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Lifetime Optimization in WSN by Healing Mechanism

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Abstract— ***Abstract* – Wireless Sensor technology is one among the fast emerging technologies in the current scenario and it has wide range of application also which has small sensors with minimum communicational and computational power. Depending on the overhead of a node, the energy consumption varies with each other. Numerous technologies have been implemented in order to enhance the lifetime of the whole network. Ex-actor node has been used in various forms such as in the clustering concept as well. In our proposed work, an Ex-actor node has been used to replace the critical node which has energy level below the threshold level and in turn the critical node will be healed in the base station by means of external hardware. The lifetime of the network has been increased considerably comparing the node rotation methodology which has been proven by means of comparison graphs generated by NS-2 software.**

Index Terms— **Ex-actor node, energy and lifetime**

I. INTRODUCTION

In wireless sensor networks (WSNs), one of the biggest lies on the complexity of logistics involving selective replacement of sensors that have ran out of energy. Due to random deployment strategy, certain areas of the monitoring [2],[3],[4] region may have low energy and serious coverage overlapping, which significantly degrades the network performance. It leads to the random death of the nodes and also nodes may die due to exhaustion of battery power, which may cause the network failure. The critical nodes can be reused by means of healing mechanism where the actor nodes will come into picture for the seamless connectivity of the network. The main challenge in using the wireless sensor network is to best utilize the available battery power effectively. Many approaches is been introduced to use the available energy in an efficient way such as [5],[6],[7] and [8].

II. ROUTING IN WSN

There are many routing protocols exists in WSN. Out of which the traditional routing algorithm AODV [13] is considered which is a reactive routing protocol that can construct the route only when the data transmission is needed. When a node wants to find a route to another one it sends a RREQ to the whole network until the destination is reached or another node is found with a fresh route to the destination. A RREP is replied to the source and the newly found route is made available. When a node detects the invalid route, it sends a RERR message to neighbours that are active and use the route.

DSR is an on-demand routing protocol [12] which is based on source routing which means that the source nodes have complete information about hop sequences to the destination with each node maintaining its route cache. The mechanisms in DSR protocol: - Route discovery and Route maintenance. These mechanisms combined in an ad hoc network to allow the discovery and maintenance of source routes and are requested only when the two nodes have to send packets to each other.

DSDV [19] provides a baseline proactive distance vector algorithm for performance comparison. In DSDV, each route is marked with a sequence number which is originated by the destination themselves . Each node has unique sequence number, this is done by assigning two greater than the old one (i.e. an even sequence number) every time.

III. PROTOCOL COMPARISON

In AODV, each node will be holding only the next hop information. In case of any network intervention, the route maintenance mechanism can be done easily which in turn reduces the packet loss. Also, an added logic is been introduced in such a way that the path selection will be also based on the amount of total energy that is available which has been introduced in order to overcome from the frequent path failure. Though DSDV being proactive, the overhead will be very much high because of the presence high control messages. In DSR, the losses in packet occur where information is held by each node of the entire path from source to destination. If any neighbour node fails because of network interruption, then no path change occurs immediately and hence there is an occurrence of the delay. Hence the Packet delivery ratio will be calculated accordingly. Thus, AODV is highly suitable for peak dynamic networks[9],[10].

IV. EXISTING SYSTEM

Extending WSN lifetime is complicated since nodes over the time experiences differential power consumption. For example, nodes nearer to the sink in

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a routing topology transmit more number of data and hence consume high power rapidly than nodes farther from the sink[14],[15],[16]. The mobile node rotation[11], a new method for using low-cost mobile sensor nodes has been proposed to address differential power consumption and extend WSN lifetime[1]. Specifically, a methodology is been implemented to rotate the nodes through the high power consumption locations which is called as node rotation. The drawbacks of this system are that it involves more number of border nodes to get rotated to reroute the data transmission via a high energy node which leads to energy drop in higher level. Also considerable amount of delay occurs during the node rotation process which leads to less packet delivery

V. PROPOSED SYSTEM

We have developed modified Swap-Level algorithm in our previous work which requires less computation from the controller and also less synchronization among nodes as nodes relocate independently of other nodes. The goal is to swap the low level energy node by high level energy node [1] with the distance and location information and also considering the problem of network interruption while swapping in order to have the uniform distribution of the energy in the whole network which achieves higher reliability. In this paper, by making use of the Ex-actor node, the critical nodes which have energy level less than threshold level will be healed by base station until which this ex-actor node involves in data transmission. Fig.1 depicts the system flow of the proposed methodology.

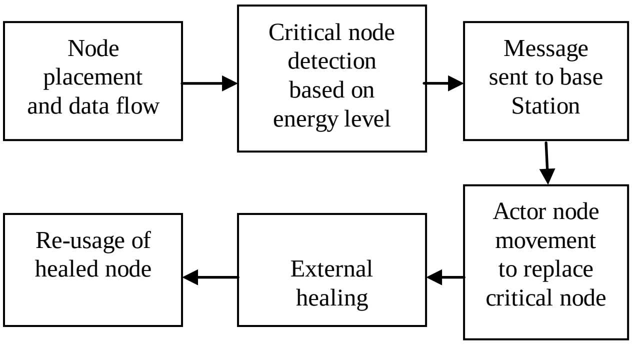

Fig.1 System Flow

Detection of low level energy node: Algorithm used detects low energy node in WSN which is a distributed and localized low level energy detection algorithm. By means of beacon signals, we can identify the low energy node characteristics [17] such as location information and the energy level information. Also, a request will be send periodically to check the failure status of the node due to network intervention. If no response has occurred, then it is marked as a critical node and accordingly swapping will be done to maintain the performance of the network. Once a node identifies itself as a stuck node it generates a new low energy node packet, marked with its ID and forwards it to the next struck. This process is repeated until the packet has travelled around the low energy and eventually been received by the forwarded node. Once the critical node is been pointed, then the message will be passed to base station regarding the details of a critical node which will be helpful in the activation of ex-actor node which will be in the sleep mode at the base station to have the maximum battery life.

Actor node and critical node swapping: Once the critical node is been detected the message holding the critical node details will be sent to base station. Once the receiver node gets the information of the critical node, then the ex-actor node which will be in the sleeping mode will be changed to wake up mode for the node replacement with the critical node. Now, after knowing the location information of the critical node, the ex-actor node from its place will move to the location of the critical node and the critical node in turn will be moving towards the base station for the healing process to takes place in order to reuse the node in the future.

Healing of critical node: Once the critical node reaches the base station, by means of external hardware the battery will be recharged and kept for the future use. Reason for not healing the node at the location of critical node is to avoid the unnecessary energy drop and if so the recharging of the battery cannot be done immediately. By doing this, the unwanted swapping of nodes can be avoided and thus energy consumption has been decreased which increases the overall network lifetime.

VI. SIMULATION RESULTS AND DISCUSSION

The energy efficient routing by using ex-actor node has been shown using the simulation results by using NS2 software. The normal data transmission taken place between the source node (2) and destination node (8) after the route has been discovered in existing methodology. Depending on the control messages over each node, the energy consumption varies that leads to the differential energy distribution.

In existing method, it is seen from Fig.2, the nodes that are not involved in data transmission have been taken into account and the swapping is performed. The nodes 26 and 36 become a critical node after some simulation period which is denoted with red color. This unwanted swapping increases the overhead and the energy consumption which affects the overall lifetime of the network significantly and degrades the performance of the system.

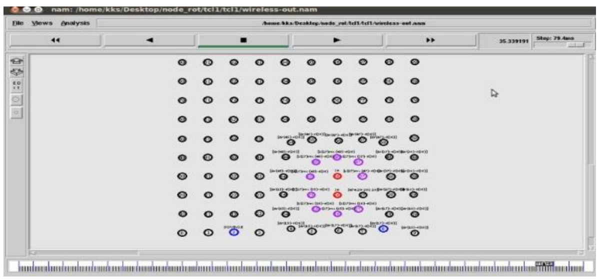

Fig.2 Unnecessary node swapping

In proposed system, the route discovery

mechanism takes place when there is a need for data transmission by modified AODV protocol. Also the path selection will be based on the total amount of energy that is present in the entire route. From Fig.3, The normal data transmission is being taking place between source node and destination node. Blue color node indicates the ex-actor node in the below picture.

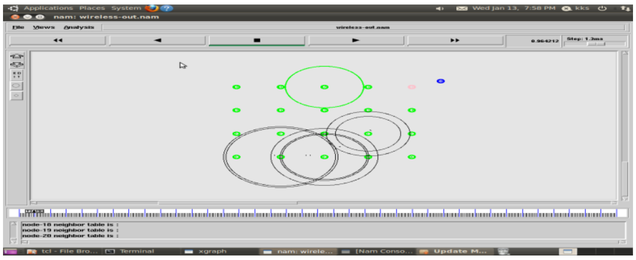

Fig.3 Unnecessary node swapping

From Fig.4, the critical node occurs because of the energy drop below the threshold level. Once the critical node is been detected, the message holding the critical node details will be sent to base station. The ex-actor node which will be in the sleeping mode will be changed to wake up mode for the node replacement with the critical node.

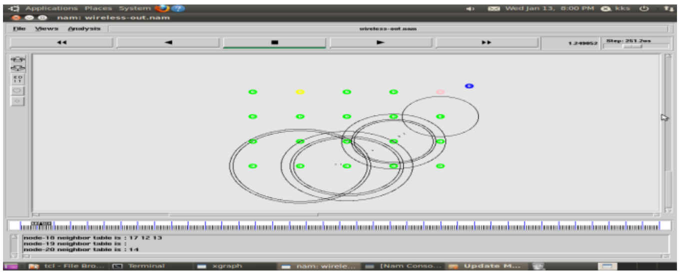

Fig.4 Occurrence of critical node

From Fig.5, after knowing the location information of the critical node, the ex-actor node will move to the location of the critical node and the critical node in turn will be moving towards the base station for the healing process to takes place in order to reuse the node in the future.

Fig.5 Actor node movement

From Fig.6, once the critical node reaches the base station, by means of external hardware the battery will be recharged and kept for the future use. By doing this, the unwanted swapping of nodes that increases the overall network lifetime.

Fig.6 Healing process

Compared the results of existing and proposed methodology with various QOS parameters such as energy, node movement, packet delivery ratio, number of failed nodes. It has been proved that the proposed work enhances the overall network lifetime by eliminating the unnecessary node movements and also helps in the occurrence of delay during the existence of critical node.

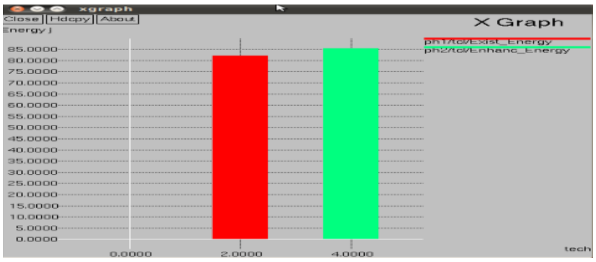

Fig.7 Energy Comparison

From Fig.7, we infer that the energy consumption has been reduced in the proposed work comparing with the existing system due to the avoidance of movement of the entire border nodes surrounding the critical node.

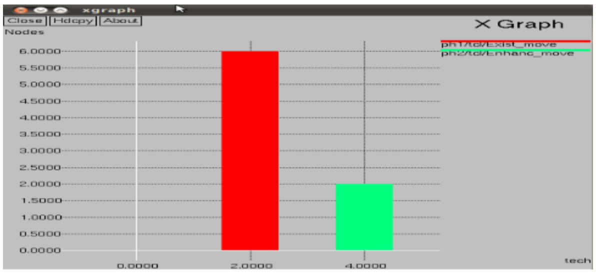

Fig.8 Node Movement

From Fig.8, we find that the mobility (node movement) has been considerably reduced in the proposed work since the only the critical node and the ex-actor node involves in the node movement.

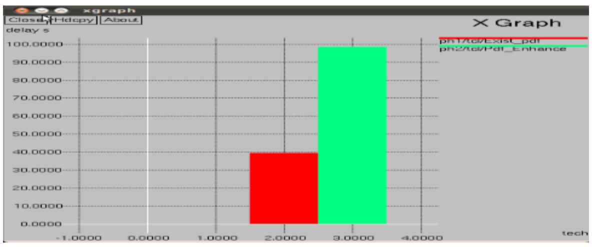

Fig.9 Packet delivery ratio

From Fig.9, we infer that the packet delivery ratio is been high in proposed work due to the nil presence of delay during the swapping of critical node and the ex-actor node.

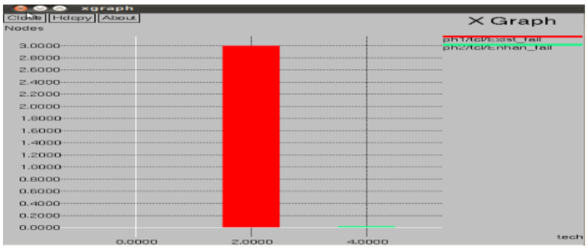

Fig.10 Number of failed nodes

From Fig.10, we find that there is no nodes in the failure state(dead node with zero energy level) in the proposed work since all the critical nodes has been recharged full for the future use.

VII. CONCLUSION AND FUTURE WORK

An energy efficient routing has been simulated by using the ex-actor node which helps in the unwanted node movements and also the critical nodes have been reused by means of external recharging. The critical nodes will be disconnected from the data transmission and the ex-actor node in the base station will be involved in data flow where the healing will be done at the base station and this healed node will be used as ex-actor node in the future occurrence of critical node. The above process will enhance the overall network lifetime.

The number of usage of ex-actor node is based on the network setup. When the node failure occurs, the critical node and ex-actor node will be involving in the node movement. The delay between these movements can be taken into account in order to improve the performance of the network which will be considered as a future work.

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