A ROBOT HAND WITH DATA GLOVE INPUTS

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To my beloved father, mother, and all my siblings and friends.

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ABSTRACT

Data glove is one of several types of electromechanical devices used in haptics application which apply tactile sensation of a human to interact with computers. Haptics device usually contact between computer and the user through an input or output device, such as joysticks or data glove, that senses the body's movements. Robot hand is an autonomous robot which allowing a direct mapping from a human movement to robot. In this paper the mechanism and design of a humanoid robot hand with a data glove remote control is presented. This system was designed with combination of robotic hand and data glove. Data glove fixed in with flex-sensors as sensation of human hand movement. PIC microcontroller use as the interact device between data glove with robot hand. Design of robot hand was base on the study of six human grasping behaviors. The project denotes that data glove input has a high potential to control humanoid robot hand to perform several dexterous grasping tasks.

ABSTRAK

Data maklumat sarung tangan merupakan salah satu sumber electromekanikal yang sangat popular digunakan dalam bidang penyentuhan iaitu bidang berkenaan dengan alat perhubungan yang menyampaikan pergerakan penyentuhan manusia kepada komputer. Biasanya, sumber sentuhan berinteraksi antara manusia dengan computer melalui sumber masukan atau keluaran seperti kawalan tangan dan data maklumat sarung tangan. Tangan robot merupakan satu robot automatik yang membenarkan peniruan pergerakan manusia kepada robot. Dalam projek ini, perbincangan memberi tumpuan terhadap reka bentuk mekanikal struktur tangan robot dengan data maklumat sarung tangan sebagai sumber masukan. System ini direka bentuk dengan pergabungan teknologi antara tangan robot dengan data maklumat sarung tangan. PIC kawalan digunakan sebagai sumber interaksi antara data maklumat sarung tangan dan tangan robot. Secara umumnya, pembentukan tangan robot adalah berdasarkan enam cara pemegangan yang biasa dilakukan oleh tangan manusia. Hasil daripada projek ini akan menunjukkan keberkesanan yang dapat dilakukan oleh pergabungan teknologi antara data maklumat sarung tangan dan tangan robot.

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CHAPTER I

INTRODUCTION

1.1 Project Overview

Data glove is one of several types of electromechanical devices used in haptics application which apply tactile sensation of a human to interact with computers. Haptics device usually contact between computer and the user through an input/output device, such as joysticks or data glove, that senses the body's movements. Commonly, data glove used virtual reality environments where the user sees an image of data glove and can manipulate the movements of the virtual environment using the glove. Robot hand is an autonomous robot which allowing a direct mapping from a human movement to robot. In this paper the mechanism of a humanoid robot hand with a data glove remote control is presented. This system was designed with combination of robotic hand and data glove. Data glove fixed in with flex-sensors as sensation of human hand movement. PIC microcontroller use as the interact device between data glove with robot hand. Robot hand was base on the study of six human grasping behaviors. The result denotes that data glove input has a high potential to control humanoid robot hand to perform several

dexterous grasping tasks. Figure 1.1 display the example outlook of the data glove with robot hand. The size of the robot hand design same as the human being size.

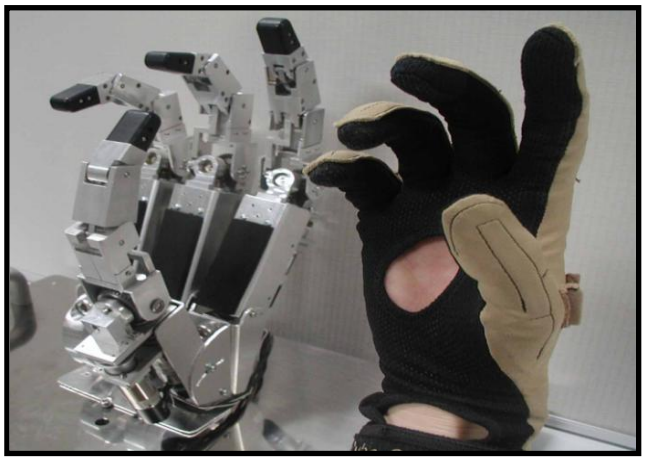

Figure 1.1 Data glove with robot hand

With the growth of interest towards humanoid robots, several robotic hands more or less anthropomorphic have been developed, the goals of each project were different, and the results are not easily comparable to the purpose of declaring one project better than another [1]. Despite such a trend towards the development of human-like robotic hands, the results so far achieved are not yet reach the level of satisfaction. In general, research on a multi-fingered hand is very useful for maintenance work in hazardous environments especially in nuclear power plants, underwater and space stations. Mostly, a function of the robot hands are limited to grasping and holding an object article, and holding and object article, and pushing up or down a lever. One of the main concerns is the control task to grasp various objects. Most of the robot hand requires many actuators to be dexterously moved. However, the control system of the humanoid robot becomes more complicated if more actuators are additionally used for robot hand design [4].

1.2 Objective of Research

The goal of this project is to design and implement a multi-fingers robot hand with a data glove input.

1.3 Scope of Research

The scopes of the research are:

a. To minimize the design expectation, the scope of this paper focuses on study existing design and control issues of the robotic hand.

b. Analyze the general structure of humanoid robot hand including the mechanical design, control system, motor and sensor.

c. Construct a robotic hand and data glove interactive device base on agile, tightly packed, control ability, form the angle of freedom degree and aesthetics.

1.4 Methodology:

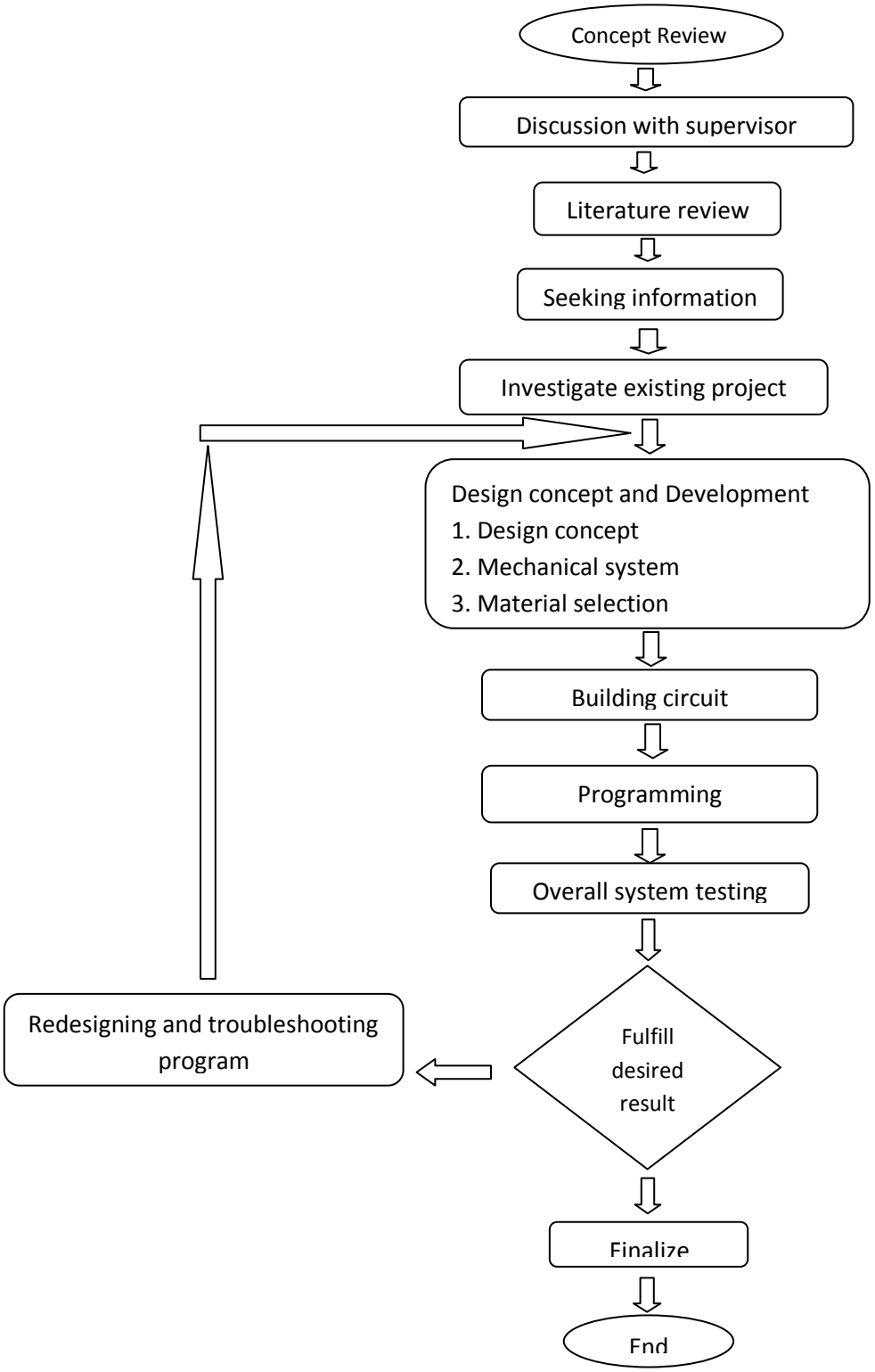

Figure 1.2: Project Flowchart

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter will discuss and analysis about various kind of robotic hand in the related field of robotic, mainly focus to the multi-fingers robot hand. Beside that, theory of multi-fingers robotic hand also will be discussed in his chapter. This analysis is used to determine an exact design and understanding the requirement for the development of this project.

2.2 Literature Study

Four fingers robot hand using ultrasonic motor and elastic elements is develop by Ikuo Yamano and Takashi Maeno [5]. Their robot hand has 20 DOF (degree of freedom) which having almost the same DOF and size as human hand. Mass of their robot is 853g only. The lightest weight is advantageous in connectivity to various robot arms. Elastic element in this robot hand is an advantage in passive compliance as well as grasp force due to strain energy of the elastic element even when the power of the motor is off. Their

robot hand has advantages over other robot hand in term of weight and DOF, thus the result is highly sophisticated as an end effecter for human operation.

Multi fingers robot hand with fingertip tactile sensor has been develop by Hideaki Hashimoto, Hideki Ogawa, Masao Obama, Toshiya Umeda, Kyoichi Tatuno Furukawa using hydraulic pressure [1]. Advantages of using tactile sensor are the silicone rubber cap is easy to fit onto any usual contact object that a human finger can handle. But a disadvantage of this sensor is that a direction and a position of measured pressure cannot be obtained. However the result of basic and applied experiments indicates the feasibility of their multi fingers robot hand system.

A humanoid robot hand with stable pinching research is carried out by Kiyoshi Hoshino and Ichiro Kawabuchi in 2005 [2]. The result of this research showed that it is difficult to generate the action of stably pinching paper or needle. However,when experiments were carried out to investigate force control characteristics of the finger tip joint. They providing the finger tip with a joint rich in force control performance even weak maximum generated force is effective for securing delicate control characteristic finger tip force.

Scale dependent grasp research has been done by Makoto Kaneko in 2000. In the research, Makoto has proposed five basic grasping strategies (direct grasp, sliding based grasp, rolling based grasp, regrasping based grasp, initial adjustment motion) which are easily applicable for general multi fingered robot hand [6]. A four fingered dexterous

robot end effectors for space operation develop in 2002. This robot hand represented the first step in developing a hand that lies in the middle of the simplicity or dexterity spectrum by being dexterous enough to utilize the majority of CATs and interface. With the database of grasping requirements obtain they turn in develop of a simple dexterous robot hand that is optimized for cylindered grasping [7].

In the paper of mechanical system and control system of a dexterous robot hand by Dirk Osswald and Heinz Wornhas show that a suitable mechanical system and fine control system is necessary to perform a fine manipulation dexterous [8]. The result was done successfully for the Karlsruhe Dexterous Hand II. Knowledge based control of grasping in robot hand using heuristic from human motor skill research carried out in 1993. In the paper, they proposed an alternative approach to high level control based upon human heuristic. They show that the classical techniques for the control robots require solution of kinematics and dynamic equation is more difficult to apply as the mechanical complexity of robot components increase [9]. In the paper has presented a methodology for transferring to a robot hand and ability of humans to adapt their grasp patterns to various tasks. In the paper of design TUAT or Karlsruhe Humanoid Hand, their research is focus o design an artificial arm and robot hand for handicapped people.

The result has show a simplify hand control system which is the hand only driven by one actuator. The control system of the humanoid robot will becomes more complicated of more actuator are additionally used for the hand design [4].