IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, November 2024

Deep Learning Approach for Suspicious Activity Detection from Surveillance Video

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Abstract: *The present generation seeks ways to live their lives free of fear. This often prompts the need for enhanced law enforcement and security systems. Suspicion activity recognition in surveillance footage has become an essential component in modern security systems, focused around the problem of recognizing inappropriate behaviors without too much human time. The advent of deep learning has made an impact in computer vision tasks within such a way the real-time detection by the evaluation of large amounts of video footage becomes realistic. In this context the paper presents a model in which deep learning, particularly Convolutional Neural Networks (CNNs), are utilized for the behavioral pattern recognition from security footage. In addition, it also improves the efficacy of detection and reduces the shortcomings associated with these systems where only the post-event analysis is performed manually or automatically. In this paper, we demonstrate a novel IP model that analyzes live video and performs normal-suspicious–threat triage in real-time. Results indicate the validity of the method in different environmental and illumination conditions. An important objective that this system is designed for is to change the way security is practiced and delivered in today's intelligent systems providing actionable intelligence and the ability to prevent threats rather than just respond to them making this a high growth opportunity for marketing high-risk and sensitive areas.*

Keywords: Convolutional Neural Networks

I. INTRODUCTION

The high prevalence of surveillance cameras across urban, commercial and institutional spaces presents great potential for boosting security levels. However, the conventional form of surveillance still relies on human monitors to observe the footage in real-time or carry out subsequent review mechanisms, which is prone to human weaknesses including boredom and limited resources. Given the virtually unmanageable scale of videos generated daily, it is no longer practical to constantly monitor them in their entirety. Thanks to the rapid development of artificial intelligence (AI) and deep learning technology, process automation of video surveillance functions becomes more realistic especially with the use of Convolutional Neural Networks (CNNs). CNNs are design patterns for cells that are streamlined to making unique signals through superior functionality of finding patterns and recognizing images. Hence, systems that are installed with this particular aspect require no supervision in the spotting of abnormal and suspicious activities. There is, hence, no need to review the footage of the CCTV feed because in real-time a number of abnormal activities can be easily detected and policies issued to mitigate the occurrence of the activities. In this paper, a CNN based detection of suspicious activities using, free, surveillance video frames will be outlined. With the beginning of routine analysis, our method improves the productivity and trueness of the activity of protection and control. This inventive system minimizes the number of people indispensable for proper monitoring, increases the speed of responding to the threats and hence, enhances the security of the society as a whole.

DOI: 10.48175/IJARSCT-22360

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II. RELATED WORK

- **Traditional Surveillance Methods**: In the past, human operatives have always been involved in watching live footage and verifying incidents using video recordings retrospectively. These methodologies are hindered by human lapses, tiredness, and great volumes of footage making real time response difficult.
- **Rule-Based and Motion Detection Approaches:** The first systems to come out were first deployed using algorithms that were rule based or only depended on motion detection. These are not effective in intricate settings and do not tailor to different scenarios.
- **Introduction of Deep Learning for Pattern Recognition:** A particularly impressive application of deep learning is the use of Convolutional Neural Networks (CNNs) to analyze and classify visualcues, thus making this function useful for the development of video surveillance analytics.
- **Applications of CNNs in Surveillance**: CNNs can be used to detect abnormal activities including trends that deviate from standard behaviors in public areas including hostile situations. Such technique encourages security agencies to monitor areas to identify potential threats prior to occurrence of incidents.
- **Studies on Real-Time Threat Detection**: Most recent SIC & VDT studies urge the integration of CNNs in the development of systems where human inputs are not needed, eliminating beatings and slow modalities of threat detection. Continuous CNN's model integration deployment in the analysis will significantly reduce the resource dependency on the physical integrity of surveillance points.
- **Current Challenges in Deep Learning-Based Surveillance:** Existing deep studying systems for surveillance face challenges such as high fake high quality prices, issue in adapting to various settings, and managing various environmental conditions (e.G., lighting adjustments, crowd density).

III. LITERATURE SURVEY

Velliangiri Sarveshwaran, *, Iwin Thankumar Joseph[1] The goal of human activity recognition (HAR) is to describe a people action constructed on a set of sensor readings. Human activity recognition can be classified into two types economic and non-economic. Economic type is used to generate revenue. Noneconomic type is used for mental satisfaction. Human activity recognition can be applied in the area of people work evaluations, elderly people care, convalescence.

Pradipti1, Shuvojit Das2, Somnath Nath [2]Nowadays, activity recognition is one of the most popular uses of machine learning algorithms. It's utilized in biomedical engineering, game production, and producing better metrics for sports training, among other things. Data from sensors linked to a person may be used to build supervised machine learning models that predict the activity that the person is doing. We will use data from the UCI Machine Learning Repository in this work. It contains data from the phone's accelerometer, gyroscope, and other sensors, which is used to build supervised prediction models using machine learning techniques like as SVM, Random Forest.

Morsheda Akter 1, Shafew Ansary [3]: Human activity recognition (HAR) performs a vital function in various fields, including healthcare, rehabilitation, elder care, and monitoring. Researchers are using mobile sensor data(i.e., accelerometer, gyroscope) by adapting various machine learning (ML) or deep learning (DL). The advent of DL has enabled automatic high-level feature extraction, which has been effectively leveraged to optimize the performance of HAR systems. In addition, the application of deep-learning techniques has demonstrated success in sensor-based HAR across diverse domains. In this study, a novel methodology for HAR was introduced, which utilizes convolutional neural networks (CNNs).

Ahatsham Hayat , Fernando Morgado-Dias 1 [4]There are more than 962 million people aged 60 and up globally. Physical activity declines as people get older, as does their capacity to undertake everyday tasks, effecting both physical and mental health. Many researchers use machine learning and deep learning methods to recognize human activities, but very few studies have been focused on human activity recognition of elderly people. This paper focuses on providing assistance to elderly people by monitoring their activities in different indoor and outdoor environments using gyroscope and accelerometer data collected from a smart phone.

Lamiyah Khattar, Chinmay Kapoor [5] Nowadays the deluge of data is increasing with new technologies coming up daily. These advancements in recent times have also led to an increased growth in fields like Robotics and Internet of

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Things (IoT). This paper helps us draw a comparison between the usage and accuracy of different Human Activity Recognition models. There will be discussion on
mainly two models- 2-D Convolutional Neural Network and Long-Short term Memory.
In order to maintain the consistency and credibility of the survey, both models
are trained using the same dataset containing information collected using wearable
sensors which was acquired from a public website

Md Zia Uddin1* and Ahmet Soylu2[6]Healthcare using body sensor data has been getting huge research attentions by a wide range of researchers because of its good practical applications such as smart health care systems. For instance, smart wearable sensor-based behavior recognition system can observe elderly people in a smart eldercare environment to improve their lifestyle and can also help them by warning about forthcoming unprecedented events such as falls or other health risk, to prolong their independent life. Although there are many ways of using distinguished sensors to observe behavior of people, wearable sensors mostly provide reliable data in this regard to monitor the individual's functionality and lifestyle. In this paper, we propose a body sensor-based activity modeling and recognition system using time sequential information-based deep Neural Structured Learning (NSL), a promising deep learning algorithm. First, we obtain data from multiple wearable sensors whilethe subjects conduct several daily activities.
Harpreet kaur lohia, Simran kaur Dari , [7]Activity recognition is one of the leading applications of machine learning algorithms nowadays. It is being used in the field of biomedical engineering, game development, developing better stats for sports training etc. Data from the sensors attached to a person can be utilised to train supervised machine learning models in order to predict the activity being carried out by the person. In this paper we will be using Data available at UCI machine learning Repository. It contains data generated from accelerometer, gyroscope and other sensors of Smartphone to train supervised predictive models using machine learning techniques like SVM, Random Forest and decision tree to generate a model. Bolu Oluwalade, Sunil Neela[8]In recent years, human activity recognition has garnered considerable attention both in industrial and academic research because of the wide deployment of sensors, such as accelerometers and gyroscopes, in products such as smartphones and smartwatches. Activity recognition is currently applied in various fields where valuable information about an individual's functional ability and lifestyle is needed. In this study, we used the popular WISDM dataset for activity recognition. Using multivariate analysis of covariance (MANCOVA), we established a statistically significant difference (p ! 0.05) between the data generated
from the sensors embedded in smartphones and smartwatches.
Snehal Wankhede*1, Dr.Sachin Chaudhari [9] The perception of Human Activity is authentically consequential these days as we all are living in the era of the latest technologies where everything comes under surveillance and everything gets recorded. For apperception of human activities through their forms of kineticism, it is paramount to detect body components like the face, ocular perceivers mouth, hand, and other body components, this detection avails in amending apperception of human activities from sundry angles. In this paper detection of the face and its components are discussed.
Kah Sin Low1 and Swee Kheng Eng1 [10]Human Activity Recognition (HAR) is crucial in various applications, such as sports and surveillance. This paper focuses on the performance evaluation of a HAR system using deep learning techniques. Features will be extracted using 3DCNN, and classification will be performed using LSTM. Meanwhile, 3DCNN and RNN are two additional, well-known classification techniques that will be applied in order to compare the effectiveness of the three classifiers. The 3DCNN-LSTM approach contributes the highest overall accuracy of 86.57percent, followed by 3DCNN-3DCNN and 3DCNN-RNN with the overall accuracy of 86.07percent and 79.60percent, respectively. Overall, this paper contributes to the field of HAR and provides valuable insights for the development of activity recognition systems.

IV. METHODOLOGY

The proposed machine for suspicious hobby detection includes numerous key ranges, along with facts series, preprocessing, function extraction, model training, and testing. Each step is designed to maximise the version's capability to recognize and classify suspicious behaviors accurately and effectively.

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- **Data Collection:** The first step entails accumulating surveillance pictures from diverse resources, ensuring that the dataset encompasses various environments, lights conditions, and sorts of human conduct. Data variety is essential to growing a model that generalizes nicely throughout unique eventualities, decreasing the probability of fake positives or neglected detections in novel conditions.
- **Data Preprocessing**: Preprocessing is vital for standardizing the input statistics and improving the version's performance. This step consists of resizing video frames, normalizing pixel values, and applying changes to improve image clarity beneath extraordinary lights situations. Frames are extracted from the video at ordinary periods to lessen redundancy and optimize computational efficiency.
- **Feature Extraction**: Convolutional Neural Networks are applied for characteristic extraction, capitalizing on their potential to become aware of complex visible styles and spatial hierarchies. CNN layers procedure frames with the aid of applying filters that hit upon edges, textures, and shapes, that are fundamental to identifying gadgets and behaviors. The extracted capabilities are then handed to fully connected layers for category.
- **Model Training and Testing**: The CNN model is skilled on a classified dataset of everyday and suspicious behaviors. Data augmentation strategies, consisting of rotation, scaling, and flipping, are hired to expand the dataset and save you overfitting. The version's hyperparameters, such as learning price, batch size, and dropout rate, are tuned thru pass-validation to optimize its overall performance. After training, the model is tested on unseen information to assess its accuracy, precision, take into account, and basic robustness in detecting suspicious sports.
- **Alert Generation**: Once skilled, the model may be deployed in a real-time putting in which it approaches stay video feeds. When suspicious hobby is detected, an alert is generated and despatched to security personnel, specifying details including the kind of hobby, severity degree, and place. This alert device allows for immediate movement and improves response time in probably unsafe conditions.

IV. CONCLUSION AND FUTURE WORK

This paper presents a deep gaining knowledge of-based totally framework for detecting suspicious activities in real-time from surveillance video feeds, leveraging the talents of Convolutional Neural Networks for effective function extraction and behavior category. The proposed device addresses the limitations of traditional surveillance strategies through automating the detection of anomalous behaviors, lowering the want for sizable human monitoring, and permitting faster, more accurate danger responses. Experimental results endorse that this technique can considerably enhance public and personal protection through providing proactive alerts in high-danger environments.

While the present day model shows promise, future studies and improvements are essential to maximise its realistic applicability in diverse settings. By incorporating multimodal facts, improving generalization techniques, and advancing temporal evaluation skills, this framework can evolve right into a complete protection solution that meets the developing demands of modern surveillance. Through non-stop refinement and version, deep studying-primarily based surveillance systems have the capacity to become integral equipment in safeguarding society against a wide variety of threats.

V. CONCLUSION

In present world, almost all the people are aware of the importance of CCTV footages, but most of the cases these footages are being used for the investigation purposes after a crime/incident have been happened. The proposed model has the benefit of stopping the crime before it happens. The real time CCTV footages are being tracked and analyzed. The result of the analysis is a command to the respective authority to take an action if in case the result indicates an untoward incident is going to happen. Hence this can be stopped.

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