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Forest Fire Using Optimized Solar Powered Wireless Sensor Networks

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ABSTRACT

Forest fires are one of the most important and prevalent type of disasters. They create a great impact on the environment, so the early detection is very vital. The main need for choosing this application is to overcome some faults or problems in existing technologies of basic wireless sensor network-based Forest Fire detection systems, which is developed for detection of forest fires. In a forest there is a network of nodes placed at a suitable distance from each other, the nodes have a capacity to communicate through devices (RF module in our case) and using Arduino. Forest fire initiates at any nodes placed on a tree in the forest. If there is any change in the temperature above the threshold value (temperature rise, smoke in the air, etc.) near a node, information is passed to a nearest intermediate node until it reaches to a main terminal. Main terminal uses a GSM modem to pass the information to a cell phone (monitoring center).In this way the message flow is regulated in this model. Each node has a temperature and humidity sensor and a smoke sensor. There is a predefined threshold value to each of these parameters. The microprocessor compares the sensor values at regular intervals with the threshold values. Based on these values the sensor detects the threshold increase and the node transmits the information

1.INTRODUCTION

Forests are part of the important resources for human survival and social development that protect the balance of the earth ecology.However, because of some uncontrolled activities and abnormal natural conditions, forest fires occur frequently.These forest fires are among the most serious disasters to forest resources and the human environment.The prevention and monitoring of forest fires has become a global concern in Forest Fire prevention organizations as in the recent years the frequency of forest fires has increased considerably due to climate changesand other factors. Forest Fire prevention methods largely consist of Patrols, Observation from watch towers, satellite monitoring and lately Wireless Sensor Networks. For example, observation from the watch tower is feasible but have some defects as in this method requires financial and material resources along with skilled labor. Major problem which arises during the monitoring process are carelessness, absence from the post, inability for real-time monitoring and the limited area coverage.

Pallavi C. et.al. [1] also tells that mechanical modeling for accessible and inaccessible areas helps in easy implementation of forest area module and system can be upgraded with low power elements. M.Anand [2] used high efficiency MPPT Algorithm to make the system run for longer period and increased efficiency. The author used the two main modules present in the project are the Monitoring Area Module and the Forest Area Module. Those include Sensors' Module, Serial Communication Module using Zigbee, Optimized Solar Energy Harvester using Maximum Power Point Tracking (MPPT), PC-based Web Server and Mechanical Modeling. The first three sub-modules belong to the Forest Area Module. They are integrated together, and mechanical modeling is done to place it in the forest, whereas the PC-based Web Server is developed for the Monitoring Area. The author of [3] used neural networks for high accuracy in the results and fast detection. Aditi Kansal et.al. [4] stated that how regression works fastest than other machine learning techniques like SVM, neural networks, etc. in forest fire detection. Mohamed Hefeeda[5] used FWI (Forest Weather Index) which was a collective data of a decade of the forest. It also comprises of 6 components- 3 fuel codes and 3 fire indexes wherein fuel codes represent the moisture content of the soil and fire indexes represent the behavior of the fire.

2.WORKING OF PROPOSED MODEL

When a fire in the forest is detected, the location information is sent to forest department through GPS and fire detector alarm. Through our model the temperature of forest area is also detected so that the fire can be controlled.Basically, in a forest there are nodes placed at suitable distances from each other, these nodes have a capability to communicate through devices such as RF module and by using Arduino. If any change above a threshold value is found in the atmospheric parameters like temperature rise, contamination of air with smoke, etc. near a node (source node), the information is passed to a nearest intermediate node until it reaches to the main terminal. The main terminal uses a GSM modem to pass the information to a cell phone. The block diagram of the proposed model is shown in Fig. 1

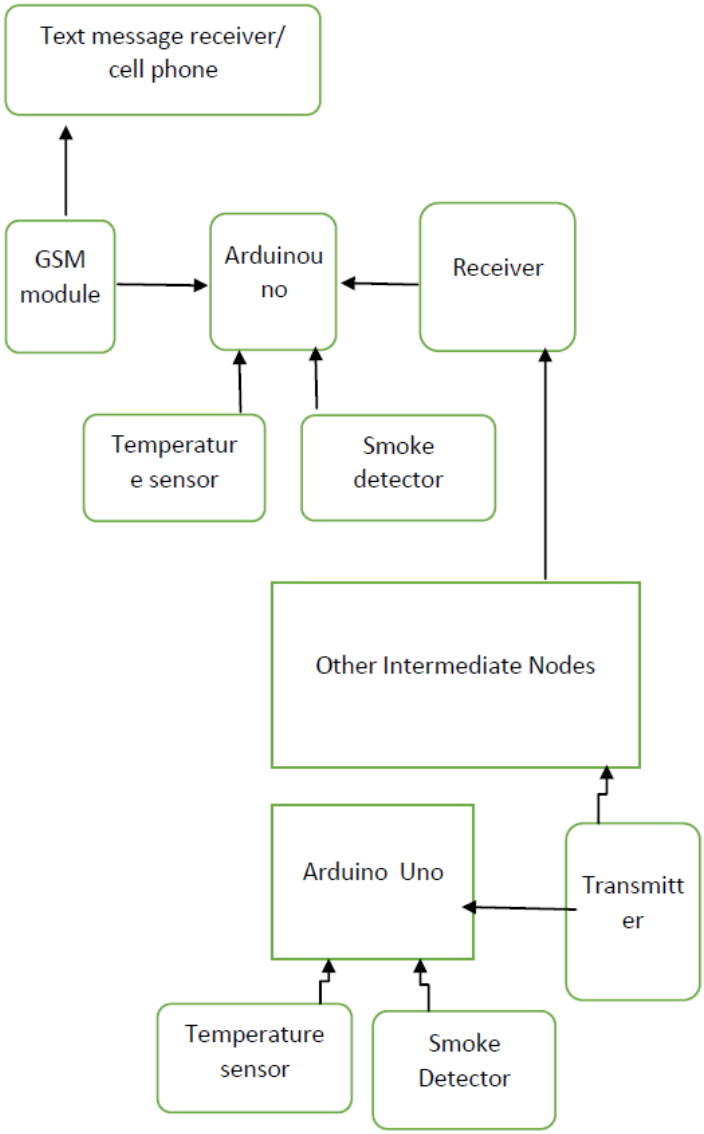

Fig 1 Block diagram of the proposed model

2.1 Power Supply

First part of the project is the power supply. Block diagram of the power supply used in the project is given in Fig. 2.

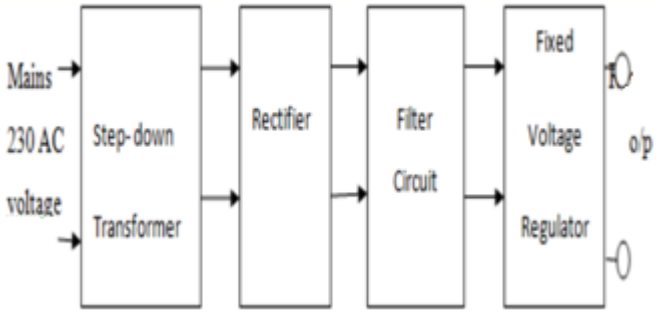

Fig. 2 Block diagram of power supply

A power supply is an electrical device that supplies electric power to an electric load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. Using step down transformer AC voltage is converted into 12V ac from the main supply, then this step-down voltage is given to full wave bridge rectifier circuit which converts the ac voltage into a pulsating dc voltage. Since output of the rectifier is not completely a dc voltage, we use a filter circuit to remove the ripples from the rectified output.

2.2 SMOKE SENSOR

A smoke sensor as shown in Fig. 3 is a device that senses smoke, typically as an indicator of fire. Commercial security devices issue a signal to a fire alarm control pattern as part of a fire alarm system, while household smoke detectors, also known as smoke alarms, generally issue a local audible or visual alarm from the detector itself.

Fig. 3 Smoke sensor

2.3 TEMPERATURE SENSOR LM35

A temperature sensor is a device, usually an RTD (resistance temperature detector), that collects the data about temperature from a particular source and converts the data into understandable form for a device or an observer. LM35 as shown in Fig. 4 is a precision IC temperature sensor with its output proportional to the temperature in degree Celsius (°C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. Temperature can be measured more accurately with LM35 than with a thermistor. It does not cause more than 0.1°C temperature rise in still air.

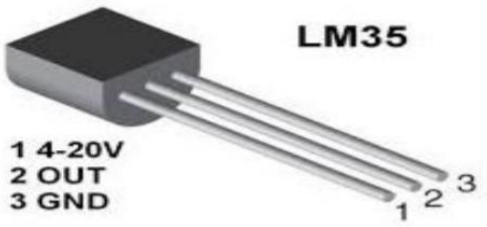

Fig. 4 Temperature sensor LM35

2.4 RF MODULE

An RF module as shown in Fig. 5 is a small electronic device used to transmit and receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. The RF modules are very small in dimension and also have a wide operating voltage, example – from 3V to 12V. Generally, the wireless systems designer has two overriding constraints it must operate over a certain distance and transfer a certain amount of information within a data rate.

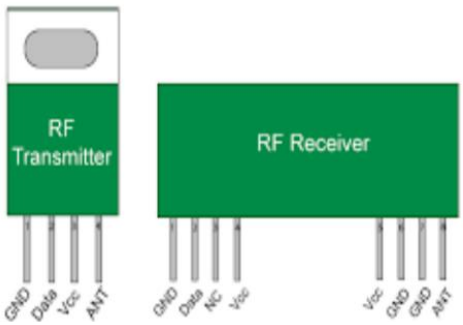

Fig. 5 RF Module

The working of the proposed model which shown in the block diagram of Fig. 1 explains that when the temperature increasesfrom the set threshold

value, the temperature sensors present on the node will detect it or the smoke of the fire will be detected by the smoke detector. This node will pass the signal to the adjacent nodes and this process will go on till the message is delivered to the main node. Then this main node transfers the message to the mobile indicating "Fire Alert" in the main post. The whole process of data transfer and detection will be done by Arduino using coding in the software. After the message received the team of watchers will go and rescue the forest with help of water, sand and etc. and will call for more help so that the fire couldn't spread. So, by this whole process the forest, the property and most important the animals living in that forest could be saved from a major disaster.

3.CONCLUSION

By using this technology, we can prevent forests from the lot of damages. It also helps us to let us know where the fire has broken which will further help usto stop it from spreading. It can be ensured that the system developed can be implemented on a large scale due to its promising results. Mechanical modeling for accessible and inaccessible areas helps in the easy implementation of the Forest Area modules. The system can also be upgraded with low-power elements.

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