Graduation Project

GMS- Glove Motion System

“Your power is in your hand “

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Thank you all.

Summary / Abstract:

This project aims to assist people with physical disabilities by developing a smart wheelchair controlled using finger motion through a wearable glove. The goal is to improve mobility and independence for users with limited motor abilities.

The glove is equipped with flex sensors that detect the bending of fingers. These bending values are processed by a microcontroller (such as Arduino), which translates the gestures into movement commands for the wheelchair (forward, backward, left, right). The system includes wireless communication and a motorized wheelchair base.

The results demonstrated high responsiveness and accuracy in translating hand gestures into real-time movement, confirming the effectiveness of the system.

In conclusion, the project achieved its main objective by offering a practical, gesture-based control solution. Future improvements could include obstacle detection, speed adjustment, or voice control integration to enhance usability and safety.

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Introduction:

`In our modern world, technology has become a vital element in improving the quality of life, especially for individuals with special needs. From this standpoint, there has been an increasing need to develop smarter and more flexible mobility solutions that enable people with physical disabilities to rely more on themselves and enhance their independence. This project aims to design and implement a smart wheelchair controlled via a smart glove equipped with Flex Sensors, in addition to control through a mobile application using Bluetooth HC-05.

The system relies on an Arduino Nano as the main controller inside the glove, which sends wireless signals to the wheelchair. The chair itself includes 24V motors, two PTS units for motion control, a dedicated Bluetooth module, and an Arduino Nano for receiving signals. A rechargeable battery is included to provide stable operational power.

This project represents a practical step toward integrating electronics, programming, and mechanics into a real-world product that serves the community—particularly those facing mobility challenges. It aims to deliver a smooth, safe, and expandable user experience, making it a solid foundation for more advanced assistive technologies in the future.

The Topic:

Component's Function:

Arduino Nano:

The Arduino Nano is a small and easy-to-use microcontroller board. It was installed on the glove to read the signals from the flex sensors and send them via Bluetooth. We chose the Nano because of its small size and lightweight, which makes it perfect for wearable projects like a glove, without adding bulk or discomfort.

Arduino Mega:

The Arduino Mega is a larger microcontroller board that has more input/output pins and memory. It was used in the wheelchair to connect and control multiple components such as motor drivers, Bluetooth module, and other inputs. We selected the Mega because it provides enough ports to handle all the connections we need for the chair system.

BTS7960 Motor Driver:

The BTS7960 is a powerful motor driver that acts as a bridge between the Arduino and the DC motors. It allows us to control the motor's direction and speed using signals from the Arduino. We used it because it supports high current and voltage, making it ideal for controlling strong motors like the one used in the wheelchair.

HC-05 Bluetooth Module:

The HC-05 is a Bluetooth module that was installed on the glove. It sends the movement commands wirelessly to the wheelchair. We used this module because it supports twoway communication, which allows the glove and the chair to stay connected and synced easily.

HC-06 Bluetooth Module:

The HC-06 Bluetooth module was placed on the wheelchair to receive the signals from the glove. It only supports receiving data (one-way communication), which is suitable for this task. We chose it because it's simple, low-power, and works well with the HC-05.

Flex Sensor:

A flex sensor is a bendable component that changes its resistance when it bends. These sensors were attached to the fingers of the glove. As the user moves their fingers, the sensors send different signals to the Arduino. We chose them because they are simple, reliable, and perfect for detecting finger movement.

Jumper Wires:

Jumper wires are small cables used to connect components together without soldering. They are used throughout the project to link the Arduinos, sensors, drivers, and other parts. We used them because they make circuit building faster, easier to test, and simple to fix if something needs to change.

Breadboard:

A breadboard is a tool used for building temporary electronic circuits without soldering. We used a breadboard in the glove to mount the Arduino Nano and connect the sensors. It allows for easy testing and quick changes during development, which is useful for wearable systems.

9V Battery:

The 9V battery powers the electronic parts on the glove, such as the Arduino Nano and Bluetooth module. We chose this battery because it is small, lightweight, and provides enough voltage for the glove's components.

MY1016Z2 DC Motor:

The MY1016Z2 is a 350W DC motor used to drive the wheelchair. It delivers strong torque and works well with 24V systems. We selected this motor because it's powerful enough to move the chair and handle heavy loads while still being compact.

Chair Battery:

The chair battery supplies the main power for the motors and electronics in the wheelchair. It provides the necessary voltage and current to ensure the system runs smoothly. We used this battery because it fits the power needs of the DC motor and other components.

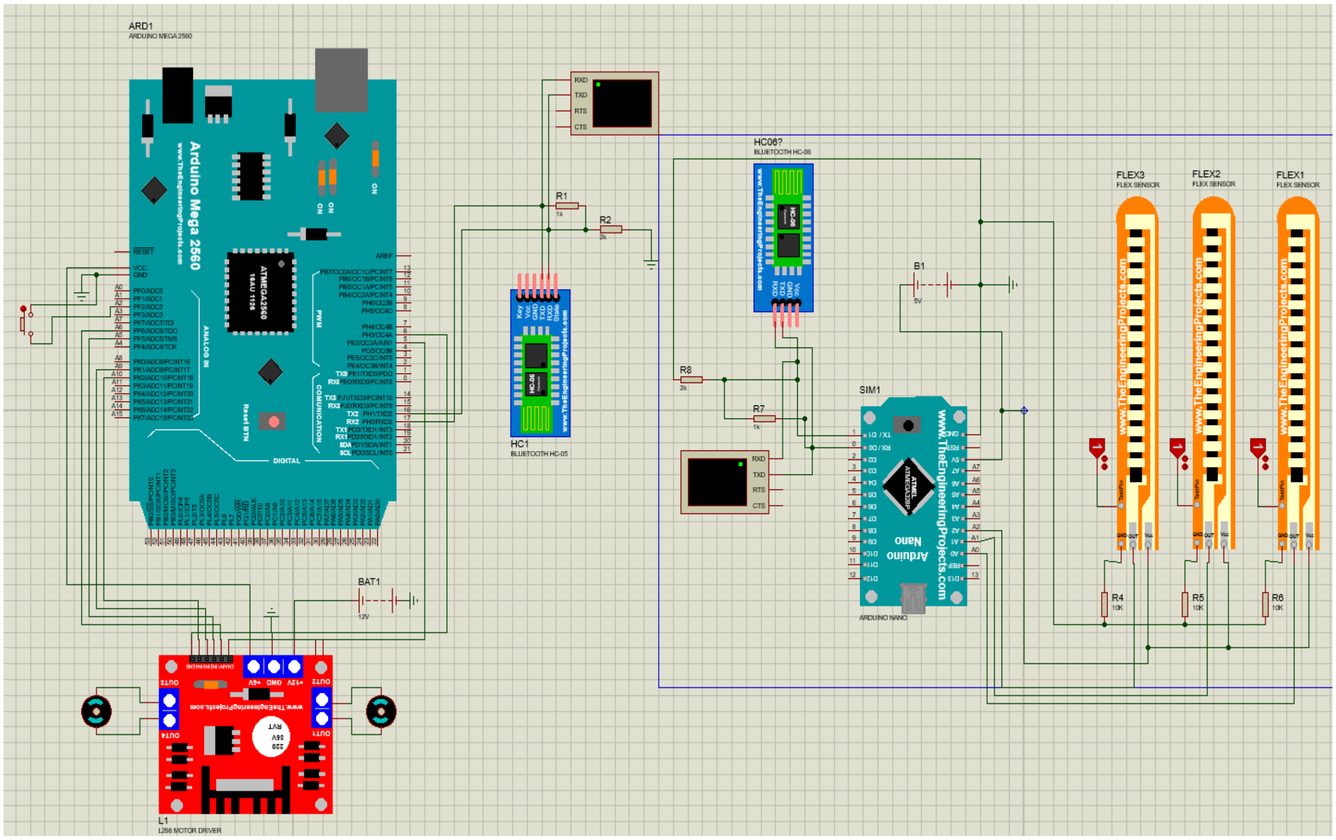
BMS S8 Smart:

The BMS S8 Smart is a Battery Management System that protects the battery from overcharging, over-discharging, and overheating. It keeps the battery healthy and improves its lifespan. We included it in the project to make sure the battery operates safely and reliably.

Push button:

This function allows the wheelchair to move backward when the push button is pressed. The button is connected to a digital input pin on the Arduino. When it is pressed, the code activates the backward direction on both motors, making the wheelchair go in reverse safely and smoothly. This feature is useful for manual control in tight spaces or when reversing is needed.

The simulation:



This image illustrates the complete simulation of the smart wheelchair control system using a glove equipped with flex sensors. The simulation was built using Proteus software to test and validate the system before physical implementation. The circuit consists of two main parts: the smart glove unit containing an Arduino Nano, flex sensors, and an HC-05 Bluetooth module; and the wheelchair unit which includes an Arduino Mega 2560, another Bluetooth module to receive signals, and a motor driver.

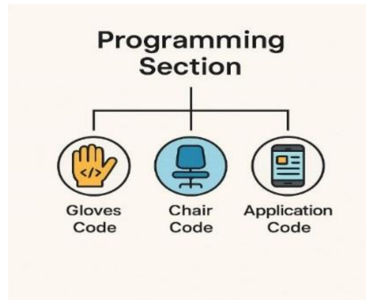
Important Note:

The L298N motor driver shield was used in this simulation instead of the original BTS7960 driver used in the real hardware, because BTS7960 is not supported in Proteus and there is no available simulation library for it. Therefore, L298N was used only for simulation purposes, while maintaining the core movement functionalities of the system.

Programming section

1.Glove Code Explanation:

The glove code is designed to read values from **three flex sensors** attached to the glove and send control commands to the Arduino Mega via Bluetooth based on these readings.



Sensor Initialization:

- The flex sensors are connected to analog pins A0, A2, and A3 on the Arduino Nano.
- The sensor readings range from 0 to 1023, where 0 indicates no bending and 1023 indicates maximum bending.

Reading Sensor Values:

- The analogRead() function is used to read voltage values from each flex sensor.
- The readings are stored in the variables val1, val3, and val4.

Command Logic:

- A default command "S" (stop) is initially assigned to the command variable.
- Depending on the sensor values:
  - If val1 > 900, the command is "F" (move forward).
  - If val3 > 880, the command is "L" (turn left).
  - If val4 > 900, the command is "R" (turn right).
- The backward movement command has been removed from the glove. It is now handled physical button on the wheelchair for easier control.

Bluetooth Communication:

- If the current command is different from the last command sent (lastCommand), the new command is transmitted via Bluetooth using bluetooth.println(command).
- The command is also printed to the Serial Monitor using Serial.println() for debugging purposes.
- A short delay of 100 milliseconds is used to avoid sending commands too frequently.

Updated Wheelchair Code Explanation:

The Arduino Mega code listens for Bluetooth commands sent from the glove and controls the wheelchair's motors accordingly. A physical button is also added to allow manual backward movement.

Pin Configuration:

- Motor control pins are initialized as outputs.
- The pins are used to control the direction and enable signals for both the right and left motors.

Back Button Feature:

- A push button is connected to pin 2 and configured with INPUT_PULLUP.
- When pressed, it overrides Bluetooth commands and immediately triggers backward movement.

Motor Control Functions:

- moveForward(): Both motors rotate forward.
- moveBackward(): Both motors rotate backward.
- turnLeft(): Right motor moves forward, left motor moves backward.
- turnRight(): Left motor moves forward, right motor moves backward.
- stopMotors(): All motor control signals are set to LOW, stopping the wheelchair.

Bluetooth Communication:

- The function bluetooth.available() checks for incoming Bluetooth data.
- When data is available, bluetooth.read() reads the command and stores it in the command variable.
- The received command is printed to the Serial Monitor.

Command Handling:

- A switch-case structure is used to determine the action:
  - 'F' → move forward.
  - 'B' → move backward (only used internally by the button now).
  - 'L' → turn left.
  - 'R' → turn right.
  - Any other input → stop motors.

Priority of Back Button:

- If the back button is pressed, the wheelchair immediately moves backward, regardless of any Bluetooth input. This ensures quick and easy reverse control in emergencies or tight spaces.

Application section:

1. Initialization:

- Declares necessary Bluetooth-related objects (Adapter, Socket, Device, Streams).
- Gets the default Bluetooth adapter.
- Finds UI elements (TextView, Buttons).
- Disables control buttons initially.
- Sets up click listeners for the buttons.

2. Bluetooth Connection:

• The “connectBluetooth()” method handles the connection process:

1. Checks for BLUETOOTH_CONNECT permission and requests it if necessary.
2. Gets the paired Bluetooth devices.
3. Iterates through the paired devices to find one named "HC-05".
4. If found:
    a. Creates an RFCOMM socket using the device's UUID.
    b. Connects to the socket.
    c. Gets the input and output streams.
    d. Updates the UI to indicate a successful connection.
    e. Enables the control buttons.
    f. Starts a thread to listen for incoming data.
5. Handles potential “IOExceptions” during the connection.

3. Sending Data:

- The “sendMessage”(String message) method sends a string to the connected Bluetooth device through the output stream.
- It also includes error handling for potential “IOExceptions”.

4. Receiving Data:

- The “beginListenForData()” method starts a background thread to continuously listen for data from the Bluetooth device.
- It reads available data from the input stream.
- Converts the received bytes to a string.
- Uses a Handler to post the received data to the main thread for UI update (appending to the textView).
- The thread continues to listen as long as the socket is connected.

Design:

The engineering design of the smart wheelchair is the core of this project. We focused on combining innovation, comfort, durability, and usability to provide an efficient and safe experience for the user.

- Seat Selection and Comfort

After evaluating several options, we chose a car seat from a Hyundai Verna due to its:

High level of comfort for long sitting durations.

Excellent support for the back, neck, and shoulders.

Strong and elegant material in black savr color, suitable for daily use.

- Frame and Dimensions

The wheelchair frame was custom-built using iron in collaboration with a skilled blacksmith to ensure strength and weight-bearing capacity. All dimensions were precisely calculated to ensure balance and stability.

Overall Chair Dimensions:

Length: 148 cm

Width: 66 cm

Height from ground level: 18 cm

Wheel Sizes:

Front main wheels: 20 inches

Rear auxiliary wheels: 6 inches

The rear positioning of the small wheels helps maintain balance and prevents tipping, especially during climbing or sharp turns.

- Internal Component Layout

A custom metal box was installed under the seat to house the core components:

Two MY1016Z2 electric motors (350W each).

A 24V $LiFePO_4$ battery (7S configuration).

Battery Management System (BMS), control board, and wiring.

All parts were securely and neatly fixed, allowing easy maintenance and proper heat dissipation.

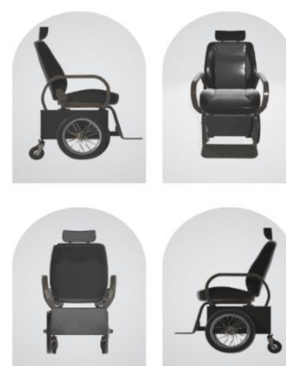
- Glove-Based Control System

The chair is operated using a smart glove equipped with three flex sensors, enabling control in three directions: forward, right, and left.

For backward movement, a manual push-button is mounted on the side of the chair for easier and more direct control.

The glove transmits signals wirelessly via Bluetooth to the chair's control system, providing a smooth and intuitive user experience.

- Visual Design Overview



To showcase every angle of the design, the following directional views were prepared:

Front View: Highlighting the seat and main front wheels.

Back View: Showing the auxiliary rear wheels and component box.

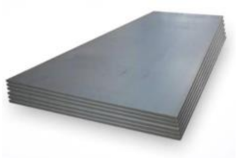
Left & Right Views: Illustrating motor placement, wheel alignment, and the external button location.

Project feasibility study:

Image	Product	Quantity	Price	Total
	Arduino Nano V3.0 CH340 Chip + Mini USB Cable	1	270.00 EGP	370.00 EGP
	Arduino MEGA 2560 R3	1	1,450.00 EGP	1,450.00 EGP
	Arduino mega cable	1	20.00 EGP	20.00 EGP
	High Power Robot Smart Car Motor Driver (BTS7960)	2	585.00 EGP	1,170.00 EGP
	Bluetooth Module HC-05 (6pin + Button)	1	225.00 EGP	225.00 EGP
	Resistance 1K	4	1.00EGP	4.00EGP
	Male to Female Jumper Wire 1 Pin (10cm)	20	0.70 EGP	14.00 EGP

	Male to Male Jumper Wire 1 Pin (10cm	15	0.70 EGP	10.50 EGP
	Female to Female Jumper Wire 1 Pin(10cm)	15	0.70 EGP	10.50 EGP
	Terminal	8	3.00EGP	24.00EGP
	Breadboard Soldless 170 Tie-points SYB-170	1	10.00 EGP	10.00 EGP
	[KIT.BLUETOOTH.HC06] HC-06 Bluetooth	1	200.00 EGP	200.00 EGP
	[SF10264] Short Flex/Bending Sensor 2.2" (56mm)	3	850.00 EGP	2550.00 EGP
	Push button	1	7.00EGP	7.00EGP
	Battery 9V Power Alkaline TOSHIBA	1	175.00 EGP	175.00 EGP

	2mm braided copper power wire	4m	20.00 EGP	80.00 EGP
	Nit-rile Gloves TSP12101	1	65.00 EGP	65.00 EGP
	MY1016Z3 motors 350 W	2	1825.00 EGP	3650.00EGP
	LiFePO4 (7S)	1	3500.00 EGP	3500.00 EGP
	BMS 8S Smart	1	2000.00 EGP	2000.00 EGP
	auxiliary wheels	2	225.00 EGP	450.00 EGP
	Basic wheel	2	775.00EGP	1550.00EGP

	Arabic chair	1	1200.00EGP	1200.00EGP
	Deep groove ball bearing	2	600.00EGP	1200.00EGP
	Thrust bearing	2	200.00EGP	400.00EGP
	Iron sheet			4000.00EGP
	Axe	1	1200.00EGP	1200.00EGP
	Spray paint	2	100.00EGP	200.00EGP
Total				***25,735.00EGP***

This project features

several important features that make it an effective and innovative solution for serving people with special needs. These features include the following:

1. Ease of Control:

The system provides a simple and easy-to-use control method, enabling the user to control the wheelchair's movement only through the movement of their fingers.

2. Flexibility of Use:

The project relies on a glove equipped with three Flex Sensors, allowing the user to control the wheelchair's movement in the forward, right, and left directions through simple finger bends. This design ensures free hand movement and smooth directional control.

3. Accuracy of Response:

The system is characterized by its ability to accurately detect the curvature of specific fingers using three Flex Sensors to determine movement forward, right, or left. Additionally, a Push Button is integrated to allow movement backward, providing a clear and reliable control method.

4. Accessibility for Modification and Development:

The project enjoys great flexibility for future updates, as many features can be added, such as:

- A wireless control system using Bluetooth technology.
- A digital display showing the system's status.
- Obstacle detection sensors to avoid collisions.

5. Economical Cost:

The project relies on simple and relatively low-cost electronic components, such as an Arduino controller and curvature sensors, making it a suitable economical solution.

6. Enhancing Safety Factors:

The system features an effective safety mechanism, where the wheelchair automatically stops moving when the user stops moving their fingers, to avoid accidents or unintended movements.

7. Ease of Installation and Use:

The sensors are simply attached to the glove, making it easy to put on and take off without requiring any modification to the wheelchair itself.

8. Humane Design:

The project takes into account the needs of wheelchair users with disabilities, providing them with a control method based on natural hand movement, facilitating adaptation and daily use.

9. Ease of movement:

It is easy for the user to move around without the need for constant assistance from others, ease of movement on the road, and ease of dealing with the chair on the roads.

10. User comfort:

It must be designed in a way that is comfortable for sitting on for long periods of time. It must be comfortable for the back and shoulders so that the body is not harmed by sitting on the chair for a long period of time.

11. Electronic control:

It can be controlled using control gloves and must be designed in a way that is comfortable for the hand so that the nerves of the hand do not get tired later.

12. Rechargeable battery:

works for long hours without the need for constant charging and lasts for long periods.

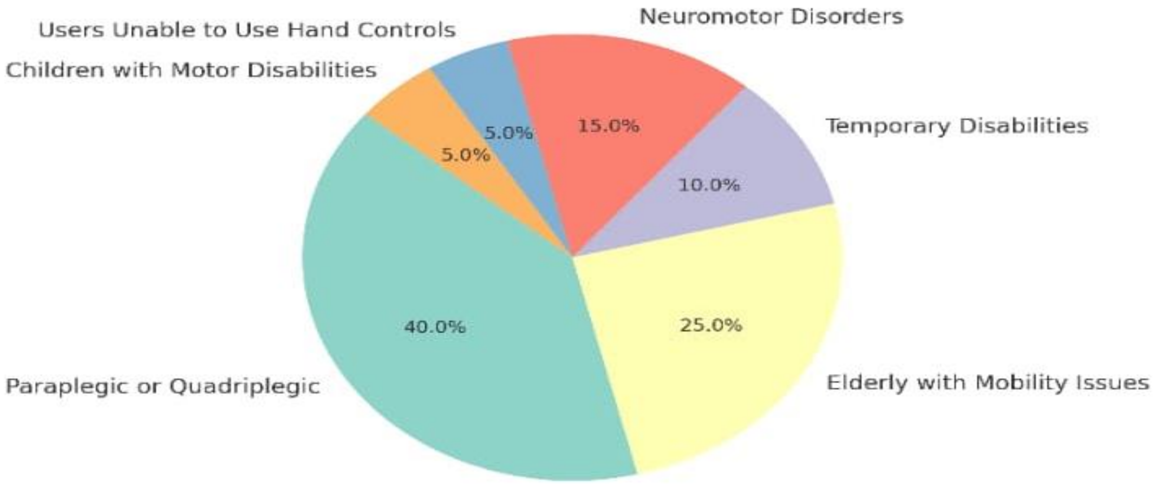
13. Bluetooth connection:

to integrate with other applications or devices.

14. Control via smartphone:

as an alternative to controlling gloves. In case of a malfunction, it can be controlled in another way.

Target User Categories for the Smart Wheelchair:



1. Paraplegic/Quadriplegic (40%)

Can't move lower or full body – glove enables easy control via finger gestures.

2. Elderly with Mobility Issues (25%)

Weak movement due to age – glove allows control without physical effort.

3. Neuromotor Disorders (15%)

Diseases like Parkinson’s – glove helps bypass tremors/stiffness.

4. Temporary Disabilities (10%)

Short-term injuries – glove helps during recovery without permanent setup.

5. Unable to Use Hands (5%)

Amputees or hand paralysis – glove works with other hand or gestures.

6. Children with Motor Disabilities (5%)

Kids with movement disorders – glove is safe and size-adjustable

Project risks:

This section outlines the potential risks that may arise during the development and operation of the smart wheelchair project:

1. Technical Risks:

- Possible decrease in the accuracy of the flex sensor over time or with frequent use.
- Interference in wireless signals (e.g., Bluetooth or Wi-Fi), leading to delayed response.
- Incompatibility between system components such as sensors, microcontrollers, and the application.
- Unexpected system failure during operation due to signal loss or hardware malfunction.

2. Software Risks:

- Programming errors that may cause the application to crash or malfunction.
- Latency in transmitting or receiving control commands.
- Issues with establishing or maintaining a stable connection between the app and the control unit.
- Instability or poor user experience within the application interface.

3. Hardware Risks:

- Battery depletion during use, which may cause the wheelchair to stop suddenly.
- Overheating of components such as motors or control boards.
- Damage to the flex sensor or glove due to overuse or poor design.
- Exposure of electrical connections or wires, increasing the risk of failure.

4. User Risks:

- Difficulty in using the glove or application, especially by people with severe physical limitations.
- Improper use due to lack of training, which may lead to incorrect control commands.
- The wheelchair might move unexpectedly if false signals are given accidentally.
- Misunderstanding the system's behavior due to unclear or complex instructions.

5. Safety Risks:

- Absence of an emergency stop button may lead to continued movement during errors.
- Possibility of the wheelchair tipping over due to imbalance or sharp movements.
- Risk of electric shock from poorly insulated wires or exposed circuits.
- Unsafe use in inappropriate environments such as uneven or wet surfaces.
- Sudden movements caused by misinterpreted input signals.

6. Maintenance & Support Risks:

- Difficulty in replacing or repairing key components such as the flex sensor or motors.
- Dependence on expensive or hard-to-find spare parts.
- Lack of skilled technicians to handle technical issues.
- Absence of a structured maintenance plan or update cycle.
- Poor documentation, making it hard to troubleshoot or improve the system.

Proposed Solutions for Project Risks:

To support the successful implementation of the smart wheelchair project, it is crucial to proactively identify and address potential risks. This section outlines practical solutions and strategies designed to minimize or eliminate the impact of each risk category.

1. Technical Risks – Solutions:

- Use high-quality flex sensors with reliable performance and durability.
- Implement regular calibration of the sensors to maintain accuracy.
- Ensure compatibility between hardware components through early integration testing.
- Design a fail-safe mechanism to stop the system in case of signal loss or malfunction.

2. Software Risks – Solutions:

- Conduct thorough code reviews and testing to reduce programming errors.
- Optimize communication protocols to reduce latency.
- Use robust libraries and reliable communication modules for stable connectivity.
- Design a user-friendly interface with proper feedback and error handling.

3. Hardware Risks – Solutions:

- Use rechargeable batteries with charge indicators to prevent unexpected shutdowns.
- Integrate thermal protection or cooling components to prevent overheating.
- Choose durable materials for gloves and sensors to reduce damage risks.
- Properly insulate and secure all wiring to avoid electrical faults.

4. User Risks – Solutions:

- Provide simple tutorials and clear instructions for users.
- Offer hands-on training for individuals using the system.
- Add confirmation cues (sound or vibration) to validate control inputs.
- Simplify the control interface to minimize the chance of user errors.

5. Safety Risks – Solutions:

- Include an emergency stop button that is easy to access.
- Design the wheelchair to have a low center of gravity for better balance.
- Enclose all electronic components to prevent exposure to moisture or shock.
- Limit the speed and integrate sensors for obstacle detection.
- Conduct real-world testing to ensure safety in different environments.

6. Maintenance & Support Risks – Solutions:

- Provide a detailed maintenance manual for all hardware and software components.
- Use widely available and affordable parts for easier replacement.
- Design the system in a modular structure to simplify repairs.
- Schedule routine inspections and preventive maintenance.
- Document all system details, including wiring diagrams and source code.

Findings / Results :

This section presents the actual results achieved after implementing and testing the project in real-world settings. Several experiments were conducted to evaluate the system's efficiency and user response, as well as to analyze performance under various conditions. The results demonstrate the system's effectiveness in terms of control, security, and ease of use for the target audience.

1- Ease of Use:

People with partial or total physical disabilities or those unable to walk found it easy to learn how to use the glove.

- After a simple 10-minute training session, the user was able to fully control the chair with ease.

2- Effectiveness of the glove control:

When testing the glove, it was found that users were able to move the chair in the desired directions (forward, backward, right, left) with precision.

- After real-world testing, the glove responded quickly, with an average delay of 0.6 seconds between movement (forward, backward, right, left) and execution.

3- Flex sensor control efficiency:

The four flex sensors were expected to operate without any damage during operation.

- During real-world operation, one flex sensor became damaged due to a malfunction. This flex sensor was replaced with a button located on the right side of the chair's handlebar, making it easy and simple to use.

4- Mobile App Performance:

The app displays the patient's name, age, and disease type.

The app allows the chair to be moved (forward, backward, right, left).

5- Device Compatibility:

The expected integration between the glove, the app, and the chair was 100%.

- After testing the integration between the glove, the app, and the chair, the compatibility rate was 95%, with some cases requiring recalibration.

6- Integration of System Components via Bluetooth:

The project's engineering planning ensures high compatibility between the glove, controller, and application. Simulations indicate a stable Bluetooth wireless connection with a success rate of up to 95% under ideal operating conditions.

7- Battery:

During real-world testing, the $LiFePO_4$ battery (7S, 22.4V) provided stable and reliable power to the system.
The wheelchair operated efficiently under different loads, and no voltage drops or overheating were observed.
The battery maintained consistent performance, allowing for long operating hours without the need for frequent recharging, making it highly suitable for assistive mobility applications.

8- Battery Management System (BMS):

Since the battery used consists of seven Lithium Iron Phosphate ($LiFePO_4$) cells connected in series (7S), it was necessary to use a battery management system (BMS) compatible with the cell type and number to ensure safe and stable performance.

The BMS we used supports seven cells (7S), is fully dedicated to $LiFePO_4$ batteries, and provides comprehensive protection against overcharging, overdischarging, high current, and high temperature.

9- Modification and Development Capability:

The project was expected to operate flexibly in future updates.

- Indeed, the project enjoys great flexibility in future updates, as many features can be added, such as:
  - A wireless control system using Bluetooth technology.
  - A digital display showing the system status.
  - Sensors to detect obstacles to avoid collisions.

Conclusion:

At the end of this project, we successfully implemented a prototype of a smart wheelchair that can be controlled using a glove equipped with flex sensors, in addition to an option for control via a mobile phone application. The system responded effectively to finger movements, translating them into precise commands to move the wheelchair in the desired directions.

The main goals of the project were achieved, as the system provided an alternative and easier control method for people with disabilities, demonstrating a good level of performance and responsiveness. Furthermore, the project showed potential for future expansion by integrating additional technologies such as EEG or EMG.

This project is expected to have a positive impact on users by improving their quality of life and enhancing their sense of independence. With this achievement, we have delivered an effective engineering solution that meets the urgent needs of a vital segment of society.

Recommendations:

To further enhance the performance, safety, and user experience of the smart wheelchair system, several future improvements are proposed:

1. Integration of IMU Sensors (Accelerometer + Gyroscope):

To improve the accuracy of detecting hand orientation and movement, making gesture recognition more precise and reliable.

2. Incorporating Artificial Intelligence (Machine Learning):

To allow the system to learn and adapt to each user's movement patterns, enhancing personalization and reducing misinterpretation of gestures.

3. Addition of GPS and GSM Modules:

To enable real-time location tracking and emergency alerts for caregivers or medical centers.

4. Mounting an LCD Display:

To show useful data such as battery status, Bluetooth connectivity, and notifications, enhancing direct user interaction.

5. Voice Command Integration:

To offer an alternative control method for users who may not be able to use the glove in certain situations.

6. Optimizing Power Consumption:

By utilizing high-efficiency LiFePO4 batteries and implementing energy-saving circuits, the system's runtime can be significantly extended.

7. Developing an IoT-Enabled Mobile App:

To allow remote control and monitoring over the internet, providing additional support and control capabilities for family or caregivers.

8. Implementing Obstacle Avoidance System:

Using ultrasonic or LIDAR sensors to ensure safe navigation and prevent collisions.

9. Emergency Stop Feature:

A dedicated emergency gesture or button to instantly halt the wheelchair in critical situations.

10. Integration of EEG (Electroencephalography) Technology:

To explore the use of brainwave signals for controlling the wheelchair, offering a solution for users with severe mobility impairments.

11. Incorporation of EMG (Electromyography) Sensors:

To detect muscle activity for gesture control, providing an alternative input method that could be more intuitive or accessible for some users.

These enhancements would not only increase the functionality and accessibility of the wheelchair but also pave the way for developing a more advanced assistive mobility system tailored to the diverse needs of users.

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