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Fire Detection Using Video Image Processing and Bag of Words Approach

Divyansh Sharma, Apoorva Bhandari, Nikita Dalwale, Shraddha Dhumal, Prof. M. P. Navale.

Dept. of Computer Engineering, NBN Sinhgad School of Engineering, Savitribai Phule Pune University, Pune, 411041, India.

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 color, shape and motion. In this paper, we propose a model which is able to detect fire by analyzing 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 color, 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: Image processing, video surveillance, monitoring system, smoke, camera.

I. INTRODUCTION

Fire detection system when used in the surveillance system monitors the indoor environment or wherever the system has been set up and issues alarm as a part of the early warning mechanism with the ultimate goal to provide a reminder i.e. precautionary measure at early stage before the fire becomes uncontrollable.

With the development of construction techniques, the high-rise buildings have been made and are now populated. In the event of fire in these buildings, as the fire is spreading, the risk of large fire is increased and the resulting casualties and property damages are increased. Therefore, the techniques to detect the flame at an early stage are necessary in order to prevent the fire and minimize the damage. There are a large number of fire detection schemes being used now a days, one of the most prominent is the physical sensor based fire detection system. The physical sensor-based flame detection technique is a technique that uses smoke, carbon and temperature sensor. These physical sensor-based fire detection techniques have limited disadvantages. For example, the sensor has to be installed closely at a regular interval to detect the fire in a large area so there is a disadvantage of increasing the installation cost in proportion to the area. For smoke sensor, the smoke may not be detected by the sensor due to the good ventilation, outdoor, or the diffusion of the air. Since the temperature sensor detects the fire when the surrounding temperature of the sensor is already high, it can't detect the fire at an early stage. In addition, if the UV detection method is used in the flame detection sensor, the sensitivity may be decreased due to the absorption of ultraviolet caused by the smoke or other floating matters, and the possibility of misdetection is high, including even responding to the welding flame.

The major goal is to identify user requirements for early warning services in case of fire or extreme weather conditions. This will be achieved through:

- Analysis of state-of-the-art in providing innovative and integrated solutions for early warning services.
- Identifying requirements for an early warning system to remotely monitor areas of archaeological interest from the risk of fire or extreme weather conditions.
- To develop novel algorithms for detecting smoke and fire using different kinds of sensors
- Provision of real time data from temperature and humidity sensors about the evolution of the fire.
- Detecting fire from Camera for live video feed.
- Parallel execution of software as well as hardware.
- Apply different sensors to detect temperature, smoke and gas.

II. CONVENTIONAL APRROACHES

Fire detection techniques being used nowadays can be classified into physical sensor-based fire detection and image processing fire detection. The physical sensor-based fire detection technique is a technique

that uses carbon, temperature and smoke sensors. These physical sensor-based fire detection techniques have limited advantages and on the contrary a large number of disadvantages, *viz.* the sensors have to be installed closely at a regular intervals to detect the fire in a large area so this is a major disadvantage of increase in the installation cost in proportion to the area. For smoke sensor, the smoke may not be detected by the sensor due to the good ventilation, outdoor, or the diffusion of the air. Since the temperature sensor detects the fire when the surrounding temperature of the sensor is already high, it can't detect the fire at an early stage. In addition, if the UV detection method is used in the flame detection sensor, the sensitivity may be decreased due to the absorption of ultraviolet caused by the smoke or other floating matters, and the possibility of misdetection is high, including even responding to the welding flame. To compensate for these disadvantages, the fire detection techniques applied with image processing techniques are being used.

The common limitation of the above mentioned approaches is that they are particularly sensitive to changes in brightness, so causing a high number of false positive due to the presence of shadows or to different tonalities of the red. This problem can be mitigated by switching to a YUV color space. For instance, a set of rules in the YUV space has been experimentally defined to separate the luminance from the chrominance more effectively than in RGB, so reducing the number of false positives detected by the system. Information coming from YUV color are combined using a fuzzy logic approach in order to take into account the implicit uncertainties of the rules introduced for thresholding the image. A probabilistic approach based on YUV has been also exploited, where the thresholding of potential fire pixels is not based on a simple heuristic but instead on a support vector machine, able to provide a good generalization without requiring problem domain knowledge. Although this algorithm is less sensitive to variations in the luminance of the environment, its main drawback if compared with other color based approaches lies in the high computational cost required as soon as the dimensions of the support vector increase.

III. PROPOSED SYSTEM

We propose a system that would make sure that all the above disadvantages are covered and a methodology is introduced which would produce less number of fault results and a more reliable system is set up so that the increasing number of fires can be reduced.The flowchart explains the probable outcomes and the procedures that are to be used in each of those.

To identify **user requirements for early warning services in case of fire or extreme weather condition**s. This will be achieved through:

1. Analysis of state-of-the-art in providing innovative and integrated solutions for early warning services.
2. Identifying requirements for an early warning system to remotely monitor areas of archaeological interest from the risk of fire or extreme weather conditions.
3. To develop novel algorithms for **detecting smoke and fire** using different kinds of sensors
4. Provision of real time data from temperature and humidity sensors about the evolution of the fire.
5. Detecting fire from Camera for live video feed.
6. Parallel execution of software as well as hardware.

Apply different sensors to detect temperature, smoke and gas.

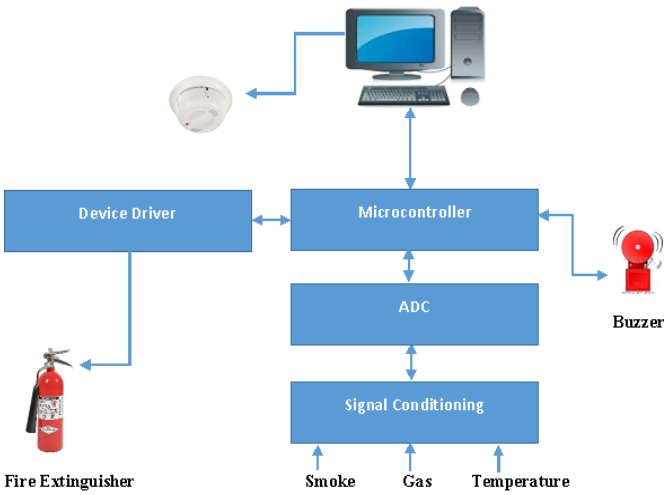

Fig (b): The Proposed System

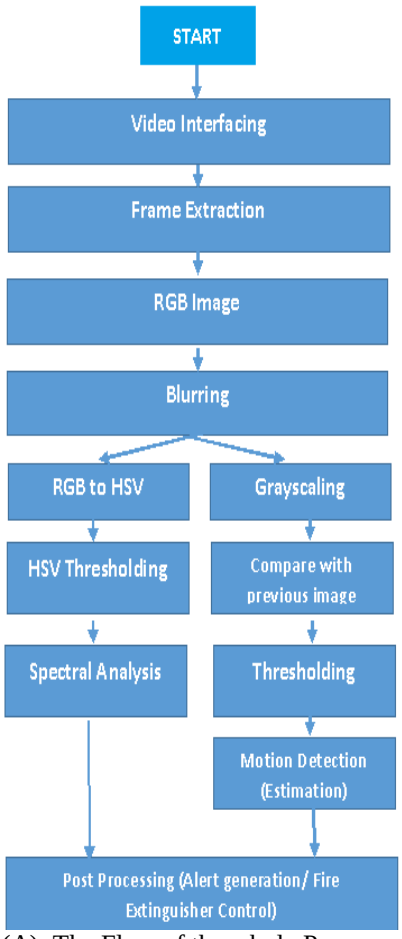

Fig (A): The Flow of the whole Process

A. FUNCTIONS

- Main activity: Mediate ( ), Workout( )
- Workout: Extract frames( ), RGB Separation ( ), Filtering ( )
- Mediate: spectral analysis ( ), RGB_HSV Conversion ( ),HSV _histogram( )
- Customize: Detection_of_fireby_image processing( )
- Detection of fire_by_hardware ( ).

B. SUCCESS CONDITION

- Fire alarm rang successfully.
- Fire detected successfully using camera.
- System architecture schedule designed successfully.
- Fire tracked and preventive measures taken successfully.

C. FAILURE CONDITION

- The first type of potential failure is when a system that has been designed and installed to meet specific objectives fails to meet those objectives.
- The second failure mechanism is when the objectives of the fire alarm system have not been properly matched and integrated with the overall fire safety mission.
- A third type of failure is when a system "fails positive" due to false or nuisance alarms.
- Camera feed is not properly or camera feed is in sunlight may causes the system failure because we are working on color model.

IV. CONCLUSION AND FUTURE SCOPE

- This paper suggests a system for Fire Detection using video image processing and bag of words with an alarm set up on the microcontroller. The circuit design includes a buzzer, sensor, a wireless camera, and a mobile based application for notifying the user.
- All the data collected from the sensors and cameras, will be sent to a data analyzing base station. This allows the users to achieve better performance in terms of reliability and false positives.

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