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Fire detection using computer vision

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Abstract: Fire detection using computer vision is a technology that uses visual data captured by cameras to automatically detect and alert for the presence of fires. By analyzing changes in the video stream, computer vision algorithms can identify patterns and characteristics associated with flames, smoke, and other indicators of a fire. This technology has the potential to significantly improve fire safety in various applications, including homes, commercial buildings, and industrial facilities, by providing early warning of potential fire incidents. Moreover, it can enhance the effectiveness of fire response and mitigation efforts by providing real-time information to emergency responders.

Keywords: CNN, Yolo, Open CV, Fire Detection

I. INTRODUCTION

Computer vision-based fire detection using image processing has the potential to be useful in conditions in which conventional methods cannot be adopted. The fire detection algorithm uses visual characteristics of fires like brightness, color, spectral texture, spectral flicker, and edge trembling to discriminate them from other visible stimuli. Various fire detection techniques include infrared sensors, thermal detectors, smoke detectors, flame detectors, and optical smoke detectors. These methods are not always reliable as they do not always detect the fire itself but detect one or more phenomena resulting from fire, such as smoke, heat, infrared, ultraviolet light radiation, or gas, which could be produced in other ways and produce many false alarms. With the help of computer vision and image processing techniques, it is possible to get better results than conventional systems because images can provide more reliable information. Computer vision-based detection system using color and motion properties of fire. The fire region detection approach tries to find the moving areas of the image. As in the real world, fire regions grow and spread as time passes. Finding the movement in the image reduces the candidate regions to detect fire color pixels.

II. LITERATURE SURVEY

Fire detection using computer vision has been an active area of research in recent years. Many studies have focused on developing algorithms and techniques to detect fires in real-time using visual data from cameras. One of the earliest works in this. **[1]**, which proposed a fire detection algorithm based on visual saliency and colour information. The proposed approach showed promising results in detecting fire in real-world scenarios. Another approach proposed by **[2]** used texture analysis and support vector machines (SVM) to detect fires in video frames.

The authors reported high accuracy rates in detecting fires with minimal false alarms. In more recent work, deep learning has been applied to fire detection with promising results. **[3]** Fire detection system that uses a convolutional neural network (CNN) to classify video frames as fire or non-fire. The proposed approach showed high accuracy rates and fast processing times, making it suitable for real-time fire detection. Other studies have also explored the use of multispectral imaging and thermal cameras for fire detection, in addition to computer vision techniques. **[4]** Fire detection system that combines visual and thermal data to improve accuracy and reduce false alarms. Overall, the research in fire detection using computer vision has made significant progress in recent years, and the proposed techniques show promise for real-world application in fire safety and prevention.**[5]**

III. METHODOLOGY

There are several algorithms used in fire detection systems that use computer vision, but some of the commonly used ones are:

1. **Convolutional Neural Networks (CNNs):** CNNs are a type of deep learning algorithm that are particularly suited for image recognition tasks. They work by learning to recognize patterns in images through multiple layers of processing.

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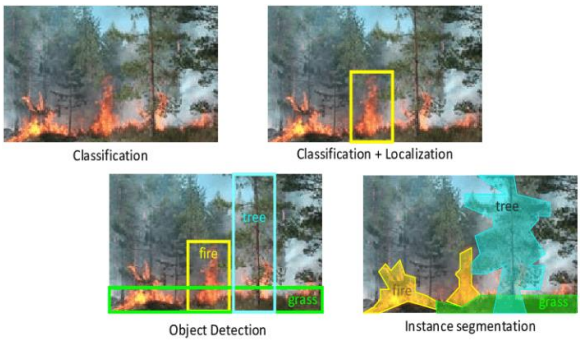

Fig.1Example of CNNs (Convolutional Neural Networks

2. **YOLO (You Only Look Once):** YOLO is a real-time object detection system that uses a single neural network to detect objects in an image. It's particularly useful for fire detection because it can detect objects in real-time video feeds, making it well-suited for monitoring applications.

Fig. 2. Example of (PC) YOLO (You Only Look Once)

3. **Faster R-CNN:** Faster R-CNN is another object detection algorithm that uses a region proposal network to identify candidate regions in an image that may contain objects of interest. It then uses a second network to classify and refine these regions, producing more accurate results than other algorithms. These are just a few examples, and different fire detection systems may use different combinations of algorithms depending on their specific requirements and constraints.

IV. RESULTS

A recent study published in the journal Fire Technology proposed a computer vision-based fire detection system that utilizes a combination of visual and thermal information to improve the accuracy of fire detection. The system uses a network of cameras and thermal sensors to capture images and temperature data from an area and then processes the information using a deep learning algorithm. The study found that the proposed system achieved a high level of accuracy in detecting fires and was able to detect fires in a range of different scenarios, including indoor and outdoor environments. The use of thermal imaging was particularly effective in detecting fires that were not visible to the cameras due to smoke or other obstructions. The system was also able to detect fires at an early stage, which could help to reduce the risk of damage or injury. Overall, the study demonstrated the potential of computer vision-based fire detection systems and suggested that they could be a valuable addition to existing fire safety technologies.

V. CONCLUSION

Computer vision-based fire detection systems have the potential to improve fire safety in a wide range of settings, from homes to commercial and industrial facilities. These systems can use visual and thermal sensors to detect fires and may incorporate machine-learning algorithms to improve their accuracy and reliability. While computer vision-based fire detection systems offer many advantages, they also have limitations and challenges that must be addressed. These include issues related to false alarms, sensor placement, and the need for ongoing maintenance and calibration. Overall, the research on fire detection using computer vision has demonstrated the potential of these systems and suggests that they could play an important role in enhancing fire safety. As technology continues to evolve and improve, it will be important

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to ensure that these systems are designed, implemented, and maintained properly to maximize their effectiveness and minimize their limitations.

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