Information Retrieval in Wireless Sensor Networks

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ABSTRACT
Information retrieval is an essential activity for extraction of information from unstructured data. This data uses simpler data model rather than traditional column database which is based on Boolean and Vector space model. There is need to focus on process like information gathering, observation and data encryption process for communication among sensor nodes. These sensor nodes play an important role in Wireless Sensor Network (WSN). Wireless Sensor Network maintains cluster based infrastructure which is formed by group of sensor nodes. These nodes are capable of performing some processing and communicating with other connected nodes in the network. This paper presents brief introduction of Wireless Sensor Network and highlights its kinds; categorized based on environmental factors. It also focuses on WSN architecture with the help of OSI Model with limitations. Further this attempt also incorporates fundamental concepts of information retrieval with WSN into an account.

Keywords
Wireless Sensor Network, Terrestrial WSN, Underground WSN, Underwater WSN, Multimedia WSN, Mobile WSN, Information Retrieval

1. INTRODUCTION OF WIRELESS SENSOR NETWORK
A wireless sensor network (WSN) are locally rationed self-governing sensors to supervise physical or environmental condition, such as temperature, sound, pressure, etc and simultaneously pass their data through the network to a main point. It is a group of specific device that converts energy from one mode to another with a communications base that uses radio to check and report physical or environmental conditions [1]. It can be defined as a network of devices that can broadcast the information collected from a monitored field through wireless links [2]. Examples of sensors which is GPS receiver, that can determine our computer's current location [3].A Sensor network is the base or platform that consist of sensing, computing and communication elements that administer an administrator the ability to monitor, detect and react to events and phenomena in a specified environment [4].

2. CHARACTERISTICS OF WIRELESS SENSOR NETWORK
2.1 Ability to cope with node failure
Actors monotonously broadcast heartbeat messages to their neighbors to make clear that they are working or not and likewise address changes to the neighbors. Absence of heartbeat messages will be used to examine the failure of actors. After this procedure it simply analyze whether the failed node is critical node or not. After checking procedure if it is children node then there will be not much effect on the network. If it is Critical or disastrous node, disjoint blocks will result within the network [5].

2.2 Mobility of nodes
A number of approaches exploiting mobility for data selection in Wireless sensor networks. In WSNs, static sinks constitute significant locations where the communication activities are concentrated [6].

2.3 Heterogeneity of nodes
The heterogeneous WSN contain sensor nodes with different capabilities such as various sensor types and communications sensing range, thus providing more flexibility in deployment. The nodes of WSN are equipped with different types of sensors which provide various sensor services [7].

2.4 Low memory, low energy, large scale needs
The lifetime of sensor nodes is determined by limited energy. So, utilization of energy and power of the sensing device should be less and sensor nodes should be energy efficient [8,9]. When wireless sensor network are not in use then normally switch off the power of both the radio transmitter and the radio receiver when not in service to preserve power [10].

3. TYPES OF WIRELESS SENSOR NETWORK
3.1 Terrestrial WSN
Terrestrial wireless sensor networks are capable of communicating base stations and consist hundreds to thousands of wireless sensor nodes expand in unstructured (ad hoc) or structured (Preplanned) manner [11].In Wireless sensor networks, the battery power is limited. Sensors have limited battery. We can cope this problem by the following points-

3.1.1 Battery is furnished with solar cells as a subsidiary power source. By using low duty cycle operations, reducing delays, and optimal routing energy conservation of these wireless sensor networks is achieved [12].

3.1.2 Fresh sensors replaced battery exhausted sensors which have full battery power

3.1.3 Dynamically changing network topology is created by deployment of fresh sensors, which places some constraints on the network [13].

3.2 Underground WSNs
There are number of sensor nodes which are unseen in the ground dwelled by wireless sensor networks to monitor underground conditions. To deliver information from the sensor nodes to the base station, new sink nodes are placed above the ground [14].

It is very difficult to recharge the nodes of underground wireless sensor networks positioned into the ground. The

sensor battery nodes which are equipped with a limited battery power are crucial to recharge. High level of attenuation and signal loss might be a threat due to underground environment wireless communication.

3.3 Underwater WSNs

A number of sensor nodes and vehicles are positioned under water in these networks. Data can be gathered from these sensor nodes using independent underwater vehicles [14].

The issue of energy conservation for underwater wireless sensor networks involves the improvement of underwater communication and networking techniques [15].

3.4 Multimedia WSNs

Tracking and monitoring of events such as imaging, video, and audio are implemented by using multimedia wireless sensor networks. Low-priced sensor nodes equipped with microphones and cameras are used in these networks. For data compression, data retrieval and correlation, these nodes are attached with each other over a wireless connection [14].

3.5 Mobile WSNs

A crowd of sensor nodes that can be collaborated on their own and can be cooperated with the physical environment are in these networks. The mobile nodes can compute sense and communicate [14].

4. ARCHITECTURE OF WIRELESS SENSOR NETWORK

Architecture for WSN follows the OSI Model which contain five layers and three cross planes[16-19] .

Table:1 Architecture of WSN based on OSI layer

PROTOCOL LAYER	FUNCTIONS	ATTACKS	DEFENSES
Physical	transmit stream of bits over physical medium, responsible for frequency selection, carrier frequency generation, signal detection, modulation and data encryption	Jamming	Detect and sleep, Route around jammed regions
		Node tampering or destruction	Hide or camouflage nodes, Tamper-proof packaging
Data Link (HDLC)[24]	responsible for multiplexing data streams, data frame detection, MAC and error control; ensure reliability of point–point or point–multipoint.	Interoggation	Authentication and antireplay, Protection
		Denial of sleep	Authentication and antireplay, Protection Detect and sleep, Broadcast attack
Network(ARP,RARP)[22, 23]	The major function of this layer is routing, data aggregation and data fusion.	Spoofing, replaying, or altering routing control traffic or clustering messages	Authentication and antireplay ,Protection, Secure cluster formation
		Hello Floods	Pairwise authentication ,Geographic routing
		Homing	Header encryption, Dummy packets
Transport(STCP,PORT, PSFQ)[18,19, 20]	The function of this layer is to provide reliability and congestion avoidance	SYN(synchronize) flood	SYN cookies
		Desynchronization attack	Packet authentication
Application(DNS,FTP,SMTP, TELNET)[21]	Responsible for traffic management and provide software for different applications that translate the data in an understandable form or send queries to obtain certain information.	Overwhelming sensors	Sensor tuning ,Data aggregation
		Path-based DOS	Authentication and antireplay ,Protection
		Deluge(deprogramming) attack	Authentication and antireplay, Protection Authentication streams

Table:2 Management Planes

Power management plane[25]	Manage the power level of sensor nodes for processing, sensing and communication.
Connection management plane[25]	Responsible for configuration or reconfiguration of sensor nodes in attempt to establish or maintain network connectivity.
Task management plane[25]	Responsible for distribution of tasks among sensor nodes to prolong network lifetime and improve energy efficiency.

5. LIMITATIONS OF WIRELESS SENSOR NETWORK

5.1 Possess very little storage capacity – a few hundred kilobytes

There are a large number of nodes which are connected in the form of wireless network in wireless sensor network. Each node consists of devices that sense physical parameters, process information, and broadcast message to each other or to a base station [14]. Sensor nodes are identified by their small size, limited battery power, low data rate transmission

and limited memory capacity. Wireless sensor networks can achieved with very little supervision. There are many solutions which are as follows:

5.1.1 Node Energy:

An important examination in WSN farming applications is the node battery life and storage capacity to support the computational and communication capabilities [26]. Research and development efforts have focused on devising techniques by using a variety of energy harvesting techniques for increasing network lifetime through increasing battery lifetime. [27].

5.1.2 Memory and storage:

The limited memory and storage capacity are caused mainly by the small physical size and low cost of the node. However, this is forwarded to a certain extent by networking the nodes and using a base station [27,28].

5.2 Possess modest processing power-8MHz

Sensing, data processing, communicating and power supply are the four basic component of WSN. Among the entire component, low power technology is the energy of WSN hardware and software design [29].

5.3 Works in short communication range consumes a lot of power

5.3.1 Power optimization techniques:

Power optimization techniques can be generally classified into following categories which are:

Table:3 Power Optimization

TECHNIQUES	FUNCTIONS	DESCRIPTION
Radio Optimization Techniques[30]	Power consumption is reduced by radio component.	The radio sub component is responsible for transmitting as well as receiving the data to and from sink node.
Power optimized routing[30,31]	Power optimized routing can be achieved through clustering.	Energy is conserved since majority of nodes only have to transmit data over a very short range.
Reducing Data[30,31]	Power optimization is done by reducing the amount of data.	Reducing the frequency of sample collection and limiting unnecessary sample colle compression and network coding can also be utilized to diminish the sensed data
Sleep Wake Mechanism[32]	Put the idle nodes in sleep mode and wake them up when there is a task for them.	The nodes might be sleeping and can be awaken if the need arises or they can set their schedule such that they sleep for some time and then stay awake for sometime or they can sleep for random duration of time before waking up.

6. INFORMATION RETRIEVAL IN WIRELESS SENSOR NETWORK

Information retrieval [33] is finding material (usually documents) of an unstructured nature (usually text) that capture an information need from within huge collections (usually stored on computers). The discipline of information retrieval concerns the organization, analysis, storage, searching, acquisition and dissemination of information [34]. Sensor networks are integrated with the Internet to support ubiquitous computing and enable people around the world to universally access information about the physical world. Sensor nodes can either periodically report sensing data to a server in a aggressive manner, or circulate sensing data on-demand, namely when a user queries the sensor nodes only in wireless sensor networks [35] .Between Internet users and sensor nodes, information retrieval enables the interaction and users retrieve sensing information. Data query phase and Data collection phase are the phases of information retrieval. By sending a query message to a sensor network, user initiates the process through sink nodes and query message to nodes in the network are broadcasted by this sink nodes. Sensors identifiers never described the destination of user's query, it is mainly described by the user's interest and then these are represented by the name of data attributes. Sensor nodes match the query deliver sensing data to the sink node at the time of receiving the query message. The sink node then sends to the user the gathered or collected sensing data via the Internet [35,36].

7. RESULT AND DISCUSSION

7.1 Overview

This will be done through implementation information retrieval in wireless sensor network to increase the lifetime of the network and proper transmission. For the implementation of work, MATLAB simulator is used.

Table 4: **Parameters Experiments**

Value	Parameters
25	Number of nodes including source and destination
1	Base station
Wireless channel	Channel type
Graphical user interface	User interface
100ms	Simulation Time

For many scenarios have been implemented to obtain accurate results and effective through which we can show the proper transmission. It is through many of the tests show there are significant developments in the performance of the wireless sensor network.

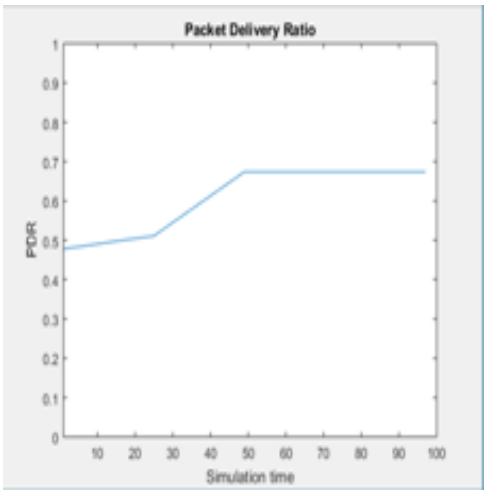

Fig 1: Packet Delivery Ratio

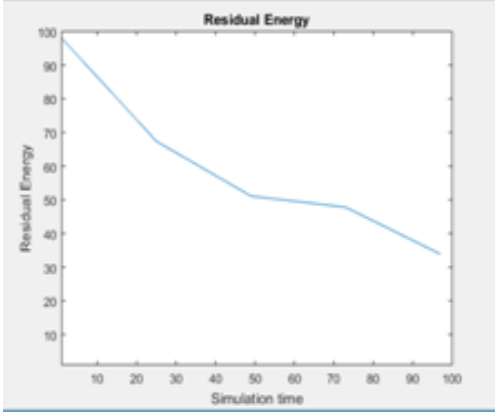

Fig 2:Residual Energy

Table 5: **Simulation Parameter**

Simulation Time	PDR	Residual Energy
10	0.49	86
20	0.495	72
30	0.5	65
40	0.59	57
50	0.66	51
60	0.66	50
70	0.66	49
80	0.66	40
90	0.66	36
100	0.66	32

Fig 1 shows the Packet delivery ratio of the nodes in which nodes increases their PDR values and the greater value of packet delivery ratio means the better performance of the protocol. Fig 2 shows the residual energy of the nodes which extends the network lifetime of wireless sensor network mainly depends on the battery lifetime of the node.

8. CONCLUSION

Wireless Sensor Network is a group of specialized device that converts energy from one form into another with a communications infrastructure that uses radio to watch and record physical or environmental conditions. From this paper it is concluded that sensor nodes play an important role in IR. Sensor has the capability to gather data and send it back to the sink nodes. Sensor nodes apply various techniques to filter the data into relevant information. This paper described the introduction of wireless sensor network, types, architecture, limitations and also fundamental concepts of information retrieval with wireless sensor network into an account. So in future there are lots of scopes to work on this field and enhance security system of the network .

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