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Human Activity Recognition using ML Techniques

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Abstract:- With the advancement of new technologies in our emerging world, Every part of our life has become an Activity. Monitoring Human activities has been an active research area since past few years with the growth of increasing demands in Health Sector. This research helps to detect Emergency situations and provides quick aid for aged people. Many Sensor based Approaches have been introduced such as Accelerometer, Gyroscope. This research paper covers predicting Activity of human using Decision Trees and Random Forest. It also discusses advantages and disadvantages of mentioned Sensor technologies. We have considered Various activities such as Running, walking, Laying, Standing etc. in our present proposed model. Firstly, Paper starts with discussing problem of the occupational diseases and Preventing People from these diseases. Then the collected data is trained and evaluated by ML Techniques. The trained model shows a satisfactory performance in all the stages. Finally, a recognition system has been developed with an accuracy of 93% in Random Forest Classifier. Experimental results showed that compared to Decision Tree Classifier, Random Forest Classifier predicts better over these various activities.

Keywords:- *Machine Learning , Decision Trees , Random Forest , Classification , Sensors.*

I. INTRODUCTION

Electronic gadgets have become a most crucial part in human's life. With the advancement of technology, they get more capable to meet customers needs and expectations. Everywhere we go, we carry our electronic gadget. To increase the power of these Electronic gadgets, let's say Smartphones, designers added new modules and devices to the hardware. In this functionality, Sensors plays a major role as they are embedded in smartphones and can be used to collect user's daily life activities. Collecting this daily life activities majorly benefits health sectors. There is a rapid increase in Occupational Diseases, they may be heavy physical work, poor posture, low level of work satisfaction. Consequently, these factors may cause some physical diseases on the workers, as example the musculoskeletal disorders, affecting the tendons, the ligaments, the peripheral nerves and can even lead to more damage. So, due to this problem, two types of sensors have been initiated. Wearable Sensors and External Sensors.

External Sensors refers to surveillance cameras. Although these have high applicability, there are even more disadvantages as they lack individual's privacy as everyone are not acceptable of getting permanently monitored by cameras. Besides this, these sensors are computational demanding. So, with all these mentioned disadvantages, it is more convenient to use wearable Sensors which are attached to our body. Wearable sensors monitor environment attributes, physiological attributes and dynamic attributes. In this context, Human activity recognition has been an active research field, which has great application prospects in intelligent video surveillance, human-computer interaction and so on[2]. It is capable of recognizing various physical activities such as running, walking, sleeping, Laying and so on. So this has become a key topic of research in wireless, smartphones and mobile computing. In our research, we have used Accelerometer and Gyroscope sensors, and a dataset which consist of signals from accelerometer and gyroscope of a smartphone carried by different men and women volunteers while doing different activities are classified using different machine learning approaches[3]. We have selected random forest approach as it shows better accuracy compared to decision trees

1.1 Accelerometer and Gyroscope

Accelerometers in smartphones are used to detect the orientation of the phone. They use microscopic crystals that go under stress when vibrations occur, and from that stress a voltage will be generated which creates a reading on any acceleration. The gyroscope adds a dimension to the information supplied by the accelerometer by tracking rotation or twist.

An accelerometer measures linear acceleration of movement, while a gyroscope measures the angular rotational velocity. Both sensors measure rate of change; the only difference is they just measure the rate of change for different things.

Data retrieved from the accelerometer will be processed to detect changes in movement. Signals retrieved by the gyroscope will be processed to detect the position and alignment of the device. As there is a meaningful difference of characteristics between data retrieved from these sensors, there will be many features generated from these sensors data to determine activity of the Person carrying the device.

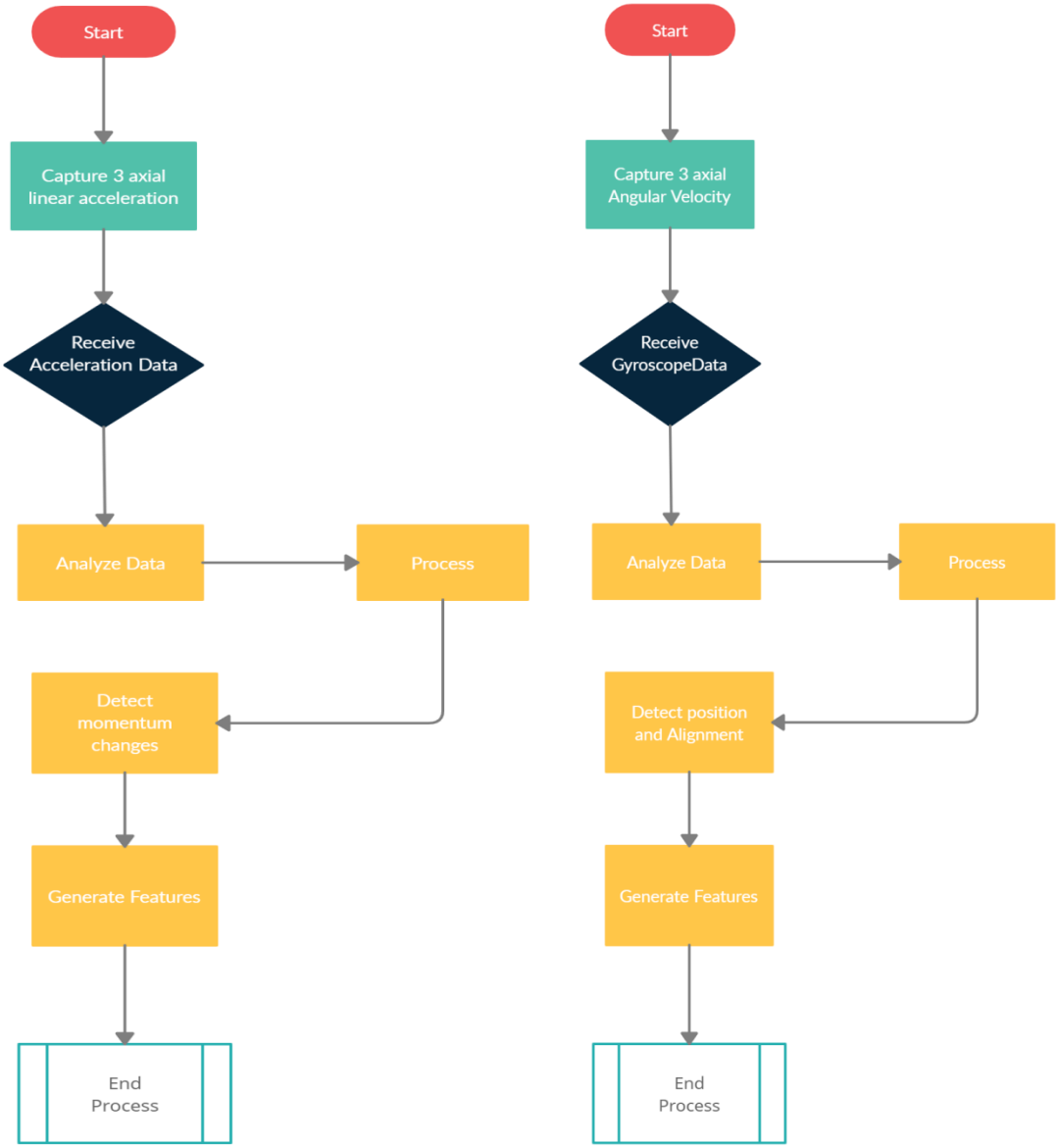

Fig : A figure of Flowchart for Accelerometer and Gyroscope. Left flowchart Represents the Accelerometer And right Flow chart Represents the Gyroscope

1.2 Activity Recognition Methodology

A. Data Collection

The dataset consists of signals from a smartphone carried by 30 volunteers within an age of 19-48 years, individuals performing 6 different activities. The cell phone based triaxial accelerometer data gives acceleration along the three axes (X, Y and Z).[5]. Activities performed are listed below with their corresponding codes.

- WALKING - 1
- CLIMBING UP THE STAIRS - 2
- CLIMBING DOWN THE STAIRS - 3
- SITTING - 4
- STANDING - 5
- LAYING - 6

Using accelerometer and gyroscope sensors which are initiated in Smartphone, we captured 3-axial linear acceleration and 3-axial angular velocity at a constant rate of 50Hz. The obtained dataset has been randomly partitioned into two sets, where 70% of the volunteers was selected for generating the training data and 30% the test data.

Dataset can be found here: https://archive.ics.uci.edu/ml/datasets/human+activity+recognition+using+smartphones

B. Data Preprocessing

As it is known, due to the nature of the inertial sensors, the acquired data should firstly pass through a preprocessing stage[4]. Data may contain noise which is needed to be filtered out. It may contain unwanted information like null values. Here Data will be filtered and balanced data will be made

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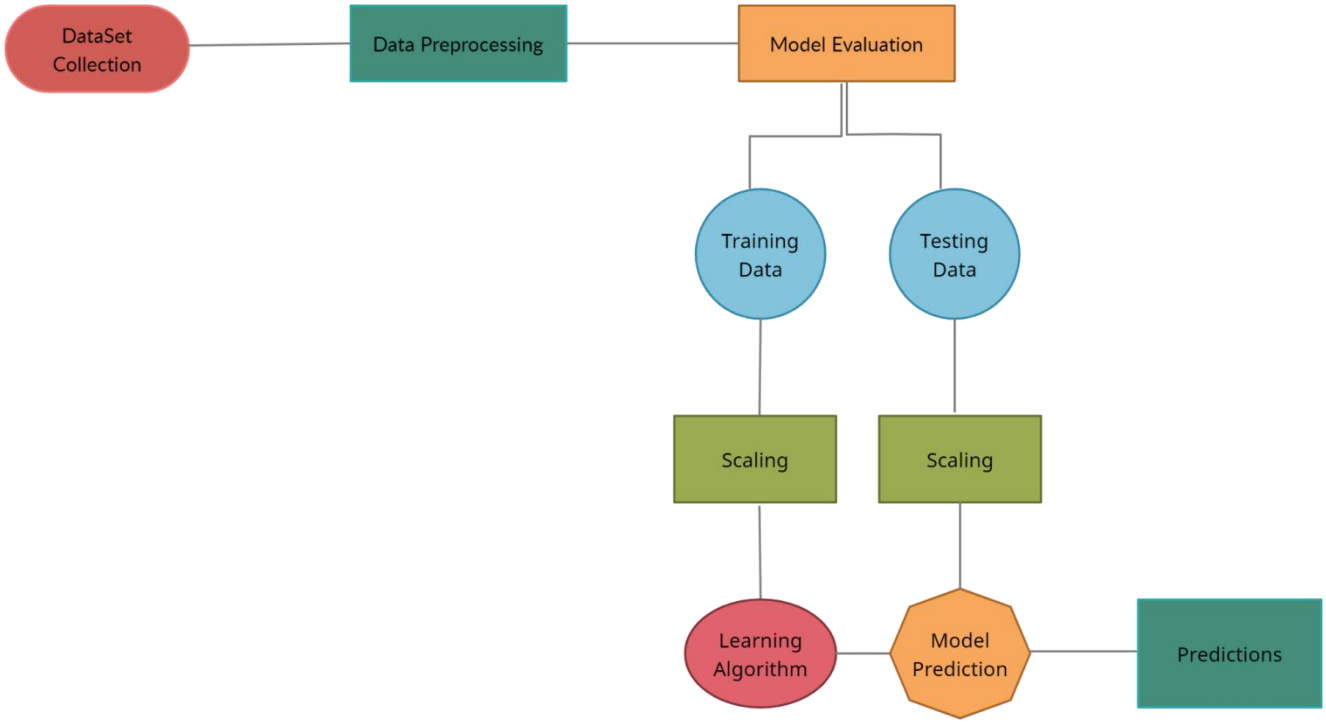


Fig: A figure of work flow of HAR System

C. Model Evaluation

Here, we are using supervised machine learning to recognize activity from dataset records. Designed models are split into training data set and testing data set. The model is first trained with a training data that consists of %80 of the total dataset, and then tested with the rest. We have used two classification algorithms for learning and then considered the best out of them.

Methods used for Classification are:

1. Decision Trees
2. Random Forest

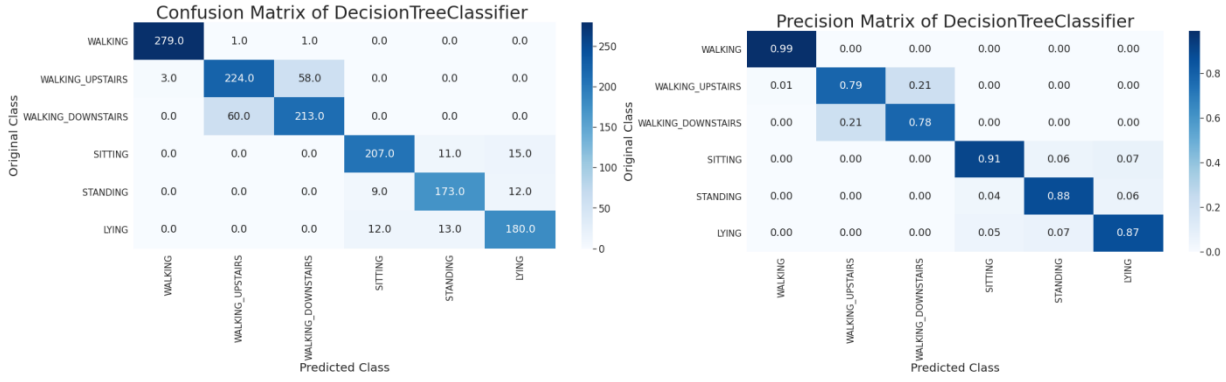
Decision Trees:

Decision trees are based on the logic of dividing complex decisions by features to create simpler ones[3]. The goal of using this algorithm is to create a training model that can be used to predict the class or value of the target variable by learning simple decision rules inferred from prior data. We have used Criterion Parameter as it determines how the impurity of a split will be measured and imputed entropy in it. We use entropy here because as it measures disorder or uncertainty of learning models so that reducing uncertainty will be possible

From confusion matrix we can say that there are 224 positive actions correctly predicted by model.213 are negative actions which are correctly predicted.58 are negative actions which are misclassified and 60 are wrong positive predictions

Here we have calculated precision to how many positive predictions made are correct. In other words, we can also say that calculating true positives

Recall is referred to as sensitivity, which is a measure of how many of the positive cases the classifier correctly predicted.



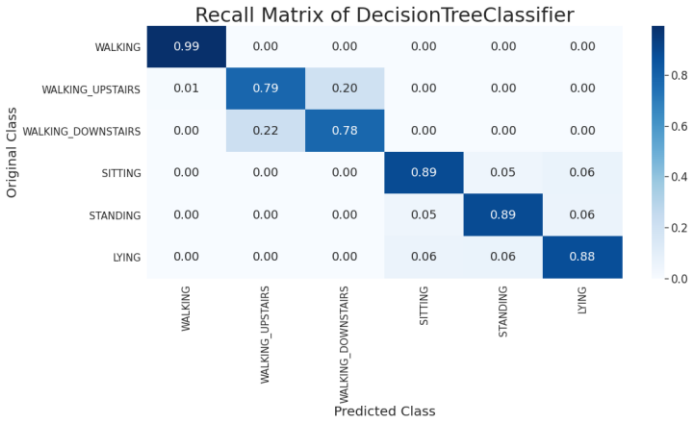


Fig : Fig shows confusion matrix, recall and precision of Decision Tree

Random Forests:

Random forest, consists of many individual decision trees. Each individual tree in the random forest is a class prediction, and the class with the many votes will be our model's prediction.

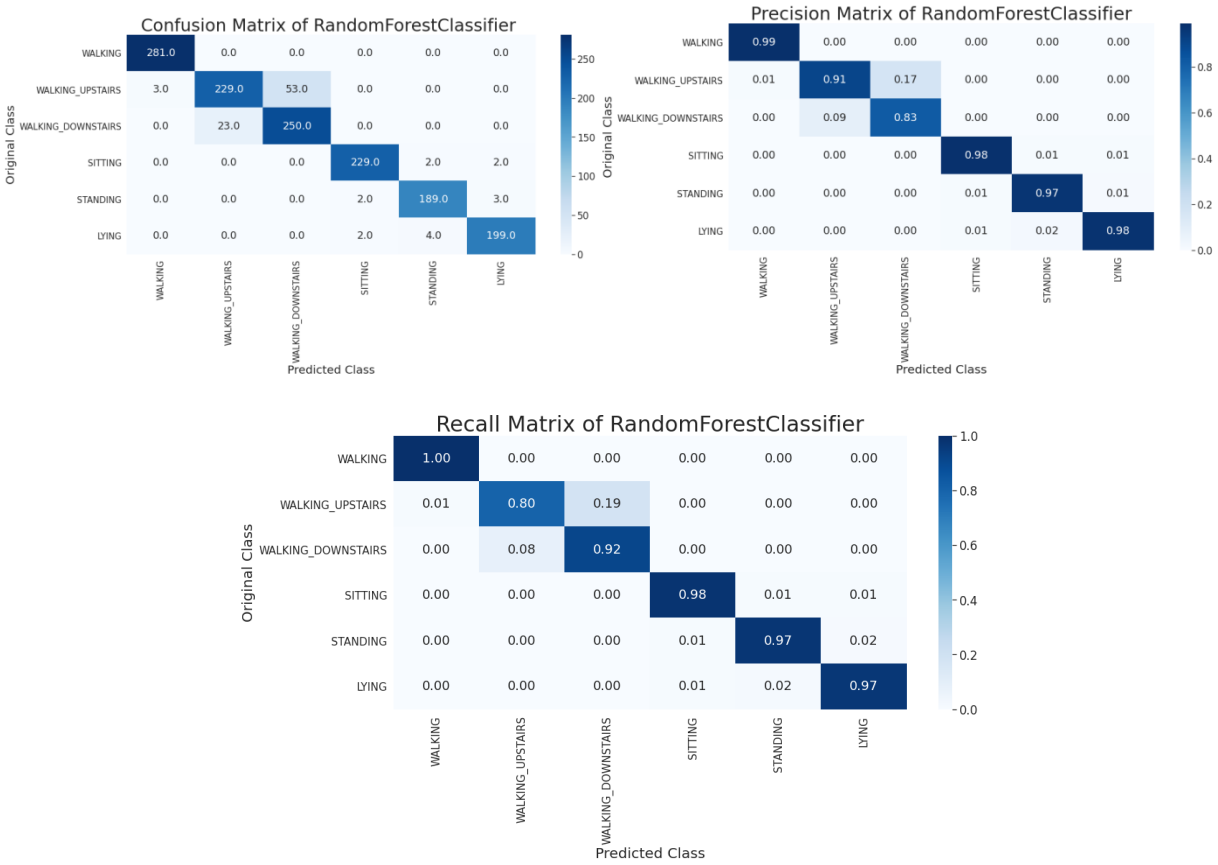


Fig : Fig shows confusion matrix, recall and precision of Random Forest

II. CONCLUSION

In this paper Human Activity Recognition System, we proposed a model trained using different algorithms, While Random Forest is the most precise approach tested in this work with an accuracy of 93%. This work could be improved by increasing the number of activities and Situations to classify and to add data received from other sensors and devices that are commonly used in smartphones to the dataset[3]. This model can be used in various sectors such as Health Sector for monitoring patients and taking preventions before anything happens seriously, Employment sector to monitor an employee to correctly perform the task

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