Design and development of a multifunctional robotic walker

Group 40 | Project Proposal Presentation

Team members

190655U - Vithanage T V R H
190582R - Senaratne N A A N R
190678R - Welangalle P D

Supervisors

Prof. Y W R Amarasinghe
Department of Mechanical Engineering
University of Moratuwa

Dr. Dumith Jayathilaka
Department of Mechanical Engineering
University of Moratuwa

Outline

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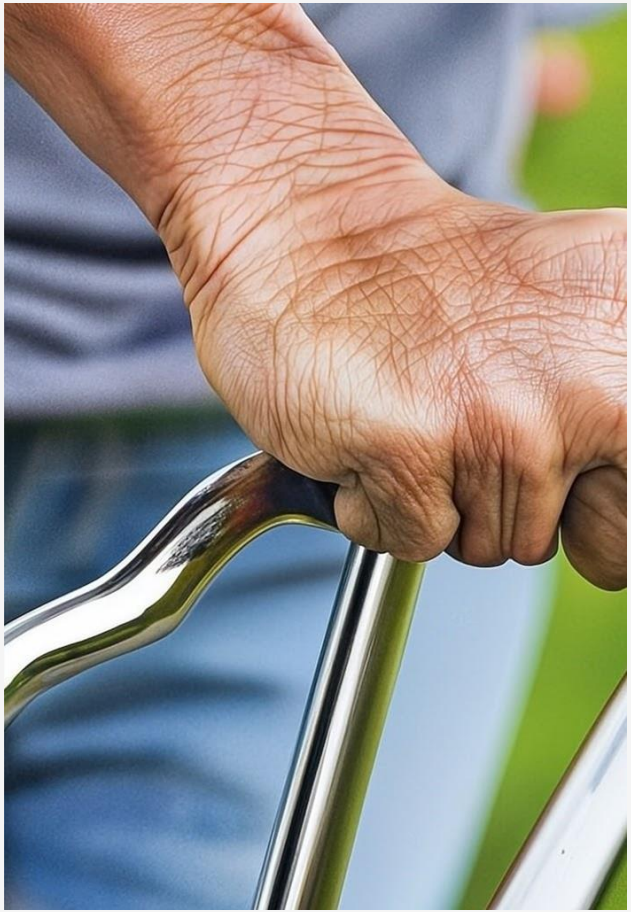

01

Introduction & Research Gap

Introduction

Walkers

- Mobility assistance device with 4 points of contact
- Current market trend: **Rollators** - Replacing the points of contact with **wheels**

Demography

General mobility issues	Weakness and Balance Disorders **2 billion elderly** in 2050 - **24%** to use mobility aids.
Neurological Conditions	Parkinson's Disease, Multiple Sclerosis, etc.
Chronic Pain Conditions	Arthritis or joint disorders, etc.
Orthopedic Conditions	Fractures, Joint Replacements Injury and Surgery Recovery

Research Gap

Shared Environment

- Hospitals, nursing homes, rehab centres, etc.
- Auto-adjustment to user operating height
- Personalised assistance for each user

Summoning Capability

- Call the walker to the user's location
- Improved independence and ease of use

Standing Assistance

- Transition between sitting and standing positions
- Helps perform essential daily activities.

02

Aim, objectives & scope of project

Aim

To improve the daily lives of individuals with mobility challenges, using assistive robotic technology.

1. Study the existing problems associated with mobility and **identify key focus areas** and **research gaps**.

2. Design and development of an **appropriate mechanical structure** for the platform of the walker.

3. Development of the **autonomous navigation system, walking guidance system**, and **standing assistance system** of the walker.

4. **Testing and validation** of the developed robotic walker.

Objectives

Scope of Project

Target Audience

- Risk of Falls: Increased likelihood of falling when walking or maintaining an upright posture without external aid.
- Navigation Impairments: Struggle to navigate within indoor environments
- Cognitive Load Management: Multitasking can be challenging for some individuals, especially in activities like avoiding obstacles while walking.

Functionalities

- Summoning Capability
- User Operating Height Adaptation
- Active Walking Guidance
- Standing Assistance

03

Functionalities of the Robotic Walker

Functionalities

1. **Summoning Capability**
   - Autonomously navigate to user's location

2. **User Operating Height Adaptation**
   - Adjust operating height suiting to the user
   - Ensures optimal ergonomic positioning

3. **Active Walking Guidance**
   - Real-time guidance and support
   - Adapts movement to user's pace

4. **Standing Assistance**
   - Gently and safely elevates the user from sitting to standing position

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Methodology

Methodology

Objective 01 - Study existing technologies

Literature Review

Research on the existing technology used in walkers and identify research gaps

Survey and Data Collection

Surveys or interviews with mobility device users, healthcare professionals.
Gather data on user requirements and preferences, and limitations of current devices.

Comparative Analysis

Comparative matrix to assess the strengths and weaknesses of existing devices.

Methodology

Objective 02 - Design and Development of mechanical structure

Conceptualisation
Brainstorm and generate multiple design concepts considering factors like stability, weight distribution, adjustability, and integration of support features.

Detailed design
Select the most optimum design and create detailed drawings and specifications.

Prototyping
Build a physical prototype using appropriate materials and manufacturing techniques.

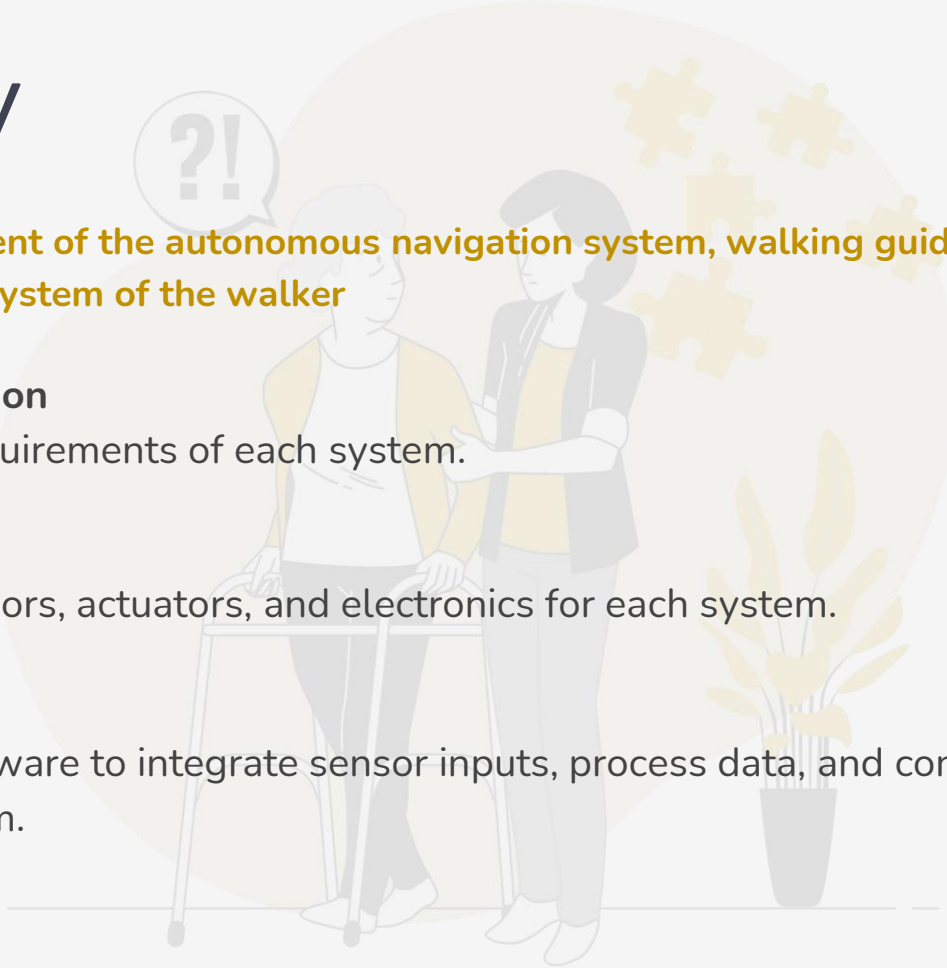
Methodology

Objective 03 - Development of the autonomous navigation system, walking guidance system, and standing assistance system of the walker

Requirement Identification
Define the functional requirements of each system.

Component Selection
Choose appropriate sensors, actuators, and electronics for each system.

System Development
Develop the control software to integrate sensor inputs, process data, and control the actuators for each system.



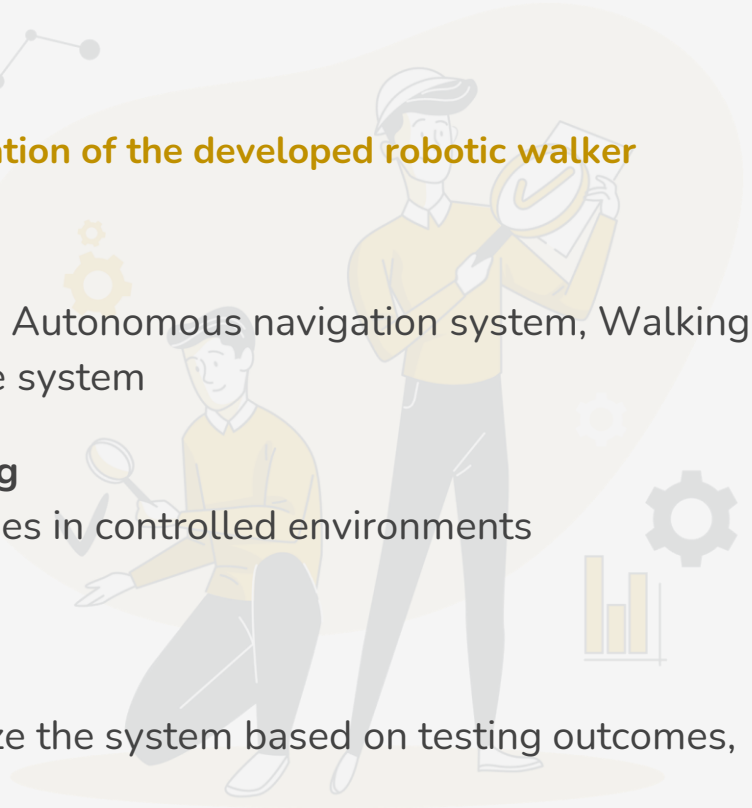
Methodology

Objective 04 - Testing and Validation of the developed robotic walker

System testing
Testing of Mechanical Structure, Autonomous navigation system, Walking guidance system, and Standing assistance system

Controlled Environment Testing
Assess the walker's functionalities in controlled environments
Conducting tests to validate

Iterative improvement
Continuously iterate and optimize the system based on testing outcomes,



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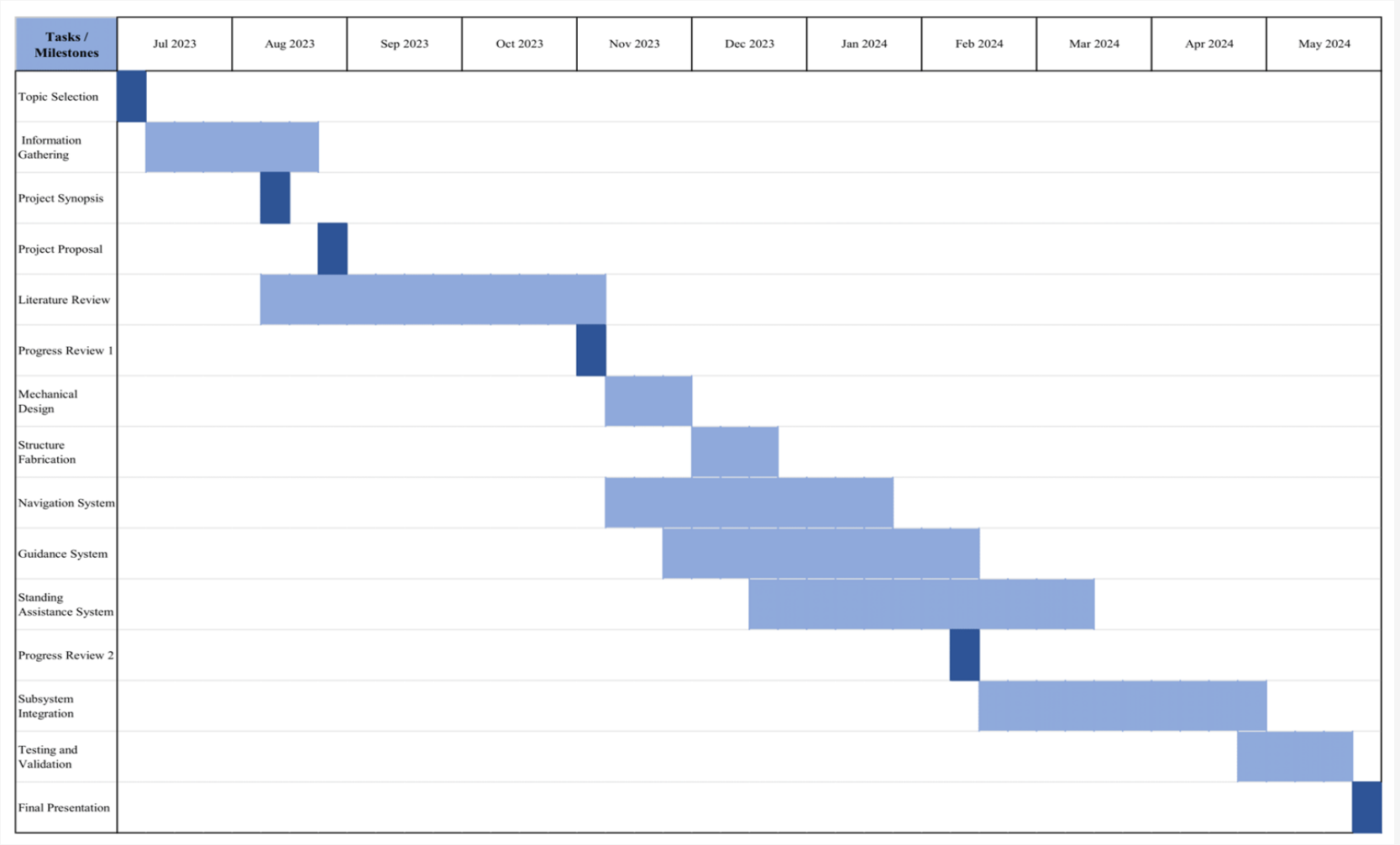
Budget & timeline of project

System	Component	Description	Price
Mechanical Structure	Aluminum Box Bars, Extrusion Bars & Fasteners	(Rough estimate. Depends on final design)	Rs. 25,000.00
	Wheels	6 inch Wheels	Rs. 1,400.00
	Caster Wheels	4 inch Caster Wheels	Rs. 850.00
Autonomous Navigation System	2D LIDAR - Slamtec RPLIDAR A1	Slamtec RPLIDAR A1	Rs. 31,462.00
	Web Camera	Logitech C270 Webcam	Rs. 8,500.00
	Microphone Array	ReSpeaker Mic Array - Far-field w/ 7 PDM Microphones	Rs. 26,000.00
Guidance System	Force Sensing Resistors (6 Nos.)	Pololu Force Sensing Resistor,1.5 Inch Square	Rs. 27,150.00
Standing Asst. System	Linear Actuator	YNT-09 Linear Actuator with stroke 400mm, 45W / 24VDC / 2000N	Rs. 12,000.00
Common to Systems	Controller Board	Raspberry Pi 4 Model B 4 GB RAM	Rs. 21,083.00
	Encoder Motors (2 Nos.)	ChiHai Motor CHP-42GP-775ABHL	Rs. 22,500.00
	Motor Controller	BTS 7960 DC Motor driver	Rs. 1,450.00
	Power Supply	24V 2A SMPS Power Supply	Rs. 1,400.00
Total			**Rs. 178,795.00**


Tasks / Milestones
Jul 2023
Aug 2023
Sep 2023
Oct 2023
Nov 2023
Dec 2023
Jan 2024
Feb 2024
Mar 2024
Apr 2024
May 2024
Topic Selection
Information Gathering
Project Synopsis
Project Proposal
Literature Review
Progress Review 1
Mechanical Design
Structure Fabrication
Navigation System
Guidance System
Standing Assistance System
Progress Review 2
Subsystem Integration
Testing and Validation
Final Presentation

Thank you!

Appendix 01

Comparison of Mobility Aids

Mobility Aid	Description	Pros	Cons
Walker	Frame with four legs for support	- Offers stability while walking - Foldable and portable - Simple design	- Limited support for severe mobility issues - Requires upper body strength - May not aid in balance
Rollator	Wheeled walker with a seat and hand brakes	- Stability with four wheels - Built-in seat for resting - Hand brakes for control	- Bulkier and less portable than canes - Limited maneuverability - Not suitable for tight spaces
Cane	Single-point support for balance	- Lightweight and portable - Easy to use - Suitable for mild balance issues	- Less stability compared to walkers and rollators - Not suitable for weight-bearing support
Quad-Stick	Cane with four-point base for increased stability	- Improved stability over regular canes - Suitable for moderate balance issues	- Bulkier and less portable than single-point canes - Limited terrain adaptability - May be more visually obtrusive

Walk with the right help

There are many walking aids available, so here is a guide on which one to get.

1 ROLLATOR

- For those who need support on both sides of their body, but do not have the strength to keep lifting their walking aid.
- May also be prescribed to those who want to practise normal walking patterns or who have cardiovascular endurance or other issues.

2 WALKING FRAME

- Prescribed to those who need support on both sides of their body, with limited standing balance and weaker lower-limb strength.
- Compared with the wheeled version, users of this frame must be able to lift it as they move.

3 BROAD-BASE QUAD STICK/NARROW-BASE QUAD STICK

- Meant for patients who have better balance and lower-limb strength and who go out more often.
- May be prescribed to patients who can use only one of their hands, such as those who have had a stroke.
- Broad-base quad sticks have a broader base, making them more stable than the narrow-base ones.

4 WALKING STICK

- Meant for patients who need only a little support from their walking aid.
- Least stable of the five walking aids, but is easiest to manoeuvre around obstacles.

NOTE: You should consult a professional before getting a walking aid.

Source: SENGKANG COMMUNITY HOSPITAL ST PHOTO: DESMOND WEE STRAITS TIMES GRAPHICS