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Survey on an Intelligent AAA Device for Fire Detection

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ABSTRACT

Fire is a huge serious disruption which can lead to economic or environmental losses. A system to detect fire and alarm the people before it breaks out is a need to our environment. In this paper, the focus is on the literature by providing an edifice and comprehensive overview of fire detection. It includes Alarming, Authentication and then Addressing the location of place where fire broke out to the admin and fire emergency services. Raspberry Pi 3 is used to control the system which are integrated with few sensors and camera. It supports image processing using OpenCV library which is used to process video more accurately with less time period. A 360ż relay motor is assembled with the camera so that it can snap the image in whatever angle the fire is detected after sensor detection. To avoid disk memory usage, this system save the image only when fire is detected. This paper also reviews the context and key features of fire detection systems. A method of combining sensor data and real-time processing help the device to avoid false alarm and image is sent to group of users. Finally, we summarize the open problems and future exploration area in detecting the fire and authenticating it to the users.

Keywords: *Fire Detection, Raspberry Pi, Sensors, Authentication, Location, OpenCV etc.*

1. INTRODUCTION

Fire is dangerous that could bring the great loss for human life. Recently Mumbai has been a witness to some of the worst fire accidents. On July 18, 2014, a fire broke at the 22-storey Lotus Business Park in Andheri west destroyed two upper floors. On 24 November 2012, fire took 117 lives in "Tazreen Fashion factory" in capital Dhaka. 8 lives were lost when a fire broke out at a textile factory in the Mirpur industrial district on May 9, 2013. Conventional methods are very old and lack fire detection technology. A system to detect fire and alarm the employees before it breaks out is a crying need. In this paper, we designed a fire alarming system with both authenticating and addressing mechanism to help detect fire as soon as possible and save precious human lives. The system will use temperature and gas (smoke) sensors to detect early symptoms of fire and then activates image processing techniques by enabling rotating camera mechanism to sense the fire properties like color, shape, etc. The strength of using image processing is the ability to monitor large and open spaces. Fire properties can be identified effectively while analyzing videos and distinguishes fire and fire colored objects. Raspberry Pi 3 is central control board that has secure SD card reader or Micro SD card reader and provides Debian Linux OS that supports python language. This paper combines both sensors based and vision-based systems. Image processing is a form of signal processing where input is a series of video frames and output is an image. The main advantage of the system is the early warning which can be installed anywhere for fire detection. The camera will capture the video and separate the image into frames, on detecting fire, the system initiates alarm system and process the captured image along with location using localization technique and then sends to the remote user through wireless networks.

2. LITERATURE SURVEY

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[6].

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.

In [3], author Sarthak Jain et.al discusses the design of a basic home automation application on raspberry pi through reading the subject of Email and the algorithm for the same has been developed in python environment which is the default programming environment provided by Raspberry pi.

In [4], author Sudhir G. Nikhade discusses wireless sensor network system that has been developed using open source hardware platforms, Raspberry pi and Zigbee. The system is low cost, low power consuming and highly scalable both in terms of the type of sensors and number of sensor nodes which makes it well suited for wide variety of applications related to environmental monitoring.

In [5] Pasquale Foggia, Alessia Saggese, and Mario Vento, proposes a method that is able to detect fires by analyzing videos. It introduce complementary information, based on color, shape variation, and motion analysis, and combined using a multi expert system known as MES. A descriptor based on a bag-of-words approach has been proposed to represent motion of objects. The method identifies moving objects based on background subtraction which is an effective method as compared to others. Then based on color, shape and movement the multi expert system works for identifying fire region.

In [6] Paulo Vinicius Koerich Borges, and Ebroul Izquierdo, proposed a new identification metric based on color for fire detection in videos. Also identified important visual features of fire, like boundary roughness and skewness of the fire pixel distribution. The skewness is a very useful descriptor as the frequent occurrence of saturation in the red channel of fire regions is identified . For newscast videos, model the probability of occurrence of fire as a function of the position, yielding an efficient performance.

In [7], author Liyang Yu, et.al proposed forest fire detection system consists of a vast amount of inexpensive and small sensor nodes. Compared with the satellite imagery based approach, our design can detect forest fire more promptly and forecast the forest fire danger rate accurately.

In [8] Martin Mueller, Peter Karasev, Ivan Kolesov, and Allen Tannenbaum proposed two novel optical flow estimators, optimal mass transport (OMT) and Non-Smooth Data (NSD). The dynamics of fire have motivated the use of motion estimators to differentiate fire from other non-fire object. The obtained moving region provides useful space on which to define motion features. These features reliably detect fire and reject non-fire motion, on a large dataset of videos. There is a chance for false detections in the presence of significant noise, partial occlusions, and rapid angle change.

In [9] Tian Qiu, Yong Yan and Gang Lu, a flame edge-detection method has been developed. The identification of fire edges is the process of determining a boundary between the area where there is thermochemical reaction and those without. First the algorithm detects the coarse and superfluous edges in a fire image and then detects the edges of the fire and removes the irrelevant artifacts. This flame edge-detection algorithm can contribute to the in-depth understanding and advanced monitoring of combustion flames. Also, the algorithm provides a useful addition to fire image processing and analysis in fire safety engineering.

In [10] C. Yu, Z. Mei, and X. Zhang, **A** real-time video fire flame and smoke detection algorithm method has been developed. Optical flow and foreground image accumulation techniques are used to detect smoke and flame in real-time. There are two cases for wrong fire detection, first is object with fire like reddish color and second might be that the background with illusion of burning fire, solar reflections, and artificial light. So to overcome this drawback, this paper used the key

to distinguish between smoke and smoke colored and flame and flame-colored objects is their physical movement. To calculate movement firstly foreground image segmentation is done using frame differential method. After that flame color model and smoke color model are created using HIS color model. RGB color model has less computation complexity but HIS color model is often adapted, because it is suitable for providing more people oriented way of describing the colors. Then weighted stack is maintained to calculate foreground images of consecutive image frames, so bigger the pixel value if more times the same region of foreground images appears in consecutive frames. The pixel values will decrease to zero, if the corresponding region no longer appears in foreground images. Foreground accumulation of flame is calculated differently for flame and smoke. Then block image processing technique is used to flame motion feature recognition. In that each image is divided into 8x8 resolution blocks and pixel value within a block is summed up satisfying the threshold value. Check block threshold if it is flame then fire alarm are given. For determining smoke region, block image processing and optical flow technique are used. If network output is smoke then fire alarm is given. It never gives fire alarm for fire due to objects like car lights or tunnel accident.

Table.1: Comparison Table on Survey Done

S.NO	PROJECT	TECHNIQUES	RESULT	ISSUES
1	Development of Fire Alarm System using Raspberry Pi and Arduino Uno	Internet-based and wireless broadband technologies are used	Creation of numerous automated and monitoring system that has low power consumption, faster processing ability at a lower cost.	The system didn't explain any approach to detect fires. No authentication system to detect false alarm.
2	An improved real-time surveillance system for home security system using BeagleBoard SBC, Zigbee and FTP web server	Motion Detection, Segmentation	High-speed data transmission and wireless networking facilities are together with a camera for remote monitoring can be effectively utilized to build an event-based real-time wireless security surveillance system to monitor different state information inside a building	The system needs an extra layer of security to the surveillance system
3	An early fire-detection method based on image processing	RGB(red, green, blue) model	The system is fully automatic surveillance of fire accident with a lower false alarm rate and this is very attractive for the military, security, commercial applications, and so on at a general cost.	Time consumption and power computation are very high.
4	Wireless sensor network system using Raspberry Pi and ZigBee for environmental monitoring applications	Wireless sensor technology	The system is low cost, low power consuming and highly scalable both in terms of the type of sensors and number of sensor nodes.	Costly and time-consuming as multiple sensor nodes decide the possibilities of fire occurrence
5	Real-time fire detection for video-surveillance applications using a combination of experts based on color, shape, and motion	MES (multi expert system)	The method identifies moving objects based on background subtraction which is an effective method as compared to others	Very high chance of false alarm.

6	A Probabilistic Approach for Vision Based Fire Detection in Videos	Probabilistic pattern recognition,	The system applicable not only for real time fire detection, but also for video retrieval in news contents, which require faster than real-time analysis	First the algorithm assumes that the camera is stationary; and second, it presents a high computational complexity despite working in real-time
7	Real-time Forest Fire Detection with Wireless Sensor Networks	Satellite imagery based approach	The system detect forest fire more promptly and forecast the forest fire danger rate accurately.	Expensive and it can be only implemented outdoor
8	Optical Flow Estimation for Flame Detection in Videos	Two novel optical flow estimators, optimal mass transport (OMT) and Non-Smooth Data (NSD)	The system motivated the use of motion estimators to differentiate fire from other non-fire object. The obtained moving region provides useful space on which to define motion features. These features reliably detect fire and reject non-fire motion, on a large dataset of videos	There is a chance for false detections in the presence of significant noise, partial occlusions, and rapid angle change.
9	A computer vision based method for fire detection in color videos	Flame edge-detection algorithm	The system yield very low error rates.	The camera is stationary and it makes use of frequency transforms and motion tracking, requiring more computational processing time.
10	A real-time video fire flame and smoke detection algorithm	HSI and RGB color model	RGB color model has less computation complexity but HIS color model is often adapted, because it is suitable for providing more people oriented way of describing the colors	It takes long time for the smoke detectors to detect the smoke.

3. CONCLUSION

This paper detects fire by combining different techniques to generate alarm and notification with greater accuracy without false alarms. The algorithm uses RGB color model to detect color of the fire which is mainly comprehended by the intensity of red color. Notifications are sent to remote user. The overall accuracy of the algorithm is greater than 85%. If the system is successfully integrated in every fire susceptible places, then it is hoped that the loss of life and property due to the fire accidents will be reduced remarkably.

4. FUTURE WORKS

The device sends the image and location through Wireless Internet connection. The system generates only alarm if internet is not connected and user must be unaware of the notifications if he/she didn't access his/her mail id. To overcome this limitation, an android application can be developed which sends text and sound notifications to enable internet connection to view the alert and directs to their login page.

5. REFERENCES

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