Group 4: Human Activity Recognition System using Smartphone Sensors

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Abstract

We propose different machine Learning and Deep Learning models that predicts the human activities such as Walking, Walking Upstairs, Walking Downstairs, Sitting, Standing or Laying. And by Comparing different machine learning model and deep learning model we got overall accuracy of 91.31%.

1 Introduction

1.1 Overview

HAR is the ability of a system to detect and identify specific human activities with the data collected through a sensor or camera. Digital images and videos from cameras are at the core of computer vision based HAR. Unfortunately, data collected through cameras has disadvantages including the inevitable capture of non-human activities that may be occurring in the background. Sensor data does not have these limitations, and therefore is a more promising way to collect human activity data. Inertial sensors which can provide accelerometer and gyroscope data have been used to collect human activity because of their small size, low energy consumption, and non-intrusiveness on subjects.[1]

1.2 Motivation

The emerging ubiquitous mobile and sensor-rich devices have led to higher de-mands for the human action recognition (HAR). Some of the major applications which are benefited from HAR, are daily lifelogging, healthcare, senior care, per-sonal fittings and etc.

2 System Design

We have used the accelerometer and gyroscope Sensor data which is preprocessed and then sampled in fixed-width windows of 2.56sec each with 50% overlap.We perform some exploratory data analysis to get better data insights.and data was split in the ratio of 70:30, where the training set contains 70 % of the data and test set contains 30 % of the data.For training the model, different ML and DL techniques were used employed with different optimization techniques. ML algorithms used for training the model are Logistic Regression,SVM,Random Forest and Decision Trees.The DL methods we included are Artificial Neural Network (ANN), Convolutional Neural Network (CNN), Long-Short-Term Memory (LSTM), CNN-LSTM.After the model classifier was built, the test set held aside was used to make final predictions.

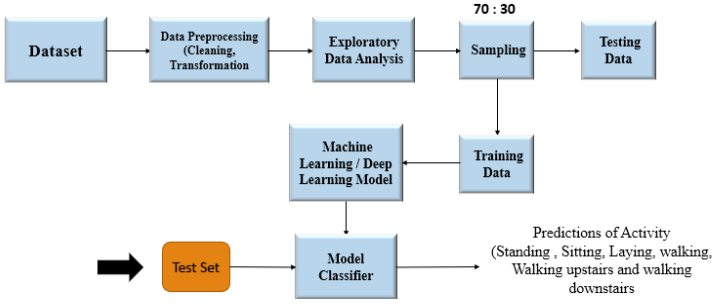
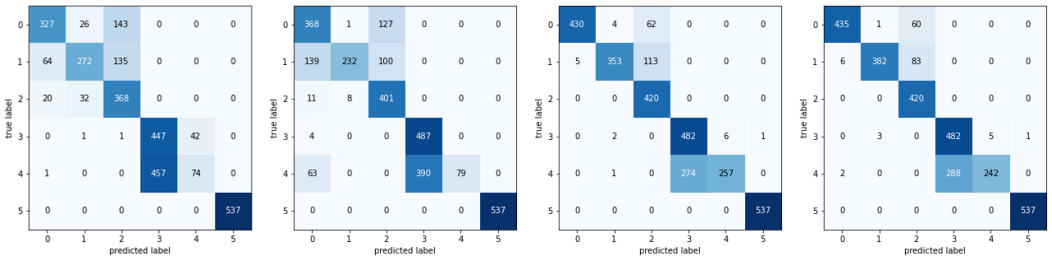


Figure 1: Proposed Framework

3 Evaluation

The models was evaluated using different metrics like accuracy, precision, recall, and F1 score. A confusion matrix was also made for algorithms to consider the difference between actual and predicted labels.
As we can see in table 1 we have got maximum accuracy of 91.31% using CNN-LSTM Model and from the confusion matrix of ML and DL models we have concluded that the models mostly confuse between sitting and standing Activities.



((a)) Decision Trees ((b)) Random Forest ((c)) SVM ((d)) L.R Model

Figure 2: Confusion Matrix of ML Models

ML & DL Models	Accuracy	Training Time
Decision Trees	68.7%	14.78sec
Random Forest	71.39%	42.27sec
SVM	84.11%	2.64sec
Logistic Regression	85%	4.77sec
LSTM	89.45%	19min 43 sec
ANN	88.3%	21sec
CNN	91.04%	8min 51sec
CNN-LSTM	91.31%	39min 30sec

Table 1: ML AND DEEP LEARNING MODELS RESULTS

4 Individual Contributions

Each member in the group have contributed equally while working in the project. Table 2 shows individual contribution of group members.

Table 2: Individual Contribution in project

Name of the Member	Contribution in project
Rakesh	Exploratory Data Analysis , Trained logistic regression model and 1-D LSMT DL Model.
Ayushi Mishra	Trained Decision Trees,Random Forest ,SVM ML models and ANN , CNN, CNN-LSTM DL MODELS.

References

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[2] Ronao, C.A.,& Cho, S.B.(2016). *"Human activity recognition with smartphone sensors using deep learning neural networks"*, Expert Systems with Applications, 59, 235-244. https://doi.org/10.1016/j.eswa.2016.04.032.

[3] Hassan, Mohammad Uddin, Md. Zia Mohamed, Amr Almogren, Ahmad.(2017). *"A robust human activity recognition system using smartphone sensors and deep learning"*, Future Generation Computer Systems. 81. 10.1016/j.future.2017.11.029. https://doi.org/10.1016/j.future.2017.11.029.