CHAPTER 1

INTRODUCTION

1.1 Introduction to Gesture Recognition

Gesture recognition is the mathematical interpretation of a human motion by a computing device as shown in Figure 1.1. Modern research of the control of computers changes from standard peripheral devices to remotely commanding computers through speech, emotions and body gestures.
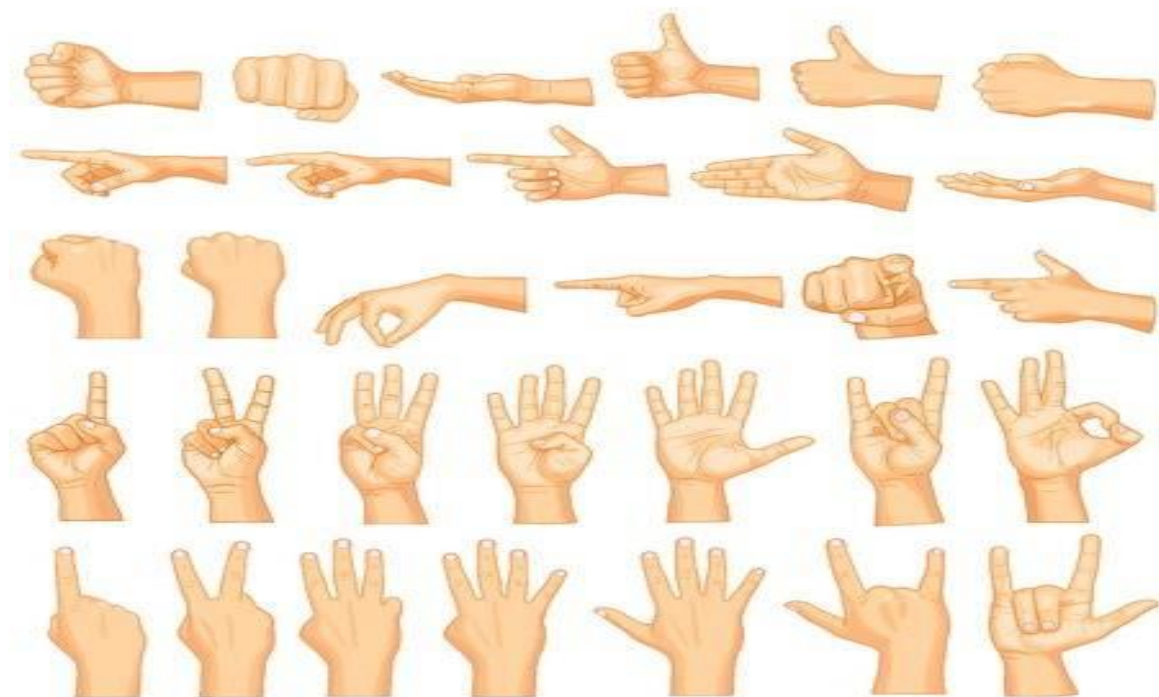
Figure: 1.1 Different types of Hand gestures

Hand gesture recognition is extremely important for human-computer interaction (HCI), and it is one of the very active research fields in recent years because of its powerful means of communication among humans. And it has been used in different applications and also implemented on different platforms such as mobile phone and so on.

The design of gesture recognition system can follow either a client-side or a server-side paradigm. The difference between them lies in whether the data is being transmitted from the mobile device to some remote computer for processing. Using embedded sensors has the advantage that all three, capturing, training and classification of the detected gestures, can be done in the own device. This approach scales well with the number of mobile devices that are running the system simultaneously and is also more appropriate for applications

that require mobility, as its operation is not dependent on connection to a server. However, gesture recognition on a mobile device presents a specific set of challenges, such as the need of realtime execution and low energy consumption, in order to run efficiently on platform highly constrained in terms of cost and system resources (including battery, computing power and storage space).

1.1.1 What is Gesture

A gesture is a form of non-verbal communication or non-vocal communication in which visible bodily actions communicate particular messages, either in place of, or in conjunction with, speech. Gestures include movement of the hands, face, or other parts of the body. Gestures are one of the most important modes of communicating with computer in an interactive environment. Recent advances in computer vision and machine learning have led to a number of techniques for modeling gestures in real-time environment. Gesture recognition is a topic in computer science and language technology with the goal of interpreting human gestures via mathematical algorithms. Gestures can originate from any bodily motion or state but commonly originate from the face or hand. Gesture recognition is a type of perceptual computing user interface that allows computers to capture and interpret human gestures as commands. The general definition of gesture recognition is the ability of a computer to understand gestures and execute commands based on those gestures. Gesture recognition is an alternative user interface for providing real-time data to a computer. Instead of typing with keys or tapping on a touch screen, a motion sensor perceives and interprets movements as the primary source of data input. This is what happens between the time a gesture is made and the computer reacts.

1.1.2 Complexities to Gesture Recognition

There are lots of complexities in gesture recognition few of them are too many noise signals in the sample, which greatly increase the difficulty of network identification. There are many challenges associated with the accuracy and usefulness of gesture recognition software. They are extremely sensitive to changes in lightning conditions and camera facing angles, that makes them unsuitable for applications in all types of environments. Items in the background or distinct features of the users may make recognition more difficult. Similarly, "smart glove" based solutions can recognize very fine gestures, e.g., the finger

movement and conformation, but they require the user to wear a glove tagged with multiple sensors to capture finger and hand motions in fine granularity. As a result, they are unfit for spontaneous interaction due to the high overhead of engagement.

1.1.3 Characteristics to Gesture Recognition

Gestures are one of the most important modes of communicating with computer in an interactive environment. Recent advances in computer vision and machine learning have led to a number of techniques for modeling gestures in real-time environment. Hand gestures are a powerful, natural form of expression for human beings, one that we use commonly in our daily lives. Nowadays, however, they have also become a very attractive communication tool for spontaneous interactions with mobile devices in the context of ubiquitous computing. Hand gestures are the dominant modality in communication between deaf people and are an essential vocabulary part of sign languages. Human gesture recognition is a rapidly growing field in various applications, such as sign language, computer vision, natural language processing, biomedical, biometrics, pattern recognition, and much more. Hand Gesture Recognition can be seen as a way for computers to understand the intentions of the human being, creating an interface between machines and humans. With the advent of technologies such as smartphones, Hand Gesture Recognition is expected to add new ways of interacting with mobile devices.

1.2 Types of Gestures

Gestures, the movement of arms and hands, are different from other body language in that they tend to have a far greater association with speech and language. Whilst the rest of the body indicates more general emotional state, gestures can have specific linguistic content. Our application belongs to the domain of human gesture recognition which is generally divided into two categories i.e. contact-based and vision-based approaches. The second type is simpler and intuitive as it employs video image processing and pattern recognition. Gestures have three phases: preparation, stroke and retraction. The real message is in the stroke, whilst the preparation and retraction elements consist of moving the arms to and from the rest position, to and from the start and end of the stroke. Within the realm of communicative gestures, the first distinction to be made is between gestures made with the hands and arms, and gestures made with other parts of the body. Examples

of Non-manual gestures may include head nodding and shaking, shoulder shrugging, and facial expression, among others.

1.3 Application of Human Gesture

Gesture recognition is a wide field with several applications, taking into account every application of this concept, it seems like it has a great scope to alter the way we interact with everyday tech. Besides Gaming, Gesture recognition can be used in Smartphones and Smart Televisions. The main application fields of gesture recognition are as follows:

- Education and life improvement for children, elderly and deaf-mutes. Through some human-computer interfaces, can complete the natural communication between children, the elderly or deaf-mutes and the computers, and thus improve their ability of education.

- Application on smart home appliances and control field. Among the computer controlled means, hand is regarded as a flexible and efficient controlling way, application on hand gesture in the field of control has obtained some results, such as video cameras controlled by gesture command such as "zoom", "panoramic" and "tilt".

- Demonstration and study of robot. By studying the mechanism of human visual language from the perspective of cognitive science to improve the human language understanding ability of computer.

- Other applications includes Numbers and alphabet recognition, robot control, switching channels without a TV remote and powerpoint control.

1.4 Challenges of Hand Gesture

There are many challenges associated with accuracy and usefulness of gesture recognition software:

- For image based gesture recognition there are limitation on the equipment used and image noise.

- Images or videos may not be under consistent lighting or in the same location.

- Items in the background or distinct features of the users may make recognition more difficult.

- The amount of background noise also cause tracking and recognition difficulties, especially when occlusion occur.

- Furthermore, the distance from the camera, and the camera's resolution and quality also cause variations in recognition accuracy.

- In order to capture human gestures by visual sensors, robust computer vision methods are also required, for example for hand tracking and hand posture recognition or for capturing movements of hand, head, facial expression or gaze direction.

- Smart glove based solutions can recognize very fine gestures, e.g., the finger movement and conformation, but they require the user to wear a glove tagged with multiple sensors to capture finger and hand motions in fine granularity. As a result, they are unfit for spontaneous interaction due to the high overhead of engagement.

1.5 Need for Hand Gesture

Gestures are one of the most important modes of communicating with computer in an interactive environment. Hand gestures are a powerful, natural form of expression for human beings, one that we use commonly in our daily lives. Nowadays, however, they have also become a very attractive communication tool for spontaneous interactions with mobile devices in the context of ubiquitous computing. Human gesture recognition is a rapidly growing field in various applications, such as sign language, computer vision, natural language processing, biomedical, biometrics, pattern recognition, and much more. Hand Gesture Recognition can be seen as a way for computers to understand the intentions of the human being, creating an interface between machines and humans. With the advent of technologies such as smartphones, Hand Gesture Recognition is expected to add new ways of interacting with mobile devices. Thus, gestures captured by the camera of the mobile can be analyzed to place orders without having to touch the screen.

1.6 Why Human Gesture

The recent and increasing trend of embedding inertial sensors, like gyroscopes, magnetometers or accelerometers, in mobile devices has enabled the development of new gesture based input modalities, in which the interaction is realized by physical manipulation of the device, effectively turning it into a communication interface. Such modalities have a

wide variety of potential applications ranging from smart environments through teaching all the way to robot control and etc. For example, gestures performed with the users mobile phone can be used to control appliances and ambiance settings in smart houses (e.g. simple up/down movement could be used to open/close the blinds, raise/lower the temperature or adjust the light intensity in the room, depending on where it is directed). Phone gestures can also be used in classrooms, or even at conferences or business presentations to control the computer and the slides. In this scenario, a left/right movement could signal the transition to the previous/next slide, a left/right spiral could be a shortcut for jumping to the first/last slide, up/down movement could control the volume of the computer if video/audio file is played, shaking the phone could switch on/off the projector in short, the possibilities are almost limitless.