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A Review on Human Activity Recognition System

Priya Pathak[1], Vinod Choudhari[2], Mansi Patil[3], Bhavika Thakur[4]

[1](Computer Engineering Department, VIVA Institute of Technology, India)
[2](Computer Engineering Department, VIVA Institute of Technology, India)
[3](Computer Engineering Department, VIVA Institute of Technology, India)
[4](Professor, Computer Engineering Department, VIVA Institute of Technology, India)

ABSTRACT:

The process of analyzing human motion using computer and machine vision technology to identify gestures, behaviors, and activities captured by sensors is known as Human Activity Recognition (HAR). HAR is an active research area combining Convolutional Neural Networks (CNN) and feature extraction classification methods for surveillance and other applications. Human Activity Recognition (HAR) is an area of active research that combines Convolutional Neural Networks (CNNs) and feature extraction classification methods to develop surveillance and other applications. However, accurately identifying HAR from a sequence of frames is challenging due to several factors such as cluttered backgrounds, different viewpoints, low resolution, and partial occlusion. Current CNN-based techniques require large computational classifiers, along with convolutional networks having local receptive fields, which limits their performance in capturing long-range temporal information. This paper gives detailed research about the different proposed systems for Human Activity Recognition. This work introduces a low computational power approach for accurate HAR, which overcomes the problems mentioned above and accurately encodes relative spatial information.

Keywords *– Classification, CNN, Deep Learning, HAR, YOLO*

I. Introduction

Decisions to install video surveillance may often follow an unpleasant incident. If violence has made people feel unsafe, people will want increased protection. Video surveillance will give peace of mind. A surveillance system with human activity recognition (HAR) that is suited to the exact needs will provide optimal security. This will allow for the investigation of crimes and effectively ward off potential criminals. In the event of an emergency, the system will also help to maintain an overview and call help quickly. Video systems are also suited, for example, for monitoring automated production processes or for tracing packages in supply chains, making a valuable contribution to optimizing processes and assuring quality. The objective of the system is to keep track of unwanted activities in the crowd, making public areas safer and live video surveillance. Previous works include various implementations of the algorithms and various use of sensors to detect Human Activity.

This paper consists of three sections. The first section is mainly the introduction, the second section is about the methodology and procedures used to implement the production and the third section is about the figures and tables used in the paper. The last section is the conclusion.

II. Review of Literature Survey

I. M. Nasir, M. Raza, J. H. Shah, M. Attique Khan, and A. Rehman [1] have proposed several techniques to increase the accuracy but the margin of improvement still exists. Detection and classification are difficult tasks due to various challenges like random changes in human appearances, clothes, video quality, illumination, and background. This proposed approach employs an efficient method to classify videos by following certain steps, such as eliminating redundant frames from the videos, extracting Segments of Interest (SOIs), and mining feature descriptors using Geodesic Distance (GD), 3D Cartesian-plane Features (3D-CF), Joints MOCAP (JMOCAP), and n-way Point Trajectory Generation (nPTG). The paper proposes an effective model for Human Activity Recognition (HAR) in an uncontrolled environment. To facilitate classification, digital cameras are used to capture 60k frames per second for 4K videos.

S. K [2] has proposed a method in which the inbuilt sensors of the phone are used to detect the activities of humans. In the proposed method seven unique kinds of exercises are indulged and Neighbor Component Analysis (NCA) is utilized to choose significant features from the huge dataset. The proposed system utilizes wearable sensors as data sources to analyze human activity, with the FSCNCA method used to select fine characteristics. Dimensionality is limited to improve data accuracy. The training data is partitioned into five overlaps, and the number of validation (test) sets is determined.

M. M. Hossain Shuvo, N. Ahmed, K. Nouduri and K. Palaniappan [3] has proposed a pattern recognition approach that aims to identify various physical activities performed by humans using different sensor modalities, which is known as Human Activity Recognition (HAR). HAR has several application areas, including surveillance-based security, context-aware computing, ambient assisted living, gesture recognition, and human behavior analysis.

However, due to the noisy nature of sensor data and the variability of activity signals among individuals, HAR remains a challenging task. Using a single classifier to recognize different activity types is often susceptible to errors.

J. D. Domingo, J. Gómez-García-Bermejo, and E. Zalama[4], have researched the technologies in the field of HAR computer vision has greatly advanced over the past few years. The use of deep neural networks along with the development of computing capabilities has made it possible to solve problems of great interest to society. In this research work, the authors focused on one such problem that has seen great development, the recognition of actions in live videos. Although the problem has been oriented in different ways in the literature, the authors have focused on indoor residential environments, such as a house or nursing homes. The given system can be used to understand what actions a person or group of people are carrying out.

R. Saini and V. Maan[5] have proposed a HAR classification method in which people have a great interest because we can find different actions of the human body like sitting, walking, running, jumping, jogging, etc. by using body-worn sensors such as accelerometer, gyroscope and applying methods like convolution neural network (CNN) and other deep learning and machine learning methods. The main objective of this review is to study different human activities, compounds, and methods that are used to recognize the actions and position of the body. A multi-layer human activity recognition strategy based on an inertial sensor and barometer is presented in this paper. With additional verifications for the classifier results, the robustness and reliability of the proposed method are enhanced.

L. Xie, J. Tian, G. Ding, and Q. Zhao [6] have proposed a human activity recognition (HAR) based method based on inertial sensors and barometers. The proposed method can identify eight human activities following a multi-layer strategy. Activities are classified into two categories: dynamic and static activities; then explicit activity recognition is taken individually into the two categories. Three classifiers are adopted for different classifications, including random forest (RF) and support vector machine (SVM). Different feature sets have been selected for different classifiers which are more targeted and effective.

M. Atikuzzaman[7] has concentrated on using CCTV videos and camera images to detect human poses by employing the HAAR Feature-based Classifier and recognizing human activities using the Convolutional Neural Network (CNN) Classifier. The Human Activity Recognition System was trained using a dataset consisting of 5648 images collected by the authors. The proposed approach achieved a high detection accuracy of 99.86% and recognition accuracy of 99.82% after 20 epochs, with an average processing rate of approximately 22 frames per second.

Kai-Tai Song and Wei-Jyun Chen[8] have presented a vision-based human activity recognition system using a mobile camera. This system aims to enhance human-robot interaction in a home setting for applications such as health care and companionship. In the first place, the camera needs to find a human in image frames. The body pose is classified for the detected human. Then human activity is recognized by combining information on the human pose, human location, and elapsed time. In order to determine the situated place of the person in a home setting, a novel space-boundary detection method is proposed in this paper. This method uses environment features to automatically set space boundaries in the image so that human location in the environment can be obtained.

L. Alpoim, A. F. da Silva, and C. P. Santos[9] have presented a paper that surveys the current research directions of human activity recognition (HAR). Firstly, it presents the problem of occupational diseases and the importance of the HAR systems in the prevention of these illnesses. Then, the main steps and the most used techniques of the activity recognition process are described. Therefore, are referred to some issues related to the HAR systems, could affect both the system's usability and recognition performance. By the end, the capital limitations related to these systems are discussed, as well as, some considerations to take into account in future work.

D. Ravi, C. Wong, B. Lo, and G. -Z. Yang[10] have introduced a deep learning-based technique for human activity recognition to facilitate precise and real-time classification using low-power wearable devices. To achieve invariance against variations in sensor orientation, placement, and acquisition rates, they have designed a feature generation process applied to the spectral domain of the inertial data. The proposed method utilizes the sums of temporal convolutions of the transformed input to improve classification accuracy.

III. Analysis

The analysis table summarizes the research paper on Human Activity Recognition. Below is a detailed description of the research papers that have been studied.

Table 1: Analysis Table

Title	**Summary**	**Advantage**	**Technology Used**
Human Action Recognition using Machine Learning in Uncontrolled Environment [1]	An improved HAR model is proposed by utilizing steps like removing redundant frames from videos, extracting SoIs, and feature descriptor mining through GD, 3D-CF, JMOCAP.	The accuracy of the proposed model is 82.55% and 91.99% in HMDB-51 and Bollywood2 datasets	J-MOCAP, CNN and (JMOCAP)
Machine Learning based Human Activity Recognition using	Implementation of the method in which the inbuilt sensors of	Seven unique	KNN, Random Forest Regression, Inbuilt Phone Sensors

Neighbourhood Component Analysis [2]	the phone are used to detect the human activities	kinds of exercises are indulged and Neighbor Component Analysis (NCA) is utilized to choose significant features from the huge dataset	
Hybrid Approach for Human Activity Recognition with Support Vector Machine and 1D Convolutional Neural Network [3]	Implementation of HAR using a two-stage learning process to recognize human activity recorded using a gyroscope sensor and waist-mounted accelerometer.	The proposed method achieved an overall accuracy of the 97.11%	Random Forest, Support Vector Machine, CNN
Improving Human Activity Recognition Integrating LSTM with different Data Sources: Features, Object Detection and Skeleton Tracking [4]	Implementation of a deep learning model that combines several RNNs with processed data from different techniques	The given system can be used to understand what actions a person or group of people are carrying out	RNN, CNN
Human Activity and Gesture Recognition: A Review [5]	The main objective of this review is to study different human activities, compounds, and methods that are used to recognize the actions and position of the body	A multi-layer human activity recognition strategy based on an inertial sensor and the barometer is presented in this paper	CNN
Human Activity Recognition method based on Inertial Sensor and Barometer [6]	Implementation of a Human Activity Recognition (HAR) method based on inertial sensors and barometer	The proposed method can identify eight human activities following a multi-layer strategy. Activities are classified into two categories: dynamic and static activities	Random Forest (RF), Support Vector Machine (SVM)
Human Activity Recognition System from different poses with CNN [7]	Implementation of a method HAAR feature-based classifier	The approach accomplished an accuracy of 99.86% and recognition accuracy of 99.82%	HAAR, CNN
Human Activity Recognition using a mobile camera [8]	Presents a vision-based human activity recognition system using a mobile camera. This system aims to enhance human-robot interaction in a home setting for applications such as health care and companion	In the integrated experiments, the human pose recognition rate of five poses (standing, walking, sitting, squatting, lying) is 94.8%	CNN
Human Activity Recognition Systems: State of Art [9]	The main steps and the most used techniques of the activity recognition process are described	Achieved the highest accuracy of 90.61 %	KNN, SVM, ANN
Deep Learning for Human Activity Recognition: A Resource Efficient Implementation on Low Power Devices [10]	A human activity recognition technique based on a deep learning methodology is designed to enable accurate and real-time classification for low-power wearable devices	The proposed method uses sums of temporal convolutions of the transformed input	Deep Learning, Low power devices, HAAR

IV. Conclusion

In conclusion, this review paper has provided an overview of the current state of research on human activity recognition systems. We have explored the different approaches and techniques used in the field, including sensor-based methods, machine-learning algorithms, and deep-learning models. Through our analysis of the literature, we have identified some of the key challenges and limitations in this area, including issues with data collection and labeling, the need for more robust and accurate models, and the need for more standardized evaluation metrics.

Despite these challenges, the research on human activity recognition systems has shown great promise in a variety of application areas, including healthcare, sports, and security. With continued advances in sensor technology and machine learning algorithms, we expect to see significant improvements in the accuracy and robustness of these systems in the coming years. Furthermore, there is a need for more research on how these systems can be integrated into real-world settings, and how they can be optimized to meet the needs of different user groups.

Overall, this review highlights the importance and potential of human activity recognition systems as a tool for understanding and improving human behavior in a variety of contexts. We hope that this review will inspire further research in this area, and contribute to the development of more effective and user-friendly activity recognition systems in the future.

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