International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 04 | Apr 2021 www.irjet.net p-ISSN: 2395-0072

Forest Fire Detection using Wireless Sensor Network

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Abstract – *A forest has different types of vegetation like herbs, trees, shrubs and different species of animals. In one way or other, these renewable resources are very essential to mankind. Forest fires are the most common hazards in forests which lead to serious destruction of forest wealth, bio-diversity and natural habitat. Early detection and preventive measures are necessary to protect forests from fires. In order to achieve early detection, there are two most used traditional methods of human surveillance. One is directly through human observation and the other is through distant video surveillance. The other is observation through distant mode, by which one can achieve surveillance through automation approach of detection. The automated fire alert detection system proposed in this paper comprises of two sensors, namely smoke and fire. These sensors detect change in a measurable physical quantity and help in the early detection of a forest fire. A key feature of this fire detection system is to alert the user remotely by using a GSM module, whenever a fire is detected.*

1.0 INTRODUCTION

Forests play an important role in the global, ecological, environmental and recreational system. It greatly impacts the amount of greenhouse gases, atmospheric carbon absorption, and reduces soil erosion. Forests contains many essential resources for human survival and social development that protect the balance of the Earth ecosystem. Forest fires are a recurrent phenomenon, natural or man-made, in many parts of the world. Global warming contributes to the increase in its number in the recent years and importance of these disasters. In this scenario, the frequency of forest fires has increased considerably due to climate change, human activities and other factors. Currently, forest fire detection methods largely consist of vigils, observation from watch towers and lately satellite Monitoring (Lai, et al., 2004). Although Observation from watch towers is easy and realizable, it has 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 detection and monitoring of forest fires has become a global concern in forest fire prevention organizations. This system can monitor real-time related parameters, e.g., temperature, relative humidity, and send the data immediately to the computer of the monitoring center. The fire alert system has low power utilization and quicker handling capacity at a lower cost and maintenance.

1.1LITERATURE SURVEY

Numerous solutions have been proposed and implemented for this problem. Most common systems used in field work are video surveillance systems. Video cameras are sensitive to smoke only in day time. Fire sensitive cameras at night, using IR thermal imaging cameras for heat flux detecting and using backscattering of laser light, detect the smoke particles. This fire alert system has a few limitations because of environmental conditions like dust particles, mist, shadows and so on. Another method is automated picture capturing of fires in forest. Capturing can be done by the cameras which are placed on top of towers. A motor was introduced to give a coverage view on the forest and for its movement (Basu et al., 2018). Captured pictures are processed using program or MATLAB simulation and matching with references taken at beginning stage. This alert system has limitation of false caution rate and visual cameras installed on towers are of high cost. Another method of fire detection is by using satellite systems. Base station collects the information sent by the satellite and runs an algorithm to recognize the facts (Basu et al., 2018). The raw data of satellites are processed and then Advanced Very High Resolution Radiometer instrument is utilized to recognize hotspots. In South Korea, forest fire surveillance system was proposed by using wireless sensor networks. Wireless sensor networks detect humidity and an application analyses the collected information (Hariyanwal et al., 2013; Kumar et al., 2017). In this methodology, there is some loss of information during communication. By using temperature sensor and GPS modem, forest fire detection can be possible (Basu et al., 2018). Here, temperature sensor collected data were sent to base station by both primary and main antennas (Alahi et al., 2017). Continuous power supply was difficult for too many antennas and sensors. In addition to the above limitations climatic changes may affect the system. In a research done by Zhang et al. (2009), Pirbhulal et al. (2017), and Alahi et al. (2017) an ad hoc network using cluster topology for forest fire forecasting model was used to predict fire prone areas. It was concluded that WSNs have greater advantages. In another research done by Demin et al. (2014), sensors were deployed and the weather data were collected. This data were used to calculate and prevent forest fires. In these researches, there was no real-time forest fire monitoring, only the data were collected and fire prone areas were predicted. Libelium (Solobera, 2010) developed a wasp mote which has four sensors for measuring gases,

temperature and humidity. It gives early warnings and consumes very less energy. Shunyang X. Du, J. Yongping and W. Riming, Realization of Home Remote Control Network Based on Zigbee (2007) [5],et al. deals with the design of remote monitoring and controlling systems. The system consists of a real-time home monitoring sub-system and a light control sub-system. A home server with a home camera caters for home status through video to client. Terradas, J. and PiÃ±ol et al. (2009)[2] has conferred this system because the wireless web based system has numerous applications in real time system. A program that analyses satellite data in near real time and converts information into instant messages and email alerts to track forest fires. ICIMOD helped design a system that uses satellite data to monitor and assess the damage of forest fires and then automatically sends SMS messages and emails to district forest officers and rangers so they are better able to monitor a fires growth and direction and alert populations when there may be a need to evacuate, L., N.Wang, et al. (2005)[3](avoidance of fire accident on running train using ZigBee wsn) proposed this system to avoid fire in running train. When fire is noticed in anyone of the compartment, temperature sensor senses the fire by the way of difference between the coach temperature and the critical temperature. It collects the signal of increased temperature and it responses to the driver display unit when it reaches above the critical fire point. Then it invokes three major processes to control the fire explosion. They are Automatic alarm system which alerts all the passengers at sleep during night. ZigBee wireless sensor network which transmits signal to the engine driver panel enabling the warning light and alarm to function. The Engine driver stops the train.

2.0 PROPOSED WORK

This section of the report will include the proposed work as to how the project has been carried out showing the Hardware used, Software's utilized, Algorithms used with respect to deep learning part of the project and working of the project.

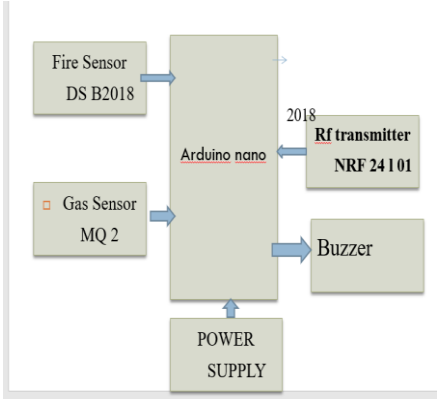

Figure 1. BLOCK DIAGRAM of Transmitter.

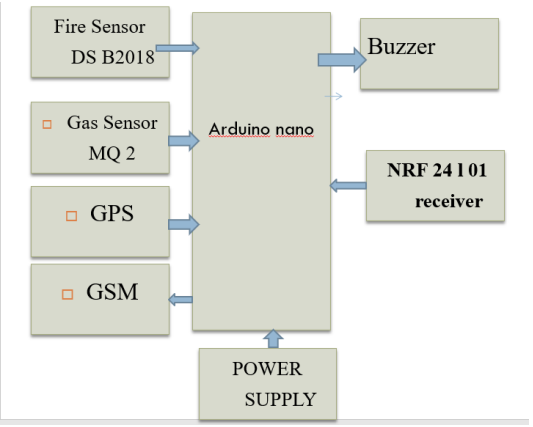

Figure 2. BLOCK DIAGRAM of Receiver

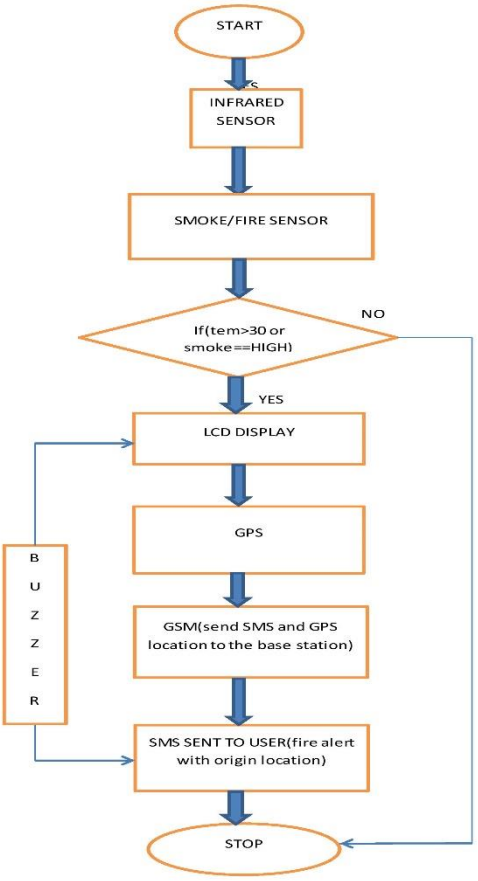

Figure 3:flowchart.

1. Fire alert system comprises of three important stages: sensing, routing and communication. For sensing the physical change in environment, a couple of sensors are used, namely smoke and fire sensor.

2. MQ-2 smoke sensor has very high sensitivity toward propane, methane, LPG, smoke, alcohol, carbon monoxide and hydrogen. At the point of target if combustible gases exist, the sensor's

conductivity rises correspondingly with a rise in concentration of combustible gases at target.

3. The fire sensor, which is highly sensitive and responsive in the presence of a fire is another key sensor. These two sensors help detect a fire in the forest and transmit the data to the leader node via RF transmitter and receiver.

4. The interface of sensors, transformer, rectifiers with Arduino micro controller is in the slave node. If the sensors in slave node detect any fire, the slave node transmits data to RF receiver at master node through RF transmitter.

5. The leader node analyses data from all the slave nodes in its cluster and if there is a fire at any node. When the master node successfully receives data from slave node, the LCD display turns ON and displays "FIRE ALERT", then it will immediately communicate with the base station using GSM modem.

6. This alert gets transmitted to the user via SMS by GSM modem with help of GPS for location.

7. GSM can receive and send messages and it can be interfaced to a computer or to a microcontroller. GSM and GPS module has a very wide coverage and is very energy efficient.

8. GPS is used to send location. The base station is alerted immediately when a node detects fire with location.

3.0 RESULT ANALYSIS

The output of the proposed system is as follows:

The fire and smoke sensors detect the respective elements and this initialises an alert and activates the system. This, in turn, sends the location, which is detected by the GPS module, with an alert message via SMS to the user with the help of the GSM module that has been incorporated into the system. Once the user receives the alert message, the required action can be taken to control and cease the fire.

The wireless transmission using RF, from one node to another node was experimented up to 100 m. As there would not be any obstructions in the forest, the RF modules can work up to half a kilometer efficiently. For GSM module to work properly, there should be a minimum network coverage to send an SMS with location. The nodes can be placed 500 m away from each other, for maximum coverage of the forest area with minimum number of nodes and to perform with good efficiency. Sleep-based topologies are also included so as to reduce energy consumption. The master node must have a bigger battery, because GSM module consumes higher energy. The fire and smoke sensors were tested up to 10 m.

3.1 APLICATIONS

Earlier the detection of the fire, lesser the damage control required. Hence, quick, reliable detection and localization of the fire is required.

1. The main applications of this system is-

2. Forest fire detection

3. Estimating the direction of the fire

4. Detection of origin of the fire to localize as early as possible

5. These networks are widely used in environmental applications, like military application, habitat monitoring, forest fire detection and agricultural research

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