International Journal of Applied Science and Engineering, 5(2): 81-86, December 2017

DOI: 10.5958/2322-0465.2017.00010.7

Implementation of Wireless Sensor Network and IOT for Real Time Forest Fire Warning System

S. Varunkumar*, P.V. Yokeshraj, V. Vignesh and S. Tamilselvan

Student, Instrumentation and Controls Engineering, St .Joseph's College of Engineering, Chennai, India

*Corresponding author: svkvarun43@gmail.com

ABSTRACT

Forest are the basis for sustaining the ecosystem and helps cleanse the environment and provides shelter food for life dependent on it. Humans owe a great responsibility in preserving the remaining forests and take preventive steps towards the destruction of forest. One of the major cause for forest destruction are forest fires. So this project deals with the development of an intelligent real time and automatic early warning system for forest fire. It enables remote monitoring of conditions inside the forest regions and creates an alert when an forest fire is detected by unique mail and sms, the sensor data are constantly monitored along with a gps location for each sensor node which are connected together by Zigbee modules capable of long range transmission, the simple battery monitoring system allows constant monitoring of power usage of the entire setup. On the whole this prototype model when implemented will be a cost effective way for preventing forest fires.

Keywords: Fires, Forestry, Wireless sensor networks, Raspberry Pi, ZigBee, Remote monitoring, communication systems, Alarm systems

As we all know, the forest is considered as one of the most important and indispensable resources, the prevention and detection of the forest fire, have been researched hotly in worldwide Forest Fire Prevention Departments. Forests are the protectors of earth's ecological balance. Unfortunately, the forest fire is usually only observed when it has already spread over a large area, making its control and stoppage arduous and even impossible at times. The result is devastating loss and irreparable damage to the environment and atmosphere (30% of carbon dioxide (CO_2) in the atmosphere comes from forest fires), in addition to irreparable damage to the ecology (huge amounts of smoke and carbon dioxide (CO_2) in the atmosphere). Among other terrible consequences of forest fires are long-term disastrous effects such as impacts on local weather patterns, global warming, and extinction of rare species of the flora and fauna. Based on the deficiencies of conventional forest fire detection on real time and monitoring accuracy, the wireless

sensor network technique for forest fire detection is being implemented here. The problem with forest fires is that the forests are usually remote, abandoned/unmanaged areas filled with trees, dry and parching wood, leaves, and so forth that act as a fuel source. These elements form a highly combustible material and represent the perfect context for initial-fire ignition and act as fuel for later stages of the fire. The fire ignition may be caused through human actions like smoking or barbeque parties or by natural reasons such as high temperature in a hot summer day or a broken glass working as a collective lens focusing the sun light on a small spot for a length of time thus leading to fire-ignition. Once ignition starts, combustible material may easily fuel to feed the fires central spot which then becomes bigger and wider. The initial stage of ignition is normally referred to as "surface fire" stage. This may then lead to feeding on adjoining trees and the fire flame becomes higher and higher, thus becoming "crown fire." Mostly, at this stage, the fire becomes uncontrollable and damage to the landscape may become excessive and could last for a very long time depending on prevailing weather conditions and the terrain.

OVERVIEW OF THE PROJECT

Millions of hectares of forest are destroyed by fire every year. Areas destroyed by these fires are large and produce more carbon monoxide than the overall automobile traffic. Monitoring of the potential risk areas and an early detection of fire can significantly shorten the reaction time and also reduce the potential damage as well as the cost of firefighting. The objective is to detect the fire as fast as possible and its exact localization and early notification is vital. This is the deficiency that the present Invention attempts to remedy, by means of detection of a forest fire at the very early stage, so as to enhance or ensure the chance to put it out before it has

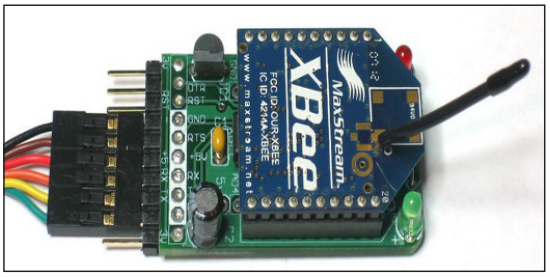

Fig. 1: Zigbee module

Fig. 2: Raspberry Pi Development Board

PROJECT IDEA

To develop a wireless sensor node network using long range Zig Bee module and Raspberry Pi to continuously monitor parameters such as temperature, humidity and air quality at real time and use GPS module to get accurate location of the prototype instalment in the forest then with real time video coverage and condition based picture capturing method to get real time alert on an occurrence of forest fire through SMTP, SMS consisting of a fire alarm message and captured forest fire picture is sent to the user whenever a forest fire is triggered. This entire cost effective setup is equipped with an instant battery monitor at the user end and peltier plates for backup supply.

PROTOTYPE MODEL

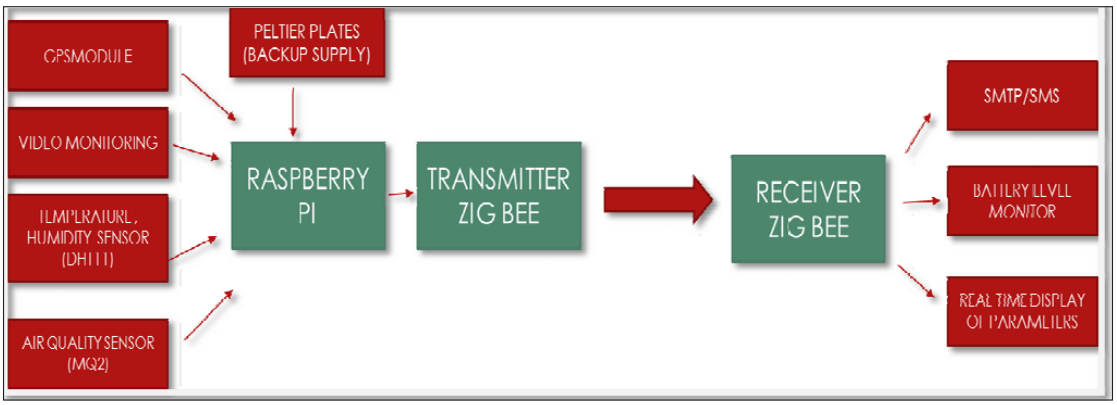

Fig. 3: Block diagram of proposed prototype model

TECHNOLOGY STACK

From Fig. 3. The entire project is controlled by the Raspberry Pi which is connected to an array of sensors to collect real time sensor data and transmit it to the receiver with the use of Zigbee module. The web camera is used for live video monitoring of the area where it is installed and using the GPS module the location of the sensor is constantly sent through SMTP and SMS to the user.

OPERATION

1. The real time transmission and reception of parameters such as humidity, temperature, air quality, and location are obtained.
2. The Raspberry Pi is more efficient than its other counterparts in multiprocessing of data with minimum expenditure of power.
3. The Wireless sensor node network ensures long distance transmission of data from inside dense forest to the receiver even if it has poor network coverage.
4. The forest is scattered with multiple zig bee node points and they transmit it to a central zig bee system and each central zig bee transmits its data individually to the receiver end which receives all sensor data from each node point in of the forest
5. The live monitoring and condition based picture capturing method ensures an additional warning system that forest fire occurred. And is programmed to be in sleep mode when not triggered to save power.
6. SMTP protocol and SMS are an efficient method to send an early warning whenever a forest fire is detected.
7. Through this way an early warning intimation when a forest fire occurs reaches the monitoring station and immediate actions on extinguishing the fire are taken.

EFFICIENT POWER SUPPLY TECHNIQUES

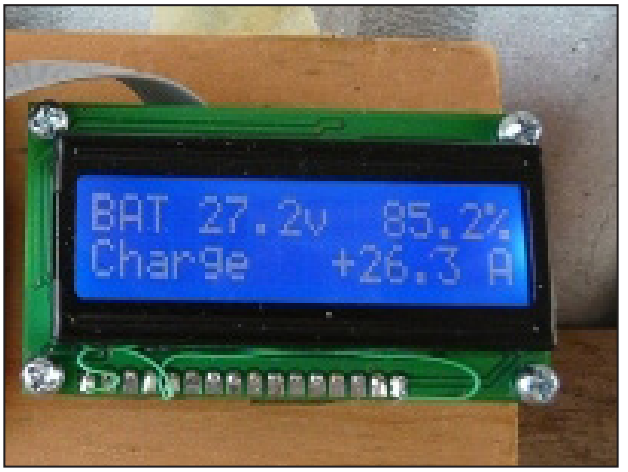

Fig. 4: Battery monitoring display

The entire setup runs in 5v power supply and through python programming the charge status of the battery is made to display at the receiving station to continuously monitor the battery level. Whenever a reduction in battery supply is detected, an array of arranged thermoelectric peltier plates act as a backup power source based on thermoelectric effect, ensuring the operation of the Raspberry Pi until the new batteries are replaced or recharged.

NECESSARY CONDITIONS FOR FOREST FIRE DETECTION

The sensors continuously fetch and transmit data to the receiving station through the wireless zig bee network. Similarily multiple zig bee network transmit data to the receiving station at the same time. The receiving station consists of a receiver zig bee with a display connected to it to view the data.

The following are the conditions fixed for the detection and intimation of forest fire in our prototype:

1. High temperature above set value – due to heat from the fire produced.
2. Decrease in humidity below the set value – as the heat from the fire produced decreases the humidity.
3. Increase in CO_2 and CO content in air above set value which is monitored by MQ2 air quality sensor.
4. When these conditions are satisfied the web camera for live monitoring captures pictures of its surrounding and through SMTP an alarm message intimating a forest fire and the captured pictures are sent to the users' mail and also SMS is sent and immediate action is taking to extinguish the forest fire.
5. The message will comprise of the temperature, humidity, CO_2, CO concentration along with latitude, longitude location of the activated sensor with time and the captured pictures by the web camera.

This entire procedure takes place in real time which is a great advantage.

RESULTS

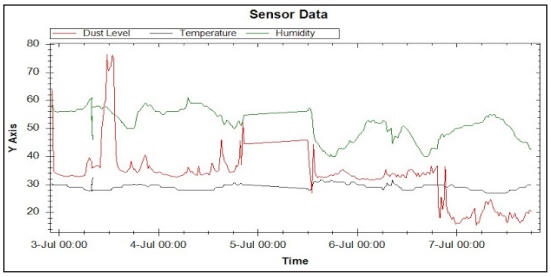

Fig. 5: Graphical representation of the sensor outputs

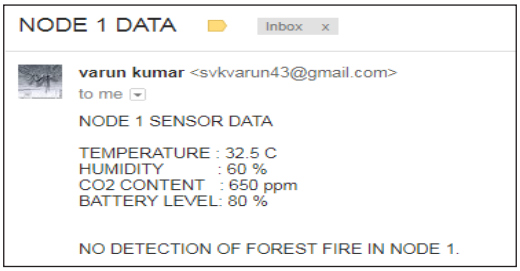

Fig. 6: Real time Mail received through SMTP

MERITS OF THE PROJECT

1. The various merits from the execution of the project has been listed as follows:
2. The entire setup is cost efficient and small in size.
3. Wireless sensor node system ensures coverage of large area of forests.
4. Instalment is simple and highly accurate in its readings
5. Power consumption is minimal and provided with reliable backup power supply.
6. Can be installed deep inside the forest.
7. Equipped with real time video, image, and various parameter sensing features to monitor occurrence of forest fires.
8. The Zig bee / 802.15.4 2.4GHz RF module has outdoor line-of-sight range of 4km while keeping power consumption at a remarkably low level of only 10 micro ampere in the sleep mode, 23mA in receive mode and 60mA in transmit mode which is a solution to transmission of data from interior of the forest to the receiver.

CONCLUSION

Forest are the one of the primary air purifiers and are an essential habitat of many species of plants and animals. Integrating the new technological sensor systems and Internet of things the real time automatic forest fire warning system has been proposed with a view of preventing forest fire. In a world of technological advancements integrating IOT and Wireless sensor networks can prove to be a great asset in real time monitoring of various conditions. Therefore the unique mail delivery system through SMTP and SMS provides an early warning to prevent imminent forest fires and through the Zigbee module long range transmission of data is now possible with minimal expenditure of power. The simple battery monitoring operation can prove extremely useful in assessing the energy maintenance and power usage of the entire setup. Therefore this project when implemented in regions of high forest fire activities can prove to be immensely useful.

REFERENCES

1. Pratik Kumar, Sumit Kumar Rajak, Gaurav Kumar, T. Stephen John, "Vision based flying robot with sensing devices for multi-purpose application", Innovations in Information Embedded and Communication Systems (ICIIECS) 2015 International Conference on, pp. 1-6, 2015.
2. Albert S. Lutakamale, Shubi Kaijage, "Wildfire Monitoring and Detection System Using Wireless Sensor Network: A Case Study of Tanzania", Wireless Sensor Network, vol. 09, pp. 274, 2017, ISSN 1945-3078.
3. Ulf Kulau, Tobias Breuer, Lars Wolf, "A clustering-based characteristic model for unreliable Sensor Network data", Internet of Things (WF-IoT) 2015 IEEE 2nd World Forum on, pp. 351-356, 2015.
4. PengJi, Chengdong Wu, Yunzhou Zhang, Hao Chu, "A wireless sensor network routing protocol for fire estimation in building", Computer Science and Information Technology 2009. ICCSIT 2009. 2nd IEEE International Conference on, pp. 154-158, 2009.
5. Alessandra Esposito, Luciano Tarricone, Marco Zappatore, "A versatile context-aware pervasive monitoring system: Validation and characterization in the health-care domain", Industrial Electronics (ISIE) 2010 IEEE International Symposium on, pp. 2791-2796, 2010.