Fire Detection and Alerting System Using Raspberry Pi

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Abstract:

Fire detection systems are the most critical element of any building design these days. In recent days, fire incidents are commonly reported. This might be due to the negligence of people in many cases. There are nearly thousands of fire accidents reported in a year. By taking all these into consideration, an automatic fire detection using a fire sensor is introduced. The existing fire detection system detects the fire by using a fire sensor, but in this paper, it is different from that. In addition to that it sends a notification to our mobile which will be having the information of the accident-prone area, and also the information needed to alert the fire station about the incident. This implemented fire detection system will be more efficient and provide more safety when compared to the conventional fire alarm systems available.

Keywords: *Camera, Fire accident, Fire detection, GPS, GSM, GPS Antenna, Raspberry pi, VNC viewer app.*

1. Introduction:

A fire detection and alerting system using raspberry pi and camera involves using a raspberry pi board with a camera module to detect and alert for potential fire hazards. This system uses image processing techniques to detect any changes in environment that indicate the presence of fire. The project typically involves setting up the raspberry pi with camera module, configuring it to capture images at regular intervals. When a fire hazard is detected, the system can send alerts to a user's phone or activate other warning mechanisms. This system can be useful for homes, offices, and other environments where the risk of fire is a concern. It can help to detect potential fire hazards early, giving occupants more time to evacuate or take necessary precautions to prevent the spread of fire. Additionally, the system can be customized to suit the specific needs of the user and integrated with other home automation systems.

2. Literature Survey:

2.1 Motivation

Internet of Things (IoT) is the network of programmable software sensors, electronics and communication facility helps to gather and transfer data the objective of the design system is to alert the remote user while the fire accident occurs. The system can be easily installed at any remote location from where fire can be easily detected by the camera. Therefore, sensors are not required for this purpose. The raspberry pi controller processes the camera input and detects fire using heat signatures by using image processing method, the report is automatically generated and sends the person immediately after the fire is being detected using Wi-Fi.

2.2 Generate Alert on Fire

The main motive of using this system is to prevent from the loss of life or any other damages to the company or the organization. Few years back the system that were installed are now obsolete because they detect fire or smoke when it reaches the maximum level until that time the loss was already done. Fire detection and alerting system is used to detect the fire in air through camera in real time monitoring system based on raspberry pi the main feature of the system is to alert and generate when fire is stated or reached it minimum level to prevent from the loss of lives.

3. Components:

- Raspberry pi model 3b+
- Camera
- GSM module
- GPS
- LCD display
- GPS antenna

3.1 Raspberry pi model 3b+:

Raspberry Pi is a series of small single board computers developed by the Raspberry Pi foundation in the United Kingdom. The Original Raspberry Pi was released in 2 and since then, several models have been released, each with different specifications and specifications and capabilities.

The Raspberry Pi boards are designed to be affordable, low-power devices that can be used for a variety of purposes, such as learning to code, building robots, creating media centers, and much more. They run on the Linux operating system and can be programmed in several programming languages, including system and can be programmed in several programming languages, including Python, Java, C, and more.

Raspberry Pi boards come in various sizes and capabilities, with the most popular being the Raspberry Pi 3 and Raspberry Pi 4. These boards have several ports for connecting peripherals like keywords, mice, and displays, as well as Wi-Fi and Bluetooth connectivity.

Overall, Raspberry Pi has become popular among hobbyists, educators, and professionals alike for its versatility, affordability, and ease of use.

The Raspberry Pi 3 Model B+ is a single board computer developed by the Raspberry Pi foundation. It is an updated version of the Raspberry Pi 3 Model B and was released in March 2018.

The Raspberry Pi 3B+ is powered by a 1.4GHZ quad-core Arm Cortex-A53 CPU and has 1GB of RAM. It features built-in wireless connectivity with both 2.4GHZ and 5GHZ Wi-Fi, as well as Bluetooth 4.2/BLE.

The board has a number of other features, including:

- Gigabit Ethernet
- Four USB 2.0 ports
- 40 GPIO pins
- HDMI output
- Camera interface (CSI)
- Display interface (DSI)
- MicroSD card slot for storage

The Raspberry Pi 3B+ is designed for a wide range of applications, from home automation and media centers to robotics and Internet of Things (IoT) projects. Its wireless connectivity and GPIO pins make it easy to connect to other devices and sensors, which its small size and low power consumption make it ideal for use in embedded systems.

Figure 1: Raspberry Pi

3.2 Camera:

A webcam is a video camera which is designed to record or stream to a computer or computer network. Since Range serves over 30,000 square miles, we decided to put up webcams that showcase some of our areas.

3.3 GSM Module:

Global system for mobile communication module is designed for wireless radiation Monitoring through short message service (SMS). The longest distance the GSM specification supports in practical use in 35 kilometers (22 miles).

3.4 GPS:

GPS module contains tiny processor and antennas that directly receive data sent by

Satellite through dedicated RF frequencies. They employ RF in the range 900MHZ.

3.5 GPS Antenna:

GPS antenna is a device designed to receive and amplify the radio signal transmitted on specific frequencies by GNSS satellite. The sensitivity of receivers for GPS are in the (-163, -155) dB range.

4. System Design and Overview:

4.1 Block Diagram

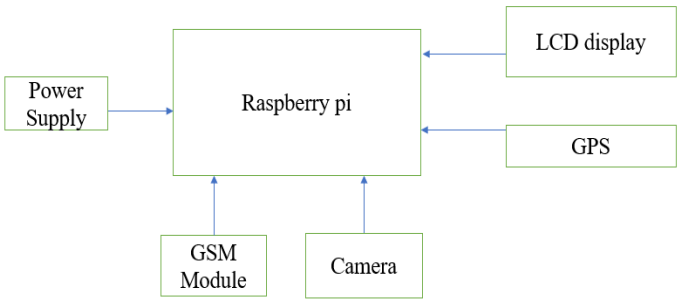


Figure 2. Block Diagram

The purpose is to create a hardware model which can detect fire from far away. This device supports the raspberry pi platform and android application. Raspberry pi model 3b+ is the heart of this project and all the actions are done in the raspberry pi. At first, we have to connect the power supply pin to the raspberry pi board and then connect the camera to the USB port and wired Bluetooth to the USB port. After that insert a sim in GSM module after connecting all these then switch on the power supply after that run the code then keep the fire in front of the camera then the fire is detected. After detecting the SMS and the GPS location is sent to the mobile phone.

Fire detection and alerting using Raspberry Pi and camera involves using computer vision techniques to detect fires in a scene captured by a camera connected to a Raspberry Pi.

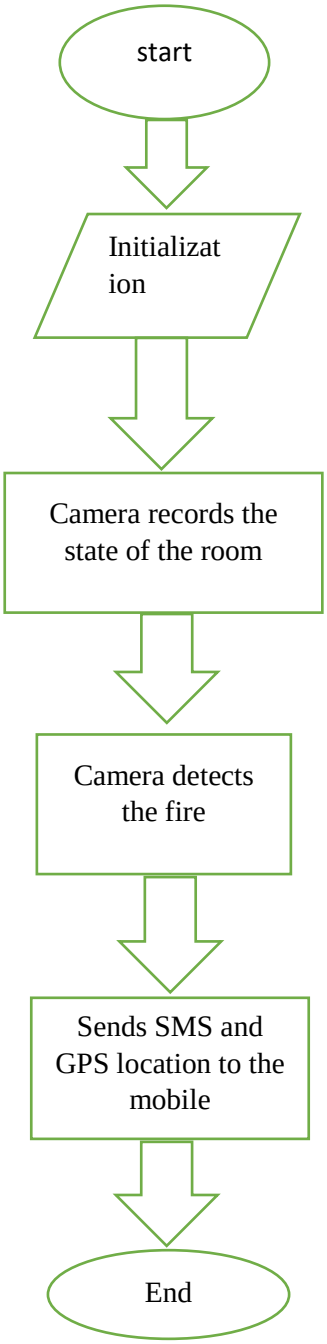
Here are the basic steps involved:

- Hardware setup: Connect a camera to the Raspberry pi board and make sure it is correctly configured and working.
- Install and configure software: Install the necessary software on the Raspberry Pi, including a suitable operating systems and programming environment, such as Python. Additionally, you will need to install computer version libraries such as OpenCV.
- Capture video frames: Capture video frames from the camera and store them as images.
- Process the images: Use image processing techniques, such as thresholding and contour detection, to detect the presence of fire in each image.
- Alert: If fire detected, use a suitable mechanism to alert users, such as sending SMS message with GPS location.
- Continuous monitoring: Continuously monitor the scene for the presence of fire by repeating steps 3-56 at regular intervals.

Overall, fire detection and alerting using Raspberry Pi and camera is an effective and low-cost solution for monitoring and responding to fire emergencies. It can be especially useful in environments where human supervision is limited, such as remote or unmanned facilities.

4.2 Overview:

Our implementation of fire detection is used to facilitates the organizations or companies to prevent from the loss of lives and damages of valuable assets. The moment when the fire is detected and to generate an alert on it through mobile application/android application to the users on the application. The flow chat is designed in such a way so that everyone can understand it and the android application is also very easy to use. The flow chat is defined below which is very important part of this project or the main part of the project. The below flow chat clearly explains the step-by-step process of the fire detection by using the camera.



4.3 Steps:

1.Start

2.Check if there in any object in the camera view

3.If there is an object, go to step 2

4.If there is an object, check if it is sufficient large enough to classify it as a potential fire

5.If the object is not large enough, go to step 2

6.If the object is not large enough, trigger a message to alert occupants in the building.

7.End

The flowchart system from this work shows in above figure. At first, we have to install the VNC viewer app and then the camera is in ready status and show all conditions of the room. Image from camera will process in raspberry pi when the fire is detected in the room or in the surrounding areas immediately the camera detects the fire and send the SMS and GPS location to the mobile phone.

5. Result:

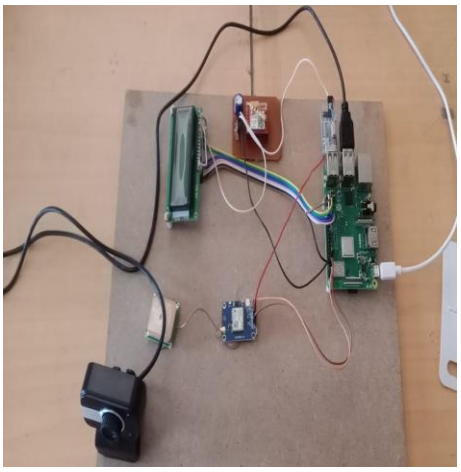


Figure 3. Project Kit

Figure 4. Database Image

The above two figures represent the project kit and the database fire image of the project.

Figure 5. Fire Detected in the LCD

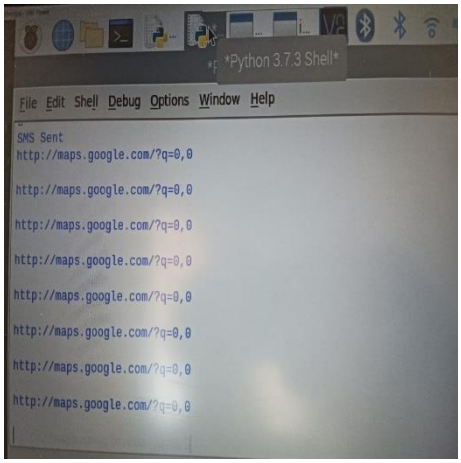
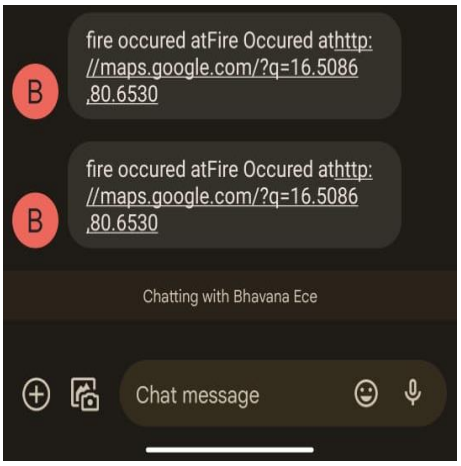


Figure 6. Message and Location Sending

The above two figures represent the fire detection in the LCD & message and location sent



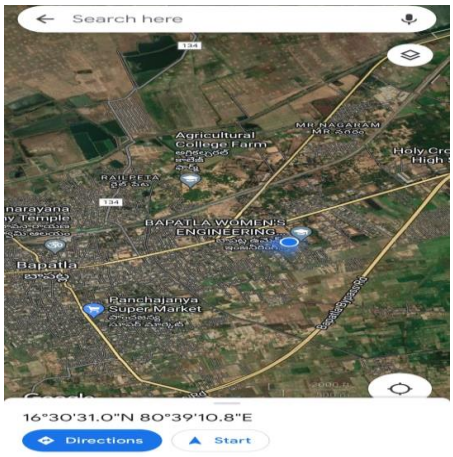


Figure 7. Message Sent to the Mobile **Figure 8. Location of the Fire**

In the above two figures represent the message sent to the mobile and the location of the fire detected.

In this paper early warning and fire detection system for forest fire on IoT platform is presented to detect the fire at the early stage and prototype was developed. Furthermore, the proposed platform also provides a very prompt and cheaper embedded system to detect true incident of fire. GSM module automatically sends SMS to alert the control room. In future work encryption of data for security purpose should be added.

6. Conclusion:

A fire detection and alerting system is proposed using raspberry pi connected with a camera. This system uses data base fire image to detect fire. Proposed model works well and we are working on its fire detection for more effective results and overcome the problems of false messages. False messages are generated sometimes due to objects of orange color and shapes. Consequently, the proposed system will result in the reduction of loss and destruction. In future, this system will help the fire fighters or rescue team to rescue someone immediately and fire fighters will stop fire immediately by tracing the location of fire.

Overall, a fire detection and alerting system based on raspberry pi can provide an effective solution for detecting fires and alerting personnel in real-time, making it a valuable addition to any buildings safety infrastructure.

7. Future Scope:

Fire accidents can be controlled to a great extent in a place such as forests, homes colleges, industries, trains and some other places and fire accidents leads to death of excess of people by using this technique we can save lives easily.

Acknowledgment:

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