

LOW COST & EFFECTIVE EARLY FOREST / BUSH FIRE DETECTION WITH WIRELESS SENSOR TECHNOLOGY USING MATLAB

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Abstract : A wildfire is often caused by human activity or sometimes natural phenomenon like lightning or lava. Hence detecting fire during initial stage is vital for preventing such events. Recently huge number of technologies have shown that exploring spatial and temporal features of the sequence is important for this task. Nevertheless, since the long distance smoke usually moves slowly and lacks significant landscapes, accurate smoke prediction and detection is still a challenging task. The objective of this project work is to design and implement an IoT based real-time system which is self-sustaining and would predict and detect the forest fires and sends the exact location to concerned officials which would help fire fighting personnel to extinguish the fire in the location where it starts slowly. It also used a sprinkler which is used to spray water with a desired pressure. This project presents a low-cost Internet of Things (IoT) prototype for fire detection in outdoor environments based on sensors and Low Power Wide Area Network (LPWAN), focused on the accuracy in the temperature and gas measurement. For this achievement, we integrated sensor components, microcontroller board, and wireless Zigbee module, following the management of information updates through MATLAB visualization for the alarm and notification settings based on the data gathered from the sensors.

Keywords: MATLAB, microcontroller, IoT, Sensors.

I INTRODUCTION

A wildfire is an unplanned fire that burns in a natural area such as a forest, grassland or prairie. The risk of wildfires increases in extremely dry conditions, such as drought, and during high winds. Wildfires can disrupt transportation, communications, power and gas services and water supply. They also lead to deterioration of the air quality and loss of property, crops, resources, animals and people. The main objective of this project is to detect and prevent the damages caused by the forest fire. This process is done by the wireless sensor technology (i.e) Zigbee and MATLAB. Because of some uncontrolled anthropogenic activities and abnormal natural conditions, forest fires occur frequently. Sensor technology has been widely used in fire detection, usually depending on sensing physical parameters such as changes in pressure, humidity and temperature.

In this paper, the exact location through GPS will be used for effective communication from the forest to the officials. Zigbee module acts as a transmitter and receiver for the transfer of information. MATLAB coding consists of the algorithms written to process the data and controls the entire working of the system. Also the ports are chosen and conversion of analog to digital data is done through this algorithm. As a result the changes in temperature, smoke and light intensity is displayed in the pop up window accompanying in the LCD display as FIRE DETECTED. Through this method we can detect and warn the officials for the emergency occurred to neglect the fire.

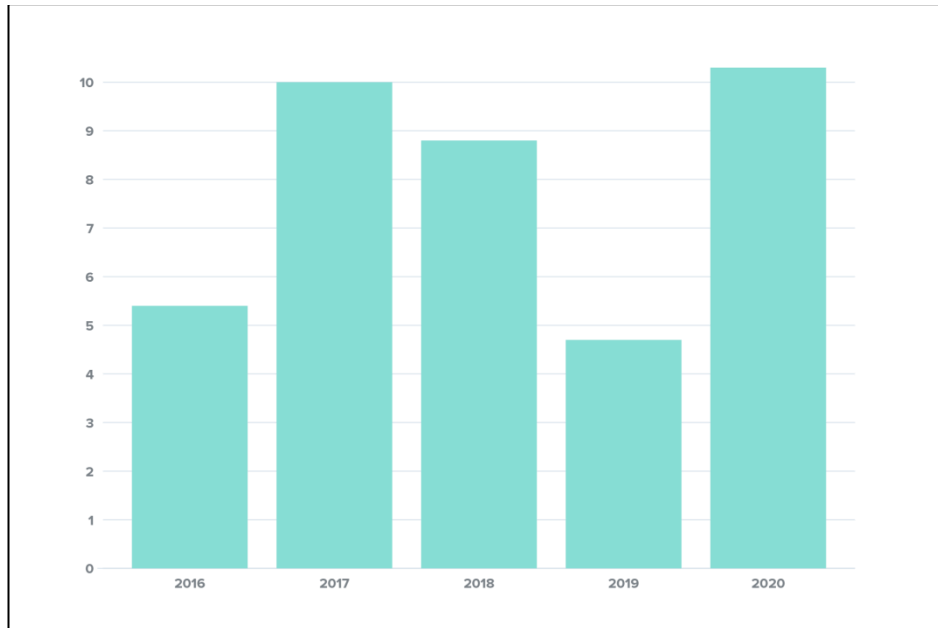


FIGURE 1 : FOREST FIRE OCCURRENCE IN YEARS(x-axis) Vs ACRES IN MILLION(y-axis)

Countries	Places	Areas affected
Asia	Uttarakhand Forest Fire Siberia Wild Fire	1.5 million hectares
Europe	Chernobyl Exclusion zone wild fires	1 million hectares
United States	California Wild Fires Nevada Wild Fires New Mexico Wild Fires Washington Wild Fires Utah Bush fires Oregon Forest Fires	10 million hectares
Oceania	Australian bushfire season	1.2 million hectares

TABLE 1: COUNTRIES FACING FOREST FIRE WITH TOTAL AREA AFFECTED

A wildfire, bushfire, wildland fire or rural fire is an unplanned, unwanted, uncontrolled fire in an area of combustible vegetation starting in rural areas and urban areas. Wildfires are among the most common forms of natural disaster in some regions, including Siberia, California and Australia.. Areas with mediterranean climates or in the taiga biome are particularly susceptible. Fossil charcoal indicates that wildfires began soon after the appearance of terrestrial plants 420 million years ago. The occurrence of wildfires throughout the history of terrestrial life invites conjecture that fire must have had pronounced evolutionary effects on most ecosystems' flora and fauna. Earth is an intrinsically flammable planet owing to its cover of carbon-rich vegetation, seasonally dry climates, atmospheric oxygen, and widespread lightning and volcanic ignitions

II SYSTEM MODEL AND ASSUMPTION

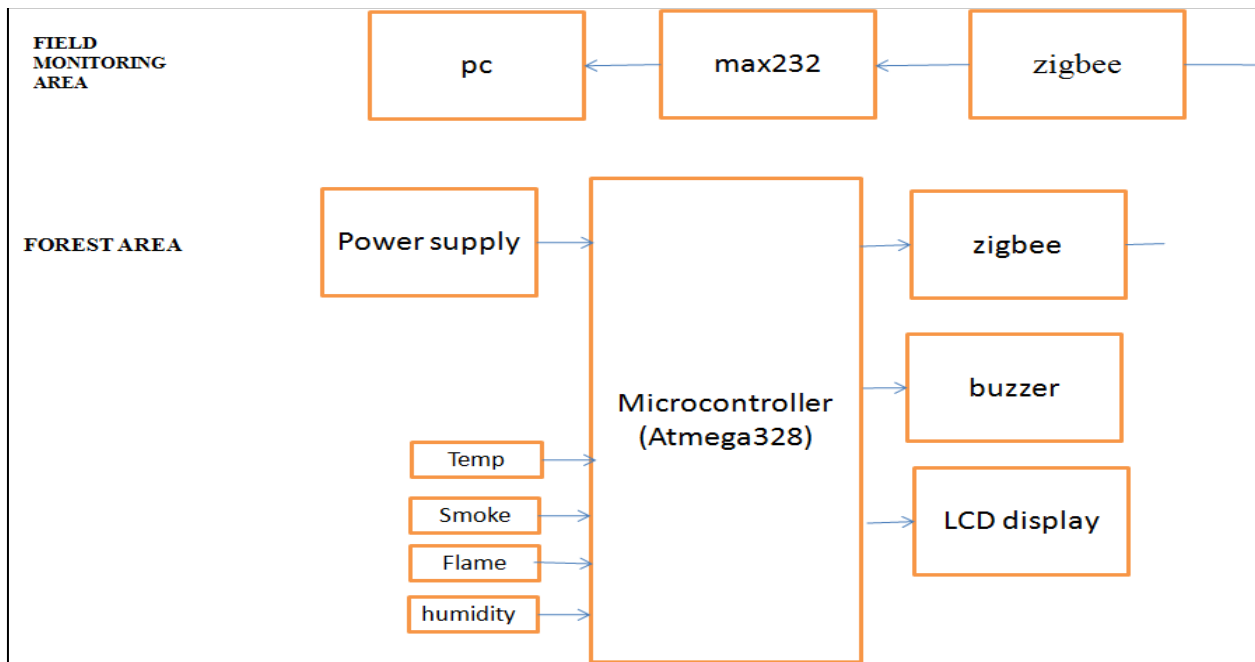


FIGURE 2: SCHEMATIC DIAGRAM OF FOREST FIRE DETECTION WITH WIRELESS TECHNOLOGY

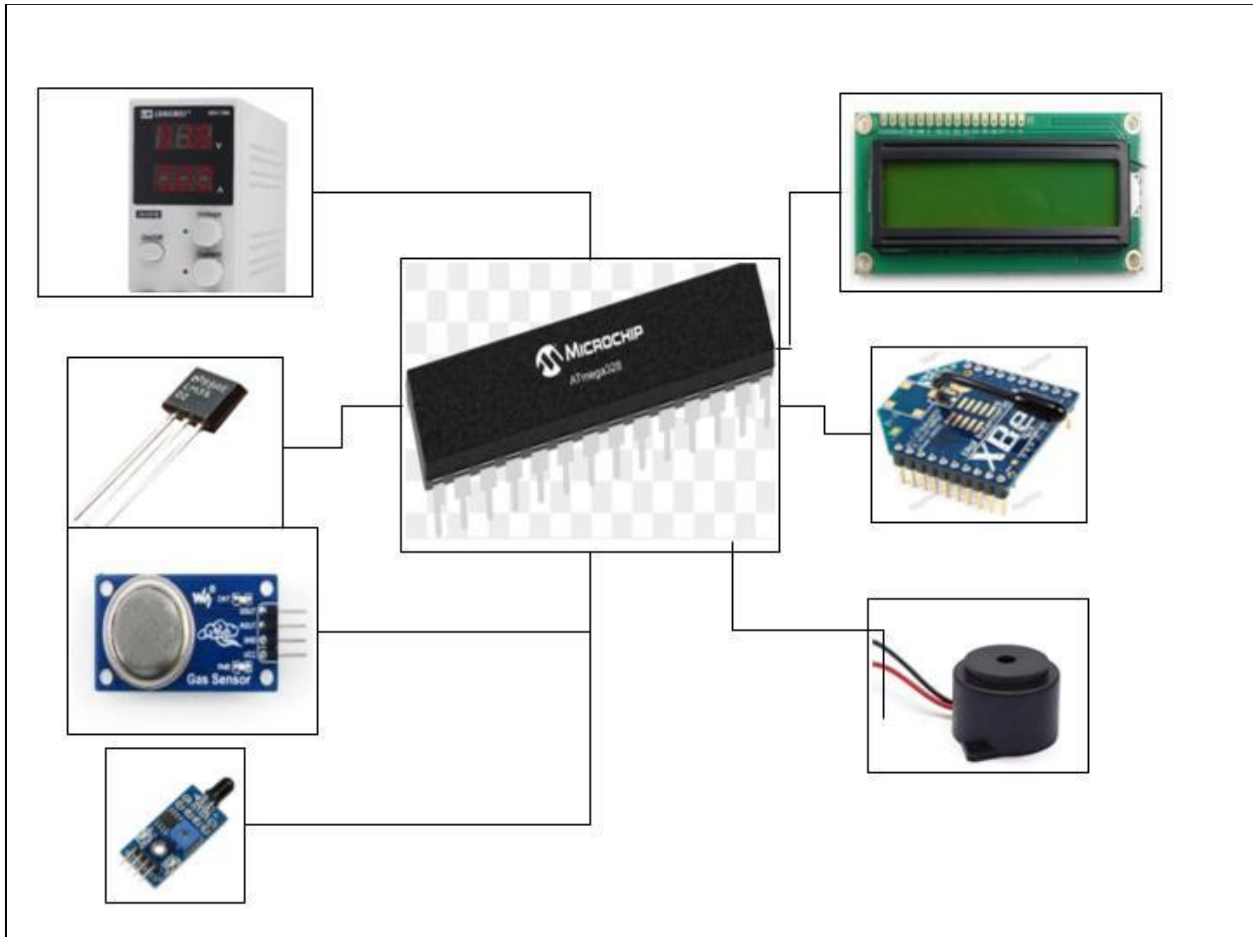
WORKING PRINCIPLE :

The voltage regulator is designed to automatically maintain the constant power. Then the sensors such as temperature, fire and smoke are connected to the microcontroller(ATmega328) to detect the particular parameters which is high performance, low power controller from microchip. Buzzer is connected for the indication purpose. LCD is used to display an alert as FIRE DETECTED. ZIGBEE is the main component which is used for transmitting and receiving purposes.

Zigbee is used to transfer the data which is connected to wireless sensor networks .Also Zigbee is used to receive the data which is connected to pc through the USB port.which gives an output as mail to the forest officials. The mail consists of the following information such as location of that area, ranges of the temperature, smoke and fire detected message with an alert. The pc is used to perform the MATLAB coding.

Temperature sensor (LM35) and fire sensor consists of 3pins .pin1 for Vcc , pin2 for output pin3 for ground. Gas sensor(MQ135) consists of 4pins. pin 1 for vcc, pin2 for ground, pin3,4 for digital and analog outputs and they are interconnected. The Arduino Nano is a small, complete, and breadboard friendly based on ATmega328. ATmega pins are connected to the LCD. D2 and D3 are connected to 4 and 5 of the LCD. D4,D5,D6,D7 are connected to DB4,DB5,DB6,DB7. The last two pins of the LCD are connected to 5v and ground respectively. Coding is performed on the MATLAB platform and is interfaced with the ATmega328 through the USB.

Fire sensor is connected to A0 of Arduino, Temperature sensor is connected to A1 of Arduino and smoke is connected to A2 of Arduino. Arduino is connected to the respective pins of LCD. Preset resistor is connected to the LCD. A preset resistor is a smaller PCB mounted version of a potentiometer. It is useful for adjustment or configuration of a circuit .Preset resistor are used in circuits when it is necessary to alter the resistance.

III HARDWARE DESCRIPTION**MICROCONTROLLER**

A microcontroller contains one or more CPUs along with memory and programmable input/output peripherals. ATMEGA328P is a high performance, low power controller from Microchip. The ATMEGA328 is a single-chip microcontroller created by Atmel in the megaAVR family (later Microchip Technology acquired Atmel in 2016). It has a modified Harvard architecture 8-bit RISC processor core. It is the most popular of all AVR controllers as it is commonly used in many projects and autonomous systems. It is most commonly implemented on the popular Arduino development platform, namely the Arduino UNO and Arduino NANO. In order to maximise performance and parallelism, the AVR uses Harvard architecture—with separate memories and buses for program and data.

ARDUINO NANO

The Arduino Nano is a small, complete and breadboard friendly board based on the ATMEGA328P. This board can be powered through a type-B micro-USB cable, or through a 9V battery. It is a small size board and also flexible with a wide variety of applications.

ZIGBEE

Zigbee is a wireless technology developed as an open global standard to address the unique needs of low-cost, low-power wireless IoT networks. Zigbee is simpler and less expensive than other wireless personal area networks. Zigbee is mainly responsible for collecting and transporting the special environment parameters of the forest including temperature, humidity, fire, smoke and so on. Zigbee acts as both receiver and transmitter.

REGULATOR

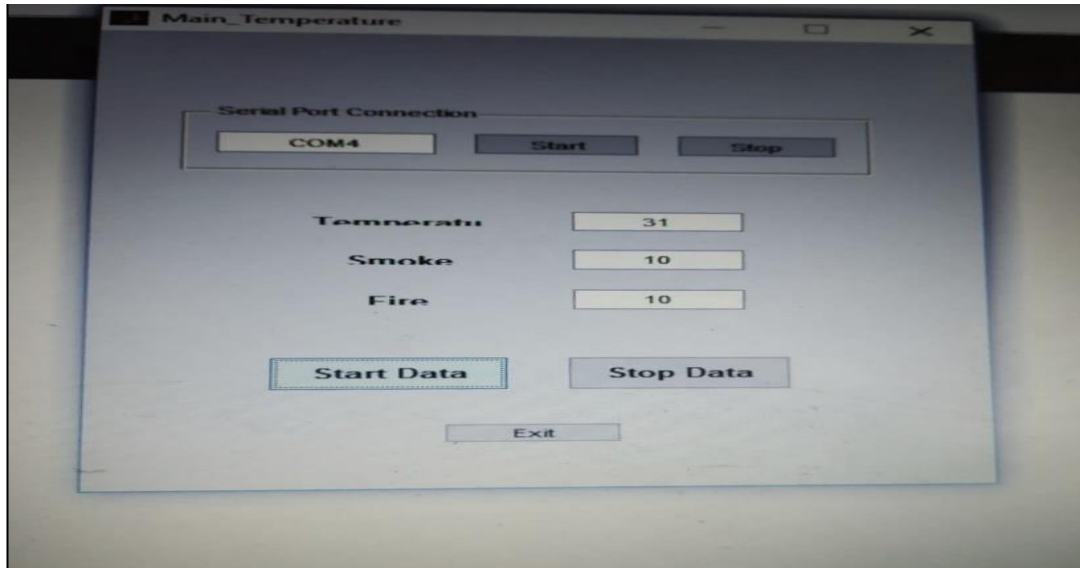
A voltage regulator is a system designed to automatically maintain a constant voltage. Depending on the design, it may be used to regulate one or more AC or DC voltages. Feedback voltage regulator operates by comparing the actual output voltage to some fixed reference voltage.

SENSOR

TEMPERATURE SENSOR: A temperature sensor is an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes.

FIRE SENSOR: Fire sensor works by detecting heat. These devices respond to the presence of extremely high temperatures that are present with a fire. A fire alarm system has a number of devices working together to detect and warn people through visual and audio appliances when fire or other emergencies are present.

SMOKE SENSOR: A smoke sensor is a device that senses smoke, typically as an indicator of fire. Smoke can be detected either by optically or by physical process.

IV RESULT AND DISCUSSION

In the fig it shows the matlab result

we computed the fire indexes according to the Fire Weather Index (FWI) System. The nodes take into account this index and the evolution of the raw measurements like abnormal temperature increments, humidity decrements, or gas detection, to generate an alarm message. Different fire scenarios were generated in a laboratory environment to detect real fires and check if false alarms were also raised. Results exhibited a 100% fire detection accuracy based on sensed temperature increasing more than 5 in less than 10 minutes and relative humidity decreasing more than 10% in the same period. The gas sensors detected in all cases significant smoke changes during the tests (**concentration changes greater than 3%**)

V CONCLUSION

Forest fires are a very serious problem in many countries, and global warming may contribute to make this problem worse. Experts agree that, in order to prevent these tragedies from happening, it is necessary to invest in new technologies and equipment that enable a multifaceted approach. This paper describes a WSN for early detection of forest fires. This network can be easily deployed at areas of special interest or risk.

We conclude that this project will detect the fire earlier, each node was provided with many sensors to get the parameter such as temperature, smoke, fire flickering to define fire incidents in that place.

Adding additional if the fire is detected the notification will be sent via mail to the incharge officer. It is capable of achieving best accuracy and less false alarm on different types of scenarios.

Automated systems are used which have less manual operation so that the flexibility is high and accurate.

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