Review on Wireless Sensor Networks: Total Technology Yesterday, Today and Tomorrow

[1]Shamneesh Sharma, [2]Keshav Kishore, [3]Vandana Chaudhary
[1,2]Dept. of CSE, School of Engg. & Tech, APG Shimla University, Shimla, HP, India
[3]Dept. of CSE, Sri Sai University, Palampur, HP, India

Abstract
The wireless sensor networks are becoming very popular since a decade back. Due to the eminent applications of this technology, almost every aspect of life is using sensors in them. So the evolution of networking in this field was a collaborative initiative for the popularity of these emerging fields. The initial step towards the sensor technology was taken only for the purpose of the use of this in wars, but various advancements in the field of electronics has made its usability almost in every field today and the efforts are still going on. The main focus of this review paper is on the analysis of what this technology was, what it is today and what it will be after few years so that it can give a clear view of past, present and future perspectives and applications of this technology.

Keywords
Wireless Sensor Networks (WSN), Micro- Electro- Mechanical-System (MEMS), Green Computing, Distributed Sensor Network (DSN) and Nano Technology

I. Introduction

A wireless network of sensor nodes for the communication is known as wireless sensor network. A sensor node is made up of four main components i.e. radio, processor, sensors and battery. The wireless sensor network is a network of Micro-Electro- Mechanical- System (MEMS) [1] which has following characteristics:

- Self- Computation Capabilities.
- Communication Capabilities.
- Sensing Capabilities.

By using all these capabilities the wireless sensor network performs all its functions that fit to its application areas. The wireless sensor network is based on the wireless communication of data sensed by the sensor node to the administrators via some internet through the channel of WSN- technology.

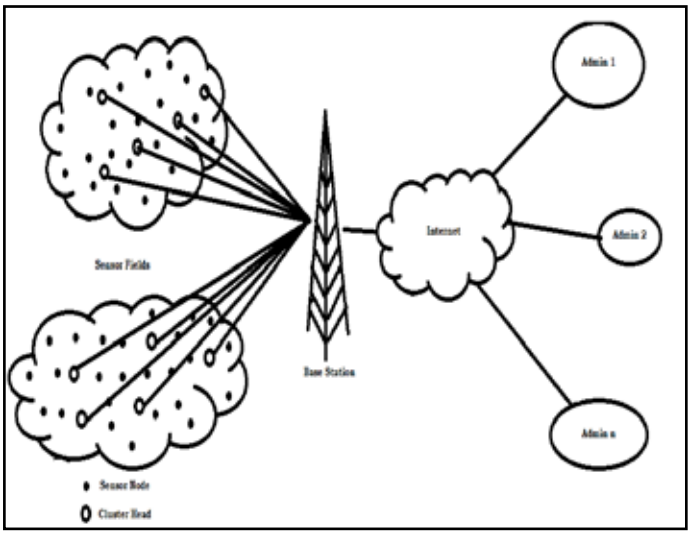

Fig. 1: Working of Wireless Sensor Networks

The working of the wireless sensor network is entirely based on its architecture or on the deployment method of sensor nodes. The initialization of the network is done by deploying the sensor nodes of same or different features; rest of the working depends upon the design of the node and the mode of application. These networks have such sensor nodes which are specially designed for particular application as per the requirement and standards of the result required. The main operation of a sensor node include sensing the data, conditioning the sensed data and then conversion of it on to the form in which it can be deliver to processor. Then processor send the processed data to other node for aggregation and that node send it to base station, from base station, that data goes to various locations specified for it via internet.

A. Past of Technology

The motivation for the development of wireless sensor network was from the beginning of cold war when an acoustic sensor system [2] has been deployed in the bottom of ocean for sound surveillance. This system was set by the United States of America to track the Soviet sub-marines. During the same time period they deployed a network of Air Defense Radars to defend its territory. After passage of time rest of development is as follows:

From Beginning to 1980's-

1. The identification of a sensing node was done in 1978 in a workshop on Distributed Sensor Network. This node was full of all the basic capabilities which can be found in today's sensor nodes.
2. After a decade research has been started on Distributed Sensor Network (DSN) [3] program at Defense Advanced Research Project Agency (DARPA). The researcher extended the concept of ARPANET by replacing the networking devices with sensor nodes.
3. In the mean time Carnegei Mellon University started a distributed project "Accent- A network operating system for DSN." This operating system was developed in the course time with a transparent access to distributed resources. After some advancement, this operating system became Mach Operating System.
4. In the middle of 1980's, Advanced Design Systems (ADS) [4] proposed an algorithm for DSN which was based upon tracking system of multiple hypotheses. The main idea was the working of DSN in the conditions like high target density, false alarms and missing detections.
5. To demonstrate the Algorithm of ADS on real test beds, MIT Labs took a PDP 11/34 PC with capabilities of processing array of acoustic signals.

From 1990's-

1. After all these experimentations on DSN, DARPA launched a project named "SensIT" [5] with low power wireless integrated micro-sensors in the mid of 1990's. Under this project almost 30 research projects were funded.
2. The development of Wireless Integrated Network Sensors (WINS) [6] in 1993 by University of California was a major move in the area of WSN. This project was full of WSN design,

sensor development up to circuit level, signal processing architectures and network protocol designs. This system was based on TDMA. This project was commercialized by Sensoria Corporation in 1998.

3. In 1999, Jan M. Rabaey from University of California started new project on Ad-hoc wireless sensor network of low cost [7], low energy sensor and monitoring nodes. The project was named Pico Radio Program. This project was based on spread spectrum and Carrier Sense Multiple Access.

From 2000 to 2010-

1. In 2000, the Project- Pico Radio Program was carried out by Berkeley Wireless Research Center with the development of low power sensors.
2. The next program in this field was Micro AMPS132 which was led by the Principal Investigator "Anantha Chaderkasan" at MIT. The main research was the development of complete system of WSN with the emphasis on low power consumption. LEACH [8] was the protocol that has been introduced in this field with low energy consumption features.
3. After leach by Chanderkasan, a detailed research had started in the field of energy efficiency; as a result within few years lots of protocols for different applications were introduced by different researchers. Some of them are HEEP [9], HEED [10], SEP [11], RDEEP [12], ERDEEP [13] and many more.

B. WSN at Present

Since from the beginning of this technology, there are so many protocols has been designed in common with protocols for a wide range according to the applications and the adaptability of WSN. The range of varying from under water acoustic networks to deep space radio networks.

Since the applications are increasing so these networks has been categorized to different types on the different bases. These categories can be on either on the basis of location of networks or on the basis types of nodes used in the sensor fields.

In the present scenario the wireless sensor network technology is based in the various technologies; basically it is based on MEMS, wireless networking/ wireless communication and low cost sensor manufacturing technologies. The roles of all these is described below:

1. MEMS is the key technology for the manufacturing of low cost and low power small sized sensor nodes.
2. The wireless communication technology is responsible for the communication of the data sensed by the nodes. Moreover the network architecture design is according to the communication algorithms.
3. The hardware and software compatibility and networking standards are based on other technologies which enable the reliable communication and safe data dissemination techniques.
4. Green computing [14] attracted WSN for the environment friendly and energy saving techniques and development processes.

More and more use of sensor technology making the field more popular in the present scenario in spite of military applications these networks has their applicability in environment monitoring, health & Medicare, traffic control & monitoring, industry and home. The present aspects of this technology is the integration of the high definition cameras on the sensor nodes and apply more and more efficient image processing algorithms so that the applicability can be enhanced to domestic as well as industrial level.

C. WSN in Future

A lot of work has been done in the field of wireless sensor network but still need to do a lot. The acoustic and mobility areas are untouched due to the need of extra sensitive and sophisticated devices; so mote architecture with application specific sensors still need some improvement. Use of extra small sensor nodes with high complex architecture and energy efficient secure algorithm development is needed in this technology.

The development of Nanotechnology [15] raised a hope of the development of more complex and tiny architecture of the sensor nodes. The projects on wireless sensor dust have already been started. More the advancements in this technology more will be the scope of this technology. The next decade will be based on sensor technology with more and more applications and lot more advancement. In future we can encounter with the wireless sensor dust [16], human communication along with brain monitoring [17] and many more with mobile and acoustic applications.

II. Conclusion

Form the discussion in all aspects we can say that the Wireless sensor network became very popular and still going on due to multi-disciplinary approach. As the field is not only associated to computer Science or electronics industry but with many other technologies so the advancement in other technologies finally results in advancements in this technology. The scope of the technology is to find the wide range of applications and usability. After a long use of WSN, it is still limited to researchers and scientists ; and there is a need to find vast number of solutions to make it efficient, low cost and in the reach of common man by commercializing it to domestic level.

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Shamneesh Sharma, B.Tech- M.Tech (CSE) Integrated. Presently working as Assistant Professor in the Department of Computer Science & Engineering under School of Engineering & Technology at APG Shimla University, Shimla, H.P. India. Worked as Head and Assistant Professor at MIT College of Engineering & Management -Bani, Hamirpur, H.P. India. Alumni of Lovely Professional University- Phagwara, Punjab, India

Keshav Kishore, MCA, M.Tech (Computer Science & Engineering). Presently working as Head & Assistant Professor in the Department of Computer Science & Engineering under School of Engineering & Technology at APG Shimla University, Shimla, H.P. India. Worked as LAMP Developer in Computer Ware India Pvt. Ltd- New Delhi, India. Alumni of SRM University, Chennai, India.

Vandana Chaudhary, B.Tech- M.Tech (Computer Science & Engineering) Integrated. Presently, working as Assistant Professor in the Department of Computer Science and Engineering at Sri Sai University, Palampur, H.P. India. Worked as Assistant Professor at MIT College of Engineering & Management -Bani, Hamirpur, H.P. India. Alumni of Lovely Professional University-Phagwara, Punjab, India.