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A Survey on Efficient Data Collection Technique in Wireless Sensor Networks

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Abstract— WSN's are surrounded by different problems like energy depletion, partitioned WSN's problems, self-adaption, routing and data efficiency etc. As we know that WSN's contains wireless sensor nodes that work wirelessly to gather the required information needed to perform specific tasks. Due to its wireless nature, it is very prone to connection failure, energy depletion due to limited power source available (which ultimately leads it to partitioned WSNs) and another problem is to analyse the bulk of data collected by various mobile sensor nodes. The main objective of this paper is to study various approaches that can deal with these problems.

Keywords: Wireless Sensor Networks, Data Mining, Mobile Robots, Robot Routing, Routing Protocols.

I. INTRODUCTION

Wireless Sensor Networks (WSNs) are the group of sensor nodes that are capable of monitoring, tracking, computing and sensing any changes happening in the environment. These sensor nodes communicate with each other to hop the data over the network and finally send it to one main collecting point. To sense and gather the information from its surroundings, the wireless sensor nodes need to be distributed into the real world that forms a network through which they communicate each other and perform the identification and computation tasks.
Wireless Sensor Networks (WSN) can be divided into two types:

1. Structured WSN
2. Unstructured WSN

In structured WSN, nodes are distributed in a pre-defined manner. Structured WSN contains less number of nodes due to which there is a less burden when it comes to network maintenance [1].
But in unstructured WSN, there is a massive collection of nodes and are distributed randomly in an ad-hoc manner. Due to its ad-hoc nature, maintenance can be of great task [1].

Architecture:

Different topologies can be used to deploy WSN. It can be as simple as star network or can be as complex as multi-hop wireless mesh network as shown in the below diagram [2].

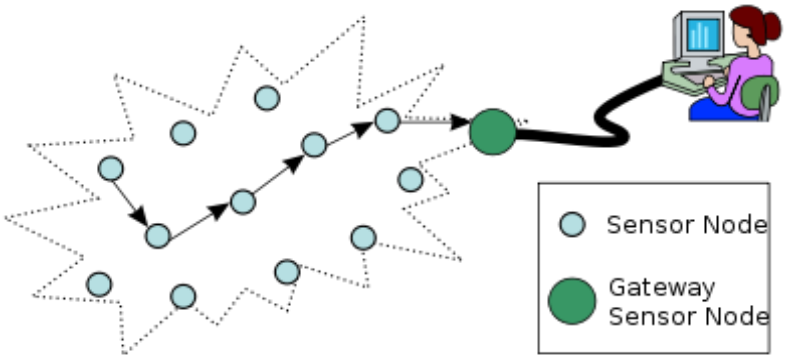

Fig. 1.1: Typical multi-hop wireless sensor network architecture

In multi-hop WSN, routing is done either by flooding or by using some predefined routing protocols.

Wireless Sensor Node:

Wireless sensor nodes consist of following parts:

1. A radio transceiver
2. A microcontroller with memory
3. Power Source
4. A sensor array
5. Wireless communication interface

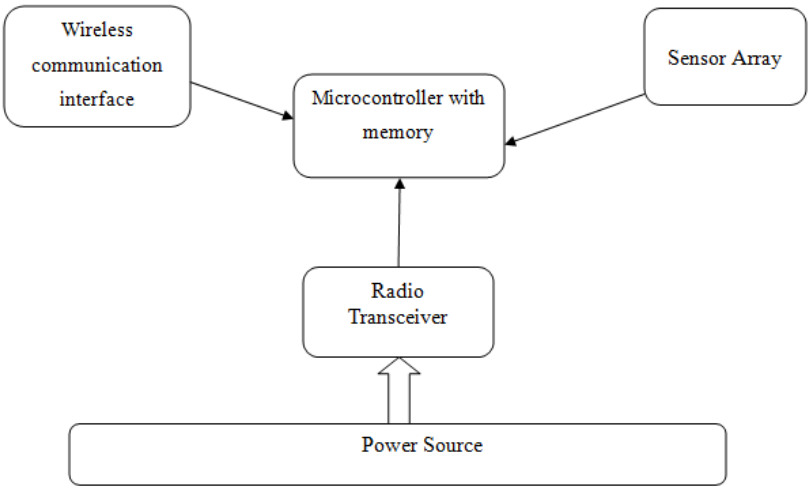

Fig. 1.2 Block diagram of a typical Wireless Sensor Node

Issues in WSN:

As we have discussed, WSN is equipped with multiple sensor nodes which are in turn obliged by the resources make available to them. The main issues associated with WSN are:

- **Energy Efficiency:**

Power source provides communicating, computing and sensing powers to WSN. The life span of complete WSN network is totally dependent on the power source supplied to it. If the energy of any sensor node depletes, it won't be able to communicate with the other sensor nodes available in the network and ultimately will be declared as dead node [3]. Because of these kinds of bottlenecks, the affected WSN will isolate itself with the other WSNs. Due to which base station will discard all the sensed data collected by this partitioned WSN and will accept only that data which are sensed by only those sensor nodes which can be seen by it[3].

- **Data Integrity:**

Apart from limited energy source, WSN is also surrounded with other problems like interferences, unwanted environmental conditions and collecting irrelevant data can also make the data unreliable. Furthermore, sometimes sensor nodes collect irrelevant data which is not required. To extract the meaningful data from the bulk of data received from the WSNs is also a task and can be done by applying data mining techniques [4]. In WSN's a revised data mining techniques are used that should be powerful enough to extract relevant and meaningful patterns or data from the large databases by analyzing them [4].

- **Routing and self-adaption:**

Due to the wireless nature of WSN, some issues like failure of sensor nodes, routing and modifications in topological structure are more likely to be occurred. WSNs should adapt itself with these kinds of changes occurring in the environment.

Possible Solutions:

- The main issue which we have discussed earlier is the limited energy source that can turn a working sensor node to a dead node. To fetch the sensed data from these dead nodes of partitioned WSNs and send it to the sink node, Mobile Robot can be used [3]. The main prerequisite is to know the location of portioned WSN before using the mobile robot [3].
- Revised and comprehensive data mining techniques can be used to extract the meaningful data from those large data continuously received by sensor nodes. Based on this meaningful information analysts take major decisions to adopt [4].
- To guide the mobile robot how to react and act while collecting the data from the sensor nodes in the wireless network, so that it can collect the data efficiently and without any hindrance caused by the obstacles in the network, appropriate navigational strategies can be used [5].

Applications:

- WSN can be used in Natural Disaster management.
- WSN can be used for monitoring various Traffic monitoring, area monitoring, activities happening in the surroundings for example agriculture monitoring and health care monitoring.
- WSN can be used to prevent the natural calamities like flood, Tsunami or earthquake etc. To do this, WSN needs to be deployed in the river to check and monitor the level of water and also the quality if water if WSN is also supposed to be used to monitor the quality of water.

- Medicines, health care, glacier monitoring, volcano monitoring, machine health monitoring and landslide detection are also some of the key applications of WSN.

II. LITERATURE SURVEY

There are various researches have been made on WSN by different researchers. Some of them are given below:

A. Wireless sensor network survey

A survey has been made by Yick, Biswanath Mukherjee and DipakGhosal in 2008 [1] on WSN in which complete overview of Wireless Sensor networks including its applications, types and structure are given. WSNs majorly use in target tracking and monitoring remote environmental conditions. The architecture of WSN includes the small sensor nodes that are not only cost effective to be interfaced wirelessly but also smart enough to communicate with each other to form network and collect the data from the network. Top-down approach is used to explain the emerging applications of WSNs and to review the literature on the basis of various key points of WSNs. Issues are categorized into three parts- first includes the internal structure that is- platform and operating system, second includes the communication protocols used and third contains the services used for networking, provisioning and deploying the WSNs.

B. Operating Systems for Wireless Sensor Networks

AdiMallikarjuna Reddy V AVU Phani Kumar, D Janakiram, and G Ashok Kumar in 2007[2], have come up with new ideas that why we need to change the existing operating system and other technologies used in WSNs and how we can remove the existing anomalies and use the ideal approach to deploy WSN. The WSN operating system should include an ideal architecture, scheduling and execution techniques, and power management to give best performance.

C. Data Collection Using Mobile Robot in Wireless Sensor Networks

A data-collecting algorithm is proposed by- Cheng Chen, Tzung-Shi Chen and Ping-Wen Wu in 2011 [3]. This algorithm trains the mobile robot to gather the sensed data from the wireless sensor nodes that belong to partitioned WSNs. The base station doesn't accept the sensed data from partitioned WSNs as it can't locate these partitioned WSNs. This is the time when this data-collecting algorithm comes into play and helps the mobile robot to locate all the partitioned WSNs. For this 2 approaches are used: 1) Global based approach and 2) Local based approach. By using the three scheduling strategies: 1) location based, 2) time based and 3) dynamic moving based, the navigation technique of mobile robot is scheduled in order to collect the sensed data from island WSNs. The authors have used ns-2 simulator to simulate these approaches and have found the positive results.

D. Robot Routing Algorithms with Data Mining Approach

Rouhollah Maghsoudi1, Somayye Hoseini , YaghubHeidari in 2011 [4], have put the light on issues related to routing of mobile robot and how data mining can be used for routing of mobile robot. As all the data gathered by WSNs is not always required to be up-to-date. Hence, there is need to extract the meaningful and relevant information from those bulk of data. For this, data mining approach is used to analyze the bulk of data available in WSNs and get the meaningful data.

E. Hybrid Mobile Robot Navigational Strategy for efficient Data Collection in Sparsely Deployed Sensor Networks

A complete implementation of hybrid navigational strategy is given by Marcelo B. Soares, Mario F. M. Campos, Dimas A. Dutra, V´_ctor C. da S. Campos and Guilherme A. S. Pereira in 2007 [5]. This technique is used by mobile robots to identify the location of island WSNs and to gather the sensed data from them. This navigational strategy is beneficial for WSNs to improve the lifespan of it by improving the level of its energy efficiency. The navigational strategy is divided into two layers- 1) Reactive Layer and 2) Planning Layer. The first layer deals with the modelling of collected data and whereas second data actually guides the mobile robot how to bypass the obstacles while collecting the data from the sensor nodes.

III. SUMMARY OF VARIOUS APPROACHES UESD TO INCREASE THE EFFICIENCY OF WIRELESS SENSOR NETWORKS

The below table contains the different types of methods proposed by different authors that explains the working and use of wireless sensor networks and how can its efficiency be improved. The below table also has some other columns like features of the theory proposed, basic ideas, hardware needs and overheads faced during the research.

METHOD	AUTHOR & YEAR	BASED ON	FEATURES	H/W NEEDS & OVERHEAD
Wireless sensor network survey	Yick, Biswanath Mukherjee and DipakGhosal in 2008	Top-down approach	Use of sensor nodes Issues are categorized into 3 parts: i) Platform and OS	Hardware devices are needed to deploy WSNs Overhead is more in

			ii) communication protocols iii) services used for networking, provisioning and deploying the WSNs	terms of energy consumption, robustness and data reliability
Operating Systems for Wireless Sensor Networks	AdiMallikarjuna Reddy V AVU Phani Kumar, D Janakiram, and G Ashok Kumar in 2007	Changes in the existing operating systems	Make use of that operating system which includes an ideal architecture, scheduling and execution techniques, and power management Reduced cost Ideal performance	Improved hardware devices are used that improve the throughput of the system(WSN) Overhead is relatively lower
Data Collection Using Mobile Robot	Cheng Chen, Tzung-Shi Chen and Ping-Wen Wu in 2011	data-collecting algorithm	It uses mobile robots to locate the partitioned WSNs. 2 approaches are used to guide the mobile robots: 1) Global based approach and 2) Local based approach	Extra hardware are needed Low overhead
Robot Routing Algorithms with Data Mining Approach	Rouhollah Maghsoudi1, Somayye Hoseini , YaghubHeidari in 2011	mobile robots data mining	For energy efficiency, mobile robots are used For making data up-to-date and analyzing the bulk of data collected by sensor nodes, data mining is used	Extra hardware device is needed for evaluation Low overhead
Hybrid Mobile Robot Navigational Strategy	Marcelo B. Soares, Mario F. M. Campos, Dimas A. Dutra, V´_ctor C. da S. Campos and Guilherme A. S. Pereira in 2007	hybrid navigational strategy	The navigational strategy is divided into two layers- 1) Reactive Layer and 2) Planning Layer	Extra hardware device is needed for evaluation Low overhead

IV. CONCLUSION

After studying all the above approaches, we can conclude that if we use mobile robots to collect the data and to find out islands WSN's can reduce the many overheads occur in WSN's but it requires extra hardware cost. Moreover, we need to use some more approaches to guide the mobile robots like Global based approach and Local based approach. So that mobile robots can successfully detect partitioned WSN's and can complete their work flawlessly. Alternatively, we can use hybrid mobile robot navigational strategy that work in to 2 layers: Reactive Layer and Planning layer. The first layer helps in providing the proper structure to the data collected by sensor nodes and second layer helps the mobile robot to overlook the obstacles while continuing its work.

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[4] Rouhollah Maghsoudi1,*, Somayye Hoseini2 , Yaghub Heidari3Department of Computer, Nour Branch, Islamic Azad University, Nour, Iran Payame Noor University of Shahrerey ,Tehran, Iran, sce.hoseyny@gmail.com Department of Electrical, Nour Branch, Islamic Azad University, Nour, Iran

[5] Marcelo B. Soares, Mario F. M. Campos, Dimas A. Dutra,V´_ctor C. da S. Campos and Guilherme A. S. Pereira

