REAL-TIME FIRE DETECTION THROUGH IMAGE ANALYSIS

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Abstract :Fire is the result of a process called combustion that combines material like oxygen and other gases which produces heat , light and flame .The light parameter and colour of flame helps to detecting fire. Fire detection using image analysishas many application that includes various scenarios and enviroments and industrial setting . It's useful in many areas such as residential and commercial Buildings,industrial facilities , public safety system , specialized Enviroment , To increase the performance of the live video stream based fire flame detection ,we propose an effective approach.Their application in fire detection systems will improve detection accuracy, which will eventually minimize fire disasters and reduce the ecological and social ramifications. In this paper shows how a tradeoff can be reached between fire detection accuracy and efficiency. In other research works arerelated to flame and fire edge detection . In that researches reported fordifferent applications; however these methods don'temphasize the continuity and clarity of the flame and fireedges . We used camera for surveillance that used to give real time video output to the user on the laptop or computer via small GUI-graphic user Interface. Thus the fire will be detecting using this model .

This project can also be served for security and surveillance application

Keywords—Fire detection, CNN, Machine learning ,Fire Detection, OpenCV, Background Subtraction, Contour Detection, Image Processing, Motion Detection.

I.INTRODUCTION

When there is emergency situation when there is an outbreak of fire in buildings or cars or any public location .This project has many application in computer vision and in other domain .Our model shown to be more reliable method to detect the fire since the closed circuit television (CCTV) surveillance systems are now available at many public places, can help capture the fire scenes. In order to detect fire from scenes of colour-videos, various schemes have been studied, mainly focus on the combination of static and dynamic characteristics of fire such as colour information, texture and motion orientation, etc. Colour-based detection methods mainly depend on chosen value of thresholds resulted in high falsealarm rate; that need to be improved by extracting dynamic features of fire from sequence of images captured in video. However, those systems are still not practical to use in large scale and hard-to-reach regions like remote and wild forests, where the configuration and maintenance of the system are difficult tasks.In a world increasingly dependent on technology, the need for efficient and reliable fire detection systems is paramount. Fires can cause catastrophic damage, loss of life, and extensive economic consequences. Traditional fire detection methods have limitations, such as response time and accuracy. This is where the fusion of image processing and computer vision techniques comes into play.

The project titled "FireWatch": Image-Based Fire Detection" is a pioneering endeavor that leverages the power of image processing to revolutionize fire detection. By utilizing cameras and computer

algorithms, this project seeks to enhance the early detection of fires in various environments, from homes and industrial facilities to forests and urban areas.

This approach not only aims to improve the speed and accuracy of fire detection but also provides the potential for proactive fire prevention. By analyzing visual data and detecting smoke or flames in real-time, the system can trigger timely alerts and response, mitigating the devastating consequences of fires.

In recent years, the quest for effective and efficient fire detection systems has intensified, driven by the imperative to safeguard lives and property from the devastating impact of fires. The emergence of advanced image processing techniques, coupled with the ubiquity of surveillance cameras and drones, has opened up newavenues for the development of innovative fire detection systems. This paper introduces and explores the Picture-Based Flame Detection System, a cutting-edgeapproach that harnesses state-of-the-art image analysis techniques to detect flames in real-time.

The Picture-Based Flame Detection System represents a paradigm shift in fire detection methodologies, leveraging the power of computer vision to scrutinize images and video footage captured from diverse sources such as surveillance cameras and drones. At the heart of this system lies the utilization of Open Source Computer Vision, commonly known as OpenCV, an open-source freeware designed explicitly for computer vision applications. This framework provides a robust foundation, enabling the implementation of intricate algorithms for image analysis and interpretation.

The fundamental principle underlying the Picture-Based Flame Detection System is the extraction and evaluation of unique characteristics inherent to flames. By focusing on key features such as color, shape, and movement patterns, the system aims to swiftly and accurately identify the presence of a fire. This innovative approach holds promise for enhancing the speed and precision of fire detection, thereby facilitating quicker response times and mitigating potential damages.

However, it is crucial to acknowledge the limitations of existing fire detection systems, particularly in outdoor environments where various factors can impact the energy of flames and the burning process. In such settings, traditional fire detection systems may be susceptible to false alarms, posing challenges in reliability and practicality. The Picture-Based Flame Detection System addresses these concerns by employing advanced image analysis techniques that are attuned to the dynamic and unpredictable nature of outdoor fires.

The ubiquity of Closed Circuit Television (CCTV) surveillance systems in public spaces has paved the way for visual-based approaches to fire detection. These systems, now commonplace in many public areas, serve as invaluable tools for capturing fire scenes in real-time. Leveraging the capabilities of CCTV cameras, the Picture-Based Flame Detection System taps into the rich visual information provided by these devices, enabling a more reliable and immediate detection of fires.

In the realm of color-based fire detection methods, challenges persist, particularly in the selection of appropriate threshold values that influence the accuracy of the system. High false alarm rates have been a recurring issue, prompting the need for improvements in dynamic feature extraction from video sequences. The Picture-Based Flame Detection System addresses this challenge by incorporating advanced algorithms that analyse the temporal evolution of fire in a sequence of images, thereby enhancing the system's accuracy and reducing false positives.

While significant strides have been made in the development of fire detection systems, practical challenges persist in large-scale and hard-to-reach regions such asremote and wild forests. The configuration and maintenance of traditional fire detection systems become formidable tasks in such environments, limiting their applicability. The Picture-Based FlameDetection System, with its emphasis on real-time image analysis and

adaptability to diverse environments, seeks toovercome these challenges and emerge as a viable solution for fire detection in remote

and challenging landscapes.

In the subsequent sections of this paper, we delve into the methodologies and technologies underpinning the Picture-Based Flame Detection System. We explore the nuances of image processing techniques, the integration of OpenCV, and the system's adaptability to outdoor environments. Additionally, we scrutinize the challenges faced by traditional fire detection systems in large-scale outdoor settings and articulate how the Picture-Based Flame Detection System offers a compelling alternative. Through a comprehensive analysis, this paper aims to contribute to the evolving landscape of fire detection technologies, offering insights into the potential of image processing in revolutionizing the field.

II.LITERATURE SURVEY

The literature survey encompasses a range of works that contribute to the development of automated fire detection surveillance systems, covering topics such as background subtraction, adaptive models, contour and structural analysis, and the use of color models. These studies collectively form a foundation for understanding the complexities and advancements in the field, providing valuable insights for the development of novel fire detection methodologies.Fire detection has become a critical aspect of ensuring safety and minimizing potential damages in various environments.

I] Automatic Fire and Smoke Detection Method for Surveillance Systems Based on Dilated CNNs Author name: Yakhyokhuja Valikhujaev 1 , Akmalbek Abdusalomov 1 In 2018.The technologies underlying fire and smoke detection systems play a crucial role in ensuring and delivering optimal performance in modern surveillance environments. In fact, fire can cause significant damage to lives and properties. Considering that the majority of cities have already installed camera-monitoring systems, this encouraged us to take advantage of the availability of these systems to develop cost-effective vision detection methods.

II] A Comprehensive Study on Fire Detection Author-Sneha Wilson .In this paper, we focus on three problems that surrounded forest fire detection, realtime, early fire detection, and false detection. For the first time, we use classical objective detection methods to detect forest fire: Faster R-CNN, YOLO (tiny-yolo-voc, tiny-yolo-voc1, yolovoc.2.0, and yolov3), and SSD, among them SSD has better real-time property, higher detection accuracy and early fire detection ability.

III]Fire Smoke Detection Based on Contextual Object Detection Author: Xuan Zhao,Hang Ji . Smoke detection based on automatic visual system has been applied to fire alarm in open spaces where traditional smoke detection system is not suitable for it. However, detecting the course of smoke posed great challenges for both systems. To address this problem, we propose a new method that combines contextaware framework with automatic visual smoke detection.

IV] Using Popular Object Detection Methods for Real Time Forest Fire Detection, In this paper, we focus on three problems that surrounded forest fire detection, real-time, early fire detection, and false detection. For the first time, we use classical objective detection methods to detect forest fire: Faster R-CNN, YOLO (tinyyolo-voc, tiny-yolo-voc1, yolo-voc.2.0, and yolov3), and SSD, among them SSD has better real-time property, higher detection accuracy and early fire detection ability.

V]Research on Image Fire Detection Based on Support Vector Machine Author: Ke Chen,Yanying Cheng.In order to detect and alarm early fire timely and effectively, traditional temperature and smoke fire detectors are vulnerable to environmental factors such as the height of monitoring space, air velocity, dust. An image fire detection algorithm based on support vector machine is proposed by studying the features of fire in digital image.

III. PROPOSED SYSTEM

A. Image Processing for Fire Detection:

Image processing techniques play a pivotal role in fire detection, involving the analysis of visual data to identify characteristic features of flames.Algorithms for edge detection, color segmentation, and texture analysis are commonly employed to

distinguish fire-related patterns from the background.

B. Multispectral Imaging and Fire Signatures:

Multispectral imaging, utilizing various wavelengths, enhances fire detection capabilities by capturing unique signatures associated with flames.Infrared bands, in particular, provide valuable information, allowing for the detection of heat emitted by fires even in challenging visibility conditions.

C. Machine Learning for Pattern Recognition:

Machine learning algorithms, such as Convolutional Neural Networks (CNNs), are increasingly applied for fire detection, learning intricate patterns from labeled datasets. These models can accurately classify images based on features like flame color, shape, and movement, contributing to the reliability of automated fire detection systems.

Fig .1. Training model to capture images [17]

D. Real-time Fire Detection and Monitoring:

Advancements in image capture technology, combined with fast-processing algorithms, enable real-time fire detection and monitoring systems.

These systems can promptly analyze captured images or video frames, triggering immediate responses such as alert notifications or activation of suppression systems, significantly reducing response times in emergency situations.

E. Background Subtraction for Fire Detection:

Background subtraction is a crucial technique in fire detection, involving the isolation of foreground objects, such as flames and smoke, from the stationary background in images or video frames.By continuously updating the background model, this method helps identify dynamic changes associated with fires, enabling the system to focus on regions with evolving characteristics.

IV.METHODOLOGY

The Steps:

1) IMAGE DETECTION:

This section covers the detail of the proposed fire pixel classification algorithm. Figure shows the flow chart of the proposed algorithm. Rule based color model approach has been followed due to its simplicity and effectiveness. For that, color space RGB and YCbCr is chosen. For classification of a pixel to be fire we have identified seven rules. If a pixel satisfies these seven rules, we say that pixel belong to fire class.

2) FIRE DETECTION:

We took two sequential images from video frames. After applying basic two methods edge detection and color detection we get probable area of fire pixel then we compare the RGB value to of frame1 to the frame 2 for corresponding pixel and if pixel value differs then motion detector will show motion and will give resultant output to the operator.

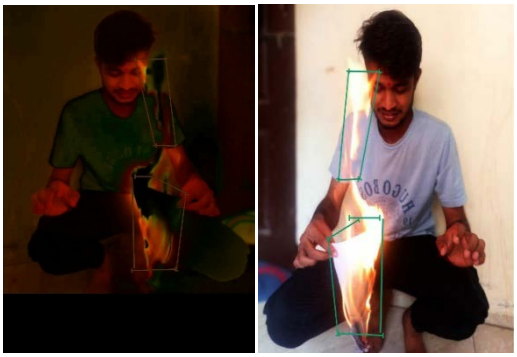

Fig.2.Real Time Detection

3) OUT PUT OF EXECUTION :

When the fire is detect to the module,those image is gives to module as a input and when according to the input the by the use of multithreading one thread is gives to output with massage to Owner “Fire Detected……Fire Detected and bip signal with sound” and other and to Fire-Extinguish Department with Address “Emergency….Emergency and Address (Shanti Niwas near Zeal College,Narhegaon,pune.

FLOWOFEXECUTION:

Diagram:

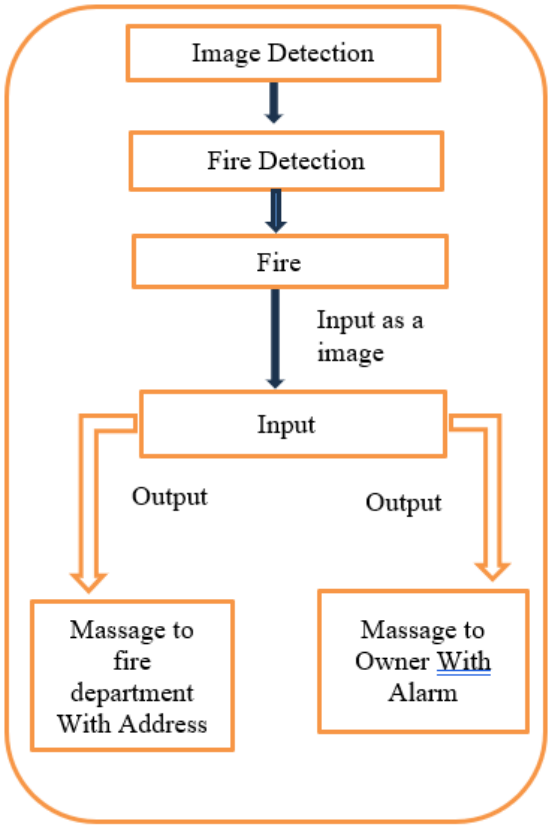

Fig. 3. Flow of Execution

PROJECTREQUIREMENT :

EXTERNAL INTERFACE REQUIREMENT

1] User Interface Application Based Fire Detection.

2] Hardware Interfaces: RAM : 8 GB

As we are using Machine Learning Algorithm and Various High Level Libraries Laptop RAM minimum required is 8 GB.

3] Hard Disk : 40 GB Data Set of CT Scan images is to be used hence minimum 40 GB Hard Disk memory is required. 4] Processor : Intel i5 Processor

5] Spyder IDE: that Integrated Development Environment is to be used and data loading should be fast hence Fast Processor is required IDE : Spyder Best Integrated Development Environment as it gives possible suggestions at the time of typing code snippets that makes typing feasible and fast. Coding Language: Python Version 3.5 Highly specified Programming Language for Machine Learning because of availability of High Performance Libraries.

6] Operating System : Windows 10 Latest Operating System that supports all type of installation and development Environment

Data Flow Diagram

In Data Flow Diagram,we Show that flow of data in our system in DFD0 we show that base DFD in which rectangle present input as well as output and circle show our system,In DFD1 we show actual input and actual output of system input of our system is text or image and output is rumor detected like wise in DFD 2 we present operation of user as well as admin.

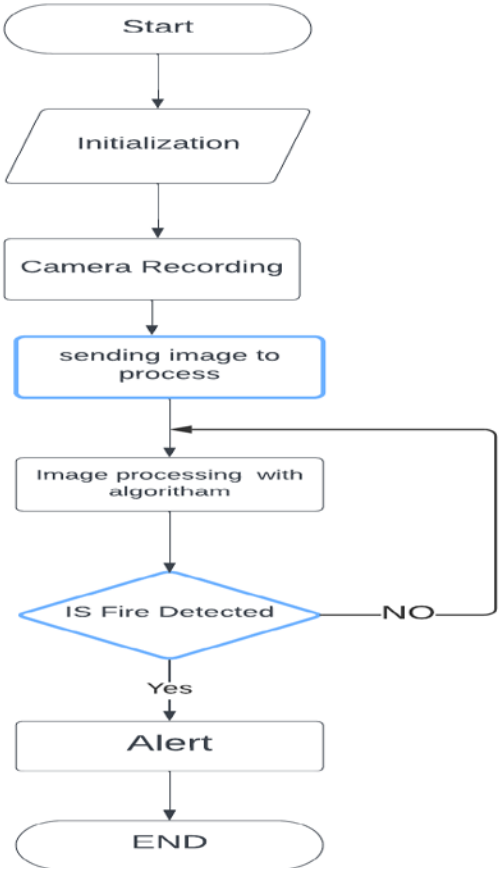

Fig. 4. Flow Chart

V. Future Scope

The Project has been motivated by the desire a system that can detect fires and takeappropriate action, without any human intervention.Implementation in a satellite to detect the accendently fire happens in the forest.

For further accuracy use of Neural Networks for decision making can be made and GSMmodule can also be implemented for sending SMS to nearby fire station in case of severe fire.

By research and analysis, the efficiency of theproposed Fire detection system can be

increased. The margin of false alarms can be reducedeven further by developing algorithms to eliminate the detection of red colored cloth as fire.By proper analysis, suitable location height and length for camera installment can be decided,in order to remove blind-spot areas.

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