WILDFIRE DETECTION AND ALERTING SYSTEM USING RASPBERRY PI

21GE614 GEOTECHNICAL & IOT MONITORING METHODS

BY :

ROHIT P (AM.EN.P2GEO22002)

VINDUJA VIJAYANAND (AM.EN.P2GEO22003

Introduction:

Forest fires, also called wildfires or wildland fires, are unattended fires that start in forests. It is essential to detect these fires early to minimize damage to the natural environment. Forested areas that have been burned make it challenging for vegetation to regrow because the soil becomes water-repellent and reduces groundwater. The 2008 Global Warming Report identified rapidly spreading fires as one of the main contributors to the Earth's increasing global temperature. In late 2016, over 4,000 hectares of forest in Uttarakhand experienced wildfires, often caused by lightning, hot and dry weather, and human negligence. One research approach suggests using wireless sensors as a strategy for early wildfire detection.

The fire detection and alerting system based on a Raspberry Pi board and camera involves utilizing a camera module with Raspberry Pi to detect and alert potential fire hazards. By using image processing techniques, the system can identify changes in the environment that indicate a possible fire. Once the system detects a fire hazard, it can send alerts to the user's phone or activate other warning mechanisms.

This system can be implemented in various settings, including homes, offices, or any place with a potential fire risk. Early detection of fire hazards can give occupants more time to evacuate or take the necessary precautions to prevent further damage. Moreover, the system can be customized to meet the user's specific needs and integrated with other home automation systems.

Objective:

The primary purpose of adopting a fire detection and warning system is to prevent loss of life and property damage. This Raspberry Pi-based device can see fire in the air as it's happening and has a real-time video monitoring system. This system's capacity to create a warning at the early stage of a fire, saving the loss of life and minimising property damage, is one of its most crucial advantages.

The Internet of Things (IoT) comprises programmable software sensors, electronic devices, and communication facilities that gather and transmit data. The primary objective of designing an IoT-based fire detection system is to alert remote users when a fire accident occurs.

This system can be easily installed in remote locations where a camera can easily detect fire, without requiring additional sensors. The system uses a Raspberry Pi controller to process the camera input and detect fire through heat signatures, utilizing image processing techniques. An automatic report is generated, and the user is immediately notified through Wi-Fi as soon as the fire is detected.

Methodology:

The suggested solution is putting up a Raspberry Pi board with a camera module and programming it to take pictures periodically. To find any alterations in the surroundings that can point to the existence of fire, image processing techniques will be applied.

The system will automatically create a report, inform the user by phone, or initiate additional warning systems. The system will relate to other home automation systems and tailored to the user's unique demands.

Components:

• Raspberry pi model 3b+

• webcam

• GSM module

• GPS

• LCD display

• GPS antenna

1) Raspberry pi model 3b+

   Raspberry Pi is a series of affordable and low-power single board computers developed by the Raspberry Pi Foundation in the UK. They have been released in several models with different specifications and capabilities and can be used for various purposes such as learning to code, building robots, and creating media centres. Raspberry Pi runs on Linux and can be programmed in multiple programming languages including Python, Java, and C.

   The Raspberry Pi is a popular series of single board computers that come in different sizes and capabilities, with the Raspberry Pi 3 and Raspberry Pi 4 being the most popular. They have multiple ports for connecting devices and built-in wireless connectivity, making them easy to use and versatile for a variety of purposes.

   The Raspberry Pi 3B+ is a single board computer that was released in March 2018 and has a 1.4GHZ quad-core Arm Cortex-A53 CPU, 1GB of RAM, and built-in wireless connectivity with both 2.4GHZ and 5GHZ Wi-Fi, as well as Bluetooth 4.2/BLE. It also has several features like Gigabit Ethernet, USB ports, GPIO pins, HDMI output, camera interface, display interface, and a MicroSD card slot for storage.

   The Raspberry Pi 3B+ can be used for home automation, media centres, robotics, IoT projects, and embedded systems due to its small size, low power consumption, and easy connectivity.

2) Webcam:

A webcam is a type of video camera that is used to record or stream video to a computer or computer network. In order to showcase some of the areas in a range of over 30,000 square miles, webcams were set up.

3) GSM Module:

A GSM module is a device that is designed to monitor wireless radiation through short message service (SMS). The practical use of the GSM specification supports a maximum distance of 35 kilometers (22 miles).

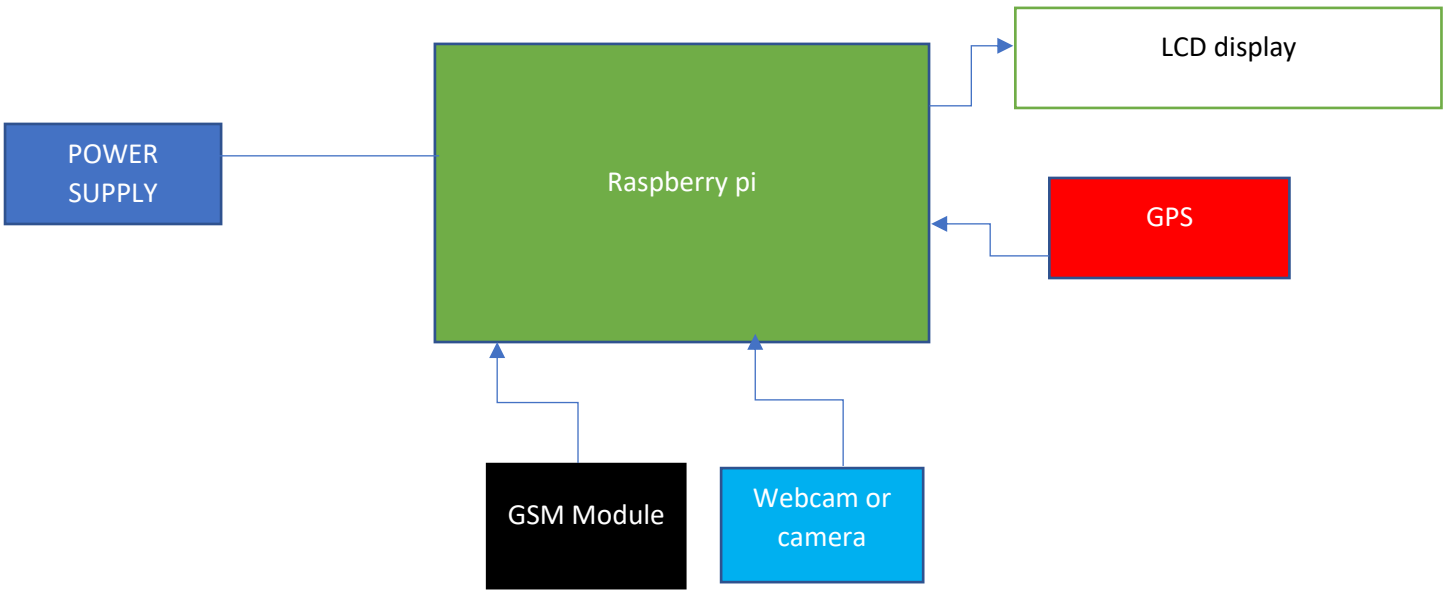
4) GPS:

A GPS module is a device that contains a tiny processor and antennas which receive data sent by satellites through dedicated radio frequencies in the range of 900MHZ.

5) GPS Antenna:

A GPS antenna is a device that is designed to receive and amplify radio signals transmitted by GNSS satellites on specific frequencies. The sensitivity of GPS receivers typically falls within the range of -163 to -155 dB.

System Architecture:



The goal of this project is to develop a hardware device that can detect fires from a distance. It is designed to work with both the Raspberry Pi platform and an Android application. The Raspberry Pi 3B+ is the central component of this project, and all operations are carried out on it.

To begin, the power supply pin must be connected to the Raspberry Pi board, followed by the camera to the USB port, and the wired Bluetooth to another USB port. Next, a SIM card is inserted into the GSM module. Once everything is connected, the power supply is switched on, and the code is run. When a fire is detected by the camera, an SMS containing the GPS location is sent to a mobile phone.

This hardware model is designed to detect fire from a distance and is compatible with both Raspberry Pi and Android platforms. The Raspberry Pi 3B+ is the central component of the system and all the functions are performed by it.

The setup process involves connecting the power supply pin to the Raspberry Pi board, plugging in the camera to the USB port, and connecting the wired Bluetooth to the USB port.

The GSM module is inserted with a SIM card, and the power supply is switched on. The code is then executed, and when a fire is detected by the camera, an SMS message with the GPS location is sent to the mobile phone.

Hardware setup: Attach a camera to the Raspberry Pi board, and ensure that it is operational and properly set up.

• Install and configure software: Set up the Raspberry Pi with the required applications, including an appropriate operating system and a programming environment like Python. Installing computer-version libraries like OpenCV is also required.

• Capture video frames: Take screenshots of the camera's video frames and save them as pictures.

• Process the images: Identify the presence of fire in each image using image processing techniques like thresholding and contour detection.

• alarm: Use a suitable alarm mechanism, such as SMS messaging with GPS location, to notify users if a fire is detected.

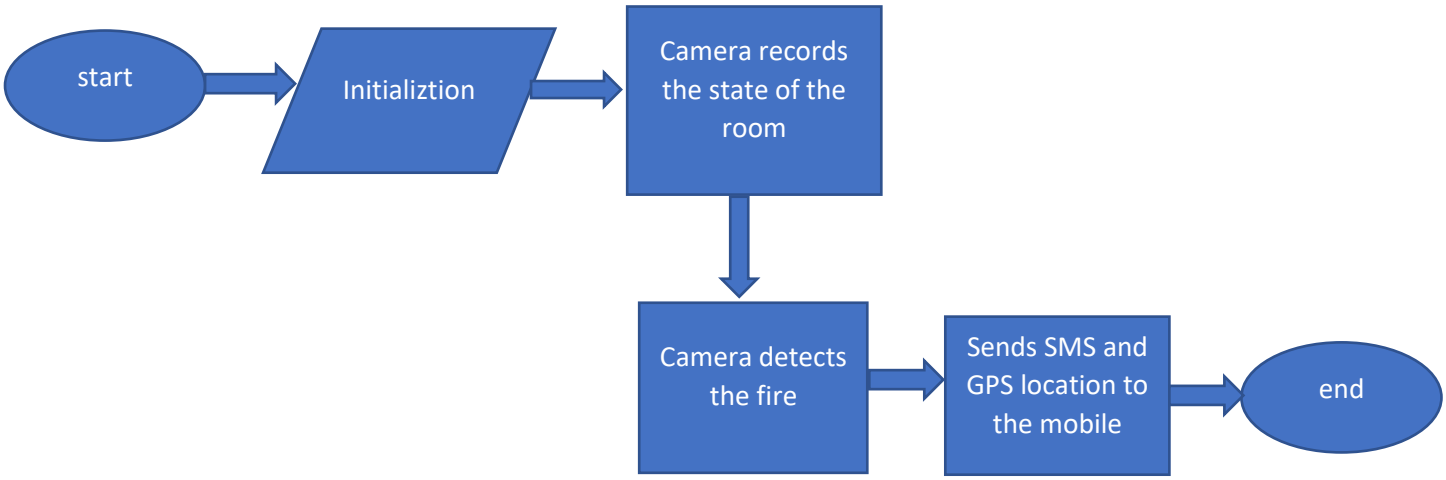
• Constant observation: Repetition of steps 3-56 at regular intervals will allow you to keep an eye out for any signs of fire across the scene.

In conclusion, utilising a Raspberry Pi and camera to detect and notify to fire situations is a practical and affordable approach. It can be particularly helpful in places with little human oversight, such distant or unmanned facilities.

Overview:

By using our fire detection system, businesses and organisations can avert the loss of life and damage to valuable possessions. When a fire is discovered, an Android or mobile application that is being used by users of the application will create an alert about it.

The project's major component or extremely significant component, the flow chat, is defined below. The flow chat below provides a step-by-step explanation of how to detect fire using a camera.



1.Start

2. Verify whether any objects are visible in the camera view.

3.Go to step 2 if there is an item.

4.If there is an object, determine if it is large enough to be considered a possible fire.

5.Continue to step 2 if the item is not big enough.

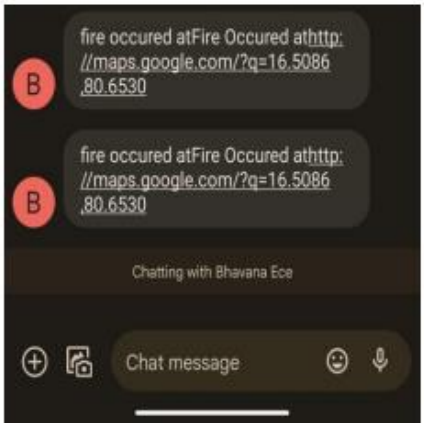
6.If the object is not big enough, send a message to the building's residents to warn them.

7.End

The above graphic depicts the flowchart system used in this study. The VNC viewer programme must first be installed before the camera is ready to use and may display the whole state of the room. Raspberry Pi will process the camera's image. The camera quickly recognises a fire in a room or its surroundings and sends an SMS with the fire's position to a mobile phone.

Expected Outcomes:

The implementation of the fire detection and alerting system using Raspberry Pi is expected to significantly improve the effectiveness of fire detection and prevention. The system will detect potential fire hazards early, allowing for timely action to be taken to prevent the spread of fire and minimize the risk of loss of life or property damage.



To identify the fire at an early stage, a prototype of an early warning and fire detection system for forest fires on the IoT platform is given in this study. The suggested platform also offers an extremely quick and less expensive embedded technology to detect actual fire incidents.

Automatic SMS alerts are sent by the GSM module to the control room. Data encryption should be introduced in the future for security reasons.

Conclusion:

A fire detection and alerting system using a Raspberry Pi connected to a camera has been proposed. The system utilizes a database of fire images to detect fires, but the team is still working to improve the accuracy and reduce false messages caused by objects with orange colour and similar shapes. This system has the potential to significantly reduce loss and destruction caused by fires and help firefighters and rescue teams locate and extinguish fires more quickly.

Overall, a fire detection and alerting system based on Raspberry Pi technology could be a highly effective solution for detecting and responding to fires.