March - April 2020
ISSN: 0193-4120 Page No. 5143 - 5150

Energy Optimization in Cluster based WSN using Modified Hybrid (MH-AODV) AODV Protocol.

[1] Mr Srinivas Kalaskar, [2] Dr Channappa Bhyri,

[1] KBN College of Engineering Kalaburagi
[2] PDA College of Engineering Kalaburagi
[1] kalaskarsrinivas@gmail.com ,[2] channubhyri@yahoo.com,

Article Info
Volume 83
Page Number: 5143 - 5150
Publication Issue:
March - April 2020

Article History
Article Received*: 24 July 2019*
Revised*: 12 September 2019*
Accepted*: 15 February 2020*
Publication*: 27 March 2020*

Abstract

Energy is the scarcest resource in the network as the nodes are battery driven. The applications of WSN are run without human involvement throughout the time since sensing area in all applications are harsh and remote. Researchers all over the globe put their effort for minimizing the energy consumed by each Node so that the overall energy of the network area can be preserved and keep the network alive as long as possible. In our proposed work the features of TEEN, LEACH-C and AODV[1] protocols are combined to form a Modified Hybrid protocol named as MH-AODV Protocol which consumes less energy, reduces number of transmissions and finds a optimum path[2] for data transmission. The results are implemented using NS2 simulator and are compared with standard AODV protocol which shows the proposed method give better results then existing protocol

Keywords; *Clusters, AODV Protocol, cluster head, Network area, Amplification.*

I. INTRODUCTION

Sensor network is a structure of sensor nodes and base station(BS).The nodes have integrated functionalities of data sensing, acquiring, processing and transmitting to the BS. These senor nodes are battery dependent. which are used to agreeably monitor the objects and ecological conditions like temp, vibration, forecast animal monitoring etc. In these applications once the battery is drained it is impossible to replace. Hence particular sensor stops functioning or it will die reducing the network lifetime. So, energy discharging problem is a major issue in any WSN. To resolve such type of problems researchers all over the globe have been attracted towards WSNs.

All the applications of WSN are run without human involvement throughout the duration. The communication functionality in the network consumes more energy then other functions. Most of the energy will spend if all the Nodes Cluster Heads and Base Station are located away from each other. So, in our proposed work we are trying to keep these distances as minimum as possible The Base Station (BS) is positioned at middle of the network area so that all the CHs in each cluster are closer to BS. After nodes deployment in the area of interest clusters are formed. CH is selected in each cluster and all the nodes will join to their respective CH. All the nodes communicate with one another within their radio communication range. Each node sense the surrounding data and send to its corresponding CH with some condition and CH receives the data and aggregate it and send to BS as single value. This approach reduces the consumption of energy by each node. Remaining part of the paper is distributed as section II. Related work. Section III. Factors which affect network life time section IV. System model assumptions. Proposed algorithm. VI. Simulation parameters & Result discussions. VII.

Published by: The Mattingley Publishing Co., Inc.

Conclusion. VIII. References

II. RELATED WORK

Many cluster based protocols has been proposed by various researchers. Some of the papers I have surveyed is given below

Heinzaelman [3] et al. proposed LEACH protocol. In this work the CH is selected by generating a random number between 0 & 1 by each node and comparing it with a threshold value. If a node having a value lower then threshold value become CH. Due to random CH selection without considering the location of the CH, sometimes there will be no CHs in the network area and energy consumption is more. If the elected CH is far away from the BS more energy is consumed by the CH node.

LEACH-C is advancement of LEACH it is a centralized protocol in which the BS is the main controller and will decide the Cluster Head in each cluster. After collecting the necessary information from all the sensor nodes the BS will decide the CH by comparing maximum residual energy of node with the average energy of the whole network. The drawback of this protocol is if the distance between CH and BS is more then nodes will loose their energy by sending information to BS.

The authors VigneshRamamoorthy H, R. Gunavathiproposed a method to improve and achieve energy efficiency so that network lifetime can be enhanced.

The authors AshaG.Ra, Gowrishankar [4]proposed a method, in this approach initially all the nodes are placed in the area to be monitor for monitoring the environmental and ecological conditions. By using soft computing algorithms through efficient clustering and moderate routing techniques, connectivity & energy efficiency is achieved.

The authors ArchanaBomnale and SaurabhMalgaonker proposed a survey on the different protocols and tested TEEN protocol experimentally.

The authors Chu-Fu Wang, Jau-Der Shih, Bo-Han Pan, and Tin-Yu Wu proposed a method to minimize the energy consumed by each node and hence extend the network lifetime. In this paper multi hop routing is used to transmit data from sensor node to Sink each sensor node transmits its data to another node which is nearer to sink these nodes has energy more then other nodes.

The authors Raghunandan[5] G.H, A ShobhaRani,Nandithaproposed a technique to address the factors which consume more energy such as the distance between CH to BS. Author used centrality based CH election and intermediate nodes to transmit the data from CH to BS for long distances.

The authors Fatehboutekkouk, Fatima Taibi, KhawlaMezianiproposed work which combines the features[6] of both clustering and chain based approaches. The author tries to find optimal cluster among the sensor nodes using firefly algorithm and inside the each cluster it find optimal chain using simulated annealing.

Hence with respect to above discussed literature there is a need for a hybrid protocol which takes care of saving energy and also monitoring the network conditions and reporting it as and when required.

III. FACTORS WHICH AFFECT THE NETWORK LIFETIME

Direct Transmission: If each node send their sensed data directly to BS, more energy will be discharged reducing the network lifetime. Hence an Cluster and Cluster Head (CH) is selected. Data is aggregated by CH and send to BS as a single value.

Distance between Node to CH and CH to BS: Most of the energy is consumed for transmission functions, even more for transmitting data for long distances. Hence to preserve the energy always keep

Published by: The Mattingley Publishing Co., Inc.

March - April 2020
ISSN: 0193-4120 Page No. 5143 - 5150

the distance of Nodes to CH and CH to BS as minimum as possible. For this BS should be positioned at the middle of network area and if the distance between Node to CH is more then the distance between Node to BS then Node send their data directly to BS

Number of transmissions: Unnecessary transmissions are minimized inside the Cluster. In some applications(sensing of physical parameter) if data sensed by a particular node is similar to previous data then no need to send this data again to destination. For this a method is to be included which compares current data with previous data if it is less or more then some prescribed value then only it should send to destination.

Distance between CH and BS: The Cluster Head(CH)is selected in each Cluster in such a way that all the nodes should be closer to the CH. So that minimum energy can be consumed by every node.

IV. SYSTEM MODEL ASSMPTIONS

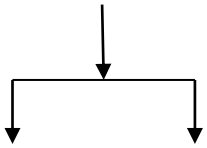
To design a system model various assumptions are made which are give below:

- All the nodes are dynamic.
- Each node have equal energy levels.
- All the nodes are battery operated.
- The nodes spend their energy for sensing, processing and transmitting purposes.
- Once the battery is discharged it can't be recharged or replaced.
- The BS is positioned in the middle of the area of interest.
- CH is selected in each cluster by Base Station(BS).
- Fuzzy based techniques are used to select new CH.
- Nodes are allowed to forward their data to the respective CH.
- Nodes communicate each other using TDMA, CSMA/CD technique..
- After forwarding data to CH nodes enters into sleeping mode.
- Each node must have a buffer to store the previous data.
- If the current data sensed by the sensor node is less or more then 20% of the previous data then only node will transmit the data to CH otherwise it will enter into sleeping mode.
- CHs in each cluster collect the data from the nodes aggregate it & store in internal sensing variable, compare the present aggregated data with the data stored in internal sensing variable. If the difference of these two is less or more then 20% then only CH will transmit the data to BS else it will enter into sleeping mode.
- By doing this multiple transmissions are reduced so that the energy of each node is saved, extending the network lifetime.

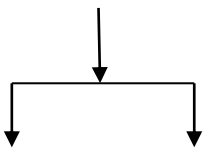
V. PROPOSED ALGORITHM

All the nodes are planted randomly in the monitoring area (the area whose parameters are to be measured). The Base station is placed at the center of the monitoring area. Clusters are formed in each region by using their transmission range and a CH is selected in each cluster. The proposed method is divided into two phases which is given below.

A. Setup Phase



B. Steady State Phase



Published by: The Mattingley Publishing Co., Inc.

March - April 2020
ISSN: 0193-4120 Page No. 5143 - 5150

A. Set Up Phase

Cluster Formation

All the nodes are planted randomly in the monitoring area. Each Node in the area try to join or connect to other nodes to form cluster. All the nodes are connected and interacts each other within their radio communication range. Various types of messages like Broadcast message, state message and join message are used to form a Cluster. A centrality based CH selection method is used in each Cluster select CH. After cluster formation and CH selection all the normal Nodes will connect and communicate with their CH. CH collects the data from their node members integrate it and send to BS as single Value**.**

Cluster Head Selection

Every node should send their information (position, residual energy and node id) to Base Station. After collecting the data the BS calculates the maximum residual energy, number of neighboring nodes and distance to BS. These values are applied to Fuzzy logic system which gives an optimum value which is used to select Cluster Head. After selecting the CH the id of this Cluster Head is broadcasted [7] by BS to all the nodes and the nodes check their id with this id if it is same then act as CH and broadcasts a joining message to all the remaining nodes else acts as a normal node. After CH selection each node in the cluster join to their CH and CH assigns a TDMA schedule to all the nodes in their cluster, according to this schedule the nodes in the Cluster communicate each other.

The following equations are used to determine Residual energy of the Node and Distance between two Nodes for each round in each Cluster.

For Present node P(n) and Present round P(r) determine the number of transmissions n(Tx) while forwarding a message to all its adjacent nodes. This broadcast message is forwarded to inform the adjacent about the survival of the node.

n(Tx) can be determined by counting the number of nodes which receives the message.

For the Present node P(n) determine the residual energy E(res) with E(int), P(Tx) and N(Tx) as input with the following formula.

$E(res) = E(int) - [P(Tx) * N(Tx)]$

Where, $E(res)$ = residual energy of the node

$E(int)$= initial energy of the node

$P(Tx)$=Transmission power of node

$N(Tx)]$ = number of transmissions

Calculate the Energy utilized Rate EUR for P(n) with E(int), E(res) and the Present round PR as input.

$$EUR = \frac{E(int) - E(res)}{CR - 1} \qquad (1)$$

Distance between Two Nodes$A(x_1, y_1)$ and

$B(x_2, y_2)$ is given by

Euclidian distance between two nodes =

$$\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2} \qquad (2)$$

Where, (x_1, x_2) and (y_1, y_2) are the co-ordinates of X-axis and Y-axis respectively.

B.Steady State Phase

Route discovery usingModified Hybrid AODV(MH-AODV) Protocol

We Proposed a Modified Hybrid AODV (MH-AODV) Protocol for forwarding the data from source to destination. This proposed Protocol not only finds the shortest path but also helps to enhance network's life time. The name Hybrid is used because it is a combination of AODV and TEEN Protocol with some modifications.

The proposed Modified Hybrid AODV(MH-AODV) protocol is as follows.

Shortest route discovery using Node count Method

i) Initially any one Node is picked as a source node which transmits the PREQ(Path Request) message to all itsadjacent nodes and these nodes reply PREP(Path Reply) message to the source with total number of nodes in the path.

ii) By using the above information MH-AODV determines distance and number of Nodes between transmitting and receiving ends.

Published by: The Mattingley Publishing Co., Inc.

March - April 2020
ISSN: 0193-4120 Page No. 5143 - 5150

iii) If the distance and Node count seems to be optimum then the MH-AODV uses this path for communication.
iv) Sensor node's residual energy plays an important role in deciding the optimum path for data communications.
v) After discovering the transmission path, MH-AODV increases the level of energy of each node which occurs in the path.
The proposed MH-AODV method is as follows,
1.For every adjacent node, node A(x_i, y_i) broadcasts a packet which includes PREQ, Node count and energy level of the node.
2. Node A(x_i, y_i) accepts this packet information
3. Verify each adjacent node's PREP for minimum number of nodes to Base station, minimum distance between node to Base Station and finally the end node maintains high energy level than the other nodes.
4 If node A(x_i, y_i) receives the best PREP (optimum path and less number of nodes) for Instance node B Than,
5 Energy amplification mode changed to HIGH for node A(x_i, y_i).
6 Starts data forwarding.
7 If node B is Base Station.
8 received the data Successfully.
9 completes transmission.
10 Energy amplification mode changed to LOW for node A(x_i, y_i).
11 Else
12 GOTO step 1.
13 End Process.
The below equation is used for Node count

$$N_c = \sum_{i=1}^{n-1} 2^{2i-1}$$

Where, N_c=Node Count, n=Number of nodes and i=number of iterations.

Data Transmission Method

After CH selection and Route discovery Phase, nodes in each Cluster communicate each other using TDMA, CSMA/CD technique. For data transmission in Clusters(node to CH) TEEN protocol concept is utilized. In TEEN Protocol Hard Threshold(HT) and Soft Threshold(ST)values are used to transmit data. Here the node senses and transmits the sensed data whenever it exceeds HT and ST values which is stored in internal sensed variable(SV). The major drawback of this protocol is it is very difficult for CH to know whether a particular node is alive. Hence to resolve this problem we inserted some condition in each sensor node i.e instead of considering HT and ST values the node is allowed to send their sensed data to CH only when it is less or more then 20% of its previous sensed data which stored in internal variable of Node. Similarly after gathering the data from all the nodes by CH the CH also compares its aggregated present data with its previous data if it less or more then 20% then only it is allowed to forward to Base Station. This method solves the draw back of TEEN protocol and reduces the number of transmissions and hence enhances the network life time

VI. SIMULATION AND RESULTS.

Simulation Parameters:

The proposed work is implemented using NS2 . To investigate the performance of the proposed MH-AODV with Existing AODV, a sensor network is created with 40 nodes deployed randomly in 1000m*1000m network area. Simulation parameters are given in below table.

Parameters	Values
Network Size	1000*1000
Number of Nodes	40
Initial Energy of Node	200j
Base Station Position	Centre (500,500)

Published by: The Mattingley Publishing Co., Inc.

March - April 2020
ISSN: 0193-4120 Page No. 5143 - 5150

Received Power	0.5 j
Transmitting Power	1.0 j
Sensing Power	0.3 j

Node Deployment: All the nodes are deployed randomly (Figure.1) in the region of interest. The "0" node indicate the Base Station(BS) located at the center of area

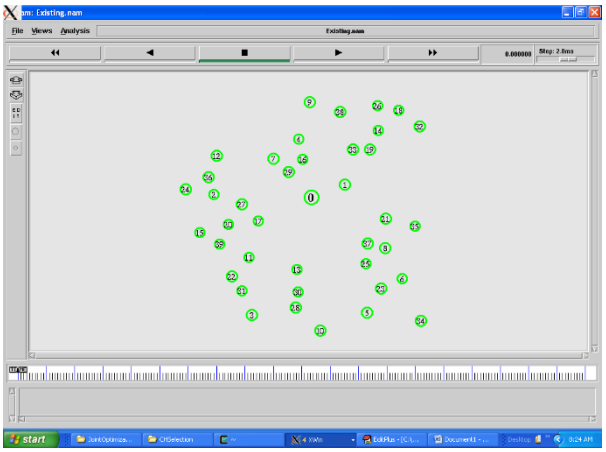


Figure 1. Node Deployement

Cluster Formation: All the nodes are joined together to form (Figure.2) cluster according to their communication range. These nodes communicate each other within their transmission range. Different colors indicate different clusters in the network area.

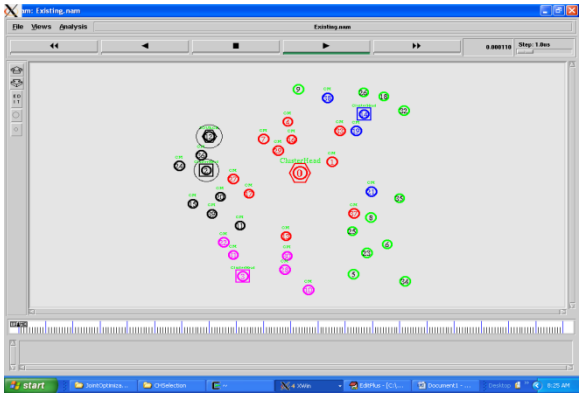


Figure 2. Cluster Formation

Cluster Head Selection: The below Figure.3 shows how all the nodes are sending their details to Base Station(BS) for electing CH. Here hexagonal shape node indicates the BS and square shape node indicates the CH and circle shape nodes indicate normal node.

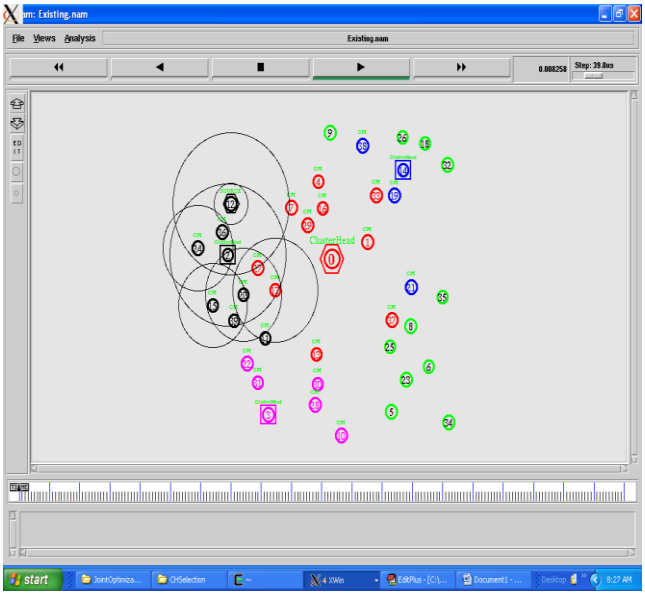


Figure. 3 Cluster Head selection

Data Transmission: The below Figure. 4 shows how the data is transmitting from source node 12 one small line going towards its cluster head 2 which indicates data sending between source node 12 and cluster head 2. And Figure. 5 shows the data is forwarding From CH 2 to BS

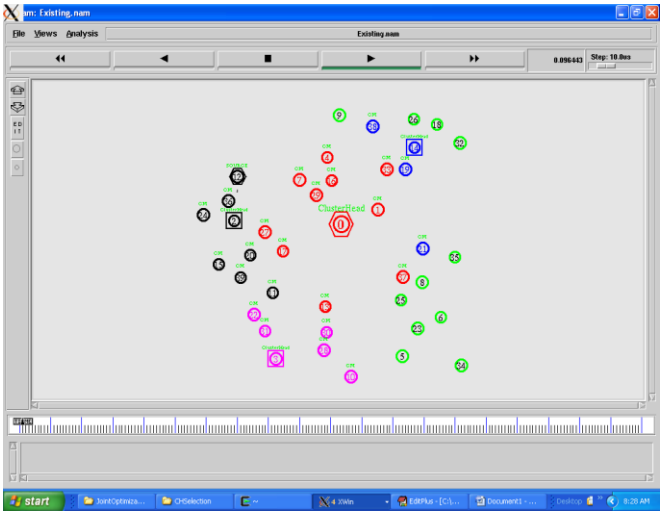


Figure. 4 Data Transmission from Node to CH

Published by: The Mattingley Publishing Co., Inc.

March - April 2020
ISSN: 0193-4120 Page No. 5143 - 5150

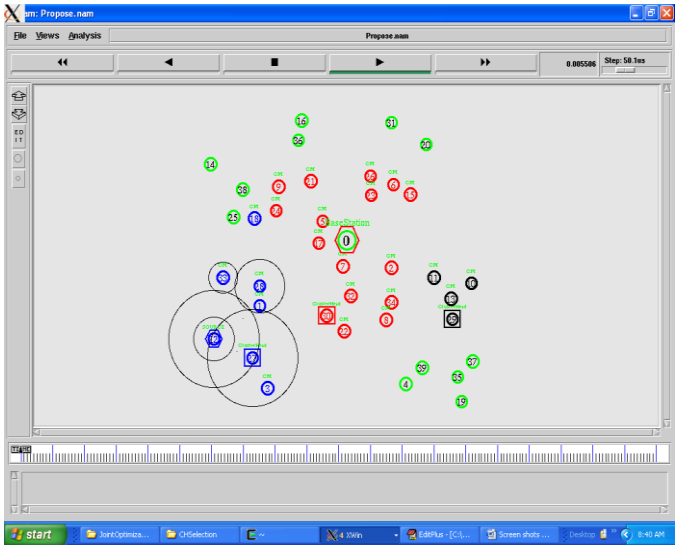


Figure. 5 Data Transmission from CH to BS

Result and performance evaluation:

Energy Consumption:

The below Figure. 6 shows the comparison between existing AODV protocol with our proposed Protocol for energy consumption by each node. Red line indicates existing protocol and green line indicates proposed protocol. The graph shows existing technique consumed total 55227 joules of energy to transmit all packets and our Propose MH-AODV protocol consumed 52126 joules of energy.

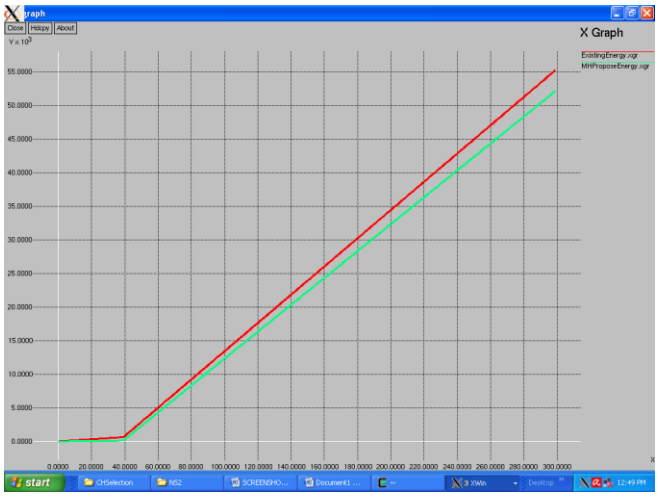


Figure. 6 Comparison of energy consumption between existing AODV and Proposed MH-AODV

Packet Delivery Ratio(PDR):

It is the ratio number of packets received by the BS to packets transmitted by the source node. The below Figure. 7 shows proposed method has 95% of PDR and existing AODV has 28%.

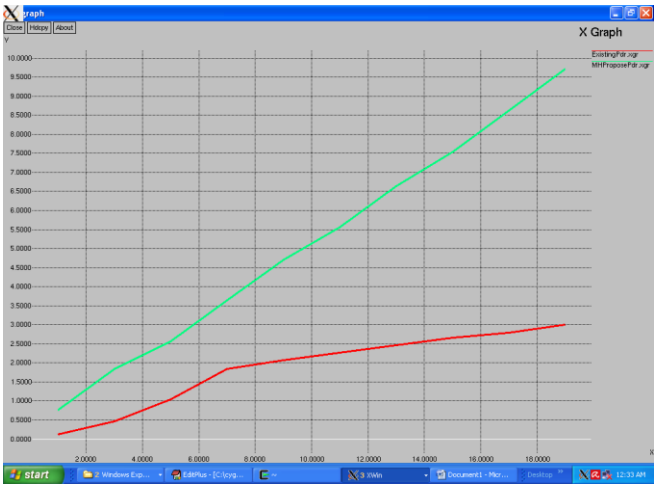


Figure. 7Comparison of PDR between existing AODV and Proposed MH-AODV.

Delay Time:

It is the Time required by the packet to reach the destination from source Node. The below Figure. 8 shows the amount of time required to send the packets to BS. In this we can see existing technique took average 0.363ms delay for each packet. And our proposed method took 0.106ms delay.

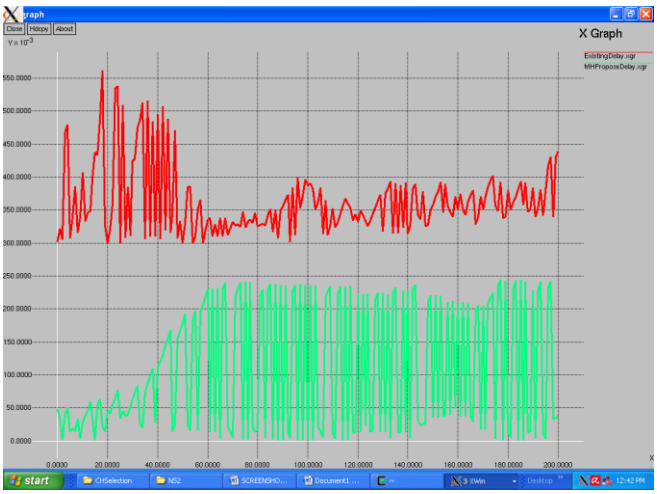


Figure. 8 Delay Time

Published by: The Mattingley Publishing Co., Inc.

VII. CONCLUSION

In this paper we presented a modified hybrid AODV protocol which is a combination of LEACH-C, TEEN and AODV protocol. This proposed method not only enhance the Network life Time but also finds a optimum path between Source to destination. We compared our results for Energy consumption, PDR and Delay Time with Existing AODV protocol which shows our proposed method has better then existing methods.

REFERENCES

[1]. S. Nouh, Mohamed I. Youssef, Mahmoud I. Marei. A New Technique for Multiple-Path Creation in AODV Protocol Based on Composite Criterion Consisting of the Factors of Energy, Traffic Load and Stability of Nodes. IJEAT ISSN: 2249 – 8958, Volume-9 Issue-1, October 2019.

[2]. Najmuddin.MMaroof& Dr. Mohammed Abdul Waheed. An efficient Information Retrieval and Routing using AODV on TDMA in WSNs. IJ

[3]. W. Heinzelman, A. Chandrakasan and H. Balakrishnan, Energy-Efficient Communication Protocol for Wireless Microsensor Networks ,Proc. 33rd Hawaii Intl. Conf. Sys. Sci., Jan.2000.

[4]. GajendranMalshetty, BasavarajMathapati. WSN Clustering Based on EECI (Energy Efficient Clustering using Interconnection) Method International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-9 Issue-1, November 2019

[5]. AshaG.Ra, Gowrishankarb Energy efficient clustering and routing in a wireless sensornetwork. The 13th International Conference on Future Networks and Communications (FNC 2018).

[6]. ArchanaBomnale, SaurabhMalgaonkar"Power Optimization In Wireless Sensor Networks."2018 International Conference on Communication, Information & Computing Technology (ICCICT), Feb. 2-3, Mumbai, India.

[7]. Raghunandan.G.H, A.Shobha Rani, Nanditha.S.YHierarchical Clustering Based Routing Technique for Overall Efficiency of WSN (2017) 2nd IEEE International Conference On Recent Trends in Electronics Information & Communication Technology.

[8]. AbhishekRai, Kanika SharmaA Fuzzy Based Techniques For Energy Efficient Cluster Head Selection For Wireless Sensor Network. International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-8 Issue-6, August 2019.

[9]. Mohamed NajmusSaqhib, Lakshmikanth .S Reckoning Network Lifetime Ratio for Wireless Sensor Network. International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-11, September 2019.

[10]. MeisamKamarei, Ahmad Patoogh, ZohrehShahsavari Lifetime expansion in WSNs using mobile data collector Journal of King Saud University –Computer and Information Sciences journal 32(2020) 65-72.

[11]. Ahmad Shelebaf, ShayestehTabatabaei Novel Method for Clustering in WSNs via TOPSIS Multi-criteria Decision-Making Algorithm. Spinger Link Wireless personal communication (2020)

[12]. Sushant Gupta,S. MurugaanandamNetwork Lifetime and Energy Management Analysis in Heterogeneous Wireless Sensor Network.International Journal of Engineering Research and Technology Published (First Online): 22-11-2019 ISSN (Online) : 2278-0181.