AL-FARAHIDI UNIVERSITY
COLLEGE OF MEDICAL TECHNIQUES
DEPARTMENT OF MEDICAL INSTRUMENTATION ENGINEERING

Design and Implementation of a Control Extension for Electric Wheelchair

A GRADUATION PROJECT SUBMITTED TO THE DEPARTMENT OF MEDICAL INSTRUMENTATION ENGINEERING TO OBTAIN A BACHELOR'S DEGREE IN MEDICAL INSTRUMENTATION

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CERTIFICATION

I certify that the preparation of this final year project entitled" Design and Implementation of a Control Extension for Electric Wheelchair" was prepared by (Ahmed Shawqi Ghazi, Aymen Hasnawi Daham, Ruqaya Ahmed Abdul Amir, Zainab Waleed Rahman, Shahad, Haider Fahim, Ali Hussein Qasim, Noor Ayad Abdel Kazem and Huda Rajeh aayil) under my supervision at AL-Farahidi University / College of Medical Techniques in partial fulfillment of the requirements for the degree of Bachelor in Department of Medical Instrumentation Engineering Techniques.

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CERTIFICATE

We certify, as an examining committee, that we have read this project entitled "Design and Implementation of a Control Extension for Electric Wheelchair", examined the student (Ahmed Shawqi Ghazi, Aymen Hasnawi Daham, Ruqaya Ahmed Abdul Amir, Zainab Waleed Rahman, Shahad, Haider Fahim, Ali Hussein Qasim, Noor Ayad Abdel Kazem and Huda Rajeh aayil) in its content and found that it meets the standard of final year project for the degree of Bachelor in Department of Medical Instrumentation Engineering Techniques.

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ABSTRACT

The prevalence of physical disabilities, particularly among those requiring mobility assistance, has been steadily increasing. Conventional wheelchairs, though commonly used, often require manual input for control, posing challenges for individuals with limited or no hand mobility. This paper proposes a novel approach to address this issue by integrating Brain-Computer Interface (BCI) technology into wheelchair control systems. By leveraging brain signals, individuals with physical disabilities can directly control wheelchair movement, providing them with increased independence and mobility. The paper reviews existing methodologies and technologies, including single photon emission tomography, positron emission tomography, functional magnetic resonance imaging, and electroencephalogram (EEG), for analyzing brain activity. Additionally, it presents related works, such as the development of power-assisted wheelchairs and electronic systems controlled by head movements. The proposed wheelchair system utilizes an Arduino-based platform and incorporates components like MPU6050 and relay modules for seamless integration with the BCI interface. By interpreting head movements, the wheelchair can be controlled in various directions, offering a promising solution for individuals with physical disabilities, particularly those with limited hand mobility. The project aims to empower disabled individuals by providing them with an affordable, efficient, and user-friendly mobility solution, ultimately enhancing their quality of life and fostering independence.

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CHAPTER I

GENERAL INTRODUCTION

1.1 BACKGROUND OF STUDY

At the present time, the amount of disabled person is increasing annually. By referring to the statistical data that obtained from the Department of Social Welfare, the information of the statistical data shows that the amount of physical disabled person is rising from year 2008 to 2011[1]. According to the statistics data, there are total of 657,152 people with disabilities registered calculated from 2009 until 2013[2]. According to the statistical data in 2013, there are 162,215 persons suffered from physical disability among 494,074 number of disabled people. The percentage of physically disabled persons among all the disabled person is 33%, which is the second majority of the disabled person [3].

Most of these physically disabled persons are facing the difficulty to move around freely. Since the physically disabled person is one of the major contributions to total number of disabled persons, this indicates that the number of disabled persons who lost their mobility are substantial. Wheelchair is the most common device that used to provide mobility for the physically disabled person. However, most of the wheelchair today especially the affordable manual wheelchair requires human power to maneuver. Even for the electrical wheelchair, it still requires user's finger to move the joystick or press the button in order to control the movement of the electrical wheelchair [4]. In this way, some users who completely lost their hands or those who having the difficulty to control their hands such as Poliomyelitis patients are not able to navigate the wheelchair movement. Hence, they are incapable to move around by themselves. With the intention to resolve this issue, another constructive way is by using the brain to directly control the movement of the wheelchair. This method will allow most of the people to navigate the wheelchair by themselves. Therefore, this will bring an extremely high impact, especially for the disabled individuals who are not able to communicate physically [5]. The activities of the brain are required to be analyzed for implementing the Brain-computer interface (BCI) for the wheelchair. According to the technology nowadays. There are several methods that can be utilized to obtain the signals of brain activities. These methods are known as Single Photon Emission Tomography, Positron Emission Tomography [6], Functional Magnetic Resonance Imaging and Electroencephalogram (EEG).

1.2 STATEMENT OF PROBLEM

Quadriplegics have the need to be transported to various locations. Thus, there is a need for quadriplegics to be able to move independently to reduce effort required by caregivers and also to give the quadriplegics a sense of independence. Electric wheelchairs are also very expensive in general which most require a working hand or foot to operate. Electric wheelchairs are used by individuals with a wide range of physical disabilities, so ensuring the safety of the control extension is paramount. This includes implementing fail-safe mechanisms to prevent accidents or injuries, as well as considering potential risks such as unintended acceleration or collision avoidance.

1.3 Aim of Project

1- To construct a wheelchair which can be directly controlled by the brain without requires any physical feedback as controlling input from the user.
2- To provide support disable people to move independently.
3- To control the wheel chair without physical support.
4- To expand the benefits of technology to general people.

1.4 Related Work

In 2020, A power-assisted wheelchair is a hybrid between a manual and power wheelchair that consists of an electric-assist system that can be easily mounted on a manual wheelchair. These devices have a demonstrated benefit on the health and mobility of wheelchair users. However, current power-assisted wheelchairs are not addressing all user needs, and as a result there is room for improvement. In this thesis, a novel power-assisted wheelchair system was developed using Stanford Design Thinking. Design requirements were developed using ISO 13485. Concept designs were iterated and a prototype was fabricated. The result is the NeuwDrive, a lightweight power-assist system. The NeuwDrive demonstrates novelty through the use of a right-angled geared motor and a hub design that maintains the overall wheelchair width and allows for easy removal of the drive system. The functionality of the NeuwDrive was verified in two ways. First, the performance was tested using an absorption dynamometer to measure torque and speed. The test results were within the specifications of class-leading devices on the market. The weight of the NeuwDrive is 10.2 kg, below any currently available hub-motor products. Second, a focus group with power-assist wheelchair users was conducted to collected end-user feedback. The results were favourable, with participants favouring the low device weight, removable batteries and narrow width of the NeuwDrive. The results of the testing indicate that the NeuwDrive is a novel power-assist system with potential for future development.[7]

In 2021, the design and implementation of an electronic system that involves head movements to operate a prototype that can simulate future movements of a wheelchair was developed here. The controller design collects head-movements data through a MEMS sensor-based motion capture system. The research was divided into four stages: First, the instrumentation of the system using hardware and software; second, the mathematical modeling using the theory of dynamic systems; third, the automatic control of position, speed, and orientation with constant and variable speed; finally, system verification using both an electronic controller test protocol and user experience. The system involved a graphical interface for the user to interact with it by executing all the controllers in real time. Through the System Usability Scale (SUS), a score of 78 out of 100 points was obtained from the qualification of 10 users who validated the system, giving a connotation of "very good". Users accepted the system with the recommendation to improve safety by using laser sensors instead of ultrasonic range modules to enhance obstacle detection.[8]

In 2022, In this proposed method, a voice-controlled mechanized wheelchair with constant impediment shirking is structured and actualized. It engages a weakened individual to move around uninhibitedly, using a voice affirmation application, which is interfaced with motors. The model of the wheelchair is amassed using a littler scope controller, picked for its insignificant exertion, despite its versatility and execution in logical assignments and correspondence with other electronic contraptions. The framework has been planned and executed in a savvy way. In this chapter, there are three sensors that measure the value from patient's body. Then these measured values are analyzed and displayed on liquid crystal display (LCD). Respiration sensor monitors chest or abdomen movement during breathing. Heartbeat sensor senses patient heartbeat rate every minute. The LM35 series are precision-integrated circuit temperature sensors, with a yield voltage straightly proportional to the centigrade temperature. The LM35 has a favored situation over direct temperature sensors adjusted in ° Kelvin, thusly the customer is not required to remove a colossal consistent voltage from the respect procure invaluable Centigrade scaling. To give normal exactnesses of ±¼° C at room, LM35 does not require any external change or slicing.[9]

In 2023, The majority of people with disabilities in the world have impairments that affect their lower bodies. In most of these cases, it was found that the affected person's upper body was in good health and capable of carrying out all activities; however, the spinal cord injury results in significant health challenges with body functions like urination, bowel movements, heart rate, and respiratory, cardiovascular, and sexual function, which require prompt medical treatment and mobility aids. This study presents the mechanical layout of a wheelchair that can switch between a sitting and a standing position. The center of gravity must be taken into account when creating an electric standing wheelchair. It is designed specifically for people with disabilities to lessen the need of outside assistance, allowing the disabled person to savour a sense of adoration. In the simulation, the electric standing wheelchair analysis is carried out by loading with a human weight of 40 and 100 kg, and the transformation angle is adjusted between 0 and 90 degrees to compare the center of gravity displacement. SolidWorks and ANSYS are used to design the prototype, assemble the product, and establish the safety factor bounds of the structure and capabilities as required. The research focuses to achieve control of speed deviation and acceleration using a fuzzy control technique. The Arduino oversees the operation of the drive system as a controller, and a linear actuator is utilized for standing and sitting positions. This method is affordable, easily constructed, and highly secure.[10]

CHAPTER II
THE THEORETICAL PART

2.1 INTRODUCTION

This section includes the hardware and software components of the practical project.

2.1.1 Wheelchair

A wheelchair is a mobility device that provides assistance to individuals who have difficulty walking or moving due to various reasons such as disability, injury, illness, or age-related conditions. It typically consists of a seat mounted on wheels, along with handles or controls for propulsion, and may include additional features such as footrests, armrests, and adjustable parts for comfort and convenience.[11]

Figure 2.1: Wheelchair

2.1.2 REES52 300W 10amp DC-DC CC CV Buck Converter Board Step Down Power Supply Module 7-32V to 0.8-28V 12A

The REES52 300W 10A DC-DC CC CV Buck Converter Board is a power supply module designed to convert a higher input voltage (ranging from 7V to 32V) to a lower output voltage (ranging from 0.8V to 28V) with a maximum output current of 12A. Overall, the REES52 300W 10A DC-DC CC CV Buck Converter Board is a versatile power supply module suitable for a wide range of applications requiring efficient voltage regulation and high output currents. Here's a breakdown of its key features and specifications:[12]

1. Input Voltage Range: The module can accept input voltages between 7V and 32V. This means it can be used with a wide range of input power sources, including batteries, DC power supplies, or other voltage sources.
2. Output Voltage Range: It can provide a regulated output voltage ranging from 0.8V to 28V. This feature allows it to be adaptable to various applications requiring different output voltage levels.
3. Output Current: The maximum output current this module can deliver is 12A. This makes it suitable for powering a wide range of devices or loads that require significant current, such as motors, LEDs, or other high-power electronics.
4. CC CV Mode: The module operates in Constant Current (CC) and Constant Voltage (CV) modes. In CC mode, it regulates the output current, ensuring a steady flow of current to the load. In CV mode, it regulates the output voltage, providing a stable voltage output regardless of load changes.
5. Buck Converter: This module utilizes a buck converter topology, which is efficient for stepping down voltages. It achieves this by controlling the duty cycle of the switching element to regulate the output voltage.
6. Power: With a maximum power rating of 300W, this module can handle significant power levels, making it suitable for high-power applications.
7. Protection Features: It likely incorporates various protection features such as overcurrent protection, overvoltage protection, and thermal protection to safeguard both the module itself and the connected devices from damage due to faults or overheating.

Figure 2.2: REES52 300W 10amp DC-DC CC CV Buck Converter Board Step Down Power Supply Module 7-32V to 0.8-28V 12A

2.1.3 (8) Channel Relay Module with light coupling 5V

The (8) Channel Relay Module with light coupling 5V is a device commonly used in electronics and automation projects. Overall, the (8) Channel Relay Module with light coupling 5V is a versatile and convenient device for switching multiple circuits or devices using low-voltage control signals. It offers isolation between control and switching circuits, making it suitable for applications where electrical noise or interference is a concern. Here's an overview of its key features and functions:[13]

1- Number of Channels: This relay module consists of 8 independent relay channels. Each channel can be controlled separately, allowing you to switch different circuits or devices independently.

2- Relay Type: The relays used in this module are typically electromagnetic relays. These relays are commonly used for switching purposes in various applications due to their reliability and ability to handle moderate to high currents and voltages.

3- Input Voltage: The module operates with a 5V input voltage. This means that it can be easily controlled by microcontrollers, Arduino boards, Raspberry Pi, or other digital logic circuits operating at 5V.

4- Light Coupling: Light coupling, also known as opto-isolation or optical isolation, is a feature of this relay module. Each channel likely incorporates an optocoupler to electrically isolate the control circuitry (input side) from the relay switching circuitry (output side). This isolation helps protect the controlling circuit from potential voltage spikes or interference that may occur in the relay side.

5- Applications: This relay module can be used in various applications such as home automation, industrial automation, robotics, IoT (Internet of Things) projects, and DIY electronics projects. It allows you to control high-power devices such as lights, motors, solenoids, and other electrical appliances using low-power control signals.

6- Control Interface: The module typically provides a control interface for each channel, often in the form of input pins or headers. These interfaces allow you to connect external devices or microcontrollers to control the state of the relays (ON/OFF).

7- LED Indicators: Many relay modules come with LED indicators for each channel, which provide visual feedback on the status of the relay (whether it is energized or not). This feature can be helpful for debugging and monitoring purposes.

Figure 2.3: (8) Channel Relay Module with light coupling 5V

2.1.4 Arduino R4 minima

The UNO R4 Minima features a microcontroller based on the Renesas RA4M1 with an operating voltage of 5 V. It has 14 digital I/O, 6 analog inputs with up to 14-bit resolution, a clock speed of 48 MHz, and 32 kB SRAM, 256 kB flash memory & 8 kB of EEPROM. It features a DAC for audio projects, RTC for accurate time tracking and HID for emulating a keyboard/mouse. The barrel jack plug (VIN) supports voltages at up to 24V, making it compatible with common higher voltage adapters.[14]

Figure 2.4: Arduino R4 minima

2.1.5 Dc Battery 30 V

"DC Battery 30V" likely refers to a direct current (DC) battery that has a voltage rating of 30 volts. Here's what this designation typically means:

1- DC: Direct current, in contrast to alternating current (AC), flows continuously in one direction through a circuit. Most batteries, especially those used in portable electronics, provide DC power.

2- 30V: This indicates the nominal voltage output of the battery, which is 30 volts. Nominal voltage represents the average voltage output of the battery during most of its discharge cycle. However, actual voltage may vary depending on factors such as the state of charge and load conditions.

Figure 2.5: Dc Battery 30 V

2.1.6 Motor my1016z

The MY1016Z is a specific model of electric motor, commonly used in various applications such as electric scooters, bikes, and small electric vehicles. Overall, the MY1016Z motor is a versatile and widely used brushed DC motor suitable for various electric vehicle and small machinery applications, offering a balance of power, speed, and durability. Here are some key features and specifications of the MY1016Z motor:[15]

1- Type: The MY1016Z motor is a brushed DC motor. Brushed DC motors use brushes and a commutator to switch the direction of current flow in the motor windings, causing the rotor (the part of the motor that spins) to rotate.

2- Voltage: These motors typically operate on a voltage range of around 24V to 36V DC. This voltage range is common for small electric vehicles and scooters, making the MY1016Z motor suitable for such applications.

3- Power Rating: The power rating of the MY1016Z motor can vary depending on the specific model and configuration, but it generally falls in the range of 250 watts to 350 watts. This power output is suitable for powering small to medium-sized electric vehicles and scooters.

4- Speed and Torque: The motor's speed and torque characteristics can vary depending on factors such as voltage, load, and gearing. Typically, MY1016Z motors can achieve speeds of several thousand RPM (revolutions per minute) and produce a moderate amount of torque suitable for driving small vehicles.

5- Mounting: The MY1016Z motor is designed for easy mounting on various types of electric vehicles and scooters. It often comes with mounting brackets or holes for attachment to the vehicle's frame or chassis.
6- Cooling: Some models of the MY1016Z motor may feature built-in cooling mechanisms such as cooling fins or fans to dissipate heat generated during operation, helping to prevent overheating and prolonging the motor's lifespan.
7- Reliability and Durability: MY1016Z motors are known for their reliability and durability, making them a popular choice for DIY electric vehicle projects and small-scale manufacturing of electric scooters and bikes.

Figure 2.6: Motor my1016z

2.1.7 MPU6050

The MPU-6050 is a popular six-axis MEMS (Micro-Electro-Mechanical Systems) sensor that combines a 3-axis gyroscope and a 3-axis accelerometer. It is manufactured by InvenSense Inc., which is now part of TDK. This sensor is widely used in various applications, including motion tracking in smartphones, drones, and other robotics projects due to its small size, low power consumption, and good performance.[18]

Key Features of the MPU-6050:

1. Gyroscope: It can measure rotational motion in three dimensions. Each axis has a gyroscope that can detect rotation around that axis. The MPU-6050 supports multiple sensitivity levels (±250, ±500, ±1000, and ±2000 degrees per second), allowing it to be used for both slow and fast rotational movements.

2. Accelerometer: It can measure linear acceleration in three dimensions. This means it can detect movement as well as the orientation of the device relative to Earth's gravity. Like the gyroscope, the accelerometer also supports multiple sensitivity settings (±2, ±4, ±8, and ±16 g).

3. I2C Interface: This sensor uses an I2C interface for communication, which is standard for many microcontrollers and allows multiple devices to be connected to the same bus.

4. Digital Motion Processor™ (DMP): One of the unique features of the MPU-6050 is its built-in DMP, which can perform complex calculations on the sensor data, offloading the host processor and reducing power consumption, latency, and I2C traffic.

Applications:

- Consumer Electronics: Used in devices like smartphones, tablets, and wearable fitness devices to track steps or orientation.
- Drones and RC Vehicles: Helps in stabilization and flight control.
- Virtual and Augmented Reality: Provides data necessary for tracking movements in 3D space.

Figure 2.7: MPU-6050

2.1.8 BST (Battery 9V)

A 9V battery, commonly recognized by its distinct rectangular shape and snap connectors at the top, is a compact power source used in various electronic devices. These batteries are highly valued for their reliability, portability, and consistency in delivering power.

Figure 2.8: BST (Battery 9V)

2.1.9 On/Off Button

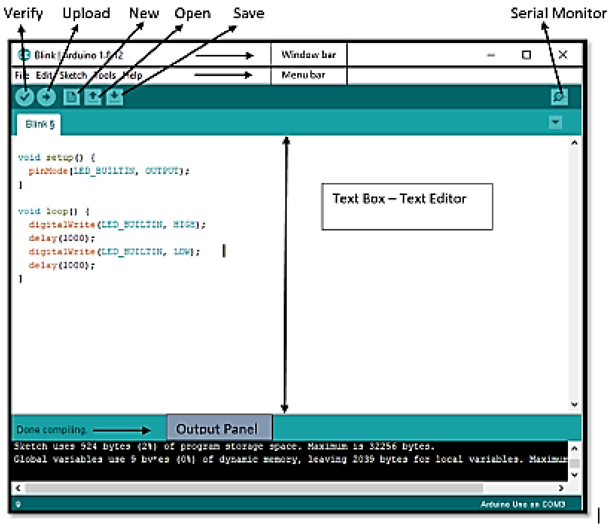
An on/off button is a control element used to switch the power supply or functionality of a device either on or off. This button can be found in a wide range of applications from electronic devices, machinery, software user interfaces, to everyday household appliances.[19]

Figure 2.9: On/Off Button

2.1.10 Arduino IDE

Arduino IDE (Integrated Development Environment) is the software for Arduino.It is a text editor like a notepad with different features.It is used for writing code, compiling the code to check if any errors are there and uploading the code to the Arduino.It is a cross-platform software which is available for every Operating System like Windows, Linux, macOS.It supports C/C++ language.It is open-source software, where the user can use the software as they want it to. They can also make their own modules/functions and add them to the software.It supports every available Arduino board including Arduino mega, Arduino Leonardo, Arduino Ethernet and more.Word file is called a Document similarly, Arduino file is called a Sketch where the user writes code. When a user writes code and compiles, the IDE will generate a Hex file for the code. (Hex file are Hexa Decimal files which are understood by Arduino) and then sent to the board using a USB cable. Every Arduino board is integrated with a microcontroller, the microcontroller will receive the hex file and runs as per the code written.[16]

Functions of Arduino IDE

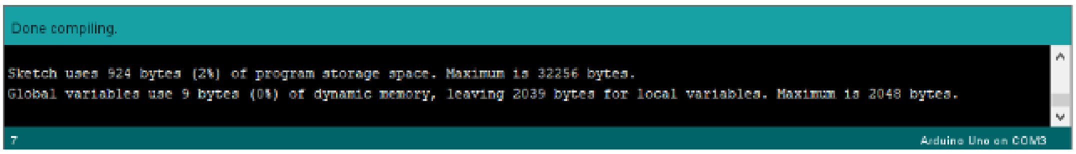


- **WindowBar:** The window bar consists the name of File and the Arduino IDE software version.
- **MenuBar:** The menu bar consists of:

    - File
    - Edit
    - Sketch
    - Tools
    - Help

- **Shortcut Buttons**
- **Text Editor**
- **Output Panel:** This output panel is used to give comments about the code

1. if the code is successfully compiled or any error occurs.
2. If the code has been successfully uploaded to the board.



Programming

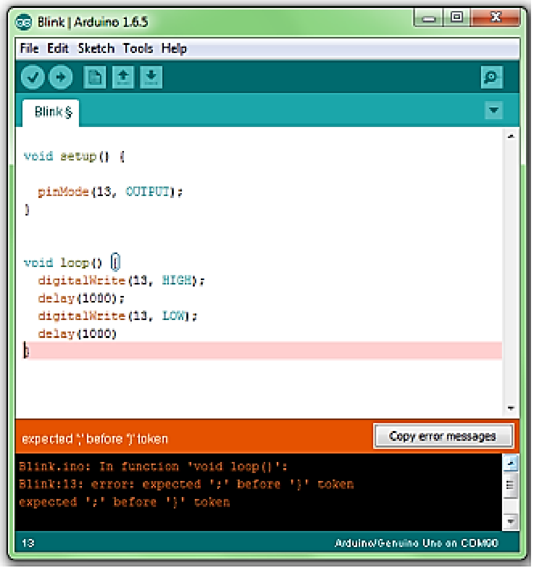
Now we can start properly. Without to much theoretical information we start directly with programming. Learning by doing. On the left side you can find the “sketches”, on the right the accompanying explanation for the commands in grey. If you work through the tutorials with this system, you will soon understand the code and be able to use it by yourself. Later on you can familiarize yourself with other features. These tutorials are only meant as first steps to the Arduino world. [17]

First of all a short explanation for possible error reports that can appear while working with the Arduino software. The two most common ones are:

1) The board is not installed right or the wrong board is selected. After uploading the sketch, there will appear an error report underneath the sketch. It looks like the one in the picture on the right. The note “not in sync” shows up in the error report.

2) There is a mistake in the sketch. For example, a word is misspelled or a bracket is missing. In the example on the left the last semicolon in the

sketch is missing. In this Case the error report often starts with “excepted..”. This means that the program is still expecting something that is missing.



Basic structure of a sketch:

A sketch can be divided in three parts.

1. Name variable: In the first part elements of the program are named (This will be explained in program no. 3). This part is not absolutely necessary.

2. Setup (absolutely necessary for the program): The setup will be performed only once. Here you are telling the program for example what Pin (slot for cables) should be an input and what should be an output on the boards.

- ✓ **Defined as Output:** The pin should put out a voltage. For example: With this pin a LED is meant to light up.
- ✓ **Defined as an Input:** The board should read out a voltage. For example: A switch is actuated. The board recognized this, because it gets a voltage on the Input pin.

```
Void setup ()
{
pinMode (pin, INPUT);
pinMode (pin, OUTPUT);
}
```

3. **Loop (absolutely necessary for the program):** This loop part will be continuously repeated by the board. It assimilates the sketch from beginning to end and starts again from the beginning and so on.

```
Void setup ()
{
Serial.begin(9600);
}
```

CHAPTER III

THE PRACTICAL PART

3.1 INTRODUCTION

The wheelchair has a critical role in the project. This chapter thoroughly explains the design and implementation to modify an existing wheelchair into an electric wheelchair.

3.2 ENGINEERING SPECIFICATIONS

Various specifications are set in order to set certain goals for the project. The design specifications are listed in table form to make it easier to compare to results obtained found. The purpose of the specifications is to be able to compare this wheelchair with commercial electric wheelchairs.

Table 3.1: Engineering Specifications

Specifications	Value
Nominal Speed	3 meter per second (m/s)
Maximum Carry Mass	100 Kilogram
Maximum Current	50 Ampere
Battery Life	5 hours

3.3 SYSTEM CONNECTIONS

Connecting the MPU-6050 to Arduino:

1. VCC to Arduino 5V.
2. GND to Arduino GND.
3. SCL to Arduino A5 (on Uno/Nano) or the appropriate SCL pin on other models.
4. SDA to Arduino A4 (on Uno/Nano) or the appropriate SDA pin on other models.
5. INT (interrupt pin, optional for this setup) can remain disconnected.

Connecting Relays to Arduino:

Assuming you are using relay modules which have built-in driving circuitry:

1. **VCC** of each relay module to Arduino 5V or external power supply.
2. **GND** of each relay module to Arduino GND.
3. **IN** pins of the relay modules connect to the respective Arduino digital pins defined in your code (2, 3, 4, 5, 6, and 7).

3.4 FLOWCHART OF SYSTEM

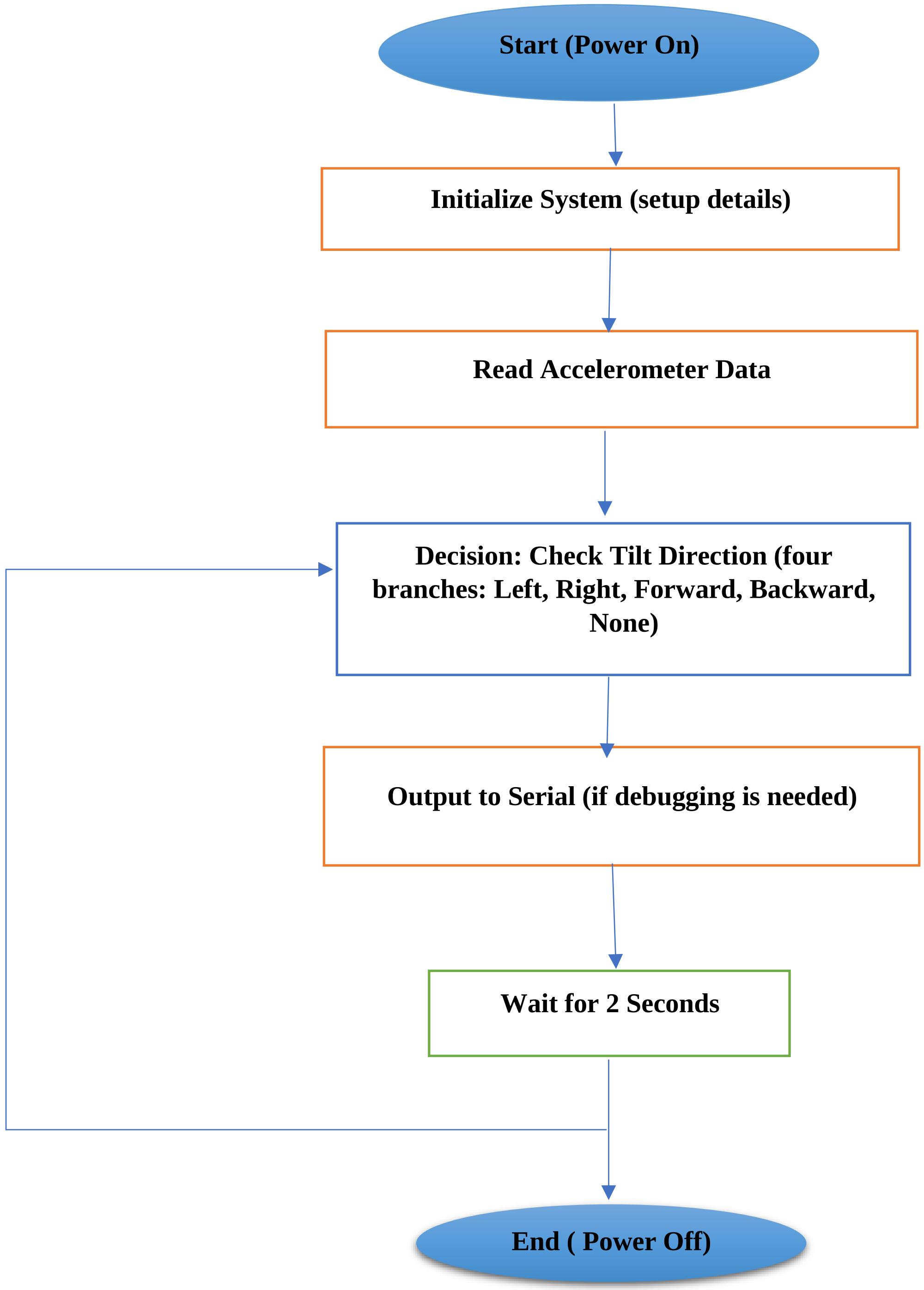


Figure 3.1: Flowchart of system

3.5 RESULT

This work targets people with paraplegia the control and sensor operate on a 9-volt battery so that we can put a plug in for the relays to work, but the 24–30-volt battery is for powering the motors only. MPU6050 reduces the high voltage coming from the battery to the motors from 30 volts to 15-18 volts, i.e., controlling the speed of the motors. When placing the MPU6050 on the hand, hips, or head (any part of the body that has balance), if the MPU6050 leans forward, it moves forward, and so on for the rest of the directions. Figure 3.3 shows the controlling device attached to the chair to operate the motors.

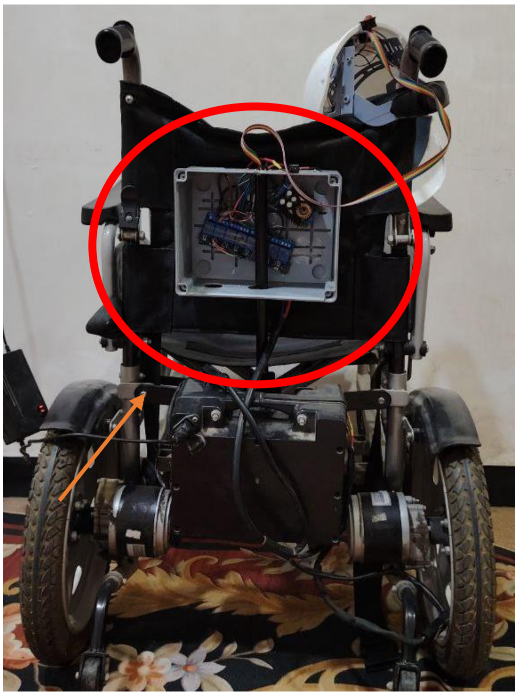


Figure 3.2: Controlling device

Figure 3.3: The final shape of the chair

The way to run and test the project is when the start button is turned on, then the helmet is placed on the head, and then the head tilts to the left, the chair will move to the left. However, if the helmet moves to the right, the chair will move to the right. If the helmet moves to the front or back, the chair will move forward or back, and so on. Movement or gestures of the head will make the chair move

Figure 3.4: Helmet shape

CHAPTER IV

CONCLUSION AND FUTURE WORK

4.1 CONCLUSION

In conclusion to the project, the employment of brain-controlled wheel chair aids to the patients suffering from conditions which make them physically unable to control their muscles efficiently. The technology brings back the integrity of the patient as they can use their healthy brain even if their body has degraded and moreover, it would keep their mind active. It is quite probable that in the future most of our appliances will be controlled directly through our wishes or the brain and this project stands as an affirmation to that vision. Signals from the brain can be further studied and the technology can be refined to bring about more specific results. The scope of the project was primarily to establish the motion through no physical motion on part of the user and it has been successful in doing so but it has also laid a foundation for many applications which would greatly improve the standard of life for all.

4.2 FUTURE WORK

To development our smart system and be more effective, some of the techniques can be recommended for future work such as:

1- Arduino can be replaced by upgraded Microcontroller or chip.

2- More sensors can be used for further applications like obstacle sensors.

3- The functionality of the brain can be used to trounce many other manual works at industries as well as at house-hold levels.

4- The day-to-day gadgets may be evolved to work using mind waves.

5- The system can be supplemented with GPS and GSM module by this we can provide safety and also it helps to track the disabled person by their parents.

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APPENDIX A

```
#include <Wire.h>
const int MPU_ADDR = 0x68;
int16_t accelerometer_x, accelerometer_y;
#define RELAY_1 2 // Relay 1
#define RELAY_2 3// Relay 2
#define RELAY_3 4// Relay 3   b
#define RELAY_4 5// Relay 4  forward  g
#define RELAY_5 6// Relay 5   b
#define RELAY_6 7// Relay 6   b
void setup() {
  Serial.begin(9600);
  pinMode(RELAY_1, OUTPUT);
  pinMode(RELAY_2, OUTPUT);
  pinMode(RELAY_3, OUTPUT);
  pinMode(RELAY_4, OUTPUT);
  pinMode(RELAY_5, OUTPUT);
  pinMode(RELAY_6, OUTPUT);
  digitalWrite(RELAY_1, LOW);
  digitalWrite(RELAY_2, LOW);
  digitalWrite(RELAY_3, LOW);
  digitalWrite(RELAY_4, LOW);
  digitalWrite(RELAY_5, LOW);
  digitalWrite(RELAY_6, LOW);
  Wire.begin();
  Wire.beginTransmission(MPU_ADDR);
  Wire.write(0x6B);
  Wire.write(0);
  Wire.endTransmission(true);
}
void loop() {
  Wire.beginTransmission(MPU_ADDR);
  Wire.write(0x3B);
  Wire.endTransmission(false);
  Wire.requestFrom(MPU_ADDR, 2 * 2, true);
  accelerometer_x = Wire.read() << 8 | Wire.read();
  accelerometer_y = Wire.read() << 8 | Wire.read();
  // Check the direction based on accelerometer readings
  if (accelerometer_x < -8000 && accelerometer_y < 3000) {
     //Moving LIFT
    digitalWrite(RELAY_1,HIGH );
    digitalWrite(RELAY_2, LOW);
```

```
    digitalWrite(RELAY_3, HIGH);
    digitalWrite(RELAY_4, LOW);
    digitalWrite(RELAY_5, HIGH);
    digitalWrite(RELAY_6, HIGH);
  } else if (accelerometer_x < 3000 && accelerometer_y > 8000) {
    // Moving forward
    digitalWrite(RELAY_1, LOW);
    digitalWrite(RELAY_2, LOW);
    digitalWrite(RELAY_3, HIGH);
    digitalWrite(RELAY_4, LOW);
    digitalWrite(RELAY_5, HIGH);
    digitalWrite(RELAY_6, HIGH);
  } else if (accelerometer_x > 8000 && accelerometer_y < 3000) {
    // Moving to the right
    digitalWrite(RELAY_1, LOW);
    digitalWrite(RELAY_2, HIGH);
    digitalWrite(RELAY_3, HIGH);
    digitalWrite(RELAY_4, LOW);
    digitalWrite(RELAY_5, HIGH);
    digitalWrite(RELAY_6, HIGH);
  } else if (accelerometer_x < 3000 && accelerometer_y < -8000) {
    // Moving to the BACK
    digitalWrite(RELAY_1, HIGH);
    digitalWrite(RELAY_2, HIGH);
    digitalWrite(RELAY_3, LOW);
    digitalWrite(RELAY_4, HIGH);
    digitalWrite(RELAY_5, LOW);
    digitalWrite(RELAY_6, LOW);
  } else {
    // No specific direction, turn off all relays
    digitalWrite(RELAY_1, HIGH);
    digitalWrite(RELAY_2, HIGH);
    digitalWrite(RELAY_3, HIGH);
    digitalWrite(RELAY_4,HIGH);
    digitalWrite(RELAY_5, HIGH);
    digitalWrite(RELAY_6, HIGH);
  }  Serial.println();
  delay(2000);
}
```

الملخص

إن انتشار الإعاقات الجسدية، وخاصة بين أولئك الذين يحتاجون إلى مساعدة في التنقل، يتزايد باطراد. الكراسي المتحركة التقليدية، على الرغم من شيوع استخدامها، غالبًا ما تتطلب إدخالاً يدويًا للتحكم، مما يشكل تحديات للأفراد ذوي القدرة المحدودة على الحركة اليدوية أو معدومة. تقترح هذه الورقة طريقة جديدة لمعالجة هذه المشكلة من خلال دمج تقنية واجهة الدماغ والحاسوب (BCI) في أنظمة التحكم بالكراسي المتحركة. ومن خلال الاستفادة من إشارات الدماغ، يمكن للأفراد ذوي الإعاقات الجسدية التحكم بشكل مباشر في حركة الكرسي المتحرك، مما يوفر لهم المزيد من الاستقلالية والحركة. تستعرض الورقة المنهجيات والتقنيات الحالية، بما في ذلك التصوير المقطعي بانبعاث الفوتون الواحد، والتصوير المقطعي بالإصدار البوزيتروني، والتصوير بالرنين المغناطيسي الوظيفي، ومخطط كهربية الدماغ (EEG)، لتحليل نشاط الدماغ. بالإضافة إلى ذلك، يعرض الأعمال ذات الصلة، مثل تطوير الكراسي المتحركة التي تعمل بالطاقة الكهربائية والأنظمة الإلكترونية التي يتم التحكم فيها عن طريق حركات الرأس. يستخدم نظام الكراسي المتحركة المقترح منصة تعتمد على Arduino ويتضمن مكونات مثل MPU6050 ووحدات التتابع لتحقيق التكامل السلس مع واجهة BCI. ومن خلال تفسير حركات الرأس، يمكن التحكم في الكرسي المتحرك في اتجاهات مختلفة، مما يوفر حلاً واعداً للأفراد ذوي الإعاقات الجسدية، وخاصة أولئك الذين يعانون من محدودية حركة اليد. ويهدف المشروع إلى تمكين الأفراد ذوي الإعاقة من خلال تزويدهم بحل تنقل ميسور التكلفة وفعال وسهل الاستخدام، مما يؤدي في نهاية المطاف إلى تحسين نوعية حياتهم وتعزيز استقلالهم.

الشكر والتقدير

نبدأ بالامتنان والتبجيل الأعظم لله العزيز القدير على رحمته وبركاته اللامحدودة التي لولاها لكانت النهاية الناجحة لهذا السعي خارج متناولنا. بالإضافة إلى ذلك، نود أن نعبر عن امتناننا العميق لمشرفنا، الدكتور أوس زهير، الذي كانت إرشاداته ونصائحه ودعمه الثابت حاسمة طوال هذا السعي. بشكل ملحوظ، لعبت خبرته الفنية الاستثنائية دورًا حاسمًا. بالإضافة إلى ذلك، نود أن نعبر عن شكرنا الخالص لرئيس جامعة الفراهيدي وعميد كلية التقنية الطبية ورئيس قسم هندسة تقنيات الأجهزة الطبية على قيادتهم الحكيمة وإدارتهم الكفوءة. نحن نعرب عن امتناننا العميق لكل واحد منكم بإخلاص صادق.

جامعة الفراهيدي
الكلية التقنية الطبية
قسم هندسة تقنيات الأجهزة الطبية

Design and Implementation of Bio-Potential Amplifiers

بحث تخرج تم تقديمه إلى قسم هندسة تقنيات الأجهزة الطبية كجزء من متطلبات الحصول على درجة البكالوريوس في هندسة تقنيات الأجهزة الطبية.

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