A Survey on Fire Detection in Surveillance Videos Based on CNN

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Abstract— The embedded processing have enabled the vision based systems to detect fire during surveillance based on convolutional neural networks (CNNs).The proposed method for a cost-effective fire detection CNN architecture for surveillance videos. The model is inspired for GoogleNet architecture. Its computational complexity and suitability for the intended problem compared to other computationally networks. To balance the efficiency and accuracy. The nature of the problems and fire data.The Experimental results helpful for fire datasets reveal the effectiveness of the proposed framework and its suitability for fire detection in CCTV surveillance systems compared to other fire detection methods.

Key words: Convalutional Neural Network, Fire Detection, Image Classification, Real-World Applications, Deep Learning, CCTV Video Analysis

I. INTRODUCTION

Deep learning algorithms can perform humans at classifying images.It's achieving levels of accuracy to the point where deep learning algorithms can outperform humans at classifying images. The embedded capabilities of devices have resulted in good surveillance.That providing a number of helpful applications in different type such that e-health, autonomous driving, and event monitoring. Digital image processing is the use of computer algorithms to perform image processing on digital images.Fire is one of the dangerous events which can result in great losses if it is not controlled at a time. The importance of developing early fire detection systems. The cost-effective fire detection CNN architecture based on surveillance videos. Fire is one of the commonly happening events, whose detection at early stages during surveillance can avoid fire disasters

II. MOTIVATION

Fire is one of the commonly happening events, that detection at early stages during surveillance can avoid and fire disasters. Other fatal factors of home fires, physical disability is the secondly ranked factor which affected 15% of the home fire victims delayed escape for disabled people as the traditional fire alarming systems. The strong fires or close proximity, failing to generate an alarm on time for such people. It's achieving unprecedented levels of accuracy to the point where deep learning algorithms can outperform humans at classifying images. The embedded processing capabilities of good devices have resulted in smart surveillance. That providing a number of helpful applications in different type of domains such that e-health, autonomous driving, and event monitoring. The digital image processing is the useful of computer algorithms to perform image processing by the digital images. The fire detection using hospital, schools, city etc. It help to detecting fire. The covalution network identifying fire or not fire. This will enable the video surveillance systems to handle more complex situations in real-world.

III. LITERATURE SURVEY

Khan Muhammad Hu et al. [1] propose a secure surveillance framework for IoT systems by intelligent integration of video summarization and image encryption. An accurate video summarization method is useful to extract the informative frames using the processing capabilities of visual sensor. The detected from key frames, an alert is sent to the concerned authority automatically. When the final decision about an event mainly depends up on the extracted key frames, the modification during transmission by attackers can result in severe losses. The issue was propose a efficient probabilistic and lightweight algorithm for the encryption of key frames prior to the transmission, considering the memory and processing requirements of constrained devices which increase its suitability for IoT systems. Our experimental results verify the effectiveness of the proposed method in terms of robustness, execution time, and security compared to other image encryption algorithms.The framework can decreases the bandwidth, transmission cost,storage and the time required for analysts to browse large volumes of surveillance data and make decisions about abnormal events such as suspicious activity detection and fire detection in surveillance applications

Jongwon Choiet et al.[2] propose Fire detection is one of the most interesting issues for surveillance. The another approaches for the fire detection suffer from a very high false positive ratio. To solve the problems, The present a patch-based fire detection algorithm with online outlier learning. In the proposed algorithm, the candidates of fire are obtained in the form of patch, while the classical candidates have been based on pixels or blobs. Because the patches of fire have more distinctive shape than the original fire, the shape classifier can recognize the candidates correctly from fire-like outliers. In addition, I propose an online outlier learning scheme which handles the irregularity of fire based on the repeatability of shape in time.The first step is to extract the distinctive patches from the all image to minimize the computational complexity. In the second step, the descriptors are obtained for the candidate patches and, for the third step, The remove the candidates that are rejected by the shape appearance classifier. In fourth step, a randomness classifier checking the repeatability of the classified descriptors by an online outlier learning scheme and rejected the fire-like outliers. In the last step, The determine a fire alarm by thresholding the detection map obtained from the positions of the remaining candidates by using spatio-temporal filter. The proposed the patch-based fire detection with the online outlier learning scheme. The next contribution is to introduce the online outlier learning scheme, which identifies the irregularity of the candidates by matching them to the words of the online outlier dictionary. The experiments that the

approach distinguished the candidates qualitatively and decided the fire alarm quantitatively.

Ali Rafiee et al.[3] propose the fire and smoke monitoring systems are helpful in different industry such that military, social security and economical. The methods for fire and smoke detection are used only motion and color characteristics this many wrong alarms are happent and this is decrease the performance by the systems. This research presents a newly method for fire and smoke detection through image processing. In this algorithm all objects in an image is considered and then checking them to figure out which objects are smoke and fire. The color, motion of fire and disorder are helpful characteristics in fire and smoke detection algorithm. Smoke of fire will be the whole or part of the images. Thus by processing of the video frames, different objects will detect.The result of evaluate the features of objects, the goal objects (fire and smoke) can be defined easily. Two-dimensional wavelet analysis is used in the presented method. The results of this research present the proposed features that can decrease the wrong alarms and increase the system performances. The new method for detecting the smoke and fire in video images.The objects were detected, and then removed the objects, which did not have the fire or smoke properties. Its detecting the color of each objects. The proposed method used the dynamic and static characteristics related to the smoke and fire. The two-dimensional wavelet analysis is a static characteristic.

Yusuf Hakan Habibo et al.[4] proposed The proposes a video-based fire detection system uses color, spatial and temporal information. The system seperate the video into spatio-temporal blocks and uses covariance-based features extracted from these blocks to detect fire. Feature vectors take advantage of both the spatial and the temporal characteristics of flame-colored position.The extracted features are trained and tested using a support vector machine (SVM) classifier. The system does not use a background subtraction method to segment moving regions and can be used, to the some extent, with non-stationary cameras.In addition, it is shown that perform a another method in terms of detection performance. The real-time video fire detection system is developed based on the covariance texture representation method. The covariance method is ideally suited for flame detection for two reasons: flames exhibit random behaviour , and another it is experimentally observed that the underlying random process can be considered to the wide sense stationary process for a small video region. The second order statistical modeling using the covariance method provides a good solution to flame detection in video. The proposed method is computationally efficient and can process 320 × 240 frames at 20 fps in an ordinary computer size. The main contribution of this system is the use of temporal covariance information in the decision process. Most fire detection methods use color, spatial and temporal information separately, but in this work use temporally extended covariance matrices in order to use all the information together. When this method for fire is clearly visible and in close range, such that the flicker and irregular nature of flames are easily observable

Turgay elik et al.[5] proposed Fire detection in video sequences using a generic color model. A rule-based generic color model for flame pixel classification is performed. The proposed algorithm uses YCbCr color space to divides the luminance from the chrominance more effectively than color spaces such as RGB or rgb. The performance of the proposed algorithm is tested on two classes of images, one of which contains fire, the other containing fire-like regions or objects. This method achieves up to 99% fire detection rate. The number of arithmetic operations for the proposed color model is linear with image size and algorithm is very low in computational complexity. This makes it suitable for the real-time applications. The color model can be used in fire detection in video sequences. I have shown that the proposed algorithm performs very well in segmenting fire regions in video sequences. In our future work, The will make the time analysis of fire regions in video sequence by measuring or evaluvating spread in the fire regions. Furthermore, the flicker nature of fire will be considered as a future work. The method uses statistical features, based on grayscale video frames, including mean pixel intensity, standard deviation, and second-order moments, along with non-image features such that humidity and temperature to detect fire in the cargo compartment. The system is commercially used in parallel to standard smoke detectors to minimize the false alarms caused by the smoke detectors

Dongil Han el al.[6] proposed the Development of Early Tunnel Fire Detection Algorithm Using the Image Processing To avoid the large scale of damage of fire occurred region in the tunnel, it is necessary to have a system to reduce and to discover the incident fast. However it is impossible to keep the human observation of CCTV images in tunnel for 24 hour. So if the fire and smoke detection system through image processing warn fire state, it can be very good convenient, and it can be possible to reduce damage even when people is not in front of monitor. In this method to proposed algorithm using the image processing, which is an early detection of the fire and smoke occurrening in the tunnel. The fire and smoke detection is different from the forest fire detection when the elements such as car and tunnel lights and others that are different type from the forest region so that an indigenous algorithm has to be developed. The two algorithms proposed in this method, are able to detect the exact position, at the earlier stay of detection. In addition, by comparing properties of each algorithm throughout experiment, I have proved the propriety of algorithm. The human observation of CCTV in tunnel for 24 hours is very difficult task. So when the fire and smoke detection and warning system which is using applicable image processing is used, it makes fire detection more convenient and it is also able to minimize damage when human observation is not available. The proposed two algorithms are able to detect different situations. The fire detection algorithm detects fire by compared image of normal state and input image using color information, while the smoke detection algorithm detects smoke using motion detection, edge detection and comparison of color information of input images.

Shubham Thakker el al.[7] proposed The presents an image processing technique for automatic real time fire detection in video images. The underlying this algorithm is based on the temporal variation of fire intensity captured from the visual image sensor. The full image sequences are analyzing and select a candidate flame region. Characteristic

fire features are extracted from the candidate region and combined to identifing the presence of fire or non-fire patterns. Fire alarm is triggered from the fire pattern persists over a period of time. The algorithm has been implemented on an Equator MAP-CATM digital signal processor (DSP).When reaction time and the sensitivity of the algorithm to adjusted according to the scene complexity and light condition, increasing the flexibility of the method. When analyse with the true fires in the laboratory showed a fast reaction of the algorithm. Other tests with true fires in non-laboratory environments—working rooms, high rack warehouses are in progress.

Artemios G et al.[8] proposed a novel method to detect fire and/or flames in real-time by processing the video data generated by an ordinary camera monitoring a scene. In addition to ordinary motion and color , flame and fire flicker is detecting and analysing the video in the wavelet domain. Quasi-periodic nature in flame boundaries is detected by performing temporal wavelet transform. Color variations in flame regions are detected by computed the spatial wavelet transformation of moving to the fire-colored regions. Another clue used in the fire detection algorithm is the irregularity of the boundary in the fire-colored region. All of the above clues are combined to reach a final result. Evaluvating results show that the proposed method is very successful in detecting fire and/or flames. In addition, it drastically decrease the false alarms issued to ordinary fire-colored moving objects as compared to this methods using only motion and color clues. An algorithm from the fire and flame detection in color video is developed. The algorithm not only help to the color and temporal variation in the information, but also checks flicker in flames using 1-D temporal wavelet transform and color variation in fire-colored moving regions using 2-D spatial wavelet transform. Methods from the color information and ordinary motion detection may produce false alarms in real scenes where no fires are taking place. The evaluvating to the results show that false alarms can be drastically decreasing by temporal and spatial wavelet analysis. The method can be helpful for detection of fire in movies and video databases, as well as real-time detection of fire.

Marti et al.[9] proposed Optical Flow Estimation for Flame Detection in Videos Computational vision-based flame detection has drawn to the significant attention based on the past decade with camera surveillance systems becoming ubiquitous. The features color, shape, texture, etc., have been employed in the literature, this method proposes the set of motion features based on motion estimators. The key idea consists of exploiting the difference in the turbulent, fast, fire motion, and the structured, rigid motion of other objects. This model do not be the characteristics of fire motion. When the two optical flow methods are specifically designed to the fire detection task: optimal mass transport models.The fire with dynamic texture, And the data-driven optical flow scheme models saturated flames. Then, characteristic features related to the flow magnitudes and directions are computed from the flow fields to discriminate between fire and non-fire motion. The proposed features are analyse on a large type of video database to demonstrate their practical usefulness. The proposed method from the fire simulations that allow for a controlled environment to analyzing the parameter influences, such as flame saturation, spatial resolution, frame rate, and random noise The very interesting dynamics of flames have motivating to the use of motion estimators to distinguish fire from other types of motion. Two optical flow estimators, OMT and NSD, have been presented that overcome insufficiencies of classical optical flow models when applied to the fire content. The obtained motion fields provide helpful space on which to define motion features. These features reliably detect fire and reject non-fire motion, as demonstrated on a big dataset of real videos. Few false detections are observed in the presence of significant noise, partial occlusions, and rapid angle change or different. In an experiment result using fire simulations, the discriminatory power of the selected features is demonstrated to separate fire motion from rigid motion. The controlled nature of this experiment allows for the quantitative evaluation of parameter changes. Key results are the need for a minimum spatial resolution, robustness to changes in the frame rate, and maximum allowable bounds on the additive noise level. Future work includes the development of optical flow estimators with improved robustness to noise that take into account more than two frames at a time.

Miller et al.[10] proposed Recurrent neural network (RNN) and long short term memory (LSTM) have achieved great success of the processing sequential multimedia data and yielded state-of-the-art results in speech recognition, digital signal processing, video processing, and in this text data analysis. The novel action recognition method by processing the video data using convolutional neural network (CNN) and deep bidirectional LSTM (DB-LSTM) network. The deep features are extracted from the all sixth frame of the videos which use to decrease the redundancy and complexity. The next sequential information among frame features is learnt using DB- LSTM network, where multiple layers are stacked together in both forward pass and backward pass of DB-LSTM to increasing its depth. The method was capable of learning long term sequences and can process lengthy videos by analyzing features for a certain time and interval. The analyzing results show significant improvements in action of recognition using the proposed method on three benchmark datasets including UCF-101, YouTube 11 Actions, and HMDB51 compared to state-of-the-art action recognition methods. When the CNN features are extract from the video frames, which are fed to DB- LSTM, where two layers are stacked on both forward and backward pass of the LSTM. This helpful in the recognizing complex frame to frame sequential patterns in the features. An analyzing the video in N chunks, where the number of chunks depend up on the time interval “T” for processing. The method is capable of learning long term complex sequences in videos. It can also process the full length videos by providing prediction for time interval “T”. The output for the small chunks is combined to the final output. The evaluvating results indicate that the recognition score of the proposed method successfully dominates other recent state-of-the-art action recognition techniques on UCF-101, HMDB51, and YouTube action video datasets. These characteristics make proposed method more suitable for processing of visual data and can be an integral component of smart systems. The features is extracted from the whole frame of the video. In future, An aim to analyze only the salient regions of the

frames for action recognition. Furthermore, I have intention to extend this work for activity recognition in videos. The method can be combined to the people counting techniques to intelligently analyze the people crowded behavior and dense situations.

IV. CONCLUSION

In this paper recent works in the field of fire detection was discussed. Many researchers had contributed and are still working in this field. This field to processing capabilities of accurate devices have shown promising results in surveillance systems for identification of different abnormal events such as fire, accidents, and other emergencies. Fire is one of the dangerous events that result can be great losses if it is not controlled at a time. This necessitates to importance of developing early fire detection method. when propose a cost-effective fire detection CNN architecture for surveillance videos. The model is inspire to Google Net architecture and is fine-tuned with special focus on computational complexity and detection accuracy. The proved that the proposed architecture dominates the existing hand-crafted features based fire detection methods as well as the AlexNet architecture based fire detection method. Although, When the improved the flame detection accuracy, yet the number of false alarms is still high and further research is required in this direction. The flame detection frameworks can be intelligently tuned for detecting of both smoke and fire. This video surveillance systems to handle more complex situations in real-world.

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