Khulna University of Engineering & Technology, Khulna

Department of Electronics and Communication Engineering

Project Report (ECE 3200)

IOT SmartCare Assist: Integrated Fall Detection, Wireless Communication, and Eye-Guided Navigation System

3rd Year 2nd Term

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IOT SmartCare Assist: Integrated Fall Detection, Wireless Communication, and Eye-Guided Navigation System

Related Courses Studied:

Title	Course Code
Computer Fundamentals & Programming	CSE 1209
Electronic Circuits Design Laboratory	ECE 2200
Antenna Engineering	ECE3207
Industrial Electronics Laboratory	ECE3102
Basic Electrical Engineering Laboratory	EEE1110

Motivation:

The motivation behind the "IOT SmartCare Assist" project is profoundly driven by the belief that transforming the lives of disabled individuals goes beyond addressing immediate healthcare challenges. This conviction is rooted in staggering statistics: approximately 10% of the world's population, roughly 650 million people, grapple with disabilities. Of this demographic, about 10% require a wheelchair for mobility. Shockingly, as of 2003, an estimated 20 million individuals in need of wheelchairs did not have access to one.

Furthermore, an alarming aspect of this scenario is the prevalence of wheelchair-related accidents. In the United States alone, an estimated yearly average of 36,559 nonfatal wheelchair-related accidents occurs, necessitating emergency department attention. These accidents, particularly falls, have been a persistent and critical issue over the years.

These statistics underscore a pervasive issue—many individuals requiring wheelchairs not only lack access to them but also face a scarcity of appropriate wheelchairs. It is evident that a significant portion of the global population with mobility needs is left without the essential tools for daily living, hindering their independence and overall well-being.

The project, "IOT SmartCare Assist," seeks to directly address this critical gap by providing an inclusive and accessible solution. By incorporating advanced technologies like IoT, wireless communication, and eye-guided navigation, the project aims to create a ripple effect that positively impacts both the individual and society at large. Beyond immediate healthcare needs, the project aspires to be a catalyst for societal change, breaking down barriers that limit the potential of disabled individuals.

Enabling a disabled patient to move independently is not just about enhancing their personal freedom; it's about unlocking a world of possibilities. Beyond the confines of their immediate environment, newfound mobility can empower individuals to seek employment, become active contributors to society, and ultimately, enhance their own sense of value and purpose.

This approach aligns with the broader goal of creating a more inclusive and equitable society, where every individual, regardless of physical abilities, has the opportunity to lead a fulfilling and meaningful life. The "IOT SmartCare Assist" project is a step towards realizing this vision, leveraging statistics to underscore the urgency of the issue and making a positive impact on the world..

Goals and Objectives:

- Enhance Accessibility:
  The aim is to ensure cost-effective access to wheelchairs for those in need, addressing disparities identified from 2003. This involves researching and developing affordable wheelchair models without compromising quality, along with establishing partnerships with manufacturers to produce cost-effective and suitable wheelchairs.

- Reduce Wheelchair-Related Accidents:

The goal is to minimize the impact of wheelchair-related accidents through a cost-effective preventive and responsive system. This includes integrating affordable IoT technology for real-time monitoring, focusing on fall detection and emergency alerts. Additionally, there is a focus on developing a responsive and low-cost communication system alerting caregivers or emergency services in case of accidents.

- Facilitate Independent Mobility:
  The objective is to enable cost-effective solutions for disabled individuals to move independently, fostering freedom and autonomy. This involves implementing affordable eye-guided navigation technology for precise movement control and developing user-friendly interfaces and cost-effective training programs for varying physical abilities.

- Empower Through Employment:
  The focus here is on empowering disabled individuals through affordable solutions, creating opportunities for employment and societal contributions. This includes advocating for businesses to adopt cost-effective, inclusive hiring practices and providing affordable training programs and resources to enhance the employability of individuals with disabilities.

- Catalyze Societal Change:This aspect aims to act as a cost-effective catalyst for societal change by challenging stereotypes and promoting inclusivity. Activities include conducting affordable awareness campaigns fostering understanding and empathy toward individuals with disabilities and advocating for cost-effective policy changes supporting the rights and inclusion of people with mobility challenges.

- Measure Impact and Continuous Improvement:
  The overarching goal is to regularly assess the cost-effective impact of "IOT SmartCare Assist" and identify areas for improvement. This involves implementing affordable feedback mechanisms to gather insights from users and caregivers and conducting regular evaluations of the project's

cost-effectiveness in achieving its goals and adapting strategies accordingly.

Research Methodology and Implementation:

Our project is subdivided into three parts

- Eye Guided Wheelchair
- Integrated Fall Detection
- Wireless Communication via Hand Command

Eye Guided Wheelchair Research Methodology and Implementation:

Literature Review:

Conduct a thorough review of existing literature on eye gaze tracking using Dlib, OpenCV, and related technologies.Explore studies on human-computer interaction using eye movement for wheelchair control.Examine methodologies for integrating Python, OpenCV, and Arduino for real-time applications.

Dataset Acquisition:

Acquire or create a dataset for training the eye gaze tracking model using Dlib 68 points Face Landmark Detection.Ensure diversity in the dataset to enhance the robustness of the trained model.

PyCharm Setup:

Install and configure PyCharm for Python development.

Set up the necessary Python virtual environment for the project.

Eye Gaze Tracking Model:

Implement the Dlib 68 points Face Landmark Detection algorithm using Python.Train the model using the acquired dataset to accurately detect eye gaze based on facial landmarks.

OpenCV Integration:

Integrate the eye gaze tracking model with OpenCV for real-time processing of webcam feed.Implement algorithms to filter and process eye movement data.

Bluetooth Communication:

Utilize Python libraries for establishing Bluetooth communication from the computer to bluetooth module HC-05Develop a protocol for sending eye gaze data efficiently.

Arduino Implementation:

Set up the Arduino Uno board with the necessary components, including a motor driver for wheelchair control.Write Arduino code to receive and process eye gaze data transmitted over Bluetooth.

Motor Control Integration:

Integrate the Arduino with the motor driver to control the wheelchair based on received eye movement data.Implement algorithms to interpret eye gaze information for accurate and responsive wheelchair movement.

Testing and Validation:

Conduct extensive testing to ensure the accuracy and reliability of the eye gaze tracking system.Validate the system's effectiveness in controlling the wheelchair based on eye movement.

PyCharm and Python Setup:

Install PyCharm and set up a Python project environment.

Ensure the installation of necessary libraries (OpenCV, Dlib, PyBluez) using pip.

Eye Gaze Tracking Model: Develop Python scripts to implement the Dlib 68 points Face Landmark Detection algorithm.Train the model using the acquired or created dataset for eye gaze tracking.

OpenCV Integration:

Use OpenCV to capture webcam feed and integrate it with the eye gaze tracking model. Implement real-time processing to extract and analyze eye movement data.Optimize the system for enhanced performance and user experience.

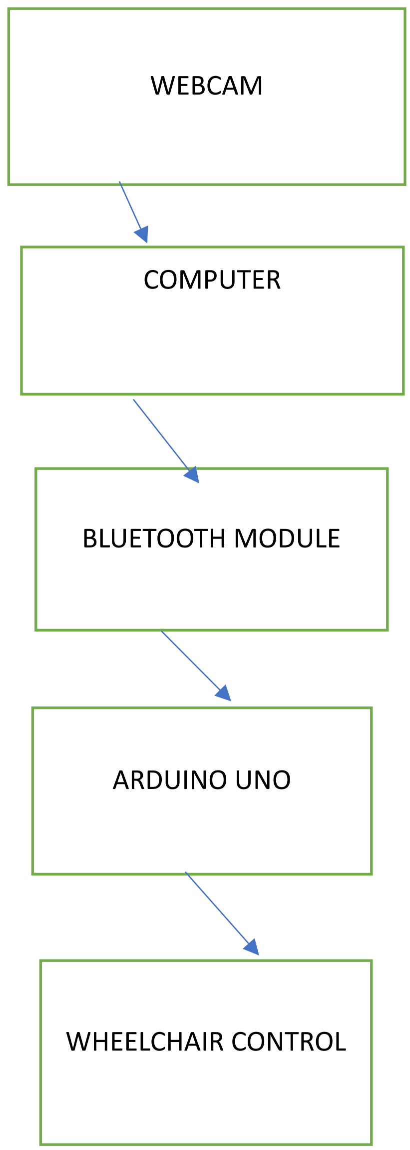


Fig- BLOCK DIAGRAM OF EYE CONTROLLED WHEELCHAIR MOVEMENT

Part II :Integrated Fall Detection:

Gyroscope Sensor Integration:

Select an appropriate gyroscope sensor for fall detection.

Review existing literature on gyroscope-based fall detection algorithms.

Understand the characteristics of gyroscope data during falls.

Esp8266 and Gyroscope Integration:

Connect the gyroscope sensor to the wifi module Implement gyroscope data reading and processing in Esp8266Integrate the ESP8266 WiFi module with the Arduino for wireless communication.Implement code on the ESP8266 to send fall detection alerts to a predefined server or endpoint using WiFi.

Server Setup for Fall Alerts:

Set up a server or cloud-based platform to receive fall detection alerts.Implement a server-side application to process incoming fall alerts and trigger notifications.

Mobile Call Integration: Develop a mobile application to receive fall detection call on the caregiver's smartphone.Enable real-time notification and response features in the mobile

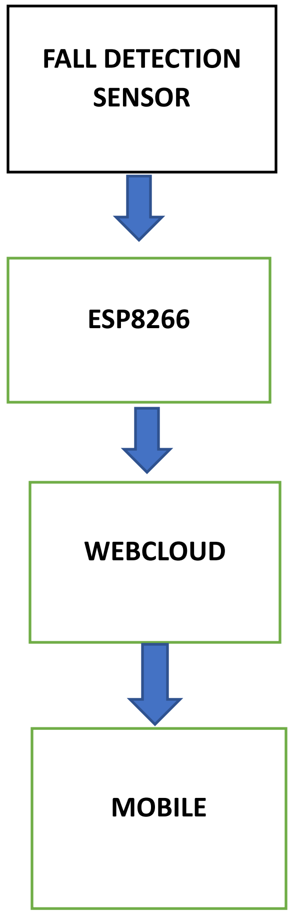


Fig- BLOCK DIAGRAM OF INTEGRATED FALL DETECTION

Part III :Hand Movement Wireless Commands

Research Methodology and Implementation: Investigate suitable gyroscope sensors for hand movement detection.Review literature on interpreting gyroscope data for diverse hand gestures.Understand gyroscope data characteristics for mapping hand movements.

Arduino and Gyroscope Integration: Connect a gyroscope sensor to Arduino Uno for real-time hand movement detection.Code interpretation algorithms to map specific hand movements to commands.

RF Transmitter and Receiver Setup: Select an RF transmitter and receiver for wireless communication.

Configure Arduino for transmitting and receiving hand movement commands.

Display Integration: Integrate LED matrix or LCD display with Arduino.Code display system for clear visualization of received hand movement commands.

Implementation (Continuation):

Wireless Communication via Hand Command:

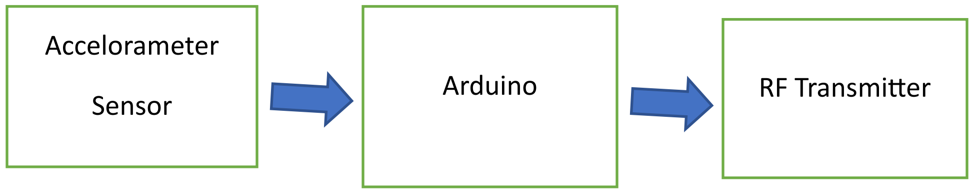
Connect a gyroscope sensor for hand movement capture.Develop and test code for accurate hand gesture interpretation**.**

Arduino and Gyroscope Integration: Write Arduino code to recognize hand movements and map to predefined commands.Thoroughly test the system with various gestures.

RF Transmitter and Receiver Setup: Set up Arduino for wireless transmission and reception of hand movement commands.Ensure accurate processing of commands on the receiver side.

Display Integration: Connect a display for visual representation of received hand movement commands.Implement code for effective display of interpreted commands.

Transmitter:



Receiver

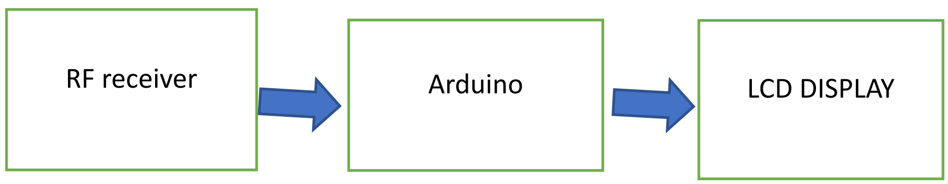


Fig- Block diagram of wireless communication using hand command

Outcome Analysis:

The successful completion of the "IOT SmartCare Assist" project marks a substantial achievement in meeting our primary objectives. The wireless hand command fall detection system has proven to be robust, ensuring a prompt response in critical situations. The integration of sensors and wireless communication has contributed to the reliability of the fall detection mechanism, achieving its intended purpose effectively.

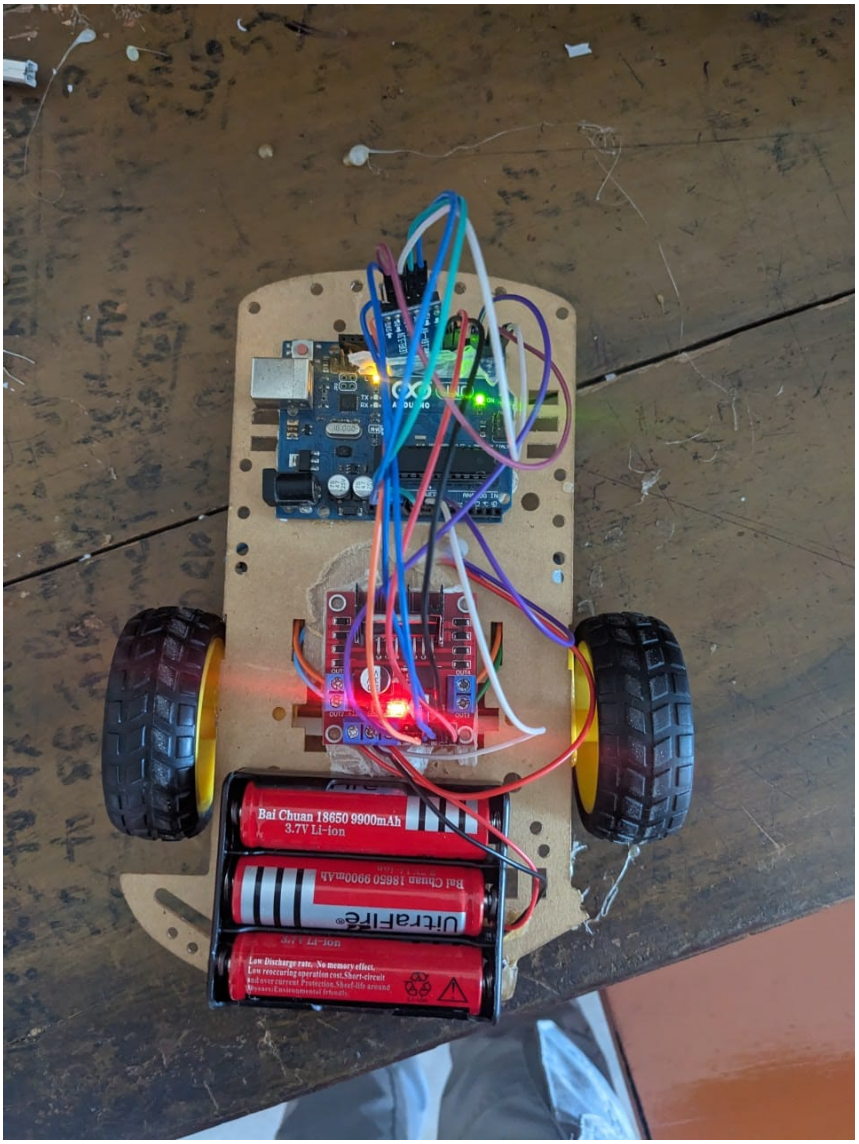
While the eye gaze-controlled wheelchair demonstrates operational functionality, the challenge lies in optimizing its stability. The sensitivity of the eye movement tracking system has been identified as a factor impacting the wheelchair's stability. To address this, a strategic focus on code efficiency is proposed, aiming to enhance the stability and control of the wheelchair. This adjustment aligns with the project's overarching goal of empowering individuals with restricted mobility.

Moreover, considering future improvisations, there is potential to enhance the wheelchair's capabilities. Incorporating features such as obstacle avoidance can significantly contribute to making the wheelchair more robust and user-friendly.

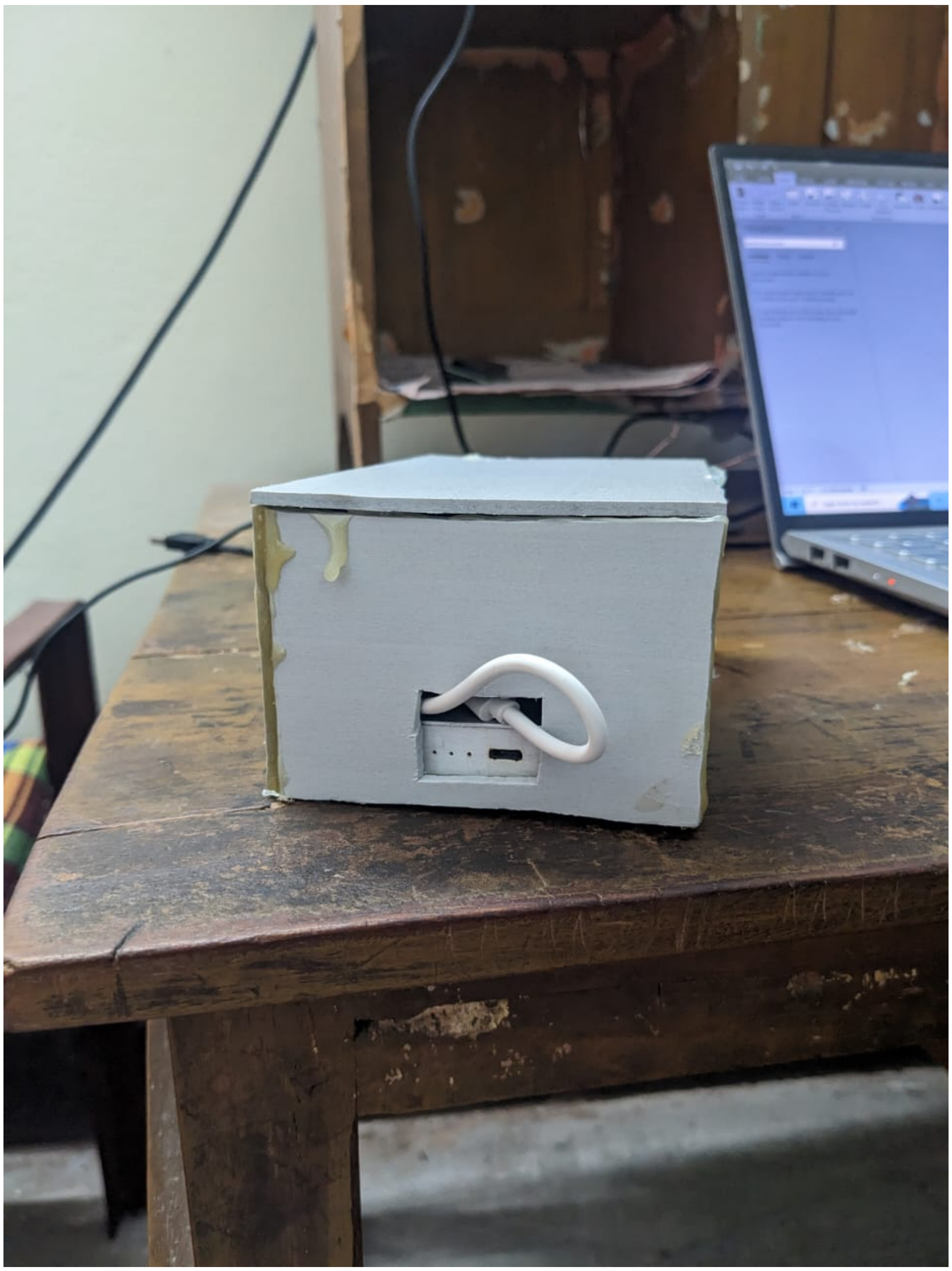
This expansion aligns with our commitment to continually improve the system's functionalities, ensuring a comprehensive and adaptable solution for individuals with diverse healthcare needs.

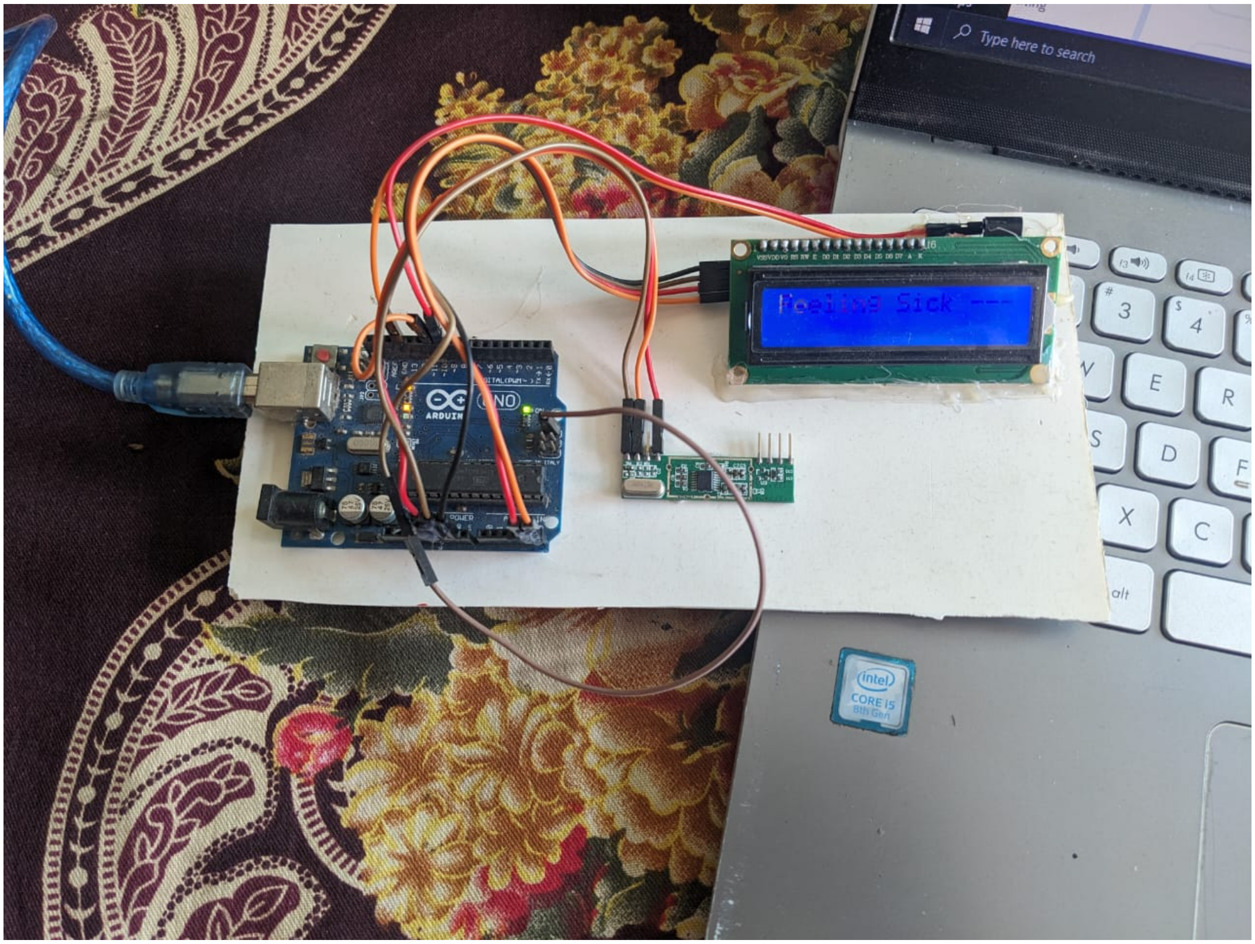
In summary, the outcome analysis acknowledges both achievements and areas for refinement. By prioritizing code efficiency and exploring additional features like obstacle avoidance, the project aims to elevate the overall functionality and impact of the "IOT SmartCare Assist" system.

Here is the Bluetooth controlled eye controlled wheelchair prototype which works well

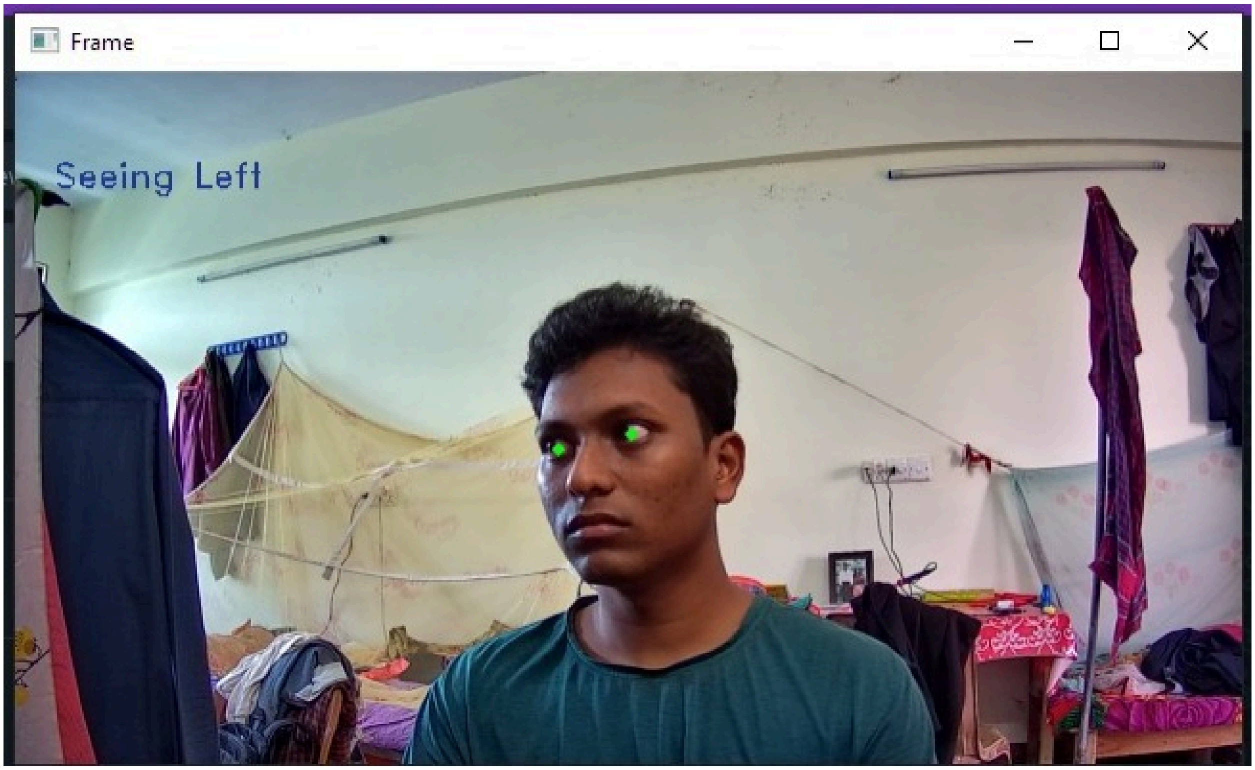


Here is the fall detection device which detects the fall of the disabled person and based on that call the attendant





Here the wireless command is shown at the LCD display, based on patient’s hand movement different command is shown to LCD display



Work Plan (Schedule): Phase 1-2: Initialization, Planning, and Literature Review (Weeks 1-4)

i. Define project scope, objectives, and team responsibilities.
ii. Develop a detailed project plan.
iii. Assemble the project team and allocate responsibilities.
iv. Set up communication channels and tools.
v. Conduct a literature review on eye gaze tracking, fall detection, and hand movement interpretation.
vi. Identify and acquire diverse datasets for eye gaze tracking, fall detection, and hand movement.

Phase 3-4: Eye Gaze Tracking Implementation and Fall Detection (Weeks 5-8)

i. Implement Dlib and OpenCV for eye gaze tracking.
ii. Train the eye gaze tracking model using acquired datasets.
iii. Integrate eye gaze data with Arduino for motor control.
iv. Investigate and implement gyroscope-based fall detection algorithms.
v. Develop and test fall detection algorithms.
vi. Integrate the fall detection system with ESP8266 for wireless alerts.

Phase 5-6: Hand Movement Command System and System Integration (Weeks 9-12)

Review literature on hand movement interpretation with gyroscope data.

i. Consider existing datasets for hand movement recognition.
ii. Connect gyroscope sensor to Arduino for hand movement detection.
iii. Code Arduino for hand movement commands via RF.
iv. Set up RF communication for wireless hand movement commands.
v. Integrate ESP8266 for wireless data transmission.
vi. Establish Bluetooth and RF communication.
vii. Write Arduino code for eye gaze data interpretation and motor control.
viii. Code Arduino for hand movement commands via RF.
ix. Conduct comprehensive testing for subsystems.
x. Validate integrated system performance.
xi. Phase 7: Optimization and Documentation (Week 13)
xii. Identify and address system inefficiencies.
xiii. Optimize code and improve system performance.

Cost Analysis:

The cost analysis for the "IOT SmartCare Assist" project now includes the chassis price for the wheelchair prototype, along with the previously mentioned components. Here's the updated breakdown:

1. Arduino Uno (3 units):
    - Cost: 600 TK each
    - Total Cost: 1800 TK
2. ESP8266:
    - Cost: 400 TK
3. Home-Used Computer with Webcam:
    - Home-Used Computer: Not Included in Cost Analysis (Assumed already available
    - Webcam: Not Included in Cost Analysis (Assumed already available)
4. RF Transmitter and Receiver:
    - Cost: 200 TK
5. MPU6050 3-Axis Gyroscope Sensor (2 units):
    - Cost: 300 TK each
    - Total Cost: 600 TK
6. Display:
    - Cost: 200 TK
7. Chassis for Wheelchair Prototype:
    - Cost: 200 TK
8. DC Motors (Assumed):
    - Cost: Not Specified

Total Project Cost (Including Chassis):

- Total Cost of Components: 3200 TK
- Total Cost with Chassis: 3400 TK

Expected Outcome and Impact:

1. Elevated Quality of Disable Patient Care:

- Dependable fall detection system for immediate critical response.
- Precise mobility via eye gaze tracking for restricted mobility patients.
- Effortless wireless command to caretaker/helper/attendant using hand movement commands.

2. Fostering Independence:

- Empowering wheelchair mobility through intuitive eye gaze movements.
- Effortless communication and control via hand movement commands.

Impact On Society and Environment:

1. Empowerment at the Individual Level:

- Provision of tools for self-expression and control, fostering empowerment.
- Inclusion of disabled individuals in daily activities and societal contributions.

2. Advancements in Healthcare Accessibility:

- Prioritization of healthcare for individuals with disabilities, reducing dependence on traditional care.
- Promotion of self-sufficiency through innovative healthcare solutions.

3. Opening Doors to Economic Opportunities:

- Facilitation of employment opportunities by enhancing mobility and communication.

- Integration of disabled individuals into the workforce, promoting economic inclusivity.

4. Global Impact on Health:

- Contribution to global initiatives addressing challenges faced by individuals with disabilities.
- Demonstration of technology's potential to revolutionize healthcare and accessibility globally.

5. Advocacy and Awareness:

- Raising awareness about unique healthcare challenges faced by disabled individuals.
- Advocating for the widespread adoption of innovative solutions to enhance the lives of individuals with disabilities.

The "IOT SmartCare Assist" project not only aims to provide technological solutions but also seeks to profoundly influence social, economic, and healthcare realms by empowering individuals with disabilities and championing inclusivity.

Conclusion:

The "IOT SmartCare Assist" project has successfully implemented a responsive wireless hand command,Integrated fall detection system, showcasing its immediate impact on critical healthcare scenarios. While the eye gaze-controlled wheelchair exhibits operational functionality, the focus on enhancing code efficiency is acknowledged for improved stability and control, aligning with our goal of fostering independence.

Looking ahead, the project envisions further enhancements, including obstacle avoidance, to fortify the wheelchair's robustness. The outcomes achieved, coupled with future-oriented plans, position the project as a promising contributor to inclusive and innovative healthcare solutions.

In conclusion, the "IOT SmartCare Assist" project exemplifies a commitment to transformative healthcare technology, addressing immediate challenges and paving the way for a more inclusive and compassionate future.

Signature of Students: **Date:**

Signature of Supervisor: **Date:**

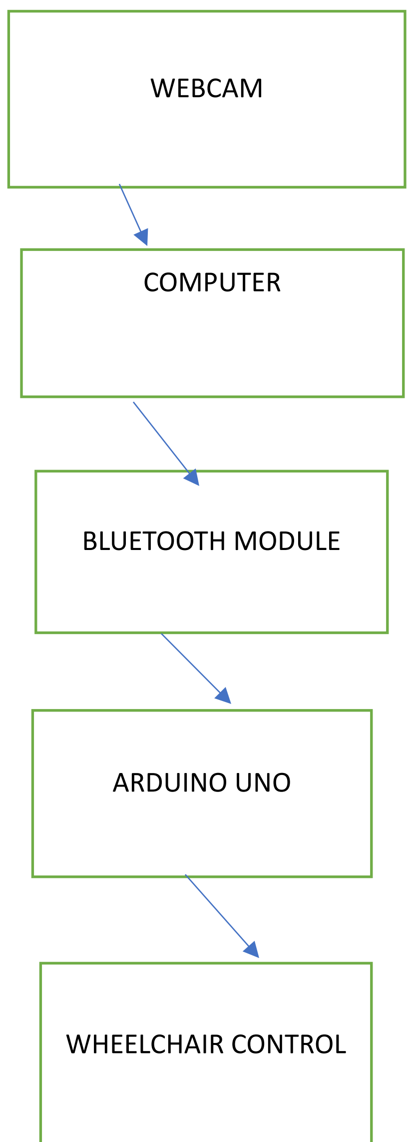


Fig- BLOCK DIAGRAM OF EYE CONTROLLED WHEELCHAIR MOVEMENT

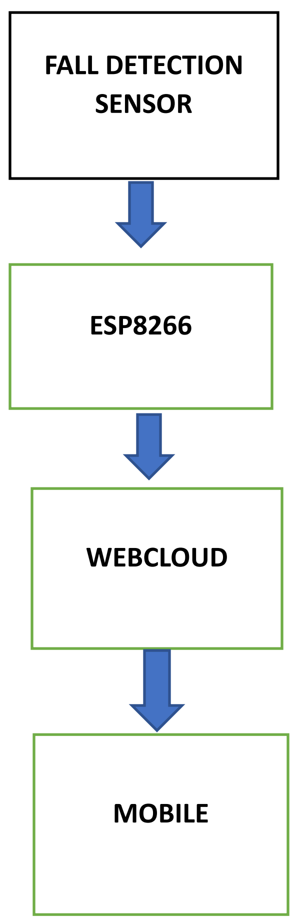
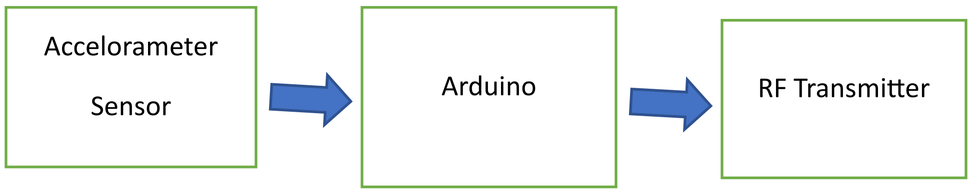


Fig- BLOCK DIAGRAM OF INTEGRATED FALL DETECTION

Transmitter:



Receiver

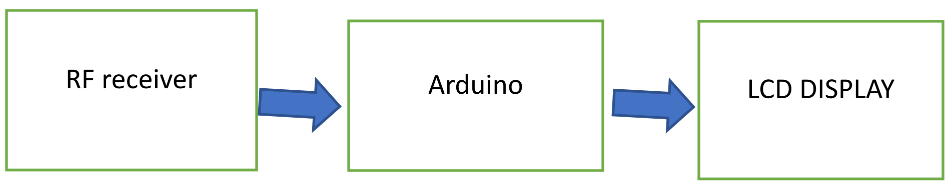


Fig- Block diagram of wireless communication using hand command