Recognition of Human Activities Using Rain Forest Algorithm with Smartphone Sensors

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Abstract- *Improving people in everyday life, be it lifestyle improvement or health care, requires the recognition of their activities. There have been a number of methods of measuring physical activities, such as self-reporting, attaching wearable sensors, etc. Since a smartphone has become widespread rapidly, physical activity can be easily measured by accelerometers in the smartphone. There are six actions that are selected for recognition that include: walking, standing, sitting, lying down, up the stairs, down the stairs. Although there were a number of studies for activity recognition exploiting smartphone acceleration data, this paper aims to increase the precision and accuracy of recognition of activities by using much better and efficient machine learning algorithm, The Rain Forest Algorithm.*

Keywords- Accelerometer, Data Acquisition, environment, Human activities, Precision, Recognition, Sensors, Smartphone .

I. INTRODUCTION

In wellbeing, healthcare, and sports monitoring, it is often important to capture the activities being performed by the subject. A detailed recording of the daily activities performed by the subject is important for many reasons, such as better understanding of wellbeing, knowing the activity being undertaken by a patient for diagnosis of pathologies, or identifying
training activities for athletes. Smartphones are been widely used by almost everyone not just for calling, as name suggests they are getting more and more smart. Embedded sensors in them are serving huge purpose of not just sensing real time attributes but also making productive and efficient use of this data in today's world of big data for the betterment of lifestyle, healthcare, sports etc. Its built in with many sensors like accelerometer and gyroscope to increase the interaction ability with the user. Thus, the idea of utilization of these sensors to make a smartphone recognize human activities becomes more realistic. This technology has the potential to promote the development of assistive technologies, for example helping the elderly people to live a better life. The human activities recognition, uses sensors to recognize human actions, to produce more simple and handy system with high precision.

II. METHODOLOGY

There are two main steps involved in designing a model :

- **Training**
- **Testing**

Human Activities Recognition System are formed from various functional blocks. Each block performs a different task for training process and identifying actions. The human activities recognition system consists of four main functional modules:

- Data acquisition and data processing module
- Feature extraction module
- Training module
- Human activities recognition module.

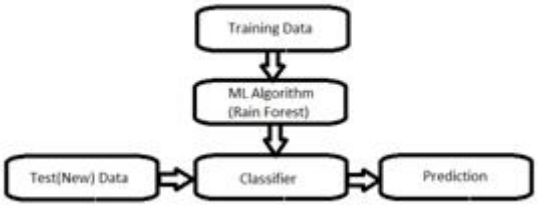


Fig 1.1

1. Training Environment :

A. Data acquisition & data processing:

This module collects data and processes signal from the users smartphone sensor modules performing the human activities. This block consists of two main components, the controller (as a software running on a Windows computer or on a smart phone) and a data

recording device (smartphone). In order to execute the data acquisition process, this module is implemented in two steps.

Step 1: establishing a connection between the controller and the data recording device.

Step 2: Turn the control signal to start the gathering process.

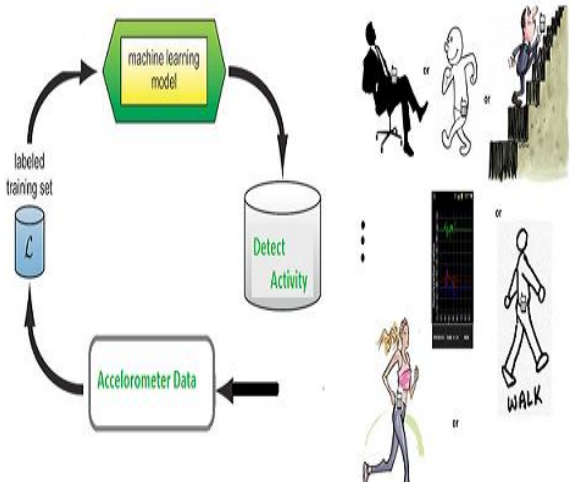
B. Feature Extraction :

The raw data collected from the sensor cannot be used directly for machine learning algorithm. Thus, a module, which conducts calculation for feature extraction and converts raw data to training samples, needs to be implemented. Those samples have the proper structure according to the requirement of machine learning algorithm. Data is collected from 2 types of sensor: gyro sensor and tri-axial accelerometer sensor. Each sensor returns three values corresponding to three dimensional x, y, z. The sensor runs at 50Hz (collecting 50 values per second) to store raw data in units of sample. Each sample includes 128 values corresponding to each sample time record of 2.56 seconds.

Table 1.1

Mean	Normal statistical mean
Standard Deviation	Normal statistical Standard deviation
Mad	Average of standard deviation
Max	Maximum
Min	Minimum
Energy	Energy of signal
Entropy	Entropy of signal

These features in table 1.1 calculated in the time domain. There are two version of this system include MATLAB version for testing in PC and Android version for implementation in a smartphone. In MATLAB, total 561 features calculated. On other side, Android version has 248 features. The raw data collected from 10 volunteers aged from 19 to 48. All of them have normal health status. The phone placed in their pocket.



C. Training :

Training converts extracted features to the recognition model, which is used as a template for activity recognition. Results of recognition needs to be analyzed and compared to find out the fault location as well as features that are calculated from those faults in order to adjust the calculation to achieve better recognition model.

D. Recognition :

To design the system for real time operation, the recognition module has to be processed in a short time of 3-5 seconds. In particular, this period of time includes the time of writing data and the time of recognition for activity. Writing data module and processing data from sensor module will record data for 2-3 seconds (128 values from each sensor). The amount of data will be processed through the features extraction module. These features are calculated in time domain over time. Totally, thus 248 features are calculated. Then, these features are recognized with the training model, which is obtained from training module. Recognition results can be displayed to the user on a PC which can be further sent for application like to a healthcare or elderly people doctor where its not feasible for a doctor to always be around a patient and keep a track of all physical activities or in sports for stamina analysis or fitness analysis etc of a sports person. Due to the requirement of continuous activity recognition, the calculation has to be done in parallel with the process of writing data, which is used for the next recognition.

2. Testing Environment :

The experiment to be carried out on 10 volunteers aged 19-48, having normal health. Each volunteer performing six basic activities. The process of data collection controlled by a computer program, and data named separately to manage,

store. Data accompanied y information on the action name, the name of volunteers and time data logging. Then data to be randomized into two data sets: 70% for the training, 30% for the inspection process. The training will be done by machine learning algorithm. Samsung S2 used for this test (any smartphone can be used though). Smartphones contain two essential sensor including accelerometer sensor and gyroscope. The sensor data recorded at 50Hz, suitable for recording data on human activities. For the process of identification, an application on smartphones running Android OS to be developed. The process begins by identifying the collection of raw data from the sensor. This data to be divided into small data samples, each sample as a sequence of 128 values corresponding to the time of collection of 2.56 seconds. Then this sampled data to be sent for characteristic calculation. Finally these characteristics to be compared with the set of trained characteristics to identify the action and classify accordingly.

III. CONCLUSION

Thus, designing a simpler system to recognize human activities which are necessary in life for the betterment of lifestyle, healthcare and fitness. Smartphones used to collect all the required data with the help of inbuilt sensors and then rain forest algorithm implemented so as to yield recognition of activities with an aim to increase accuracy and precision of recognition than earlier work by using more efficient algorithm The Rain Forest Algorithm.

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