3: Methods

The proposed method for recognizing human activities is presented in Figure 1 and detailed below. The method is divided into four stages: (I) Preprocessing (II) segmentation of data with window size (III) features extraction (IV) human activities classification.

Data acquisition is detailed in Section 3.1. Once the data has been collected, the acceleration signals are preprocessed and segmented (see Section 3.2). Finally, descriptive features are extracted from signals to classify the human activities, as it is detailed in Section 3.3.

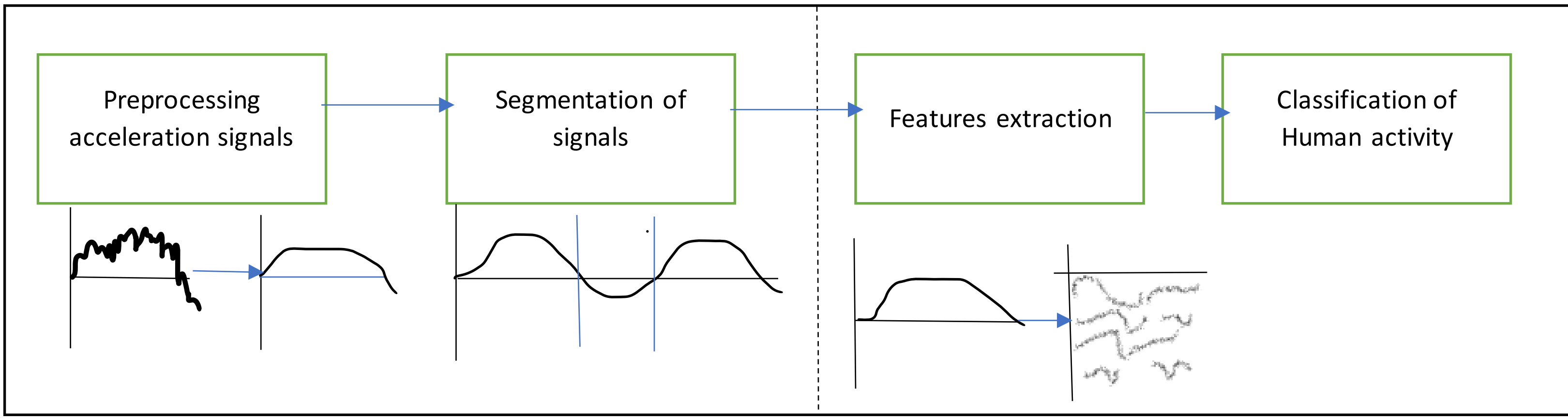

Figure 1. Proposed human activity recognition method.

3.1. Data acquisition:

Depending on accelerometer sensor in smart phones, we create a flutter application that acquiring acceleration data.

Five test subjects (21-22 years) carry smartphones in their right pocket where top of the smartphone is in the bottom of pocket and smartphone's screen faced their bodies during the capture sessions.

The human activities to be performed were: (I) Walking, (II) Going downstairs, (III) Going upstairs, (IV) Standing, (V) Sitting. The test was performed around NNN times at speed comfortable. The environments to carry out the activities were mixed between indoors and outdoors.

3.2 Preprocessing

At this stage acceleration signals are captured during the test then it has been processed through two techniques: (I) Filtration, (II)Smoothing

Filtration techniques depends on low-pass filter that applied to the acceleration signals x, y, z, using the coefficient a which filters the highest frequencies, the value of a was manually selected at ####. The purpose pf the filter to avoid artifacts due to movement and to decrease noise in acceleration signals.

Gaussian smoothing function is applied to filtered signals through using of gaussian_filter1d function from SciPy library. By giving gaussian_filter1d function acceleration data x, y, z, then sigma value to get smoothed data

Filter Algorithms:

Inputs: x, y, z. a: filter coefficient.

Output: smoothed signals

Start

Fn Filter (signals):

Set coefficient of filter (a),

Set values of signals into list (S),

Set empty list (X)

For i←0:Size(S) do

If i==0:

Append (a*S[i]) in list X

Else:

Append ((1-a) * X[i-1] +a * S[i]) in list X

Return List X.

End

3.2 Signal Segmentation:

As Classification algorithm cannot directly applied to the raw time-series data. Using of Windowing techniques in which dividing data into windows of # second and then generating new feature by aggregating new sample contained within # seconds. for assigning label against the transformed feature we take the most frequent activity in the window

Windowing techniques Algorithms:

Start

Declare lists x_list, y_list, z_list, label_list

Set window size

Set step size

For i←0 in Size(length of rows in data – window size) with step size:

X=values of x acceleration signal

Y=values of Y acceleration signal

Z=values of Z acceleration signal

Label= from label select mode value

Append X in x_list

Append Y in y_list

Append Z in z_list

Append Label in label_list

End

Section 3.3: Features Extraction:

For each window results from Section 3.2. Feature Extraction applied to extract about 18 Features:

I. mean
II. standard deviation
III. average absolute deviation
IV. minimum value
V. maximum value
VI. difference of maximum and minimum values
VII. median
VIII. median absolute deviation
IX. interquartile range
X. negative values count
XI. positive values count
XII. number of values above mean
XIII. number of peaks
XIV. skewness
XV. kurtosis
XVI. energy
XVII. average resultant acceleration
XVIII. signal magnitude area

Section 3.4 Classification:

Finally, in this section the features extracted are used to build human activity classifiers. Five algorithms were selected which are I) Support Vector Machines (SVM), II) Random Forest, III) Decision Tree, IV) K-Nearest Neighbors(KNN), V) Naive Bayes (NB).