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HUMAN MOTION PATTERN DETECTION

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Abstract: There is a growing need to have effective surveillance systems that can identify and flag alarming behaviour instantly in the current era. In this study, we propose a new method of recognizing suspicious activities of video data using deep learning algorithms. We employed the DCSASS Dataset which contained videos from thirteen categories of suspicious activity, like abuse, arson, assault, robbery and so on. A mixed architecture involving both ResNet50 and I3D was used because it could handle the temporal and spatial complexities that come with video data. The model is trained to recognize subtle cues concerning suspicious behaviour as it exhibits remarkable training accuracy. By subjecting our model to rigorous evaluation on a separate validation set, it shows encouraging results at about 85% accuracy. To improve the performance of the model further, we consider various strategies such as data augmentation, fine-tuning of hyper parameters as well as ensemble methods. We also try to make our models interpretable by employing techniques such as class activation mapping for better understanding of decision making process.

Keywords: DCSASS Dataset, Deep learning algorithms, ResNet50, I3D.

I. INTRODUCTION

There has been a widespread growth in the use of surveillance systems in the past few years, as cases of insecurity and threats to safety have increased in both public and private places. The traditional surveillance methods depend largely on human attention, which is expensive, error prone and not agile enough to offer immediate results. Thus, there has been a rise in interest towards automated surveillance systems with capabilities of self- detecting unusual occurrences. The subfield of artificial intelligence known as deep learning that is inspired by human brain structure and function has become an important tool for examining intricate data varieties such as images, audio and video. Computer scientists have exploited this approach extensively while working on computer vision studies leading to high precision and fast process time. Well, our project fits into this framework because our objective is to create a sophisticated monitoring system that will identify suspicious activities using deep learning algorithms. Our solution must also overcome several challenges posed by video data such as temporal dynamics, spatial relationships as well as semantic understanding.
Keywords: Automated surveillance systems, Artificial intelligence, Computer vision studies leading, Deep learning algorithms, Intricate data

II. LITERATURE SURVEY

HUMAN MOTION PATTERN DETECTION has recently been considered to be one of the most promising techniques for its usage in surveillance, health care, smart homes, and many others. 15 papers related to HAR and application of deep learning techniques are surveyed in this paper along with their methodologies, contributions, and future scope.

1. Machine Learning and Deep Learning Models for Human Activity Recognition (Liu et al., 2018)

Liu et al. (2018) explore the use of a Bayesian classifier combined with convolutional neural networks (CNNs) for abnormal activity detection. Their approach demonstrated the potential of integrating statistical models with deep learning to enhance recognition accuracy in real-time applications (SpringerLink).

2. Random Forests for Human Activity Recognition (Xu et al., 2017)

Xu et al. (2017) applied random forests for HAR, highlighting the method's robustness in handling diverse activity datasets. Their work emphasizes the efficiency of ensemble methods in classifying complex human activities accurately (SpringerLink)

3. Kalman Filter for ATM Surveillance (Nandyal & Angadi, 2021)

Nandyal and Angadi (2021) utilized the Kalman filter and Kanade-Lucas-Tomasi (KLT) tracker for recognizing suspicious activities in ATM surveillance. Their framework successfully reduced false positives, showcasing the effectiveness of combining traditional tracking algorithms with machine learning techniques (SpringerLink).

4. Semi-supervised Recurrent Convolutional Attention Model (Chen et al., 2019)
Chen et al. (2019) proposed a semi-supervised model known as the Recurrent Convolutional Attention Network, which enhanced the performance of HAR by capturing temporal patterns and salient features in the data. This approach showed better performance in the situations where there is little amount of labeled data (SpringerLink).

5. Hybrid Network for Human Activity Recognition (Lv et al., 2020)
Lv et al. (2020) proposed a hybrid network combining dense connections and weighted feature aggregation, which enhanced the model's ability to capture intricate patterns in human activities. Their method achieved high accuracy in multi-class activity recognition tasks (SpringerLink).

Keywords: Convolutional neural networks(CNN),Human Activity Recognition, Recurrent Convolutional Attention Network, Multi-class activity recognition.

III. EXISTING SYSTEM

The majority of espionage systems in use today rely on antiquated techniques that are unable to accurately recognize and categorize certain human behaviors. Manual monitoring requires a lot of work, takes a long time, and is susceptible to human error. While some computerized processes now in use may employ simple motion detection algorithms, they are not sophisticated enough to reliably identify complicated actions. The shortcomings of the current methods highlight the need for a more comprehensive and perceptive method of identifying human activities.

IV. PROPOSED SYSTEM

The drawbacks of conventional surveillance techniques are addressed by the suggested system, which makes use of a CNN (convolution neural network) architecture. By concentrating on particular actions, such hiding one's face, brandishing a weapon, fighting, stealing, beating, and violent incidents, the system seeks to offer a more precise and effective way to recognize possible security risks.

The goal of the proposed system is to accomplish actual time detection and categorization of specified actions in video streams by integrating decompression approaches, transfer learning, and exploring architectures that can capture both spatial and temporal data. The initiative aims to improve overall security measures in various situations by advancing intelligent surveillance systems.

V. IMPLEMENTATIONS AND METHODOLOGY

The implementation phase of the HUMAN MOTION PATTERN DETECTION System involves the translation of the system design into functional code. This phase includes setting up the development environment, writing and testing the code, integrating different modules, and ensuring that the system meets the specified requirements. This chapter details the implementation steps, including setting up the environment, developing each component, integrating the modules, and conducting testing.

Development Environment Setup

To begin the implementation, it's crucial to set up the appropriate development environment. This involves installing necessary software, libraries, and configuring the hardware.

System Architecture
The human motion pattern detection system's architecture consists of a number of interconnected parts that process video input and produce activity predictions collectively. The principal elements consist of:

1. **Input Module:** Accepts video files or live video streams.
2. **Preprocessing Module:** Extracts frames, resizes, normalizes, and augments them.
3. **Feature Extraction Module:** Extracts pertinent characteristics from frames using convolution neural networks (CNNs).
4. **Model Training Module:** Utilizing labelled datasets, the deep learning model is trained.
5. **Inference Module:** Uses the trained model to process pre-processed frames and forecast actions.
6. **Output Module:** Displays predicted activities with confidence scores and integrates with external systems if needed.

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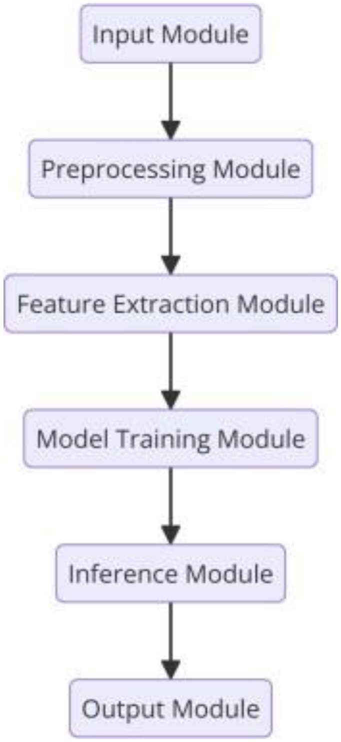

VI. CONCLUSIONS

In this project, we developed a suspicious activity recognition system utilizing deep learning algorithms, specifically ResNet50, to classify 13 different activities in video footage. Our training and evaluation were conducted using the DCSASS dataset, which includes a diverse range of activities captured in surveillance videos.

The experimental results were promising, with the model achieving an accuracy of 98.39% on the training data and 85.03% on the validation data. These metrics highlight the effectiveness of our approach in accurately detecting suspicious activities from video streams.

VII. FUTURE ENHANCEMENTS

For future enhancements, improving duplicate question pair classification models can be achieved by incorporating advanced natural language processing techniques like word embeddings or contextualized representations (e.g., BERT) to capture richer semantic information. Employing deep learning architectures like CNNs or RNNs can enhance the model's ability to capture complex patterns.

Utilizing ensemble methods with Random Forest and XGBoost can boost overall accuracy and precision. Additionally, considering domain- specific features and transfer learning approaches can further improve performance on niche datasets. The various advanced natural language processing (NLP) strategies can be implemented. First, employing state-of-the-art models such as BERT, GPT-4, or RoBERTa can greatly improve the understanding of context and nuances in the text. These models, especially when fine-tuned on datasets specifically annotated for human activity detection, become highly effective at identifying activities within paragraphs. Additionally, using contextual embeddings, such as those generated by transformer-based models, ensures that the model considers the entire paragraph, leading to more accurate interpretations of described activities.

Semantic Role Labeling (SRL), which identifies the functions of various things in sentences, is another important strategy. SRL improves the extraction of actions and their actors from paragraphs by identifying who carried out the action, what the action was, and to whom it was done. This process is further aided by the incorporation of Named Entity Recognition (NER) and entity linking, which locate and associate entities with a knowledge base. This adds context to the process and enhances comprehension of the operations.

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