CHAPTER I

Introduction

1.1 Background

When a person becomes a limb amputee, he or she is faced with staggering emotional and financial lifestyle changes. The amputee requires a prosthetic device(s) and services which become a life-long event.

In medicine, a prosthesis, (from Ancient Greek prósthesis, "addition, application, attachment")[1] is an artificial device that replaces a missing body part, which may be lost . It is part of the field of biomechatronics, the science of fusing mechanical devices with human muscle, skeleton, and nervous systems to assist or enhance motor control lost by trauma, disease, or defect.

An artificial limb is a type of prosthesis that replaces a missing extremity, such as arms or legs. The type of artificial limb used is determined largely by the extent of an amputation or loss and location of the missing extremity.

1.1.1 Limb Loss Statistics

There are nearly 2 million people living with limb loss in the United States [2]. Among those living with limb loss, the main causes are vascular disease (54%) – including diabetes and peripheral arterial disease – trauma (45%) and cancer (less than 2%) [2].

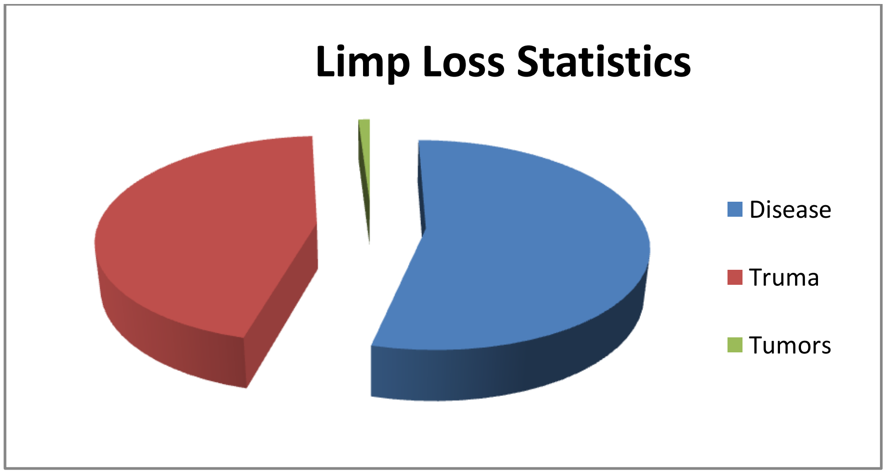

Figure 1.1: Limb Loss Statistics

Approximately 185,000 amputations occur in the United States each year [3].In 2009, hospital costs associated with amputation totaled more than $8.3 billion [4]. African- Americans are up to four times more likely to have an amputation than white Americans [5]. Nearly half of the individuals who have an amputation due to vascular disease will die within 5 years. This is higher than the five year mortality rates for breast cancer, colon cancer, and prostate cancer[6] Of persons with diabetes who have a lower extremity amputation, up to 55% will require amputation of the second leg within 2-3 years [7].

Diseases that can cause amputation are varied, but the most common ones are vascular disease and diabetes. Vascular disease limits the circulation to the extremities. Diabetes, which affects blood sugar, can decrease the body's ability to heal itself.

Trauma resulting in amputation is most frequently related to motor vehicle accidents and industrial accidents.

Congenital malformation or birth defects can result in either the person having no limb or a very short limb that is treated as an amputation, for which a prosthetic device is made.

Tumors of the bone, called osteosarcoma, can sometimes be treated by amputation of the limb.

1.1.2 History

Two artificial toes have been found on Egyptian mummies made of fiber – these date back to 1,000BC. However it is not known if they were actually used in life.

Figure 1.2: Historical artificial limbs (a)

* The dark Ages: basic peg legs and hand hooks Prostheses were more cosmetic than functional; meant to hide disgrace and weakness of defeat from other battles.

* Renaissance: Ambroise Pare (contributed to amp. Surgery and prosthetics) invented "Le Petit Lorrain" (a hand operated by springs and catches).

* Armorers in the 15th and 16th centuries made artificial limbs out of iron for soldiers who lost limbs. Over the next several centuries, craftsmen began to develop artificial limbs from wood instead of metal because of the lighter weight of the material.

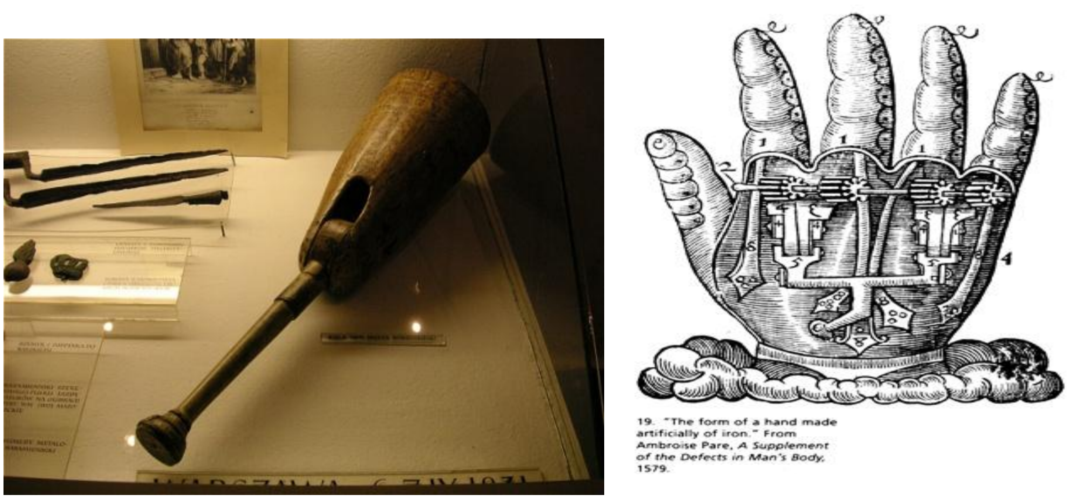

Figure 1.3: Historical Artificial Limbs (b)

* 1600's - 1800's: refinements of the prosthetic and surgical principles; invention of the tourniquet, anesthesia, analeptics, blood clotting styptics, and disease fighting drugs

* Late 19th century: artificial limbs became more widespread (Civil War).

* After World War II, the Artificial Limb Program was started in 1945 by the National Academy of Sciences.

* In 1962 the government guaranteed prostheses for veterans who lost them in the war.

1.1.3 Presently

In 20th Century: Modern plastics are stronger and more lightweight. The most exciting development has been the development of myoelectric prosthetic limbs. But RECENTLY Computers have been used to help fit amputees with prosthetic limbs.

A great deal of emphasis has been placed on developing artificial limbs that look and move more like actual human limbs and the Advances in biomechanical understanding, the development of new plastics, and the use of computer aided design and computer aided manufacturing have all contributed in the development of more realistic artificial limbs.

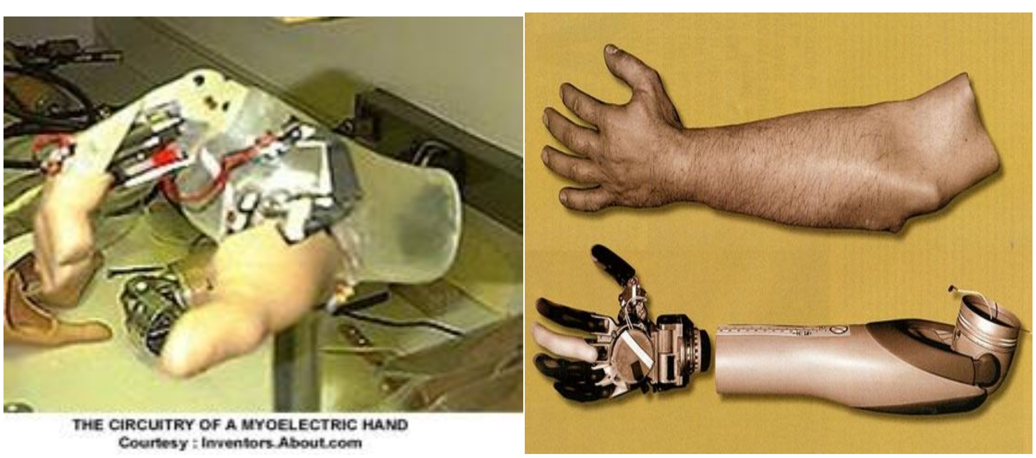

Figure 1.5: Present Artificial Limbs

1.1.4 Types of Artificial Limbs

1-Transradial Prosthesis

Artificial limb that replaces an arm missing below the elbow joint.

2-Transhumeral Prosthesis

Artificial limb that replaces an arm missing above the elbow joint. In This case mimicking the correct motion with an artificial limb is very difficult.

3-Transtibial Prosthesis

Artificial limb that replaces a leg missing below the knee. Transtibial amputees are usually able to regain normal movement more readily than someone with a Transfemoral amputation.

4-Transfemoral Prosthesis

Artificial limb that replaces a leg missing above the knee. Transfemoral amputees can have a very difficult time regaining normal movement.

The type of prosthesis depends on what part of the limb is missing.

1.2 Problem Statement

Amputee needs all types of features like Myoelectric arm but the feed signal should not be EMG it needs critical surgical operations to attach electrodes to get EMG signals. It has been seen that the signal strength decreases as the years of amputation increases.

For the amputation above 20 years, EMG signal lost forever in that situation (MyoElectric arm) will be of no use.

As a solution of the above stated problem, we design a prosthetic arm, similar to real one where most the features are present but the input feed is not an EMG signal, It’s operates using voice commands by interfacing it to speech recognition module.

1.3 Project Objectives:

The objectives of this project are:

1. To design a robotic arm and built a control system and interface it with the speech recognition module.
2. To provide safe and fast functioning solution to amputees people without critical surgical operations, long healing time, drug side effects and biohazards.
3. To simplify the control of the prosthetic arm as to make it easier and simpler to operate. With this simplified operation, many disabled people can use the system without long training or adaptation time.
4. To minimize cost and give chance to poor disabled peoples to get solution by avoiding expensive systems and complicated long Medical intervention.

1.4 Methodology

The design and development of the system involves the implementation of Mechanical design of the prosthetic hand, hardware and software of the control system. These approaches must be well implemented so that it will produce satisfactory outcome of the system which is to produce the correct prosthetic arm movement upon receiving voice input command.

1.4.1 The mechanical design of the hand

The structural design has undergone several revisions in the prototyping of the model. The initial design consisted of four fingers and a thumb attached to a palm, all of which were to be constructed from aluminum sheet metal. Actuation was to be provided using a servo motor driving a belt, through a series of pulleys to the joint requiring motion. This design was altered as it became overly complicated to create relative motion between the joints in one finger when only one motor was being used to drive three degrees of freedom in the finger.

1.4.2 The Control System design

The actuation of the prosthetic hand is accomplished by voice commands. The voice commands, such as “pick up” and “release,” are processed by a special voice command recognition circuit (to be described next), and appropriate drive signals are sent to the DC motors. The controller electronics, in addition to sending these drive signals. The prosthetic hand control block diagram is shown in chapter III.

1.5 Research Outline

This thesis consists of six chapters. Chapter 1 gives the introduction of Prosthetics, its background and brief history and the significance of the project, project objectives and its methodology. Chapter 2 describes the literature review of this project. It includes the current and previous research on the topic related to this project. Chapter 3 illustrates some ideas on how the project is carried out. It lists out the steps involved in each stage of the project includes the hardware design. It also describes the function of the all individual modules. Chapter 4 explains the overall theory of operation system which involves software design and their development. Chapter 5 presents the result and data for the system evaluation. It discusses on how is working in order to analyze the performance and command accuracy. Chapter 6 discusses the conclusion of the whole project. This chapter also contains the suggestions for future improvements and future plans.