

Ph.D Research Proposal

Submitted by

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MACHINE LEARNING BASED METHODS FOR HUMAN ACTIVITY RECOGNITION

Abstract:

Human Activity Recognition (HAR) has been a challenging problem yet it needs to be solved. It will mainly be used for eldercare and healthcare as an assistive technology ensemble with other technologies like machine learning and Internet of Things(IoT). HAR can be done with the help of sensors, smart phones or images. Activity recognition system can be adopted in a smart home health care system to improve their rehabilitation process of aged persons. There are various ways of using different sensors for Human Activity Recognition. Through wearable sensors it provides valuable information about an individual's degree of functional ability and lifestyle. There are various challenges and issues in recognizing human activities like scalability, time and accuracy. There has been a widespread use of conventional techniques available for human activity recognition. Despite being an active area of research for more than a decade, most of the existing approaches require extensive computation to extract feature, train model, recognize activities and less accuracy and still needs improvement. Machine learning techniques provides solutions to meet the challenges and issues in various applications. Hence in this work, machine learning based methods for Human Activity Recognition is proposed.

Introduction

The field of Human Activity Recognition (HAR) has become one of the trendiest research topics due to availability of sensors and accelerometers, low cost and less power consumption, live streaming of data and advancement in computer vision, machine learning, artificial intelligence and IoT. In HAR, various human activities such as walking, running, sitting, sleeping, standing, showering, cooking, driving, opening the door, abnormal activities, etc. are recognized. The data can be collected from wearable sensors or accelerometer or through video frames or images. HAR can be

extensively used in medical diagnosis. For keeping track of elderly people, HAR can be used. Crime rates can be controlled using HAR by monitoring. The smart home environment can be created by the daily activity recognition. Driving activities can be recognized and lead to safe travel. Military actions can be recognized using HAR.

HAR aims to recognize the actions and goals of one or more persons from a series of observations (sensor data) on the human actions and environmental conditions.

HAR is an important and popular research in various application areas include;

- ▶ Continuous monitoring of daily human behaviors (Walking, cycling, running, jogging, jump front and back, climbing stairs, standing, Driving, lying down, knees bending, talking and sitting)
- ▶ Simple and complex activities detection
- ▶ Abnormal behavior detection
- ▶ Surveillance systems
- ▶ Personal fitness assistant and
- ▶ Assist elderly people.

Statement of the problem

The proposed system basically consists of three main parts: Sensing, Feature extraction, and recognition. The first part is sensing. It collects data from various sensors as input to the HAR system. For this work, three prominent sensors in smart phones have been selected for data collection: triaxial accelerometers, magnetometer and gyroscopes. In the second part the essential features are extracted from the HAR dataset. Finally, the human activity is recognized using proposed machine learning methods.

Literature Review

Research in any field needs review of literature. This section discuss various recent literature related to human activity recognition;

Abdulhamit Subasi, Kholoud Khateeb, Tayeb Brahim and Akila Sarirete[1], represented machine learning methods to recognize human activities using wearable sensors located in different parts of the body. The performances of the classifiers were evaluated in terms of total classification

accuracy, F-measure, ROC area, and Kappa measures. The best level of accuracy for SVM shows 99.43% which is the best among all the selected classification methods.

Md Osman Gania et.al[2] presented a computationally efficient smartphone based human activity recognizer, based on dynamical systems and chaos theory. A reconstructed phase space is formed from the accelerometer sensor data using time-delay embedding. A single accelerometer axis is used to reduce memory and computational complexity. A Gaussian mixture model is learned on the reconstructed phase space. A maximum likelihood classifier uses the Gaussian mixture model to classify ten different human activities and a baseline. One public and one collected dataset were used to validate the proposed approach. Data was collected from ten subjects. The public dataset contains data from 30 subjects. Out-of-sample experimental results show that the proposed approach is able to recognize human activities from smartphones' one-axis raw accelerometer sensor data.

Liyakathunisa Syed , Saima Jabeen, Manimala S., Abdullah Alsaeedi[3] proposed a smart healthcare system for ambient assisted living using Internet of Medical Things, Big Data Analytics and by employing Machine Learning algorithms. The purpose of this research is to predict the physical activities of the subjects under observation in order to assist them for healthy living. IOMT the future development of technology is deployed in order to interconnect wearable sensors, patients, healthcare providers and caregivers via software and communication technology. Promising results are obtained with 97.1% accuracy of the classification model to predict the 12 physical activities of the subjects under observation. Further each physical activity has very high precision and recall accuracy, from the 12 physical activities, 10 activities were predicted with minimum and no confusion, which means that classifier predicted the activities correctly and relevant results were returned.

Mohammed Mehedi Hassan , Md. Zia Uddin , Amr Mohamedc, Ahmad Almogren[4] presented A robust human activity recognition system using smartphone sensors and deep learning in which a smartphone inertial sensors-based approach for human activity recognition. Efficient features are first extracted from raw data. The features include mean, median, autoregressive coefficients, etc. The features are further processed by a kernel principal component analysis (KPCA) and Linear Discriminant Analysis (LDA) to make them more robust. Finally, the features are trained with a Deep Belief Network (DBN) for successful activity recognition.

Abdulhamit Subasi, Dalia H. Dammas, Rahaf D. Alghamdi, Raghad A. Makawi, Eman A. Albiety, Tayeb Brahim, Akila Sarirete [5] proposed here a novel approach for activity recognition using wearable sensors. The results demonstrated that the proposed system has been checked for

seven different physical activities and 99.9% an overall accuracy has been achieved by using Adaboost with random forest.

Min-Cheol Kwon and Sunwoong Choi[6], proposed a human activity recognition system that collects data from an of-the-shelf smart watch and uses an artificial neural network for classification. The proposed system is further enhanced using location information. They considered 11 activities, including both simple and daily activities. Experimental results show that various activities can be classified with an accuracy of 95%.

Proposed Methodology

The proposed machine learning approach aims to improve; energy efficiency, computational complexity and accuracy. It can support; clinical diagnosis, severity estimation and prediction of adverse events. It provides good decision support for doctors and improve the rehabilitation of patients.

The main purpose of this work is to develop healthcare human activity recognition system based on sensor's data collected from various sources. It seems very feasible to use smart phones for activity recognition as the smart phone is one of the mostly used devices by people in their daily life not only for communicating each other but also for a very wide range of applications, including healthcare. Plan to focus on more features and learning for more efficient and complex activity's recognition in real time environment.

Data Mining techniques such as pre-processing, association rule mining, classification, outlier detection and clustering can be used to solve the issues and challenges. Machine learning algorithms can be used to find the physical activities of human with high accuracy. Machine Learning techniques like decision trees, K-nearest neighbors, Support Vector Machines, Hidden Markov Models also can be used.

The proposed method aims to recognize different movements and types of actions simultaneously. Based on the shape and features human actions will be recognized using machine learning classification model. The figure 1 shows the proposed machine learning model.

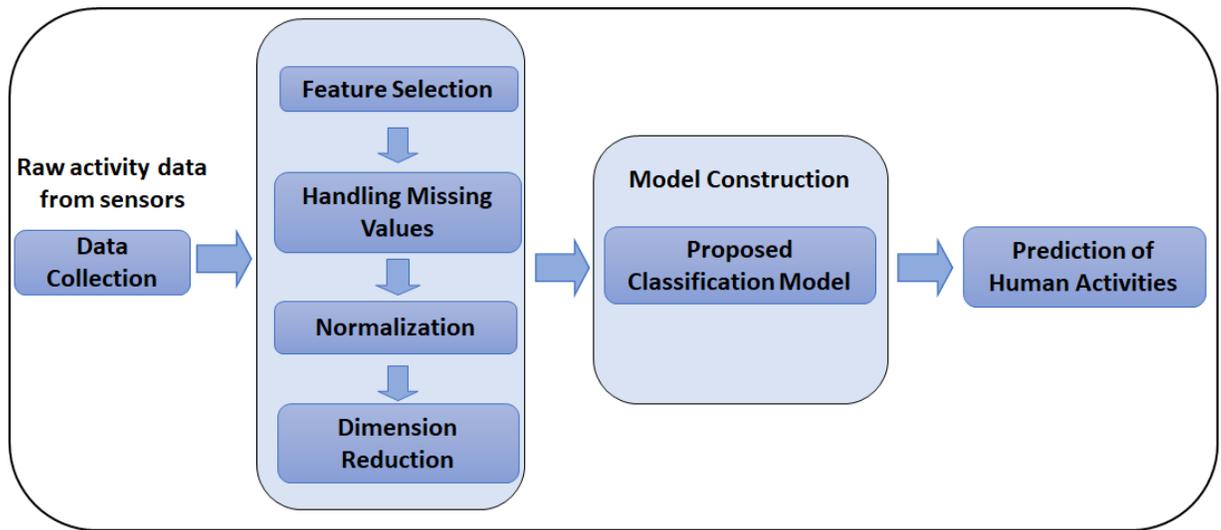


Fig1. Proposed Model

The steps involved in proposed method are collecting dataset, preprocessing (Feature selection, Application of features, Handling missing values, Normalization, Data reduction), classification model and Recognition of Human activities. The soft computing techniques may also can be used for construction of proposed model.

Tools of Data Analysis

Different datasets are used for each of the methods wherein the data are collected by different means such as sensors, images, accelerometer, gyroscopes, etc. and the placement of these devices at various locations. M-health Datasets collected from UCI machine learning repository[7][8][9], mobile and wearable (Smart Phone, Band, elastic straps, Watch and Smart Belt) body sensor high dimensional data can be used. Real time datasets collected from patients / Hospitals can also be used.

Different performance evaluation metrics such as Confusion Matrix, Precision, Recall, F1 measure, accuracy, sensitivity, specificity can be used to validated the proposed method.

References

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