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Latest Advancements and Future Patterns in Wireless Sensor Networks

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ABSTRACT

Wireless Sensor systems (WSNs) have turned out to be a standout amongst the most intriguing ranges of research in the previous couple of years. A WSN is made out of various remote sensor hubs which frame a sensor field and a sink. These vast quantities of hubs, having the capacities to detect their environment, perform constrained calculation and impart remotely frame the WSNs. Late advances in remote and electronic advances have empowered an extensive variety of uses of WSNs in military, activity reconnaissance, target following, environment checking, human services observing, et cetera. There are numerous new difficulties that have surfaced for the creators of WSNs, keeping in mind the end goal to meet the necessities of different applications like detected amounts, size of hubs, and hubs' independence. Accordingly, upgrades in the present advancements and better answers for these difficulties are required. The future advancements in sensor hubs must create capable and financially savvy gadgets, with the goal that they might be utilized as a part of utilizations like submerged acoustic sensor frameworks, detecting based digital physical frameworks, time-basic applications, subjective detecting and range administration, and security and protection administration. This paper likewise portrays the examination challenges for WSNs.

Key words: Future trends, recent advances, research challenges, wireless sensor networks

1. Introduction

With the advances in the technology of micro-electromechanical system (MEMS), developments in wireless communications and WSNs have also emerged. WSNs have become the one of the most interesting areas of research in the past few years. Here, we look into the recent advances and future trends in WSNs.

WSNs are usually composed of small, low-cost devices that communicate wirelessly and have the capabilities of processing, sensing and storing. The development of WSNs was motivated by military applications such as battlefield surveillance. WSN are being used in many industrial and civilian application areas, including industrial process monitoring and control described by Kay and Mattern (2004), machine health monitoring described by Tiwari (2007), environment and habitat monitoring, healthcare applications, home automation, and traffic control presented well by Kay & Mattern (2004) and Hadim (2006).

A WSN generally consists of a base-station (also called as gateway sometimes) that can communicate with a number of wireless sensors via a radio link. Wireless sensor nodes collect the data, compress it, and transmit it to the gateway directly or indirectly with the help of other nodes. The transmitted data is then presented to the system by the gateway connection. This paper discusses the recent advances in WSNs that enable a wide range of applications and future development in applications like underwater acoustic sensor systems; sensing based cyber-physical systems, time-critical applications, cognitive sensing and spectrum management, and security and privacy management. Rest of the paper is organized as follows. Section 2 describes the recent advances in WSNs. We discuss future trends in WSN in Section 3. Section 4 describes the research challenges for WSN. Finally Section 5 presents the conclusion.

2. Recent Advances

Recent advances in wireless and electronic technologies have enabled a wide range of applications of WSNs in military sensing, traffic surveillance, target tracking, environment monitoring, healthcare monitoring, and so on. Here we describe such type advances in WSN and their applications in various fields.

2.1. Sensor Localization and Location-Aware Services

2.1.1. Smart Home/Smart Office Smart home environments can provide custom behaviors for a given individual. Considerable amount of research has been devoted to this topic. The research on smart homes is now starting to make its way into the market. It takes a considerable amount of work and planning to create a smart home. There are many examples of products currently on the market which can perform individual functions that are considered to be part of a smart home.

2.1.2. Military

New and emerging technologies, such as networks, support military operations by delivering critical information rapidly and dependably to the right individual or organization at the right time. This improves the efficiency of combat operations. The new technologies must be integrated quickly into a comprehensive architecture to meet the requirements of present time. Improvement in situation awareness (Chien-Chung Shen, 2001) is must requirement. Doumit and Agrawal (2002) described some other important application is detection of enemy units' movements on land/sea, sensing intruders on bases, chemical/biological threats and offering logistics in urban warfare. Command, control, communications, computing, intelligence, surveillance, reconnaissance, and targeting systems are well described by Akyildiz (2002).

2.1.3. Industrial & Commercial

Since the long time wireless transmission of data is being done in industrial applications, but recently it has gained importance. Successful use of wireless sensors in systems such as supervisory control and data acquisition has proved that these devices could effectively address the needs of industrial applications. The critical process applications of WSNs in industry are monitoring temperature, flow-level, and pressure parameters.

2.1.4. Traffic Management and Monitoring

The vehicle tracking application is to locate a specific vehicle or moving object and monitor its movement. This work also describes design of WSN for vehicular monitoring. As the power source (battery) is limited, it is important that a design of sensor node is power efficient

2.1.5. Structural Healthcare Structures are inspected at regular time intervals, and repairing or replacing based on the time of use, rather than on their working conditions. Wireless sensing will allow assets to be inspected when the sensors indicate that there may be a problem. This will reduce the cost of maintenance and preventing harmful failure.

2.1.6. Agriculture

Agriculture can also be benefited by the deployment of WSN to get the information regarding soil degradation and water scarcity. With help of WSNs we can check the clean water consumed in irrigation and manage it.

2.2. Topology and Coverage Control Topology control is one of the fundamental problems in WSNs. It has great importance for prolong lifetime, reducing radio interference, increasing the efficiency of media access control protocols and routing protocols. It also ensures the quality of connectivity & coverage and increase in the network service as well. A significant progress in research can be seen in WSNs topology control. Many topology control algorithms have been developed till date, but problems such as lack of definite and practical algorithm, lack of efficient measurement of network performance and idealness of mathematical model still exist.

2.3. Mobility management

Mobility is one of the most important issues in next generation networks. As WSNs are becoming the next elements of the future Internet, it is crucial to study new models that also support mobility of these nodes. WSNs are applicable in variety of cases that make it difficult to produce a standard mobility scenario. Intra-WSN device movement is probablythe most common scenario in WSNs architectures, where each sensor node has the ability to change from its local position at run time without losing the connectivity with the sensor router (SR). In the case of inter-WSN device movement, sensor nodes move between different sensor networks, each one with its SR responsible to configure and manage all the aggregated devices.

2.4. Security and Privacy Concern The field that paid less attention is the privacy concern on information being collected, transmitted, and analyzed in a WSN. Such private information of concern may include payload data collected by sensors and transmitted through the network to a centralized data processing server. The location of a sensor initiating data communication, and other such context information, may also be the focus of privacy concerns.

In real world applications of WSNs, effective countermeasures against the disclosure of both data and context-oriented private information are indispensable prerequisites. Privacy protection

in various fields related to WSNs, such as wired and wireless networking, databases.

2.5. Biomedical/Medical

The uses of WSNs in biomedical and medical are in growing phase. Biomedical wireless sensor networks (BWSNs) show the future opportunities for supporting mobility while monitoring vital body functions in hospital and home care. There is a requirement for BWSN to develop in order to cover security handling, improved signal integration and visualization. They can also be used to achieve extended mobility outside the surgery room, monitoring of several patients/persons at the same time, and further adaptations to medical experts needs for information.

3. Future Patterns

The future developments in sensor nodes must produce very powerful and cost-effective devices, so that they may be used in applications like underwater acoustic sensor systems, sensing based cyber-physical systems, time-critical applications, cognitive sensing and spectrum management, and security and privacy management. In this section we will look into all possibilities of further development in WSN applications.

3.1. Cognitive Sensing

Cognitive sensor networks are used for acquiring localized and situated information of the sensing environment by the deploying a large number of sensors intelligently and autonomically. Managing a large number of wireless sensors is a complex task.

3.2. Underwater Sensor Systems Underwater sensor nodes and vehicles should be capable of coordinate their operation, exchanging their location and movement information and hence relay monitored data to an onshore base-station. A new research paradigm of underwater wireless sensor networks (UWSNs) poses challenges like large propagation delays, node mobility and high error probability of acoustic underwater channels, compared to the ground-based WSNs.

3.3. Coordination in Heterogeneous Networks

Since the sensor nodes are energy constraints so the main obstacle in the coordination with other networks is limited energy of sensor nodes. Sensor networks are very useful for applications like health monitoring, wildlife habitat monitoring, forest fire detection and building controls. To monitor the WSN, the data produced by sensor nodes should be accessible.

3.4.Time-Critical Applications

A new generation of distributed embedded systems, with a broad range of real-time applications, such as fire monitoring, border surveillance, medical care, and highway traffic coordination, can be represented by WSNs. Due to severe resource limitations in highly dynamic environments these systems face new kinds of timing constraints. Many classical approaches to real-time computing like wireless networking protocols, operating systems, middleware services, data management, programming models, and theoretical analysis are challenged by WSNs.

3.5.New Models

WSN is a self-organized network of battery-powered wireless sensors that can sense, process, and communicate. We have discussed many technical challenges so far that deserve sincere consideration. These challenges are not limiting the progress in WSNs so much as lack of perfect WSN architecture.

4. Research Challenges

1. Power: Power is always been a challenge for WSNs designs. One of the ways to prolong the network lifetime is to design the energy efficient algorithms and hardware that uses power intelligently.
2. Hardware Cost: One of the main challenges is to produce low cost and tiny sensor nodes. Current sensor nodes are mainly prototypes with respect to these objectives. Low cost of sensor nodes can be achieved by recent and future progress in the fields of MEMS.
3. Security: Security is one of the major challenges in WSNs. Most of the attacks that are performed on WSN are insertion of false information by compromised nodes within the networks. Development of security schemes for WSN also faces challenges related to constrained environment.
4. System Architecture: Researches in the field of WSN is going on around the world but still there is no unified system and network architecture, on the top of that different application can be built.
5. Real World Protocols: protocols need to be developed for real world problems considering the theoretical concepts and synthesizing novel solutions into a complete system-wide protocol for real world application.
6. Analytical and Practical Results: Till date very few analytical results exists for WSNs. All new applications only get confidence when it is tested & analyzed practically and results are compared with existing schemes.

5. Conclusions

The innate way of WSNs makes them deployable in an assortment of conditions. They can possibly be all over the place, on streets, in our homes and workplaces, woodlands, front lines, fiasco struck zones, and significantly submerged in seas. This paper overviews the application zones where WSNs have been conveyed, for example, military detecting, activity reconnaissance, target following, environment observing, and human services checking as abridged in Table 2. The paper additionally reviews the different fields where WSNs might be sent sooner rather than later as submerged acoustic sensor frameworks, detecting based digital physical frameworks, time-basic applications, subjective detecting and range administration, and security and protection administration. These application ranges are being investigated broadly by different individuals over the business and academician.

6. References

1. R. Kay and F. Mattern, "The Design Space of Wireless Sensor Networks" IEEE Wireless Communications Vol.11.No.6 (2004) pp 54–61

2. A. Tiwari, P. Ballal and F.L. Lewis, "Energy-efficient wireless sensor network design and implementation for condition-based maintenance" ACM Transactions on Sensor Networks (TOSN) Vol.3.No.1 (2007) pp 1-7.

3. S. Hadim, N. Mohamed, "Middleware: middleware challenges and approaches for wireless sensor networks" Distributed Systems Online, IEEE Vol.7.No.3 (2006) pp 1-1.

4. S. Hussain, S. Schaffner and D. Moseychuck, "Applications of Wireless Sensor Networks and RFID in a Smart Home Environment" Proceedings of the 2009 Seventh Annual Communication Networks and Services Research Conference (2009) pp 153-157.

5. Chien-Chung Shen, C. Srisathapornphat and C. Jaikaeo, "Sensor Information Networking Architecture and Applications" IEEE Personal Communications (2001) pp 52-59.

6. S. S. Doumit and D. P. Agrawal, "Self-Organizing and Energy-Efficient Network of Sensors" IEEE (2002) pp 1-6.

7. J. Chinrungrueng, U. Sununtachaikul and S. Triamlumlerd, "A Vehicular Monitoring System with Power-Efficient Wireless Sensor Networks" ITS telecommunications Proceedings, 6th International Conference on (2006) pp 951-954.

8. S.W. Arms, C.P. Townsend and M.J. Hamel, "Validation of Remotely Powered and Interrogated Sensing Networks for Composite Cure Monitoring" paper presented at the 8th International Conference on Composites Engineering (ICCE/8), August 7–11, 2001.

9. Na Li, N. Zhang, Sajal K. Das and B. Thuraisingham, "Privacy preservation in wireless sensor networks: A state-of-the-art survey" Ad Hoc Networks 7 (2009) pp 1501–1514.

10.Inam Ullah Khan, Muhammad Abul Hassan "Network Layer Attacks Mechanisms in MANETS-A Survey ", International Journal of Research in Computer & Communication Technology (IJRCCT) , volume 5, Pages 303-307, June - 2016, ISSN (Online) 2278- 5841, ISSN (Print) 2320-5156.

11.Engr. Alamgir Safi , Inam Ullah Khan , Muhammad Abul Hassan , Engr. Muhammad Asghar "Mobile Ad hoc networks in the Global system of Interconnected Computer Networks", International Journal of Science Engineering and Advance Technology, IJSEAT, Vol. 4, Issue 9, ISSN 2321-6905, September -2016.

12. InamUllah Khan, Faheem Numan, Shaheen Ahmad "Mobile Ad Hoc Networks Challenges", International Journal of Science Engineering and Advance Technology, IJSEAT, Vol. 4, Issue 9, ISSN 2321-6905, September -2016.

13.Inam Ullah Khan, Muhammad Abul Hassan "Transport Layer Protocols And Services", International Journal of Research in Computer and Communication Technology, IJRCCT, Vol 5, Issue- 9, September- 2016, ISSN (Online) 2278- 5841, ISSN (Print) 2320- 5156.

14.Inam Ullah Khan, Faheem Numan, Shaheen Ahmad "Open Systems Interconnection model Seven Layers of Computer Networks, International Journal of Mechanical Engineering & Cpmputer Applications, IJMCA, Vol. 4, No. 5, Sept – Oct, ISSN - 2320-6349, 2016.