THE AUTO ASSIST BAR SYSTEM FOR DISABLED PEOPLE

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ABSTRACT

This paper presents the development of the auto assist bar system to help the disabled people especially paralyzed in the legs where they have a problem to doing transaction stand-to-sit and sit-to-stand. An example the difficult movement of people with disabilities are from wheelchair to bed or from wheelchair to the toilet bowl. Many people with disabilities use the grab bars or assist bar are sold in the markets where it is too difficult and require a lot of energy to use which can cause them to fall and injured. Through this system, the disabled people can do the transaction stand-to-sit and sit-to-stand without assistance from other persons. The work will be performed during this project is testing performance of the sensors, design for the entire system either on mechanical parts and use the PID controller by using Arduino to control of dc motor. PID parameter values of Kp, Ki and Kd is obtained which is suitable to enable a dc motor rotates smoothly. The overall results obtained from this project found all managed to achieve the overall objectives of the system where the system is able to support people with disabilities to stand up and sit down.

ABSTRAK

Kertas kajian ini mempersembahkan tentang pembangunan sistem palang pembantu auto bagi membantu golongan kurang upaya terutama lumpuh di kaki di mana mereka mempunyai masalah untuk melakukan transaksi berdiri ke duduk dan duduk ke berdiri. Contoh pergerakan yang sukar bagi orang kurang upaya adalah dari kerusi roda ke katil atau dari kerusi roda ke tandas. Ramai orang kurang upaya menggunakan palang pemegang atau palang pembantu yang dijual di pasaran di mana ia adalah agak sukar dan memerlukan banyak tenaga untuk digunakannya sehingga boleh menyebabkan mereka jatuh dan cedera. Melalui sistem ini, orang-orang kurang upaya boleh melakukan transaksi dari berdiri ke duduk atau duduk ke berdiri tanpa bantuan dari orang lain. Kerja-kerja dilakukan untuk projek ini adalah dengan membuat pengujian prestasi terhadap sensor, merekabentuk keseluruhan sistem pada bahagian mekanikal dan menggunakan pengawal PID dengan menggunakan Arduino untuk mengawal motor dc. Nilai-nilai parameter PID iaitu Kp, Ki dan Kd yang sesuai diperolehi bagi membolehkan motor dc berputar dengan lancar. Keputusan keseluruhan yang diperolehi daripada perlaksanaan projek ini adalah kesemua objektif telah tercapai di mana sistem ini mampu memberi bantuan kepada orang kurang upaya untuk berdiri dan duduk.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS AND ABBREVIATIONS

UN	-	United Nations
DC	-	Direct Current
P	-	Proportional
I	-	Integral
D	-	Derivative
PI	-	Proportional Integral
PID	-	Proportional Integral Derivative
PWM	-	Pulse Width Modulation
StSi	-	Stand-to-sit
SiSt	-	Sit-to-stand
ARSD	-	Assistant robot with standing-up devices
ADAMS	-	Automated Dynamic Analysis of Mechanical Systems
RFID	-	Radio-Frequency IDentification
TTL	-	Transistor–transistor logic
AlN	-	Aluminium nitride
pMUTs	-	Piezoelectric micromachined ultrasonic transducers
PSO	-	Particle Swarm Optimization
ZN	-	Ziegler-Nichols
MZN	-	Modified Ziegler-Nichols
Kp	-	Proportional gain
Ki	-	Integral gain
Kd	-	Derivative gain
IDE	-	Integrated Development Environment

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Introduction

People with disabilities are the individuals who often have difficulty in performing daily activities such as walking, sitting, eating and going to the restroom. From the World Health Organization, term of disabilities is covering impairments, activity limitations, and participation restrictions. Impairment is a problem in body function or structure; an activity limitation is a difficulty encountered by an individual in executing a task or action; while a participation restriction is a problem experienced by an individual in involvement in life situations. Thus, disability is a complex phenomenon, reflecting an interaction between features of a person's body and features of the society in which he or she lives.

All countries in the world on average have at least one per cent of the disabled (according to statistics from the United Nations (UN)). Department of Social Welfare Malaysia has recorded 331,606 registered disabled. This includes 115,000 people with physical disabilities, 28,732 blind, deaf 40,915, mental 5.873, speech 505 and 126,000 with learning disabilities. Disability can cause a deficiency in the ability of the physical, sensory, emotional, mental, developmental, or a combination of these. Most of the disabled people require assistance from a normal person in doing any activities. Therefore, many researchers are conducting a research to produce a product that helps disabled people in their daily activities.

Examples of activities are difficult for disabled people are standing up and sitting on their own without help from others. Many people with disabilities use the grab bars or assist bar are sold in the markets where it is too difficult and require a lot of energy to use. Figure 1.1 below is an example of a grab bar in the market.

Figure 1.1: An example of a grab bar in the market.

In this paper, the research will be conducted to produce the auto assist bar system for disabled persons where this product can help them to stand or sit while in the process of changing place or location. For this project, specialization disabled person using this system are individuals who are paralyzed in the legs.

1.2 Problem Statement

People with disabilities, especially those paralyzed in the legs have a problem when they want to move from one location to another. An example the movement of people with disabilities from a wheelchair to a bed or from a wheelchair to the toilet bowl. Most of them use the grab/assist bar to do the activity. Most grab bars are

available in the market is a manual handling where people with disabilities have to use a lot of energy to enable them stand up and sit down. This will cause some of them are falling while using the grab bar due to the inability or lack of energy while clinging to the bars.

1.3 Aim And Objectives

The auto assist bar system for disabled people is the aim of this research. This system will assist people with disabilities using the assist bar where the bar will operate for up and down automatically. To achieve this aim, the objectives of this research are formulated as follows:

i) To design and develop the assist bar that can accommodate individuals to move vertically up and down.
ii) To develop an Android application for control of DC motor by using PID controller.
iii) To analyse PWM performance of DC Motor.

1.4 Research Scope

The scope of the research is focused on the development of the auto assist bar system to assist persons with disabilities to facilitate them in daily activities. Activities for people with disabilities are focused on this research only during a transaction stand-to-sit and sit-to-stand. The specialization of disabled people using this system is individuals paralyzed in the legs. Due to the difficulty to find many people with disabilities so this project will do a sample from normal individuals of different sizes and weights. The ability of the system is designed to accommodate a maximum load of 80 kg only.

1.5 Thesis Outline

This thesis is organized into 5 chapters which are introduction, literature reviews, methodology, result and analysis, conclusion and recommendation.

This chapter is only the introduction of this proposed project; the chapter covers the brief idea about problem area, aim, objective and limitation to solve the problem.

Chapter 2 will cover all the literature review about the principles of technique implemented in distance sensor, controlling of DC Motor, PWM and PID Controller,

Chapter 3 will cover the methodology of this project. The methodology is on the work that must be done and focus in order to achieve the aim and objective specified before.

Chapter 4 covers the simulation and experiment result using Arduino Uno and Oscilloscope. The simulation and experiments result of the system performance have been observed.

The last chapter will summarize all the works that has been done in this project. This chapter will summarize the problems faced during the project as well as the solution found to handle the problems occurred for future works that can be done to improve the system.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapters are arranged to see some research that have been done before that can be used in the production of auto assist bars for use by disabled persons. Major research highlighted is related to the grab/assist bar, the use of a distance sensor and control of DC motor. Overview of the related previous research will be able to assist in design of project structure, knows the system the appropriate control and reference to the analysis that have been made.

2.2 Design of support structures for standing and sitting.

Amaya Arcelus, Member,cMegan Holtzman, Rafik Goubran, Senior Member, Heidi Sveistrup, Paulette Guitard, and Frank Knoefel [1] has conducted research to enable older adults to live a safe where they could potentially fall in house. They have made the analysis of commode grab bar usage for the monitoring of older adults in the smart home environment where the high correlation has been found between the risk of falling and the mechanics of postural transitions such as stand-to-sit (StSi) and sit-to-stand (SiSt) especially during transfers to and from the bathtub or toilet. The commode grab bars instrumented with embedded pressure sensors where the sensors record a trial of StSi and SiSt transfers performed. The results of a study conducted clinical parameters were successfully extracted to characterize the sequences which clinical parameters are as transfer length, maximum force and range of contact location. To obtain beneficial in the prevention of falls, the enhanced knowledge of

grab bar usage over varying populations could contribute to the optimization of their design and implementation.

Guangming Xiong, Jianwei Gong, Taisen Zhuang, Tao Zhao, Dongxue Liu and Xijun Chen [2] are produce the research about an assistant robot with standing-up devices (ARSD) for the disabled people especially paraplegic patients and elderly people where the robot can assist disabled persons during the sit-to-stand transfer. It is also can carry the paraplegic patients and elderly people to move with ease. The implement path following for the robot, they are proposes an algorithm based on neural network speed control. The standing-up process of ARSD is shown in Figure 2.1. Through samples training and learning, a neural network is used to map the relationship between system outputs and inputs. Neural network also used when the analytical and accurate expression between speed and posture could not be obtained. The speed control is based on the trained network acts. The virtual prototype software ADAMS and control system software MATLAB forms a closed loop are the co-simulation system are used for this project.

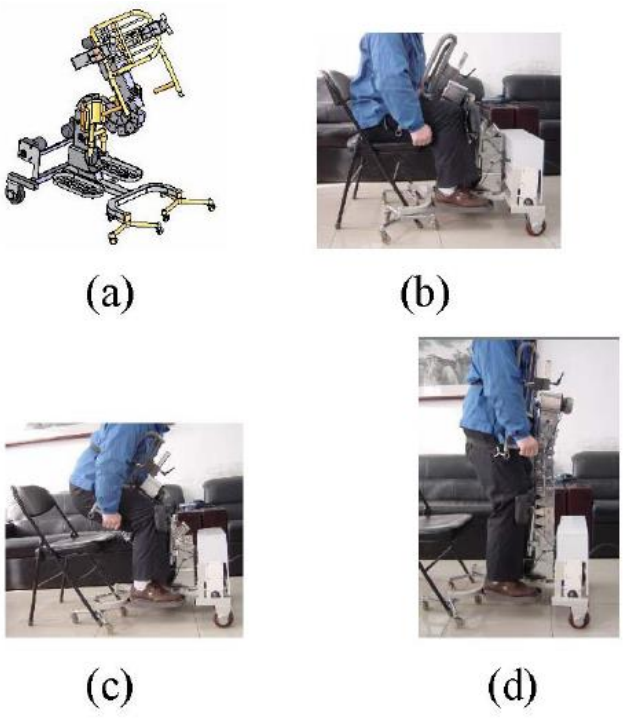

Figure 2.1: Standing-up process of ARSD [2]

S. Liawatimena, B.T. Felix, A. Nugraha and R. Evans [3] were designing a mini forklift robot that can store and pick up object to/from specified storage slot from/to a base using line follower and RFID. Forklift structures can be used as a reference in the assist bar structure will be made for the use of persons with disabilities. The design forklift structures are shown in Figure 2.2.

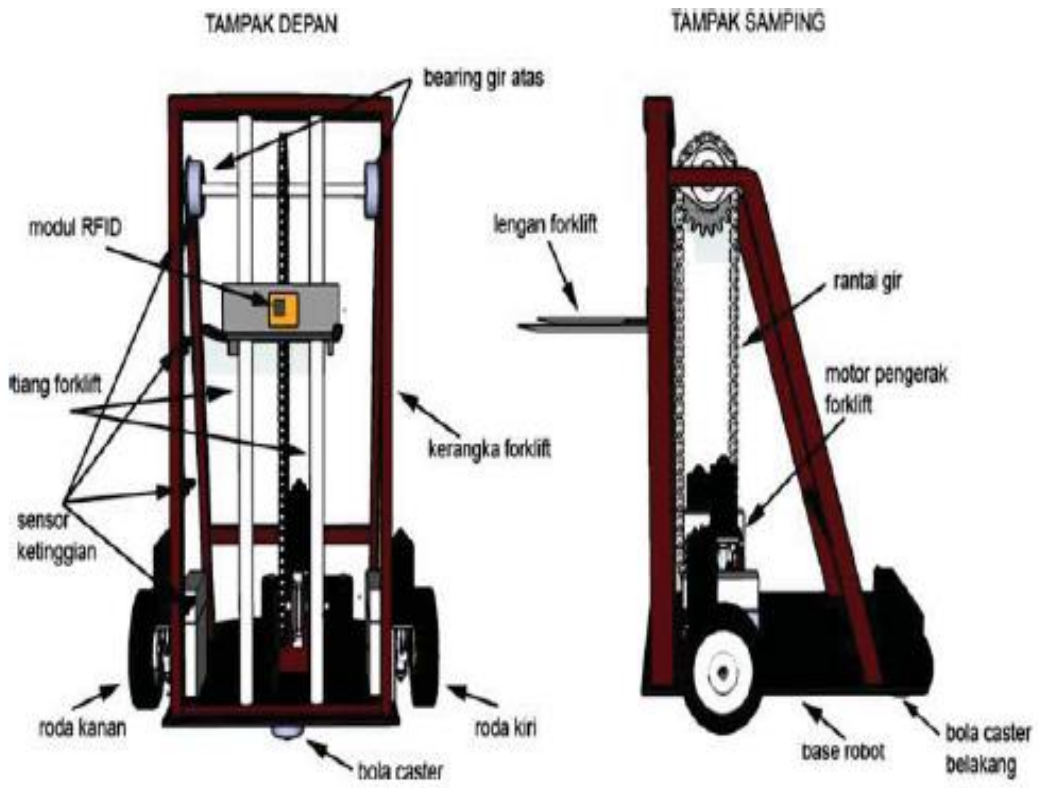

Figure 2.2: The design forklift structures [3]

Forklift use motor driver L298N driver IC, dual full-bridge driver where has four input to use for motor controller movement and two enable input used for motor state switching from on and off state which designed to receive standard TTL level logic and drive inductive load such as motor, relay and solenoid. H-Bridge forklift motor driver that can lift up stuff into specified row and supply up to 6 until 7 Ampere and the height sensors on the forklift beam used to know whether the forklift arm is reaching specified row. The height sensors schematic are shown in Figure 2.3.

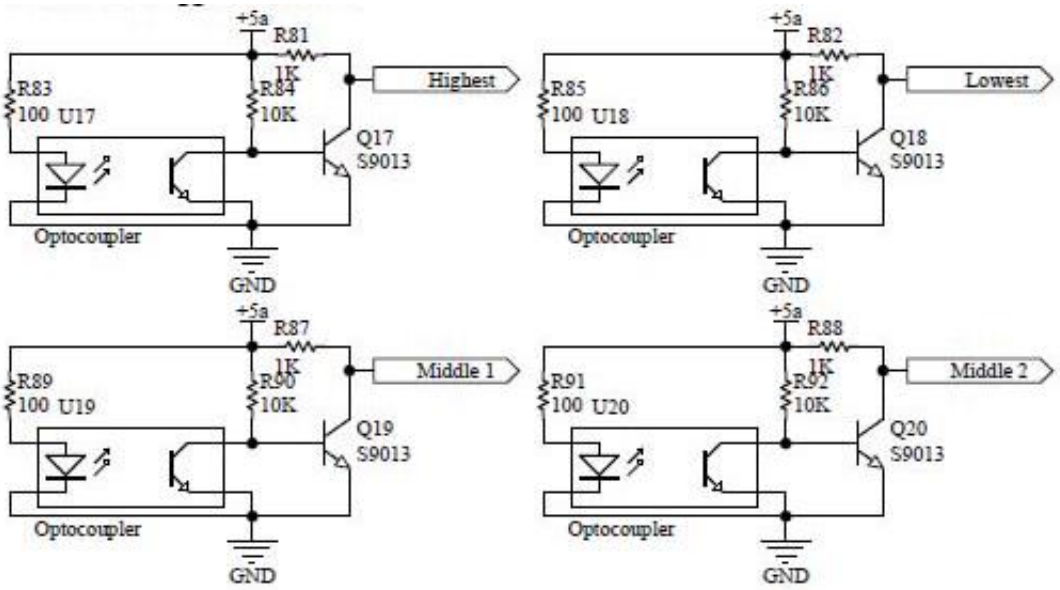

Figure 2.3: Height sensors schematic [3]

2.3 Distance Sensor

Wongwit Senavongse, Noramon Dron, Pornsuang Prakopkaew and Wanidar Tammawong [4] develop an automatic sensor that is simple and easy to use by using ultrasonic sensor and the Arduino board for stroke patient rehabilitation by treadmill. The research on sensor used in this project is equivalent to sensors used at the smart assist bar. This sensor is based on ultrasonic sensor applied at Arduino board where it measure the distance using the echo principle. A sound wave and measures the time are generated by the piezo element and it required for the piezo to transmit and then receive the sound wave. The basis for measuring the distance to the target is defined as the travel time by using the following equation (2.1):

$$\text{Distance to Object} = (T \times \text{Speed of sound})/2 \qquad (2.1)$$

T = Time between an ultrasonic wave is emitted and it is received. Division by 2 is because the sound wave has to travel to the object and back. The findings from the test of performance of the sensor against ten individuals found the means of the accuracy are 93.26% and 94.83% respectively for accuracy of first distance and accuracy of second distance. The accuracy was found using the equation (2.2):

$$\text{Accuracy} = (\text{Average distance}/\text{Standard distance}) \times 100 \qquad (2.2)$$

It can be concluded that the system has a useful function which can be used with any treadmill, can offer good safety, can reduce nurse staffs and can be made at low cost.

Richard Przybyla, Anita Flynn, Vipul Jain, Stefon Shelton, André Guedes, Igor Izyumin, David Horsley and Bernhard Boser [5] has done research on a micromechanical ultrasonic distance sensor with over 1 meter range that include theory, design equations, and measured the distance between two identical aluminium nitride (AlN) pMUTs. The speed of sound is 6 orders of magnitude slower than the speed of light, so the ultrasonic distance measurement is an attractive alternative to systems which rely on the speed of light. Distance noise is created when amplitude noise is converted to timing noise by the finite rise time of the transmit pulse where that system called a time-of-flight based and the ideal transmit waveform has zero rise time. The distance accuracy can improves if the device dimensions are scaled down. The expressions for the signal-to-noise ratio and the random distance error show that there is a trade-off between the maximum range and the random distance error.

2.4 Position Control

Francisco Aguilar-Acevedo and Vignaud Granados Alejo [6] focuses on the research for trajectory control of DC gear motors with encoder by using the open-source platform Arduino UNO. The system allowed the angular position control of DC motors and it is suitable with to develop the smart assist bar for disabled people. The block diagram of control DC motor is shown in Figure 2.4. Firmware running on the Arduino Uno and host computer software are two sections of software used in this project. A closed loop method was used at this research to adjusting the PID parameters. Overall, the research found the Arduino Uno platform has the ability to perform automatic control tasks and presents a proper supporting frame for inclusion of different control technique.

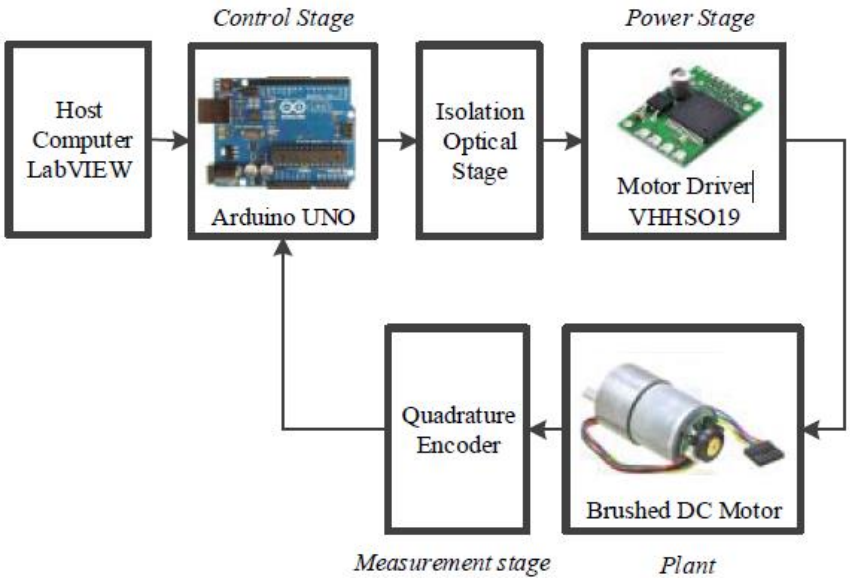

Figure 2.4: The block diagram of control DC motor [6]

Jiwon Choi, Chang-Hyuk Lee and Young-bong Bang [7] made a research of Initial Positioning of a Smart Actuator Using Dual Absolute Encoders where one of absolute encoder is connected to the motor shaft and the other low-resolution absolute encoder is connected to the output shaft of the speed reducer. The research of this encoder can be applied for control of DC motor to be used at the smart assist bar for disabled people. Regardless of the power supply interruption, precise and accurate absolute position data can be derived from the two-encoder data. The Resolution Index should be smaller than 0.25 for the dual encoder system without error occurrence during measure the output angle generated. The Resolution Index can be derived by using the following equation (2.3):

$$\text{Resolution Index} = \frac{Ratio}{n_{res}} + \frac{Ratio \times Backlash}{360^{\circ}} = Ratio\left(\frac{1}{n_{res}} + \frac{Backlash}{360^{\circ}}\right) < \frac{1}{4} \quad (2.3)$$

2.5 Speed Control

Hadis Karimipour and Heydar Toosian [8] produce the research about a new adaptive fuzzy control for DC motor position control to replace the usual methods i.e. armature voltage control or field control. They are propose the new Mamdani

adaptive-fuzzy controller for position control in which steady state error of desired position is decrease significantly. The block diagram of proposed method is shown at Figure 2.5. To design the rule base of fuzzy using the Mamdany method, they are deciding the input is a position error (e) and the variation of the error (de) and the armature voltage is the output. The simulation is run for three situations. First situation are using one controller, second are using two controllers with and without output torque as input to fuzzy controller and the third are using output torque as third input. The result of the research is found by using two fuzzy controllers are better than one fuzzy controller where the second controllers which reduce small error make better performance for position controlling. The output torque for this situation is the third input to the second controller. By using the fuzzy is better performance in compare with classic controllers and fuzzy adaptive controller can overcome uncertainly and reduce the error.

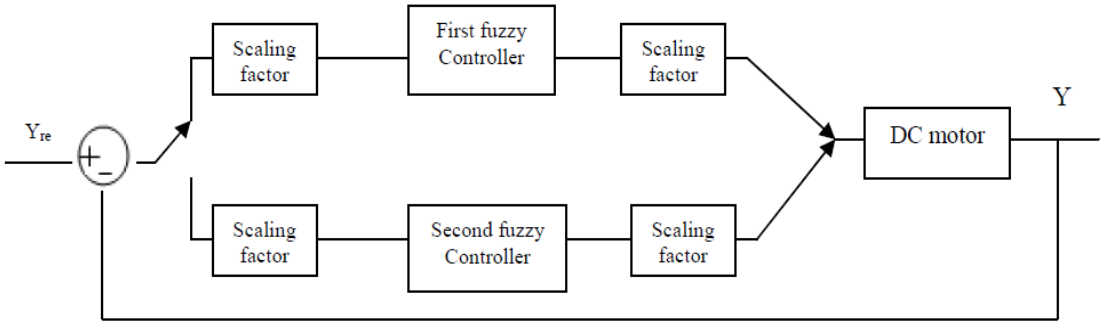

Figure 2.5: Block diagram of system [8]

Kristaps Vitols, Nadav Reinberg, Ilya Galkin and Alvis Sokolovs [9] has done research focuses on stabilizing the DC motor torque and monitor motor current to protect power converter from dangerous current overshoots and applied at an electric cart. The controlling motor torque is very imported because the torque response is much faster. The example of application at electric cart, it is very dangerous because if the driver presses the acceleration pedal too much then the car can jumps. Control torque techniques used can be well incorporated in the motor to be used at the smart assist bar where they can avoid the bar moves up and down as fast at the beginning. Sufficient control of DC motor can be achieved using closed current loop regulator because DC motor torque is proportional to motor current. The

response and settling time of output signal or controlled parameter are the relevant parameters for the regulator performance evaluation. The proportional (P), proportional-integral (PI) and proportional-integral-derivative (PID) controllers are several types of regulators that can solve particular tasks. Microcontroller is used to implementing the regulator. Figure 2.6 shows the experimental regulator. The results of this research are approving that the PI regulator can be used in particular electric kart application. PID controller is not an absolute necessity because the most processes in motor control take relatively long time and P regulator is not sufficient to control the DC motor.

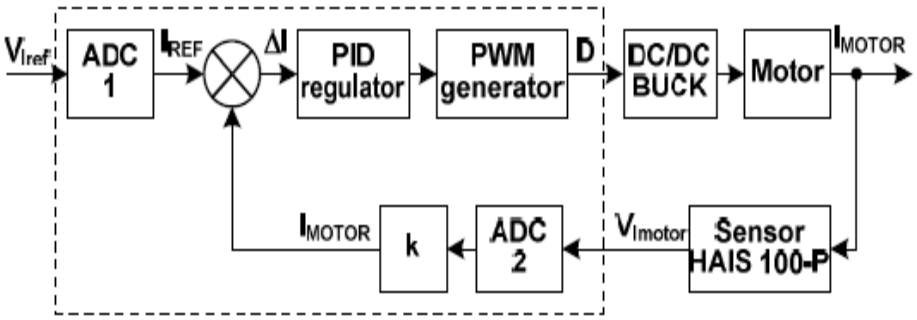

Figure 2.6: The experimental regulator [9].

Rohit G. Kanojiya and P. M. Meshram [10] has focused its research on optimal tuning of PI Controller for Speed Control of DC motor drive using Particle Swarm Optimization (PSO) algorithm and compare with PID controller is designed using traditional Ziegler-Nichols (ZN) tuning and Modified Ziegler-Nichols (MZN) tuning method. This is another technique for speed control of DC motor that can be taken when developing the assist bar. Minimize the rise time, maximum overshoot and settling time is the performance measure of the PID controller. XY axis position and also the velocity are expressed by vx (the velocity of X axis) and vy (the velocity of Y axis) are the position of each agent and modification of the agent position is realized by the position and velocity information. Figure 2.7 shows the concept of modification of searching point by Particle Swarm Optimization. The finding of the research, the particle swarm optimization tuned controller efficiently, the most robust technique and better than the Ziegler-Nichols and Modified Ziegler-Nichols controller.

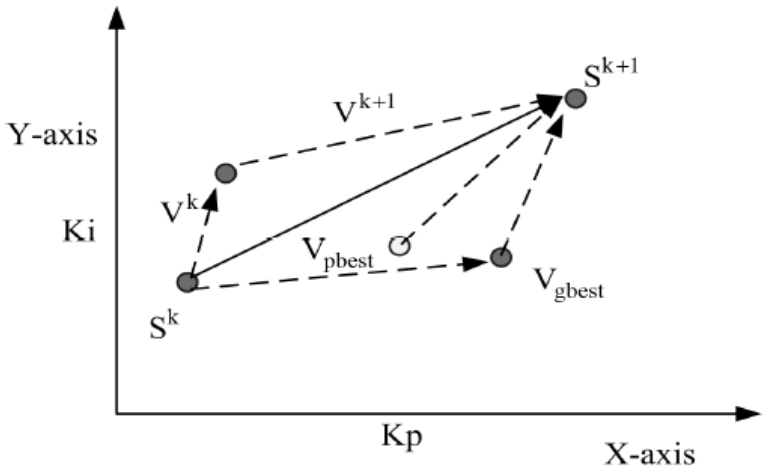

Figure 2.7: Concept of modification of searching point by PSO [10]

2.6 Controlling the Pulse Width Modulation (PWM)

Atul Kumar Dewangan, Nibbedita Chakraborty, Sashi Shukla and Vinod Yadu conducted research about PWM based automatic closed loop speed control of dc motor [11]. Adjusting directly the motor speed are concept used in controlling the PWM duty cycle is equivalent to controlling the motor terminal voltage. This work is a practical one and high feasibility according to economic point of view and accuracy. PWM is a very efficient way of providing intermediate amounts of electrical power between fully on and fully off. A simple power switch with a typical power source provides full power only, when switched on. PWM is a comparatively recent technique, made practical by modern electronic power switches.

PWM is method that may be used as an efficient DC motor speed control. I G. A. P. Raka Agung, S. Huda2 and I W. Arta Wijaya made a research about Speed Control for DC Motor with Pulse Width Modulation (PWM) Method Using Infrared Remote Control Based on ATmega16 Microcontroller [12]. The results of researches that have been conducted found the direction and rotation speed of a DC motor can be controlled with PWM method using infrared remote control based on ATmega16 microcontroller and the relationship between PWM and terminals voltage with a rotation speed of the motor is directly proportional. The terminal voltage will also increase so that the motor will rotate faster if give the greater of PWM.

In the Figure 2.8 show the difference duty cycle where it gives effect to PWM by using Arduino [13]. The green lines represent a regular time period where the

duration or period is the inverse of the PWM frequency. With Arduino's PWM frequency at about 500Hz, the green lines would measure 2 milliseconds each and analogWrite() is on a scale of 0 - 255, such that analogWrite(255) requests a 100% duty cycle (always on), and analogWrite(127) is a 50% duty cycle (on half the time) for example.

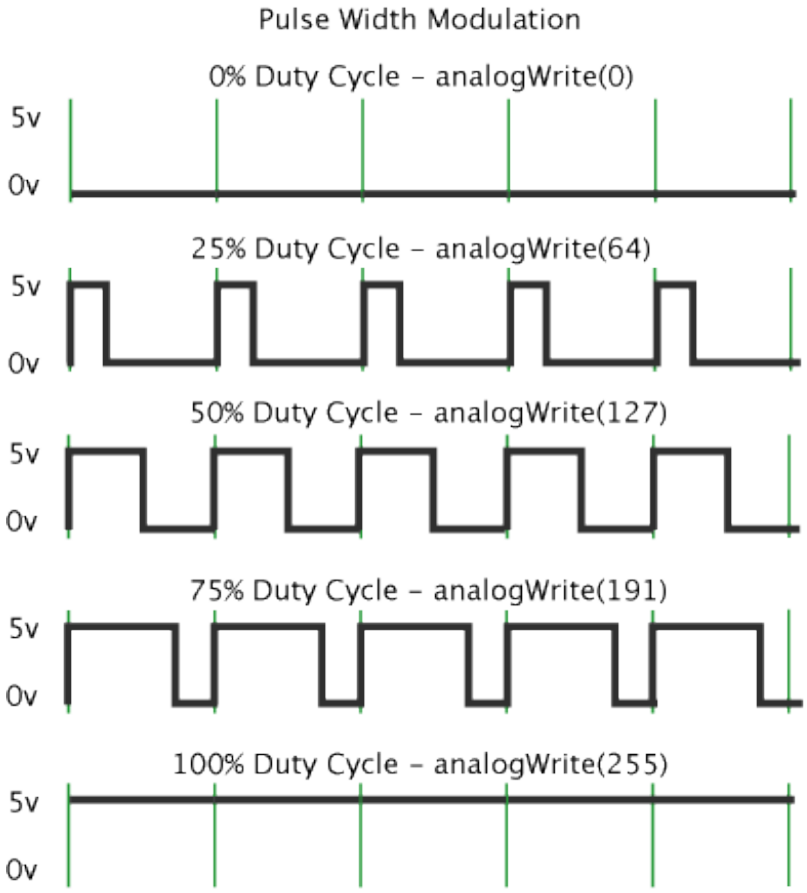

Figure 2.8: Example Controlling the PWM by using Arduino [13]

2.7 PID Controller

A PID controller is capable used for regulation of temperature, pressure, flow, speed and other process variables. This controller can be attributed partly to their robust performance in a wide range of operating conditions and partly for their practicality engineers can operate them in a simple and straightforward manner. Proportional-Integral-Derivative (PID) controller is prominent for its simplicity [14][19]. PID controlled system is a combination of three parameter which are proportional (Kp),

integral (Ki) and derivative (Kd). Equation below, describing u(t) as the controller output, the final form of the PID algorithm is at equation (2.4):

$$(t) = (t) = K_p e(t) + K_i \int_0^t e(\tau)d\tau + K_d \frac{d}{dt}\ e(t) \qquad (2.4)$$

Where,

$e = error$

$\tau = time\ or\ instantaneous\ time$

Tuning parameter

$K_p = proportional\ gain$

K_i = integral gain

$K_d = derivative\ gain$

The PID controller calculation involves three separate constants and is accordingly sometimes called three-term control i.e. the proportional, the integral and derivative value which is denoted by P, I and D [15]. The theory of PID controller is the error is multiplied by a negative (for reverse action) proportional constant P, and added to the current output. P represents the band over which a controller's output is proportional to the error of the system. For integral, the error is integrated (averaged) over a period of time, and then multiplied by a constant I, and added to the current control output. I represent the steady state error of the system and will remove measured value errors. Derivative is the rate of change of the error is calculated with respect to time, multiplied by another constant D, and added to the output. The derivative term is used to determine a controller's response to a change or disturbance of the process temperature. The larger the derivative term, the more rapidly the controller will respond to changes in the process value. Figure 2.9 shows the block diagram of a PID controller in a feedback loop.

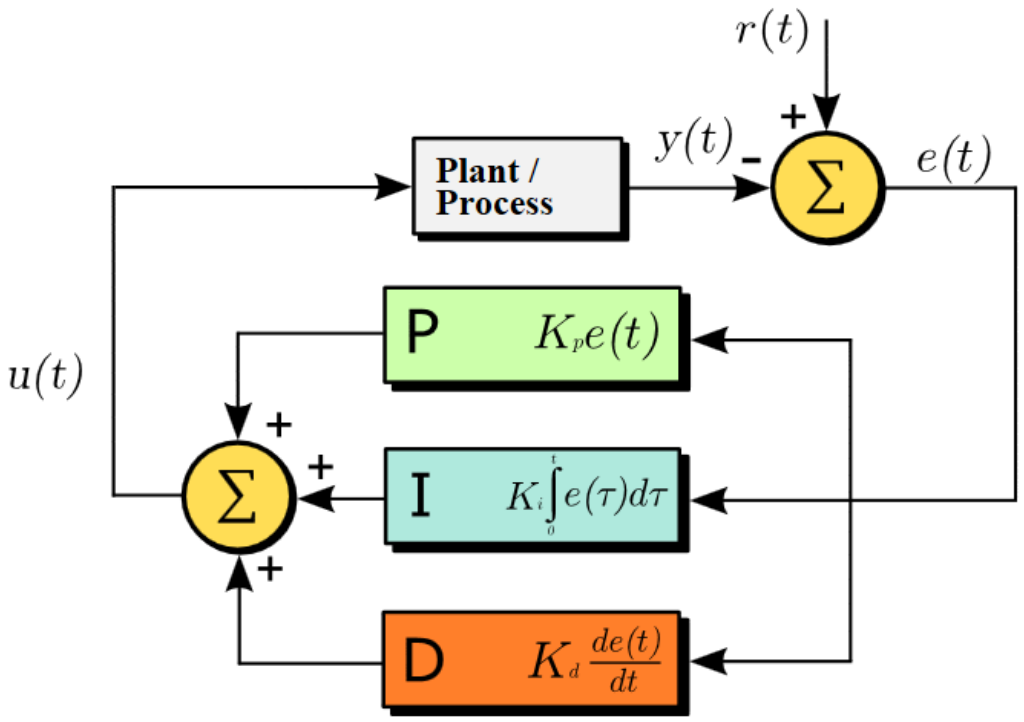

Figure 2.9: A block diagram of a PID controller in a feedback loop

Using the above equation of the PID controller in time domain it is possible to develop an equation of a digital PID controller in order to use it on the Arduino. To approximate the final form of the PID algorithm, a T period sampling rate was used, thus the integral action is close to the sum of all values of the sampled error multiplied by the period, and the derivative action multiplied by the difference between the current and previous error divided by the period [16].

PID controllers used to extract the fundamental component of the load current thus facilitating reduction of harmonics and simultaneously controlling dc-side capacitor voltage of the voltage source inverter because of their benefit to the system that PID controller gives better speed response in terms of settling time, rise time and steady state error [17].

Madhavi L. Mhaisgawali and Mrs.S.P.Muley [15] have focused its research on Speed Control of Induction Motor using PI and PID Controller where from the result of research get the compression of speed. The measured parameter for the motor is speed, settling time and rise time where all of parameter compared weather controller, with PI controller or using PID Controller. The comparison of controller method used to improve the speed is shown at Figure 2.10.

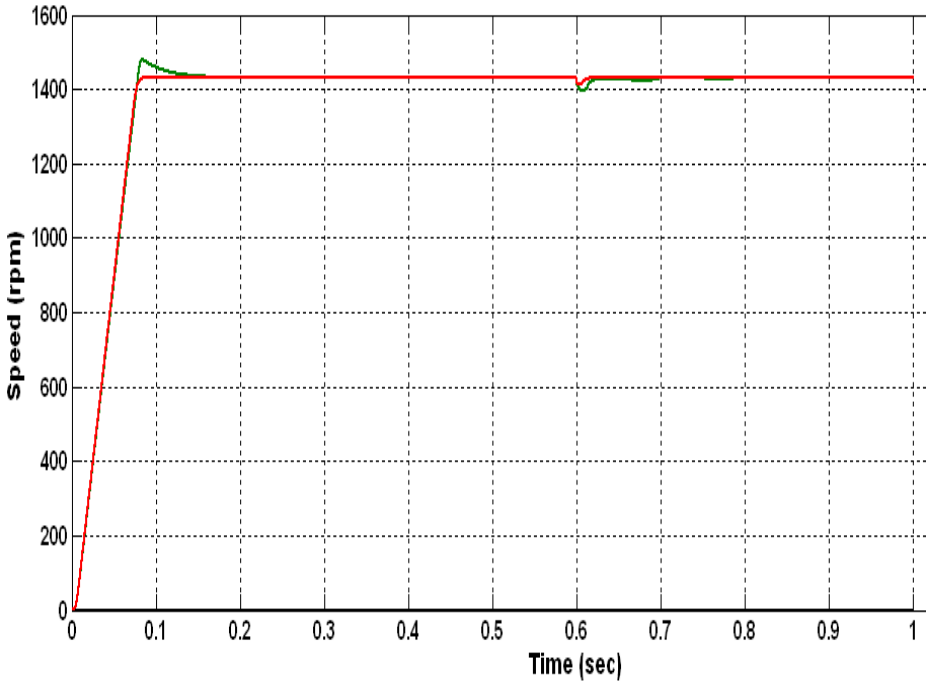

Figure 2.10: Comparison of speed [12]

The speed of induction motor compression using PI and PID controller get the PID controller gives better speed response in terms of settling time, rise time and steady state error.

2.8 Tuning and Analysis of PID controller

If improper values of the controller tuning constants are used cause the control system performs poor in characteristics and even it becomes unstable and it becomes necessary to tune the controller parameters to achieve good control performance with the proper choice of tuning constants. The conventional approach to tuning PID controller is Ziegler Nichols Method. If a PID algorithm is being used, controller tuning involves the selection of the best values of kc, Ti and TD [17].

The first steps, set the controller to P mode only and next, set the gain of the controller (kc) to a small value. Keep increasing kc (by a factor of two) until the response becomes oscillatory. Finally, adjust kc until a response is obtained that produces continuous oscillations. This is known as the ultimate gain (ku). Note the period of the oscillations (Pu). The Ku=gain margin of the system and the Pu = (2*pi)/W_{eg}. Table 2.1 show the control law settings are then obtained and Table 2.2 shows the PID controller gain value after simulation.

Table 2.1: Control law settings

Controller	Kp	Ti	Td
P	Ku/2		
PI	Ku/2.2	Pu/1.2	
PID	Ku/1.7	Pu/2	Pu/8

Table 2.2: PID controller gain values

Gain Coeff.	Kp	Ti	Td
Value	18	0.045	0.0182

Analysis of tuned PID controller must following 3 parameters:

- Rise time, tr
- Maximum Overshoot, Mp
- Settling time, ts

From the analysis, the system has not been tuned to its optimum and the system requirements are given at Table 2.3.

Table 2.3: System requirement of PID controller

System specifications	Maximum overshoot	Rise time(sec)	Settling time(sec)
	1	<0.2	<0.25

Guoshing Huang and Shuocheng Lee [18] do the analysis from the research about PC-based PID Speed Control in DC Motor where they try several parameter value Kp, Ki and Kd of PID controller. Through the experimental get the result where the system will produce an unstable phenomenon when Kp is greater than 7 and Ki is greater than 8. If raise KP then can get a quicker transient response, and can reduce a steady state error of the system in PID controller then if raise KD, will make the transient response become slower, but cannot improve a steady state error. A margin of the steady state error can removed via raising the Ki. The best control parameters of this system are chosen as R = 1, Kp = 5, Ki = 5 and Kd = 0.01.

2.9 Summary

The search in the journal, most devices are designed to help disabled people is focus on providing assistance to stand-to-sit and sit-to-stand activities. In developing the smart assist bar system, a reference to the structure can be obtained through the research of the forklift. It is involved in moving the smart assist bar to which it can lift disabled people up and down. Focusing on the speed control and position control is essential to enable the DC motor used does not harm people with disabilities using this system. The research of the sensor was able to make this system run automatically according to the current situation of people with disabilities who will use it.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter contains the methods that are to be done in order to achieve all the objectives contained in this project that aims to produce the auto assist bar system for disabled people successfully implemented. It is include of the design for the entire system either on mechanical parts, use the controller, the application of the sensor and the control of dc motor.

3.2 Flow Chart of the project

The flow chart is given in Figure 3.1 shows the overall process to develop the auto assist bar for disable people. From the start, the process divided into four main processes i.e. study about the distance sensor, programming Arduino microcontroller for design controller of DC motor, design and develop mechanical part and control the assist bar that can be automatic move to armpit user by using PID controller.

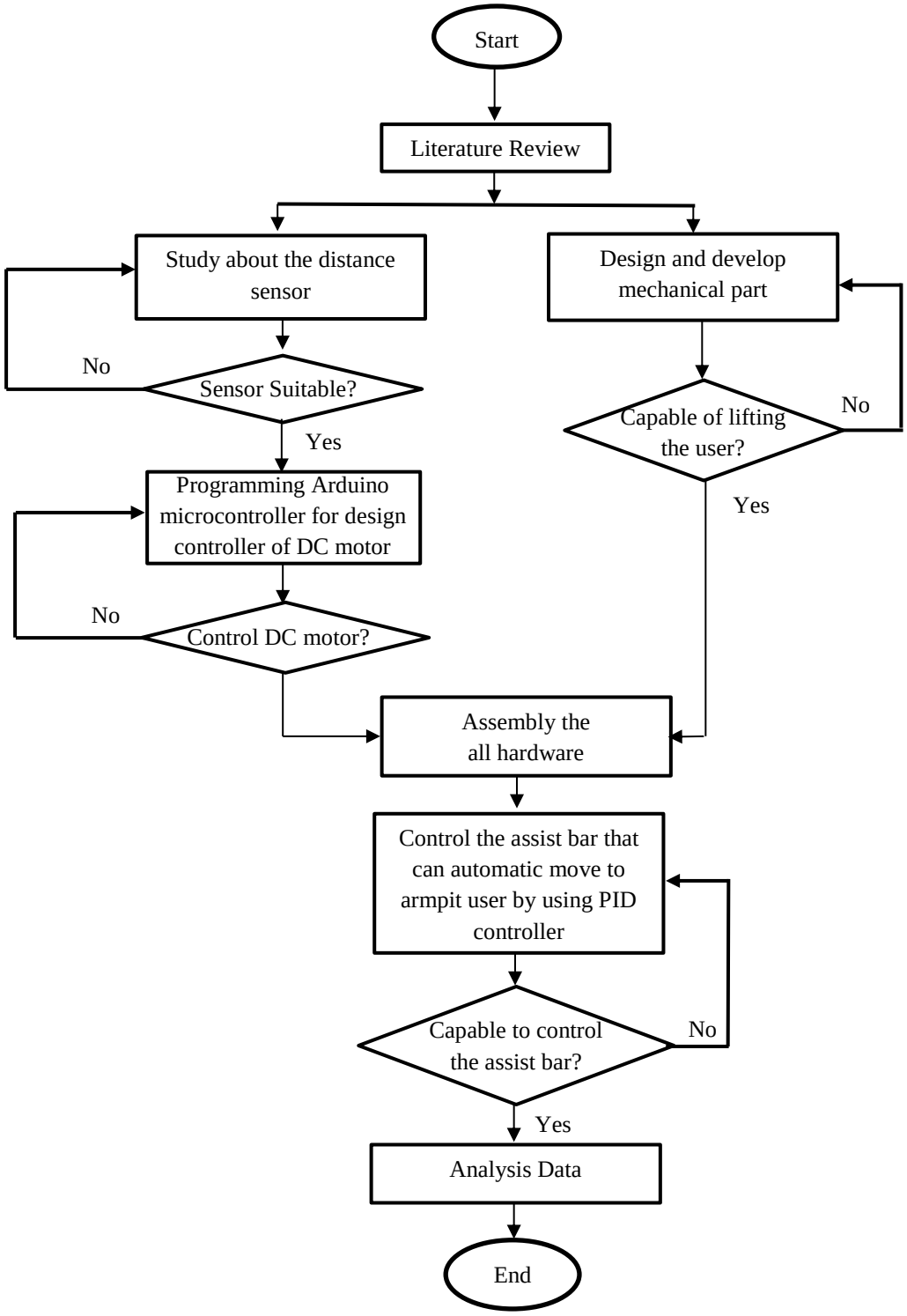

Figure 3.1: Flow chart of the research

3.3 Overview design of the project.

The preliminary design of the project to be made is shown in Figure 3.2. When disabled people want use the system, they should be directly under the sensor. Ultrasonic distance sensor will measure the altitude of the user based on their user either standing use crutches or sitting in a wheelchair. Once the height of the user is identified, grab bars are automatically going down until reach the armpit level of users. After neatly held by the user, grab bars will move up in the height of the user to stand. Green indicator light is to notify that the system in a state ON while the red indicator light shown the system is OFF. Emergency switch is used when the user in a dangerous situation and want to turn OFF the system. The Arduino is used as a controller for this system.

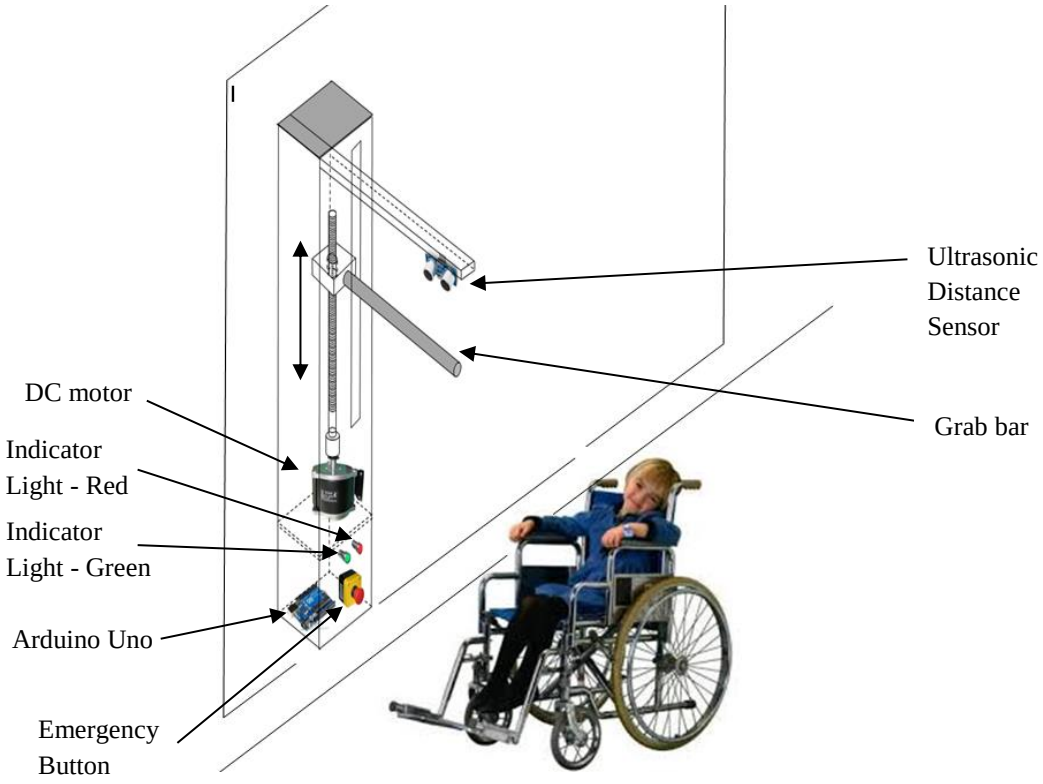

Figure 3.2: The preliminary design of the smart assist bar

However there are a few changes to the original design where the actual design has made some additions to get better results. But arguably it still follows the original design concept. Figure 3.3 shows the actual design of the auto assist bar. In the actual design use 2 units ultrasonic distance sensor which a first sensor for

measuring the height of the user and the second sensor is to give signal at system if the assist bar at the stop level.

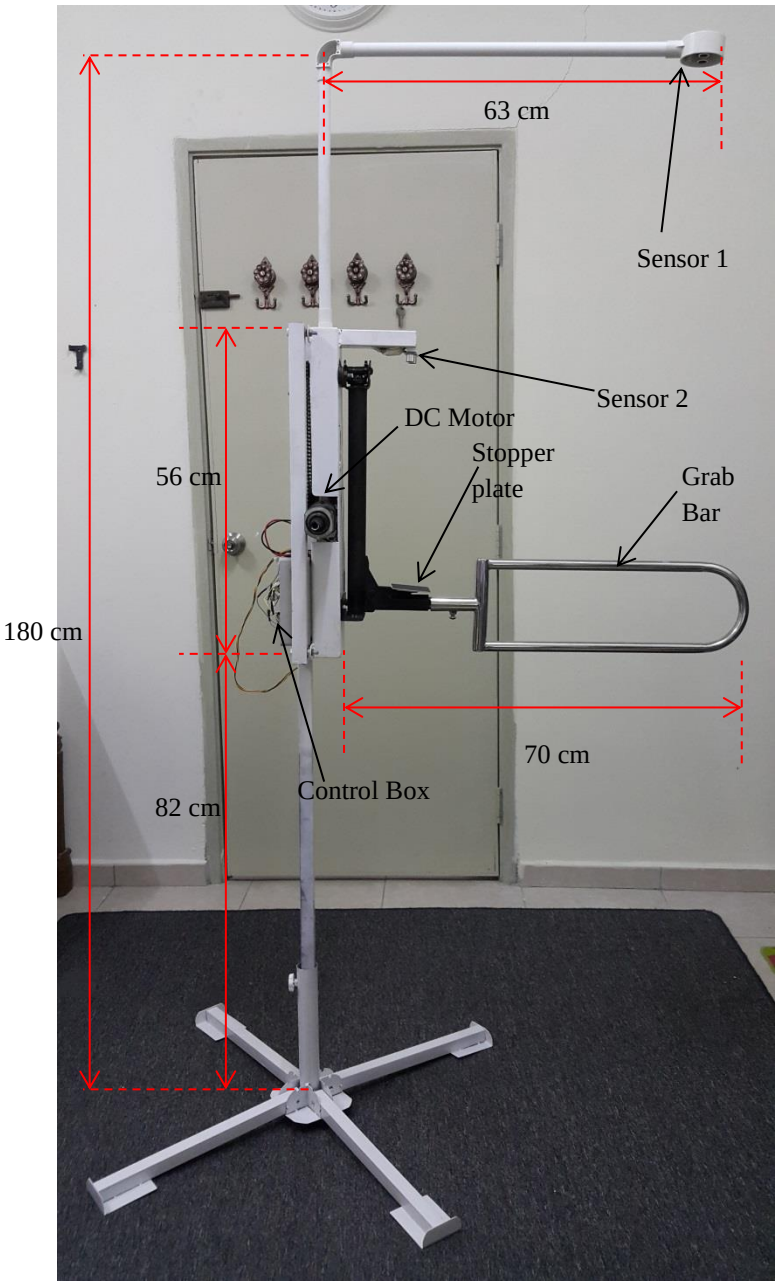

Figure 3.3: The actual design of the auto assist bar

3.4 Mechanical parts for grab bar movement

This project is focused on the design of mechanical parts for ensuring resilience to lift heavy loads. Due to the movement of the grab bar use Genuine Steel Car Lifting Jack for BMW car. Use of this jack is well suited for its ability to lift up weighing 2

tons. With such capabilities, so it can be raised to help the user to stand up and sit down without damaging the overall structure of the project. The original structure jack have a gear system which may reduce the pressure on the dc motor because of the pressure that exists at the load has been accommodated in the gear system is available on the jack. Figure 3.4 shows a genuine steel car lifting jack used to move the grab bar.

Figure 3.4: A genuine steel car lifting jack used to move the grab bar.

3.5 DC motor and gear support

Selection of a suitable dc motor is extremely important to ensure that the bar can lift users. Selection of a high torque is needed because if the motor torque is low is certainly not capable of lifting the user from sitting to standing. For this project are using the power seat car dc motor in which capacity is appropriate to the project. The rated torque of the selected motor is 100kg-cm. Normally, if torque is high then the motor will rotate slowly, while if a low torque, the motor rotation will faster.

There are 3 methods to try to achieve the objectives of this project. The experiments are made to obtain the assist bar ability to lift weights at least 80kg. The first trial is shown in Figure 3.5 in which the rectangular structure.

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