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Computer Based Fire Detection System Using Video Image Processing

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Abstract: ***Image processing stands for the analyzation of an image which results in the calculation and detection of various components of the image such as colour, shape and motion. In this paper, we propose a model which is able to detect fire by analysing images acquired by a surveillance camera and sensors. The circuit includes a microcontroller, ADC, sensors, camera, and buzzer. All the data taken from sensor and camera will be monitored via data monitoring system wirelessly to detect the fire. We propose this system based on two main novelties: first, based on colour, shape and motion analysis and second, the bag-of-words approach for representing motion. This system will produce results with a reduced number of false positives and the system can be run on an embedded system.***
Keywords: Smart System, buzzer, smoke, video image processing.

I. INTRODUCTION

A. Problem Definition

The Problem Definition is- To design a Smart system for detecting fire by using sensors and camera which will produce more accurate results than the previously designed systems. We are using light, temperature and gas sensors in the proposed system.

B. Introduction

Security is the basic need of human society. Fire Detection Systems are used in Educational institutes, Hospitals, Military areas, Shopping centres and many more public places.

"Detecting fire before it becomes uncontrollable and a quick alarm" is the prime need. We have systems designed for fire detection which use physical sensors and image processing algorithms. But this systems create false positives like if someone smokes in the area, the fire rings. This happens because the system uses smoke sensor for fire detection. Basic needs of a Fire Detection System are:

1) It should detect fire before it becomes uncontrollable
2) It should not create false positives.
3) Not only the alarm but some more facility should be provided to the user so that he comes to know about the fire has been detected in his house or anywhere he has installed the system.

II. LITREATURE SURVEY

Sr. No.	Title of Paper	Description
1	Fire Detection using Image Processing IEEE Trans 2015	This paper proposes a system which works on video surveillance. It works on information based on colour, shape and motion. It has been tested on a wide database taken from real environment and web. This system produces better results than the previous systems and a consistent results of less false positives is been seen through this

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		system.
2	An Early Fire Detection Method based on Image Processing.	This system is based on RGB (Red Green Blue) model based chromatic and disorder measurement for extracting fire and smoke pixels. It uses iterative checking for raising flames. As the flames raise, alarm will ring when it meets the alarm raising condition. Further Fuzzy Neural Network can be applied.
3	Efficient Visual Fire Detection for Video Retrieval.	In this system, a new image event detection method is proposed for identifying fire in videos. The fire and background characteristics in a single frame are analysed and evaluated into a Bayes Classifier to get to a decision. The features form frame-to-frame are analysed. The features are colour, area, size and skewness.
4	Campus Fire Recognition Based on Video Image Processing.	This system proposes based on data mining method and improved campus fire recognition based on vision recognition function. It uses Gray processing and Binarization process for fire recognition. The Normalization process is used for reducing background interference.
5	An Intelligent System for False Alarm Reduction in Infrared Forest-Fire Detection	This system proposes a system which combines results of various sensors. Various sensors are geographical sensors, infrared sensors and visual cameras. This proposed system combines computer vision tools, neural networks, and expert fuzzy rules to detect forest fires in open area. The FAR system is composed of a sensor interface, an image-processing tool, and a decision function.

III. PROJECT SCOPE

Presenting a design and implementation of Fire Detection System using live camera feed and analog values provided by sensors. It parallely focuses on the results generated through sensors and camera. The system produces the results which reduces number of false positives.

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A. Aim

The aim of our proposed system is to detect the fire as early as possible and ring the alarm as well as an email will be sent to the registered email id in our system. User will be informed through an email that fire is been detected at a place where he has installed this system.

B. System Architecture

The system architecture proposed in this paper has two main modules:

1) Software Module

The software module can be also termed as control system. This system will fetch the values from camera and sensors installed in the hardware unit.

The software unit will perform following tasks:

a) Frame Extraction from the video captured through the camera.

b) RGB Image generation through the frames.

c) Blurring of images.

After blurring will have two different series of tasks which will be done simultaneously. RGB to HSV, HSV Thresholding and Spectral Analysis.

Grayscaling, Comparison of the current image with the previous image, Thresholding and Motion Detection (Estimation).

These two tasks will lead into a positive or negative result of detection of fire. If the results are positive, the buzzer will start ringing.

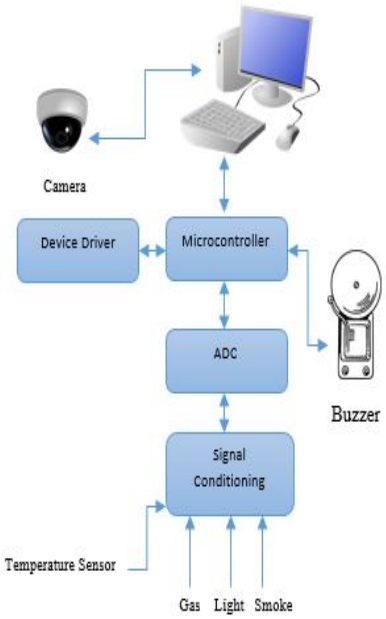
2) *Hardware Unit:* Sensors and camera on the hardware unit will be working continuously. The sensors will be sensing the area and updating the values at the system every time.

The camera will record the videos and the system will process it via extracting frames from it.

There will be a buzzer in this unit which will start ringing after it gets the command from system.

We have set some variable threshold values in the system according to the environment. These values can be changed by the end user as per his requirement.

When these threshold values will be matched or crossed by the values generated by sensors, the buzzer will get a command to ring. This is a signal that fire has been detected.



Fig[a]. Designed System

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C. Functional Requirement:

This requirement specifies each task which is performed throughout the system as per the user's requirements. So, the system features are given below:

1) System Feature: Software Unit
a) User has to register his email id in the system.
b) System will notify the user. Ex: alarm.

2) Non-Functional Requirement
a) *Performance Requirement:* The system shall be available 24/7. The data provided by the sensors and camera will be continuously analysed frame by frame.
b) Safety Requirement:
c) Our system is protected by username and password. So no one other can access the system. The user should not reveal his/her login details
d) Security Requirement: Every time the user tries to access the system, he will be asked for login details.

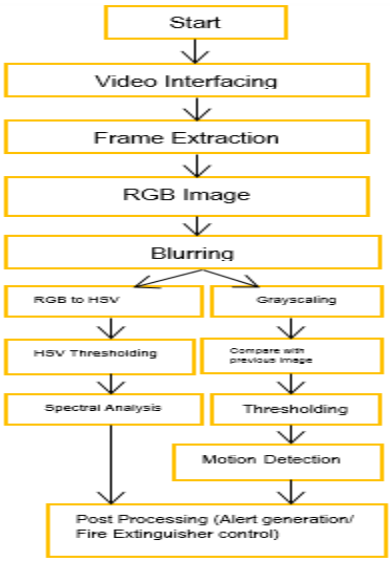

Fig [b]. Flow Diagram

D. Software Development Life Cycle

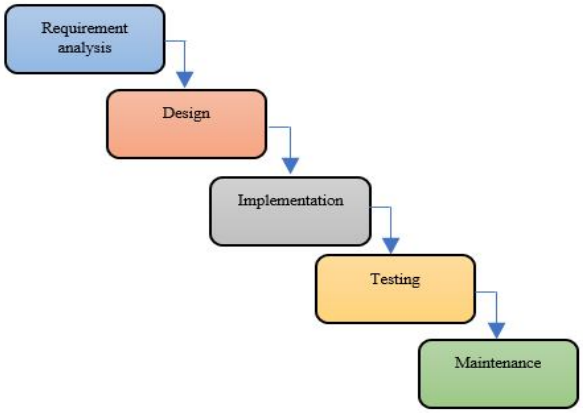

Fig [b]. Process diagram(SDLC)

E. Mathematical Model

Let S be the system defined as:

$S = \{U, A, S, F, O_o, S_u, F_i\}$

Let us discuss the system in detail.

$S = \{U, A, S, F, O_o\}$

Where,

U = Set of Users where,

$U = \{U_1, U_2, - - - - - - , U_n\}$

A = Set of Algorithms where,

A = {A1, A2, - - - - - - ,An}[Bag of Words Approach]

S = Set of Sensors

$S = \{S_{temp}, S_{smoke}, S_{gas}, S_{light}\}$

F = Set of Functions

$F = \{F_1, F_2, - - - - - - - - - , F_n\}$

Where,

F1 = Capture_Image()

F2 = Generate_Histogram()

F3 = RGB_to_Histogram()

O_o = The set of Fire Detected Area

$OO = \{O_{O1}, O_{O2}, - - - - - - - - , O_{On}\}$

Su = Success state

This state will be achieved when fire will be successfully detected by the fire detection system.

Fi = Failure state

This state can occur due to system failure or false alarms of fire detection.

F. Assumptions

We are connecting the user and system via internet. So we are assuming that there will be a good internet connection at user level. All the hardware is working properly assumed if the sensors and webcam is working properly.

1) Success Condition:

a) An email is sent to the user immediately by the system when the fire is detected

b) Fire should be detected as per the already set threshold values at the system.

2) Failure Condition:

a) If the sensors don't work after installation, the system will fail to provide the sensors values to the user via email.

b) If the camera will not detect the fire, the system will not be able to send the image of fire detected to the user

c) Poor internet connection may lead to a problem of sending email to the user.

IV. DEPLOYMENT AND MAINTENANCE:

The system can be deployed after successful completion of Software Development Life Cycle (SDLC). All the system components are assembled in the deployment phase.

Sensors, microcontroller, camera and buzzer, etc. are assembled on a board for testing. After the team members analyse the product, it is ready for deployment.

For long term usage of the product, it needs to be maintained. The hardware products like sensors are to be checked regularly for precise output generation.

V. CONCLUSION

The proposed methodology in Fire Detection System will lead in a major progress for early fire detection which will save environment, human life and property as well. This system will help to generate more accurate results and in much less time as parallel processing of the values will be done of the generated values. Reduction of false positives will be a major advantage of this

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system as the system will be producing results using multiple values. Informing the user about the detection is a prime need which is fulfilled through this system. In the world of internet, user will be notified as soon as the fire is detected.

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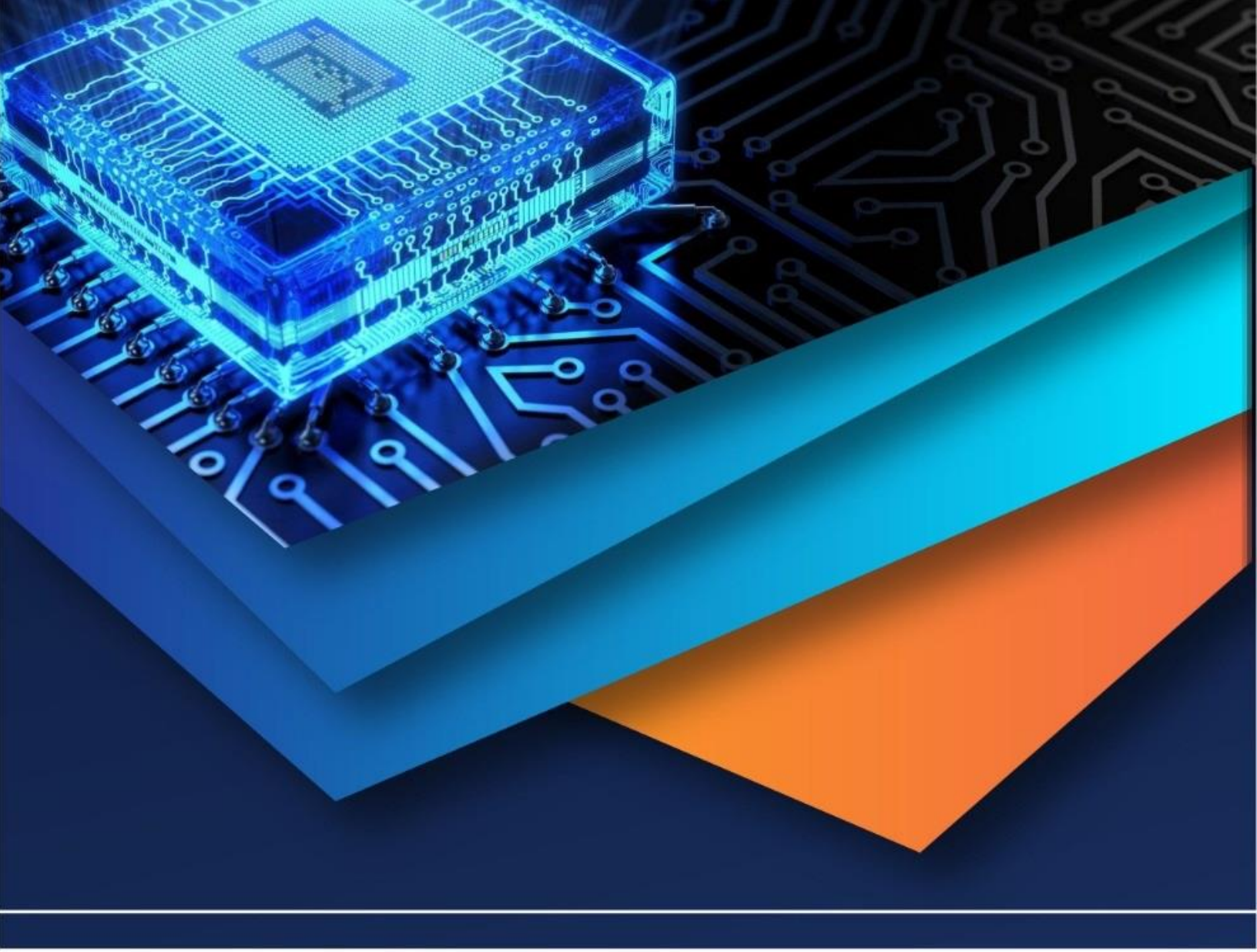

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