© 2017 IJSRSET | Volume 3 | Issue 8 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section : Engineering and Technology

Applications of Wireless Sensor Network - A Survey

D. Asir Antony Gnana Singh[1], E. Jebamalar Leavline[2], M. Sushmitha[1], E. Manjula[1]
[1]Department of Computer Science and Engineering, Anna University, BIT Campus, Tiruchirappalli, India
[2]Department of Electronics and Communication Engineering, Anna University, BIT Campus, Tiruchirappalli, India

ABSTRACT

Wireless sensor networks (WSN) play a vital role in our day-to-day life to sense and report various parameters for facilitating data-driven decisions. WSN can be formed by placing sensor nodes ad-hoc network fashion that can communicate in wireless mode. The sensor nodes contain the sensing element, processing unit, power supply unit, external memory and transceiver. The WSN can function as infrastructure-less network. Moreover the sensor nodes that are deployed in this kind of network are self-organized. Therefore, this network can be easy formed for various applications in different fields including agriculture, water quality monitoring, forest fire detection, military applications, land slide detection, etc. This paper presents a review of the research works on wireless sensor network that are carried out by many researchers for different applications.

Keywords : Wireless Sensor Network, WSAN, ADC, Internet of Things

I. INTRODUCTION

Wireless sensor networks (WSN) also known as wireless sensor and actuator networks (WSAN) are spatially distributed autonomous sensors to monitor physical or environmental conditions such as temperature, sound, pressure etc. and to cooperatively pass their data through the network to other locations as shown in Figure 1.WSN is useful for sensing and transmission of information, communication. The sensor node consists of the transceiver, power source, sensors, micro controller, extended memory and analog-to-digital converter (ADC) convertor.

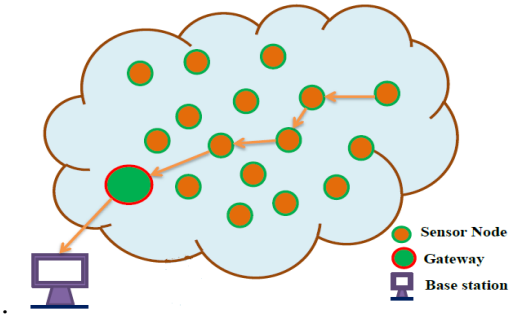

Figure 1. The schematic view of the wireless sensor network

The sensors sense the physical environment or environment conditions such as temperature, sound, pressures, etc. in analog form and the analog-to-digital converter (ADC) converts the analog signal into digital value or signal which is then given to the microcontroller for further process and decision making. The transceiver receives and transmits the messages.

The power source is used to provide the required power to the node. The photovoltaic cells are used for the generation of power. The microcontroller contains one or more central processing unit (CPU) cores along with memory and programmable input and output peripherals. Program memory in the form of ferroelectric random-access memory (RAM) or one-time programmable non-volatile memory (OTP) read-only memory (ROM) are also often included on chip, as well as small amount of RAM. The sensed information (input data) is stored in the memory of the processor. The routing algorithm is programmed to process the information and generate output. The routing algorithm is a set of step by step operations used to direct the data traffic efficiently. When a

packet of data leaves its source, there are many different paths it can take to its destination. The routing algorithm is used to determine mathematically the best path to take from a particular source node to destination node. Finally, the microcontroller is processed.

WSN is used in different fields including agricultural, water quality monitoring, forest fire detection, military applications, land slide detection, etc. This paper presents a review of the research works on wireless sensor network that are carried out by many researchers for different applications. This paper is organized as follows. Section 2 discusses the researches that are carried out in the wireless sensor network for various applications followed by conclusion in Section 3.

II. RESEARCH ON WIRELESS SENSOR NETWORKS

The wireless sensor network is used for various fields for various applications that include agriculture, irrigation, water quality monitoring, forest fire detection, military applications, and landslide detection. This section presents the researches that are carried out by the many researchers in various fields.

2.1 WSN in Agriculture

Agriculture is the backbone of any country since it produces and provides the food and directly contributes to the economic growth of the nation. The wireless sensor networks are used in the field of agriculture in many ways such as automated water pumping. In agriculture, the crops or plants are cultivated in the farms or fields and water is pumped to the plants. Every farmer need to maintain the correct level of pumping water to the crops or plants. Moreover, over spilling causes damage to the plants and it may not produce good yielding. If the supplied water for the crops or plants is less than the actual need of the plants, it may cause to dry up the crop or plants. Therefore the consistent level of water should be maintained according to the water need of the plants. The sensor networks sense the level of water for the crops and the plants and operate the motor to pump the water for the crops and the plants when required. The sensor network reduces the working time and cost of the farmers. Here temperature and humidity sensors are placed in the soil that help to sense the temperature and humidity level of the soil. Then the sensed information is passed to the microcontroller where the information is processed. According to the signal, the water is pumped to the plants.

Joaquin gutierez et al presented automated irrigation system to optimize the usage of water for the agricultural crops. In order to achieve the optimised usage of water, the distributed sensor network is used. Moreover the temperature and soil-moisture sensors are employed and they are placed in the root area of the plants. In order to ensure the water quantity present in root area of the plant with the sufficient threshold level, an algorithm is developed and deployed on the microcontroller and it is connected through the web application. The web application allows the users to schedule the irrigation needed to the plants and based on the schedule water is automatically pumped to the plants [1]. Zhang Feng presented an automated irrigation system using the sensor network to provide an efficient water usage in the farmland. This system reduces the irrigation cost and regulates water supply to the plants. Moreover, the routing protocols that are employed or sensor network are analysed to provide the better service concerning to the irrigation [2]. Filipe Caetano et al presented a water irrigation system for the urban gardens to improve the efficiency in water irrigation.

This system is nurtured using monitoring and forecasting of environmental conditions and soil moisture in each garden. However, this system makes a decision to ensure the quantity of the water that is sufficiently and not excessively needed for garden [3]. Kabilan N et al employed the image processing and the classification method to carry out the efficient irrigation. In this method, the plant image and the soil are collected and the features from the images are extracted. The extracted features are used for developing a model using machine learning algorithm and the developed model is used to identify the quantity of the water that is necessary for a plant. The irrigation is carried out based on the decision performed by the machine learning model. This irrigation system is motivated by the Internet of Things (IoT) [4]. Yiming Zhou et al employed a ZigBee wireless sensor network for remote intelligent irrigation system for irrigation management in order

to save the cost spent for labour and water. Moreover, the design of software algorithm and hardware architecture is employed for the intelligent irrigation management. This proposed system provides high reliability at low cost. Furthermore, this system is expendable for forming the large size of the network to provide irrigation to a large area [5].

2.2 WSN in Water Quality Monitoring

Water is the most important substances needed for the survival of human, animals, and plants in the world. The contaminated water affects health by spreading the bacteria, parasites, and viruses. Therefore, the quality of water should be monitored and maintained. Moreover, many researchers paid their attention to develop sensor networks to monitor the quality of the water. Francesco Adamo et al. presented a sea water quality monitoring system using the wireless sensor network. In this network, smart sensors are deployed to collect the data by monitoring the surface seawater in order to evaluate the quality of the seawater. The quality of the seawater is taken care to make decision in order to solve the critical environmental issues [6].

Tomoaki Kageyama et al designed a wireless sensor network for monitoring water quality. In this network, different types of sensors are deployed to sense the chemical and physical properties of water that includes electrical conductivity, temperature, and illumination. This network is employed in the lake for validation process and it is observed that the proposed wireless sensor network for monitoring the water quality performs better [7]. Ruan Yue et al developed a system to monitor water quality using the wireless sensor network. The sensors deployed in the wireless sensor network are powered by the solar panel. The sensor nodes are deployed to sense the pH value, turbidity, and oxygen present in the water and send to the base station. Moreover, the proposed system consumes less power, low carbon emission, and it is more flexible [8].

2.3 WSN in Forest Fire Detection

The forests are the very essential resource of the earth for survival of human, animals, and plants. The balance of the ecosystem is protected by the forests. The forest contributes to get rain, clean the air, feeding the animals, produce some medicines, providing a relaxing place to the human, etc. However, sometimes the forest fire occurs in unexpected way due to many reasons such as abnormal weather condition, lightning, human activities, and other factors. However, detecting and mitigating the forest fire is a challenging task. Many researchers conducted research in wireless sensor network for monitoring and detecting the forest fires. Bolourchi et al developed a forest fire detection system using wireless sensor network (WSN) in order to make intelligent decisions. The fuzzy logic algorithm is developed using the different membership functions for the parameters humidity, distance, smoke, temperature and light. Moreover, this system achieves power efficiency through the solar power sources [9]. Junguo Zhang also presented a forest fire detection system using the wireless sensor network (WSN). They discussed the cluster-based wireless sensor network for forest fire detection and the impact of forest fire detection and reviewed various forest fire detection techniques using wireless sensor networks [10]. Yuanyuan Zhang et al developed routing protocol for the wireless senor networks that is used for prevention of the forest fires. The protocol can increase the lifetime of the sensor network. The proposed routing protocol is simulated and its performance is analyzed. Moreover, the different routing protocols are reviewed that are used for the sensor network [11].

Anamika Chauhan et al presented a method to detect the forest fire using the wireless sensor network and classification algorithms. The wireless sensor networks are used to collect the data from the forest. The collected data is given to the classification algorithms such as artificial neural network, support vector machine for classification and detection of the forest fire. The experiments are conducted with the sensed data using the classification algorithms and it is identified that the proposed method performs better [12]. Anand S Bhosle et al presented a model for detecting the forest fire for disaster management in order to protect the wild life using the wireless sensor network. Moreover, the classification of the sensors and the wireless sensor standards are presented [13].

2.4 WSN in Military Applications

The safety and security of a country is ensured by the military. Moreover, the military is employed for the rescue operations during different natural calamities.

The senor network is employed for the different military applications. Hence, many researchers conducted their research on the sensor networks that are employed for military applications. Daesung Kim et al conducted a comparability study on the routing protocols that are employed to the military application in terms of packet delivery ratio, control packet overhead, average end-to-end delay, and average amount of energy consumption [14]. Tarek Azzabi et al presented the challenges in securing the data collection and exchange in wireless sensor network that is employed for the military applications. Moreover, the WSN cryptographic protocols are analyzed in terms of their strengths and weakness [15].

Ens Scott M Diamond et al conducted a study to develop a system model for the sensor network for situation awareness in military operations. Moreover, a model is described for symmetric threats and the system architecture is described for military operations [16]. Sang Hyuk Lee et al proposed wireless sensor network architecture for military environment to monitor enemies and to ensure protection. The proposed sensor network architecture is encompassed with the cluster- tree based multi-hop model that elects the cluster headed in an optimized way in order to achieve the tactical requirements such as inter-networking with backbone, QoS and security in the military environment [17].

2.5 WSN in Landslide Detection

Landslide can be the mud slide, rock fall and any failure of the deep slope. The landslide can be caused due to the various reasons including climate change, earthquakes, weathering, erosion, volcanoes, forest fires, and gravity. The landslide can cause damage of corps of the land, damage of infrastructures, damage to the beauty of the land, losses of life, etc. Therefore, detecting the landslide is very essential. Wireless sensor networks are employed to detect the landslide. Hence, some researchers paid their attention in developing the wireless sensor network for the landslide detection. G. N. L. Ravi Teja presented a landslide detection system using geophysical sensors with wireless sensor network in order to collect the geological data and analyze them to predict the landslide [18].

Maneesha V. Ramesh developed a landslide detection system using wireless sensor network and developed an efficient algorithm to provide better data collection and aggregation in order to detect the land slide. Moreover, this system can be configured with heterogeneous networks to collect the data and analyze to detect and send the warning message about the land slide [19].

III. CONCLUSION

This paper conducted a review on the applications of wireless sensor network. Moreover, this paper presented the typical representation of wireless sensor networks. Further, this paper discussed researches that are carried out by many researchers for various fields that include agriculture, irrigation, water quality monitoring, forest fire detection, military applications, and landslide detection.

IV. REFERENCES

[1]. Gutierrez, J., Villa-Medina, J.F., Nieto-Garibay, A. and Porta-Gándara, M.Á., 2014. Automated irrigation system using a wireless sensor network and GPRS module. IEEE transactions on instrumentation and measurement, 63(1), pp.166-176.

[2]. Feng, Z., 2011, April. Research on water-saving irrigation automatic control system based on internet of things. In IEEE International Conference on Electric Information and Control Engineering (ICEICE), 2011 (pp. 2541-2544).

[3]. Caetano, F., Pitarma, R. and Reis, P., 2014, June. Intelligent management of urban garden irrigation. In IEEE Conference on Information Systems and Technologies (CISTI), 2014 9th Iberian (pp. 1-6).

[4]. Dursun, M. and Ozden, S., 2010, September. A prototype of PC based remote control of irrigation. In IEEE International Conference on Environmental Engineering and Applications (ICEEA), 2010 (pp. 255-258).

[5]. Zhou, Y., Yang, X., Wang, L. and Ying, Y.,2009, April. A wireless design of low-cost irrigation system using ZigBee technology. In IEEE

International Conference on Networks Security, Wireless Communications and Trusted Computing, 2009. NSWCTC'09. (Vol. 1, pp. 572-575).

[6]. Adamo, F., Attivissimo, F., Carducci, C.G.C. and Lanzolla, A.M.L., 2015. A smart sensor network for sea water quality monitoring. IEEE Sensors Journal, 15(5), pp.2514-2522.

[7]. Kageyama, T., Miura, M., Maeda, A., Mori, A. and Lee, S.S., 2016, October. A wireless sensor network platform for water quality monitoring. IEEE In SENSORS, 2016 (pp. 1-3).

[8]. Yue, R. and Ying, T., 2011, March. A water quality monitoring system based on wireless sensor network & solar power supply. In IEEE International Conference on Cyber Technology in Automation, Control, and Intelligent Systems (CYBER), 2011 (pp. 126-129).

[9]. Bolourchi, P. and Uysal, S., 2013, June. Forest fire detection in wireless sensor network using fuzzy logic. In Fifth IEEE International Conference on Computational Intelligence, Communication Systems and Networks (CICSyN), 2013 (pp. 83-87).

[10]. Zhang, J., Li, W., Yin, Z., Liu, S. and Guo, X., 2009, May. Forest fire detection system based on wireless sensor network. In 4th IEEE Conference on Industrial Electronics and Applications, 2009. ICIEA 2009. (pp. 520-523).

[11]. Zhang, Y., Cao, N., Chang, G., Zhou, L., Yu, X. and Liu, Y., 2017, July. Wireless Sensor Routing Protocol Research Based on Forest Fire Protection. In IEEE International Conference on Computational Science and Engineering (CSE) and Embedded and Ubiquitous Computing (EUC), 2017 (Vol. 2, pp. 265-268).

[12]. Chauhan, A., Semwal, S. and Chawhan, R., 2013, December. Artificial neural network-based forest fire detection system using wireless sensor network. In Annual IEEE India Conference (INDICON), 2013 (pp. 1-6).

[13]. Bhosle, A.S. and Gavhane, L.M., 2016, March. Forest disaster management with wireless sensor network. In IEEE International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT), (pp. 287-289).

[14]. Kim, D., Kim, D., Park, H. and Yoo, S.M., 2011, June. Performance evaluation of routing protocols for wireless sensor networks in military scenarios. In IEEE Third International Conference on Ubiquitous and Future Networks (ICUFN), 2011 (pp. 101-106).

[15]. Azzabi, T., Farhat, H. and Sahli, N., 2017, January. A survey on wireless sensor networks security issues and military specificities. In IEEE International Conference on Advanced Systems and Electric Technologies (IC_ASET), 2017 (pp. 66-72).

[16]. Diamond, S.M. and Ceruti, M.G., 2007, June. Application of wireless sensor network to military information integration. In 5th IEEE International Conference on Industrial Informatics, 2007 (Vol. 1, pp. 317-322).

[17]. Lee, S.H., Lee, S., Song, H. and Lee, H.S., 2009, October. Wireless sensor network design for tactical military applications: Remote large-scale environments. In IEEE Communications Conference Military, 2009. MILCOM 2009. (pp. 1-7).

[18]. Teja, G.R., Harish, V.K.R., Khan, D.N.M., Krishna, R.B., Singh, R. and Chaudhary, S., 2014, February. Land slide detection and monitoring system using wireless sensor networks (WSN). In IEEE International Advance Computing Conference (IACC), 2014 (pp. 149-154).

[19]. Ramesh, M.V., 2009, June. Real-time wireless sensor network for landslide detection. In IEEE Third International Conference on Sensor Technologies and Applications, 2009. SENSORCOMM'09. (pp. 405-409).