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Pi Cam Based Smoke/Fire Alerting System

B.R.B. Jaswanth[1], I. Priyanka[2], G. Chaitanya[3], J. Srinadh[4], T. Siva Ganesh[5]

Corresponding author, Assistant Professor, Department of Electronics and Communication Engineering, Gudlavalleru
B.Tech Students, Department of ECE, Gudlavalleru Engineering College, Gudlavalleru, Andhra Pradesh, India

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Abstract - *Besides the enhancement of technology, the problems that are faced by the people in a day to day life also increase especially due to smoke such as fire accidents and several health issues cause of public smoking. Between them fire accidents cause a havoc of life and property. In the field of natural and man-made disasters, fire has played a predominant role .The extrinsic effects of disasters caused by fire have progressively changed over the centuries, especially in the twentieth. As a result, owing to industrial, technological, and military development, as also to the increasing number of armed conflicts, there has also been a rapid change in the modalities and numbers of burn injuries.*

This paper provides a better solution to the fire accidents and public smoking. This paper proposes a system which would be able to detect smoke and activate the Pi Camera as soon as it detects smoke and automatically sends the video captured by it to the wireless monitoring system. So, one can view the cause of smoke and handle the situation instantaneously.

Key Words: Raspberry Pi, Pi Camera, MQ2 Sensor, Flame Sensor, Python programming.

1. INTRODUCTION

At present there are a number of different smoke detectors are available in the market, like optical smoke detectors, ionization smoke detectors, and air sampling smoke detectors to control fire and smoke. Research and development has continued to improve well established detection technologies and provided an array of new technologies to improve fire detection while also being less susceptible to the causes of false alarms. The main problem with the existing techniques is that the response time is slow to take immediate action and another drawback is that the exact reason for the cause of smoke cannot be known. This paper helps to overcome these drawbacks. Before going any further it's important to lay the foundation for what is fire; fire also known as combustion is a sequence of exothermic chemical reactions between a fuel and an oxidant accompanied by the by-products of combustion being; heat, smoke & electromagnetic radiation . It is also important to recognize that smoke is an aerosol or mixture of particulates suspended in air that comprises a collection of airborne solids, liquid particulates and gases emitted when a material undergoes combustion.

Smoke detectors are recognized as the most common method of fire detection for life safety throughout the world. There are five types of smoke detection available with the most common two point types being photo-electric and ionisation. The other three being projected (optical) beam, aspirating and video smoke detection are generally used for specialist applications.

This paper provides a better way of handling with fire accidents and smoking with the help of raspberry pi, Pi Camera and Smoke Sensor. Programming the raspberry pi is a key factor, it can be done using various programming languages like C, C++, Python etc., This paper makes use of Python 3.5 for programming raspberry pi board also known as pi board for wireless video streaming through network and getting data from the sensor. The monitoring system at remote area could be able to stream live video into a web page that you can access in any device that has a browser and is connected to the same network the Pi is.

2. LITERATURE SURVEY

This chapter gives a brief explanation on different existing systems. There are many existing systems which sound an alarm in case a smoke or fire is detected in a smoking zone. There are currently three types of smoke alarms in the market such as ionization, combination ionization/ photoelectric and photoelectric. Apart from smoke alarms, heat detectors are also used to detect fire. These are the oldest type of automatic fire detection device. Heat detectors feature a detecting element inside the unit that activates when it reaches a predetermined fixed temperature or when a specific increase in temperature has occurred.

Fire Alarm Using Thermistor is a simple fire alarm system with the help of 555 Timer IC**,** which will sense the fire (temperature rise in surrounding), and trigger the alarm. The key component of the circuit is Thermistor, which has been used as fire detector or fire sensor.

Fire Detection with Image Processing and PIR sensor is another method for fire detection with image processing for detecting the fire and use PIR sensor to detect the temperature to be sure it. It works by collecting image from camera and process it by means of different image processing techniques. Based on the color of the image and the values from the PIR sensor it can detect the fire.

Drawbacks of these systems are they have high false alarm rates and in contrast, the temperature sensor provides more reliable responses but with slow response time. The main cause of the smoke or fire is unknown in these techniques.

3. PROPOSED METHODOLOGY

This proposed system overcomes the drawbacks of the existing detection techniques by letting know the exact cause for the fire/smoke incidents through pi camera. The components that are required for the implementation of this project are listed below.

1. Raspberry pi 3 model B
2. MQ2 sensor
3. Flame detector
4. Pi Camera
5. Ethernet Cable
6. Bread board and
7. Connecting wires

3.1 Block Diagram

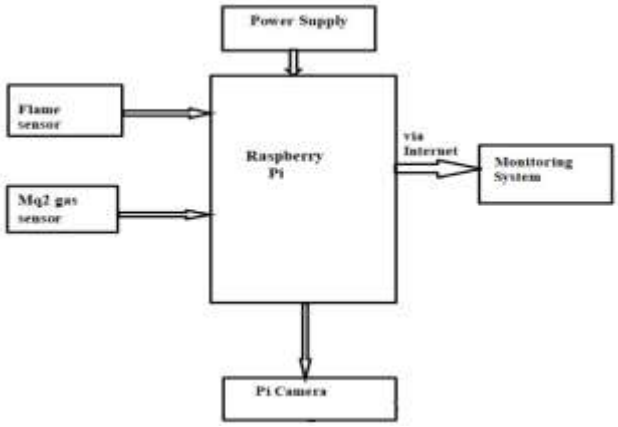

Fig -3.1: Block Diagram of the Proposed System

The working of this project includes below steps:

1. Reading the data from the MQ2 and Flame Sensors.
2. Raspberry pi activates the pi camera whenever gas or smoke is detected.
3. Live video will be sent to the monitoring system via Internet.

4. SYSTEM IMPLEMENTATION

To implement this system we rely on both hardware and software. Besides hardware, software programming also plays a key role for working of this system. So the system is described by means of hardware and software separately.

4.1 Hardware Implementation

Raspberry pi is the heart of this system. It is the main component in this system. Implementation of this system is done through interfacing raspberry pi with MQ2 and flame sensors and the pi camera. Different interfaces that we encounter for this system implementation are given as:

1. Interfacing MQ2 Sensor with Raspberry Pi.

2. Interfacing Flame Sensor with Raspberry Pi.

3. Interfacing Pi Camera with Raspberry Pi.

4.1.1 Interfacing MQ2 Sensor with Raspberry Pi

Connections between the pins of MQ2 Sensor and Raspberry pi are:

1. VCC of MQ2 Sensor is connected to 5V supply of raspberry pi.

2. Ground of the sensor is connected to GND of Raspberry pi.

3. Digital output pin D0 is connected to the one of the GPIO pins of raspberry pi as programmed.

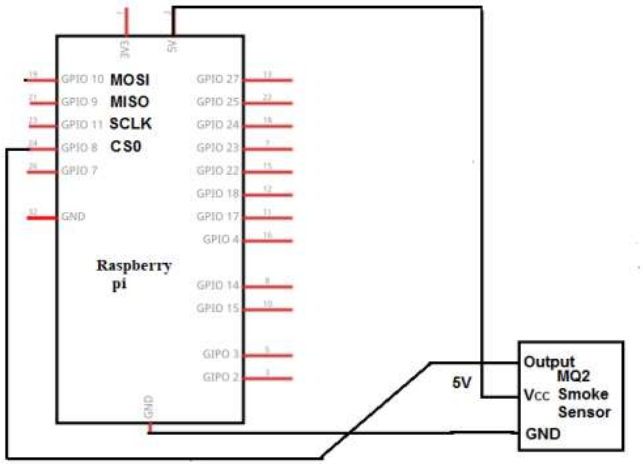

Fig - 4.1: Connecting MQ2 Sensor to Raspberry Pi

Table - 4.1: Connections between Raspberry Pi and MQ2 Sensor

Raspberry Pi	Flame Sensor
5V (VCC)	5V (VCC)
GND	GND
GPIO 21	D0

4.1.2 Interfacing Flame sensor with Raspberry Pi

Similar to the MQ2 Sensor Flame Sensor also has three pins that are used to connect with Raspberry pi. They are:

1.VCC
2. GND
3. Digital out D0

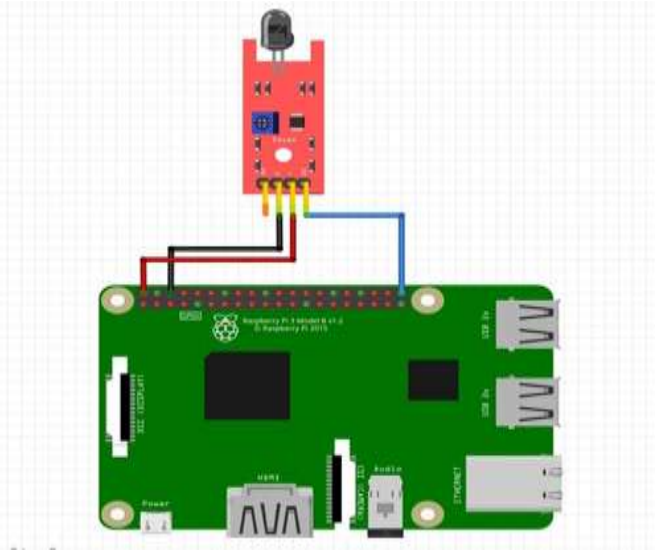

Fig -4.2: Connecting Flame Sensor with Raspberry Pi

Table -4.2: Connections between MQ2 Sensor and Raspberry Pi

Raspberry Pi	Flame Sensor
5V (VCC)	5V (VCC)
GND	GND
GPIO 21	D0

4.1.3 Interfacing Pi Camera with Raspberry Pi

The camera board attaches to pi board via a 15 way ribbon cable. Connect camera module to the CSI port on Raspberry Pi; this is the long thin port adjacent to the HDMI socket. Gently lift the collar on top of the CSI port. Slide the ribbon cable of the camera module into the port. The blue cable of camera should face towards Ethernet port of the raspberry Pi. While installing the camera module, raspberry pi should be in OFF state. Fully Insert the ribbon cable into the slot, ensuring it is set straight, then gently press down the tabs.

In order to use the applications of pi camera on raspberry pi board, first one must enable the camera in the settings available in the raspberry pi monitor.

1. Start up the Pi.

2. Open the Raspberry Pi Configuration Tool from the main menu.

3. Ensure the camera software is enabled

Fig -4.3: Connecting Pi Camera to Raspberry pi

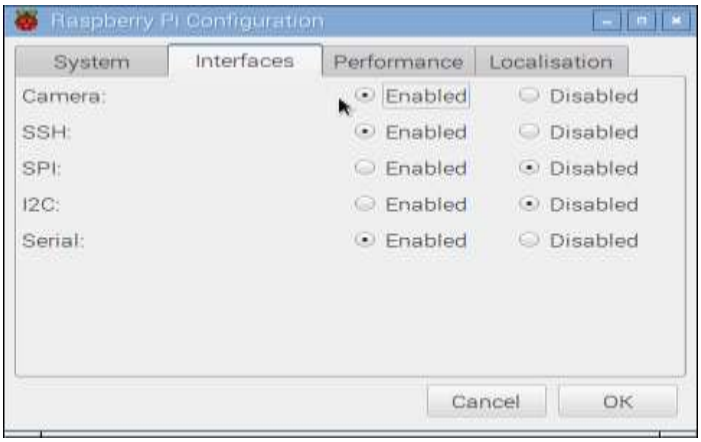

Fig -4.4: Enablig Pi Camera

Now, apply power to Pi board. Once booted, start the Raspberry Pi Configuration utility and enable the camera module. If it's not enabled, enable it and reboot Pi to begin. Once rebooted, open the terminal and run the following command:

$ Sudo apt-get update

$ Sudo apt-get upgrade

4.1.4 Overall Hardware Connection

Upon connecting all the hardware components like MQ2 sensor, Flame sensor, Pi Camera with Raspberry pi power up the raspberry pi with 5V power supply. Connect raspberry pi to the laptop or monitor via Ethernet or HDMI cable. After connecting that a new desktop for raspberry pi will appear on the screen which is called raspberry pi desktop.

Fig -4.5: Pi window on laptop monitor

4.2 Software Requirement

This system makes use of Python programming language for programming the Raspberry Pi. Every python program should save with extension .py.

Python is a wonderful and powerful programming language that's easy to use (easy to read and write) and with Raspberry Pi lets you connect your project to the real world. Python syntax is very simple, clean with an emphasis on reliability and uses Standard English keywords. Start by opening IDLE from the desktop.

Python is a high-level, interpreted, interactive and object-oriented scripting language. Python was designed to be highly readable which uses English keywords frequently whereas other languages use punctuation and it has fewer syntactical constructions than other languages. We have different types of python versions. Python 2.7, Python 3.4 are most popular versions.

Fig -4.6: Python Idle on Raspberry Pi Monitor

5. RESULTS AND DISCUSSION

This chapter deals with the experimental results with the help of photographs with detailed report at every level. Those experimental results consist of the pictures that are obtained after conducting the project.

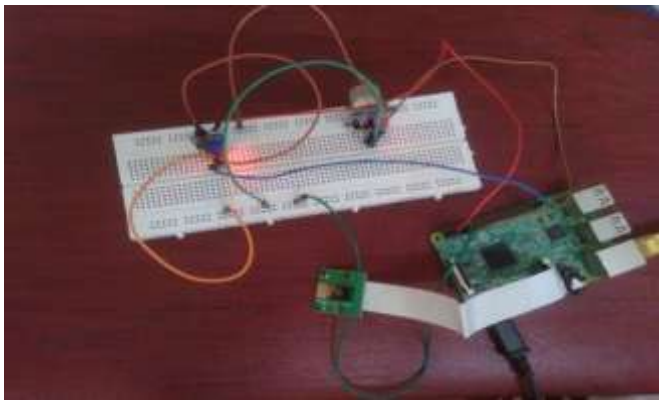

Fig -5.1: Circuit in the Absence of Smoke

5.1 Output in the Absence of Smoke

Intially there is no smoke produced surrounding the sensors. Sensors are activated by the power supply given by pi board. Since there is no smoke around the sensors, Camera is in OFF state and there is no video recording. Console window displays a message as no gas detected as printed statement based on sensor reading.

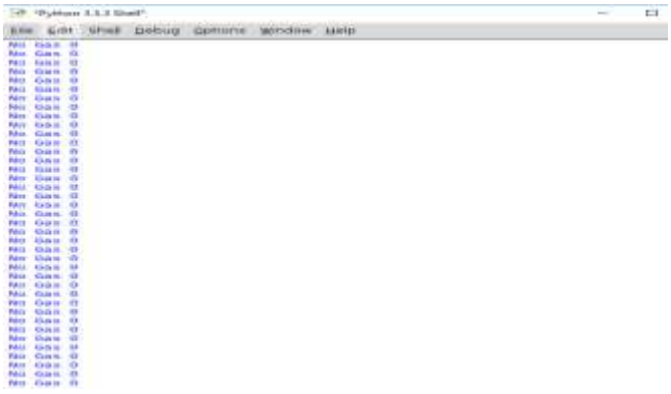

Fig -5.2: Output of the Sensors with No Smoke

5.2 Output in the Absence of Smoke

In order to produce smoke a pair of burned match stickes are brought close to the sensor. As a result gas is detected by the sensor. MQ2 sensor detects smoke as a result pi camera is activated as shown and starts recording the video. Below figure shows the message displayed on the screen and the sensors digital data.

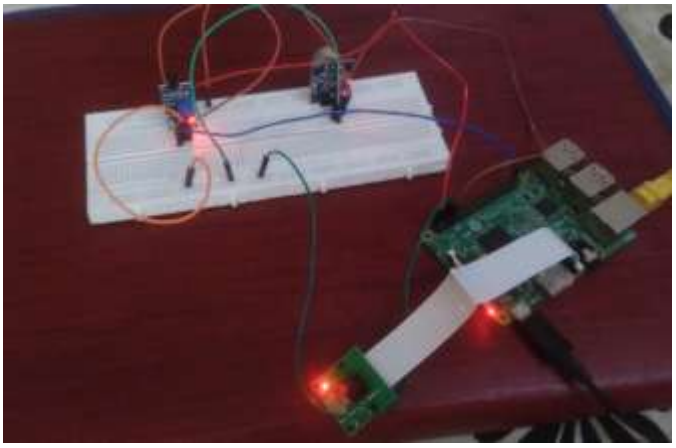

Fig -5.3: MQ-2 Sensor in the Presence of Smoke

Fig -5.4: Smoke Detection Display message

Fig -5.5: Video Steaming through web browser with IP address

In this image, the top most URL is used to watch the video in ones laptop through internet. In this way,the project provides a better detection method for smoking and fire accidents.

6. CONCLUSION AND FUTURE WORK

This project dealt with detecting of the smoke/fire in a better way. Controlling methods can also be added as its scope. The controlling methods include automatic operation of fire controllers like water sprinklers, fire extinguishers and sending alert messages. The scope of this project can be enhanced by sending a message to the controller whenever smoke is detected and providing a facility of remotely accessing the devices to control the situation instantaneously.

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[6] M.Lavanya*, P. Muthukannan, Y.S.S. Bhargav, V. Suresh EEE Department, Saveetha School of Engineering, Saveetha University, Chennai 602 105

BIOGRAPHIES

B.R.B. Jaswanth is working as Assistant professor in Electronics and Communication Engineering department, Gudlavalleru Engineering College, Gudlavalleru. His current areas of interest are VLSI and Embedded systems.

I. Priyanka, a student of Electronics and Communication Engineering department, Gudlavalleru Engineering College, Gudlavalleru.

G. Chaitanya, a student of Electronics and Communication Engineering department, Gudlavalleru Engineering College, Gudlavalleru.

J. Srinadh, a student of Electronics and Communication Engineering department, Gudlavalleru Engineering College, Gudlavalleru.

T. Siva Ganesh, a student of Electronics and Communication Engineering department, Gudlavalleru Engineering College, Gudlavalleru.