REVIEW ON WIRELESS SENSOR NETWORK USING ZIGBEE FOR FOREST ENVIRONMENT MONITORING SYSTEM

[1]Ms. P. V. Ambatkar, [2]Prof. V. R. Thakare
M.E. Student Jagadambha College of Engineering & Technology, Yavatmal[1], Asst. Professor Jagadambha College of Engineering & Technology, Yavatmal[2]
poojaambatkar@gmail.com[1]

ABSTRACT

A wireless sensor network (WSN) consists of sensors which are densely distributed to watch physical or environmental conditions, like temperature, sound, pressure, etc. The sensor data is transmitted to network coordinator which is heart of the wireless personal area network. within the modern scenario wireless networks contains sensors also as actuators. ZigBee is newly developed technology that works on IEEE standard 802.15.4, which may be utilized in the wireless sensor network (WSN). The low data rates, low power consumption, low cost are main features of ZigBee. WSN consists of ZigBee coordinator (network coordinator), ZigBee router and ZigBee end device. The sensor nodes information within the network are going to be sent to the coordinator, the coordinator collects sensor data, stores the info in memory, process the info , and route the info to appropriate node.

Zigbee may be a low-rate, low-cost and low-power quite transient wireless network communication protocol. Compared with other wireless methodologies, Zigbee has unique advantages of safe and reliable data transmission, a simple and versatile network configuration, low equipment costs and long-standing batteries. By applying a wireless sensor network supported Zigbee to a fire supervising system, information like temperature and humidity at any a part of the forest covered by the network could easily be collected, addressed and examined at any time. additionally , the system are often extended significantly

Keywords: fire , Zigbee, Arduino, Sensor Network , WSN.

1. INTRODUCTION

Forests are a part of the important Resources for human survival and social development that protect the balance of the world ecosystem. However, due to some uncontrolled anthropological activities and irregular natural conditions, forest fires happen frequently. These fires are the foremost uncontrollable disasters to forest resources and therefore the human environment condition. In this scenario, the frequency of forest fires has increased considerably thanks to global climate change , human activities and other factors. The detection and monitoring of fire s has become a worldwide concern in forest fire prevention organizations. Currently, fire detection methods largely contains vigils, observation from watch towers and lately satellite Monitoring (Lai, et al., 2004). Although Observation from watch towers is straightforward and realizable, it's several obstructions. In the first place, this method needs many financial and material resources and a up skill labor force. Second, many problems with fire protection manpower abound, such as inattentiveness, absence from the post, lack of ability for real-time monitoring and the limited area coverage. The scope of application of satellite detection systems is also restricted by a number of parameters, which reduces its effectiveness in forest fire detection. For example, a satellite monitoring system features a long scanning cycle and therefore the resolution of its saturated pixel dots of images is low. Another problem is cloud layers may mask images during the scanning period and the real-time mathematical quantification of fire parameters is very difficult to achieve (Shu et al., 2005; Yu et al., 2005; Calle et al., 2006). Given these shortcomings of traditional monitoring, we propose the ZigBee wireless sensor network technology and explain its application as a monitoring system. This system can monitor

real-time related parameters, e.g., temperature, ratio , and send the info immediately to the pc of the monitoring center. The collected data are going to be analyzed and managed by the pc . Compared with the traditional baroscopic information and basic forest resource data, the system can make an instantaneous assessment of a possible fire danger. The analytical results will then be sent to the relevant department because the policy-making basis by which the department will make the choice of fireside fighting or fire prevention

1.1WSN

WSN A wireless sensor network may be a collection of nodes. Each node consists of processing capability (one or more MCUs or DSP chips), multiple sorts of memory (program, data and flash memories), a RF transceiver, an influence source (batteries), and accommodates various sensors and actuators [11]. The nodes communicate wirelessly and sometimes self-organize after being deployed in a billboard hoc fashion. A WSN is a distributed realtime system. Most past distributed systems research has assumed that the systems are wired, have unlimited power, aren't real time, have a hard and fast set of resources, treat each node in the system as vital and are location independent. In contrast, for wireless sensor networks, the systems are wireless, have scarce power, are real-time, utilize sensors and actuators as interfaces, have dynamically changing sets of resources, aggregate behavior is vital and site is critical. Many wireless sensor networks also utilize minimal capacity devices which places an extra strain on the power to use past solutions. Usually these devices are small and cheap , in order that they will be produced and deployed in large numbers, then their resources in terms of energy, memory, computational speed and bandwidth are severely constrained. There are different Sensors like pressure, accelerometer, camera, thermal, microphone, etc. They monitor conditions at different locations, such as temperature, humidity, vehicular movement, lightning condition, pressure, soil makeup, noise levels, the presence or absence of certain kinds of objects, mechanical stress levels on attached objects, the present characteristics like speed, direction and size of an object. Normally these Sensor nodes consist there components: sensing, processing and communicating. Wireless Sensor Networks (WSNs) are traditionally composed of multiple sensor nodes that sense environmental phenomena and generate sensor readings that are delivered, typically, through multi-hop paths, to a selected node (called the sink) for collection [6].

1.2SENSOR AND SENSOR NODE

Sensor may be a device that receives and responds to a sign or stimulus. It is a component that senses a variation in input energy to supply a variation in another or same sort of energy. A sensor (also called detector) may be a converter that measures a physical quantity and converts it into a sign which may be read by an observer or by an instrument. For example thermocouple converts temperature to an output voltage which may be read by a voltmeter. For accuracy, most sensors are calibrated against known standards. A sensor may be a device which receives and responds to a sign when touched. A sensor's sensitivity indicates what proportion the sensor's output changes when the measured quantity changes. Sensors that measure very small changes must have very high sensitivities. Sensors got to be designed to possess alittle effect on what's measured; making the sensor smaller often improves this and should introduce other advantages. Technological progress allows more and more sensors to be manufactured on a microscopic scale as micro sensors using MEMS technology. In most cases, a micro sensor reaches a significantly higher speed and sensitivity compared with macroscopic approaches [10]. The low cost sensors are densely deployed in WSN, which collect environmental data. The environment are often monitored and controlled by the utilization of sensors and actuators in WSN. Sensor nodes have various energy and computational constraints due to their inexpensive nature and ad-hoc method of deployment [8]. Recently research has been developed at energy efficient routing. The sensor nodes are small

and distributed, which are capable of local processing and wireless communication. Each sensor node is capable of only a limited amount of processing. But when coordinated with the knowledge from an outsized number of other nodes, they need the power to live a given physical environment in great detail. Thus, a sensor network are often described as a set of sensor nodes which co-ordinate to perform some specific action. Unlike traditional networks, sensor networks depend on dense deployment and co-ordination to carry out their tasks. The multiple sensor nodes are required to overcome environmental obstacles like obstructions, line of sight constraints etc. The environment to be monitored has an ad-hoc infrastructure for communication. Another requirement for sensor networks would be distributed processing capability because communication is a major consumer of energy [8].

2.LITERATURE REVIEW

I have gone through the various research article's for forest monitoring and energy efficient scheme using wireless sensor network the existing techniques are

 Research on ZigBee wireless communication technology and its application ZigBee, as an emerging two-way wireless communication technology of short distance, low complexity, low power consumption, low rate and low cost, effectively makes up for the vacancy of low cost, low power consumption and low rate wirelesscommunication market.

 Environment monitoring and device control using ARM based Embedded Controlled Sensor Network- demonstrates designing of embedded controlled sensor networks used for controlling the home devices as well as monitoring the environmental parameters. The features of GSM and Zigbee are explored to design the system for long distance as well as short distance .

 Wireless Sensor Network Applications: A Study in Environment Monitoring System - the wireless sensor network applications which focus mainly on the environmental monitoring system. These systems has low power consumption, low cost and is a convenient way to control real-time monitoring for unprotected agriculture and habitat. Moreover, it can also be applied to indoor living monitoring, greenhouse monitoring, climate monitoring and forest monitoring. These approaches have been proved to be an alternative way to replace the conventional method that use men force to monitor the environment and improves the performance, robustness, and provides efficiency in the monitoring system.

 Forest Monitoring and Wild land Early Fire Detection by a Hierarchical Wireless Sensor Network Distributed Energy Efficient Adaptive Clustering Forest Monitoring System- paper describes a WSN for early detection of forest fires. This network can be easily deployed at areas of special interest or risk. There are two types of nodes from the physical structure point of view: SNs, to collect data from the environment, and CNs, to gather data from the SNs and transmit the information to a Control Centre.

 Motion Tracking System

 Mobile Animal Tracking System

With referring to all above available techniques, they have certain drawback in power consumption and signal processing.

3. PROPOSED WORK AND OBJECTIVES

Integration of the multiple wireless sensor node is challenging task, wireless node should be run on low power & should be running 24x7, here proposed system uses Zigbee for wireless communication, ZigBee is newly developed technology that works on IEEE standard 802.15.4, which can be used in the wireless sensor network (WSN). The low data rates, low power consumption, low cost are main features of ZigBee. WSN consists of ZigBee coordinator (network coordinator), ZigBee router and ZigBee end device. The sensor nodes information within the network are going to be sent to the coordinator, the coordinator collects sensor data, stores the info in memory, process the info , and route the data to appropriate node. Parameters that will be sense are:

1 Temperature

2 Humidity

3 Light intensity

3.1SYSTEM ARCHITECTURE

The diagram of wireless sensor network of the project is as shown figure below. The ultrasonic proximity sensor is connected to SPI of a controller 89v51 through buffer IC74LS125. The ZigBee module-1 (Tarang F4) is additionally connected to SPI via buffer. They are communicating alternatively via buffer IC. The temperature sensor LM35 is connected to port-1 via ADC-0804. The LCD is connected to port-2 of MCU. ZigBee module-1 is communicating to ZigBee module-2 (Tarang F4) via wireless link . The ZigBee module-2 is connected to PC via RS-232 cable. The sensing data is displayed on the LCD then to PC Hyper-terminal. The ultrasonic proximity sensor is employed to live the space of any stationary object. The sensor data is captured at interface of an MCU. This data is stored in MCU memory also as displayed on LCD. The sensor can measure distance minimum 10cm and maximum 400cm (4m). If distance is a smaller amount then 10cm the message is displayed on LCD that distance is lesser then min range. The data pin of ultrasonic proximity sensor is connected to RXD pin of MCU through buffer. The data received on RXD pin by the MCU is in ASCII format at rate of 9600 baud . The received format is XXX.XXcm, where X is '0' to '9' ASCII character and is printing operation where the string terminates. The temperature sensor LM-35 is employed to sense the environmental temperature. The Vout pin of LM-35 is connected to Vin pin of ADC for analog to digital conversation. The 8 bit digital output DB0 to DB7 is connected to port1 of MCU. The temperature reading of 8 bit stored inside MCU memory. The LM35 is precision integrated-circuit temperature sensor, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. This will require a voltmeter to sense the temperature. Vout can be measured by voltmeter. The output voltage is converted to temperature by an easy factor . The sensor has a sensitivity of 10mV/ . Hence factor is that the reciprocal, which is 100 /V. The general equation wont to convert output voltage to temperature is: So if Vout is 1V, then, Temperature = 100 . The output voltage varies linearly with temperature. Temperature reading is additionally displayed on LCD with the space reading. ZigBee module1 is connected to MCU via SPI. The Dout pin of ZigBee module is connected to RXD pin of MCU via buffer IC and Din pin of ZigBee module is connected to TXD pin of MCU. Both the sensor data are often transfer to Zigbee module1 through wired connection. This sensor data is transferred to ZigBee module to via link . ZigBee module2 is connected to COM port of PC via RS232 cable. The same sensors reading displayed on the LCD are often displayed on PC in hyper terminal. Here the network formed by both the ZigBee module is unicast network, communication between two nodes only. For unicast network it must assign source address and destination address for both of the ZigBee module. The Zigbee module utilized in this project is Tarang-F4

module, which works on 3.3v to 3.6v operating voltage and ISM 2.4 GHz band of frequency. Fig- 3: diagram of wireless sensor network 5. ZIGBEE/IEEE STANDARD 802.15.4 ZigBee may be a worldwide open standard for wireless radio networks within the monitoring and control fields. The standard was developed by the ZigBee Alliance (an association of international companies) to satisfy the subsequent principal needs:

• Low cost
• Ultra-low power consumption
• Use of unlicensed radio bands
• Cheap and easy installation
• Flexible and extendable networks
• Integrated intelligence for network set-up and message routing

Some of the above requirements are related - for instance , the necessity for very low power consumption is motivated by the utilization of battery-powered nodes which may be installed cheaply and easily, with none power cabling, in difficult locations. The IEEE 802.15.4 standard defines the characteristics of the physical and MAC layers for Low-Rate Wireless Personal Area Networks (LR-WPAN). The figure shows a generic LRWPAN node architecture. The node architecture is defined into variety of structural blocks called layers. Each layer implements a subset of the LR-WPAN standard and offers services to its upper layers and gets services from its lower layers. The layered architecture of each network node

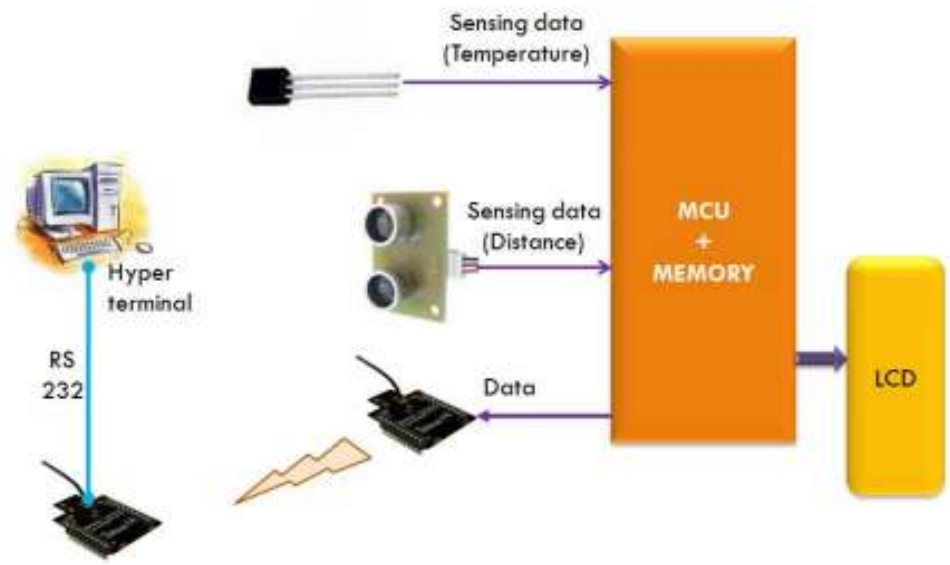

Fig : System Architecture.

REFERENCES

[1] Simin Long ,Feng Miao Research on ZigBee wireless communication technology and its application 2019 IEEE 4th Advanced Information Technology, Electronic and Automation Control Conference (IAEAC 2019)

[2] Vaneet Singhi, I. P. Singh, s. K. Sud, Environment monitoring and device control using ARM based Embedded Controlled Sensor Network

[3] M. Angeles Serna and et. al. Distributed Forest Fire Monitoring Using Wireless Sensor Networks. In International Journal of Distributed Sensor Networks. Hindawi Publishing Corporation. Article ID; 964564. 2015.

[4] Teng Ma and et. al. Forest Fire Monitoring Based on Mixed Wireless Sensor Networks. In International Journal of Smart Home. Vol. 9 Issue. 3 Pp. 169-184, 2015.

[5] Antonio Molina-Pico, David Cuesta-Frau, Alvaro Araujo, Javier Alejandre, and Alba Rozas, Hindawi Publishing Corporation Journal of Sensors Volume 2016, Article ID 8325845,

[6] Shalli Rani and et. al. A novel Scheme for an Energy Efficient Internet of Things Based on Wireless Sensor Networks. In Journal of Sensors. ISSN 1424-8220, 2015.

[7] Priyanka Tambat, Arati Dixit, Energy Efficient Scheme for Wireless Sensor Networks. In International Journal on Recent and Innovation Trends in Computing and Communication. Volume 3 Issue 2. ISSN 2321-8169. Pp: 646-653. Feb. 2015.

[8] Prachi Sharma. Wireless Sensor Networks for Environmental Monitoring. In International Journal of Scientific Research Engineering & Technology (IJSRET) IEERET-2014 Conference Proceeding, 3-4 November, 2014.

[9] Kechar Bouabdellah and et. al. Using Wireless Sensor Networks for Reliable forest fires detection. In the 3rd International Conference on sustainable energy Information Technology. Publisher M. Hefeeda and M. Bagheri, "Forest fire modeling and earlydetection using wireless sensor networks," Ad-Hoc and Sensor Wireless Networks, vol. 7, no. 3-4, pp. 169–224, 2009.

[10] Z. Li, S. Nadon, and J. Cihlar, "Satellite-based detection of Canadian Boreal forest fires: development and application of the algorithm," International Journal of Remote Sensing, vol. 21, no.16, pp. 3057–3069, 2000.

[11] J. Zhang,W. Li,N.Han, and J. Kan, "Forest fire detection systembased on a ZigBeewireless sensor network," Frontiers of Forestry in China, vol. 3, no. 3, pp. 369–374, 2008.

[12] Y. G. Sahin and T. Ince, "Early forest fire detection using radioacoustic sounding system," Sensors, vol. 9, no. 3, pp. 1485–1498,2009.

[13] J. Lloret, M. Garcia, D. Bri, and S. Sendra, "A wireless sensor network deployment for rural and forest fire detection and verification," Sensors, vol. 9, no. 11, pp. 8722–8747, 2009.

[14] U. Ganesh, M. Anand, S. Arun, M. Dinesh, P. Gunaseelan, and R. Karthik, "Forest fire detection using optimized solar powered Zigbee wireless sensor networks," International Journal of Scientific and Engineering Research, vol. 4, pp. 586–596, 2013.

[15] Tillett J, Yang S J, Rao R, Sahin F (2004). Optimal topologies for wireless sensor networks. In: Proceedings of SPIE–the International Society for Optical Engineering, Unmanned/Unattended Sensors and Sensor Networks. London: SPIE, 192–203

[16] Yu L Y, Wang N, Meng X Q (2005). Real-time forest fire detection with wireless sensor networks. In: Proceedings of 2005 International Conference on Wireless Communications, Networking and Mobile Computing. Wuhan:WCNM, 1214–1217

[17] Zenon C, Fady A (2005). Wireless sensor network based system for fire endangered areas. In: Proceedings of the 3rd International Conference on Information Technology and Applications.Sydney: ICITA, 203–207

[18] Zhang G (2004). Study on forest fire dynamic monitoring in Guangzhou City. Dissertation for the Doctoral Degree Zhuzhou: Central South Forestry University (in Chinese)

[19] V. Mhatre and C. Rosenberg, "Design guidelines for wireless sensor networks: communication, clustering and aggregation," Ad Hoc Networks, vol. 2,no. 1, pp. 45-63, Jan. 2004.

[20] A. M. Adnan, "Data Gathering In Wireless Sensor Network For Environmental Monitoring," 2010.

[21] W.-S. Jang, W. M. Healy, and M. J. Skibniewski, "Wireless sensor networks as part of a web-based building environmental monitoring system,"Automation in Construction, vol. 17, no. 6, pp. 729-736, Aug. 2008.

[22] R. Mittal and M. P. S. Bhatia, "Wireless Sensor Networks for Monitoring the Environmental Activities," Analysis, 2010.