DEVELOPMENT OF FOURWHEEL - WALKER IN CEREBRAL PALSY KIDS

HARITH HAFIZUDDIN BIN AZAHA

POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ

DR. HJ. ZUNUWANAS BIN MOHAMAD
KETUA PROGRAM
IJAZAH SARJANA MUDA TEKNOLOGI KEJURUTERAAN ELEKTRO
(ELEKTRONIK PERUBATAN)
POLITEKNIK SULTAN SALAHUDDIN
ABDUL AZIZ SHAH

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HARITH HAFIZUDDIN BIN AZAHA

THESIS SUBMITTED IN PARTIAL FULFILMENT FOR THE DEGREE OF BACHELOR OF ELECTRONIC ENGINEERING TECHNOLOGY (MEDICAL ELECTRONICS) WITH HONOURS

DEPARTMENT OF ELECTRICAL ENGINEERING
POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ

2017

ENDORSEMENT

I hereby acknowledge that I have read this report and I find that its contents meet the requirements in terms of scope and quality for the award of the Bachelor Of Electronic Engineering Technology (Medical Electronic) With Honours

Signature : .... ZARINA BINTI CHE AMIN
Pensyarah Kanan DH44
Name of Supervisor : .... Jabatan Kejuruteraan Elektrik
Date : ...7/7/2017... Politeknik Sultan Salahuddin Abdul Aziz Shah

DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged.

Signature : ....

Name : HARITH HAFIZUDDIN BIN AZAHA

Registration No : 08BEU15F3031

Date : 24 MAY 2017

ACKNOWLEDGEMENT

First and foremost, I would like to express my heartily gratitude to my supervisor, Puan Zarina Binti Che Amin for the guidance and enthusiasm given throughout the whole process of this project. In addition, I would also like to thank Dr Zunuwanas b Mohamad for lending a helping hand to provide relevant information and guidance.

My appreciation also goes to my family members who has been tolerant and supporting me all these months in accomplishing my final year project. Thanks for their encouragement, loves and emotional support that they had gave to me. Million thank you also to my parents for supporting in mental and at the same time contribute time and money for my project.

Nevertheless, my great appreciation dedicated to the metal fabricating team at my hometown for helping me a lot in accomplishing this project according the schedule, especially during my hard time of task solving and troubleshooting session, who have involved directly or indirectly in my reject. Overall, thanks a lot to all of you.

ABSTRACT

Cerebral palsy (CP) is a term used to describe a problem with movement and posture that makes certain activities difficult. CP kids had difficulties in moving their muscles. Parents are often the first to notice that their kids are not developing normal such as slow to roll over, sit, crawl, or walk which is known as developmental delay. As a result, there are numerous mobility aids are designed to help with mobility limitations associated with CP. Mobility aids greatly improve a child's quality of life, as well as increase their independence. The development of a four wheel – walker is a device that use to increase the muscle strength of CP kids with mobility limitations. The device is a combination walker and DC geared motor that control by using joystick and switch to produce movement. The analysis shows that the CP kids average maximum weight can be used this walker is 50kilogram and the average maximum distance travel is 80meters. By using this device, we can increase and improve muscle strength for CP children's.

ABSTRAK

Cerebral palsy (CP) adalah istilah yang digunakan untuk menggambarkan masalah pergerakan dan postur yang menjadikan aktiviti tertentu sukar. Kanak-kanak CP mengalami kesulitan untuk menggerakkan otot mereka. Kebiasaannya, ibu bapa adalah orang yang terawal menyedari bahawa anak mereka tidak membesar secara normal contohnya seperti lambat untuk bergolek, duduk, merangkak, atau berjalan. Oleh itu, terdapat banyak alat bantuan pergerakan direka untuk membantu kanak-kanak yang ada batasan pergerakan yang berkaitan dengan CP. Alat bantuan pergerakan ini membantu meningkatkan kualiti hidup kanak-kanak CP, serta meningkatkan kebebasan pergerakan mereka. Dengan membangunkan alat bantuan pergerakan empat roda ini, ia dapat membantu kanak-kanak CP yang mengalami pergerakan terbatas, meningkatkan kekuatan otot mereka. Peranti ini adalah gabungan antara *walker* dan motor DC yang dikawal dengan menggunakan *joystick* dan suis untuk menghasilkan dan mengawal pergerakan. Analisis menunjukkan bahawa purata berat maksimum kanak-kanak CP yang boleh mengunakan alat bantuan pergerakan ini adalah 50kilogram dan purata jarak maksimum ia mampu bergerak adalah 80meter. Dengan menggunakan alat bantuan pergerakan empat roda ini, ia dapat meningkatkan dan membaikpulih kekuatan otot untuk kanak-kanak CP.

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INTRODUCTION

1.1 Background of Study

Cerebral palsy (CP) is a disorder that affects muscle tone, movement, and motor skills (the ability to move in a coordinated and purposeful way). There is no cure for the symptom. However, treatment, therapy, special equipment, and, in some cases, surgery can help children's who are living with the condition. There are many type of therapy and equipment that can help this child to continue their life. It is usually being caused by brain damage that happens before or during a baby's birth, or during the first 3 to 5 years of a child's life. This brain damage also can lead to other health issues, including vision, hearing, and speech problems and learning disabilities.

CP is one of the most common congenital (existing at or before birth) disorders of childhood. The three types of CP are spastic cerebral palsy (causes stiffness and movement difficulties), athetoid cerebral palsy (leads to involuntary and uncontrolled movements) and ataxic cerebral palsy (causes a problem with balance and depth perception). Since CP affects muscle control and coordination, even simple movements like standing still are difficult. Other functions that also involve motor skills and muscles such as breathing, bladder and bowel control, eating, and talking also may be affected when a child has CP. Cerebral palsy does not get worse over time.

Physical therapy is typically the first, and most important, step toward treating cerebral palsy. It usually begins at a young age and is geared toward improving independent motor function. The types of physical therapies used for children depend on their specific movement problems and symptoms that coincide with cerebral palsy. Physical therapy can improve strength, mobility, posture, balance, and flexibility.

This project is to develop a gait lift and transfer walker in the CP kids. Furthermore, the device is designed to improve self confidence in CP patient with limited self-mobility and physical disability.

1.2 Problem Statement

Prior to this, a prototype had been designed to support the patient at the standing position. The patient could not stand by themselves, therefore, they need a support and help from somebody to assist them to moving using walker. However, from the article "Introduction to Cerebral Palsy" written and reviewed by the My Child Without Limits Advisory Committee summarized that the CP patient always need attention from the guardian, always need assist to move and walk to help the patient be more self-independent, and help caretaker work lesser.

1.3 Objectives

This paper is focuses on the main objectives. There are the following objectives which are:

- To investigate the need of walking device for CP kids
- To develop a lift and transfer walker for CP kids
- To assists the CP kids to entrance their self-independence

1.4 Scope of Project

The purpose of this project is to develop a walker to lift and transfer for CP kids. The target for this survey, is cerebral palsy kids that age between 3 – 6 years old. The product prototype will be tested on the subject and the result will be analyses. The CP kids' walker is designed to allow the user to generate and control by themselves.

1.5 Significant of the Project

The importance of this project is to, provide a self-care activities to enhance their self-independent. Furthermore, help the parents or caretaker have less burden on the kids. The purpose of this project is to help students to learn about technology and know well about cerebral palsy patients.

LITERATURE REVIEW

Cerebral Palsy is a blanket term commonly described by loss or impairment of motor function, Cerebral Palsy is actually caused by brain damage. The brain damage is caused by brain injury or abnormal development of the brain that occurs while a child's brain is still developing — before birth, during birth, or immediately after. Cerebral Palsy affects body movement, muscle control, muscle coordination, muscle tone, reflex, posture and balance. It can also impact fine motor skills, gross motor skills and oral motor functioning.

2.1 History Of The MkII Hart Walker

The MkII Hart Walker was developed by David Hart, a bio-engineer living in Keighley, England. In the mid 1980's Mr. Hart was approached by a friend whose child had Cerebral Palsy. They inquired if he could design a walker that would give their child independent mobility. The original Hart Walker was finally developed in 1989 by

Mr. Hart, it became known as the Mk I Hart Walker. After working with the Mk I Hart Walker for four years, Mr. Hart redesigned the walker making it lighter and easier to use, thus the development of the MK II Hart Walker in 1993. In the fall of 1998 a clinical team from OrthoProActive Consultants, Inc. was trained and became the first clinicians to have the expertise to bring the Mk II Hart Walker to the children in North America. What Mr. Hart created is truly a remarkable device that has enhanced the lives of so many special needs children and their families. Mr. Hart's profound feeling is.... "May every child walk with pride, for it is their right."[1]

2.2 Assistive Technology For People With Cerebral

There are many mobility devices that help people with CP to be mobile, either to walk or to move around in another way. Any equipment should be prescribed by professional staff according to the patient's needs. The device has to be appropriate for patient's functional abilities. In the case of a child, it should be appropriate for the stage of child's development and should not hinder child's developmental progress. Equipment should be made according to the patient's measurements and it must be adjusted as growth occurs.[2]

Walking aids that help people with CP are: special footwear, ankle foot orthoses, short leg calipers, long leg calipers, reciprocal calipers, a thigh abduction splint, walking sticks, crutches, different walkers, etc. The patient's condition is one of the major factors influencing the type of the aid to use. Whenever these types of walking aids are used, attention must be given to the patient's posture, which may become too flexed at the hips and knees.[2]

2.3 Effects Of A Functional Therapy Program On Motor Abilities Of Children With Cerebral Palsy

Children with cerebral palsy typically receive physical therapy to facilitate motor development and to enhance their independence in motor skills, self-care, play, and leisure activities. Over the years, many systems of treatment have been developed (eg, neurodevelopmental treatment [NDT], the Vojta method, conductive education, sensory integrative therapy) that differ in their specific treatment strategies, but aim at leading children with cerebral palsy toward the greatest degree of independence possible. When distinguishing therapeutic approaches on their main emphasis, 2 basic principles can be recognized: (1) emphasis on normalization of the quality of movement or (2) emphasis on functional activities.[3]

Evaluation of treatment for cerebral palsy is complicated by the fact that therapists often do not use therapeutic approaches uniformly. Therefore, we first performed a pilot study in which we examined the intervention of all children who were referred to us to participate in the study. We asked their therapists to describe the methods of therapy they used with the children and their treatment goals. We concluded that all participating therapists based their therapy mainly on the principle of normalization of the quality of movement.[3]

2.4 The Help Guide To Cerebral Palsy

Stability in stance, progression and foot clearance in swing are necessary for efficient walking. Stability is disturbed in CP because of impaired balance, increased muscle tone leading to contractures and muscle weakness. The common problems in stance are equinovarus, jump knee, crouch knee and internal rotation of the legs. Progression of the body is disturbed because of weakness and contractures as well. The common problems of swing are shortened step length and impaired foot clearance such as that which occurs in stiff knee gait.[4]

The child's walking pattern changes with age. Diplegic children begin standing with the hips, knees and ankles extended and the legs crossed. Later, hip and knee flexion and ankle plantar flexion occur. Crouch occurs as the child grows older. Walking patterns are established at approximately 5 to 7 years of age. In the sagittal plane, look for three types of pathologically abnormal gait: The jump, the crouch and the stiff knee gait[4]

2.5 BEGINNING POWER MOBILITY: For young children with cerebral palsy

Research has shown that power mobility helps children with disabilities:

- Move around easily
- Do things without help
- Play and share with other children
- Initiate contact with others or with objects
- Be motivated to take part in activities
- Understand language and communicate with others
- Use their hands and arms
- Be more self-confident
- Participate with children their own age

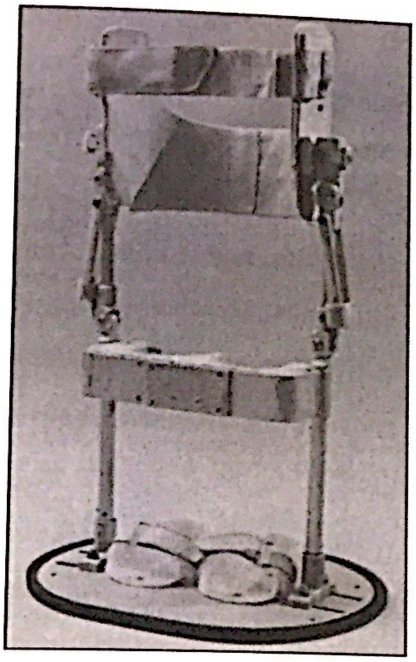
Children with CP need to be able to choose where they want to go and what they want to do. Power mobility can be one of the options that they use. Adults may use a car for long distances, a bike when they want exercise, or choose to walk a short distance. In the same way, children with CP may use walker or bike for exercise. They may be pushed in a manual chair for outings and power mobility can be used to help them play and explore like a other children.[5]

2.6 What Are The Therapies/Treatment That Offer The Most Researched Results?

Contemporaneous management of cerebral palsy can bebroadly categorized into 3 areas of focus: Child-active rehabilitation approaches. Child-active approaches are where the child is actively practicing real-life tasks during intervention (usually in real-life environments), for the purpose of gaining or consolidating real-life skills that they want to learn. Child-active approaches are consistent with current neuroscience evidence about inducing maximal neuroplasticity, and these learning-based approaches include the following features: goal-based, task-specific practice, high dose repetition, use-dependent plasticity, experience dependent plasticity, and learning-dependent plasticity.40 The distinction between child-active and child-passive approaches is of paramount importance when considering motor skill acquisition. Therapy that is: (1) ''done to the child'' for the purpose of gaining motor skills, where the child's role predominantly is passive, and/or (2) involve nonspecific motor stimulation aimed at normalizing movement—conflict with neuroplasticity evidence and for the most part have been proven.[6]

2.7 Orthotic Devices For Atnbulation Children Cerebral Palsy And Myelomeningocele

The Toronto parapodium (Fig. 10) has one lock for both hip and knee joints, whereas the Rochester parapodium has separate hip and knee joint locks. With the child standing, the parapodium should fit such that the center of the chest pad is at the xiphoid, the knee pad is across the patellae, and arid the metal portion of the trunk support clears the axillae by one to two fingers. If the metal expends too proximally, the brace may restrict arm use. If too low, the child may outgrow the appliance quickly. From the side, alignment of the trunk, hips, knees, and ankle joints should be checked. Cut-outs on the knee pad should neither be so minimal they cause knee hyperextension nor so extreme they allow excessive knee flexion. The foot mold should align the malleoli slightly posterior to the knee. The final step of a parapodium fit check involves determining whether the child's pelvis rotates to contrast swing to walking with swivel walking.[7]



(Fig. 10) The Toronto parapodium

2.8 Hip Orthoses

There is no evidence that hip orthoses (for example the SWASH orthosis) prevent progressive hip subluxation/dislocation over time. However, it is suggested that hip positioning devices (orthoses, seating, postural management devices) may produce other benefits. For non-ambulant children, hip orthoses may improve symmetry of sitting posture and comfort; outcome measures that could be assessed include range of hip motion, seated pressure mapping, and/or timed sitting tolerance. For ambulant children, hip orthoses may control scissoring of the lower limb during gait and thereby improve stability, acquisition of skills and gait efficiency. Further research is required to substantiate these potential benefits of hip orthoses. Hip orthoses are useful for positioning in postoperative management regimens.[8]

2.9 The Relationship Between Posture, Movement, Stability And Function

Posture may be defined as, "the position of one or many body segments in relation to one another and their orientation in space" (Ham et al, p26). Body 'segments' are referred to as the head, thorax, pelvis, lower limbs and feet, whilst the body 'linkages' are considered as the spinal joints, hips, knees, ankle and shoulder joints (Pope 2002). When considering posture, one should not consider it as static, but as an active and dynamic process which underpins movement and function (Hong 2005). Normally, our postures continuously shift and change position to facilitate movement to engage in functional activities. Pope (2002) identifies that posture is a prerequisite for movement. Howe and Oldham (2001) also highlight that posture and movement are inextricably linked, referring to posture as a temporary arrested movement, which is in a constant state of change. From a neurodevelopmental perspective, Nichols (2001) suggests that the development of postural control and acquisition of motor milestones are intrinsically linked. Ham et al (1998) support this assumption highlighting that there is constant neuromotor activity being used to maintain body balance and posture. Engström (2002) further suggests that biological and physiological influences affect body position and posture. This is also in addition to the somatosensory, vestibular and musculoskeletal systems (Nichols 2001).[8]

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter describes the research methodology to understand the whole system of hardware and functional in sequences. This chapter also explain the development of the system operation including the block diagram of the system in the project. It is very important to choose the right components with correct specification in order to get full function circuit. The idea applies for the hardware construction and development.

For this project, it has 3 method. That is to investigate the need of walking device for Cerebral Palsy kids, to develop a lift and transfer walker for CP kids and to assists the CP kids to entrance their self-independence. This is because the CP kids has no ability to walk and need the walking aids for them to move and walk. Children with cerebral palsy typically receive physical therapy to facilitate motor development and to enhance their independence in motor skills, self-care, play, and leisure activities. Over the years, many systems of treatment have been developed (eg, neurodevelopmental treatment [NDT], the Vojta method, conductive education, sensory integrative therapy) that differ in their specific treatment strategies, but aim at leading children with cerebral palsy toward the greatest degree of independence possible.[1]

3.2 Design Four-Wheel CP Walker

3.2.1 Over view of the device

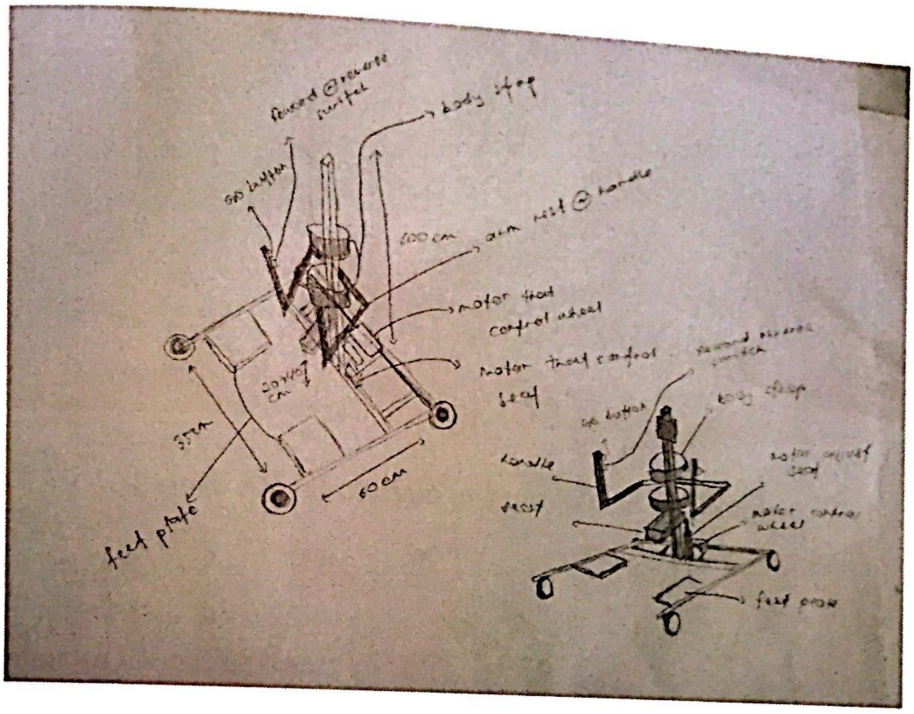


Figure 3.1: Sketch of Four-Wheel CP Walker

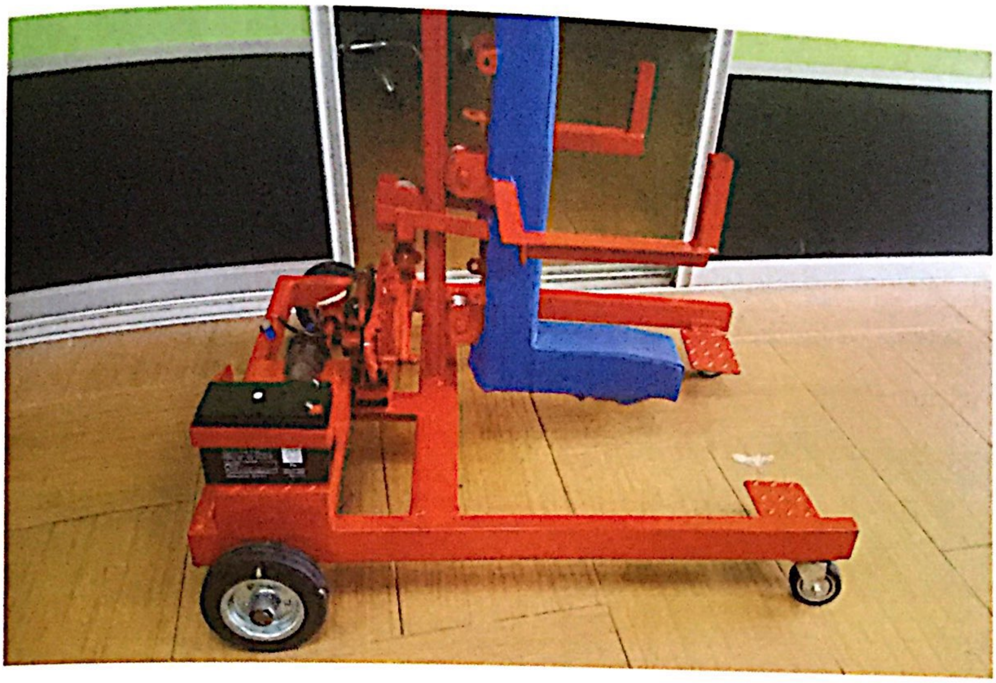


Figure 3.2 : Prototype of Four Wheel CP Walker

3.2.2 Example of Circuit Connection

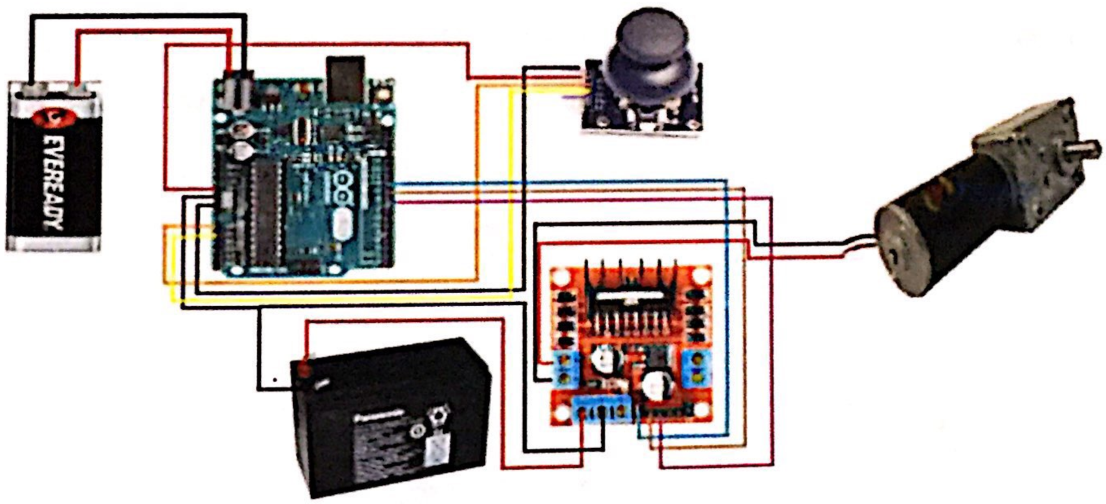


Figure 3.3 : Circuit connection

3.3 Hardware/component

For the project design, there are several electronic components and several main modules that I use. For the main module, I use it the arduino uno, L9110s and L928N H Bridge motor controller and the rotary encoder and arduino joystick module. The rest of electronic component is switch, gear dc motors and other electronics accessories. The duration to get all the component is 2 weeks. To make the programming connected with the motor, I produce a programming with arduino software to integrate with the circuit and motors.

3.3.1 Arduino Uno

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

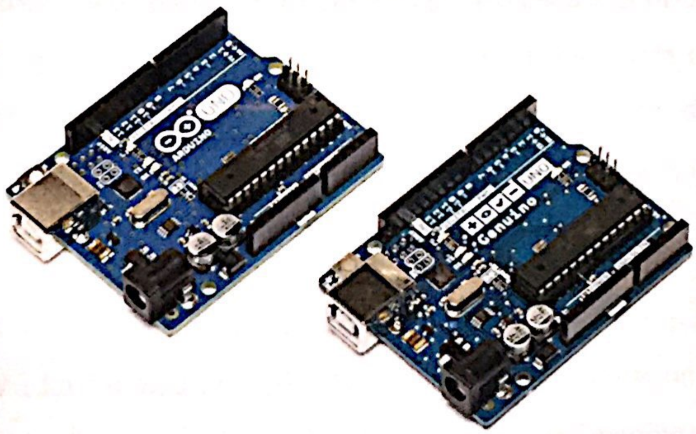


Figure 3.3.1: Arduino Uno

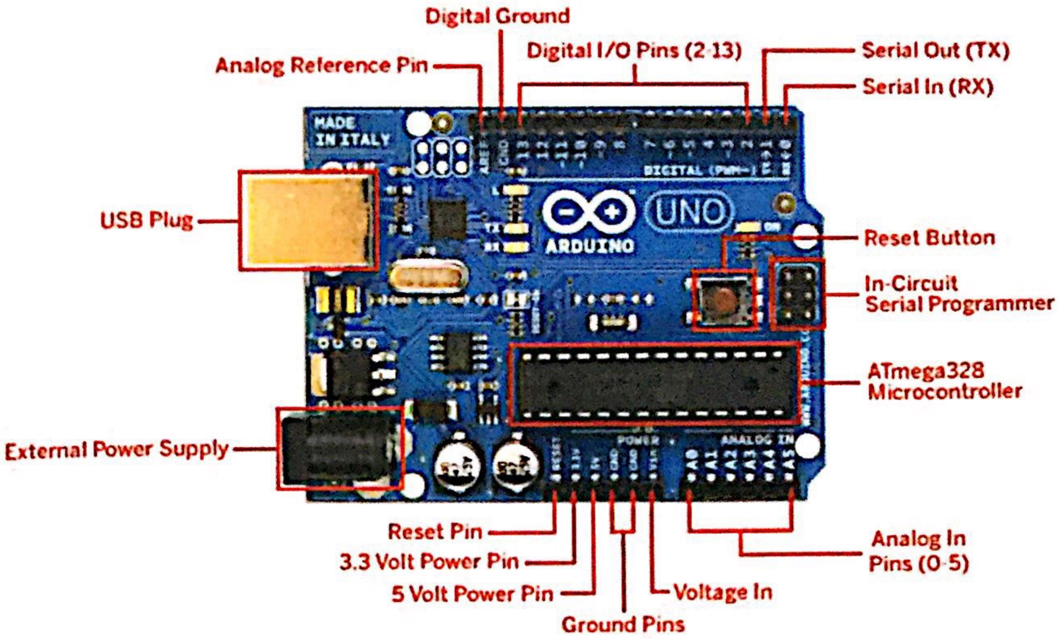


Figure 3.3.1(2): Arduino Uno Pins

3.3.2 L298N H-Bridge

The L298N is an integrated monolithic circuit in a 15-lead Multiwatt and PowerSO20 packages. It is a high voltage, high current dual full-bridge driver designed to accept standard TTL logic levels and drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the input signals. The emitters of the lower transistors of each bridge are connected and the corresponding external terminal can be used for the connection of an external sensing resistor. An additional supply input is provided so that the logic works at a lower voltage.

An H-Bridge is a circuit that can drive a current in either polarity and be controlled by Pulse Width Modulation (PWM). Pulse Width Modulation is a means in controlling the duration of an electronic pulse. In motors try to imagine the brush as a water wheel and electrons as the flowing droplets of water. The voltage would be the water flowing over the wheel at a constant rate, the more water flowing the higher the voltage. Motors are rated at certain voltages and can be damaged if the voltage is applied to heavily or if it is dropped quickly to slow the motor down. Thus PWM. Take the water wheel analogy and think of the water hitting it in pulses but at a constant flow. The longer the pulses the faster the wheel will turn, the shorter the pulses, the slower the water wheel will turn. Motors will last much longer and be more reliable if controlled through PWM.

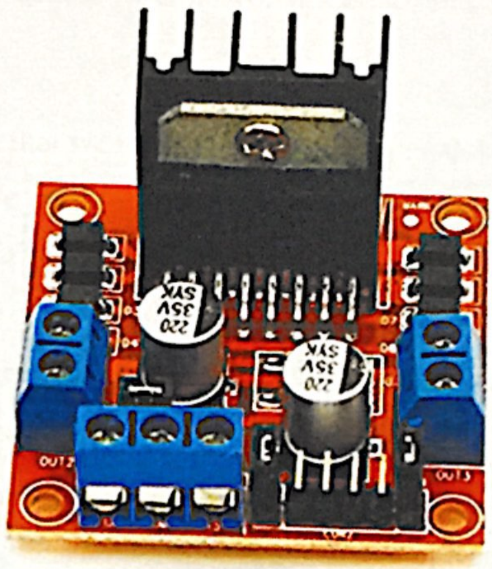


Figure 3.3.2: L298N H Bridge

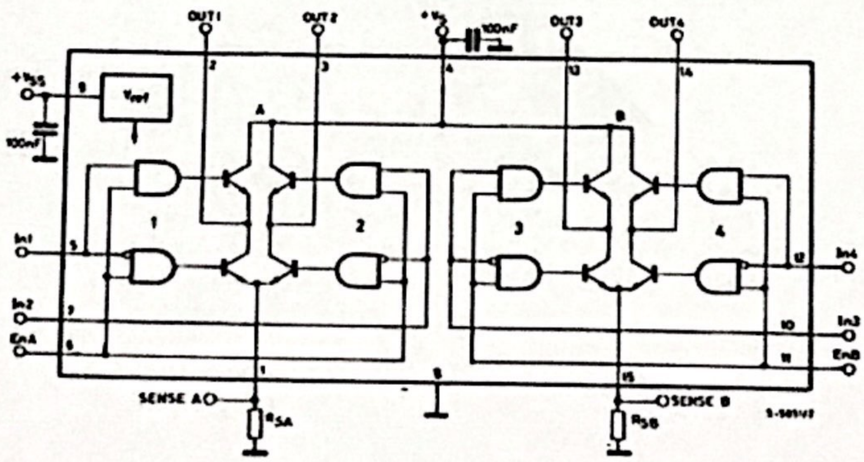


Figure 3.3.2(2): L298N H Bridge circuit diagram

3.3.3 Arduino Joystick Module

The joystick is nothing but two potentiometers that allow us to measure the movement of the stick in 2-D. Potentiometers are variable resistors and, in a way, they act as sensors providing us with a variable voltage depending on the rotation of the device around its shaft.

The kind of program that we need to monitor the joystick has to make a polling to two of the analog pins. We can send these values back to the computer, but then we face the classic problem that the transmission over the communication port must be made with 8bit values, while our DAC (Digital to Analog Converter - that is measuring the values from the potentiometers in the joystick) has a resolution of 10bits. In other words, this means that our sensors are characterized with a value between 0 and 1024.

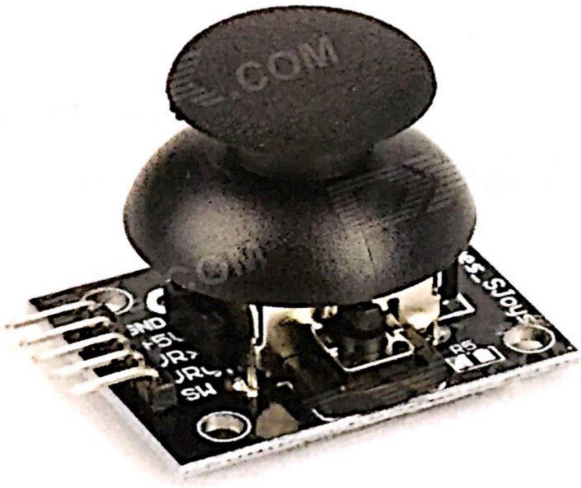


Figure 3.3.3: Arduino Joystick Module

3.3.4 12v Battery And 9v Battery

Lead-acid batteries are rechargeable batteries which require no watering. Adopting lead-tin-calcium alloy as the grid alloy, it has outstanding characteristics against severe use conditions such as overcharge, overdischarge, vibration, shock and, also for various storage conditions. The SLA battery covers a broad range of applications including VTR's, electric tools, engine starters, UPS, and other back-up power applications.

Capacity	7.2Ah
Nominal Voltage	12V
Dimensions	94 x 64.5 x 151mm
Construction	AGM
Eurobat Classification	6 to 9 Years
Terminal Type	Faston F1
Operating Temperature Range	-15 → +50°C
Weight	2.5kg
Minimum Operating Temperature	-15°C
Maximum Operating Temperature	+50°C

Table 3.3.4 12V Battery specification

Figure 3.3.4: 12V Battery

The nine-volt battery format is commonly available in primary carbon-zinc and alkaline chemistry, in primary lithium iron disulfide, and in rechargeable form in nickel-cadmium, nickel-metal hydride and lithium-ion. Mercury-oxide batteries of this format, once common, have not been manufactured in many years due to their mercury content.

Classification	"Carbon Zinc" (Zinc Chloride)
Chemical System	Zinc-Manganese Dioxide (Zn/MnO2) No Added Mercury or Cadmium
Designation	IEC-6F22
Nominal Voltage	9.0 volts
Typical Capacity:	400 mAh* (to 4.8 volts)
Capacity Test	5 mA continuous drain (21°C)
Operating Temperature	-5°C to 55°C
Typical Weight	37 grams
Typical Volume	20.3 cubic centimeters
Jacket	Metal

Table 3.3.4(2) 9V battery specification

Figure 3.3.4(2): 9V Battery

3.3.5 Geared 12 Volt Dc Motor

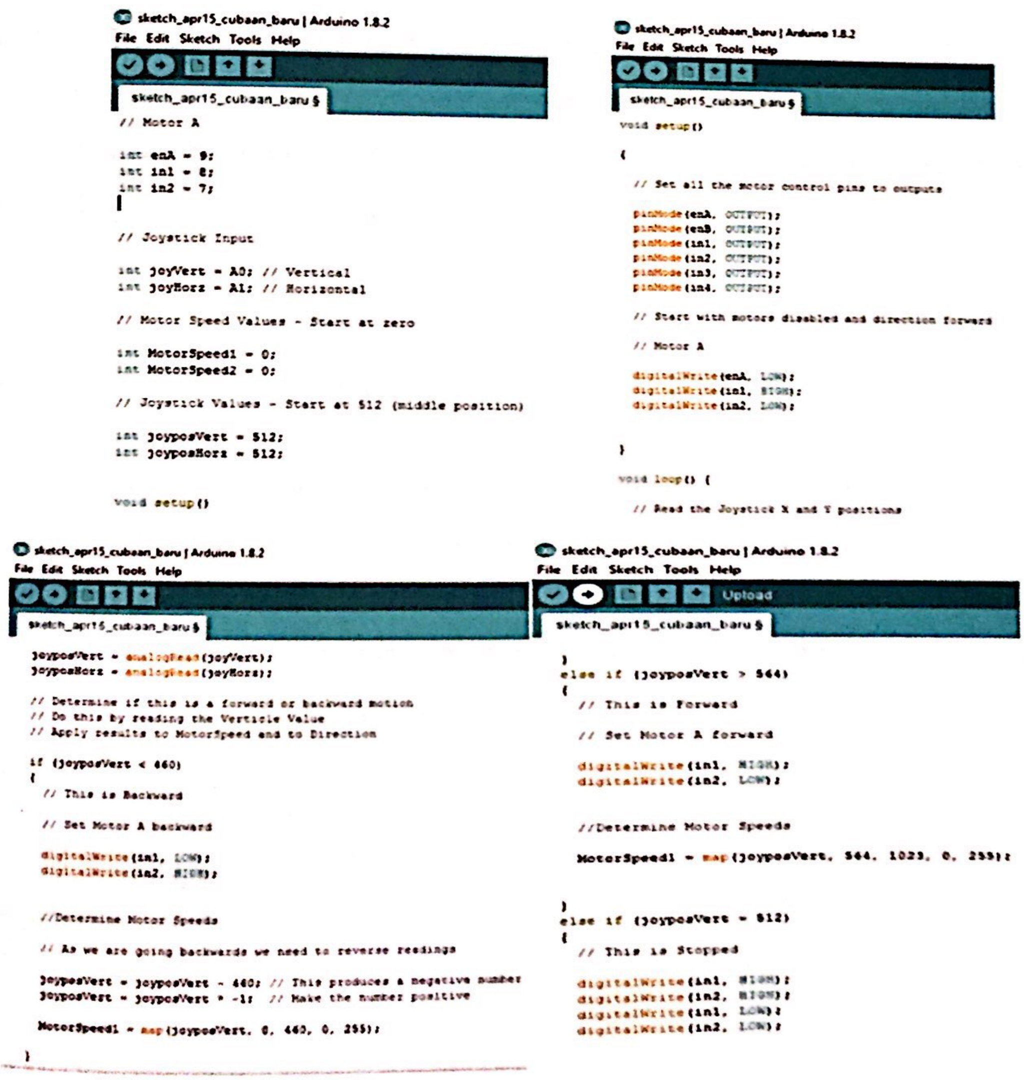
Geared DC motors can be defined as an extension of DC motor which already had its Insight details demystified here. A geared DC Motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM. The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gears in a gear motor, its speed can be reduced to any desirable figure. This concept where gears reduce the speed of the vehicle but increase its torque is known as gear reduction.

Torque	3.0Nm
Protect Feature	Totally Enclosed
Output Power	5.0W-16.0W
Certification	ROHS, Other
Construction	Permanent Magnet
Speed (RPM)	3.5-1500rpm
Voltage(V)	6V-36V
Type	Gear Motor
Commutation	Brush
Continuous Current	0.7A

Table 3.3.5 12V DC geared motor specification

Figure 3.3.5: 12V Geared DC Motor

3.3.6 Arduino Programming



```
// Motor A

int enA = 9;
int in1 = 8;
int in2 = 7;

// Joystick Input

int joyVert = A0; // Vertical
int joyHorz = A1; // Horizontal

// Motor Speed Values - Start at zero

int MotorSpeed1 = 0;
int MotorSpeed2 = 0;

// Joystick Values - Start at 512 (middle position)

int joyposVert = 512;
int joyposHorz = 512;


void setup()
```

```
void setup()

{

  // Set all the motor control pins to outputs

  pinMode(enA, OUTPUT);
  pinMode(enB, OUTPUT);
  pinMode(in1, OUTPUT);
  pinMode(in2, OUTPUT);
  pinMode(in3, OUTPUT);
  pinMode(in4, OUTPUT);

  // Start with motors disabled and direction forward

  // Motor A

  digitalWrite(enA, LOW);
  digitalWrite(in1, HIGH);
  digitalWrite(in2, LOW);


}

void loop() {

  // Read the Joystick X and Y positions
```

```
joyposVert = analogRead(joyVert);
joyposHorz = analogRead(joyHorz);

// Determine if this is a forward or backward motion
// Do this by reading the Verticle Value
// Apply results to MotorSpeed and to Direction

if (joyposVert < 460)
{
  // This is Backward

  // Set Motor A backward

  digitalWrite(in1, LOW);
  digitalWrite(in2, HIGH);


  //Determine Motor Speeds

  // As we are going backwards we need to reverse readings

  joyposVert = joyposVert - 460; // This produces a negative number
  joyposVert = joyposVert * -1;  // Make the number positive

  MotorSpeed1 = map(joyposVert, 0, 460, 0, 255);

}
```

```
}
else if (joyposVert > 564)
{
  // This is Forward

  // Set Motor A forward

  digitalWrite(in1, HIGH);
  digitalWrite(in2, LOW);


  //Determine Motor Speeds

  MotorSpeed1 = map(joyposVert, 564, 1023, 0, 255);


}
else if (joyposVert = 512)
{
  // This is Stopped

  digitalWrite(in1, HIGH);
  digitalWrite(in2, HIGH);
  digitalWrite(in1, LOW);
  digitalWrite(in2, LOW);
```

Figure 3.3.6: Arduino programming

The figure above shows how the programing process to control the motor to move forward or reverse using the joystick. First thing is to determine the output at arduino pins. As we can see I'm using 7, 8 and 9 as output pins for the motor. After that, I set all the motor control pins as output. After done with the motor, I set the joystick position. The joystick has two movement that is vertical and horizontal. For the joystick, we should set the movement first. To make sure the motor move according the movement of joystick. I have set the joystick vertically at < 460 to move backward. To make the motor move forward, I set the joystick vertically at > 564.

3.4 Software

To make sure the ability to control this project, the are some software that been use for programming, circuit designing and data analysis. Software that will be used to completing of development fourwheel - walker in cerebral palsy kids such as Arduino software (ide), Proteus 8 professional and Microsoft excel. Basically, all the source code or coding will be write in Arduino based (ide) and will try on Proteus to see whether the coding is running correctly or not.

3.4.1 Arduino Software (ide)

Arduino is an open source, computer hardware and software company, project, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. It run on Windows, Mac OS X and Linux. The environment is written in Java and based on Processing and other open-source software. It is easier than the ordinary microcontroller.

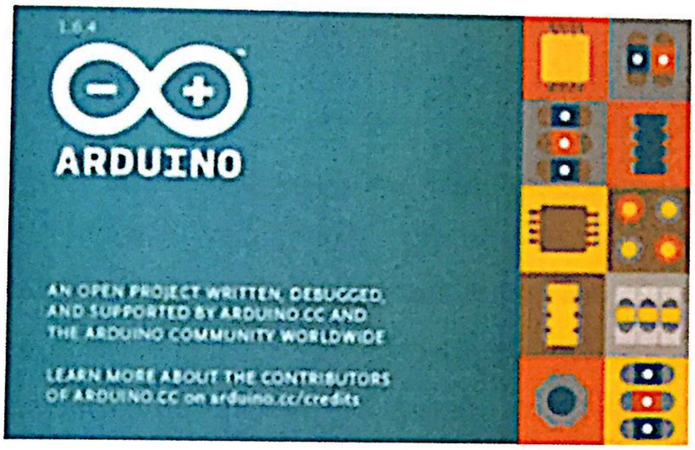


Figure 3.4.1: Arduino software ide

3.4.2 Proteus 8 profesional

Proteus 8 is a best simulation software for various designs with microcontroller. It is mainly popular because of availability of almost all microcontrollers in it. So, it is a handy tool to test programs and embedded designs for electronics hobbyist. It can simulate programming of microcontroller in Proteus 8 Simulation Software. After Simulating the circuit in Proteus 8 Software it can directly make PCB design with it so it could be an all in one package for students and hobbyists.

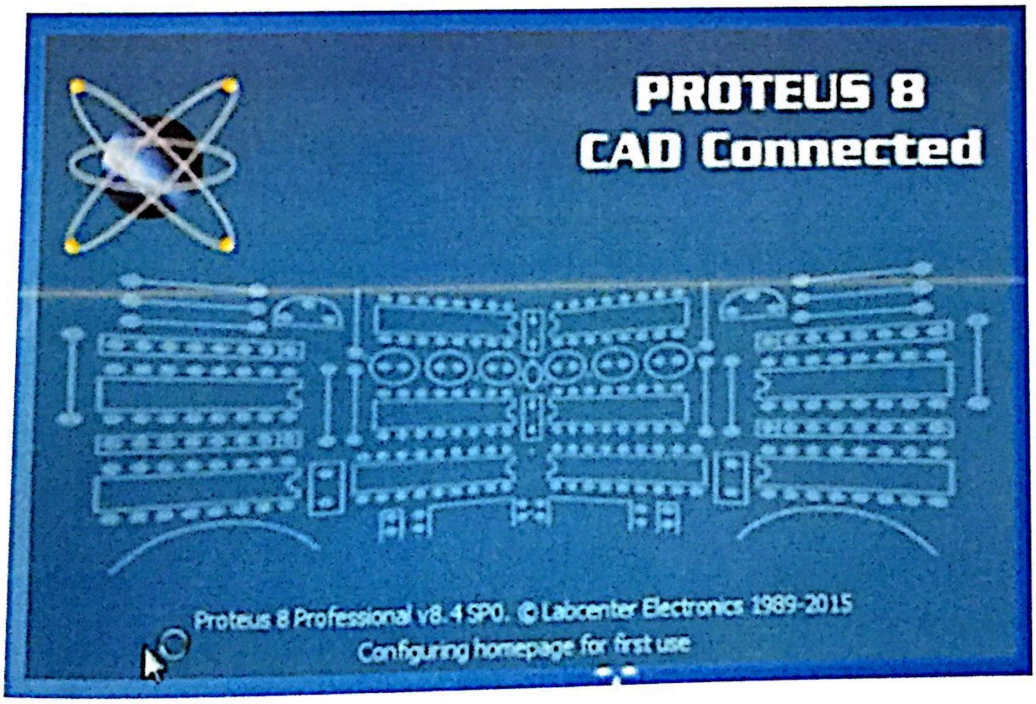


Figure 3.4.2: Protues 8

3.4.3 Microsoft Excel

Excel is an Electronic Spreadsheet Program. An electronic spreadsheet is a computer software program that is used for storing, organizing and manipulating data. Electronic spreadsheet programs were originally based on paper spreadsheets used for accounting. As such, the basic layout of computerized spreadsheets is the same as the paper ones. Related data is stored in tables - which are a collection of small rectangular boxes or cells organized into rows and columns. Current versions of Excel and other spreadsheet programs can store multiple spreadsheet pages in a single computer file. The saved computer file is often referred to as a workbook and each page in the workbook is a separate worksheet.

Figure 3.4.3: Microsoft excel

3.5 Flow Chart

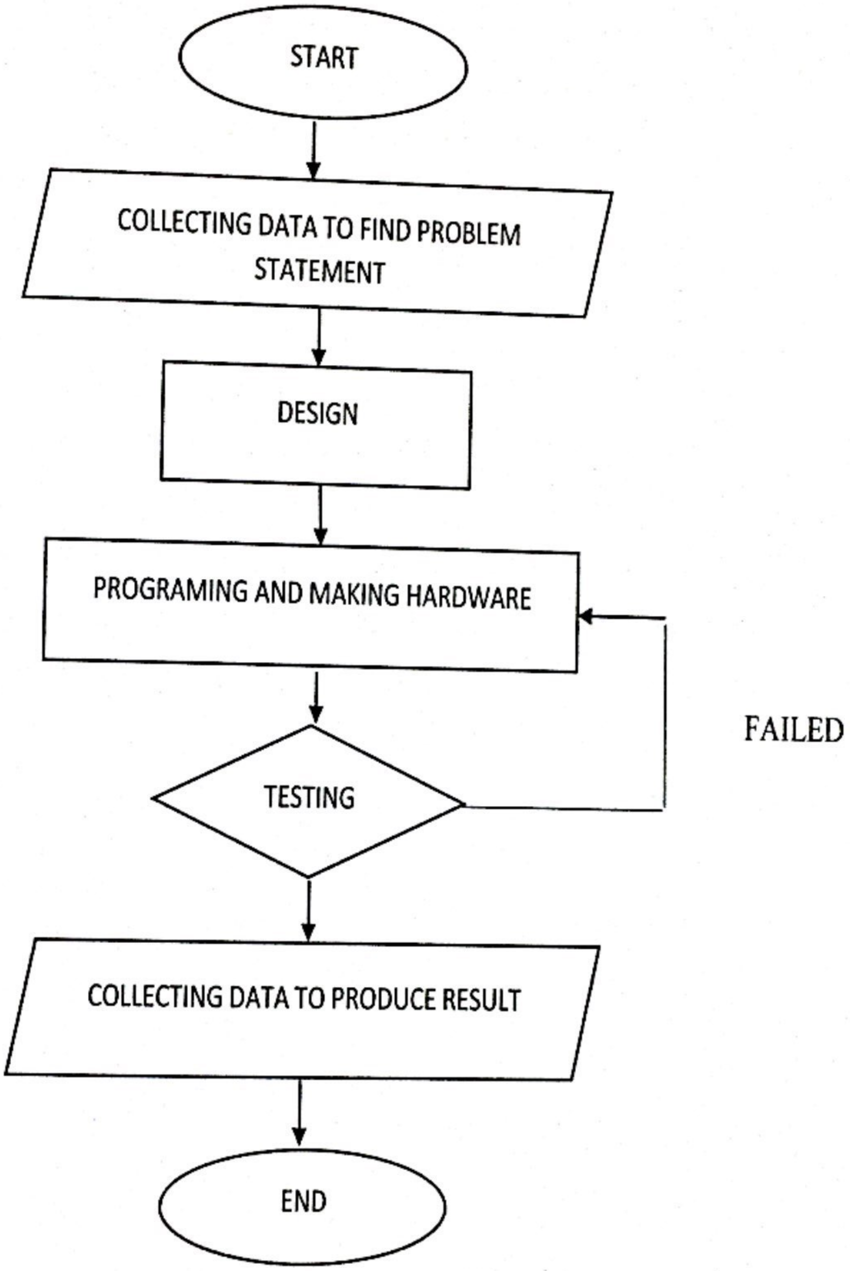
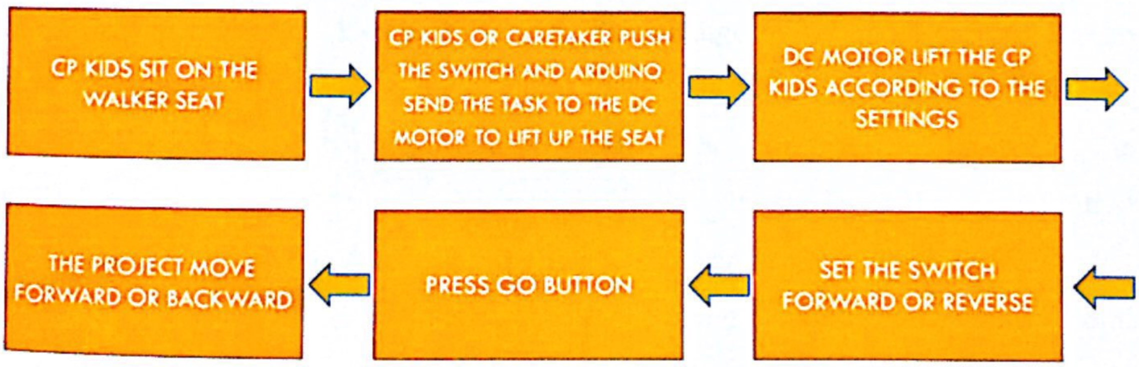


Figure 3.5: Flow chart of project

Based on the flow chart, it shows the step of process how I do the project. First thing that I do is make a data collection about cerebral palsy. I also make a research about history the previous cerebral palsy walking aids. After the collecting data is finished, I determine the problem statement for this project. After the confirmation on problem statement, process making the project design is proceed. Starting with the size of the project, I make an observation on cerebral palsy kids that age between 3 until 6 years. After that I calculated the size to get the average size of CP kids. After that, I make the arduino programming to integrate with the circuit I designed. The whole progress takes 2 weeks to finish it. After finished make the programming and design the circuit, I test it on proteus 8 simulation.

After finish tested the program and hardware where it functioning smoothly or got an error, I will get back to the programming process and making hardware to troubleshoot what is the problem. After done the troubleshooting process, next step is collect the data and result of this project whereas it have achieve the project objective or not. The last process is make the conclusion and recommendation about the project.

3.6 Block Diagram



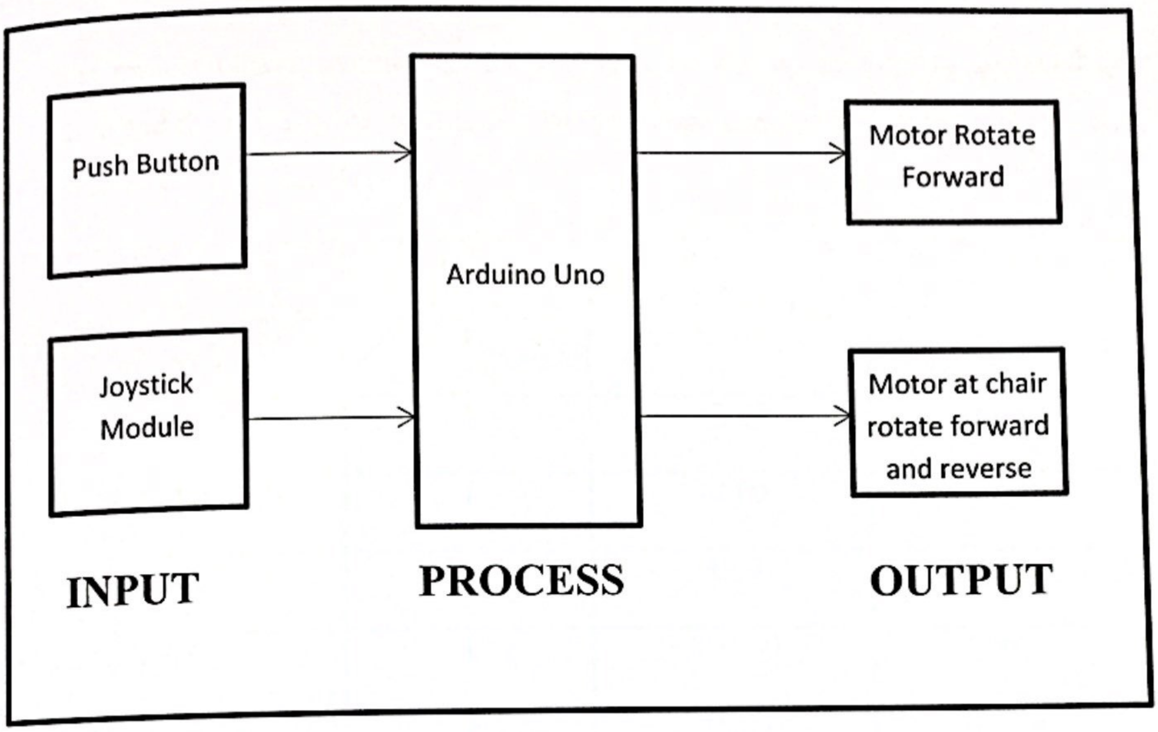


Figure 3.6 : Block diagram

This block diagram has shown of the process using fourwheel - walker in cerebral palsy kids. The cerebral palsy kids as the input. The change of height of the seat at the fourwheel walker is control by the cerebral palsy kids. It is by powered the gear DC motor and will control it upward and downward. The output for this process is the controller of the seat and the cerebral palsy kids will self-stand with that. Besides that the cerebral palsy kids can determine whether he/she want to walk by own self or to use the motor. If the cerebral palsy kids want to move using the motor, they can control it by set the switch to forward or backward. Then the cerebral palsy kids just press the go button and the walker will move according to the switch that set by the cerebral palsy kids.

3.7 Estimation Cost Of Project

For this project I have planned to use low cost for the component to archived my objective and the price is reasonable for everyone that capable to use it. So this is cost of project to develop this device.

COMPONENTS	QUANTITY (UNIT)	PRICE (PER UNIT)	PRICE (RM)
ARDUINO	1	50.00	50.00
L928N	1	12.00	12.00
JOYSTICK MODULE	1	14.00	14.00
PUSH BUTTON	1	3.00	3.00
FRAME WORK	1	800.00	800.00
CASING	1	25.00	25.00
CABLE (PER METER)	4	0.70	2.80
12V BATTERY	1	70.00	70.00
9V BATTERY	1	5.00	5.00
2nd HAND DC MOTOR	2	50.00	100.00
OTHERS	-	50.00	50.00
TOTAL	RM 1,131.80		

Table 3.7: Cost of project

3.8 Gantt Chart Of The Project For First Semeter

Table 3.8: Gantt chart of the project for first semester

Progress / week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Choose project tittle														
Make research														
Initial proposal														
Development the device														
Defend proposal														
Log book														

Table 3.8 shows the Gantt chart of the project for semester 1. It is a plan to conduct on this project. On week 1 and 2 the project progress will be choose the tittle of project and write the report in log book. On week 3 until 4 is the time to make a preparation for initial proposal also make a research about this tittle and write the report on logbook. On week 7 until 13 was planned for a defend proposal.

3.9 Gantt Chart Of The Project For Second Semester

Table 3.9: Gantt chart of the project for second semester

Progress / Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Development of the device														
Collect data														
Thesis Writing														
VIVA														
Log book														

Table 3.7 shows the Gantt chart of the project for semester 2. It is a plan to conduct on this project. On week 1 until 6 the project progress will be development of device and write the report in log book. On week 4 until 8 is the time to collect some data from survey questions and also write the report on logbook. On week 7 until 12 was planned for a thesis writing. On week 12 and 13 is a VIVA presentation.

CHAPTER 4

DATA ANALYSIS

4.1 Introduction

This chapter will cover the explanation of data analysis. In this part, it is implement analysis and collection of data. Through this data collection, it can help to make comparison between the weight and distance while using the four-wheel walker in cerebral palsy kids. There are several parts that constructed in completing the four-wheel walker in cerebral palsy kids. All the data is recorded in tabulated data and graph form.

4.2 Questionnaire

Through this part, the questionnaire is conducted among public and respondent at Rumah Ramah Seksyen 10 Shah Alam. Apart from that, all the data in the survey form is tabulated in graph bar below. As overall, through the data collected from this questionnaire showed positive feedback in development of Four-wheel - Walker For Cerebral Palsy Kids.

From what we can see at graph below, 100 percent of respondent are agree about difficulty to move for cerebral palsy kids and 90 percent have a special equipment for cerebral palsy kids to move at home. They also told that the previous equipment are difficult to operate. About 40 percent agree about that. Question about having a CP walker at home also has been asked to them, only 20 percent of them are have the CP walker at home. Then, the question about their opinion on exist CP walker with electronic motor would help CP kids walking and move been asked. Only 60 percent of them agreed about in. Next, 80 percent of them believe that usage of material for the project is suitable. They believe that walker using motor and adjustable seat is very effective for the CP kid. For this question 80 percent of them agreed. 90 percent of them agreed that current walking aids need to be improve. Lastly, 90 percent of the parents are agreed about the walking aid is helping the CP kids with their daily activity

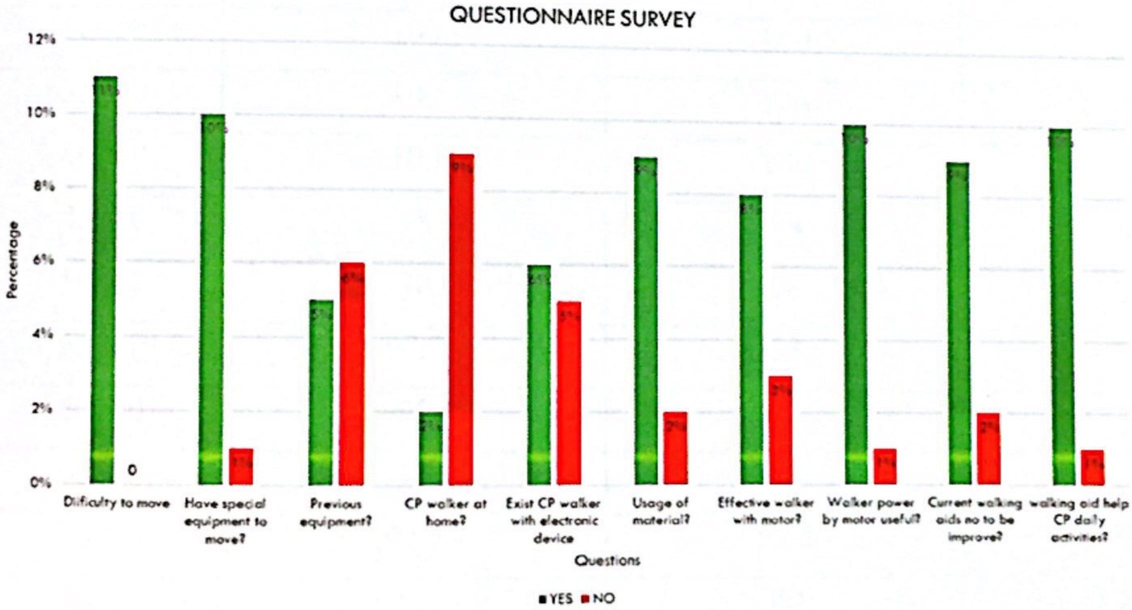


Figure 4.1: Graph survey questionnaire

4.3 Performance analysis of four wheel walker

For performance test of the four-wheel walker, the parameter use for the test is the weight of user and the distance travel. For weight parameter, the unit use for collecting the data is gram (g). Meanwhile, for distance parameter, the unit use for collecting the data result is in meter (m). this four-wheel walker can travel up to 100 meter if no weight had been applied. The walker ability to transfer according to the weight had been apply on the walker.

Weight (g)	Distance test 1 (m)	Distance test 2 (m)	Distance test 3 (m)
10000	100	100	100
15000	100	100	100
20000	100	100	100
25000	100	100	100
30000	100	100	100
35000	100	100	100
40000	100	100	100
45000	98	98	98
50000	98	98	98
55000	97.7	98	98
60000	95	95	95
65000	93	93	93
70000	92.5	92.5	92.5
75000	80	80	80
80000	73	73	73
85000	71	71	71
90000	66	66	66
95000	60	60	60
100000	57	57	57
105000	41	39	40

Table 4.3 Distance travel with weight applied

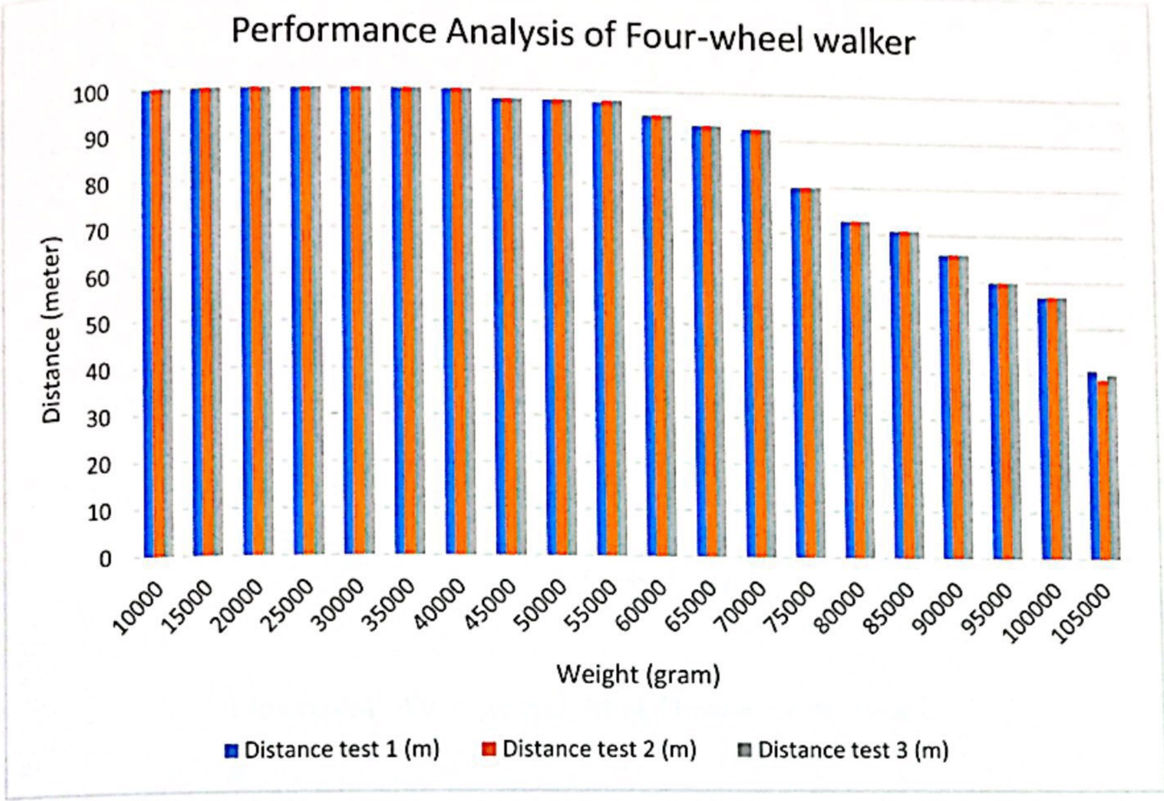


Figure 4.3 Performance Analysis of Four-wheel walker

4.4 Average Weight Vs Average Distance Analysis

For this part, , average weight vs average distance test had been done to calculate how far the walker can travel constantly. For the test, 80kg load had been applied on the walker and test how far the walker can travel until the walker stop by itself. The test had to been done 3 time to get a perfect result. The table below will show how the test have been done.

Average Weight	Distance (m)
test 1 (57500g)	86.11
test 2 (57500g)	86.025
test 3 (57500g)	85.975

Table 4.4 Average weight vs Distance Table

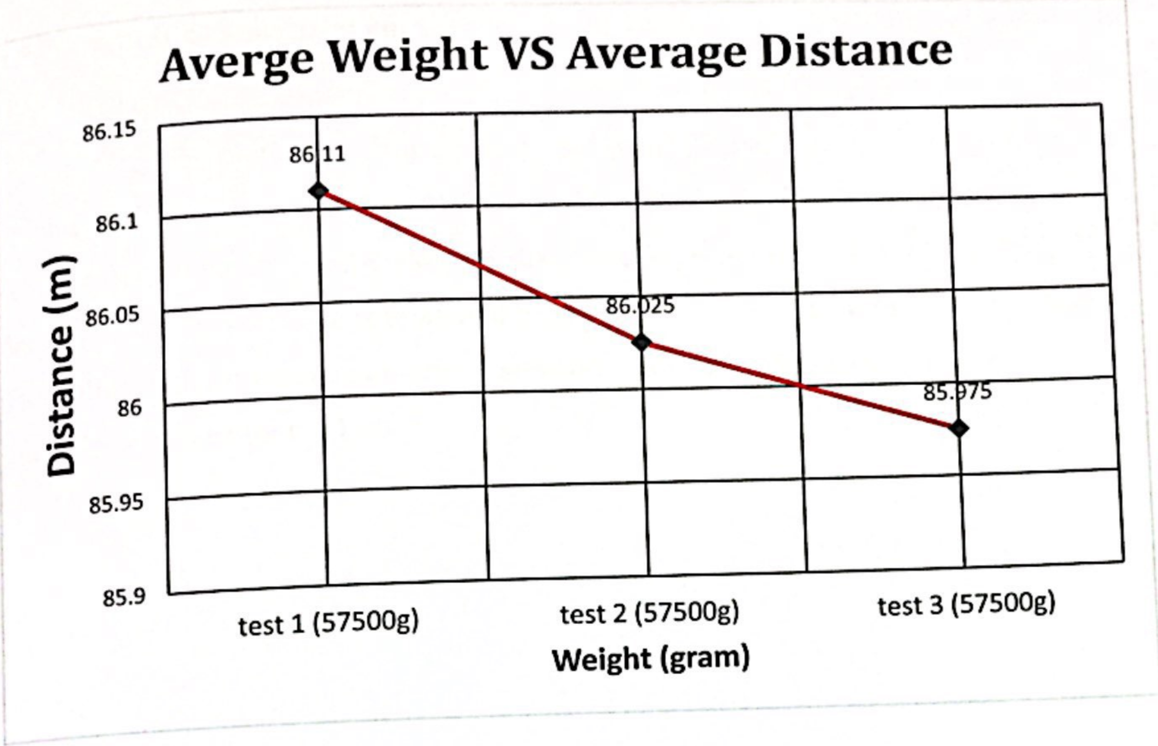


Figure 4.4: Average weight vs Distance Line Graph

Figure above show a line graph of the average test. As we can see that the distance is decreasing. This is because the walker is already 40kg and adding the load 58kg, so the total weights the walker will be 98kg. The weight factor is important because the heavier the load the shorter distance the walker will be travel. The line graph also show that constant load applied to the walker but the distance still decreasing. This is because the power from the battery is decreasing. As the mention earlier, the test had been 3 time using the same battery.

4.5 Questionnaire post survey

After completing hardware part, to see reliability of the device, data collection among public and respondent at Malaysian Association for The Blind. Through this part, the questionnaire (post-survey) is distributed among them. Apart from that, all the data in the survey form is tabulated in graph bar below. As overall, through the data collected from this questionnaire showed positive feedback in development of four-wheel walker for CP kids

POLITEKNIK
Sultan Salahuddin Abdul Aziz Shah
Jabatan Pengajian Politeknik

SURVEY QUESTIONNAIRE – DEVELOPMENT OF FOUR_WHEEL WALKER FOR CP KIDS

DISCLAIMER:

This survey is based on final year project of Bachelor of Electronic Engineering (Medical Electronic). The name of this device is Four wheel walker. The aim of this survey is to understand the device after the pre-survey is done. It can be helpful to improve and to enhance the device in future. It is also to analyze the device in getting the correct readings and measurement. Participation of this survey is completely voluntary and anonymous. You may choose to discontinue this survey at any time. No harm will befall to anyone of the participation. This device is focusing for below three months age. All the data will be recorded and analyzed.

CONSENT:

I have read and understood all the information written above. My participation in this survey is voluntary and I am willing to share necessary information for this survey.

This survey is divided into three sections. Section A, B, and C.

SECTION A

1. Are you agree that this device is suitable to use?

☐ Yes
☐ No

2. Are you familiar with this device? Do you heard about similar device like this before?

☐ Yes
☐ No

3. Do you understand the function of this device?

☐ Yes
☐ No

4. If this device is in market, do you prefer to have it?

☐ Yes
☐ No

5. Which one of the method did you prefer?

☐ Normal walker (current)

☐ Upgraded walker

6. Is this device is suitable to use and help CP kids?

☐ Yes

☐ No

SECTION B

Directions: Please check and rate yourself honestly based on what you actually do given the statements using the following scales:

5 - Very satisfied 4 - Somewhat satisfied 3 - Neither satisfied
2 - Somewhat dissatisfied 1- very dissatisfied

NO	STATEMENTS	5	4	3	2	1
1	Is this device convenient to use?					
2	Is this device easy to use for CP kids?					
3	Can this device is safe to use to CP kids?					
4	Do you agree if this device placed in market of our country?					
5	Do you think caretaker @ parents of CP kids will use this walker?					

SECTION C

Please rate how strongly you agree or disagree with each of these statements.

Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I happy use this product.					
This product is safe to use.					
I would purchase this product.					
This product brings more benefit to user.					

Recommendation / Comments:

____

____

____

____

Signature,

____

Date:

Figure 4.5: Example Questionnaire

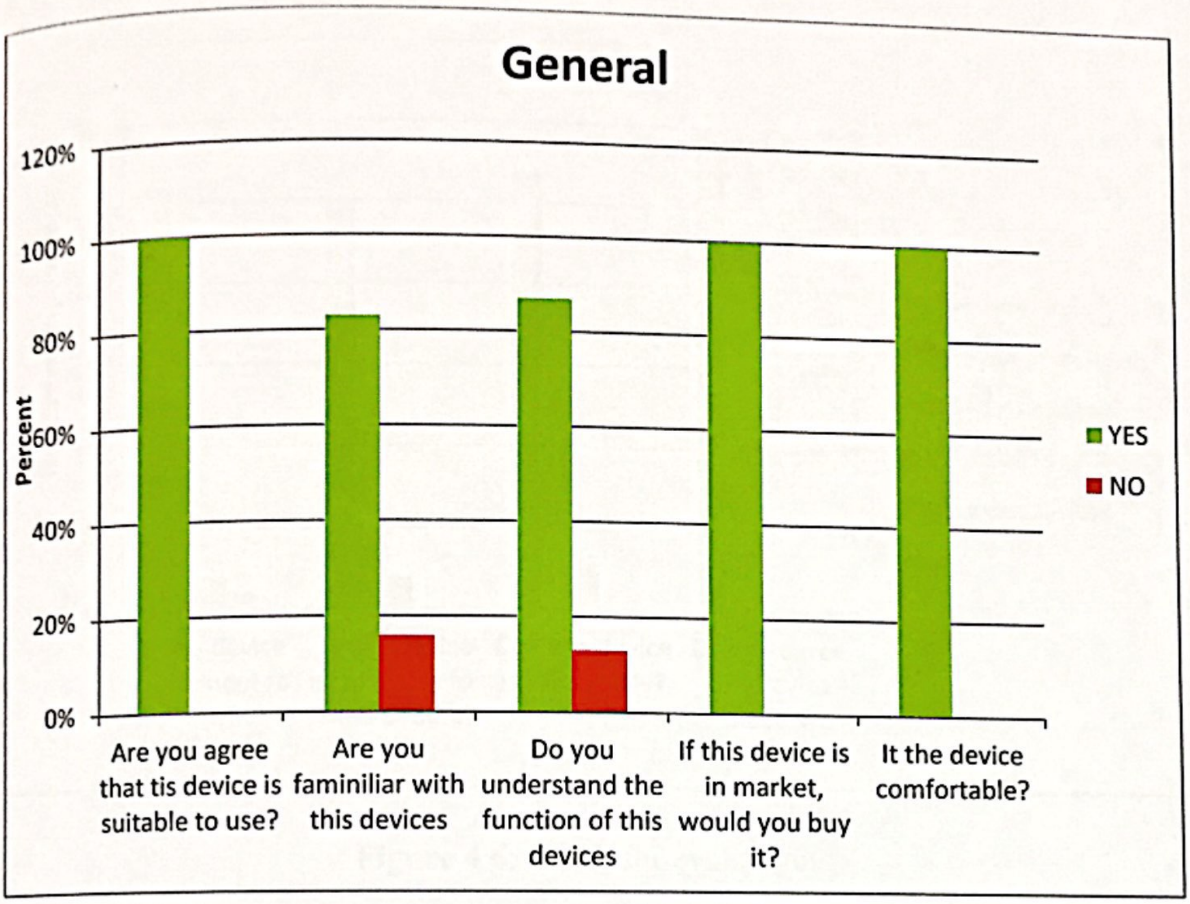


Figure 4.5(2): Graph for General

From figure 4.5 shown the data of general question about the device. 100% agree that this device is suitable to use and some of respondent not familiar with this device but 83% familiar with this device. 87% agree that they know and understand function of this device and 100% of respondents agree to buy this device in market and also agree this device comfortable.

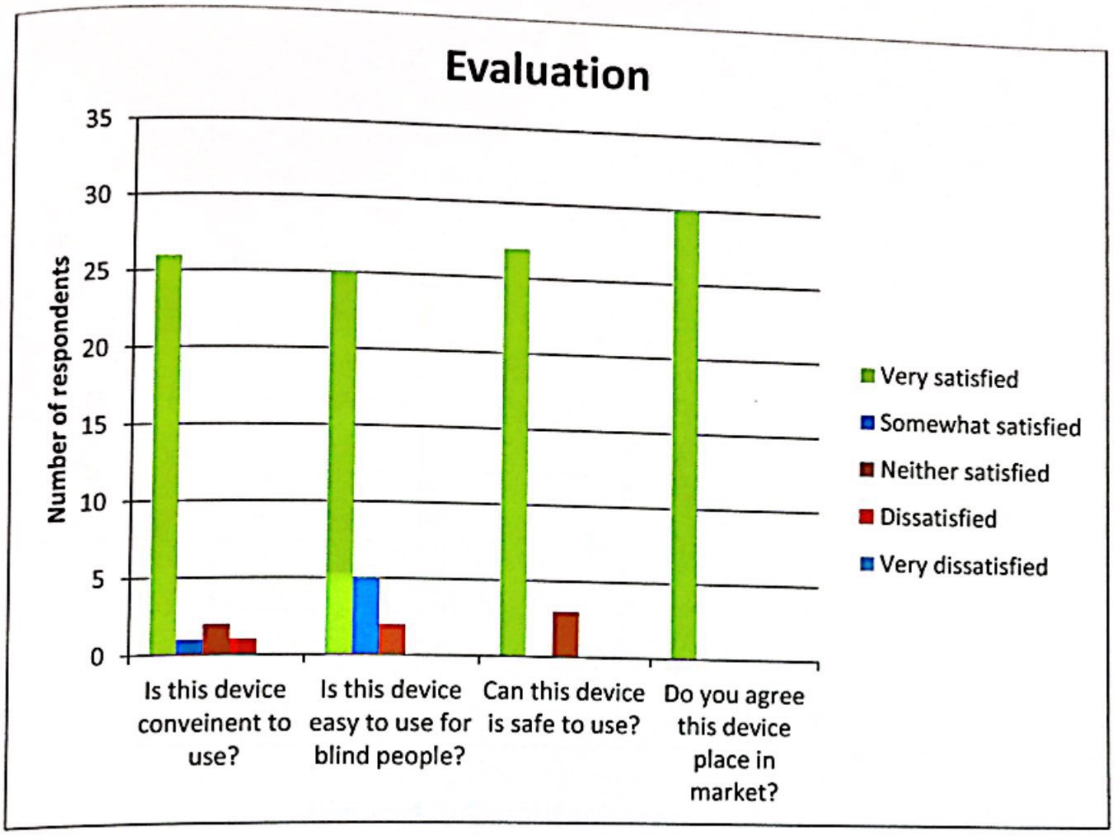


Figure 4.6: Graph for evaluation

From figure 4.6 above shown data for evaluation of device. 26 of respondent very satisfied that this device convenient to use and 24 respondents also very satisfied that this device easy to use for CP kids. 30 respondents say they agree this device place in market and 27 among them say this device is safe to use.

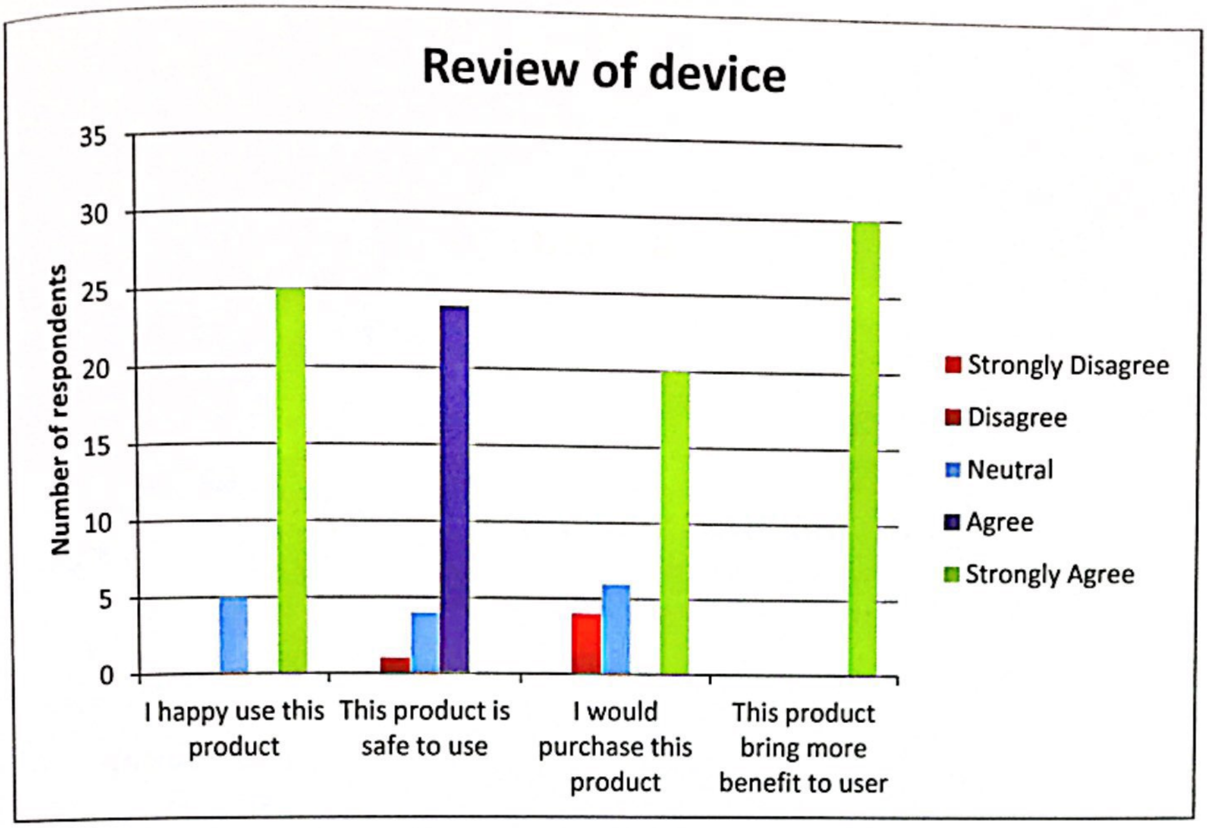


Figure 4.7: Graph for Review of device

From figure 4.7 above shown of data for review of device. 25 respondents strongly agree that they happy use the product and 30 respondents strongly agree the product bring more benefit to user.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Introduction

This is the last chapter in this writing. This section can lead to a conclusion, summarization and recommendation about The Development of Four-Wheel Walker For Cerebral Palsy Kids. Based on the previous chapter, there is a lot of knowledge and the information and there is also data collection in order to prove the accuracy, correlation and learning process in designing The Development of Four-Wheel Walker For Cerebral Palsy Kids

5.2 Conclusion

By using prototype of this walker, they can feel that their standing like a normal child. Beside that it also can help them to train their leg muscle become stronger than usual. The geared DC motor that attach at the seat helping them to adjust their height according the comfortable. If they feel tired they can seat and control the walker using the joystick provided. Furthermore, the battery that use at the walker is rechargeable and no need to buy the new battery.

In conclusion, the development of the four-wheel - walker for CP kids helping them to simulate their muscle to be able walking as normal kids. This walker also can assist the CP kids lift and transfer them, also to entrance their self-independence. The walker is also suitable to use in the house because of its size and easy to maneuver.

5.3 Recommendation

After carrying out this project, a development four-wheel walker for cerebral palsy kids can be found many benefits to consumers primarily by the caretaker or parents because the system is functioning and helping the cerebral palsy kids to move and transfer. The walker gives big impact for the cerebral palsy kids compare to the existing product. The component used for this project also a fundamental component and commonly used in electronic circuit.

However, the walker has some weakness or disadvantage but it still can be overcome for the next researcher. The weakness of this walker is the design is look too bulky. It will great if the framework design has a curved edge. To overcome other disadvantage of this project, there are several recommendations were made to improve the project.

- Make the adjustable seat can move higher
- Insert a braking system
- Make the framework lighter
- Make the motor can move left and right
- Add some vibrator at the seat to simulate CP kids muscle
- Provide the charger circuit for easy charging when the battery run out

REFERENCES

[1] H. W. System, *Clinical Medical Policy Clinical Medical Policy Hart Walker System*. 2000.

[2] A. Zupan and M. Jenko, "Assistive technology for people with cerebral palsy," *East. J. Med.*, vol. 17, no. 4, pp. 194–197, 2012.

[3] M. Ketelaar, A. Vermeer, H. Hart, E. van Petegem-van Beek, and P. J. Helders, "Effects of a functional therapy program on motor abilities of children with cerebral palsy.," *Phys. Ther.*, vol. 81, no. 9, pp. 1534–45, 2001.

[4] R. Cummins, *Cerebral palsy*. 2011.

[5] A. S. Hill, "BEGINNING POWER MOBILITY : For young children with cerebral palsy," no. 604, pp. 5–8.

[6] I. Novak, "Evidence-Based Diagnosis, Health Care, and Rehabilitation for Children With Cerebral Palsy.," *J. Child Neurol.*, vol. 29, no. 8, pp. 1141–1156, 2014.

[7] L. M. Knutson and D. E. Clark, "Orthotic devices for ambulation in children with cerebral palsy and myelomeningocele.," *Phys. Ther.*, vol. 71, no. 12, pp. 947–960, 1991.

[8] D. Condie and C. Morris, *Recent Developments in Healthcare for Cerebral Palsy: Implications and Opportunities for Orthotics*. 2009.

[9] http://machinedesign.com/sensors/basics-rotary-encoders-overview-and-new-technologies-0

[10] https://www.arduino.cc/en/Main/ArduinoBoardUno

[11] http://www.engineersgarage.com/insight/how-geared-dc-motor-works

[12] http://www.robotic-studio.net/2015/08/tutorial-learn-to-use-dc-motor-driver.html#.WEZgKuZ97IU

[13] https://brainy-bits.com/tutorials/l9110s/