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Adaptive Uninterrupted Communication Algorithm for Wireless Mesh Network by Using UV-Rays and Dijkstra's Algorithm

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Abstract--- Now a day's wireless sensor networks are the main source of communication, so it is an important area of research. The main issues of wireless sensor networks are energy consumption and communication consistency. In this research paper the energy is reducing by minimizing the distance between sensor nodes and increases the accuracy of message transfer. An adaptive uninterrupted communication algorithm is proposed to maintain the consistency of network by using wireless mesh network topology. Mesh topology is used as it is a less expensive network than traditional network, it is extremely adaptive and expandable and it also supports high demand. UV-rays are used to data transmission in wireless mesh network since UV-links can give faster communication rate. In this research paper dijkstra's algorithm is used to find out the shortest path between source and destination nodes, so that as the distance between the sensors nodes are minimised as a result less energy is used in wireless mesh network communication ($E \propto d^2$).

Keywords--- wireless sensor network (WSN), dijkstra's algorithm, AUICA algorithm, sensor node, UV-rays, topology management, mesh wireless network.

I. INTRODUCTION

The technology has become the rising curve in the modern world of the networking. Network is a set of devices which is connected by communication links. Wired networks is also called Ethernet network, these networks are the most common types of local area network technology. The types of wired network are LAN, MAN, WAN and the cellular network. Wireless network is any type of network that uses wireless data connection for connecting network nodes. The main two types of wireless networking are Peer to peer Ad-hoc and infrastructure Wi-Fi. The wireless network is more beneficial than wired network because it provides easy connectivity between computers, cost effective [1].

At present wireless communication technology finds their applications in sensing, monitoring, smart phones, laptops, Bluetooth, technology and in networking. Wireless sensor network (WSN) or wireless sensor & actuator network (WSAN) are spatially distributed sensors to monitor environmental or physical conditions such as temperature, humidity, fire etc. and to cooperatively pass their data through the network. WSN consist of three main components nodes, gateways and the software [2].

A sensor node is a small device that has four basic components. A sensing or actuating unit, a processing unit, transceiver unit and power supply unit. The sensor node may also be equipped with location detection unit such as a Global Positioning System (GPS), a mobilizer etc. The different types of network in sensor networks are such as thermal, visual, seismic, and infrared are used to monitor a variety of ambient conditions such as humidity, temperature, pressure and characteristics of objects and their motion [3].

Wireless sensor networks have a massive amount of applications, ranging from environmental to military domains. These applications include habitat monitoring, contamination tracking, health monitoring, traffic monitoring, building surveillance and monitoring, industrial and manufacturing automation, distributed robotics and enemy tracking in the battleground [4].

At any time every sensor node can obtain its location information from other positioning system and send data to sink. The characteristic of this is to split wireless sensor network into network based on Topologies i.e. Bus, Tree, Star, Ring and Mesh Information of the position of nodes, and those nodes are planned within the network by the Topological way. The expansion of WSNs has taken traditional network topologies in new directions [5].

Optical wireless communication is a form of communication in which unguided visible, infrared (IR), or ultra violet (UV) light is used to transmit a signal. In wireless optical communication, data send from transmitter to receive in the form of packet for long distance. Here Dijkstra's algorithm used for finding the shortest path between transmitter and receiver [6]. In this research paper showing results are carried out by Dijkstra's algorithm using on assuming network.

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Nowadays the use of wireless communications has become critical the available RF spectrum has become limited. UV communication system can improve the spectrum constraint making UV communication system a prospective alternative to future communication demands. Also, UV links can give faster communication rate and can be used in grouping with existing RF communication links, providing new communications variety with higher user capacity [7]. Ultra violet-Rays is using for data transmission because the ultraviolet rays have wavelength which are shorter than that of visible light and longer than that of X-rays. The UV wavelength is in between 10 nm to 400 nm and it has energies between 3 eV to 124 eV.

The rest of this paper is organized as follows: the types of topologies are in section II, problem identification and proposed network is in section III, in section IV is an adaptive uninterrupted communication algorithm generated in WSN, apply dijkstra's algorithm in section V, after that result and analysis in section VI and the paper concluded in section VII.

II. TYPES OF TOPOLOGY

Topology management is a main component of network management of WSNs. The most important goal of topology management is to conserve energy while maintaining network connectivity [8].

Normally, a Wireless Sensor Network can be defined as a group of sensor nodes organized into a co-operatively network which can sense and control the environment enabling communication between embedded computers or persons and the surrounding environment. Most of the conventional wireless systems, such as cellular telephone networks and WLAN (wireless local area networks); make use of either Ring topology. Recently, a new wireless network topology, mesh topology, has been emerged with the growing use of wireless sensor networks (WSN) in industrial applications. Sensor networks are used to share the information about their local environment with nearby peers and further communicating this information to the central node where it can be processed and used to improve the performance of the network [9].

A. Star Topology

In Star Topology, a central node is present which is connected to all sensor nodes that work like personnel area network (PAN) co-ordinator. Without using the central node as communication points the end nodes do not forward the data or communication to each other. If any node used for communication is collapsed or crashed, then it does not affect the whole network but only affects the particular node. On the other hand if the central node is crashed, then entire sensor network is affected and communication will stopped.

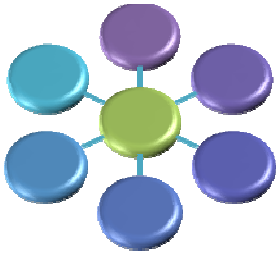

Fig. 1: star topology

B. Ring Topology

According to the name in ring topology, generally messages are passed in the ring. Only the adjacent nodes are able to communicate with each other. If any node or link is collapsed during the communication, then it will affect the entire sensor network. At the present time, ring topology is not preferred much in applications. The main advantage of ring topology is that it does not have any leader (central node).

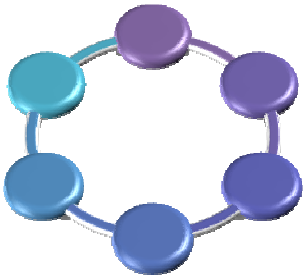

Fig. 2: ring topology

C. Mesh Topology

In mesh topology, all sensor nodes are able to communicate with central node as well as with each other, basically it is a multi-hoping system. The transmission of data through mesh allows a sensor network to extend, theoretically the range is extended unlimited. Because of each sensor nodes have multiple paths; this sensor network is highly fault-tolerance. If any node of this sensor networks is get collapsed, then the network automatically re-arrange itself around the failed node.

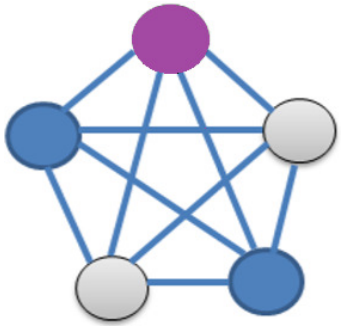

Fig. 3: mesh topology

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Thus in the Mesh Network Topology the probability of single point network failure is greatly minimized.

D. Tree Topology

In tree topology, a central hub is present and a root node is present as a main communication router. This topology is consisting of different levels and these levels form a star network. This topology can be considered as a mixture of both peer-to-peer and star networking topologies. This sensor network path may be single hop or multiple hops. In this sensor network the data is transferred from the root node to the parent nodes and from the parent nodes to the children nodes and so on. The main problem which occurs is the load balancing scheme at each level of fat tree and there is communication between two nodes. If there is a link break in the unipath on the active route then communication also breaks [10].

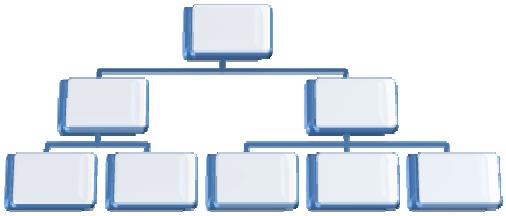

Fig. 4: tree topology

In these topologies features is defined in a given table.

TABLE. 1: Topologies Features

STAR	*RING*	*MESH*	*TREE*
The star Topology every sensor nodes are linked to a single node. The end nodes do not forward the information / communication to each other rather they make use of middle node as a communication point. If the middle node is stopped, then whole sensor network is affected and communication will blocked.	Only adjacent nodes are capable to communicate with each other. If any node or connection is broken during the e-mail, phone call or any type of communication, then it will influence the whole sensor network. At that time, the ring topology is not preferred much in applications.	All sensor nodes can easily communicate with central node as well as with each other. If any node causes crash, then the whole network automatically reconfigures itself around the crash node. The chance of single point network failure is greatly minimized only with Mesh Network Topology.	Sensor node for getting information sense from the environment and forward them to the sink and sensor sends them to its parent after receives information from its children. If there is a connection break in the single path on the active route then message communication also breaks.

III. PROBLEM IDENTIFICATION AND PROPOSED NETWORK

- The main issue is maintaining the consistency of communication in wireless sensor networks.
- In Wireless Sensor Networks, the main issue is energy consumption because sensor nodes have limited battery power.
- In this research paper the energy is reducing by minimizing the distance between sensor nodes and increases accuracy of message transfer.

Using the topology management on WSN because the primary goal of topology management is to conserve energy while maintaining network connectivity and UV-rays is using for data transmission and dijkstra's algorithm is using for find out the shortest path. With the help of these, an adaptive non-stop communication algorithm is generated for diminish all problems in WSN.

A wireless optical communication system depends on an optical wave with wavelength ranging from infrared, visible light, to ultraviolet (UV) to transmit information. After comparing with an RF system, it shows a number of potential advantages, such as huge unlicensed bandwidth, low-power and miniaturized transceiver, higher power densities, high resistance to jamming, and potential increase of data rate. In the wireless optics communication, infrared and UV waves are very valuable carriers. High unregulated bandwidth and virtually free of multiple access interference conditions are commercially attractive, while inherent security characteristics receive the military's attention [11].

In this paper assumed a wireless sensor network, where some nodes are deployed. The distance between sensors nodes are already given in network.

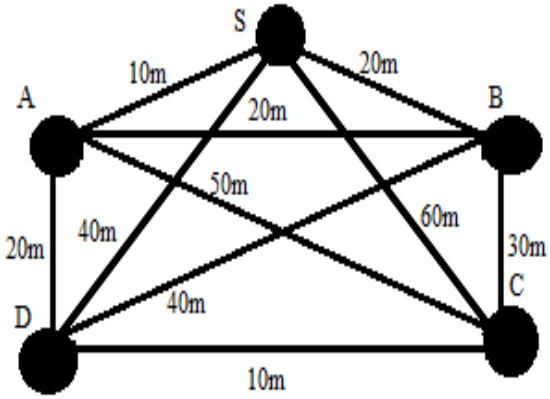

Fig. 5: consider network

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IV. ADAPTIVE UNINTERRUPTED COMMUNICATION ALGORITHM (AUICA)

In this research paper an adaptive algorithm has been generated for non-stop communication. The steps of algorithms are as follows:

Step1: initially consider a wireless sensor network.

Step2: identify the topology.

(According to the features of ring, star, mesh and tree topologies, only mesh topology is suitable for uninterrupted communication)

So it's called Wireless Mesh Network.

Step3: if

It is a mesh topology, and then proceeds to next step.

else

Stop algorithm.

Step4: apply Dijkstra's algorithm on consider network.

(The network is wireless mesh network)

Step5: after finding all shortest paths a compact (compress) network is generated.

Step6: according to the energy formula

$E \propto d^2$

(The energy depends on the distance between nodes)

Step7: now using the UV-rays for data transmission.

Step8: End.

Flowchart of this algorithm is given blow.

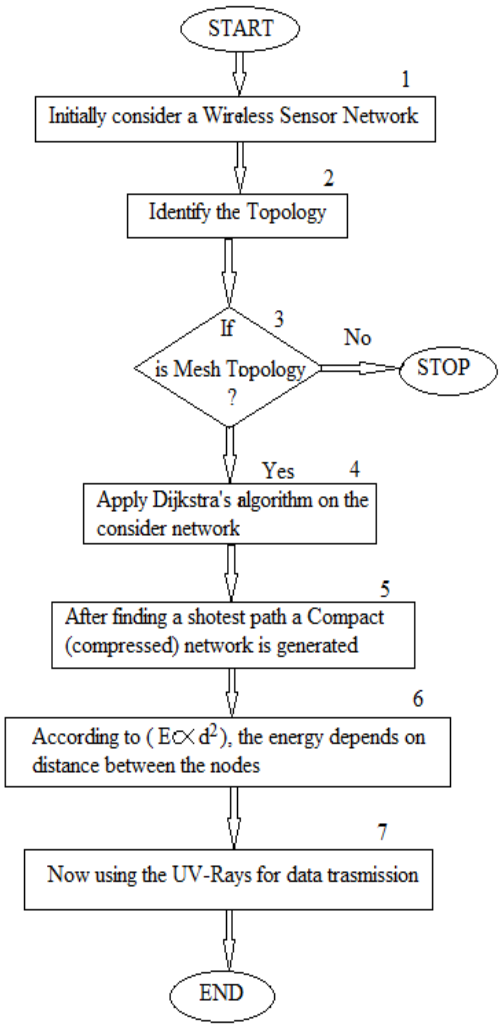

Fig. 6: Flowchart for Adaptive uninterrupted communication algorithm in WSN

V. APPLY DIJKSTRA'S ALGORITHM

In this research paper, dijkstra's algorithm is used to define the shortest path between two nodes of any graph. Dijkstra's algorithm is a greedy algorithm that solves the single source shortest path problem with non-negative edge. According to the network topology, where all nodes which connect to each other are showing in the graph.

In this algorithm initializing that if the all node can't define the path then shortest path consider infinite (∞). If the start node is selected then in this condition start node consider at zero (0) it means Current distance is zero [12].

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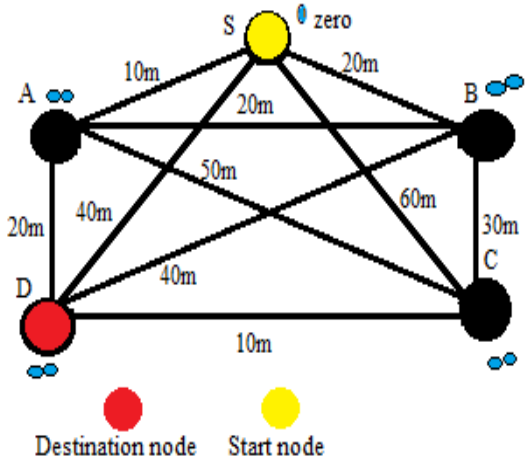

Fig. 7: considered wireless mesh network

1) We start with the source node S, according to this algorithm assign the distance is 0 (zero) to this node and make it the first start node.
2) Examine each adjacent node from the S and find the minimum value from it.
3) Then relax all nodes leaving S.
4) Now secondly take the minimum distance from node A (according to our graph) and find the minimum value from A and relax all nodes except node A.
5) Then we repeated and consider the value of next minimum node and similarly find the minimal distance of every node from the start node.
6) These processes are showing in the figure is given below.

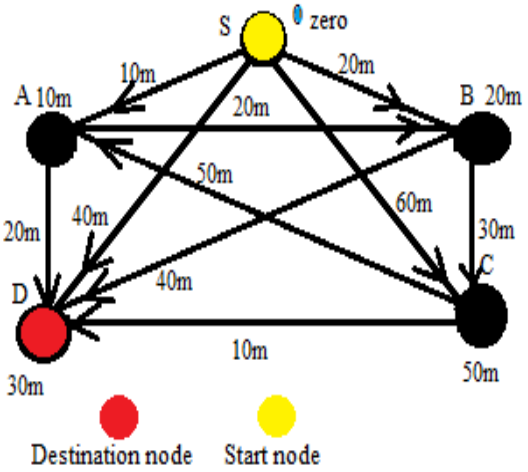

Fig. 8: shortest distance graph between nodes after apply dijkstra's algorithm

In this graph when consider the start node (S) and destination node is (D), so find out the shortest path between all nodes from S are given as:
S = 0
S → A = 10m
S → B = 20m
S → B → C = 50m
S → A → D = 30m
These are the shortest distance between all sensor nodes from "S".
Similarly, when consider the start node is "A" and destination node is "C", so find out the shortest path between all sensor nodes from A are given as:
A = 0
A → B = 20m
A → S = 10m
A → D = 20m
A → D → C = 30m
These are the shortest distance between all sensor nodes from "A".
Similarly, for all nodes to find out a shortest distance between each other's with the help of dijkstra's algorithm.

VI. RESULT AND ANALYSIS

Description of step-6 from the (AUICA) adaptive non-stop communication algorithm, the energy used in data transmission:

$E = \frac{1}{2} mv^2 \rightarrow (1)$

Where $d = \frac{v}{t}$

$\rightarrow \quad v = d \times t \rightarrow (2)$

From equation (1) and (2), put the value of v in equation (1),

$E = \frac{1}{2} m (d \times t)^2$

Consider m (mass) and (time) t is constant;
Then,

$E \propto d^2$

So, the energy is directly proportional to the square of distance.
Now the energy Vs distance graph is showing in figure 9.

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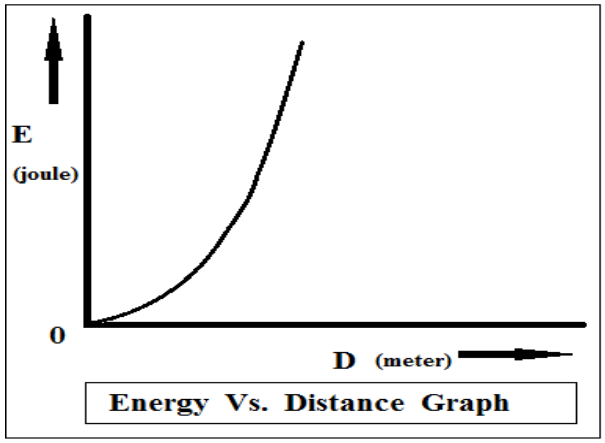

Fig. 9: according to the formula distance Vs energy graph

The next graph is a path vs. distance graph, where assuming the start node is (S) and destination node is (D). After that energy is showing according to the distance. The distance is long then energy consumption will also high; the distance is minimum then energy consumption will also minimum.
The minimum distance from "S" to all nodes and energy levels are showing in the figure 10.

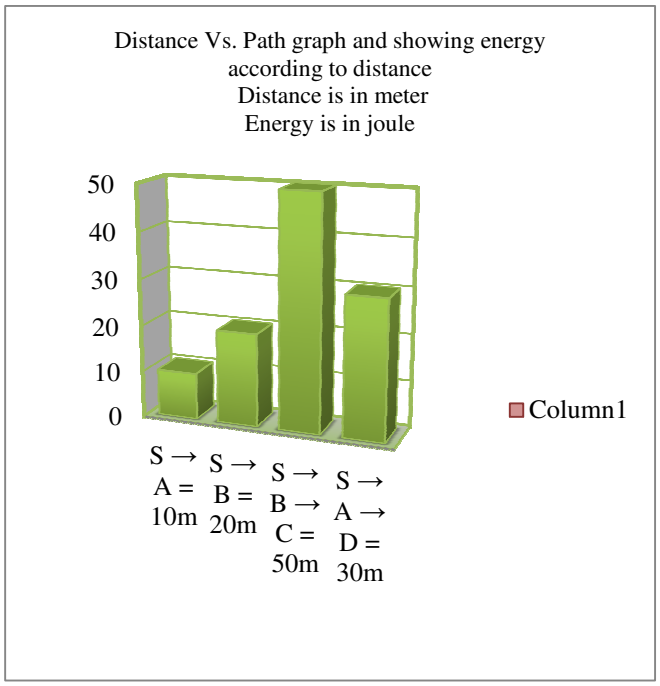

Fig. 10: Start node (S) to destination node (D) Path Vs distance graph

The next graph is a path vs. distance graph, where assuming the start node is (A) and destination node is (C).
The minimum distance from "A" to all nodes and energy levels are showing in the figure 11.

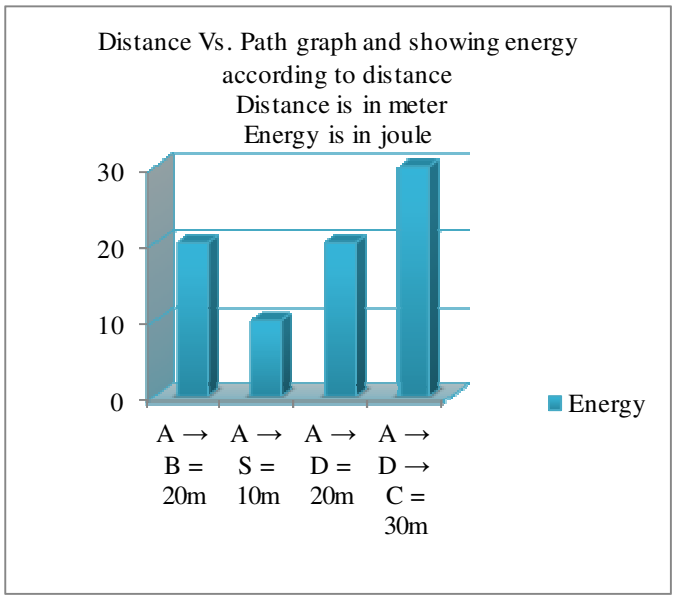

Fig. 11: Start node (A) to destination node (C) Path Vs distance graph

Now maintain the continuous consistency of communication between nodes, use wireless mesh network topology management with shortest path. This is more effective in comparison to a normal mesh network.
The comparison graph is showing in figure 12.

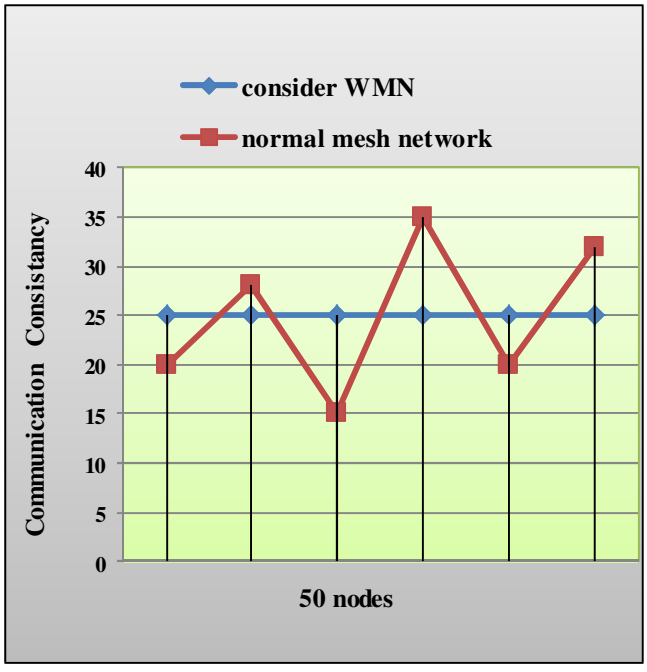

Fig. 12: consistency graph between considered wireless mesh network and normal mesh network

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Now the accuracy between wireless mesh network (WMN) with dijkstra's algorithm and a normal mesh network without dijkstra's algorithm. The accuracy is WMN with dijkstra's algorithm higher in comparison to normal mesh network.
Accuracy graph is showing in figure 13.

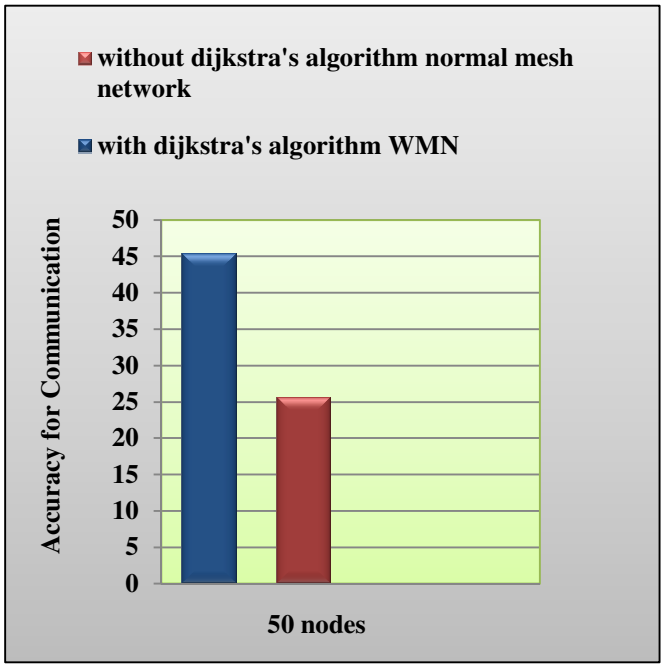

Fig. 13: Accuracy graph between with dijkstra's algorithm in wireless mesh network and without dijkstra's algorithm in normal mesh network

VII. CONCLUSION

In this research paper, many points are showing for uninterrupted communication in wireless sensor network. The mesh topology is very helpful for the consistency because all nodes are connected to each other and no effect will occur in communication, when any node/link will crash. Now UV-Rays is using for data transmission because the ultraviolet rays have wavelength which are shorter than that of visible light and longer than that of X-rays. The ultraviolet wavelength is in between 10 nm to 400 nm and it has energies between 3 eV to 124 eV. After that according to the energy formula, the energy (E) is directly proportional to the square of distance (d).

Distance between the sensor nodes is maintained by the dijkstra's algorithm so that the shortest path may occur between the sensor nodes, which help in less consumption of energy. The accuracy of wireless mesh network increases after applying dijkstra's algorithm. All techniques are showing through the designing adaptive uninterrupted communication algorithm (AUICA) that is generated in this research paper.

REFERENCES

[1] et al. Chanchal Yadav et al., "Security Techniques in Wireless Sensor Networks: A Survey", International Journal of Advanced Research in Computer and Communication Engineering Vol. 4, Issue 4, April 2015.

[2] et al. Vijay S. Kale and Rohit D. Kulkarni, "An Overview on Wireless Sensor Networks Technology and Simulation Software's", International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 5, May 2016.

[3] et al. Sanjeev Kumar Gupta and Poonam Sinha, "Overview of Wireless Sensor Network: A Survey", International Journal of Advanced Research in Computer and Communication Engineering Vol. 3, Issue 1, January 2014.

[4] et al. M. Vahabi, M. F. A. Rasid, R. S. A. R. Abdullah, and M. H. F. Ghazvini, "Adaptive Data Collection Algorithm for Wireless Sensor Networks", IJCSNS International Journal of Computer Science and Network Security, VOL.8 No.6, June 2008.

[5] et al. S.S. Gautam, Shivlal Mewada, P Sharma, "Classification of Efficient Symmetric Key Cryptography Algorithms", (IJCSIS) International Journal of Computer Science and Information Security, vol. 14, no. 2, Feb 2016.

[6] et al. Shivlal, Pradeep Sharma, S.S Gautam, "Exploration of Efficient Symmetric AES Algorithm", IEEE 2016 Symposium on Colossal Data Analysis and Networking (CDAN), pp(1-5), Mar, 2016. Doi: 10.1109/CDAN.2016.7570921,

[7] et al. Ricardo O. Rodríguez Cruz and Carlos L. Santos Vázquez, "Ultraviolet Communication", http://facultad.bayamon.inter.edu/ cgonzalezr/ELEN4618 /Paper_spring_09/Ultraviolet %20Comm.%20Paper.pdf,

[8] et al. Sharma, Shamneesh, Dinesh Kumar, and Keshav Kishore. "Wireless Sensor Networks-A Review on Topologies and Node Architecture." International Journal of Computer Sciences and Engineering 1.2 (2013): 19-25.

[9] et al. Jolly Soparia and Nirav Bhatt, "A Survey on Comparative Study of Wireless Sensor Network Topologies", International Journal of Computer Applications (0975 – 8887) Volume 87 – No.1, February 2014.

[10] et al. Kukade, Madhavi S., and Kapil N. Hande. "Analysis of Uniform Distribution of Storage Nodes in Wireless Sensor Network." International Journal of Computer Sciences and Engineering, (2014): 43-47.

[11] et al. Zhengyuan Xu, Gang Chen, Feras Abou-Galala and Michael Leonardi, Research Gate "Experimental performance evaluation of non-line-of-sight ultraviolet communication systems", The International Society for Optical Engineering, DOI: 10.1117/12.735183, October 2016.

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[12] et al. Ambreen and Haque Nawaz, "Wireless Sensor Network Through Shortest Path Route", International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, , Volume 3, Issue 2, February 2013.

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