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Review Article

Forest Fire Detection and Prediction using IoT and Node MCU

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A B S T R A C T

This paper presents a fire detection and alert system based on IoT. Here a specific environment is monitored 24×7 and the user is alerted in case of any fatal situation. This can be implemented using a nodemcu and a number of sensors for detecting different physical parameters that can go high during a fire-related accident. Nodemcu is an IOT-based controller board with an onboard WIFI module called ESP8266. Here two parameters are being monitored continuously temperature and the presence of smoke. For sensing temperature, the LM35 temperature sensor is used. For sensing the presence of smoke a gas sensor called MQ6 is used, this sensor can detect and measure any carbon-based gas smoke that produces CO2 which makes it possible to detect smoke using MQ6. Also, a PIR sensor is used for detecting the presence of any human. Both gas and temperature sensor is analogue so cannot be connected to a digital pin but to an analog pin that is input to an ADC (analogue to digital converter). Nodemcu has a one-channel ADC which presents a problem since there are two analog sensors. This can be solved by adding an ADC module called MCP3008. MCP3008 is a sixteen-pin IC with an eight-channel ADC. Also, forest areas can be monitored through a camera using this camera fire can be detected using image processing. For this we can run a Python program from a PC and using the OpenCV library fire can be detected. This can be used as a contingency system if the sensors malfunction. If any fire is detected then a water sprinkler will be turned on to prevent fire also an alert is sent to the concerned person for further action.

Keywords: Analog, Nodemcu, Temperature, Forest Fire Detection, Image Processing

Introduction

Around the world, fire accidents are frequent occurrences that frequently result in the loss of human life. Any location, including homes, businesses, movie theaters, etc., could experience this mishap. The risk of death is particularly high in industrial settings when accidents happen. Creating a universal system to remotely or locally monitor any kind of environment will take care of this. In this paper, this system is implemented.

Objectives

The objective of implementing a forest fire detection and prediction system using IoT and NodeMCU is to detect and predict the occurrence of forest fires in real time. The system aims to achieve the following objectives:

Early Detection: The system should be able to detect the presence of a forest fire as early as possible. This will help in preventing the fire from spreading and causing significant damage.

Accurate Prediction: The system should be able to predict the occurrence of a forest fire accurately. This will help in taking preventive measures and mitigating the effects of the fire.

Real-time Monitoring: The system should be able to monitor the environment in real-time and provide continuous updates on the temperature, humidity, and smoke levels.

Alert System: The system should be able to alert the authorities in case of a forest fire. The alert system should be reliable and timely to prevent any delay in taking preventive measures.

Cost-Effective: The system should be cost-effective and easy to implement. This will ensure that the system can be deployed in remote areas where forest fires are more likely to occur.

Working

Forest fires can cause significant damage to the environment and human life. Therefore, detecting and predicting forest fires is crucial to prevent and mitigate their effects. One way to achieve this is by using IoT and NodeMCU. In this project, a temperature sensor, humidity sensor, and smoke sensor are used to detect the presence of a fire. The data collected by these sensors is sent to the cloud using NodeMCU, where it is analyzed to predict the occurrence of a forest fire.[1,2,4]

The following are the steps involved in implementing a forest fire detection and prediction system using IoT and NodeMCU:

Hardware Setup: The hardware setup involves connecting the temperature sensor, humidity sensor, and smoke sensor to the NodeMCU board. The temperature sensor is used to measure the temperature of the environment, the humidity sensor is used to measure the humidity of the environment, and the smoke sensor is used to detect the presence of smoke.

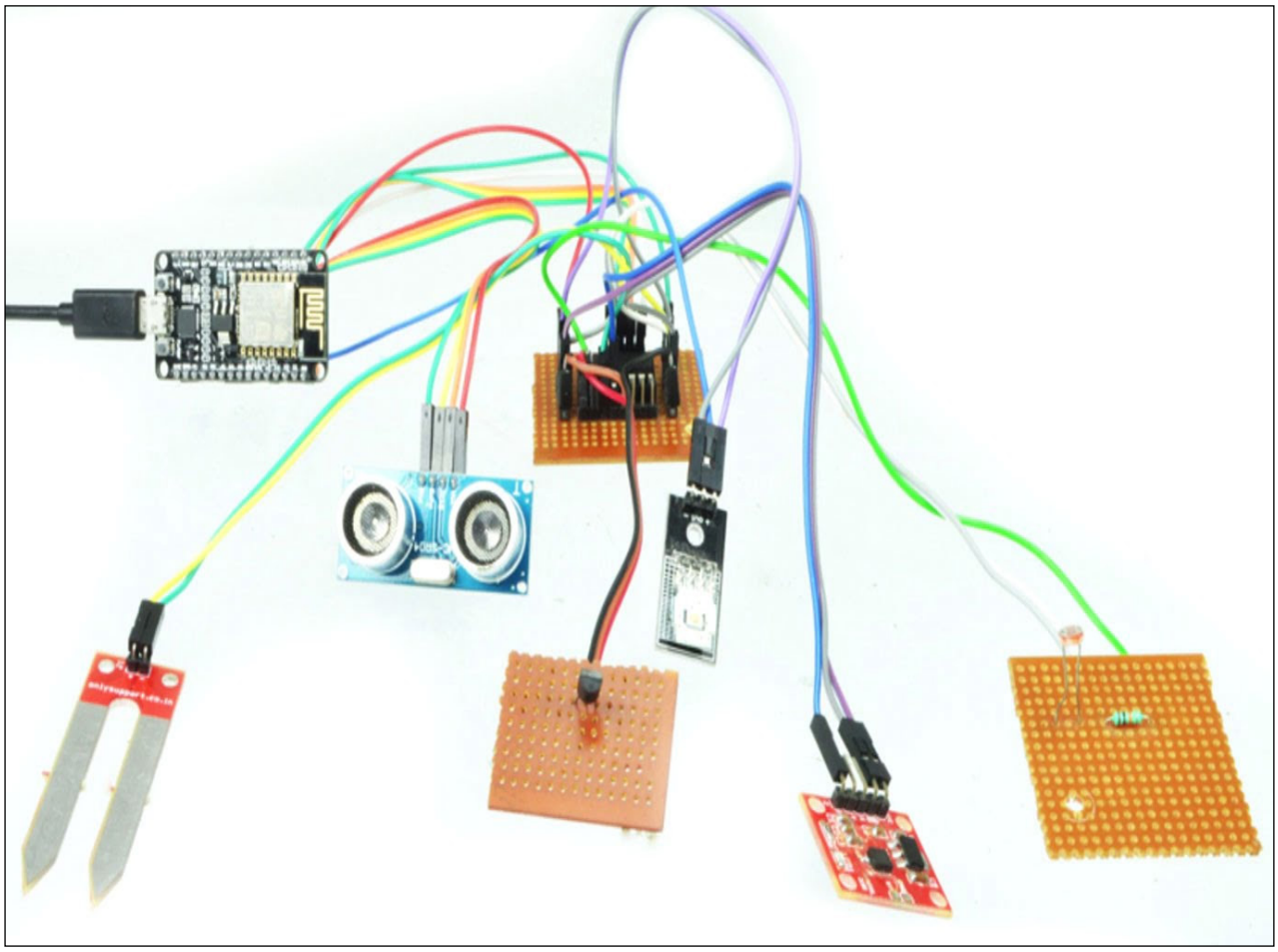

Figure 1

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Programming NodeMCU: The NodeMCU board is programmed to read the data from the sensors and send it to the cloud. The programming language used is Arduino, and the code is uploaded to the NodeMCU board using the Arduino IDE.

Cloud Setup: The cloud setup involves creating an account on a cloud platform such as ThingSpeak or AWS IoT. The data sent by the NodeMCU board is received by the cloud platform, where it is analyzed to predict the occurrence of a forest fire.

Data Analysis: The data collected by the sensors is analyzed to predict the occurrence of a forest fire. Machine learning algorithms such as decision trees, random forests, and support vector machines can be used for this purpose. The analysis can be done on the cloud platform or on a local computer.

Alert System: An alert system is set up to notify the authorities in case of a forest fire. The alert system can be in the form of an email, SMS, or phone call.

Disadvantage

Current systems are local hence the alert is not conveyed to authorities far away. Also, the local system could be damaged in the fire

Proposed System

- Nodemcu-based fire monitoring system
- IoT-based alerting system
- Sensor-based monitoring?
- Can be monitored continuously from anywhere in the world
- Connected to the internet all the time

Advantages

- both local and global fire alert is provided
- internet is used for global alerts?
- concerned personnel can monitor from anywhere in the world
- very low-cost implementation?
- also, camera-based detection is provided as a failsafe in case sensors malfunction

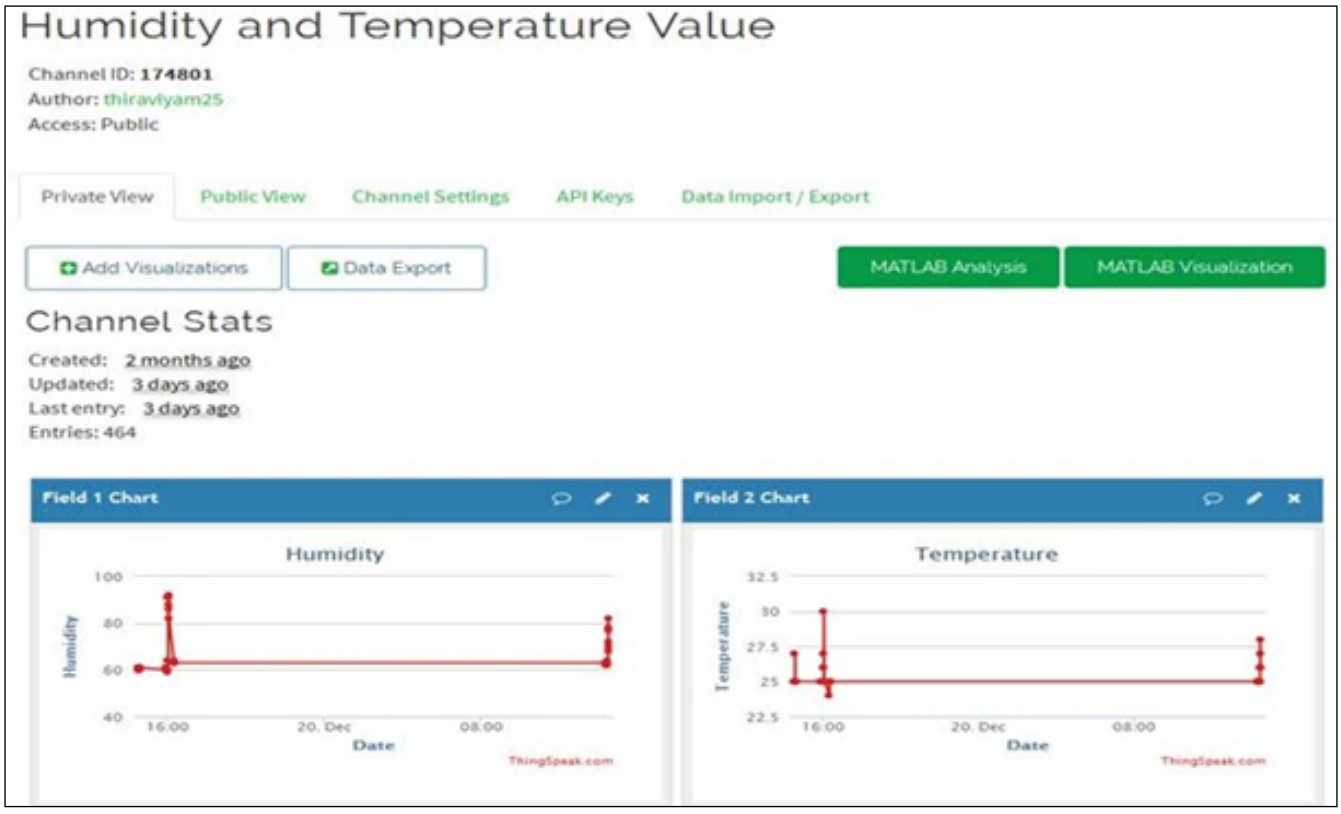

Figure 2. Forest Fire Detection and Prediction using IoT and Node MCU

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Block Diagram

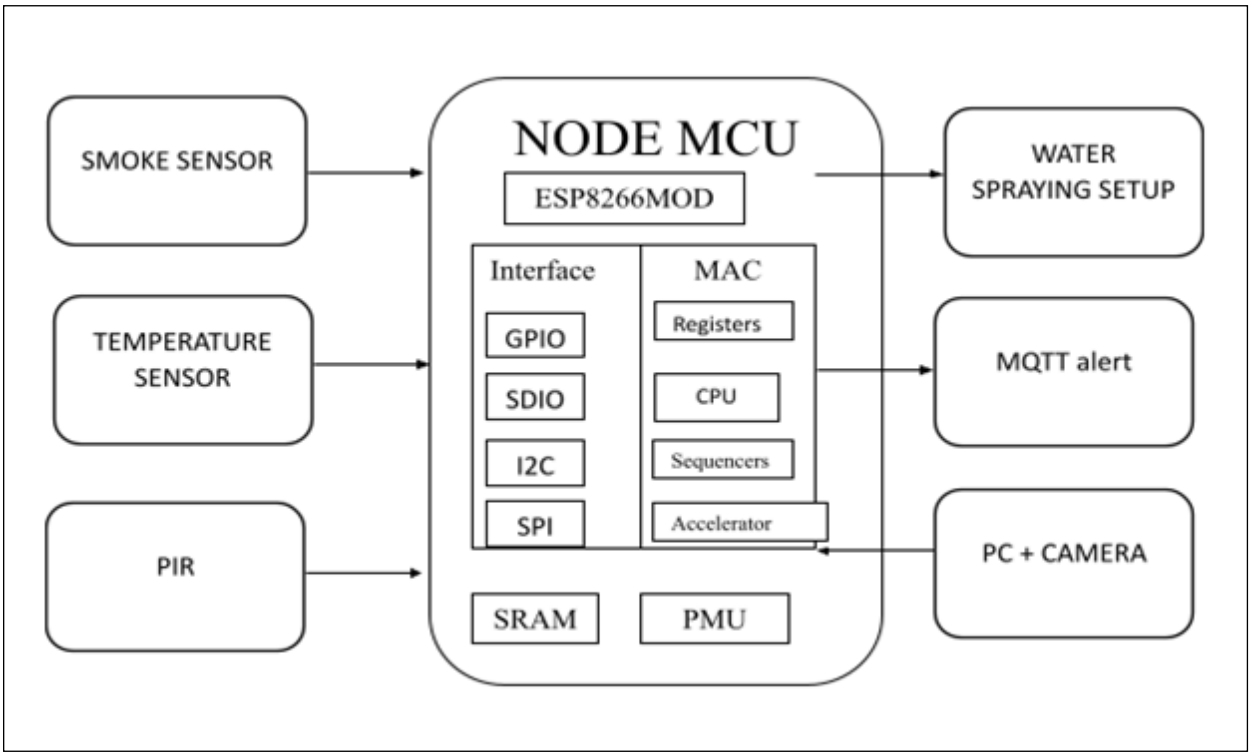

Figure 3

Block Diagram Explanation

- Nodemcu is the central part of the whole system
- Every other component is connected to it as shown in the above diagram
- LM35 and MQ6 are connected to nodemcu through MCP3008
- That is not shown in the diagram but can be seen in the circuit diagram
- PIR sensor is connected to a digital pin?
- It will go high if any human is present
- Nodemcu is connected to Thingspeak through a WIFI network
- Also, forest areas can be monitored through a camera using this camera fire can be detected using image processing

Hardware Requirement

- Nodemcu
- MQ6
- LM35
- PIR sensor
- Water pump

Software Requirement

- ARDUINO IDE
- C programming?
- Python 3 IDLE

Applications

- remote forest fire detection
- remote forest fire prevention?
- a man less fire fighting
- automated fire department????

Conclusion

In conclusion, forest fire detection and prediction using IoT and NodeMCU is an effective way to prevent and mitigate the effects of forest fires. The system involves connecting sensors to the NodeMCU board, programming the board to send data to the cloud, analyzing the data to predict the occurrence of a forest fire, and setting up an alert system to notify the authorities.

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