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FOREST FIRE DETECTION USING LORA MESH NETWORK

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Abstract

California's recent wildfire has devastated several businesses and homes. A wildfire broke out on July 14 this year and consumed 2, 78, 000 hectares. On the basis of statistics from, the forest inventory, 35.71% of India's woods have never detected a fire of any significance, while the rest 54.40% have had occasional millenniums, 7.49% have experienced typical millenniums, and 2.405 have experienced high incidence rates. Annual forest fires, which have a negative impact on the mobility of forest commodities and services, result in the loss of valuable forest resources, including carbon stored in biomass. The project aims to provide 24/7 forest fire monitoring and tracking service. The fire sensor module and the CO2 gas detection module are used to detect flames and increase the concentration of CO2 gas in the air due to smoke, respectively. In these spaced networks, the LoRa module is used for long-distance access. For its compact size, and many features such as built-in Wi-Fi, we use the ESP8266 microcontroller.

Keywords: IoT: Internet of things, ESP8266: Micro Controller (NodeMCU), MQ-135: Smoke sensor, LoRa Module: Long Range module, DAC: Digital to analog converter

1. INTRODUCTION

The most common danger in forests is forest fires. They observed a threat in forest resources as well as to the entire state of wildlife and the wildlife that is most affected by biodiversity and the environment and the environment of the region. In the summer, when there is no rain for many months, the forests are covered with dry, fragrant leaves, which may burst into flames. Himalayan forests, in particular, the Garhwal Himalayas have been burning every summer for the past few years, with significant losses of vegetation of that region. The purpose of this project is to explored LORA Mesh Network-based system to test forest fires and send an emergency signal or message to the appropriate person [1-3]. The IoT program aims to provide forest fire monitoring and detection services 24/7. If a fire appears to be starting, a fire spread in a large area can be prevented and immediate steps to improve the fire. LoRa Mesh transmitter and receiver contains components like flame sensor, CO2 gas sensor and GSM module. This can predict and detect forest fires and send a direct signal to affected officials. The main purpose of this method is to informed and prevents forest fires in advance [4-7]. LoRa WAN are used for wetland and forest fires, with the benefits of low power and long-distance transmission of LoRA WAN are very effective to detect the object with remotest hotspot and IoT-based forest fire detection across a wide area using Arduino. As a result, when the temperature rises, it will send a signal of awareness and a message to the authorities.This method allows us to preservethe forest and wildlife.Our strategy will be crucial in averting forest fires, which could prevent significant resource losses and monetary losses. [8].

According to statistics from the forest inventory, 35.71% of India's woods have never experienced a fire of any significance, while the remaining 54.40% have had occasional millenniums, 7.49% have experienced typical millenniums, and 2.405 have experienced high incidence rates. Forest fires create environmental inequality and endanger biodiversity by reducing the richness of animals and flowers. Forest fires degrade the fertility of soil also[10-12]. Traditional methods of fire prevention are not effective and it is now important to raise public awareness of this issue, especially for those who live near or in forested areas [9-24].

In this paper, section 2 explored an overview of forest fire method. The description of the components with their working is given in section 3. The working principle of forest fire detection device is explored in section 4 and their summary is shown in section 5.

2. PROPOSED SYSTEM

The proposed system (device) consists of a fire sensor module and a CO2 (Carbon Dioxide) gas sensor module, both of which are connected to a microcontroller (ESP8266). The fire sensor module will detect the fire while the CO2 gas sensor module will detect an increase in the concentration of CO2 gas in the air. The LoRa (Long Range) module will also be attached with a small controller. The LoRa module will help build a mesh network using LoRa Technology. As a mesh network is used,

this can cover a large area of forest. LoRa is a transceiver module that sends and receives data over radio waves. It detects the forest areas which is burning and alert the forest fire officer. The GSM module here gives the exact location with latitude and longitude that in which forest area fire is caught in the form of message.

Fig. 1 Transceiver Block Diagram

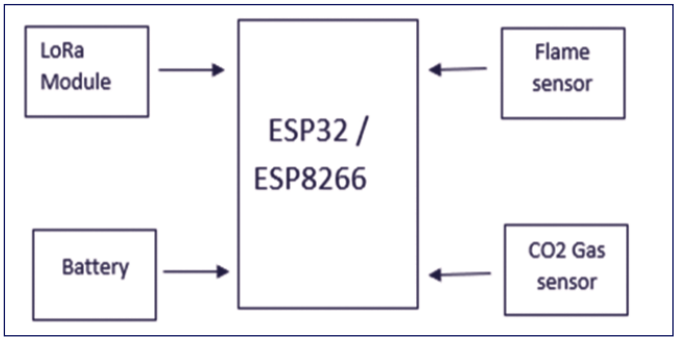
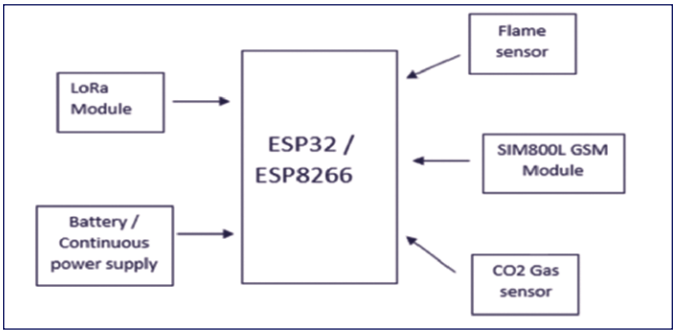


Fig. 2 Master node Block Diagram



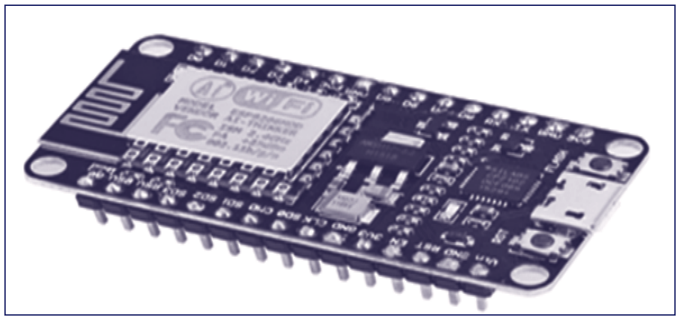
3. COMPONENTS DESCRIPTION

3.1 Hardware Components

3.1.1 ESP8266 (Node MCU)

Node MCUESP8266 Wifi Module is an open-source designed development board and firmware for IoT based applications. It features hardware based on the ESP12 module toruns on EspressSystems' ESP8266 Wi-Fi SoC.

Fig. 3 Node MCU



3.1.2 Smoke Sensor (MQ-135)

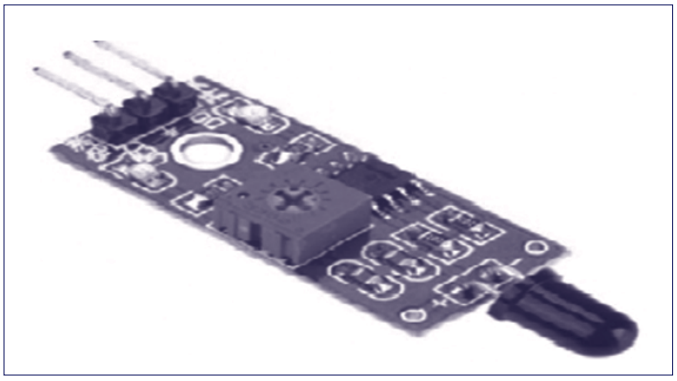
Digital and analogue output pins are present on this sensor to identified poisonous smokes and gases as NH3, S, C6H6, CO and CO2. The approximate concentration of these gases in the atmosphere is determined using the analogue output pin.

Fig. 4 Smoke Sensor

3.1.3 Flame Sensor

A sensor is used to both for detecting and reacting the object for prevents the fire and flame in forest. The flame detection response may be impacted by its fitting. It can serve as an alarm system, a propane line, a natural gas line, and a fire suppression system.

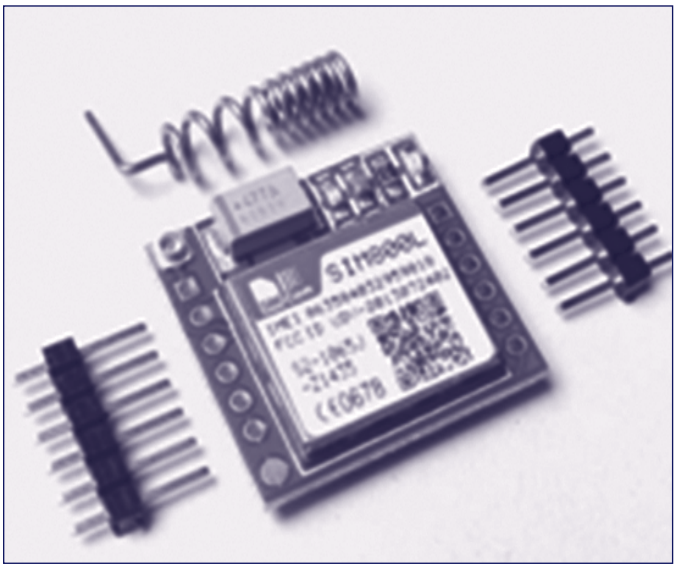
Fig. 5 Flame sensor



3.1.4 GSM module

Generally GSM are used to Global System in Mobile Communication. It enables a communication between a microcontroller or microprocessor and GSM. The GSM module here gives the exact location with latitude and longitude that in which forest area fire is caught in the form of message.

Fig. 6 GSM module



3.1.5 LoRa 1276 Module

The LoRa TM long range modem, is a feature of the 868MHz SX1276 RF transceivers. The industry leading link budget produced by the high sensitivity in combination with the built +20dBm power amplifier makes it the best option for any application needing range or resilience. It covers a large area.

Fig. 7 LoRa module

3.2 Software Components

3.2.1 Embedded C

The most popular programming language for creating software for electronic appliances is embedded C. Each processor utilised in an electronic system is connected to embedded software. The embedded C programming is essential for the processor to carry out particular tasks.We utilise a variety of technological devices in our daily lives, including our mobile phones, washing machines, digital cameras, etc. These devices' whole operation is based on embedded C-programmed microcontrollers.

3.2.2 Arduino IDE

The C and C routines used to create the Arduino Integrated Development Environment (IDE) make it a cross-platform application that runs on Windows, macOS, and Linux. It is used to create and upload programmes to boards that are compatible with Arduino.The Arduino IDE has specific law structure principles to support the languages C and C.Many typical input and yield operations are provided by the software library from the Wiring design that is provided by the Arduino IDE.For the sketch and the main programme circle, Stoner's written law only needs two introduction functions,

which are collected and linked with a programme grubber and main into an executable cyclic administrator programme with the GNU toolchain, also provided with the IDE distribution. The executable law is converted by the Arduino IDE's use of the programme avrdude into a text train in hexadecimal coding, which is then loaded into the Arduino board by a programme in the board's firmware.By neglect, the user law is uploaded onto authorised Arduino boards using avrdude as the uploading tool.

4. WORKING PRINCIPLE OF FOREST FIRE DETECTION

The nodes in the mesh network as fig. 8 and 9 are located in the jungle i.e. the slave nodes contain a fire sensor and a smoke sensor. The smoke sensor is connected to the analog pin of the microcontroller and continuously emits an analog amount of Carbon dioxide present in the air while the fire sensor is connected to the digital microcontroller pin and provides a digital value (if flame is then 1 then 0). These values are sent to the main node i.e. the node that contains the GSM module in aJSON message format. This message contains readings of both sensors, latitude and node length and node number.The Master node analyzes the readings of both sensors. If the value of any sensor is above / below a certain value then there is smoke or fire detected. Now the master node will immediately send a text message to the control center. The message is a Google map link that contains the latitude and longitude of the node where the fire is detected.

Fig. 8 Forest Fire Detection Nodes

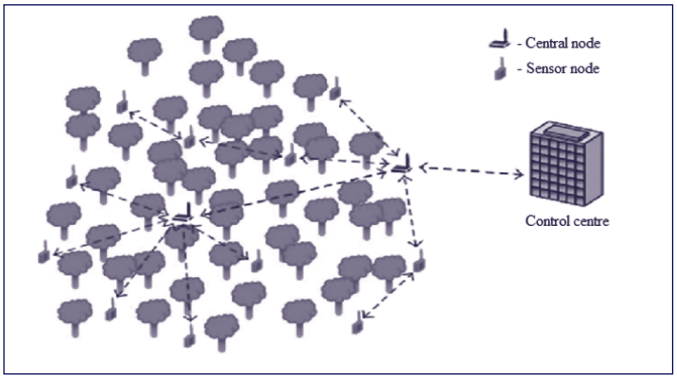
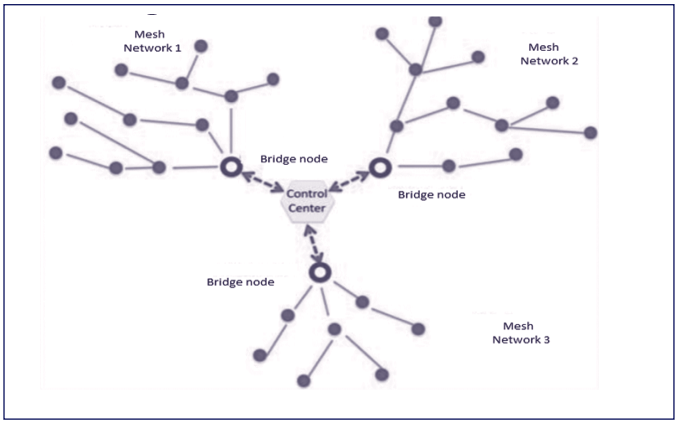


Fig. 9 Mesh Network Structure



5. CONCLUSION

The proposed plan will help reduce the number of forest fires worldwide. It can be used with a small embedded system on the board and will respond effectively and help login. Reducing forest temperature regularly will also help save the environment and animal health. This design requires minimal cost and embedded devices, it is easy to install, manage and build.A communication system may be established for people living near the forest to receive notification in the event of a fire.All components can be integrated into a single small embedded system, which will help reduce costs and system size.An animal tracking system can also be connected to a mesh network so that the animal's living environment can be identified.Strong and broad acquisition compared to non-stationary sensors.

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