Real-Time Fire Detection using Combination of three Fire Parameters: Color, Motion and Shape in Conjunction with the use of Fuzzy Logic

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Abstract- *Many systems are existed for fire detection. Most of them are having performance issues and some systems require high cost for installation & maintenance. So we proposed the method in this paper is fire detection using video surveillance camera and fuzzy logic concept. There are so many methodologies available in the market for this project. The major drawback for previous system is that system does not works upon traditional logic so the ratio of failure is maximum. To decrease the failure ratio we define some novel idea. We are detecting fire by using video surveillance camera with fuzzy logic because it works on floating points also so the failure ratio can be reduced to a great extent.*

Keywords: *Fire detection, Fuzzy logic, video surveillance.*

I. INTRODUCTION:

Due to increasing in the number of occurrences of fire in indoor and outdoor. Sometimes it happens whenever fire is occurred, it increases rapidly in indoor and outdoor. It is very dangerous to control the fire in such condition and this may results in huge losses of life and infrastructures. So we are preparing a method for fire detection using video surveillance and fuzzy logic with the features of fire color, shape and motion.

In this system we are capturing the video by using surveillance camera and making the frame or snapshots according to set interval of time so that we can easily do operation on that frame. Each frame is send to the fire features where we do the operation on each frame using color model and shape. If the images behaves like fire then we send it for fuzzy logic operation.

There are two types of logic in the programing language. One is traditional and another is fuzzy logic. The traditional logic works only on the number 0 & 1 or true and false, so false ratio is maximum. That's why we are using here fuzzy logic. It works upon number between 0 & 1, so the false ratio gets minimized.

After processing the video on the basis of color, shape and motion, it is sent for the fuzzy logic processing. Fuzzy logic system is the system which is able to take real time decision according to the acquired input. Fuzzy logic is mainly used in the intelligent system so that it can take its own action. It is used in almost all camera/image processing technique. Fuzzy logic algorithm is developed using five membership function. It is very suitable for those application which are uncertainties in nature. After performing various operations under fuzzy logic, it is decided that whether this is occurrence of fire or not.

In this paper section II is dedicated to literature survey, where section III is describes the various proposed techniques in details. Section IV describes goal and objective. Section V concludes the paper with the some possible future extensions.

II. RELATED WORKS

Pasquale Foggia, Alessia Saggese and Mario Vento. [1] This paper narrates about the, a method that is able to detect fires by analyzing videos acquired by surveillance cameras. Two main novelties have been introduced. First, com- elementary information, based on color, shape variation, and motion analysis, is combined by a centralized multiexpert system. The main aim advantage deriving from this approach lies in the fact that the system's overall performance significantly increases with a not much effort made by the designer. Second, a novel descriptor based on a bag-of-words approach has been proposed for

representing motion. Method which is described in this paper has been tested on a large dataset of fire videos and images acquired both in real environments captured using surveillance camera.

Byoung Chul Ko, Sun Jae Ham, and Jae Yeal Nam [2] In this paper, fire-flame detection is difficult using a video camera because a flame has irregular characteristics, i.e., vague shapes and color patterns. Therefore, in this paper, they propose a novel fire-flame detection method by using fuzzy finite automata (FFA) with probability density functions based on visual features, thereby providing a systemic approach to handling unregularity in computational systems and the ability to handle continuous spaces by combining the capacity of automata with fuzzy logic. First, moving regions are detected via background subtraction, and the candidate flame regions are identified by applying flame color models.

Letricia P. S. Avalhais, Jose Rodrigues-Jr., Agma J. M. Traina [3] The semantic segmentation of events on emergency circumstances involves the identification of previously defined events of interest. In which, the semantic event focused on the presence of fire in videos. This literature presents several methods for fire detection, but these methods were built under assumptions, such as stationary cameras and controlled lightening conditions that are often in direct contrast to the videos acquired by hand-held devices.

Simon Y. Foo [4] A fuzzy logic technique is applied to detect hydrocarbon fires in aircraft dry bays and engine compartments. The inputs to the fuzzy system consist of a set of statistical measures derived from the histogram and image subtraction examine of successive image frames. Specifically, fuzzy rules based on the median, standard deviation, and normalized first-order moment statistical measures histogram data and the mean statistical measures image subtraction data of successive frames are used to compute the probability of a fire event

Jian-Mei Xiao, Xi-Huai Wang [5] This paper has investigated a fuzzy neural network approach of fire detection in ships in order to detect a fire at the earlier stage and then give a high reliable judgement result. Conventional ship fire alarm systems often make simple logic judgement which is based on single sensor. To ‘make a less erroneous alarm, in this approach two fire parameters (temperature and smoke density) are used.

Paulo Vinicius Koerich Borges [6] This paper narrates Automatic fire detection is an interesting research topic in computer science. In this paper, they explain and analyze a new technique for detecting fire in videos. In contrast, the proposed methodology can be applied not only on surveillance but also to automatic video classification for retrieval of fire images in databases. The proposed method analyzes the image-to-image change of specific minor level feature showing potential fire region. Those features are size, color, area, surface coarseness, boundary roughness and skewness within estimated fire regions.

Martin Mueller, Peter Karasev, Ivan Kolesov and Allen Tannenbaum [7] This paper describes, Computational vision-based fire detection has shown significant attention in the past ten years with surveillance by camera systems becoming unique. Whereas many features, such as shape, texture, color, etc., have been employed in the literature survey, this paper proposes a set of motion features based on motion estimation. The idea consists of explaining the difference between the fire flames motion and the structured, rigid motion of other objects. Since classical optical flow methods do not model the characteristics of fire motion, two optical flow methods are specifically designed for the fire detection.

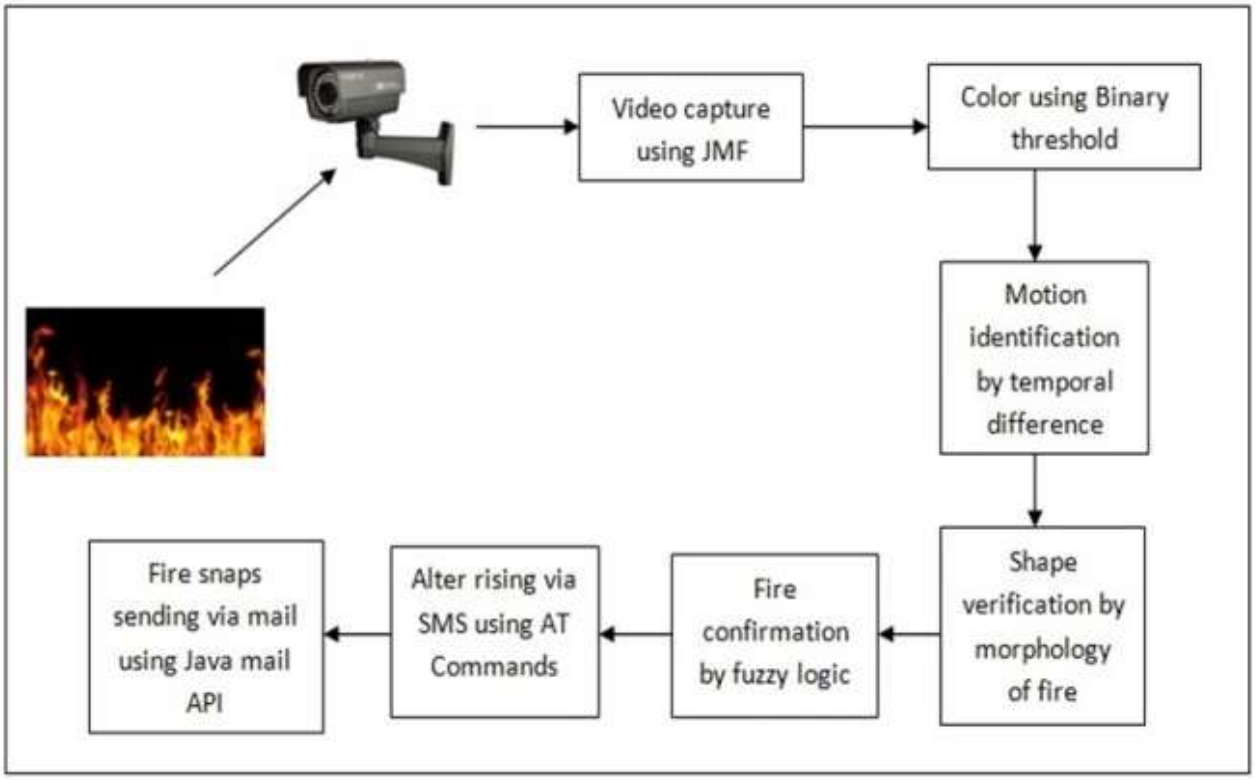
Begoña C. Arrue, Aníbal Ollero, and J. Ramiro Martinez de Dios [8] In this proposed system, there are many things which are combined to detect the fire like location, size and motion, geographical and meteorological information, memory of previous events, image matching, and visual infrared. The techniques applied are based on image processing. Fuzzy rules to detect the fire of forest in open areas, neural network and computer vision tools.In this paper, the approach is the False Alarm Reduction system—proposes an alternative real time infrared visual system that overcomes this problem.

Chin-Lun Lai, Jie-ci-yang [9] in this paper, an effective and simple algorithm is used to detect the calamity event of fire automatically when monitoring is going on via real time video analysis. It also warns about the fire early so that the loss can be reduced from the fire accidents. There are fire detection algorithms – a) Detection flow chart description and

b) Applying robustness strategy. By using these algorithms the system insures that accuracy of fire detection and robustness of strategies. Cost can be also reduced so that system will be cost efficient.

Robert A. Sowah, Abdul R. Ofoli, Selase N. Krakani, and Seth Yayra Fiawoo[10] In this paper the design and development of a web based notification system and a fuzzy logic based multisensor fire detection system. Until recently, most consumer grade fire detection systems relied on smoke detectors. The protection provided by these has been established to be limited by the detection technology and the type of fire present at use. The problem is further compounded by notification mechanisms and the lack of adequate alert.

III. PROPOSED METHOD



Project can be design and implement with the following modules of development cycle.

- Capturing the live steam video.
- Getting Video Frames in said interval of time
- Fire Detection by Color, Shape and motion factor
- If Change is detected then raise alert by GSM modem connected to the system.

Fire Detection Algorithms:

Algorithm 1:

For Gray scale Conversion and Binary threshold for Fire detection using color component

// Input: Video Frame **F**

// Output: Fire detected image

Step 0: Start

Step 1: Get Image path.

Step 2: Get Height and width of the Image **F** (L*W).

Step 3: FOR **i**=0 to width.

Step 4: FOR **j**=0 to Height.

Step 5: Get a Pixel at (i, j) as signed integer.

Step 6: Convert pixel integer value to Hexadecimal to get R, G, and B.

Step 7: **AVG**=(R+G+B) /3

Step 8: **IF AVG** >**T**

Step 9: Pixel at (i,j) is FIRE

Step 10: **ELSE**

Step 11: Pixel at (i, j) is NOT FIRE

Step 9: End of inner for

Step 10: End of outer for

Step 11: Stop

Algorithm 2:

For Fire morphology identification

Step 0: Start

Step 1: Get Image path.

Step 2: Get Height and width of the Image (L*W).

Step 3: FOR x=0 to width.

Step 4: FOR y=0 to Height.

Step 5: Get a Pixel at (x, y) as signed integer.

Step 6: Convert pixel integer value to Hexadecimal to get R, G, and B.

Step 7: if (R!=255 and G!=255 and B!=255) (checking for fire pixel)

Step 8: Get the Y value for the pixel

Step 9: Then ratio $R_{t=}$ Y/Height

Step 10: Add R_t into an array called RA

Step11: End of inner for

Step 12: End of outer for

Step 13 : Stop

Algorithm 3:

For Fire Detection by motion

// Input: Time **T**, Frame $\mathbf{F_c}$, Frame $\mathbf{F_p}$, Threshold Fire pixels $\mathbf{T_h}$

// Output: Fire Detection through motion

Step 0: **Start**

Step 1: **WHILE** (TRUE)

Step 2: for each time **T**

Step 3: $F_p \rightarrow F_c$

Step 4: calculate pixel positions of $\mathbf{F_p}$ in an vector $\mathbf{V_p}$

Step 5: calculate Pixel positions of $\mathbf{F_c}$ in an vector $\mathbf{V_c}$

Step 6: IF ABSOLUTE DIFF ($\mathbf{V_p} - V_c$) > $\mathbf{T_h}$

Step 7: Label Frame for Fire

Step 8: **END IF**

Step 9: **END WHILE**

Step 10: Stop

Implementation:

- Video capturing
- Color identification of fire
- Motion identification of fire
- Shape verification of fire
- Fuzzy logic detection to identifies the fire
- Sending alert to fire department via sms
- Sending Fire snaps to fire department via mail

IV. GOAL AND OBJECTIVE

Goal:

- Detect the Fire using only camera
- Alert the through SMS and Email
- Alert to the Fire Department also through SMS

Objective:

- Detect the Fire Using only camera and adding no extra cost to the existing system
- System can be implement in all the scenarios where there is a need to detect fire, that is for indoor fire and outdoor fire.
- Start recording the video session only when Fire is detected , this reduces the burden on secondary storage device to store unwanted video
- Alerting the Owner and nearest Fire station as soon as Fire is detected in the camera.

V. CONCLUSION

In the system the presence of flame and fire is detected by monitoring the surveillance camera and collecting the information related to grey scale, color, shape and motion of fire. Major components of proposed fire detection system are: fire color detection, motion identification, shape verification and fuzzy logic approach.

The system is based on a combination of various methods used for fire detection using surveillance cameras. It delivers us facility to adjust the system by using different combinations of video image processing based fire detection methods and implementing the system according to different area requirement. It also provides us the best possible method for accurately detecting the flame and fire in terms of decreased false fire detection rate and hence increasing the accuracy of the system.

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