Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF A ROBOTIC HAND FOR ELECTRICAL INSTALLATION

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Bachelor of Electrical Engineering Technology (Industrial Power) with Honours

2021

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A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology with Honours

Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI KEJURUTERAAN ELEKTRIK DAN ELEKTRONIK

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : DEVELOPMENT OF A ROBOTIC HAND FOR ELECTRICAL INSTALLATION

Sesi Pengajian : SEMESTER 1 2021/2022

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I declare that this project report entitled “Development of a robotic hand for electrical installation” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature	:	ikhmal omar
Student Name	:	Ahmad Ikhmal Hakim Bin Omar
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Signature : 

Supervisor Name : ARMAN HADI BIN AZAHAR

Date : 10 JANUARY 2022

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DEDICATION

To my beloved mother,Hasimah Mohamad, and father, Omar Busu,

ABSTRACT

Present-day, the construction sector has been criticized for being reluctant to implement new technology, and labor productivity has remained stagnant. In order to make this construction grow fast as needed, it required new technology to replace human work to ensure the electrical construction grows faster, accurately, and safely. A robotic hand with hand gesture was introduced to easily control the electrical installation without human touch. Hand gesture recognition is an emerging field of technology in robotics and human interaction. An urge needs to create such a device that can substitute the human for doing works safely. Due to a wide range of applications, such as pick-and-placed, upper-limb prosthesis, and robotic hands development, robotic hands development has been a lot of interest in recent years. The objectives of this study are to develop a prototype robotic hand that hand gestures can control, create a mechanical hand finger, utilize a flex sensor and wireless communication and demonstrate how a prototype robotic hand works and how well it performs Mechanical hands are designed to mimic our agility and versatility in manipulating objects. Understanding the anatomy and motion of the human hand is also crucial for robot hand study. This is a detailed project overview for the robotic hand system. A human hand (user) has been declared on the left side, consisting of an ESP32 (user) using five flex sensors. Aside from that has been designated as a robotic hand that operates the ESP32 (mechanical design) using five servo motors that drive the robotic hand's fingers. The project's design is being developed as soon as all of the necessary information has been obtained. Microcontrollers (ESP 32), a motor, a flex sensor, and a glove were used in this project. A servo motor is the type of motor that we use. As the microcontroller with a built-in wireless connection or module, the ESP 32 was chosen. It includes everything you will need to connect the microcontroller to a computer or power it up, including a USB cord. In conclusion, an initial result in this research is expected to meet the objective of this studies and give significance to the researchers and users.

ABSTRAK

Pada masa ini, sektor pembinaan dikritik kerana enggan mengimplementasikan teknologi baru, dan produktiviti tenaga kerja tetap tergendala. Untuk menjadikan pembinaan ini berkembang dengan pantas seperti yang diperlukan, ia memerlukan teknologi baru untuk menggantikan kerja manusia untuk memastikan pembinaan elektrik tumbuh dengan lebih cepat, tepat, dan selamat. Tangan robotik dengan gerakan tangan diperkenalkan untuk mengawal pemasangan elektrik dengan mudah tanpa sentuhan manusia. Pengecaman isyarat tangan adalah bidang teknologi yang muncul dalam robotik dan interaksi manusia. Desakan perlu membuat alat sedemikian yang dapat menggantikan manusia untuk melakukan kerja dengan selamat. Oleh kerana terdapat banyak aplikasi, seperti pemutaran tangan-kanan, prostesis anggota atas, dan pengembangan tangan robotik, pengembangan tangan robotik menjadi sangat menarik dalam beberapa tahun kebelakangan ini. Objektif kajian ini adalah untuk mengembangkan prototaip tangan robotik yang dapat dikawal oleh gerakan tangan, membuat jari tangan mekanikal, menggunakan sensor fleksibel dan komunikasi tanpa wayar dan menunjukkan bagaimana tangan robot prototaip berfungsi dan seberapa baik ia berfungsi. Tangan mekanik dirancang untuk meniru ketangkasan dan fleksibiliti kita dalam memanipulasi objek. Memahami anatomi dan gerakan tangan manusia juga penting untuk kajian tangan robot. Ini adalah gambaran keseluruhan projek terperinci untuk sistem tangan robotik. Tangan manusia (pengguna) telah dinyatakan di sebelah kiri, terdiri dari ESP32 (pengguna) yang menggunakan lima sensor flex. Selain itu telah ditetapkan sebagai tangan robot yang mengendalikan ESP32 (reka bentuk mekanikal) menggunakan lima motor servo yang menggerakkan jari tangan robotik. Reka bentuk projek sedang dibangunkan setelah semua maklumat yang diperlukan telah diperoleh. Mikrokontroler (ESP 32), motor, sensor flex, dan sarung tangan digunakan dalam projek ini. Motor servo adalah jenis motor yang kita gunakan. Sebagai mikrokontroler dengan sambungan atau modul tanpa wayar terbina dalam, ESP 32 dipilih. Ini merangkumi semua yang anda perlukan untuk menyambungkan mikrokontroler ke komputer atau menyalakannya, termasuk kabel USB. Sebagai kesimpulan, hasil awal dalam penyelidikan ini diharapkan dapat memenuhi objektif kajian ini dan memberi kepentingan kepada penyelidik dan pengguna.

ACKNOWLEDGEMENTS

Alhamdulillah and praise to Allah S.W.T for giving excellent health for me to accomplish my Final Year Project. Without it, it is tricky for me to complete this Final Year Project. I also want to express my deepest gratitude to my supervisor, Sir Arman Hadi Bin Azahar, for the guidance and motivational support.

I also appreciate the continuous support and motivation from my family, especially my parents, Omar bin Busu and Hasimah Binti Mohamad. My family kept me up on my feet as I yearn to complete this Final Year Project. Many thanks also for the everlasting encouragement, love, and emotional support that had given to me all these years. Finally, my gratitude would be for my course mates and those who supported me along with the completion of this project. I was very grateful to each other between my supervisor and I, including my friends who has the same supervisor with me as we have a solid bonding to face ups and downs through the journey of the project together and gave total commitments along this journey.

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LIST OF SYMBOLS

°C	-	Degree Celsius

LIST OF ABBREVIATIONS

3D	-	Three Dimensions
CPU	-	Central Processing Unit
DOF	-	Degree Of Freedom
ESP	-	Espressif Systems
IOT	-	Internet Of Things
IDE	-	Integrated Device Electronics
MCU	-	Microcontroller Unit
PC	-	Personal Computers
PWM	-	Pulse Width Modulation
RF	-	Radio Frequency
SPI	-	Serial Peripheral Interface
SDIO	-	Secure Digital Input Output
SRAM	-	Static Random-access Memory
USB	-	Universal Series Bus
VDC	-	Voltage Direct Current
Wi-Fi	-	Wireless Fidelity
DC	-	Direct Current
V	-	Voltage
A	-	Ampere
A	-	Ampere
AC	-	Alternating Current

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CHAPTER 1

INTRODUCTION

1.1 Background

Present-day, the construction sector has been criticized for being reluctant to implement new technology, and labor productivity has remained stagnant [1]. This proved by [2], the researchers compared other industries and found that labor productivity in the construction sector has remained flat over the last two decades. Therefore, to make this construction grow fast as needed, it required new technology to replace human work to ensure the electrical construction grows faster, accurately, and safely.

Electrical also a crucial part of the construction, but electrical construction grows slow as today the oil and gas industries also use electrical to control, install, and monitor the equipment of the process. The central problem of the installation of electrical parts is high risk. When performing dangerous tasks such as landmine demining or clearance in the military, driving hazardous vehicles in transportation, exploring outer space, or working with high temperature melting metal in industrial manufacturing, people can face high levels of risk and even life-threatening situations [3]. To imitate or replicate life-like behaviors and appearances, various scientific disciplines, such as ethics, psychology, anthropology, and neuroscience, must be enriched by robotics and artificial intelligence to reduce accidents.

Figure 1.1 Instrument technician control and calibration [4]

In industry, robot technology for works was striking until 80%, especially in the automotive, factory, military, office, and hospital sectors. The robot is made to facilitate human creation that is high risk—for instance, installation and calibration of electrical devices or electrical parts in hazardous places. The new capabilities of robots significantly impact how humans view them as the robotic communicate with them [5].

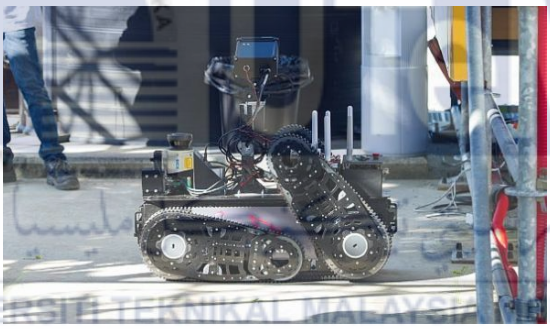

Figure 1.2 Supervisory robot at field [6]

Therefore, a robotic hand is invented to solve the problems. According to [7], the robotic hands or known as anthropomorphic robotic hands, most likely originates from the expectation of using motorized prosthetic hands to restore lost hand dexterity. The robotic hand is developed to substitute the human work during the execution of electrical work that is high risk due to current flow or electrical shortage that quickly exploded. In addition, this robotic hand is an accessible and effective device that can reduce the risk and maintain worker safety.

The development of a robotic hand for electrical installation purposes is a concept that comes after several studies in the electrical field. According to industry inquiry, it is essential to minimize the risks of an individual employee, which can cause injuries during managing and controlling the hardcore duties. Employees in the electrical sector, for example, are more vulnerable to hazards such as electrical sparks, which are incredibly harmful. Thus, a wireless robotic hand is vital to scale down the risks as the workers are not directly in contact with the electrical devices. Only the wireless robotic hand will take the job that is controlled by human gestures. The direction of a human finger governed the mechanism of robotic hand movements.

Figure 1.3 Oil and Gas industry [8]

Hence, this research further investigated the evolution of a robotic hand by creating a new controlling feature that using gloves with the addition of a wireless component. The robotic hand moves simultaneously with a human hand gesture to install the electrical parts in the factories, plants, or place that difficult to access by a human. The robotic hand implements a flex sensor as input parts to control the mechanical movement like a real human finger. Besides that, the servo motor function as actuators and wireless modules to connect between transceiver and receiver.

1.2 Problem Statement

High risk in the workplace was overgrowing as the workers needed to be involved in the electrical industry exposed to hazard. There are numerous unwanted accidents in manual electrical handling operations, such as hand burning due to explosion even though the workers already wore a set of PPEs. In 2019, an electrical technician on-site almost lost his hand during the shutdown due to electrical burning during the termination of the wire at the generator [9]. To avoid direct touch during hazardous electrical handling, another mechanism that functions precisely like a human hand is required.

A robotic hand with hand gesture was introduced to easily control the electrical installation without human touch. Hand gesture recognition is an emerging field of technology in robotics and human interaction [3]. An urge needs to create such a device that can substitute the human for doing works safely. The development of a robotic hand for electrical installation has a positive impact, especially in hazardous workspaces such as humans challenging access and high voltage. Hence, this is important to examine the viability of the robotic hand as a substantial device for electrical installation in a power plant. Over the last few decades, productivity increases made possible using industrial robots have aided in developing new robotic applications in on-site building construction [2].

1.3 Project Objective

Various objectives must be met to complete this project. The objectives are:

a) To develop a prototype robotic hand that hand gestures can control.

b) To create a robotic hand finger, utilize a flex sensor and wireless communication.

c) To develop and evaluate the finger control system.

1.4 Project Scope

This process will be done by producing a robotic hand for electrical installation to use a flex sensor and a wireless device and installing the necessary software and hardware. The input using the sensor, which is a flexible sensor, is the project's first constraint. There are five flexible sensors in this project that symbolize the five fingers on a robotic hand. The adjustable sensor's purpose is to collect bending resistance like a human finger, which can then be converted to voltage readings using a microcontroller. The actual flex sensor reading were set 2100 to 2900 for index, middle and ring finger while 3000 to 3500 for pinky and thumb finger as using 5.5” and 6.7” sensor.

Next, two ESP32 microcontrollers were used as the primary controller device for the process aspect of this project. This microcontroller includes a 512 KiB SCRAM memory size with an integrated Wi-Fi and Bluetooth module. This ESP32 uses an ultra-low power co-processor and runs at 160 or 240 MHz with up to 600 DIMPS. This microcontroller requires only 3.3V of electricity and 5A of current to switch on. The built-in wireless system has a range of about 10 meters.

Finally, there are five servo motors in the output portion, SG90 Tower Pro Micro Servo. The robotic hand are best for low-speed, standard-size applications that require precise positioning. This servo motor can control robotic fingers by tying a thread to the servo motor shaft and connecting it to the robotic fingers. Aside from that, this servo motor has a maximum rotation of 180 degrees, which corresponds to the flexible sensor employed.