UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF A PORTABLE POWER WHEELCHAIR WITH HAND GESTURE RECOGNITION

This report is submitted in accordance with the requirements of Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Computer Engineering Technology (Computer Systems) with Honours

by

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APPROVAL

This report is submitted to the Faculty of Electric and Electronic Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Computer Engineering Technology (Computer Systems). The member of the supervisory is as follow:

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Sir Shamsul Fakhar Bin Abd Gani

(Project Supervisor)

……

Sir Ahmad Fauzan Bin Kadmin

(Project Co-Supervisor)

ABSTRAK

Projek ini adalah untuk menghasikan kerusi roda bermotor mudah alih yg murah dan mempunyai pengawal mudah alih mengunakan 'accelerometer'. Kerusi roda bermotor dikawal oleh pengawal mudah alih 'accelerometer' tanpa wayar. Kaedah ini digunakan bagi membantu seseorang yang mempunyai kesukaran atau kecacatan dan tidak boleh mengawal di sebabkan beberapa faktor iaitu kurang upaya, hilang keupayaan dan strok. Tayar yang mempunyai binaan dalam motor dipasang di bahagian belakang kerusi roda supaya ianya boleh bergerak mengikut input dari pengawal mudah alih 'accelerometer'. Sistem ini di hubungkan dengan Radio Frekuensi berinteraksi antara kerusi roda dan pengawal mudah alih 'accelerometer' telah dibina dengan gabungan beberapa modul iaitu Radio Frekuensi, 'Accelerometer' dan Arduino nano sebagai mikropengawal. Kerusi roda itu juga telah dipasangkan dengan modul Radio Frekuensi supaya ia dapat berinteraksi dengan pengawal mudah alih 'accelerometer'. Motor dikawal menggunakan pemandu motor, relay dan Arduino mega 2560 yang telah diprogramkan. Segala perlaksanaan dan reka bentuk telah dibentangkan di dalam laporan ini.

ABSTRACT

The project is to produce a cheap mobile motorized wheelchair and has a portable controller with an 'accelerometer'. Motorized wheelchairs are controlled by wireless 'accelerometer' wireless controller. This method is used to help a person with difficulty or disability and cannot control because of several factors ie handicap, loss of ability and stroke. Tires that have built-in motors are mounted on the back of the wheelchair so they can move according to the inputs of the 'accelerometer' mobile controller. The system is connected to the Radio Frequency interaction between wheelchairs and the 'accelerometer' controller was built with a combination of several modules namely Radio Frequency, Accelerometer and Arduino nano as a microcontroller. The wheelchairs have also been paired with Frequency Radio modules so that they can interact with the accelerometer mobile controller. The motor is controlled using a programmable mega 2560 motorbike, relay and Arduino. All implementations and designs have been presented in this report.

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DEDICATION

To ALLAH SWT , RASULLAH SAW , mama , dad , my supervisor Mr Shamsul Fakhar Bin Abd Gani and my co sv Mr Ahmad Fauzan Bin Kadmin

ACKNOWLEDGEMENT

Firstly, this appreciation and thanks for all the support and help are countless to all persons who contributed to making this project possible. Mr. Shamsul Fakhar Bin Abd Gani, my supervisor, for all your support, advice, guidance, ideas, critics, the suggestion that helped in making this project complete and successful. Thank you for all sharing of all the knowledge until this project finish.

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LIST OF ABBREVIATIONS

ADC	Analog-to-Digital Converter
BLDC	Brushless Direct Current
LCD	Liquid Crystal Display
PWM	Pulse-Width Modulation
PIR	Passive Infrared Sensor
RF	Radio Frequency
USB	Universal Serial Bus
3D	Three-Dimensional

CHAPTER 1

INTRODUCTION

1.0 Introduction

A portable power wheelchair is a wheelchair that moves by using an electric motor rather than manual advancement by the client control. A portable power wheelchair is especially helpful and important especially for the people who suffer from stroke conditions where their arms are too weak to move the wheelchair. This project will help a lot of individuals who face ineptitudes by freely controlling a wheelchair from any other person or without required someone else to aid by using hand gesture recognition. The establishment, goals, criticalness, and degrees of the project will be discussed in this part.

1.1 Background

The development of a portable power wheelchair with hand gesture recognition is to provide a prominent medical device for the client. Various people with difficulty couldn't afford to own a motorized wheelchair that is currently in the market because it cost a fortune to have it. Therefore, this invention can be a remarkable moment for those people because the portable power wheelchair is cheaper and affordable. Moreover, the wheelchair is a multifunction and portable which will make a person life easier as it is user-friendly. They can use and control their wheelchair easily without the help of others by simply using the hand gesture recognition. Thus, there are a few conditions of a basic developments movement of a wheelchair that is needed to be known by the client for them to use the wheelchair efficiently. There is seven conditions of the movement in total which is going forward left, forward right, going forward, going backward, turn right, turn left and lastly stationary or in a static condition.

For this project, a lot of decision has been made with the objective is to provide a more comfortable life for the client and don't have to depend too much on others. One of the decision is basic security and extra versatility for the client. For example, if the client requires to move to another place or to the information counter as soon as possible, the client can control the speed of it whether it is faster or slower. This project describes outline and change of the behavior of the control for the wheelchair by using hand gesture recognition

1.2 Problem Statement

Based on the current customers that use an electric wheelchair for a very long time continually needs to spend a fortune to make sure the electric wheelchair in a good condition and can always use which prevents the client from purchasing and utilizing a motorized wheelchair as they feel that it is only a waste of money.

Other than that, some individual faces handicap or trouble to control the wheelchair independent from anyone else assistance. For instance, stroke and paralyzed person. These individuals couldn't control the wheelchair on their own that enable them to easily move to wherever they want, accordingly, they require another person to enable them to control the motorized wheelchair.

1.3 Objectives

I. To develop a portable power wheelchair with wireless hand gesture control

II. To develop a plug and play motorized system that can be easily attached or detached

1.4 Scopes

In view of this project, the motorized wheelchair can only be used on a flat surface area and could not be used to climb the staircase.

Other than that, the distance that can be covered by the Hand Gesture Recognition that is used to move the portable power wheelchair is calculated between 0 to 50 meters which means the controller could move the wheelchair up to 50 meters.

CHAPTER 2

LITERATURE REVIEW

2.0 Overview

The wheelchair regularly abridged to simply “seat”, is a seat with wheels, utilized when strolling is troublesome or incomprehensible because of sickness, damage, or incapacity. Wheelchairs arrive in a wide assortment of organizations to meet the particular needs of their clients. The primary known committed wheelchair is designed, since 1595 and called an invalids seat and was made for Philip II of Spain by an obscure innovator. In 1655, Stephen Farfler, a paraplegic watchmaker, fabricated a self-impelling seat on a three-wheel suspension.

2.1 Related Research

2.1.1. Design and Implementation of a Smart Wheelchair

(Trivedi, Kumar, & Digumarti, 2013) has completed a smart wheelchair can re-establish self-governance to patients with sensorimotor incapacities by empowering them to move around unreservedly without relying upon the guardians. The target of a keen wheelchair is to diminish client exertion in controlling the wheelchair and to guarantee wellbeing amid development. In this paper, their concentration is to plan and build up a keen wheelchair utilizing economical equipment and open-source programming to make it moderate to a bigger area of the objective populace, especially in creating countries. In this wheelchair system, the client can control the wheelchair utilizing three interfaces to be specific, console, a webcam, and an amplifier. The webcam is utilized to identify head-tilt which can be utilized

for turning the wheelchair. An amplifier is utilized for controlling the wheelchair through discrete voice summons. The wheelchair can be worked in three modes specifically, manual, programmed and teleoperation modes. The product and equipment motorizing of the stage are depicted in detail and trials are performed to show the ease of use of the stage.

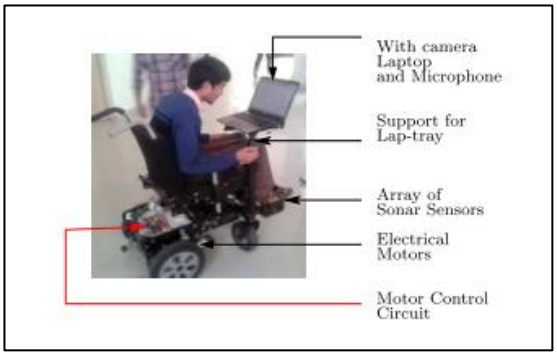

Figure 2.1: The completed smart wheelchair (Trivedi et al., 2013)

Figure 2.1 above shows that the final and completed smart wheelchair which is created by Trivedi. The smart wheelchair is done successfully.

2.1.2. Development of Head Gesture Interface for Electric Wheelchair

(Yoda, Sakaue, & Inoue, 2013) said for people with extreme incapacities who think that it's hard to utilize the joystick of an electric wheelchair, there have built up an interface that empowers an electric wheelchair to be worked by signals, for example, head developments. By utilizing a camera for visual detecting, their intent to execute a non-contact non-compelling interface, in this manner making the interface substantially more helpful to utilize. There are keeping this examination client arranged by leading clinical tests with the assistance of genuine clients to figure out where the camera should be arranged, how it should be utilized, and so on.

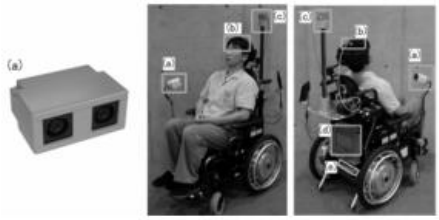

Figure 2.2: A stereo camera and experimental system (Yoda et al., 2013)

2.1.3 Hands-Free Gesture Control with a Capacitive Textile Neckband

(Hirsch, Sundholm, & Lukowicz, 2014) show a novel recognizing philosophy for sans hands movement controlled user interfaces, in light of dynamic capacitive identifying. Four capacitive terminals are composed of a material neck-band, allowing relentless unobtrusive head advancement observing. Theirs examine the limit of the proposed structure for seeing head signs and positions. An examination including 12 subjects was finished, recording data from 15 head signs and 19 remarkable positions. We show a quantitative appraisal in light of this dataset, achieving a general accu-stunning of 79.1% for head movement affirmation and 40.4% for perceiving head positions (69.9% while combining the most adjoining positions), independently. These results demonstrate that our approach is promising for sans hands control interfaces. A case application circumstance of this advancement is the control of an electric wheelchair for people with motor shortcomings, where seen movements or positions can be mapped to control orders.

Figure 2.3: Hands-Free Gesture Control sensor (Hirsch et al., 2014)

Motion-controlled user interfaces are built up in countless identified with zones, for example, stimulation, restorative recovery or shrewd home control. Regularly, signals begin from hand and arm stance and development. Additionally, hand motions speak to frequently the most expressive choice in these applications. Be that as it may, there exist situations where a motion-controlled interface in view of hand motions isn't possible. For instance, an elective approach is required for clients who have limited appendage developments, caused by injury or illness. Consequently, without hands control interfaces are an essential theme of research.

2.1.4. Mechatronics Operation recognition for power-assisted wheelchair

As indicated by (Gracious, Kong, and Hori, 2014) a wheelchair is an obligatory gadget for individuals with versatility issues. Average wheelchairs are moved by solid powers transmitted to wheels. Such wheelchairs, in any case, are physically requesting in different conditions, e.g., tough or step. For this reason, electric wheelchairs have been created and popularized for improvement of the mobility and wellbeing of individuals with a strong shortcoming. Such frameworks include finish human-machine connection, and therefore it is important to precisely watch the physical state and the natural condition progressively. For this thinking, a sensor-combination strategy and a basic leadership a calculation for the entire perception of the physical conditions of the wheelchair and the discovery of the task conditions are presented in this paper. The physical states to be watched incorporate the wheel speed, the pitch point, and the outside powers, which are the essential physical amounts for the control of a power-helped wheelchair framework in day by day living conditions. For the obtaining of such data, various movement sensors (i.e., encoders, gyrators, and accelerometers) are used and cleverly melded. At that point, the evaluated physical amounts are additionally prepared progressively so as to identify the ecological conditions. The proposed techniques are altogether confirmed by tests in this paper.

2.1.5. 3D Hand Gesture Recognition for Controlling an Intelligent Wheelchair

(Xiaodong Xu, Zhang, & Hu, 2014) developed the Hand Gesture Recognition is easy to understand and natural means for human-machine collaboration. They're also proposing a novel 3D hand signal acknowledgment strategy for controlling a savvy wheelchair in light of both shading and profundity data. Picture profundity data of human palm is acquired by a 3D Kinect vision sensor and after that its position is gotten through the hand investigation module in OpenNI. The enhanced Centroid Separation Capacity is utilized to remove 3D hand direction highlights, while shrouded Markov demonstrate (Gee) is connected to prepare tests and perceive hand signal directions. At long last, the acknowledgment comes about are changed over into control orders through a specially appointed system and sent to a savvy wheelchair for its motion control. The test comes about to demonstrate that the proposed strategy has great invariance to lighting changes, hand turn, and scaling conditions and is exceptionally powerful to foundation impedance.

2.1.6. Using a wireless visual sensor network to navigate wheelchairs

(Tian, Chao, Feng, Xing, & Shah, 2016) found that Harmonic navigation of numerous low-cost automated wheelchairs in a topology of remote sensor hubs that are conveyed in a dynamic and swarmed indoor condition is a Non-deterministic Polynomial-time hard (NP-difficult) issue. To address this issue, we propose a circulated multi-wheelchair worldwide consonant route calculation. The recognizing highlights of the proposed route calculation are worldwide inquiry and neighborhood compromise capacities. In the proposed calculation, a movement time expectation strategy receives a punishment for potential clashes in light of wheelchairs' need, speed, and separation between the hubs. Besides, three consonant guidelines are proposed for: (1) giving the most noteworthy need to people, (2) giving the most elevated need to wheelchairs, (3) giving adaptable need to wheelchairs. Through broad quantitative reproductions, we investigate the execution of

wheelchairs in different floor design topologies and diverse esteem for the framework parameters and show that the properties of swarmed indoor situations have an imperative impact on the execution of a worldwide route, for example, benefit time. The third symphonies control sets up the exchange off between the execution of people and automated wheelchairs. In the meantime, physical model wheelchairs are actualized and they check the proposed worldwide symphonies route calculation. A few recommendations for mechanical wheelchair originators, building designers, and building proprietors are given in light of the finish of the test comes about.

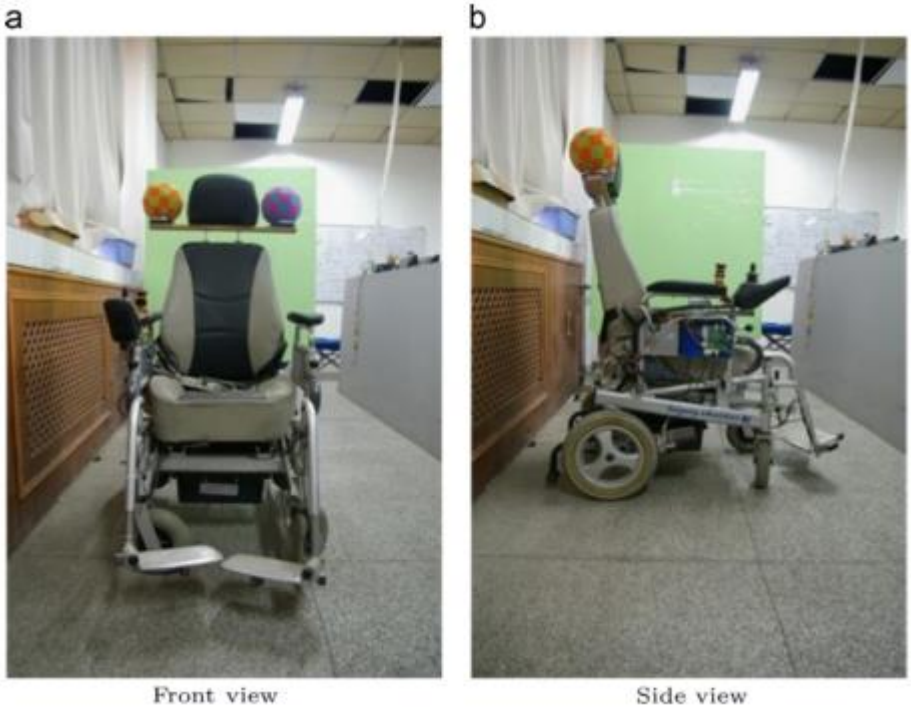

Figure 2.4: Automated Wheelchair (Tian et al., 2016)

2.1.7. Remote Monitoring and Control of an Electric Powered Wheelchair

(Lucena, 2016) showed that Ambient Intelligence can be characterized as an advancement of the regular computerization frameworks, which are an arrangement of PCs, sensors, and actuators that universally and unavoidably

have the motivation behind encouraging the execution of day by day errands. One essential induction from Ambient Intelligence is the Assisted Living Environments that are perplexing frameworks intended to help individuals cooperating with different gadgets. The effect of such frameworks in regular day to day existence is all the more effortlessly watched when discussing clients with incapacities. That is the situation of the project depicted in this paper. Adjustments were made to an electric-controlled wheelchair keeping in mind the end goal to empower its remote control by utilizing cell phones. Those alterations have concentrated on the wheelchair framework and planned to imitate it in programming with the goal that Smartphones and Tablets could control the wheelchair. Points of interest of the created framework, with accentuation on the telematics control, will be given along the paper.

Figure 2.5: Basic Architecture of the Project (Lucena, 2016)

2.1.8. Automatic Gesture Recognition for Wheelchair Control

(Vázquez-valencia, Martín-ortíz, Olmos-pineda, Olvera-lópez, & Pinto-avendaño, 2016) in this work, they propose an approach for controlling a wheelchair utilizing Motion Capture, specific motions from the face are considered as orders for the fundamental control tasks required for driving a wheelchair. Signal acknowledgment is completed preparing an Artificial Neural Network, which is a standout amongst the best classifiers in Pattern