposed algorithm which provides the reduced energy consumption in the wireless sensor network and improve the WSN lifetime.

Index Terms – WSN, Transmission range, MATLAB model, Energy saving.

I. INTRODUCTION

The first wireless local area network standard adopted by IEEE is IEEE 802.11 in 1997[1]. The wireless networks provide the advantages over the wired network. The mobility is the great feature of the wireless network. And it makes the wireless network interested and gives user the capability to move freely during connected to the network. One of the important types of the wireless network is wireless sensor network (WSN). The idea of the sensor networks is new and the first article on the WSN concept was published in 1998. The wireless sensor network is considered as the most sensitive research area with the specification of physical environment which provide the large number of communication applications of the sensor network. These applications of sensor networks include the health applications, statistical applications, environmental applications, military application and scientific research application etc.

Wireless sensor network is defined a self-organized wireless network in which large number of sensor nodes and the resources are combined to perform the communication [2]. Thus, the sensor nodes act as sensing device and as routing devices. Many sensor nodes may be used to transmit the data from the source node to the destination node and act as intermediate nodes. The destination node in a WSN is specified as a sink node or Base station. The sink node collects the data from all sensor nodes in the real time. The sink node relay the data over the internet to the user devices like computer, laptop etc.

Each sensor nodes are powered by the power subsystem, and the every action that is performed by a sensor node uses the energy which slowly spends the sensor node's power. When the sensor nodes perform communication with other nodes require a large power. But the other actions of sensor nodes like processing and sensing the data require less power. When the sensor nodes losses their all power then these are not able to perform any function. When a single sensor node is dead then it does not affect the performance of WSN. But when the other nodes die out, the performance of the WSN is reduced because the sensor network is no longer reliable. The WSN itself is a resource constrained and has the limited lifetime [3].

II. WIRELESS SENSOR NODE

The wireless sensor node is also called the mote. The wireless sensor node consists of a set of necessary or important components. As shown in Fig.1, the necessary components of sensor nodes are the power supply unit, the communication unit, the controller unit, the sensors unit and the data storage or memory units. Each component of sensor node has the different and the unique characteristics.

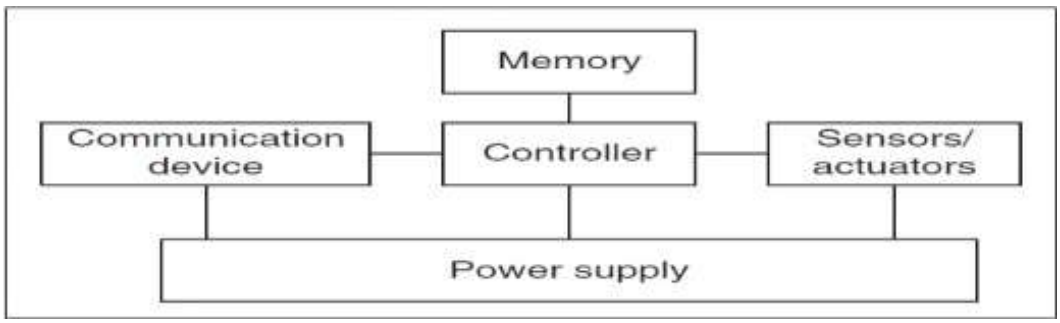

Figure1: Sensor Node Architecture

The different components of the sensor node in the wireless sensor network perform the different function are explained below.

1. **Power Supply Unit:** The power supply unit consists of the non-rechargeable batteries. These batteries are neither rechargeable not replaceable especially when sensor nodes are deployed in the inaccessible environment.
2. **Processor/Controller Unit:** This is the main component of the sensor node that executes the programs. The processor unit is usually based on the 8-16 bits RISC architecture and a few numbers of registers. For example, Atmel128L microprocessors can process a maximum rate of 8 MIPS when running at 8 MHz [4]. The controller unit also contains the ADC. ADC performs the

analog to digital conversion of raw data to generate real values usable by the microprocessor or controller. In some cases, ADC is integrated with the processor unit and some cases ADC is a separate unit.

3. **Sensors/Actuators Unit:** There are different types of sensors for measuring the different physical quantities like: pressure, vibration, temperature, humidity, motion, luminosity etc. They generate and store the raw sampled data before conversion by the ADC unit. The requirements of sensor units are energy saving and early detection. In addition, the accuracy is required in the entire sensing range. Sometime the sensor unit also consists of the actuators.
4. **Memory Unit:** The memory or storage unit consists of the flash memories of RAM type or EEPROM type for storing the volatile and the permanent data. The storage units are usually small. The storage unit can be represented by a long-array of 8-16 bits words.
5. **Communication Unit:** This unit is also called transceiver unit or the radio unit. This unit is composed of radio antennas, transceiver and wireless interfaces. The function of the communication unit is the sensing of the carrier signal, the modulation and demodulation of the radio signals and the transmission of signal and reception of signal over the wireless medium.

III. LITERATUTE SURVEY

Mohamad Hefeeda and Hossein Ahmadi [5], have defined a new probabilistic coverage protocol (PCP) for Wireless sensor network. This protocol provides the probabilistic sensing models of the sensor network. Authors designed the PCP that no single sensing models will better model for the all types of sensor in the different environment. Authors defined the different sensor types are required different sensing models. Authors used the two sensing models are Probabilistic exponential sensing model and Deterministic disk sensing model. The Probabilistic exponential sensing model provides the conservation of sensing capacity estimation and this model can be used for first approximation for many another sensing models. The second model Deterministic disk sensing model provides that PCP protocol can function as a deterministic coverage protocol.

S. Taruna, Sheena Kholi and G. N. Purohi [6], have presented the new approach of cluster head selection for the Homogeneous Wireless sensor network (HWSN). The routing algorithm is related to the energy of the sensor nodes and the distance between the sensor nodes. The routing algorithm presented is the LEACH-MP. The authors are defined algorithm provides the selection of cluster head in the cluster of sensor nodes in sensor network which is the nearest to the middle point between the base station and sensor node. The sensor nodes are mobile in network. Authors have compared the result of the presented algorithm with LEACH protocol. The authors simulated the presented algorithm LEACH-MP using Matlab Simulink.

Swapnil Jain and Sunita Gupta [7], have defined the scheduling scheme for Wireless sensor network to increase the life time of sensor network and also using the different type of the sensor nodes. The sensor nodes are in active mode when they are sensing the surrounding and the sensor nodes are in sleep mode when they are ideal. The authors implement the scheduling scheme for the wireless sensor network (WSN) using the Matlab (Matrix Laboratory) Simulink. The authors defined the Active Sleep Scheduling (ASS) algorithm.

S. Indhumathi and D. Venkatesan [8], have used genetic algorithm to improve the coverage deployment of dynamic sensor nodes in the Wireless sensor network. Authors defined the Gap cluster technique with genetic algorithm. Genetic algorithm is used to deploy sensor nodes for the maximum coverage in the area of sensor network. Authors evaluated the coverage sensing distance for all sensor nodes in the sensor network. The authors provided the gap cluster technique for coverage improvement which provide the long lifetime of the Wireless sensor networks (WSNs). Author implemented the work in Java.

Liudmila I. Khudonogova and Sergey V. Muravyov [9], have defined an active node set selection algorithm (ANSS), based on preference aggregation. The authors defined the algorithm to reduce the number of active sensor nodes in the Wireless sensor network to decreasing energy consumption in the network. The accuracy level is maintained in the ANSS algorithm for the reduced energy consumption of Wireless sensor network. The active node set of sensor nodes are selected on the basis of parameters such as energy consumption, distance to a cluster head and multisensory accuracy.

Muhammad K. Shahzad and Tea Ho Cho [10], have presented the Energy-aware routing and filtering node (ERF) selection for increase the lifetime of the Wireless sensor network in the Communicative cipher-based en-route filtering (CCEF). The authors investigated a novel communicative cipher-based en-route filtering (CCEF). The CCEF provides drops false and the fabricated reports which do not take the part in the symmetric key sharing among the sensor nodes. The authors evaluated the ERF in a custom built simulator in the Microsoft Studio 2010 using C++. In the ERF method, the filtering nodes are selected on the basis of attack information, present state of a sensor node in the sensor network and presence of witness key in the given routing path.

Sowmya.M and Manju Devi [11], have defined the method or algorithm for reduction in energy consumption in the Wireless sensor network called ENSHR (Energy Saving via Heuristic Routing). The ENSHR algorithm is designed to provide minimum power or energy cost of data relay in the network and less residual energy of sensor nodes in the network. The ENSHR algorithm included the two methods or algorithm which are Heuristic routing algorithm and Greedy algorithm. If one routing protocol or method is failed then another algorithm is used. The authors provided the ENSHR algorithm for the shortest path between the sensor nodes in the sensor networks. The authors used the immobile or static sensor nodes in WSN. Authors simulated the algorithm using NS2 software.

IV. RESEARCH METHODOLOGY

In the wireless sensor network, the distance is the major factor respective to which routing algorithm is designed. But in this presented work we have considered the multiple parameters to identify the right communication path over the wireless sensor network. The parameters included in this work are distance, energy, maximum transmission coverage range and the hop count. This proposed work is concentrated on reducing the energy consumption and increasing the lifetime of the WSN by using algorithm called Minimum Hop Maximum Range routing (MHMR). The proposed algorithm is based on the path selection concept and the energy preserving concept.

The proposed algorithm is start as the sensor network is designed with small number of sensor nodes. Initially, the source node and the destination node specify in the sensor network. The routing path will be generated between these nodes and the parameters are also set for all sensor nodes in the network. Now, to perform the effective communication we need to find the next effective neighbor node over which the communication will be performed. In this work, the parametric analysis is performed on each node to identify the best neighbor node. Based on the parameters analysis on the sensor nodes the reliable routing path will be generated and communication will be performed on that path. In the existing work, a shortest distance neighbor node is considered for communication. But in this proposed work, the maximum distance node within the transmission coverage range and having suitable energy is considered as next effective node and communication with least energy cost will be performed over that node. The process is continued until the data is not reached to the sink node.

V. NETWORK MODEL

In the proposed work, the WSN network MATLAB model or design is constructed on the basis of following parameters:

1. **Network Setup:** The network model which we used is having the topography dimension of a square 100 meter by 100 meter area. There are 50 nodes in the network model including the one sink node. These numbers of nodes can easily be adjusted and these are the reasonable number of nodes based on the size of the geographic area and range of nodes. 50 sensor nodes are sufficient to provide the coverage in the area of interest.
2. **Placement of Sink Node:** The position of the sink node is fixed in the network.
3. **Placement of Nodes:** The nodes are static manually placed in the entire area of the network.

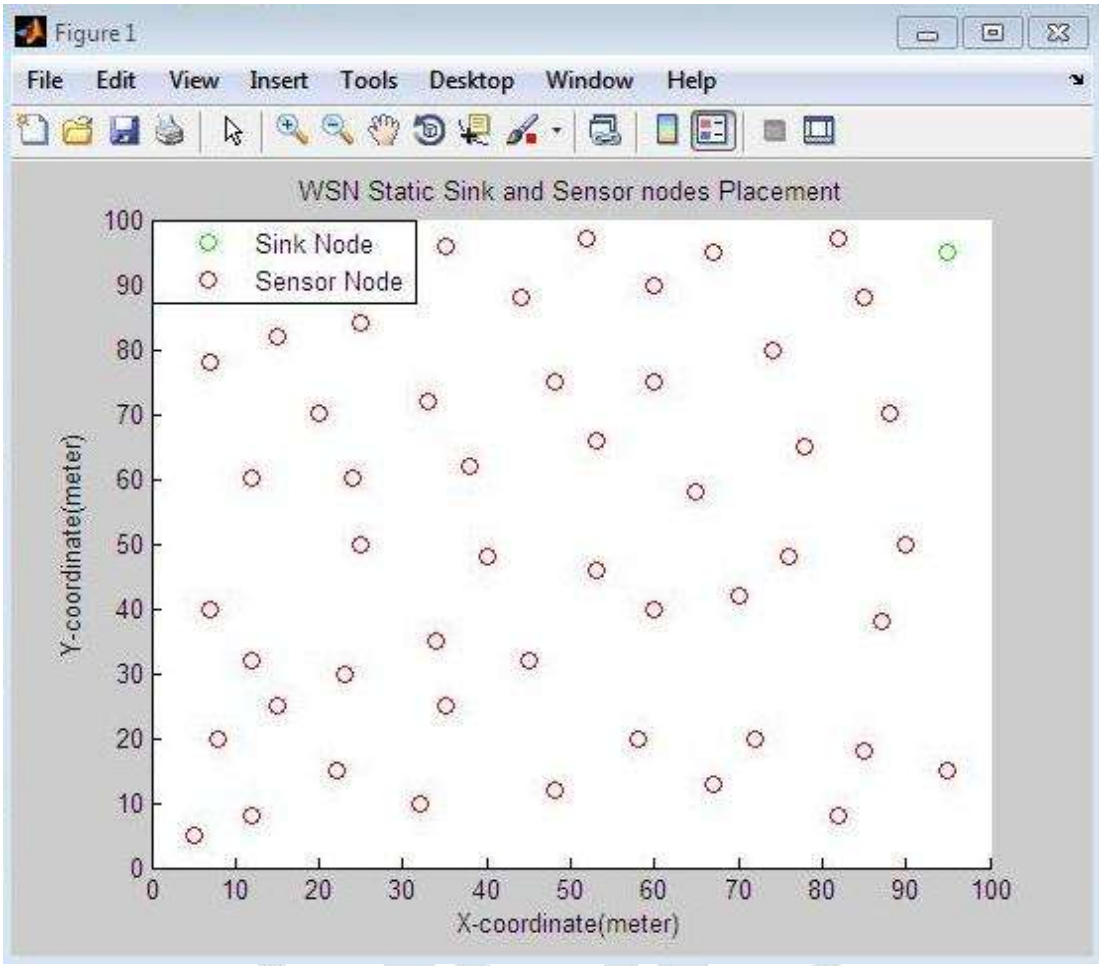

Figure2: WSN MATLAB Model

All of the information of network design is coded in MATLAB, and the network model of the sensor node in the network is shown in Fig. 2. As we can see the nodes are defined under the positional vector respective to the sensor area network.

Table1: Network Parameters

Parameter	Value
Number of Nodes	50
Topography Dimension	100m*100m
Topology	Fixed
Sink Node	50th
Transmission Energy	20nJ
Receiving Energy	20nJ
Forwarding Energy	10nJ
Transmission Range	30meter

In the proposed work, the network is designed with some defined parameters given in Table1. A sensor node can transmit data to the other sensor node within the transmission range. In this work, the maximum transmission range is 30meter.

VI. RESULT ANALYSIS

The aim of this research paper is to obtain reduced energy consumption with the maximum coverage range and communication or transmission range of the nodes in the wireless sensor network to increase the sensor network lifetime and the energy efficiency. The tool used in this work is MATLAB software.

The sensor nodes of the sensor network perform communication using the proposed MHMR algorithm and then search the minimum hop route between the source node and the destination or sink node. As shown in Fig. 3, the generated path between the source node and the sink node for the existing approach over the sensor network. In this figure node 30th is given as the source node and node 50th as the sink node or destination node. The path is generated based on the energy and transmission distance. The existing work is about to perform the selection of the effective energy sensor node. The result of the generated path obtained from the work are given here under

30 =>31 =>35 =>36 =>43 =>44 =>48 =>50.

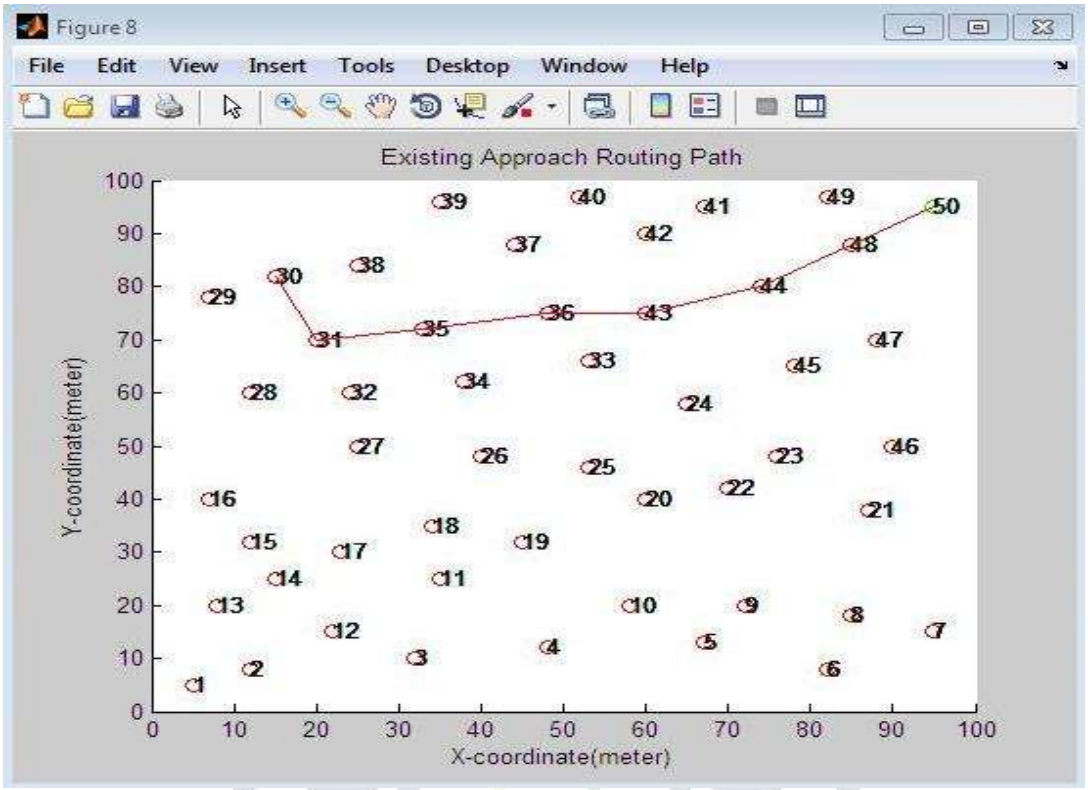

Figure3: Generated Path (Existing Approach)

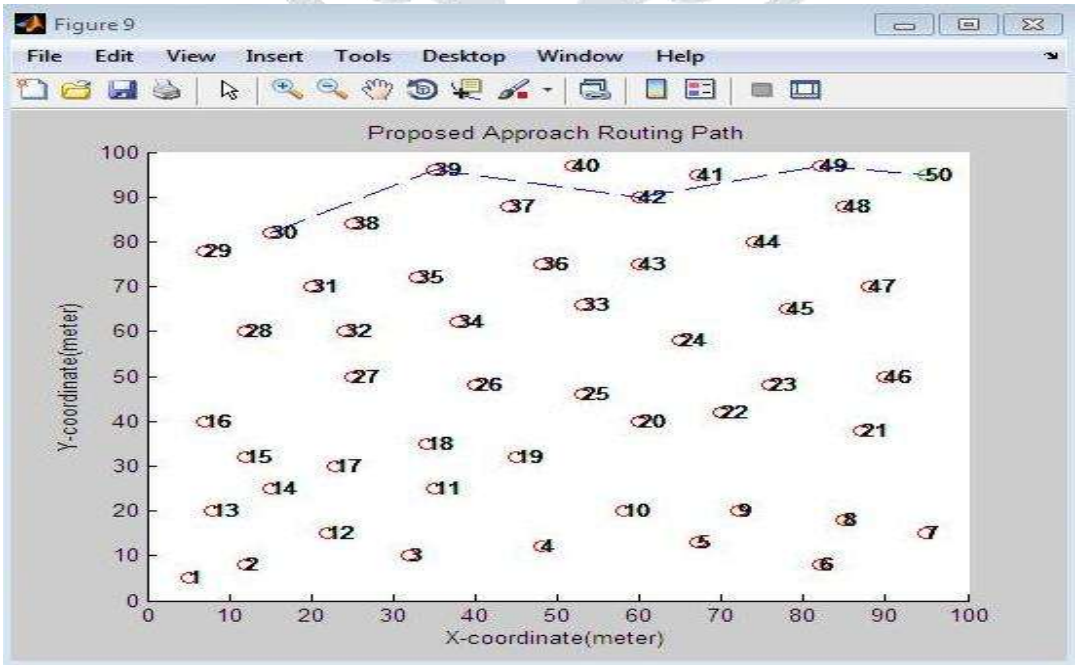

Figure4: Generated Path (Proposed Approach)

Fig. 4 shows the generated path over the sensor network for proposed approach which is the minimum hop efficient path and consumes less energy than existing approach generated path. The path is generated based on the energy, transmission distance and hop consideration. The work is about to reduce the number of hop in communication path so that the energy consumption over the network will be reduced. The node 30th is source node and node 50th is the sink node. The result of the generated path obtained from the proposed work are given here under
30 =>39 =>42 =>49 =>50.

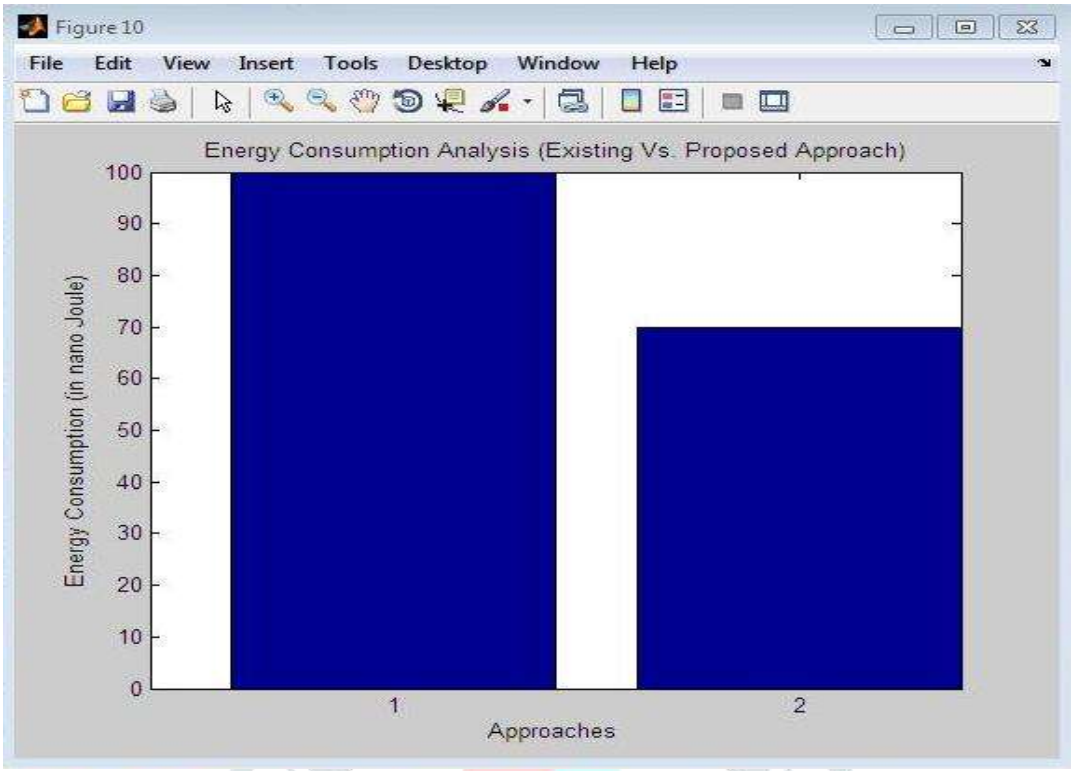

Figure5: Energy Consumption Analysis (Existing Vs. Proposed Approach)

Here Fig. 5 shows the energy consumption analysis of the existing and the proposed approach. As shown in the figure, the proposed work reduces the energy consumption over the network.

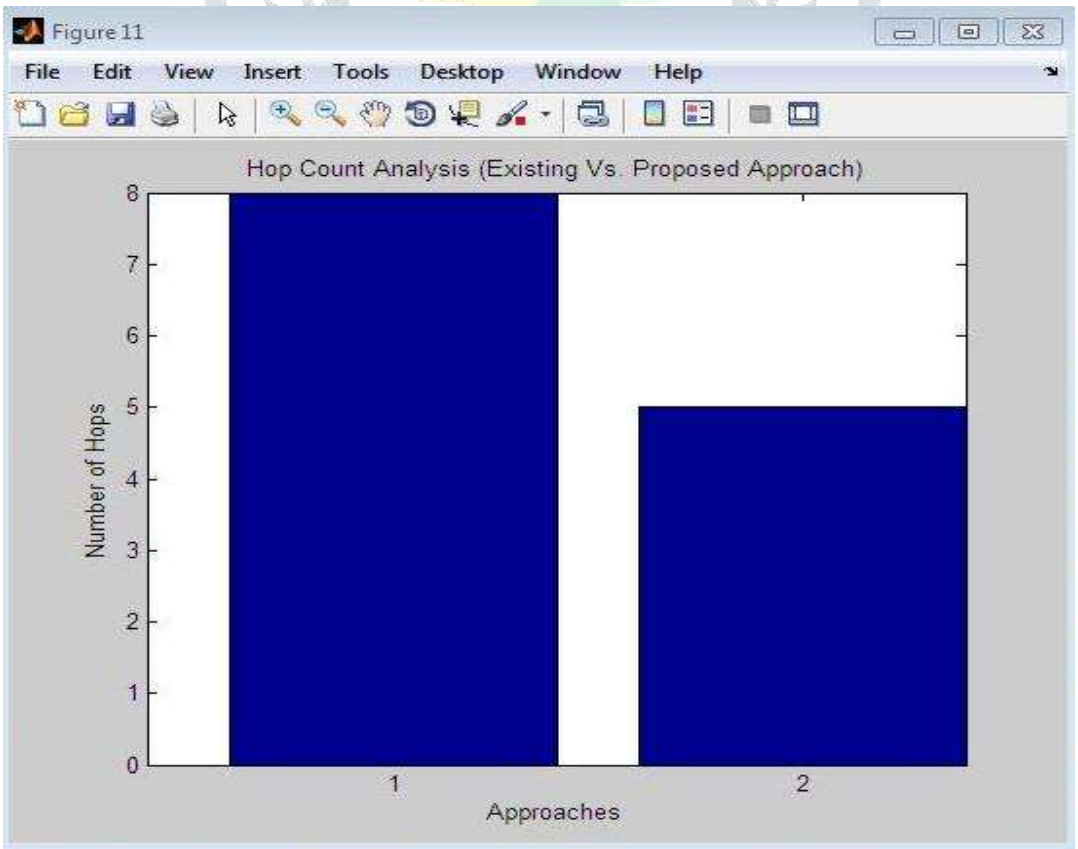

Figure6: Hop Count Analysis (Existing Vs. Proposed Approach)

Total energy consumption over the generated path by existing approach is 100 nJ (nano joule) and the energy consumption in the generated path by proposed algorithm is 70nJ.
Here, Fig. 6 is showing the hop count analysis of existing and proposed approach. As shown in the figure, the proposed work has reduced the number of intermediate nodes. In the existing approach generated path the eight or 8 nodes are involve in the communication and in the proposed approach path five or 5 nodes are involve in the communication. So, the proposed approach reduces the hops or nodes in communication path and also reduces the energy consumption and improves the network life.

VII. CONCLUSION AND FUTURE WORK

In this work we have defined a minimum hop energy effective communication path over the network. The work is defined for the fixed placement of all network sensor nodes and sink node in the network. All these nodes are defined with the energy specification. This work is provided a route that uses the lesser number of intermediate nodes between the source or target node and sink node so that the energy consumption over the route is reduced. The results in MATLAB software show that the energy consumption over the route is reduced. So, the lifetime of the WSN is also improved. In future the improvement to this work can be done in various ways. The mobile sink node can be used in future work. The energy efficiency of the WSN can be more increased in the future work.

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