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# SMART STAND-UP WHEELCHAIR FOR LEGDISABLE PEOPLE

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## Abstract

This project discusses about the advance system that can be used by leg disable patient. They always face difficulties for reaching places for example from wheelchair to bed and vice versa. Some of them try to use walker that have higher risk of losing balance and fall that can cause injuries. In order to avoid these cases, this smart stand up wheelchair can be used. This system is equipped with gear DC Brush motor, linear actuator, battery, wheelchair, Arduino ATMEGA2560 as the microcontroller and ESP 8266 Wi-Fi module as Internet of Thing (IoT). The user can control the wheelchair to achieve their desire movement. User can move the wheelchair by using their phone with the Blynk apps. They can toggle the joystick display in the Blynk to move forward, backward, left and right position. In addition, to make the wheelchair rise, user can press the up button in the Blynk app and to come back to the same position they can press the down button. In conclusion, this project is one of the best ways to reduce dependencies on care taker and user can move around more conveniently.

*Keywords:* Internet of Things (IoT); Arduino AT Mega 2560; Blynk apps; Microcontroller, Parallax Data Acquisition (PLX-DAQ)

## 1.0 INTRODUCTION

The World Health Organization (WHO) defines disability as an umbrella team, covering impairments, activity limitations, and participation restrictions. An impairment is a problem in body function or structure,an activity limitation is a difficulty encountered by an individual in executing 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 [1]. In 2013, the Christopher and Dana Reeve Foundation unveiled staggering statistics based on research into the prevalence of paralysis across the United State. According to the study, there are nearly 1 in 50 people living with paralysis [2].

Malaysia also has many patients with disability for example leg disable person, stroke, spinal cord injury and so on. These disabilities limit them from moving around and in need of care taker. This project is focus more on leg disable person where developing a smart stand up wheelchair to ease their movement every day.

Smart stand up wheelchair is design to facilitate the movement of patient. It can be controlled by patient desired movement whether left or right, forward or backward and up and down. The angle of up and down also can be controlled by patients. Blynk was used for patient to select the movement and Arduino ATMEGA2560 was used to execute the program.

## 2.0 EXPERIMENTAL

System configuration refers to the configurations ofthe machine resource allocated to a specific device. By modifying these settings, many professionals will improve the system performance. All hardware devices have configuration settings that can affect the overall performance and function of the system.

### A. Mechanical Design Structure

The wheelchair is divided into two major parts. The first parts are physical layout whereit shows the design of the wheelchair. The second part are electrical and hardware layout where all these parts are located underneath the seat of wheelchair. Based on the fig 1 below, it shows the solid work of the wheelchair and mechanical part such as gear brush DC motor, linear actuator, battery can be seen. The wheelchair is powered by a 12V battery and is connected to the Arduino. Then, the ESP 8266 Wi-Fi Module will be connected to the Arduino user on the hotspot at their phone. After that, whatever output decide by Arduino, will be displayed through the Blynk apps. Fig 2 shows the actual prototype of the wheelchair.

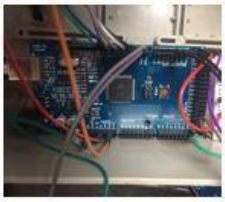
Fig 1: Solid Work of Wheelchair

Fig 2: Actual Prototype of Wheelchair

### B. Hardware Implementation

Table 1 below will show the implementationsof hardware and electrical parts.

Table 1: Hardware and electrical Development

| Hardware Item | Electrical Development | Function |
|---|---|---|
|  |  | The Arduino Mega 2560 is a microcontroller board used for this project due to it have more i/o pins than other board. |
|  |  | The 5V 4-Channel Relay interface board is used to control movement of motor to move forward, reverse, left and right. |
|  |  | The 5V 4-Channel Relay interface board is used to control the movement of actuator in lifting up and down the wheelchair. |

| | | |
|---|---|---|
|  |  | The ESP 8266 Wi-Fi Module is used to communicate the Arduino Mega and sent data from Arduino Mega through Internet of Things (IoT). |
|  |  | The physical push button is used to control the movement of actuator in lifting up and down the wheelchair manually. |

### C. Project Flowchart

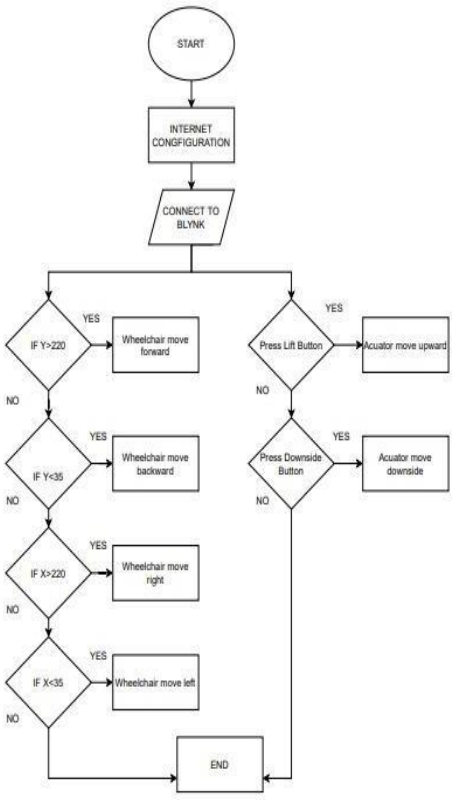



Fig 3: Smart Stand-up Wheelchair Flowchart Fig.

3 shows the program start with internet configuration which means when user ON the Wi-Fi at their phone and opened the Blynk apps. After that, user can control the movement of the wheelchair by toggle the joystick at their Blynk apps as their desired.

If user toggle to the joystick in Y-axis>220, the wheelchair will move forward and if Y-axis>35, the wheelchair will move backward. Moreover, if user toggle the joystick in X-axis>220, the wheelchair will move to right and if X<35, the wheelchair will move to left.

In addition, the wheelchair also can rise up and down. If user press up button, the wheelchair will ascend and if user press down button the wheelchair will descend. Lastly, if user OFF the Wi-Fi at their phone, the system will end.

### D. Software Development

```
//esp8266
#define BLYNK_PRINT Serial
#include <ESP8266_Lib.h>
#include <BlynkSimpleShieldEsp8266.h>

#define EspSerial Serial1
#include <SoftwareSerial.h>
//SoftwareSerial EspSerial(3, 4); // RX, TX
#define ESP8266_BAUD 9600
ESP8266 wifi(&EspSerial);

char ssid[] = "Aida"; //phone name
char pass[] = "1234567890"; //password
char auth[] = "wcj1kjBbBAWtB9UMMzpN9H67PkYYaout"; //coin from email
```

Fig 4: Connecting ESP 8266 to Arduino Board

Fig 4. shows one of the coding that were used in Smart Wheelchair. It shows the coding for connecting ESP 8266 to Arduino Board. It required to put user's phone name, user data password and token given by Blynk via email.

## 3.0 RESULTS AND DISCUSSION

3.0 will discuss about the result that has been achieved while completing this project. The system of Smart Stand-Up Wheelchair shows that the result has been obtained by simulation from Arduino IDE and Parallax Data Acquisition PLX DAQ. It shows the result of the project which explained on the process of the Smart Stand-Up Wheelchair.

| TIME | DATE | XAXIS | YAXIS |
|---|---|---|---|
| 8:52:28 PM | 19/10/2020 | 150 | 253 |
| 8:52:28 PM | 19/10/2020 | 149 | 253 |
| 8:52:29 PM | 19/10/2020 | 148 | 253 |
| 8:52:29 PM | 19/10/2020 | 146 | 254 |
| 8:52:29 PM | 19/10/2020 | 142 | 254 |
| 8:52:29 PM | 19/10/2020 | 139 | 255 |
| 8:52:29 PM | 19/10/2020 | 136 | 255 |
| 8:52:29 PM | 19/10/2020 | 138 | 255 |
| 8:52:29 PM | 19/10/2020 | 142 | 254 |
| 8:52:29 PM | 19/10/2020 | 144 | 254 |
| 8:52:30 PM | 19/10/2020 | 146 | 254 |
| 8:52:30 PM | 19/10/2020 | 148 | 253 |
| 8:52:30 PM | 19/10/2020 | 149 | 253 |
| 8:52:30 PM | 19/10/2020 | 148 | 253 |
| 8:52:30 PM | 19/10/2020 | 142 | 254 |
| 8:52:30 PM | 19/10/2020 | 137 | 255 |
| 8:52:30 PM | 19/10/2020 | 136 | 255 |
| 8:52:30 PM | 19/10/2020 | 137 | 255 |

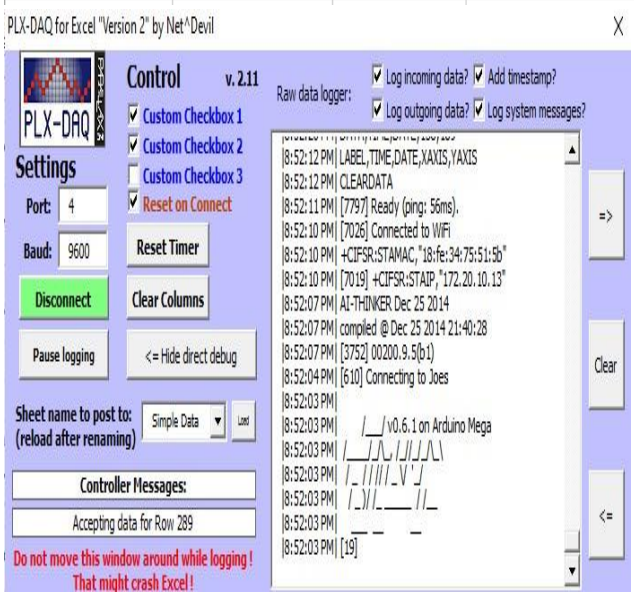



Fig 5: PLX-DAQ in Excel

Fig 5. Show the PLX-DAQ is functioning inthe real time data Arduino which gathers into Excel, where data processing makes so much easier. Log excels sheets for laboratory or other DAQ purposes are simple to build.

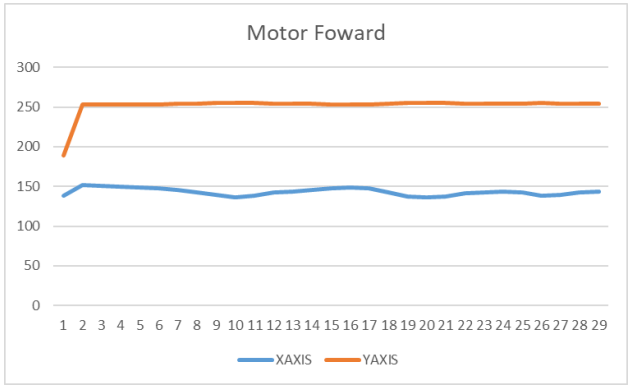



Fig: 6: Graph for Motor Forward

The data was collected from the reading value of joystick from the Blynk apps. This is because in this project, only joystick has given value in analog, so that the data can be analyze. All the data are shown below. Based on the graph in fig. 6, it shown the situation when the joystick toggle in x-axis more than 128 (midpoint value) and y-axis also more than 128 but less than 255 (maximum value that been set). In this condition,the relay will trigger and both of the motor will spin forward.

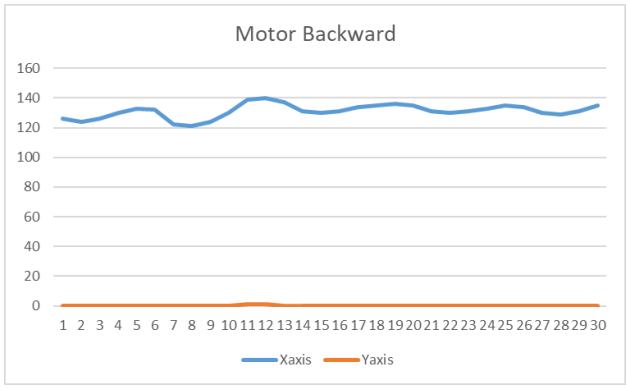



Fig 7: Graph for Motor Backward

Based on the graph in fig. 7, it shown the situation when the joystick toggle in x-axis more than 128 and y-axis equal to 0. In this condition, the relay will trigger and both of the motor will spin backward.

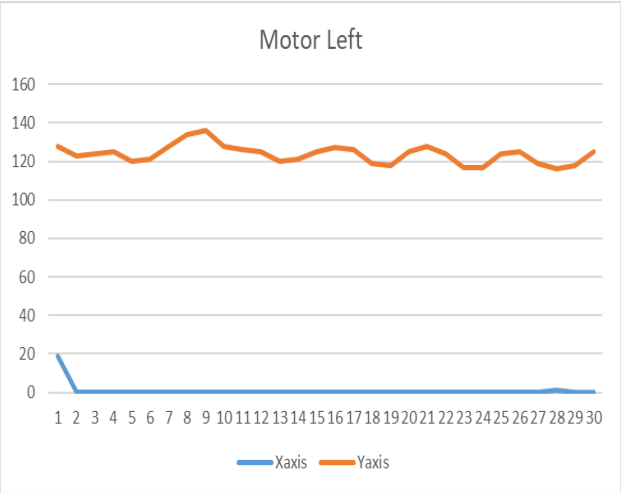



Fig 8: Graph for Motor Left

Based on the graph in fig. 8, it shown the situation when the joystick toggle in x-axis equal to 0 and y-axis more than 128. In this condition, therelay will trigger and one of the motor will spin forward and the other motor will spin backward.

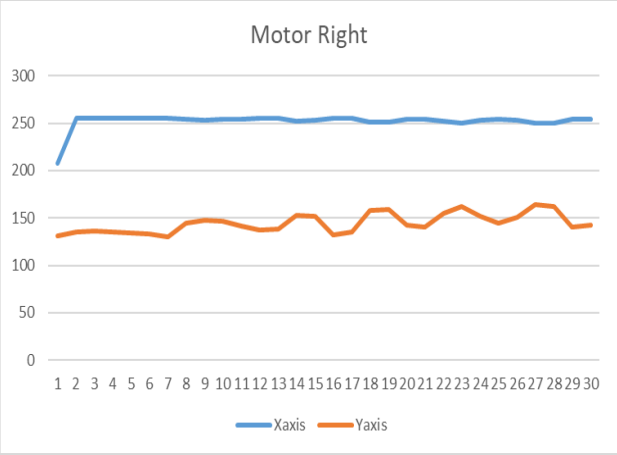



Fig 9: Graph for Motor Right

Based on the graph in fig 9, it shown the situation when the joystick toggle in x-axis more than 128 and y-axis also more than 128. In this condition, the relay will trigger and one of the motor will spin forward and the other motor will spin backward.

## 4.0 LIMITATION AND RECOMMENDATION

There are several constraints in completing this project such as selection of motor and actuator due to it specification and low demand in market, so it is hard to find the most suitable for this project.

Besides, due to the situation of pandemic COVID-19 in Malaysia, some of major component such as gear motor and actuator were delivered later than the expected time. This have delayed the progression of this project.

Moreover, some difficulty faced when the gear motor and actuator want to be mounted at the wheelchair. Last but not least, the cost for this project is quite high due to every component and equipment is pricey.

Hence, In the future, the "Smart Stand-Up Wheelchair for Leg Disable People" can be targeted to a different audience such as all disable user for example paralyzed user. Artificial Neural Networks (ANN) could be implemented in order for fully paralyzed people can move easily according to their desired.

This project also can be improved by adding sensor which can automatically sense obstacles in order to avoid accident. Moreover, an emergency buttonalso could be considered to be installed to avoid theuser from moving too fast and hit something that cancause accident and more injury. Last but not least,upgrade the controller joystick into a mechanical joystick to make the project more convenient to control by user if their phone's battery was drained or have no internet connection.

## 5.0 CONCLUSION

This project was designed to help leg disable people in Malaysia or whole world to ease their movement and not too depend on other people or care taker to assist them every time or everywhere they want to go. This project can be considered as a fully functional prototype as the wheelchair is able to move in desired command and able to lift up and down during the testing process. Furthermore, the objective of this project which is to develop a prototype known as "Smart Stand-Up Wheelchair for Leg Disable People" were achieved successfully.

The important component of this project was the implementation of the mechanical part which are motor and actuator to ensure the wheelchair can move. Moreover, the joystick and Blynk also play an important rule which allow user to control the movement of the wheelchair according to theirdesired.

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## References

[1] World Health Organization (WHO), (2011) Disability: World Report on Disability.

[2] Christopher&Dana Reeve Foundation, (2013), Prevalence of Paralysis in United States