**CHAPTER - 1**

**INTRODUCTION**

**1.1 Motivation and Goal:**

With the advancement of technology, machine learning and deep learning methods are being applied in numerous fields. Among these Human activity recognition (HAR) has been the one of the most significant topics in the active research field. Human activity recognition intends to monitor, recognize the activity of a person based on series of observations and surrounding environment. In easy words, HAR technology is used in recognizing human daily activities, from simple activities like standing, sitting, walking upstairs, running to complex activities like cooking while standing, watching TV while sitting or lying [1].

Human activity recognition, due to availability of devices and wearable sensors in low cost has become an integral part of people’s daily lives and is being applied broadly in common domains like health management - elderly monitoring, disease prevention, rehabilitation, in the idea of smart cities – domestic activity monitoring. Furthermore, HAR is applied in security concerns like through individual activity monitoring solutions, crowd anomaly detection. Besides, wearable and inertial sensors combined with embedded systems are being used in sports activities [2,3].

In this project our goal is to develop a model to recognize daily and simple human activities real time. For simplicity our goal is to recognize 6 activities and we used 2 types of sensor data for this (3-axis accelerometer and 3-axis gyroscope).

**1.2 Approaches to human activity recognition**

In order to recognize human activities, different methods maybe applied. Methods and way of approaching may vary from, type of collecting data and data processing to detection approaches. Based on collecting activity data, HAR can be divided into two types:

1. Computer Vision based
2. Sensor based

**1.2.1 Computer Vision based approach**

In computer vision based approach, images and videos are collected by means of optical sensors like cameras, CCTVs and then captured images or videos are analyzed. Vision based data being affordable and collectible hardly with any trouble, vast majority of researches have been conducted on vision based HAR [4]. Besides, contact based like wearable sensor based approach sometimes requires sophisticated equipment and also it has to be affordable in cost, correct size and also the user’s acceptability. Moreover, vision based system will not require the user to wear devices uncomfortable to them in different parts of the body. In this type of approach mainly three stages are followed which includes – 1. detection (first stage), which determines the part of the body to recognize or follow (methods like using skin color, shape, pixel values etc. are used), 2. Tracking (second stage), where link between successive images are provided (methods like feature tracking, contour tracking, optimal estimation etc. are used) and 3. Classification, which is the final stage, and where different machine learning and deep learning algorithms are used to finally recognize the activity [5].

**1.2.2 Sensor based approach**­

As mentioned, human activity recognition can be carried out in a sensor based approach. Sensors of different kinds are used in data acquisition for the recognition to be performed. Sensors can be integrated in a device or can be used separately. Based on the platforms used, sensors can be:

1. Wearable Sensors
2. Smartphone Sensors

**(a) Wearable Sensors:**

This type of sensors is used for only one particular purpose/function. These can’t take any other measurements other than the ones these are made for. Usually these sensors are integrated into a device used for the given task only. Wearable sensors can further be classified into more types – *Inertial sensors* include accelerometer, gyroscope, magnetometer, *Physical health sensors* includes heart rate sensors(HR), skin temperature, oxygen saturation (SPO2) etc., *Environmental sensors* include, temperature, barometer, humidity, light sensors etc. Sometimes these wearable sensors are not used in applications, for example in human activity recognition due to size, price and acceptability to carry by the user [6].

**(b) Smartphone Sensors:**

Since smartphones, as well as smartwatches, are easy to carry and use, they are used widely to collect data. Today smartphones and smartwatches are embedded with sensors like accelerometer, gyroscope, barometer, GPS, temperature etc. Smartphones and watches are now also used in other fields alongside human activity recognition, like, health monitoring, monitoring sports activities etc. [3,6].

**1.3 Challenges in sensor based human activity recognition:**