

# REVIEW ON IMAGE PROCESSING BASED FIRE DETECTION USING RASPBERRY PI

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**Abstract** – Internet of things (IoT) is the network of entities that consists of electronics, programmable software, sensors, and communication facility that enables these entities to gather and transfer data. The objective of the proposed system is to alert by using image processing method with the help of buzzer which gives an alarm, while the fire accidents occur. The main advantage of Image Processing Based Fire Detection System is the early warning benefit. This system can be installed just about any where in a commercial building, malls and at many more public places for fire detection. This system uses camera for detecting fires. So we do not need any other sensors to detect fire. The Raspberry Pi controller processes the camera input and detects fire using heat signatures. System processes the camera input and then processor processes it to detect fires. The heat signatures and fire illumination patterns are detected in images to determine if it is a fire and take action accordingly. On detecting fire system goes into emergency mode and sounds an alarm. Also displays the status on the LCD display informing about the system.

**Key Words:** IOT, CSI, CV, USB, RAM, NOOBS

## 1. INTRODUCTION

Fire is one of the most fateful threaten for mankind. Fire can be determined by light, smoke and temperature. We may resort to power failure, water spraying for alarming. However, fire alarm is still a difficult problem for large space. Because there are many factors such as the height of the space, the heat barrier, the coverage, the signal transmission and so on, it is difficult to control.

To detect fire, only using color information may produce false alarm, so color and temporal variation information should be used to get good performance of the fire detection system. Some researchers used RGB input and the simple and effective procedure for real time application. Others adopted panoramic camera, wavelet transform, neural networks, etc. For relatively complicated fire detection system. And some were very specific specific purposeed system like tunnel fire, ship compartment fire, forest fire, etc.

So it is not easy to compare the fire detection systems directly.

Sensors are used to measure the desired parameters in most of the methods. Applying several sensors is essential in order to cover all desired area while it is not cost-effective. The sensors are contact sensors. They should be install near the ceiling, thus it causes delay until the smoke reach to them. These restrictions lead to image processing in the fire detection. The characteristics that are used in image processing are color and motion.

If a motion happens in background and the object is the same color as fire, it is consider as fire object but these features cannot produce the required performance. For instance if a red car has a movement in a garage, the system will assumes the motive object as fire. Therefore, an image processing system uses both color and motion characteristics for proposed applications in different conditions. Here we use a Raspberry pi3 because of raspberry pi is low cost, credit size computer that plugs into a computer monitor or TV, and uses standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in language like scratch and python. It is capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games [3].

Moreover, the other features such as dynamic movement and disorder, in the shape of fire and smoke, should be used for high performance detection. The color feature is a static characteristic and it depends on the fuel. The motion is a dynamic characteristic and it highly depends on the airflow. The growth and disorder features are also dynamic characteristics and they depend on fuel and airflow.

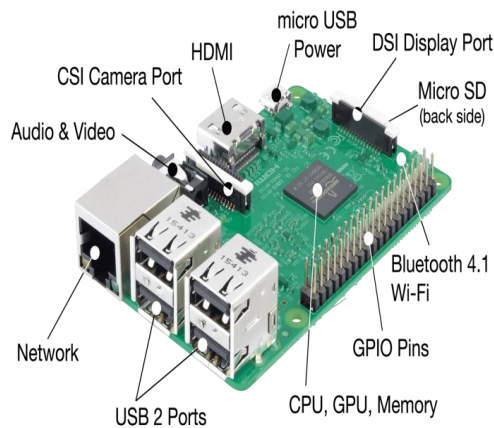


Figure 1: Raspberry pi kit structure

## 2. REVIEW OF LITERATURE

Apart from causing tragic loss of lives and valuable natural and individual properties including thousands of hectares of forest and hundreds of houses, fires are a great menace to ecologically healthy grown forests and protection of the environment. Every year, thousands of forest fires across the globe cause disasters beyond measure and description. This issue has been the research interest for many years; there are a huge amount of very well studied solutions available out there for testing or even ready for use to resolve this problem.

In [1], author Md Saifudaullah Bin Bahrudin et.al discusses a real-time monitoring system that detects the presence of smoke in the air due to fire and captures images via a camera installed inside a room when a fire occurs. The embedded systems used to develop this fire alarm system are Raspberry Pi and Arduino Uno. The key feature of the system is the ability to remotely send an alert when a fire is detected. When the presence of smoke is detected, the system will display an image of the room state in a web page. The system will need the user confirmation to report the event to the Firefighter using Short Message Service (SMS).

In [2], author V. Rakesh et.al discusses the implementation of an embedded system for monitoring wireless sensor nodes and camera installed inside a building for security surveillance. Remote alerting on fire and intruder detection are the key features of the system. When smoke or intruder movement is detected, the system sends warning messages through Short Message Service (SMS) to cell phones, starts capturing real-time video for fixed duration and makes the alarm on. The captured video clip is immediately uploaded to

an FTP (File Transfer Protocol) web server so that it can be retrieved later from anywhere around the world.

## 3. PROPOSED SYSTEM

The proposed system uses Image processing; strength of using image processing in fire detection is the ability to serve large and open spaces. Proposed system consists of three stages: In the first stage, camera will capture the image and it will send that image to controller for further evaluation. And then the process of further detection has been started. In the second stage, the images are converted into frames and it will compare those images into already booted images. In the third stage, buzzer will give an alarm.

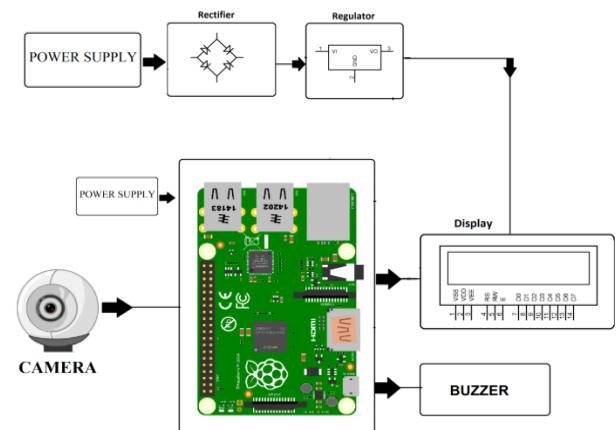


Figure 2: Block Diagram

## 4. MODULE DESCRIPTION

We segmented our system design into four modules. Video recording and transferring to controller is first module of our system design. In this module the camera captures continuous frames from the area of its coverage. All the captured images or frames transfer to the controller for applying image processing function. Second module is Color based segmentation in this module after separating the frames as single image it is subjected to standard color base segmentation. The segments are further divided into constant sized blocks. Third module is Fire pattern recognition in this module the blocks of the segmented image will be examined for the presence of heat signature or fire patterns. Emergency trigger is our four module here, if any peculiar pattern is identified in any of the blocks for a particular period of time, it will switch on the emergency mode and will give an Alarm.

## 5. METHODOLOGY

Fire is detected using fire patterns with heat Signature. Heat signature is color patterns to represent the fire. There are three filters are used to find the heat signature [4]. They are:

- a) RGB filter
- b) cieLAB filter
- c) Both
- d) RGB filter 2

### A) RGB filter:

RGB filter is used to Extract Red (R) Green (G) and Blue (B) component of each pixel. And then in every pixel two conditions are verified. They are

- If  $R > G > B$
- If  $R > R_t$  ( $R_t$  is the red threshold value between (0,255). This is based on light in the image. Here value 125 is used.

### B) cieLAB filter:

Here the LAB color model is used .cieLAB color model are Highlights red, yellow and related colors like orange. For all pixels in the frame the mean value of L, A and B components are identified.

- For every pixel four filters are used.
  - If  $L > L_{mean}$
  - If  $A > A_{mean}$
  - If  $B > B_{mean}$
  - If  $B > A_{mean}$

### C) Both:

To satisfy various lighting conditions both the RGB and cieLAB filters are used. If any one of the filter passes a pixel, it is a fire signature.

### D) RGB filter2:

Another filter that uses RGB components. It will works well at night mode. In this method the R, G, and B components are compared with threshold values.

- $r_t=140, g_t=100, b_t=100$
- Three conditions are checked:
  - $R > r_t$
  - $G > g_t$
  - $B < b_t$

### ❖ PYTHON:

Python is an interpreted high-level programming language for general-purpose programming. Python has a design philosophy that emphasizes code readability, notably using significant whitespace. It provides constructs that enable clear programming on both small and large scales. Python features a dynamic type system and automatic memory management. It supports multiple including objectoriented, imperative, functional and procedural, and has a large and comprehensive standard library.

Python interpreters are available for many operating systems.

IDLE is Python's Integrated Development and Learning Environment.

IDLE has the following features:

- coded in 100% pure Python, using the GUI toolkit
- cross-platform: works mostly the same on Windows, Unix, and Mac OS X
- Python shell window (interactive interpreter) with colorizing of code input, output, and error messages
- multi-window text editor with multiple undo, Python colorizing, smart indent, call tips, auto completion, and other features
- debugger with persistent breakpoints, stepping, and viewing of global and local namespaces
- configuration, browsers, and other dialogs

## 6. ADVANTAGES

- Image Processing in fire detection is the ability to serve large and open spaces.
- Raspberry pi has higher specification

## 7. CONCLUSION

This paper proposed a fire detection algorithm which is free from sensors as the ordinary fire detection systems contain. The objective of this paper was to create a system which would be able to detect fire as early as possible from a live video feed. System is expected to detect fire while it is still small and has not grown to mammoth proportions. Also, the hardware is minimal and has been already existent in places, thus saving capital. It also saves cost by getting rid of expensive temperature and heat sensors etc. Based on the results produced, the system has proven to be effective at detecting fire. This system is an amalgamation of various fire detection algorithms.

## REFERENCES

[1] Md Saifudaullah Bin Bahrudin, Rosni Abu Kassim. "Development of Fire Alarm System using Raspberry Pi and Arduino Uno," Electrical, Electronics and System Engineering (ICEESE), 2013 International Conference on. IEEE, 2013

[2] Rakesh, V. S., P. R. Sreesh, and Sudhish N. George. "An improved real-time surveillance system for home security system using BeagleBoard SBC, Zigbee and FTP web server," India Conference (INDICON), 2012 Annual IEEE. IEEE, 2012

[3] Jain, Sonal, Anant Vaibhav, and Lovely Goyal. "Raspberry Pi based interactive home automation system through Email," Optimization, Reliability, and Information Technology (ICROIT), 2014 International Conference on. IEEE, 2014

[4] Pasquale Foggia, Alessia Saggese, and Mario Vento, "Real-time fire detection for video-surveillance applications using a combination of experts based on color, shape, and motion," Circuits and systems for video technology , vol. 25, no. 9, September 2015.