International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 1840-1845 www.ijaem.net ISSN: 2395-5252

Fire detection and alert system using cam and sensor

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Submitted: 15-05-2022 Revised: 20-05-2022 Accepted: 25-05-2022

ABSTRACT—The innovative idea of our project is to detect fire using camera through OpenCV and detect smoke through gas detection sensor. Now a days there are sensors which sense smoke and provide alarm but, in this project, there is camera-based fire image recognition/detection with that, this system provides an alert through SMS, E-mail and Speaker.The major advantage of this system is that this system will detect smoke through smoke sensor and recognize image continuously, if both the things (smoke and fire) or individual thing (smoke or fire) will be detected then system will provide an alert over message and mail to the owner of the site, building security office and fire department etc. alert system mail and SMS recipients can be modified as per infrastructure where this system is used.Basically, it is machine which detects fire through camera and smoke through smoke sensor and gives alerts based on detected parameters.

Index Terms— Alert, Camera, Detection, OpenCV, Recognition, SMS, Sensor.

1. INTRODUCTION

1.1 Problem Statement:

As per the ADSI-2019 report, there were 11,037 fire accidents reported across the country in 2019. As per data available with the NCRB indicates that the number of fire accidents in the country reduced by over 40% between 2015 & 2019 but the number of deaths per year is above 10,000.

Because of this major problem we are trying to solve following problems:

- To save lives: Alarms like sirens, E-mail and SMS can notify all occupants to giving them enough time to evacuate.
- To reduce loss of property: Fire alarm systems can notify the responders automatically and fire trucks can be dispatched quickly. As fast as this system notifies the fire incidence, the lesser the damage and loss of property.
- Shorten recovery time: Lesser the property's damage, the shorter the downtime until you can reopen for production or business. This will reduce major losses from the fire and allow you to return to 'business as usual' quickly.
- For insurance discounts: Many insurance companies give discounted rates on insurance policy premiums for businesses if there is a code-compliant fire alarm system in place.

1.2Objective & Scope:

Objectives of doing this project are:

To build fire and smoke detector system using image analysis.

- To provide prompt alarm system which will notify incident as soon as it happens.
- With using smoke detection sensor this system will give pre fire indications.
- To cover large areas through camera for detecting fire.

1.3 Relevance:

The National Crime Records Bureau Data indicates that a total of 113961 people lost their lives due to Fire Accidents from 2010 to 2014. This is an average of 62 deaths a day and as per records of year 2018, Thirty-five Indians die in a fire incident daily. based on the 12,748 lives which are lost due to fire incidents in year 2018.

This is a big problem and to avoid major lives damage we made this system which will promptly response and alert necessary responders to take remedial action.

1.4 Applications

Following are the applications of this project:

1. Main application of the system is to detect fire and alert.
2. Secondary application is to reduce loss of property.
3. Post detection immediate response provision for Shorten recovery time

1.5 Advantages

Following are the advantages of this mini project.

1. Fire stream can be seen from anywhere wirelessly.

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2. Efficient system to notify the fire incidences while non-working hours and while sleep.
3. Easily captures large area with better quality camera.
4. System consumes low power.
5. Cost of the system is low.
6. E-mail alert system is free of cost.

II. BACKGROUND AND LITERATURE REVIEW

Previously there were few projects done on this topic but in this project, we have improved it a lot and with training more to the database accuracy of identifying the fire image will improve a lot which will not lead to false alarm for that only in this project with camera through fire detection MQ2 sensor module is also implemented to be really sure on the fire detection.In few circumstances there is a chance that Gas leakage will be there in then only that as well will be detected with this system.

Previously this system was built to detect fire only but post research and through literature review improvisation is done here. In some scenarios before fire lit gas starts emitting and then it converts into fire so for that this MQ2 sensor module is really helpful to detect early stage.

III. SYSTEM DEVELOPMENT

3.1 Introduction

The innovative idea of our project is to detect fire using camera through OpenCV. Now a days there are sensors which sense smoke and provide alarm but, in this project, there will be camera-based image recognition and fire detection.The major advantage of this system is that this system will detect smoke through smoke sensor and continuous image recognition, if both the things (smoke and fire) or individual thing (smoke or fire) will be detected the system will provide an alert over message and mail to the owner of the site, building security office and firefighting department.

As soon as fire gets detected alarm will also start to alert everyone in on the floor. Basically, it is machine which detects fire through camera and smoke through smoke sensor and gives alerts based on detected parameters.

3.2 Proposed Methodology

This project is based on embedded and image processing domain for this project to work we can use different microcontrollers for example, PIC, AVR, Arduino different series and Raspberry pi. In this project we are going to use Raspberry PI board which is capable of doing things which we want to do in our project like using OpenCV python libraries to work on image and video processing and sensors which we are using in the project.

3.3 Block diagram

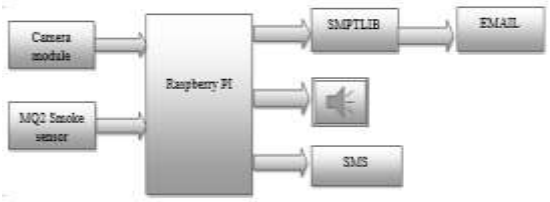

Fig. 3.3.1: Block diagram.

3.4 Working Principle

- As shown in figure 3.3.1 (Basic block diagram of system) Input to the system is from camera and smoke detection sensor. Input to Raspberry pi board from camera is captured live video and smoke detected digital signal from (MQ2) smoke detector sensor.
- Raspberry pi board: It is having Broadcom BCM2387 chipset microcontroller with multiple inbuilt functionalities. Input from camera and detected smoke value will go to Raspberry pi as input, which is used to compare live input image with pre-recorded dataset so based on that it will result in identification of fire detected frame from live video steam and it will give output through speaker and will initiate mail and SMS generation with few libraries.
- Speaker: Speaker is used here in this system to play prerecorded alert sound when fire or smoke will be detected.
- SMTPLIB is a library which is used to deliver email post detection of fire or smoke. Same like email with provided phone number SMS will be delivered.
- Post detention all alert system is working with multithreading so all systems will trigger the alerts parallelly.

3.5 Hardware Implementation:

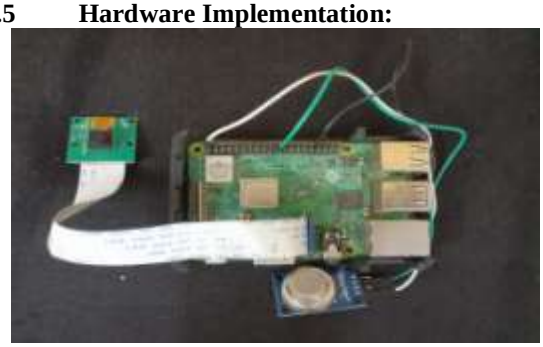

Figure 3.5.1: Hardware implementation of project - Image 1.

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MQ2 sensor module is having 4 pinouts as shown below:

1. D0: Digital output.
2. A0: Analog output.
3. GND: Ground.
4. VCC: Power supply (5V)

On raspberry PI to connect MQ2 sensor digital input is taken which shows high when gas is detected and LOW on neutral situation. Sensitivity is adjustable through potentiometer.

- To connect (D0) Digital output pin of MQ2 sensor GPIO9 which is pin no 21 used.
- To provide on board power supply pin no 2 is used which is providing 5 volts to MQ2 sensor module.
- Ground is provided through Pin no 34 which is on board ground pin.
- Connection is done through female-to-female connector cables.

Till now this was the explanation of connection of MQ2 sensor to Raspberry PI moving ahead with the connection of Raspberry PI camera module.

Raspberry PI camera module is connected to the CSI port on Raspberry Pi, this is the long thin port adjacent to the HDMI socket.

Power supply need is provided through 5 volt DC charger and it is conned directly to Raspberry pi board.

Figure 3.5.2: Hardware implementation of project – Image 2

3.6 Software Implementation:

3.6.1 Flow chart

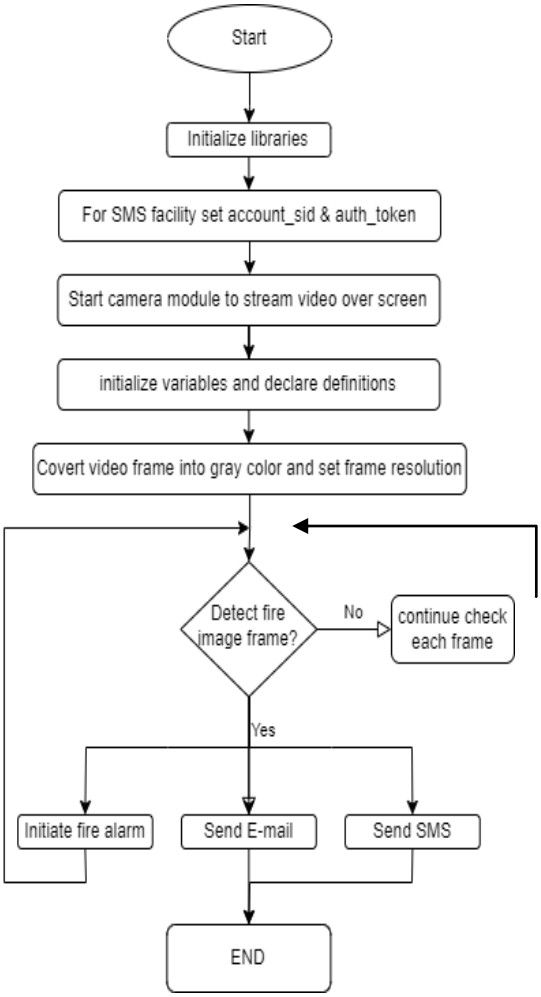

Figure 3.6.1: Flowchart of the code.

For software implementation we have used of Python IDLE platform through that script is written and post script run execution single script will run the project.

3.6.1 Libraries include

- CV2 library for OpenCV dependency with that video/image capture and operations on the same can be performed.
- Threading library is for creating threads which allows code to run in parallel.
- Playsound library is used for alarm sound (MP3 pre-recorded audio play.)
- Smtplib library is used for sending email post detection of fire.
- Twilio.rest library is used to send SMS post detection of fire.

3.6.3 Output of camera module

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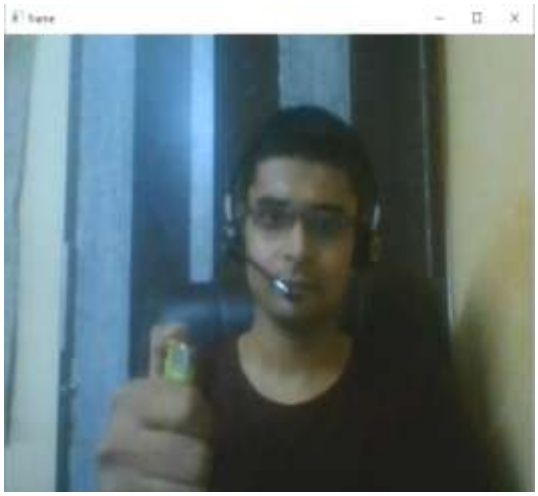

Figure 3.6.2: No fire lit image

Video stream starts over Raspberry PI board as shown in fig 3.8.2 where fire is not lit so just video stream is on and alert system is not activated. Post running the code written on python screen this screen will be visible which will continuously monitor each and every frame with the "haar cascade algorithm" to check if any of the fire image detects on video frame.

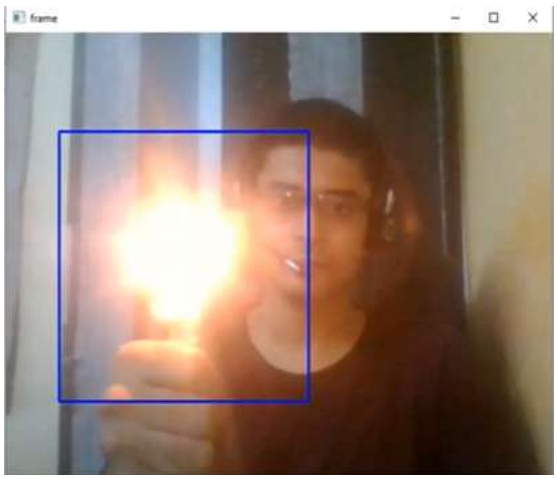

Figure 3.8.3: Detected fire image

While comparing each and every frame when fire is lit at that time that image will be compared with positive images of "haar cascade algorithm" and it will mark the detected section with blue box as shown in figure 3.8.3 after this stage only alarm will start and with that SMS and E-mail till be sent to selected cannels.

Figure 3.8.4: Executed code

Post detection of fire frame as shown in figure 3.8.4 fire alarm initiates as per code snap line no.1 where E-mail and SMS sending initiates. Just for clarification, above shown is (output) console window where execution log will be visible.

3.7 Output of MQ2 sensor module

MQ2 sensor on module:

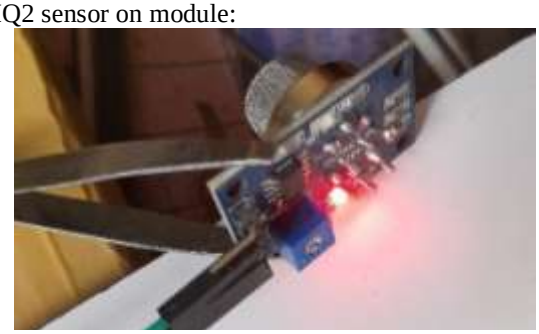

Figure 3.8.5:MQ2 sensor on rest state

As it is illustrated in Chapter 3 - system development point 3.2.5 there are 4 pinouts of MQ2 sensor module, as soon as we connect 5V power supply to the power pinout and GND pinout to ground of the raspberry pi circuit completed and red-light glows on MQ2 sensor module which indicates the MQ2 sensor is turned on. MQ2 sensor provide outputs in 2 forms. In this project we have taken direct digital output through D0 pin which works as input pin to the Raspberry pi.

There is potentiometer which is with blue color and screw on it which is used to adjust the sensitivity of the sensor means at how much gas flow on sensor we want indication that we can adjust trough that potentiometer.

Figure 3.8.6:MQ2 sensor at rest state code execution

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In above shown fig 3.8.6 MQ2 sensor is in on state with red led indication at the same time we can see on output console on Python IDLE it is showing nothings (Blank) in from of "mq2 sensor" name.

MQ2 sensor under on stage:

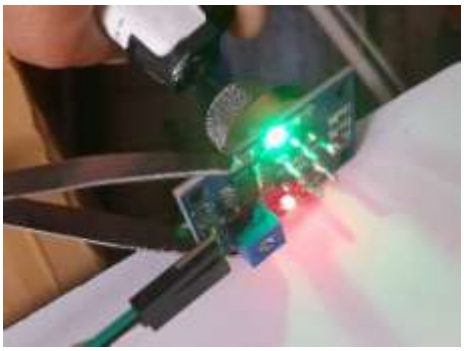

Figure 3.8.7: MQ2 sensor when gas is detected

To provide gas to the MQ2 sensor we have used lighter post lighting lighter with air blow if we blow the flame then only gas will emit from lighter without harming sensor which is getting detected with green light on sensor which we can see in above shown fig 3.8.7.

Figure 3.8.8:MQ2 sensor at gas detected state code execution

The same thing we can see on output console as well it indicates with the text "MQ2 sensor through gas is detected". Which really helps to detect the pre-condition of the fire. Before fire in some situations gas emits and that scenario, we are covering through this MQ2 sensor.

3.8 Final output on console:

Figure 3.8.9: Final code execution output

On Python IDLE we can see output written on console line by line which indicates starting of the process and ending of the process.On first line as we can see post detection on fire on video frame fire alarm immediately and post that Mail and SMS triggers. One more facility is that SMS and E-mail will not continuously send, it will send once and next time it will give update that SMS and E-mail is already sent.

IV. ADVANTAGES, DISADVANTAGES & APPLICATIONS

4.1 Advantages

1. To save lives.
2. Reduce loss of property.
3. Machine building cost is Low.
4. Shorten recovery time.

4.2 Disadvantages

1. Currently limited set of fire data is provided to decide/detect fire which need to be increased by providing more positive and negative images.
2. False alert may cause in rare situation.

4.3 Application

1. In Industries, Production factories, Hostels, Residential societies, Hotels, etc.
2. With speaker alarm system it can alert to visually deaf person.
3. One of the applications is to keep record of fire incidences and informing it to government firefighting office.
4. In Schools, colleges and educational institute for students and staff safety.

V. CONCLUSION AND FUTURE SCOPE

For the final stage project presentation, the required research work has been completed and the validation of project has been proved. Hence it can be said that the aim of the project "Fire detection and alert system using cam and sensor" is achieved successfully. The further designing and implementation of the working model is complete. After which we will conduct different experiments for Accuracy improvement in which we can provide more positive fire images and negative fire images to improve the comparison and to reduce the false alarm.

ACKNOWLEDGMENT

I would like to express my special thanks of gratitude to my guide (DR. S. D. Lokhande) who gave us the golden opportunity to do this wonderful project on the topic (Fire detection and alert system using cam and sensor), We came to know about so many new things I am really thankful tothem. Secondly, I would also like to thank my parents and friends who helped me a

lot in finalizing this project within the limited time frameReferences and Footnotes.

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