

A Review on Fire Detection System through Machine Learning

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Abstract— There has been an increased incidences of fire and fire related damages all across the world. There has also been an increase in the number of forest fires across the world. Studies show that the wildfires are becoming increasingly powerful and deadlier in the recent years. The increase in the number of incidences across the world warrants the implementation of an effective fire mitigation strategy to combat such occurrences. The first step for the prevention and reduction of such instances is the detection of fire in a timely and effective manner. Therefore, there is the need for a fire detection system that is highly accurate and can be reliable as a fire detection system. The conventional approaches towards fire detection utilize expensive sensors that are slow to respond and have a large error of detection. This survey paper outlines effective techniques that have been used for the purpose of achieving fire detection. The analysis of the approaches have been effective in the design of our methodology that utilizes the paradigm of Convolutional Neural Networks and Decision Tree. This approach will be elaborated further in the upcoming editions of this research.

Keywords: Convolutional Neural Networks and Decision Tree

I. INTRODUCTION

The discovery of fire by early humans has been one of the greatest discoveries of all time. This is due to the fact the early humans could not understand the process of fire and how to harness the power of the fire. Once humans could control the fire, the whole course of human history changed significantly. Ever since the discovery of the fire, humans started eating cooked food. This cooked food gave them a lot more nutrition that could support large brain sizes. This was essential in pursuing other interests and achieving mastery over the fire. The controlled combustion has been effectively used in a variety of applications even today. The combustion powers our vehicles and electricity generators all over the world.

The fire is also a highly destructive force that can lay waste to almost everything in its path if left unchecked. The fire is also highly susceptible to external conditions and can spread quickly to neighboring areas if the conditions are suitable. This has led to large wildfires that happen every year in hot and arid regions. These wildfires destroy large tracts of forests and can lead to large scale destruction when they come close to the city. The wildfires are highly difficult to control as they are massive in nature. These fires should be detected at an early stage that makes them controllable to mitigate any adverse effects of the fire and reduce the destruction.

The conventional techniques for the purpose of fire detection utilize extensive amounts of sensors and other related equipment. These sensors either detect the presence of smoke or detect the rise in temperature of the surroundings. These approaches are expensive as the sensor arrays have a high cost. These arrays are also limited to a certain range after which they are helpless. The paradigm of detection of fire

through video surveillance. This approach is considered as the video can cover large areas and doesn't require extensive sensor arrays to achieve fire detection goals.

There has been a multitude of related research papers that have been analyzed in detail in this research article. The related works have been effective in developing our approach for the purpose of fire detection through the use of video. The technique utilizes Convolutional Neural Networks along with the inclusion of fuzzy logic. The approach defined in this survey will be outlined effectively in the upcoming editions.

This literature survey paper dedicates section 2 for analysis of past work as a literature survey, and finally, section 3 concludes the paper with traces of future enhancement.

II. RELATED WORKS

Z. Jiao explains for natural and public security forest resources safety is very important. In the recent years, fire detection algorithms based have attracted much attention of the researchers due to recent most harmful natural hazards occurred in a wild forest fire because of this human faces many loss such as heavy losses in the life of firefighters and the forest resources. [1] Thus the proposed paper implements a deep learning fire detection algorithm to improve the detection accuracy and efficiency by using the unmanned aerial vehicle (UAV). Thus the result of the paper indicates a recognition rate of the detection is about 91%.

K. Chen specifies to judge whether there is a fire or not by Traditional fire detection technology is not up to date. In past some years there has rapid development in the field of Computer Science. In the proposed paper the researcher studied the features of fire in a digital image and developed the image fire detection algorithm based on a support vector machine.[2] To monitor image fire detection technology uses a camera and this image is sent to a support vector machine for classification and recognition. Fire videos are taken to a trained support vector machine and then it is tested. The algorithm can detect early fire more accurately by implementing the proposed technique.

S. Leil presents a new technology called video fire detection technology which is used for fire detection during the last few decades. Smoke detection and temperature detection is compared with conventional methods thus it is more reliable. RGB-HIS color model is used to detect the areas similar to fire. [3] Video tracking algorithm and a new fire detection model implement the centroid movement of these areas are calculated. The result of this proposed paper gives an efficient warning and alert after detecting the fire.

X. Xu proposes the fire test platform for a home kitchen is built, and oil pan fire, kitchen flue fire, and cabinet fire tests. A lot of research on kitchen safety, mainly focusing on kitchen fire hazards made by the many types of research. [4] The Law of temperature, smoke, and fire situation is studied by the authors before developing the proposed model.

Fire test platform includes the main structure of the kitchen combustion chamber, cabinet, cooker, kitchen range hood, kitchen flue, ignition system, measurement system, etc. are partly required for the composition of the kitchen.

X. Xiang presents optical flow computation based on LUV color space. In optical flow, it is merged with weighted neighborhood least squares to use the brightness information. The neighborhood of the gray image weight is adopted LUV color space such as U channel and V channel. [5] Many algorithms are developed back to back such as optical flow algorithm, matching optical flow algorithm, energy-based optical flow algorithm, and phase-based optical flow algorithm. The authors present gray and color information from optical flow by improving the accuracy of optical flow computation.

O. Giandi states fire alert detection is one of the smart functions. Many technologies have been developed in a difficult way for making a better life. Smart Home Technology is one of the technologies which is the fastest growing technology in the field of science. [6] Thus the new system is developed by the researcher to predict the explosion and fire earlier called fire predictor and the fire appearance detector. The system predicts gas leak concentration and gives the alert. Thus the system uses a fuzzy system to make the fire detector classification.

D. Pritam describes using image processing techniques as a fire detection system capturing the image using a digital camera, analyze the images, and detect the existence of fire. Fire can cause a severe threat to life and property. To cover a large area large number of sensors is required for sensor-based fire detection and the sensor requires time for a trigger. [7] Thus the proposed paper works flame color detection merged with other motion and area of the frame. Fire detection system depends on LUV color space and hybrid transforms. For flame color detection RGB and YCbCr are common color models.

S. Li explains the number of buses in China is increasing day by day due to the development of the social economy until June 2018 850,000 buses are running in China. As there is an increase in buses in china there is also an increase in bus fire accidents. [8] If a fire occurs on the bus while intensive people are traveling by bus it may cause mass casualty and serious social impact. Thus it is very important to set up a fixed fire extinguishing system in buses. Water mist extinguishing bus fire was implemented based on characteristics of a bus fire. Bus cabin was used for the water mist fire extinguishing system in the proposed application.

S. Wu states one of the oldest and traditional methods of detecting fire detection is the human observation which is labor-consuming and time-consuming. In the proposed paper author focuses on the major three issues in forest fire detection are real-time, early fire detection, and false detection. Faster R-CNN, YOLO (tiny-yolo-voc, tiny-yolo-voc1, yolo-voc. 2.0, and yolov3), and SSD this technique was used to detect the forest fire. Among these, the SSD was having higher detection accuracy, better real-time property, and early fire detection property. In the proposed technique author comes up with the updated version of the YOLO's tiny-yolo-voc structure

S. R. Vijayalakshmi describes fire accident makes great damage to our life and property. In modern security

sensing systems, Fire flame detection is an important issue faced. The detection of the fire is done on basis of smoke, heat, or radiation using ionization or photometry and is detected by the infrared sensors, optical sensors, or ion sensors. Sensors are activated only when particles or heats reach the sensors and the main disadvantage is that they cannot issues the alert till the sensor is not activated. A fire alarm will be activated when the system detects fire in a certain position and the time interval surpasses the threshold.

H. Dang-Ngoc claims due to human causes and dry climate rate of forest fires reports have increased. Many detection techniques have been widely implemented to avoid a terrible disaster of fire. Thus because of the low cost and simple installation, most of the traditional methods are based on sensors. To detect the fire since the closed-circuit television (CCTV) surveillance by using a visual-based approach of image or video processing is said has a most successful method implemented. Fire detection model most of the time the fire detection is missed due to thick smoke. Thus the proposed paper has updated the smoke detection system.

De Zhang explains the fire detection and warning systems are developed on large scale to avoid the loss of fire disaster fires could cause huge material damage and often lead to lots of human casualties. In large building spaces, conventional smoke and fire detectors are failed to detect the fire. In the past few years, video-based fire detection methods are implemented on the large scale. The main advantage of this video sequence data that it can cover a wide area for fire detection. Thus the proposed technique is tested on six diverse video sequences and results achieve more than 97% correct detection rate.

III. CONCLUSION AND FUTURE SCOPE

The paradigm of fire detection through video has been detailed. The related approaches for the purpose of designing our methodology have been outlined in this research. The fire is measured as one of the vital and imperative assets. Identification of flame and fire using the computerized monitoring methods such as the video surveillance systems has a significant consideration over the last decade. Traditional way of detecting fire make mostly the use of sensors which sense the fire using fire parameters but the sensors requires the certain amount of time to detect the presence of fire. But this technique takes more amount of time to detect the fire and till then flames of fire may get converted to the hazardous damage causing fire which leads to huge loss of properties. Therefore, an effective technique for identification of the fire through video is being designed using Convolutional Neural Networks and Decision tree. This approach will be elaborated further in the upcoming researches on this topic.

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