HUMAN ACTIVITY RECOGNITION USING SMARTPHONES

GUIDE:PROF PRIYA S A

C M SUBHADRA
S4 MCA
TVE20MCA-2053

OVERVIEW

- System to identify human actions using integrated sensors in smartphones.
- There are seven actions that are selected for recognition include:Walking,Sitting,Standing,Jogging,Biking,Walking Upstairs,Walking Downstairs.
- There were 10 participants involved in data collection,performed each activity for 3-4 minutes.
- Each participant is equipped with five smartphones in five body positions.

LITERATURE REVIEW

1. W. Qi, H. Su and A. Aliverti, **"A Smartphone-Based Adaptive Recognition and Real-Time Monitoring System for Human Activities,"** in IEEE Transactions on Human-Machine Systems, vol. 50, no. 5, pp. 414-423, Oct. 2020, doi: 10.1109/THMS.2020.2984181.

- Adaptive HAR is used.
- Creation,Recognition & Online learning modules.
- In creation module-HC classifier to establish 12 original activities.
- In recognition module-HC classifier is implemented for HAR in real time ,carrying smartphones on waist or left pant pocket.
- In online learning module-A new activity is identified in an unsupervised manner which is not included in those 12 activities.

LITERATURE REVIEW

2. K. Nakano and B. Chakraborty, **"Effect of dynamic feature for human activity recognition using smartphone sensors,"** 2017 IEEE 8th International Conference on Awareness Science and Technology (iCAST), 2017, pp. 539-543, doi: 10.1109/ICAwST.2017.8256516.

- Correct recognition of human activities,efficient feature selection from time series data is important.
- Efficiency of dynamic feature over static feature is noted.
- Dynamic feature-Recurrence plot (dynamic behavior of time series data)of accelerometer time series,gyro time series or both together.
- Static feature-Mean value,Standard deviation etc.

EXISTING SYSTEM

- There is very limited number of project that investigate a human activity recognition system built right on the smartphone.
- Major application of this project is in medical field.
- Now a days old age people’s activities are monitored manually.
- Costly.
- Risky.

PROPOSED SYSTEM

- Activities such as Walking,Sitting,Standing,Jogging,Biking,Walking upstairs,Walking downstairs.
- The patients who need the medical assistant can be monitored remotely.
- Identification of human actions, the monitoring health care application will provide medical staff with more crucial information of particular patients for giving warnings.
- This process can be done automatically to reduce the workload of medical institutions.

REQUIREMENTS

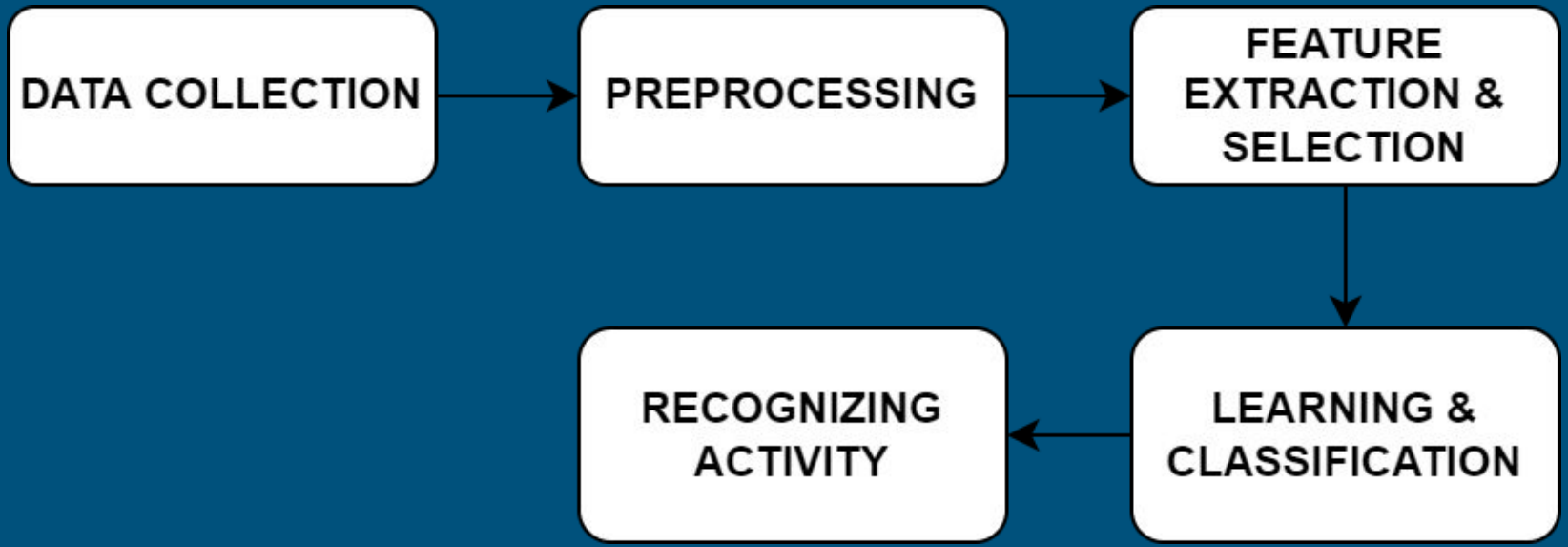
Software requirements

- Front end:Android xml,Java
- Backend-Python
- Machine learning libraries-Numpy,Matplotlib,os,Pandas,Tensorflow

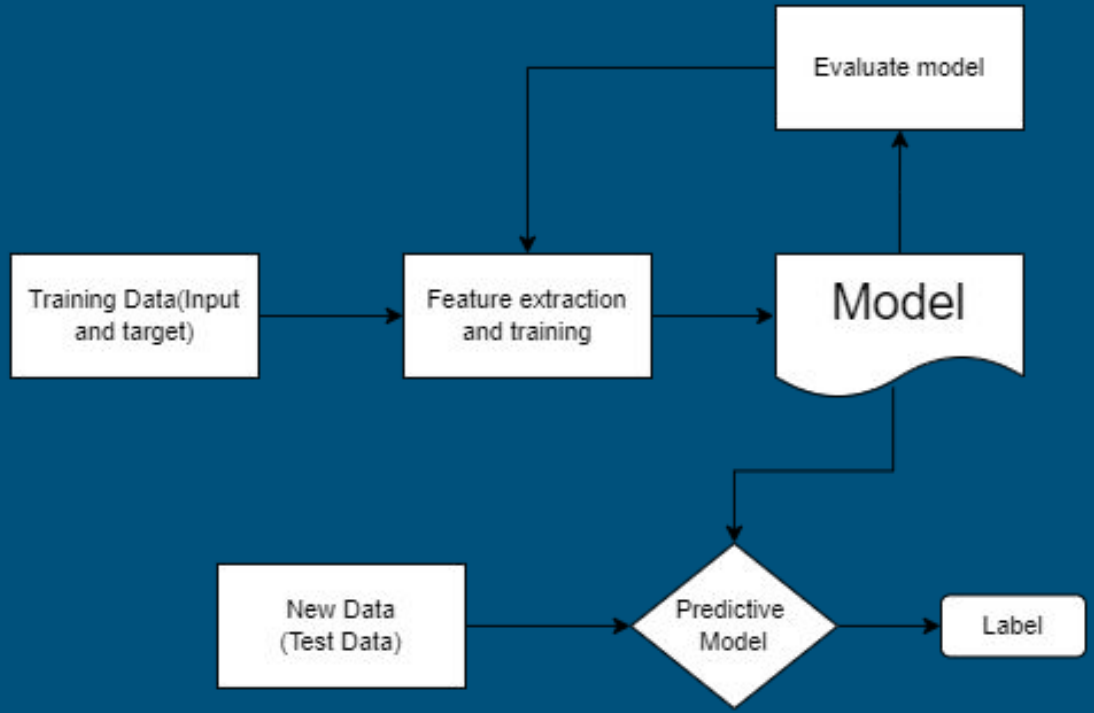
Hardware requirements

- Processor-Any
- Main memory-4 GB or above more preferable
- Android smartphone.

OVERALL DATA FLOW



UML DIAGRAM


Evaluate model
Training Data(Input and target)
Feature extraction and training
Model
New Data (Test Data)
Predictive Model
Label

METHODOLOGY

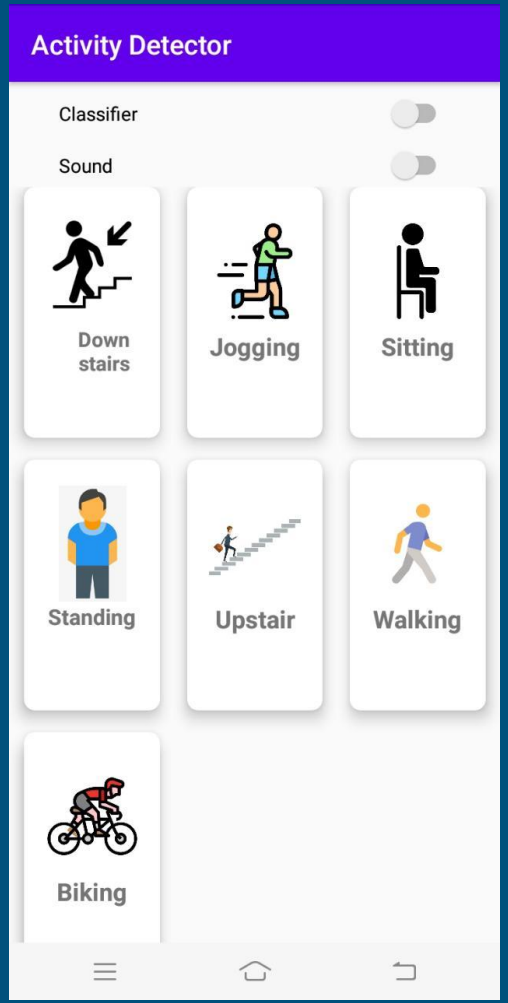
1. Dataset is taken from the smartphone’s sensor values.
2. CNN and LSTM models are created for comparison purpose.
3. LSTM model is taken into the android application.
4. System is tested by performing an activity.
5. Start classification when toggle button named “Classifier” is clicked.
6. Activity is predicted to any one of the 7 activities based on the highest probability.
7. Using TTS ,app sounds the corresponding activity when toggle button labelled “Sound” is clicked..

SMARTPHONE’s BUILT IN SENSORS

I. **Accelerometer** ⟶ Computes the acceleration in m/s2 applied on all three axes (x, y and z), including the force of gravity.
II. **Gyroscope** ⟶Computes the rate of rotation in rad/s around each of the three axes (x, y and z).
III. **Linear Acceleration**⟶ Computes the acceleration force in m/s2 applied on all three axes (x, y and z), excluding the force of gravity.

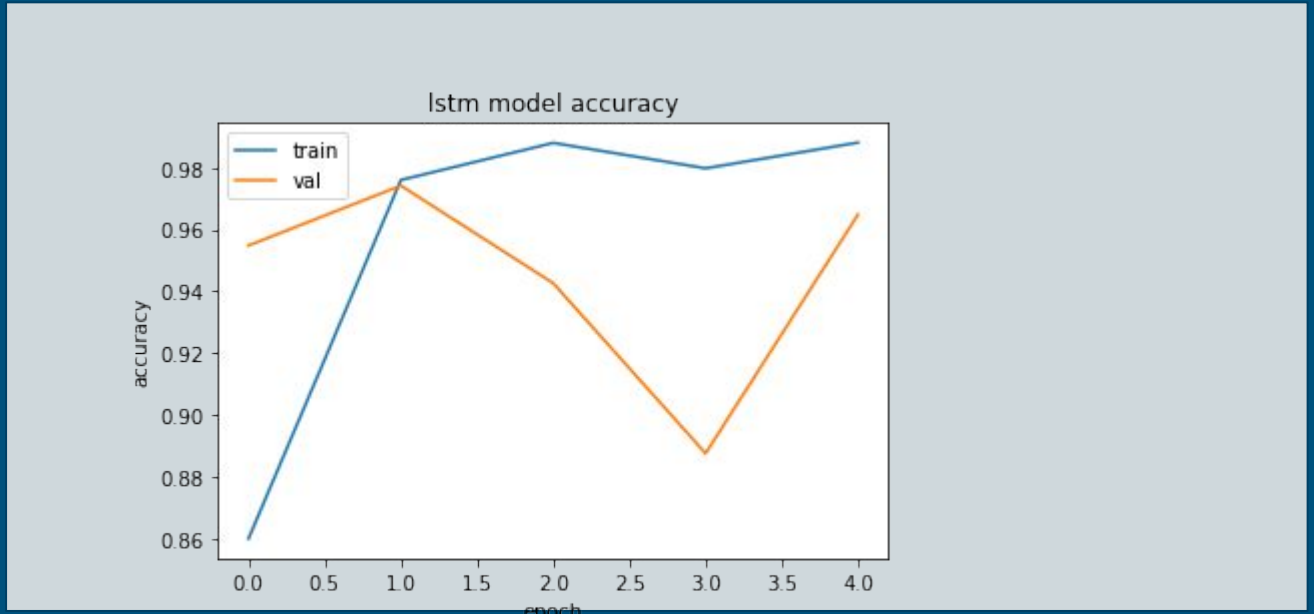
USER INTERFACE

-*Activity Detector*



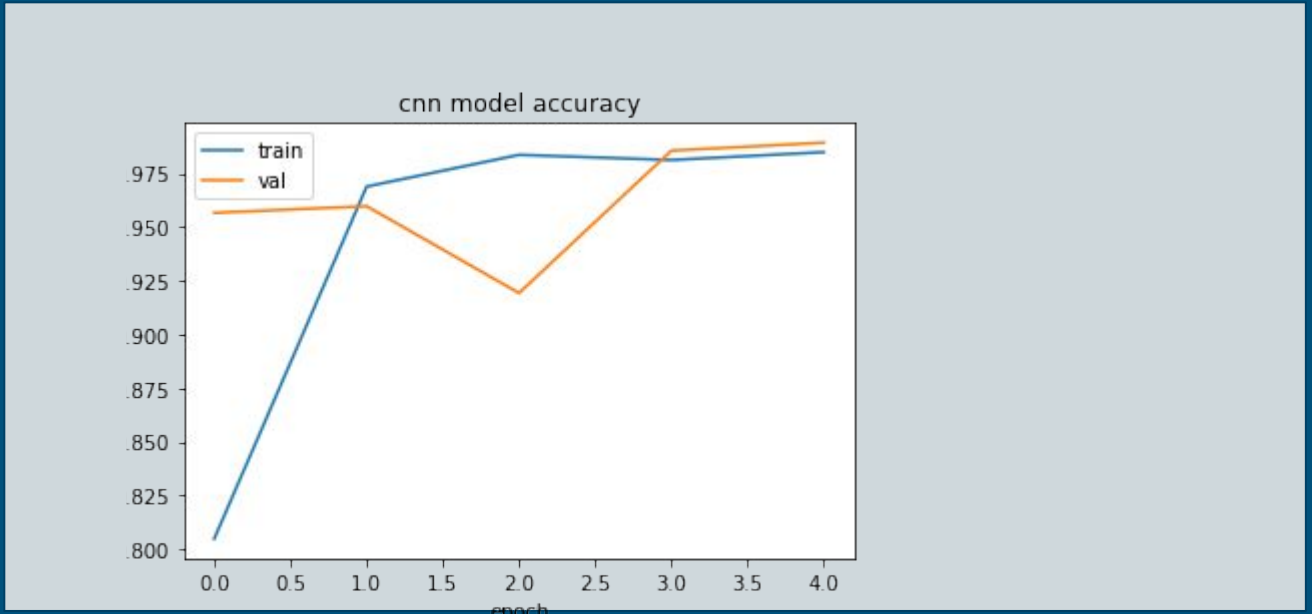
RESULT AND ANALYSIS

- LSTM model has training accuracy of 0.9881 and validation accuracy 0.9648



RESULT AND ANALYSIS

- CNN model has training accuracy of 0.9849 and validation accuracy 0.9893



FUTURE WORK

- This system can be applied in many fields of practice especially health care field.
- One particular application as identification of patient falls, the index measuring applications advocacy.
- The system still has some certain restrictions,percentage of recognition is low in some action.
- In the future, there should be more research to improve the performance and increase the detection capabilities of the system.

Paper Publication

Human Activity Recognition in Android Smartphone Using Convolutional Neural Network

C M Subhadra
Department of Computer Applications
College of Engineering,Trivandrum
Kerala, India
cmsubhu1999S@gmail.com

***Abstract*—In this study, we designed and constructed a system to identify human actions using integrated sensors in smartphones. There are six actions that are selected for recognition include: walking, standing, sitting, lying down, up the stairs, down the stairs. In this system, Support Vector Machine (SVM) is used to classify and identify action. Collected data from sensors are analyzed for the classification model - the model file. The classification models are optimized to bring the best results for the identified human activity. After forming the classify model, the model will be integrated into the system to identify the human activities. Human activities recognition system is written on Windows and Android platforms and operate in real time. The accuracy of the system depends on selected features and the quality of the training model. On the Android system running on smartphone with 248 features achieve 89.59**

***Index Terms*—**

I. Introduction

In the world, the human activities recognition, which use sensors to recognize human actions, have been studied for a long time to produce the more simple system with high precision [1]. However, there is very limited number of project that investigate a human activity recognition system built right on the smartphone. A great advantage of this integrated system is the real time and full time supervision. The human activities recognition built in smart phone promises to open up a new direction not only in monitoring and health care but also in other fields. In fact, the proportion of the population aged 65 and over in the world is projected to grow from an estimated 8 percent of the world's population in 2010 to nearly 16 percent in 2050 [2]. This increase will put the health care institutions under very large pressure, specifically considering the fact the health care cost per capita for persons over 65 years are three to five times greater the under 65 [3]. Thus, medical institutions are actively seeking cost-cutting solutions. The patients who need the medical assistant can be monitored remotely. Through the identification of human actions, the monitoring health care application will provide medical staff with more crucial information of particular patients for giving warnings for accidents such as falling down [4]. This process can be done automatically to reduce the workload of medical institutions. In order increase feasibility of such application, His study focus on some particular activities of human activities recognition include walking, up, down, sitting, standing and laying. Nowadays, smartphone is going to get more popular in the world over the next five years. According to Ericsson mobility report, there will be a massive jump from the 2.6 billion smartphone users recorded in 2014 to 6.1 billion by 2020 [5]. The number of smart devices, which always beside everyone, is quite huge. Moreover, it is built with many sensors to increase the interaction ability for user includes acceleration and gyroscope sensor. Thus, the idea of utilization of these sensors to make a smartphone application for human activities recognition become more realistic. In detail, acceleration sensor measures acceleration in three orthogonal axes. All of objects in the Earth are affected by the gravity. The linear acceleration measures the acceleration effect of the device movement, excluding the effect of Earth's gravity on the device. The gyroscope uses Earth's gravity to help determine orientation of smartphone. The combination of parameters which are collected from these sensors allow to determine the status and the change of physical movement of smartphone in the space. The large collected data provide many important data to recognize the human physical activities.

II. Related Works

A. Support Vector Machine

In the last decades, there were several machine learning methods that can use for classifier and recognition of human physical activities including Naïve Bayes, Support Vector Machines (SVMs), Threshold based and Markov chain [6]. Although there is not any study that can find out the best method for human physical activities classification, but SVMs have been successfully widely used in many research related to handwriting recognition and speech recognition. Therefore, in this study, SVMs method will be used to classify and recognize human activities. In order to find out the best hyperplane for data classification, SVMs search the hyperplane which has the largest margin. Figure 1 shows both two hyperplanes can be divided in two class. However, figure 1.b shows the larger margin between two classes than figure 1.a. The larger margin will help the classification in next modules easier and avoid mistakes as much as possible. Thus, in SVMs

CONCLUSION

- In this project,we designed a smartphone based activity recognition system.
- We can recognize overall seven activities ie Walking,Sitting,Standing,Jogging,Biking,Walking Upstairs,Walking Downstairs.
- The system collected time series signals from the built-in accelerometer,gyroscope and linear acceleration sensor in smartphone.

CONCLUSION

- Features are get selected in order to improve the efficiency.
- The activity data get trained using lstm model and tested.
- When smartphone is placed in left or right pocket amd activities are performed ,it will recognize to any of the seven activities mentioned above.
- The result is conveyed through the android application we created.

REFERENCES

[1] W. Qi, H. Su and A. Aliverti, **"A Smartphone-Based Adaptive Recognition and Real-Time Monitoring System for Human Activities,"** in IEEE Transactions on Human-Machine Systems, vol. 50, no. 5, pp. 414-423, Oct. 2020, doi: 10.1109/THMS.2020.2984181.

[2] K. Nakano and B. Chakraborty, **"Effect of dynamic feature for human activity recognition using smartphone sensors,"** 2017 IEEE 8th International Conference on Awareness Science and Technology (iCAST), 2017, pp. 539-543, doi: 10.1109/ICAwST.2017.8256516.