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HUMAN ACTIVITY (RUN-WALK) PREDICTION

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Abstract−An increasingly useful application of machine learning (ML) is in predicting features of human actions. The objective of this study is to analyze a dataset of human activities containing running and walking. Initially, we started our project by gathering our data collected by sensors, which gave us information about human movements of running and walking. Later we imported some python libraries and implemented a few nonlinear ML models on our dataset. After acquiring the accuracies from our respective models, the model with maximum accuracy was selected for this dataset. Assessing the goodness of the model we have treated it as the essential role to keep our project real and meet real world expectations

I. INTRODUCTION

Human activity recognition (HAR) aims to classify a person's actions from a series of measurements captured by sensors. Recently, collecting this type of data is not an enormous or difficult task. Due to the development of the Internet of Things, almost everyone has some gadget that monitors their activities through a smartwatch, a pulsometer, or even a smartphone. Generally, this is performed by following a fixed-length sliding window approach for the features extraction. Here two parameters need to be fixed: the size of the window and the shift. Some of the data we can use are:

- Body acceleration.
- Gravity acceleration.
- Body angular speed.
- Body angular acceleration.
- Etc.

The machine learning model we are using is the Run Walk Prediction Model. We have collected our pre-processed data from Kaggle. Run Walk Prediction using accelerometer data plays a crucial role in human-to-human interaction and interpersonal relations. Because it provides data about the identity of a person, his personality, and mental state, it is difficult to extract. The human ability to identify another person's activities is one of the main subjects of study of the scientific areas of computer vision and machine learning. As a result of this research, many applications, including video surveillance systems, human-computer interaction, and robotics for human behaviour characterization, require a multiple activity recognition system. Among various classification techniques two main questions arise: "What action?" and "Where in the video?". When attempting to recognize human activities, one must determine the

kinetic states of a person, so that the computer can efficiently recognize this activity. Human activities, such as “walking” and “running,” arise very naturally in daily life and are relatively easy to recognize. On the other hand, more complex activities, such as “peeling an apple,” are more difficult to identify. Complex activities may be broken down into other simpler activities, which are generally easier to identify. Usually, the detection of objects in a scene may help to better understand human activities as it may provide useful information about the ongoing event. Most of the work in human activity recognition assumes a figure-centric scene of uncluttered background, where the actor is free to perform an activity. The growth of a fully automated Run Walk Prediction using accelerometer system, capable of classifying a person’s activities with low error, is a challenging task due to problems, such as background clutter, partial occlusion, changes in scale, viewpoint, lighting and appearance, and frame resolution. In addition, annotating behavioral roles is time consuming and requires knowledge of the specific event. Moreover, intra- and interclass similarities make the problem much more difficult. That is, actions within the same class may be expressed by different people with different body movements, and actions between different classes may be difficult to distinguish as they may be represented by similar information. The way that humans perform an activity depends on their day-to-day happenings and routine, and this makes the problem of understanding the underlying activity quite difficult to determine. Along with it, the construction of a visual model for gaining knowledge and analysing human activities in real time with incomplete benchmark datasets for evaluation is difficult. Run Walk Prediction has been a popular field of research in recent times. Many approaches have been implemented in literature with the aim of recognizing and analysing human activity. In this project we have investigated the Run Walk Prediction based on the data collected through the accelerometer sensor of mobile devices. We employ different machine learning (ML) classifiers, algorithms, and deep learning (DL) models across different benchmark datasets. The experimental results from this study provide a comparative performance analysis based on accuracy, performance, and the costs of different ML algorithms and DL algorithms, based on Logistic Regression, K - Nearest Neighbour (KNN), Support Vector Machine (SVM), Naïve Bayes, Convolutional neural network (CNN) models for activity recognition.

II. LITERATURE SURVEY

“Research on machine learning algorithms and feature extraction for time series” from IEEE Journal 2018, methodology of this paper describes Support vector machine (SVM), long short-term memory (LSTM) and other algorithms to predict the user's consumption behavior,some advantages of this particular paper can be LSTM-SVM is most outstanding in prediction and some limitations include High cost, Difficulty in obtaining the data [1]. “Scalable Nearest Neighbor Algorithms for High Dimensional Data” published in 2014, introduces three new selection algorithms named Nearest Neighbor Matching Algorithms, Partitioning Trees, Hashing Based Nearest Neighbor Techniques, Nearest Neighbor Graph Techniques. These techniques are used to select the tips for approval. They have High dimensional spaces, a core problem in many computer vision and machine learning algorithms and which is often the most computationally expensive part of these algorithms , and some limitations include scaling to very large size data sets by proposing an algorithm for distributed nearest neighbor matching on compute clusters [2].

"AdaBoost Support Vector Machine Method for Human Activity Recognition" published in IEEE Journal 2021, methodology of this paper describes Support vector machine (SVM), long short-term memory (LSTM) and other algorithms proven to be able to improve the performance of AdaBoost.Also,widely connected to data science and used in different fields of robotics. Boosting with highest accuracy of 96.40% some limitations include The remaining accuracy becomes sensitive to outlying data and noisy data. [3]. "High accuracy human activity recognition using machine learning and wearable devices' raw signals" published in 2021, describes Data segmentation and prepossessing and classification Variable data segmentation using fast Fourier transformation Data Prepossessing. Correctly identify human activities by considering a dataset, obtained using two wearable devices. Using the introduced *VSM*, we could deploy a highly accurate HAR model and also recognize the transition between activity moments.[4]

"Human Activity Analysis using Machine Learning Classification Techniques", published in 2019,includes data collection, design approach, its results and discussion. Human activity analysis is a popular activity in the growing industry and we have applied different machine learning algorithms. Comparative study performed among the applied various techniques kNN, SVM, Random forest, Neural Networks, Logistic regression and Naïve Bayes. The issue with it is Logistic Regression and neural network gave good results whereas Naive Bayes result was not good. [5]. "Machine Learning: Algorithms, Real-World Applications and Research Directions", from IEEE Journal 2021, includes supervised, unsupervised, semi-supervised, and reinforcement learning in the area. It can be used as a reference guide for potential research and applications for both academia and industry professionals as well as for decision-makers, from a technical point of view.The issue with it is data isn't not straightforward, although the current cyberspace enables the production of a huge amount of data with very high frequency.[6] "Human Activity Recognition on Smartphones using Machine Learning Algorithms" published in IEEE 2018, included SENSORS IN SMARTPHONES Accelerometer Dataset Description Random Forest Approach Activity Recognition (AR) is one of the maximum vital technology behind many packages on a smartphone consisting of health tracking, fall detection, context-aware cellular packages, human survey gadget, and home automation and many others. Smartphone based activity recognition system is an energetic vicinity of studies because they could lead to new kinds of smart applications was one of its disadvantages. [7]

III. WORKING WITH DIFFERENT ALGORITHMS

1. KNN:

K-Nearest Neighbor is one of the simplest Machine Learning algorithms based on Supervised Learning technique

KNN works by finding the distances between a query and all the examples in the data, selecting the specified number examples (K) closest to the query, then votes for the most frequent label (in the case of classification) or averages the labels (in the case of regression). It is a very simple algorithm to understand and interpret and is very useful for nonlinear data because there is no assumption about data in this algorithm. But, It is computationally a bit expensive algorithm because it stores all the training data and high memory storage required as compared to other supervised learning algorithms.

KNN can be used in the banking system to predict whether an individual is fit for loan approval, does that individual have the characteristics similar to the defaulters one,etc.
With the help of KNN algorithms, we can classify a potential voter into various classes like “Will Vote”, “Will not Vote”, “Will Vote to Party ‘A’, “Will Vote to Party ‘B’.

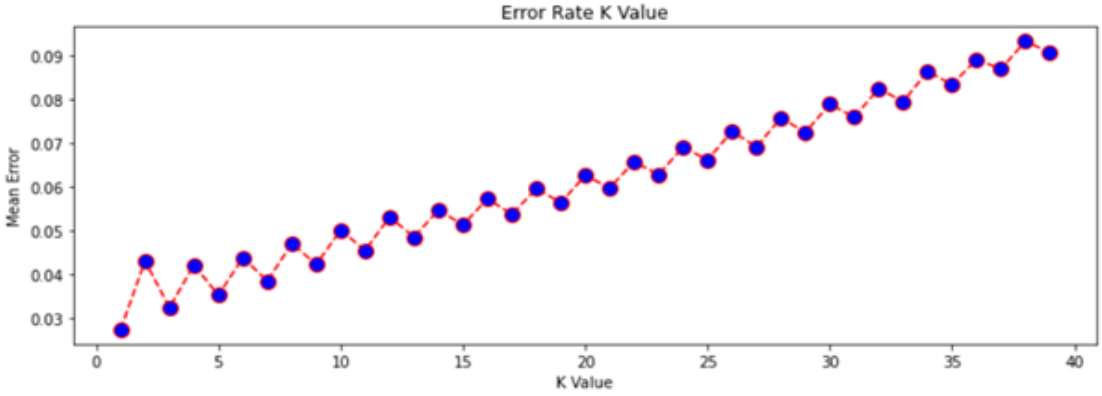

Fig 1: Accuracy By KNN

Accuracy for KNN: 0.9888472479342575

2. CNN:

A Convolutional Neural Network, also known as CNN or ConvNet, is a class of neural networks that specializes in processing data that has a grid-like topology, such as an image. A digital image is a binary representation of visual data. A CNN typically has three layers: a convolutional layer, a pooling layer, and a fully connected layer. CNNs use image recognition and classification in order to detect objects, recognize faces, etc. They are made up of neurons with learnable weights and biases. With CNN, we now have sophisticated models like R-CNN, Fast R-CNN, and Faster R-CNN that are the predominant pipeline for many object detection models deployed in autonomous vehicles, facial detection, and more.

CNNs are used with recurrent neural networks to write captions for images and videos. This can be used for many applications such as activity recognition or describing videos and images for the visually impaired.

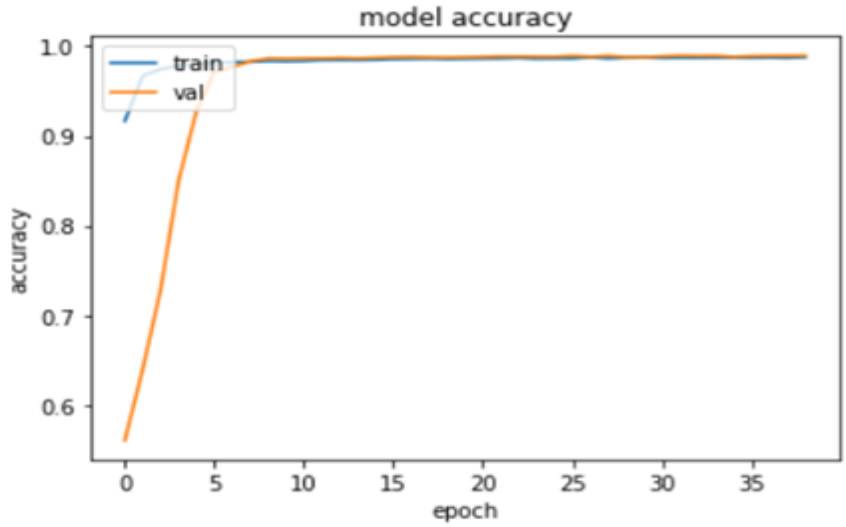

Fig 2: Accuracy By CNN

Accuracy for CNN: 0.9878461956977844

3. SVM:

SVM or Support Vector Machine is a linear model for classification and regression problems. It can solve linear and non-linear problems and work well for many practical problems.

SVM works by mapping data to a high-dimensional feature space so that data points can be categorized, even when the data are not otherwise linearly separable. A separator between the categories is found, then the data are transformed in such a way that the separator could be drawn as a hyperplane.

The SVM kernel is a function that takes low-dimensional input space and transforms it into higher-dimensional space, i.e. it converts non separable problem to separable problem. It is mostly useful in non-linear separation problems.

Simply put the kernel does some extremely complex data transformations then finds out the process to separate the data based on the labels or outputs defined.

Accuracy for SVM: 0.9870411342394003

4. LOGISTIC REGRESSION:

Logistic regression is a statistical analysis method to predict a binary outcome, such as yes or no, based on prior observations of a data set.

It is used when the data is linearly separable and the outcome is binary or dichotomous in nature. That means Logistic regression is usually used for Binary classification problems.

The logistic regression model is a statistical method for binary classification that can be generalized to multiclass classification. Scikit-learn has a highly optimized version of logistic regression implementation, which supports multiclass classification tasks.

The primary difference between linear regression and logistic regression is that logistic regression's range is bounded between 0 and 1. In addition, as opposed to linear regression, logistic regression does not require a linear relationship between inputs and output variables.

Train and test => ((66441, 6), (66441,))

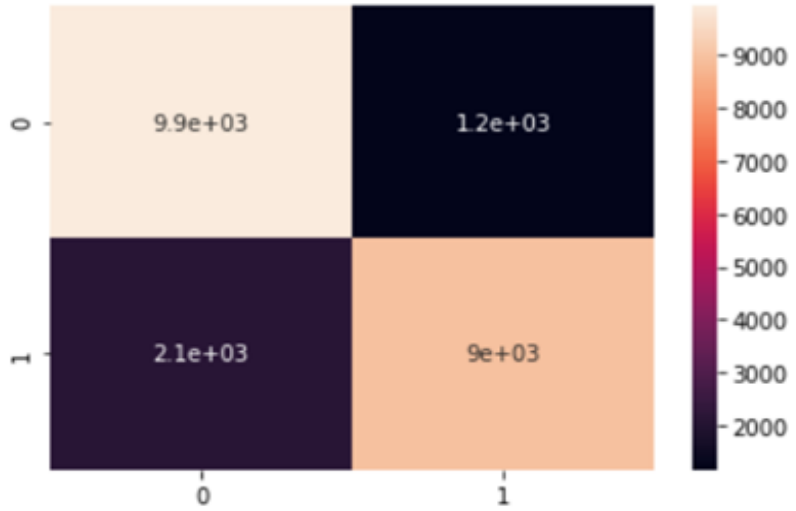

Fig 3: Accuracy By Logistic Regression

Accuracy = 0.8530726509233756

5. NAIVE BAYES:

Naïve Bayes is a simple learning algorithm that utilizes Bayes rule together with a strong assumption that the attributes are conditionally independent, given the class.

It predicts membership probabilities for each class such as the probability that a given record or data point belongs to a particular class. The class with the highest probability is considered as the most likely class.

Naive Bayes classifier is successfully used in various applications such as spam filtering, text classification, sentiment analysis, and recommender systems. It uses Bayes theorem of probability for prediction of unknown class.

Naive comes from the fact that the classifier will go ahead and assume / accept the fact that some features are actually dependent on others, but even with this interdependence, there are still good, fast, reliable results with large data sets.

Accuracy for Gaussian Naive Bayes: 0.9581433151216869

IV. DESIGN SYSTEM

4.1 FLOW CHART

Fig 4: Flow Chart

V. EXTENSIONS

This section lists some ideas for extending the tutorial that you may wish to explore.

More Algorithms. Five machine learning algorithms were evaluated on our problem; we tried some more nonlinear and ensemble methods.

Algorithm Tuning. No tuning of the machine learning algorithms was performed; mostly default configurations were used. We picked a method such as SVM to see if you can further lift performance on the problem.

Data Scaling. The data is already scaled to [-1,1], perhaps per subject. Explore whether additional scaling, such as standardization, can result in better performance, perhaps on methods sensitive to such scaling such as KNN.

VI. RESULT AND CONCLUSION

Since computer vision is a trending topic these days, systems like Human Activity Recognition systems are quite useful and effective for solving a variety of applications. The proposed model helps us to analyse the human activities of running and walking. According to our analysis, Logistic regression gives us the least accuracy of 85.3% while KNN gives us the highest accuracy of 98.8%. However, SVM, CNN and Naïve Bayes have the accuracy rates as 98.7%, 98.6% and 95.8% respectively. One can exploit the rich scope such insights have to offer in developing real time human asset monitoring in highly secured installations, tracking Elderly or population with movement. We have preferred non-linear models such as SVM, KNN, Naïve Bayes Algorithm for our running and walking prediction model as the prediction can be either related to one another or not relatable at all and we tested and trained our training data set in a ratio of 75:25

VII. FUTURE SCOPE

Run Walk Prediction can also assist in surveillance or monitoring, or lend a helping hand to the elderly and blind people etc. This not only provides additional comfort to the end-users but also can be utilized by different organizations in order to reduce the employees' workload. The model shows good results on video streams while performing decently on image data. Activity Recognition systems are of great importance in modern days due to the convenience and problems which the system offers and solves. Need of Activity recognition for monitoring and surveillance, video segmentation etc. has tremendous demand in which this system can help substantially. This system can be incorporated in mobile apps to further help the elderly and blind people. It is cost-effective and an immense time saving system which is also prone to human errors. This system acts as a base solution for many other applications involving activity recognition. Hence, this system is very advantageous for both individuals and organizations for general or specialized purposes.

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