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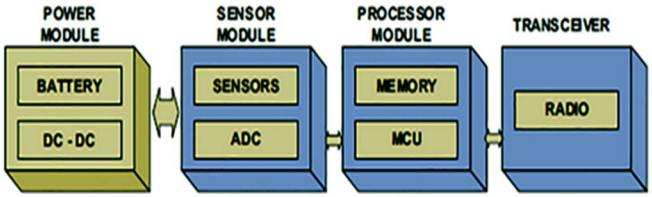
Enhancing the Wireless Sensor Network Efficiency using Coverage and Energy Utilization Technique

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Abstract: ***Wireless sensor networks have witnessed a major growth in several domains such as the industrial sector and research. Sensor network is one of the major part of automation application. Data from a small area to a large area can be collected efficiently using these sensor networks. But these sensors also have some major drawbacks such as the coverage issues, battery life, so in this research paper we have described about some major challenges and the algorithms using which we can ultimately enhance the coverage and life span of battery.***
Keywords: Internet of Things (IoT), IEEE, WSN, Arduino IDE.

I. INTRODUCTION

In a wireless sensor network large number of sensory nodes are present ranging from from low to high for performing several tasks in numerous fields. As the wireless sensors nodes are witnessing a major growth and covering various domains such as military surveillance to local monitoring. The sensor nodes are used for collecting the information from several other nodes around it and further processing the data after the sensing operation is over. But there are several issues regarding the sensor nodes such as its ranging power and limited battery lifespan or energy backup.
We can setup the source nodes in several manner either planned or unplanned depending upon the situations where it is to be used, for eg. military purposes only unplanned or random deployment has to be done because of safety issues.



II. ISSUES RELATED WITH WIRELESS SENSOR NETWORK

The working lifespan of the sensors is too small as the sensors are involved in the continuous real time monitoring and are battery operated due to which they vanish eventually. And the cost factor and size are the major issues which restricts the extension in the battery power in the sensors.

A. Power Issues

During the communication process in a WSN network the information associated with the other nodes consumes power and the sensors die out.

B. Installation Issues

As we know in a planned deployment, we can place sensors in ordered manner and modify it accordingly to the network needs, but in case of unplanned network i.e. in military domain it is not possible for us to place the sensors in ordered manner at precise locations, no doubt using an aircraft this operation can be done, but it will not be a feasible option to be used in the battleground.

C. Coverage Issues

Sometimes sensors are deployed in random manner in the network hence it becomes difficult to trace the precise location of nodes and replacing the faulty nodes becomes a time consuming and difficult task. As a result the coverage performance is affected and the important information stored in the nodes is lost.

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D. Target Motion

In the scenario of dunamic target, the sensors sometimes fail unfortunately to respond to capture the desired information related to their target due to its motion. The mobility of the target remains unrevealed sometimes or targeted by sensors in some cases which ultimatelty becomes a target motion issue.

III. PROPOSED SOLUTIONS FOR OVERCOMING THE WIRELESS SENSOR NETWORK PROBLEMS

Some of the solutions proposed for overcoming the problems faced in wireless sensor network are as follows:-

A. Range

The coverage or the range issues can be resolved by using different methods using which the whole area can be captured and the sensor nodes will be able to function properly thus increasing the efficiency of functioning.

Tracing & Serving the Cells: This step includes dividing the cluster area into different cells, so that whole cluster is segmented into small parts. So that by using this method it becomes easier for us to trace the uncovered and weak areas of cells.

The next step is to forward the collected information to other cells after collecting information about weak and uncovered cell areas by their respective heads.

B. Redundant Node Movement

In this step we assign a certain task to the cluster head to find the redundant node of the network and further plan to move the redundant to the uncovered area for better coverage to the network.

C. Time Management of Node Movement

We make use of Dijkstra or Floyd algorithm (shortest path algorithm) for the relay movement which helps the node to find out the intelligent path serving the destination node in order to boost the coverage power.

Hence by using the phenomena we can cover the uncovered slot by its neighbor node which is covered by its last node through this redundant node settling down in its nearest empty slot.

IV. BATTERY LIFE

The wireless sensor network possess several issues like limited on board battery backup, so power saving mode of sensor nodes will help in increasing the lifespan of the whole network.

A number of routing methods have been proposed to fix these energy conservation issues in WSN.

A. Low Power Adaptive Clustering Technique

This method balanced the load by the formation of cluster heads and on rotation policy.

B. Power Efficient Gathering in Sensor Information

The following method works on the principle of creating a chain in order to cover all the networks and conserve the energy.

C. Sensor Protocol for Information via Negotiation

The proposed approach helps to decrease the transmission of redundant and unnecessary data and it also prevents energy wastage by transferring metadata which ultimately helps in conserving more energy.

D. Greedy Perimeter Stateless Routing

In this method, routing is done either by forwarding the data toward the closest node or by following right-hand rule which means data is forwarded to the right-neighbor node to forward the data to the destination.

E. Energy Allocation Algorithm

The following technique allows sensor node to work efficiently by utilization of proper energy resources based on battery level.

In this technique, sensor node does not fall short of power as in this case the current power level is firstly compared with the energy amount required and balance can be assigned.

The procedure is as follows:-

1) Energy is distributed among all nodes
2) Main node as well as sensor node becomes power bank.
3) Energy initialization harvesting.
4) Transmission of data to all nodes.
5) Allocation of optimal energy.

So this technique allows the sensor node to manage its energy use efficiently.

F. Optimal Sampling Rate Assignment

This technique firstly sets the passing sampling rate so that its energy is not depleted. The adaptive rate of sampling ultimately helps to reduces energy loss during its transmission. The sampling rate can be varied according to its requirement of sensor which thereby allows transmission and communication between nodes at the optimal sampling rate assigned to the sensor nodes.

1) *Sleep/ Wake Up Scheduling: For a* asynchronous type of sleep/wake-up scheduling periodically only certain nodes have to wake-up and send or receive. All the other nodes should be in sleep state.

While going for a switch from active to sleep state, and then from sleep to active state, the condition to be checked is that the energy it consumes for the switch should be low when compared with the energy it consumes when it is always in the active state.

$$E_{\text{wasted in switching}} < E_{\text{Saved}}$$

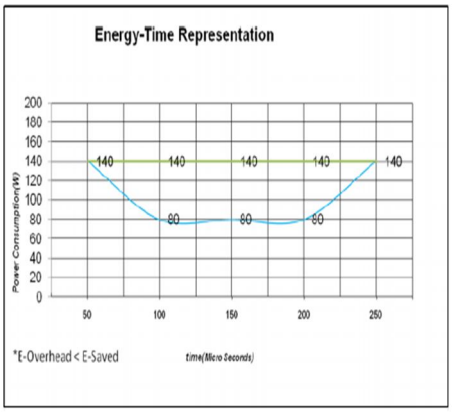


Figure 1. Graph depicting change in power consumption by using a sleep/wake-up scheduling

The Energy wasted in simply switching between states E_{wasted} in switching can be calculated by

$$E_{\text{wasted in switching}} = t_{s\text{-}a}\,(p_{\text{active}} + p_{\text{sleep}})/\,2$$

Table 1. Notations used

Notations	Descriptions
r_s	Radio in sleep state
r_t	Radio in transmitting state
r_r	Radio in receiving state
r_l	Radio in listening state
E_{sl}	Energy consumption during the switch from sleep state to listen state
E_{st}	Energy consumption during the switch from sleep state to transmitting state
E_{sr}	Energy consumption during the switch from sleep state to receiving state
p_{active}	Power consumed in active state($r_t r_r r_l$)
p_{sleep}	Power consumed in sleep state r_s.
$t_{s\text{-}a}$	Time taken for going to active state($r_t r_r r_l$) from sleep state.
$t_{s\text{-}a}$	Time taken for going to sleep state from active state($r_t r_r r_l$).
t_a	Time at which the radio becomes active as per the schedule to send or receive any data.
t_s	Time at which the radio decides to go to sleep state as per the schedule.

2) *Utilization Time Determination of External Energy:* The following method involves decision-making power regarding the right time external energy harvesting so that improvement is done over time and energy estimation.

In the designed scheme:

At each node balanced energy level is taken into consideration.

a) We determing the optimal time slot at which the energy can be harvested.

b) If case the reserved energy at a node is below a certain level, then energy is harvested at the optimal time slot.

c) With the help of supplemented energy the nodes can communicate at the optimal time periods.

This technique provides improvization to both the previous algorithm in terms of time determination for energy harvesting.

3) *Clustering:* This idea is inspired from the work of LEACH (Low Energy Adaptive Clustering Hierarchy). In this algorithm, different set of nodes become the cluster heads each time. Every time the node which is the cluster head takes the responsibility of aggregating the data from its nearby nodes and sends the data to the BS, there by reduces the energy wastage of all the nodes. There are also other types of routing techniques available. Most of them are derived from the LEACH In Directed Diffusion method, the query will be broadcasted from the node, it will reach only the active (alive) nodes. The interested nodes will then send back the data to the desired node. In turn this will lead to lot of energy wastage, since broadcasting needs lot of energy. So the cluster based routing is best suitable routing protocol for Environmental monitoring applications. In this work, the clusters are formed based on a weight attached to each node. While forming the clusters, the following rule should be followed- No two clusters should have one or more nodes in interference range. Interference range is that , the two nearest nodes in two different clusters should not be in either *transmitting (rt) or receiving state(rr). This will cause interference and overhearing of packets and thereby wastage of energy*.

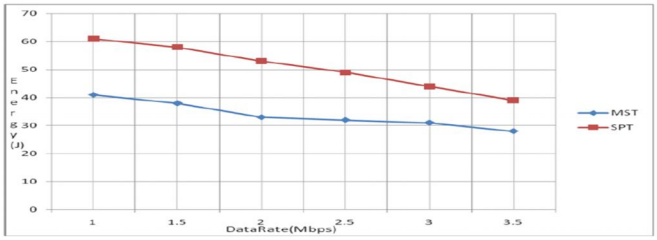


Figure 1. Graph depicting the comparison of Energy consumption by SPT and MST

V. CONCLUSION

In this research paper, we have focused on techniques to overcome the problem of coverage and battery-related issues faced in wireless sensor network without violating the performance of the whole network.

This method helps to cover more targets as each and every node according to their schedule becomes active to serve the cell, this scheduling helps also to conserve the energy and life of sensor is extended to some extents

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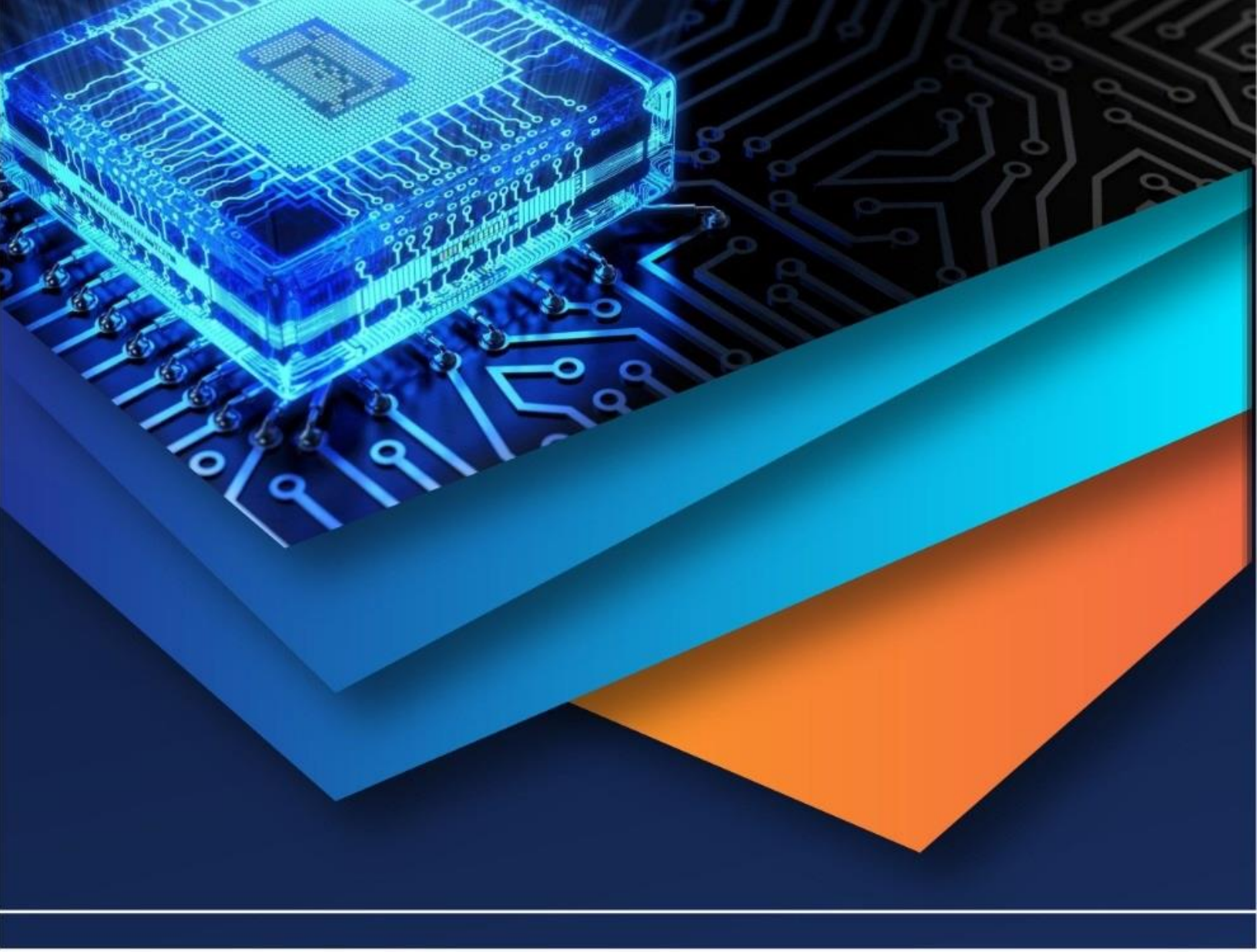
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