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HUMAN ACTIVITY RECOGNITION USING MULTI-CLASS SVM

Kaarthick. C[1], Kaarthik Ganapathy. S[2] and Dr. Sethuraman. R[3]
[1., 2, 3]Department of Computer Science and Engineering (CSE), Sathyabama Institute of Science and Technology, Chennai, Tamil Nadu, India
ajay113019@gmail.com, kaarthikganapathy@gmail.com and sethuraman.cse@sathyabama.ac.in

ABSTRACT
Recognizing human activity is a crucial challenge for many applications, including surveillance, healthcare, *and human-computer interaction. This paper suggests a novel method for identifying human activity using a multi-class SVM (SVM). The three key steps of the suggested methodology are preprocessing, feature extraction, and classification. A depth map is first transformed into a silhouette for each frame during the preprocessing stage by separating foreground items from the background. After that, to lessen the impact of size and position variances, the foreground silhouettes are normalized by shrinking and cropping. Spatial and temporal features are derived from the normalized silhouettes in the feature extraction stage. In particular, the histogram of directed gradients, the histogram of optical flow, the motion history image, and the two dimensional Discrete Cosine Transform are all taken into consideration. A feature vector is created for each frame by concatenating the retrieved features. The collected features are then used to identify activities using a multi-class SVM classifier. The usefulness of the suggested strategy is demonstrated by experimental findings on three benchmark datasets, which achieve high accuracy rates for activity recognition. The advantage of the suggested method is that it can withstand changes in occlusions, illumination, and view angles. Overall, it of ers a viable option for precise and trustworthy human activity identification in practical settings.*

Index Terms – classification, depth map, Discrete Cosine Transform, histogram of optical flow, histogram of oriented gradients, human activity recognition, motion history image, multi-class SVM, silhouette, spatio-temporal features.

INTRODUCTION
Recognition of human activity is a critical task in computer surveillance to healthcare. Many benefits can be derived from the ability to precisely identify and categorize human behaviors from visual data, including greater security, individualized healthcare monitoring, and human-computer interaction. Support vector machines (SVMs), a form of machine learning technique that has demonstrated promising results in a variety of disciplines, are a popular and efficient method for addressing this issue.

A multi-class SVM is used in human activity recognition to categorize the various activities carried out by humans. The objective is to train the SVM model using a set of labeled training data, where each sample corresponds to a class label and represents a human action. Using the attributes gleaned from the data, the SVM model then learns to classify samples of hidden activity into predetermined groups.

The capability of a multi-class SVM to handle non-linear correlations between features and labels is one of the main benefits of utilizing it for human activity recognition. The input data is mapped into a high-dimensional feature space using a kernel function used by SVMs, and then a hyperplane is constructed to divide the input data into multiple classes. With the help of this non-linear mapping, the SVM can more accurately classify data by capturing complicated patterns and decision boundaries.

With a multi-class SVM, human activity recognition usually involves a number of steps. In order to extract useful features, the raw input data, such as video frames or sensor measurements, are first preprocessed. Depending on the particular application, these features could be motion descriptors, shape properties, or temporal data. The feature extraction process is essential because it guarantees that the SVM model obtains pertinent and discriminative data for precise classification.

After that, the multi-class SVM model is trained using the preprocessed features. Finding the best hyperplane to maximally isolate the training samples from various activity classes is a step in the training process. This is accomplished by resolving an optimization problem that maximizes the margin between samples and the decision border while minimizing the classification error. After being trained, the SVM model may then accurately predict the activity class labels of brand-new, untried samples.

Using approaches like feature selection, dimensionality reduction, or ensemble methods can improve the performance of the multi-class SVM model in recognizing human activities. The effectiveness and scalability of SVM algorithms to handle huge datasets and real-time applications are also being worked on in continuing research.

Finally, human activity recognition using a multi-class SVM is a strong and flexible method that permits the precise classification of human activities. This strategy has demonstrated considerable potential in numerous fields by utilizing the advantages of SVMs, such as their capacity to handle non-linear relationships and their robustness to noisy data. The creation of sophisticated multi-class SVM models and cutting-edge feature extraction methods is anticipated to substantially improve the precision and usability of human activity detection systems as technology progresses.

RELATED WORKS

[1] A wearable multi-sensor data fusion system for human activity detection is proposed in this paper using machine learning algorithms. The research delves into the integration of data from several sensors with the aim of improving the accuracy of systems that detect human activity. These findings have wide-ranging applications in fields such as healthcare, fitness monitoring, and security.

Combining deep learning techniques with an algorithm for marine predators, the article introduces a new approach to activity identification

[2]. Improving the robustness and efficiency of activity identification systems is a broad goal, and this novel technique may have ramifications beyond just wildlife monitoring.

[3] System development for the benefit of the elderly via activity recognition is the primary emphasis. Improving the quality of life for seniors is possible only by integrating deep learning and machine learning methods into care and support systems.

[4] This work takes a close look at how metaheuristics may be used for human activity identification and fall detection using wearable sensors. This research elucidates how activity identification systems may be improved in terms of accuracy and reliability via the use of state-of-the-art optimization techniques, with a focus on healthcare and safety.

[5] The accuracy of activity detection in several sectors, including sports and medicine, may be enhanced using this technique, which employs sensor data and convolutional neural networks..

[6] Using a mixed deep learning model, the study explores the process of activity identification.. Through the integration of several deep learning techniques, this research seeks to improve the performance of activity identification systems that might find use in healthcare and smart homes.

[7] The primary focus of this study is the detection of human actions inside IoHT applications. Through the use of mathematical optimization methods and deep learning, this research aims to create systems that can better track human behavior in healthcare and wellness contexts.

[8] Improved activity detection is possible, according to the author, by combining the results of simpler sensor branch classifiers. The enhanced precision and efficiency of this technology has wide-ranging applications in home automation and security.

[9] An in-depth look into how convolutional neural networks can recognize human activities is provided in this article. Covering the current landscape, existing datasets, challenges, and potential future directions, it provides valuable insights for academics and professionals in the field.

[10] For researchers and programmers involved in activity detection systems, this article summarizes the topic, offers a taxonomy of approaches, and examines unresolved problems; it is a priceless resource.

EXISTING SYSTEM

The current approach for multi-class Support Vector Machine (SVM)-based Human activity recognition has a high computational complexity, which is one of its key drawbacks. The goal of SVM is to identify the hyperplane that optimizes the margin between several classes by solving a challenging optimization problem. Due to the requirement for real-time recognition in dynamic contexts, this complexity is heightened in the context of human activity recognition. SVM's computational complexity makes it difficult to deploy the system on devices with limited resources or in programs that need for quick responses.

Lack of adaptability in managing complicated and varied operations is another drawback. When the actions being detected are unique and clearly segregated in the feature space, SVM performs effectively. Yet, human behavior can vary widely in real-world circumstances, making it challenging for SVM to accurately capture the complexity. When this occurs, SVM may have trouble correctly classifying the activities, especially if they are similar or share characteristics. This constraint makes it difficult for the algorithm to precisely identify a variety of human actions.

Another flaw in the current method is that feature selection must be done manually. The classifier in SVM-based activity recognition uses predefined characteristics that are retrieved from the input data. For these aspects to accurately portray the activities of interest, careful planning and selection are required. Due to the fact that it calls for in-depth knowledge of the activity patterns and domain expertise, this process is frequently labor- and time intensive. Moreover, the chosen features could not always capture the pertinent data or completely utilize the data's discriminative capability, resulting in subpar performance in real-world applications.

Moreover, the scalability and adaptability of the current technology may be restricted. SVM is a binary classifier, making binary classification problems its main focus. SVM must be modified to handle multi-class situations, such as simultaneously identifying numerous activities, by using one-vs-all or one-vs one approaches, which can result in more complex models and more computing cost. Moreover, SVM may have trouble addressing changes in activity patterns or responding to new activities without retraining the entire model, which can be difficult and time-consuming in dynamic contexts.

As a result, the multi-class SVM-based system now in use for recognizing human activity is computationally complex, unable to handle a variety of activities, requiring manual feature selection, and possibly having limited scalability and adaptability. It will be essential to overcome these drawbacks in order to create systems for human activity recognition that are more effective across a range of application fields.

PROPOSED SYSTEM

Building a trustworthy system for activity recognition using a multi-class support vector machine (SVM) approach is the main goal of the suggested study. The need for accurate activity detection in several fields inspired this study's inception, including but not limited to healthcare monitoring, human-computer interaction, and surveillance. Improving the overall efficiency, reliability, and precision of systems that detect human activity is the primary focus of this study.

In order to achieve this objective, the proposed endeavor would include many critical steps. An extensive dataset of human activities will first be collected using sensors such as gyroscopes and accelerometers. The subjects will have these sensors attached to different regions of their bodies so that precise data on their movements may be captured. Dataset preprocessing steps include filtering, normalization, and feature extraction. Several parameters in the time and frequency domains, such as the mean, variance, and Fourier transformations, will be extracted from the sensor data.

Following preprocessing, a multi-class SVM classifier is designed and put into action. To train the SVM classifier, we will utilize the features and activity labels acquired from the dataset. In order to achieve precise classification, the SVM classifier optimizes the hyperplane to maximize the margin between different activity classes. To improve the classifier's performance, we will utilize grid search and cross validation techniques to choose models and change hyperparameters.

After training the multi-class SVM classifier, the system will be subjected to rigorous testing using an independent testing dataset. To measure how well the system works, we will utilize metrics like recall, accuracy, precision, and F1-score. Achieving great robustness and accuracy in recognizing various human activities, including walking, running, sitting, and more, is the goal of the proposed study.

Ultimately, the goal of the proposed research is to develop a human activity identification system that uses multi-class support vector machines. If the sensor data is accurate, the feature extraction algorithms are advanced, and the SVM classifier is efficient, the system will be more effective and dependable overall. A trustworthy and versatile system for human activity recognition will be the final product, ready for deployment in real-world contexts to bolster healthcare monitoring, surveillance, and other uses.

SYSTEM ARCHITECTURE

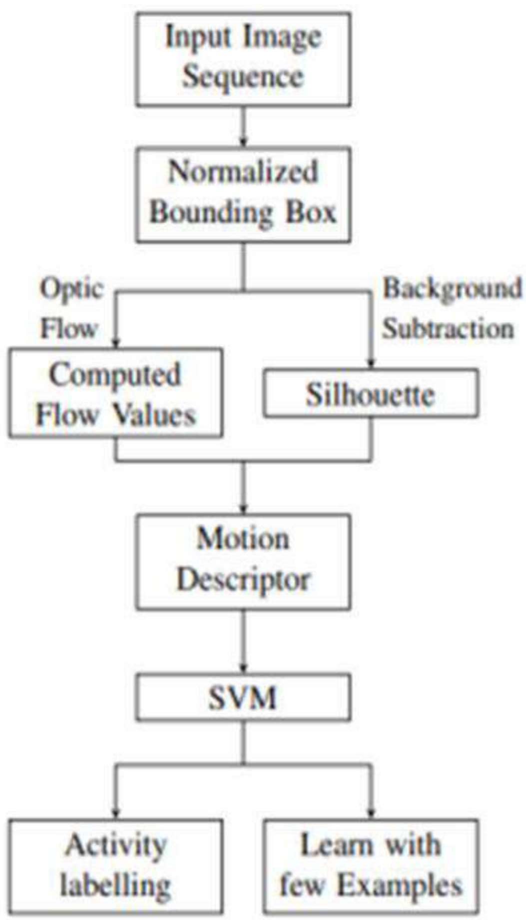

Fig. 1. System Architecture

METHODOLOGY

1. **Data Collecting and Preprocessing:** The initial step in this module is to gather data on human behaviors. Wearable technology or sensors like accelerometers can be used for this. The information gathered may cover bodily motions, acceleration, or any other pertinent parameters. Data must be preprocessed after collection to get rid of noise, outliers, and any discrepancies. Techniques like segmentation, feature extraction, or filtering may be used for this. Following preprocessing, the data is prepared for additional analysis and model training.

2. **Feature Extraction and Selection:** In this module, significant features that can represent various human activities are extracted from the preprocessed data through analysis. For feature extraction, a variety of methods are available, including wavelet transform, frequency-domain analysis, and time-domain analysis. These methods aid in locating pertinent patterns and traits in the data. The most pertinent and discriminative features are chosen by feature selection after feature extraction. As a result, the data's dimensionality is reduced, and the model's effectiveness and accuracy are increased.

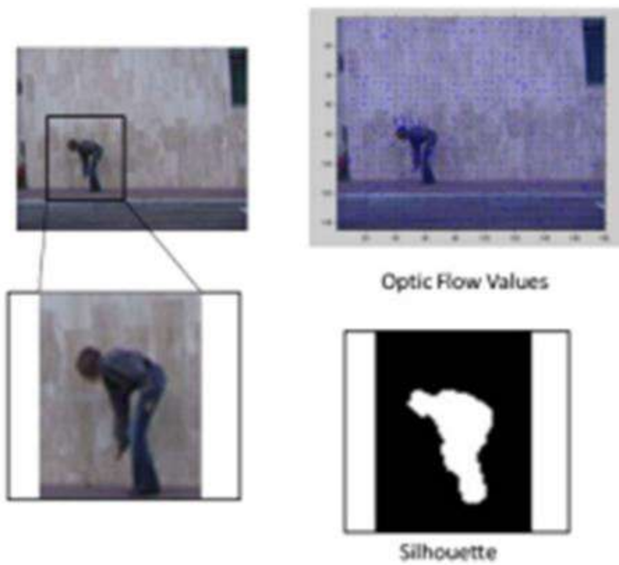

Fig. 2. The feature extraction as a graphical representation.

3. **Multi-class SVM Classification:** When compared to other classification algorithms, SVM is straightforward to apply and performs well in many domains [11]. SVM uses feature space linear decision hyperplanes to do classification. Hyperplanes are computed during training to partition the training data according to distinct labels. Extensions, regression, density estimation, and kernel principal component analysis are all possible using SVM's kernel function. The training data is transformed into a new space using a kernel function if they are not linearly separable. In the new vector space, the data must be linearly separable. SVMs not only work well with huge training sets, but they also provide accurate results at a cost that is easy on the wallet. Classification is unaffected by the training complexity, which grows in direct proportion to the number of training samples. In this module, a multi-class Support Vector Machine (SVM) model is trained using the retrieved and chosen features. An efficient machine learning approach for multi-class classification issues is SVM. It operates by locating an ideal hyperplane in the feature space that divides several activity classes. Each data sample is given a class label that represents a particular human behavior, and this labeled data is used to train the SVM model. In order to forecast the activity class of fresh, unused data samples, the trained model can then be used.

RESULT AND DISCUSSION

An Advanced System for Q&A Generation from Provided The multi-class approach for recognizing human activity SVM is a potent technology that can precisely categorize and identify a variety of human behaviors. The Support Vector Machine (SVM) technique is used by this system to classify a variety of activities in an efficient manner. SVM is a well-liked machine learning method that can handle challenges involving high-dimensional data and nonlinear classification.

The system begins by gathering a sizable amount of sensor data from several sources, including accelerometers, gyroscopes, and magnetometers. The key features that capture the characteristics of different activities are then extracted from the preprocessed data. These characteristics could have temporal, geographical, or frequency-based data. The retrieved characteristics are then used to train a multi-class SVM model. The SVM method constructs a decision boundary that maximally separates various activity groups after learning from the training data. The SVM improves the hyperplanes that mark the divisions between activities during training, enabling precise categorization. Once trained, the model can be used to detect human activity in the present. New sensor data is examined and contrasted with the remembered decision boundaries during the recognition phase. The machine can correctly predict and categorize the ongoing human action based on this comparison.

Several industries, including healthcare, sports performance monitoring, and human-computer interaction, can benefit from the system's capacity to distinguish human activities. It can be used to spot odd behaviors, keep track of physical activity, or make tailored recommendations.

The multi-class method for human activity detection using Support Vector Machines (SVM) is a strong technology that can accurately classify and identify a wide variety of human actions. SVM is a well-known machine learning method that excels at solving problems involving high-dimensional data and nonlinear classification, which makes it a great option for systems that recognize activities.To begin, the system gathers a significant amount of sensor data from multiple sources, such as magnetometers, gyroscopes, and accelerometers. After undergoing preprocessing, this rich information is carefully examined to extract important features that accurately capture the chronological, geographical, or frequency-based aspects of various activities. This stage makes that the model fully represents the subtleties present in different human behaviors.

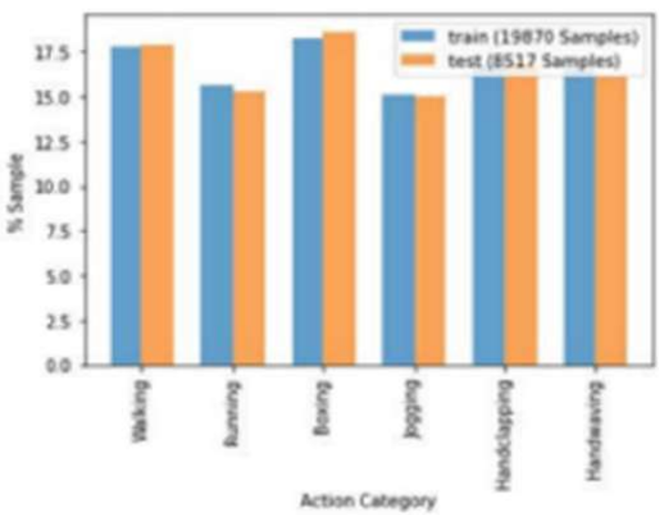

Fig. 3. Relative Category of Samples per category of actions

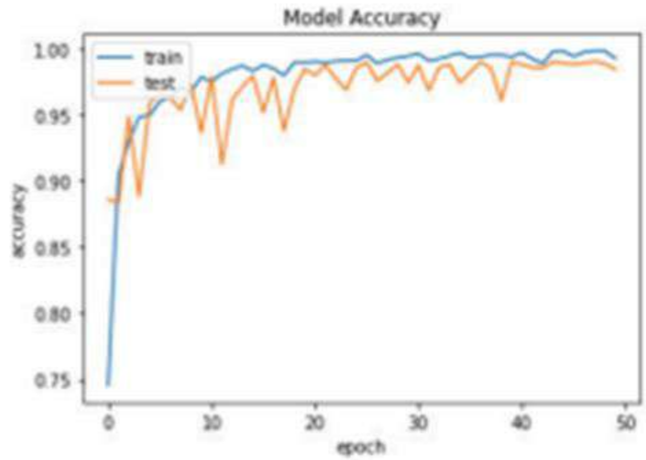

Fig. 4. Plot for model accuracy verses number of epochs

CONCLUSION

This research work presents a better approach for improving the accuracy in human activity recognition. By offering a thorough analysis of both traditional and modern approaches to handwritten text recognition, this paper opens the door to widely used smartpen-based automated data entry. Our study highlights notable advancements in the field as handwritten text recognition capabilities improve and the need for effective data collection systems increases. Our findings provide insights into a variety of contexts and users, encompassing a range of techniques from conventional handwriting identification to the newest in machine learning and deep learning. This research provides fundamental knowledge that is useful in many academic fields, especially when studying automated systems. The novelty of this research project lies in its distinct approach to improving the accuracy of human activity recognition, with a primary focus on handwritten text recognition methodologies. Unlike conventional studies that solely delve into traditional approaches, our project provides a comprehensive analysis that spans both historical techniques and the latest advancements in machine learning and deep learning. The unique proposition of incorporating smartpen-based automated data entry systems adds a layer of innovation to the research. By bridging the gap between legacy methods and cutting-edge technologies, our project not only captures the evolutionary trajectory of handwritten text recognition but also positions it within the context of emerging applications, particularly in the realm of smartpen technology. This dual perspective not only contributes to the academic understanding of automated systems but also offers practical insights for the development and optimization of data collection processes, making our research a pioneering endeavor in the interdisciplinary intersection of human activity recognition and smartpen-based automated data entry systems.

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