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Solar Powered Wireless Forest Fire Detection

Chaitali Tikhe[1], Nimisha Rail[2]

Asst. Professor Department of Electronics, Dr. D.Y. Patil College, Pimpri, Pune, India[1,2]

Abstract: A forest consists of different types of trees, herbs shrubs and other verity of vegetation. In different ways this renewable resource is helpful to man. The most common hazard in forests is forests fire. Forests fires are as old as the forests themselves. This fire seriously damages forest wealth as well as the bio-diversity gets disturbed. Since forest is very important natural resource it has a great impact on environment due to which their early detection is very vital. The aim of our project is to continuously monitoring forest condition, detect ion of forest fire and its position and to inform the forest authority. So that necessary action can be taken immediately in case of fire. The two main modules present in the project are the Monitoring Area Module and the Forest Area Module. This paper gives an importance of wireless sensor technology. The DHT 11 sensors collect the data and transmit to the central unit as well as alert is send via call or message using GSM. It also shows that the Optimized Solar Energy Harvester increases the efficiency to about 90%.

Keywords: GSM, GPS, RF, DHT11,Wireless Sensor Technology.

I. INTRODUCTION

An uncontrolled forest fire can devastate everything in its path, spread for miles, crossing rivers and roads. Each year, between **60**,000 and 80,000 forest fires occur, destroying between 3 and 10 million hectares. Depending on the different causes, there will be different effects on the environment.
A few hundred years ago**,** forest fires were a natural "activity" caused mostly by rare phenomena, such as a volcanic eruption or an earthquake or lightning. But today, natural causes are much less frequent and now give place to human activities. Since a forest is a valuable natural resource it must be safe from frequent occurring of fire and hence we need an early warning system and real time data transfer**.** The use of solar power system resolves the power supply requirement to the system as well as wireless sensor in this paper presents one of the techniques for early forest fire detection.

II. RELATED WORK

Stipanicev D., Vuko T., Krstinic D., Stula M., Bodrozic L presented a paper on Video Surveillance System for early detection of fire in forest [1]. It is divided into four categories: Video Cameras sensitive in visible spectrum based on recognition of smoke during day light and fire flames at night, Infrared (IR) Thermal Imaging cameras based on detection of heat flux from the fire, IR Spectrometer which identify spectral characteristics of smoke gases and Light Detection and Ranging (LIDAR) system which measures the laser light backscattered by smoke particles. The limitation of these systems was high false alarm rate due to atmospheric conditions such as presence of fog, shadows, dust particles etc.
Losso A., Corgnati L., Perona G. used Visual Cameras which were mounted on the top of communication towers to take photos of the forest to detect the fire. With the help of rotating motor the images are obtained from the camera and using MATLAB code they are processed and are compared with the initial reference images
Another method is the use of satellite system to detect the forest fire. The main components of the system are satellite(s) and the base station that collects the data send by the satellite(s) and runs the analyzing algorithm. The raw data from the satellite(s) is processed and then Advanced Very High Resolution Radiometer (AVHRR) instrument is used to detect presence of Hot Spots. However the clouds greatly affect the system [4, 5].

III. PROPOSED SYSTEM

DHT11 is a humidity and Temperature Sensor, which generates calibrated digital output. For measuring humidity they use the humidity sensing component which has two electrodes with moisture holding substrate between them. Due to change in the humidity there is a corresponding change in the conductivity of the substrate and also the resistance between these electrodes changes. On the other hand, for measuring temperature these sensors use a NTC temperature sensor or a thermistor. A thermistor is actually a variable resistor that changes its resistance with change of the temperature. These sensors are made by sintering of semi conductive materials such as ceramics or polymers in order to provide larger changes in the resistance with just small changes in temperature. The term "NTC" means "Negative Temperature Coefficient", which means that the resistance decreases with increase of the temperature.

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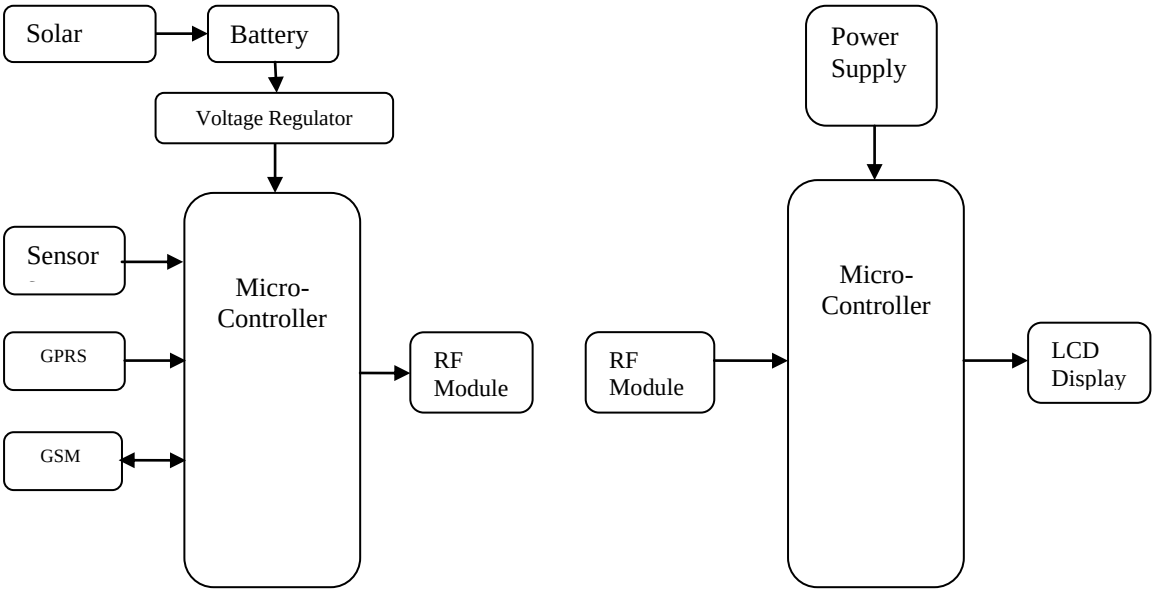

Fig.1. Block Diagram of Proposed System

DHT 11:

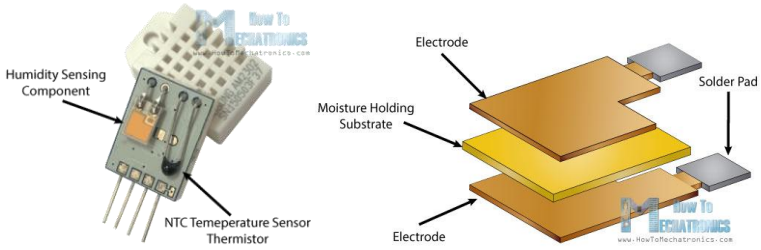

Fig.2. Structure of DHT 11

GPS:

A GPS module is the Global Positioning System to determine the location of a required area. GPS receivers are used to provide reliable navigation, positioning and timing services to the users at anytime and anywhere on the earth. By using 24 to 32 satellites GPS provides data to the receivers. GPS module calculates the position by reading the signals that are transmitted by the satellites. Each satellite transmits the messages continuously which contains time was sent. Based on the information received by the receiver position is calculated. The received raw data is converted for the user as LATITUDE, LONGITUDE, ALTITUDE, SPEED and TIME.

GSM:

GSM Global System for Mobile communications module which is used to communicate over a network like a mobile phone. To communicate over a network it accepts a SIM card and performs the function such as calling, sending or receiving message over the network. The GSM module can be communicate with the PC or microcontroller. The communication between the GSM and microcontroller is done by the means of serial communication. The communication between the GSM and PC is done by using serial port (RS232 & the communication between the GSM and microcontroller is done through the TTL pins Rx and Tx.

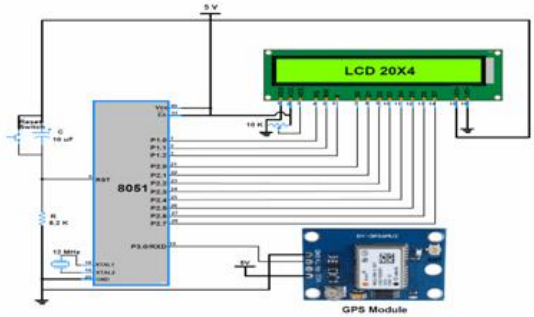

Fig.3. Interfacing of GPS with Microcontroller 8051

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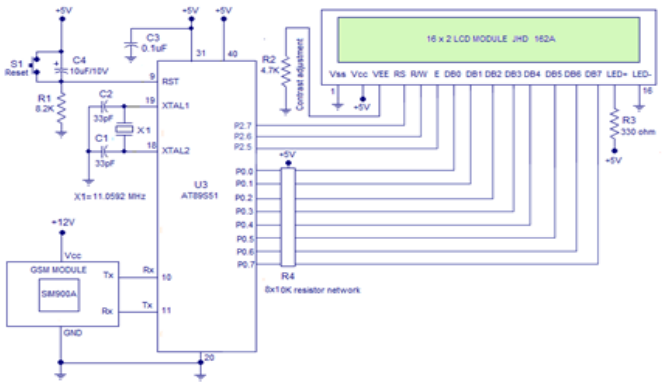

Fig.4. Interfacing of GSM with Microcontroller 8051

Figure shows the interfacing of GSM module to 8051 microcontroller. The communication between the GSM module and the microcontroller is done by using serial communication. Rx pin of the 8051 is connected to Tx pin of the GSM module and Tx pin of the 8051 is connected to the Rx pin of the GSM module. In our system if fire is detected SMS is send to forest authorities through GSM.

Solar DC Power Supply with battery charging

In our project we are using solar panel to provide supply to the controlling unit at the forest side. Since in a forest the electrical energy may be critical and sun is a big source of energy during the day time. In a day time battery is charged as well as it is used as a supply for controlling unit.

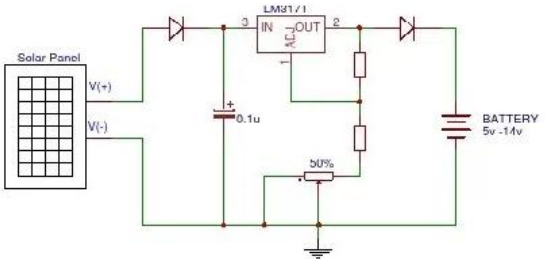

Fig.5. Solar DC Power Supply with battery charging

Figure shows the Solar battery charger. As shown in the figure it consists of LM 317. LM 317 is a voltage regulator IC which provides constant output voltage in the range of 1.25V – 37V. The required output voltage can be adjusted precisely by adjusting the value of external resistor. Battery is charged using the same current. LM317 can produce a voltage from 1.25 to 37 volts maximum and maximum current of 1.5 Amps.

RF module:

The RF module operates at Radio Frequency in the range of 30 kHz & 300 GHz. In this RF system, RF module uses Amplitude Shift Keying (ASK) in which amplitude of carrier changes according to the digital data. RF signals can travel long distance hence for large range applications. RF signals can easily travel from transmitter to receiver even though there is an obstruction between them**.** The RF **module consists o**f an **RF Transmitter** and an **RF Receiver which operates at a frequency of 434MHz.** The speed of RF transmission is from 1Kbps - 10Kbps.

WSN and Structure of the Sensor Node:

A Wireless Sensor Network consist of different types of sensors such as humidity, temperature etc and self directed, minute, low powered devices named sensor nodes called motes. These networks covers certain distant areas and consist of battery operated, embedded devices. These devices are connected in network to collect process and transfer data to the operators. The operators use this data for further processing and analysis.

CONCLUSION

An advanced system for Forest Fire Detection was developed which overcomes the demerits of the Existing technologies of Forest Fire Detection. This paper describes a WSN for early detection of forest fires. This network can be easily deployed at areas of special interest or risk. The use of solar energy overcomes the power supply requirement which is difficult to provide in forest. The RF Module is used for transmission and reception of data. The DHT 11 sensor gives indication of temperature and humidity. The position is determined by GPS module and if the temperature

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and humidity values are greater than threshold value then the alert is send to base station through call or SMS. With the help of mesh network the size of node as well as distance between the nodes can be increased upto several kilometres.

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