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Smart walker for clinical rehabilitation

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Problem Statement

What is the problem?

Patients undergoing rehabilitation often use walkers incorrectly, leading to:

- **Improper foot placement.**
- **Uneven weight distribution.**

These issue causes :

- **Increased risk of injuries.**
- **Slower recovery times.**

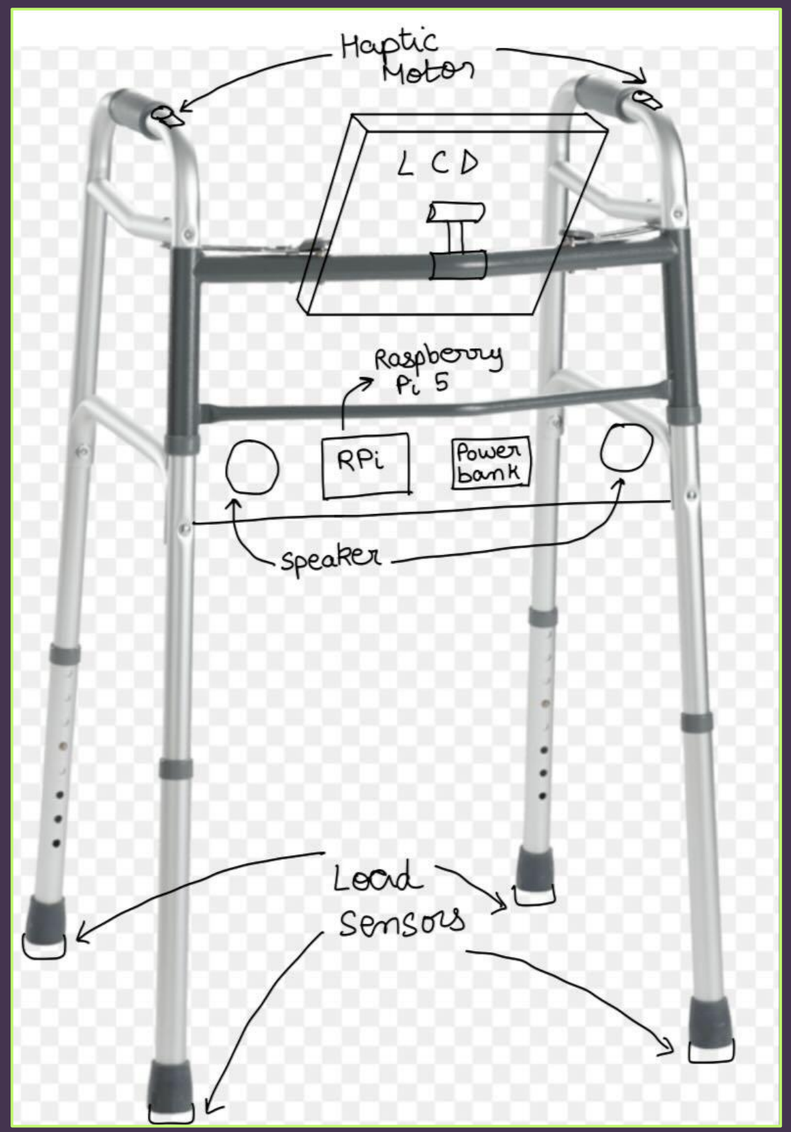
Why is this Important ?

- Improper walker usage can lead to long-term mobility issues.
- There is a need for a smart, assistive device to improve rehabilitation outcomes

Current solutions lack real-time feedback to guide patients effectively !

02

Proposed Solution



Our Solution

A Smart Walker that provides real-time feedback to users during rehabilitation.

Key features:

- Correct foot placement guidance using a stereo camera.
- Weight distribution monitoring using load cells on each leg.
- Real-time feedback via haptic sensors, LCD display, and voice feedback.

Value Proposition:

- Reduces risk of injuries during rehabilitation.
- Accelerates recovery by ensuring proper walker usage.
- Provides clinicians with data to monitor patient progress.

03

How Will We Achieve the Specifications?

Methodology and Component Selection:

- **Research & Literature Review:** Identified gaps in existing walker technologies.
- **Professor Meet:** Discussions with Prof. Neeta (BSBE Dept) to identify problems to analyse.
- **Cost Optimization:** Selected affordable components considering accuracy factor.

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Technical Details

Bill Of Materials

Sr. No	Usage (Name of the "Circuit block/Functional block" in which components is used)	Part description (OpAMP,ADC,DAC etc)	Manufacturing Part Number	Package type/Footprint	Availiable in WEL?	Vendor	Required Qty + Spare	Cost per each item	Total Cost
1	Weight Sensing Block	Load Sensor	613 N	load cell sensor	No	Robu	4+2	108	648
2	Weight Sensing Block	ADC	HX711	Breakout Board	No	Robu	4+2	40	240
4	Compute Block	Raspberry Pi 5	Raspberry Pi 5 Model 8GB	Development Board	No	Robu	1+0	8209	8209
5	Display Module	HDMI Capactive Touch	N/A	N/A	Yes		1+0		
6	Stereo Camera Module	Stereo Camera Module	IMX219-83	Camera Module	No	Robu	1+0	4799	4799
7	Haptic Feedback	DC Vibration Motor Module	N/A	Vibration Module	No	Robu	2+2	54	216
8	Audio System	Digital Amplifier Board	PAM8403	Digital Amplifier Board	No	Robu	1+1	65	130
9	Audio System	Speaker	N/A	8OHM Trumpet	No	Robu	2+2	42	168
10	Power Source	Power Bank	APB-15	Power Bank	No	Amazon	1+0	1899	1899
11	LED Feedback	LED	CJMCU-123 WS2812	LED Module	No	Robu	4+2	15	90
12	Data Logging	SD Card	Raspberry Pi Micro SD	Memory Card microSD	No	Robu	1+0	399	399
13	Walker	Walker			No	Amazon	1+0	853	853
								TOTAL	17651

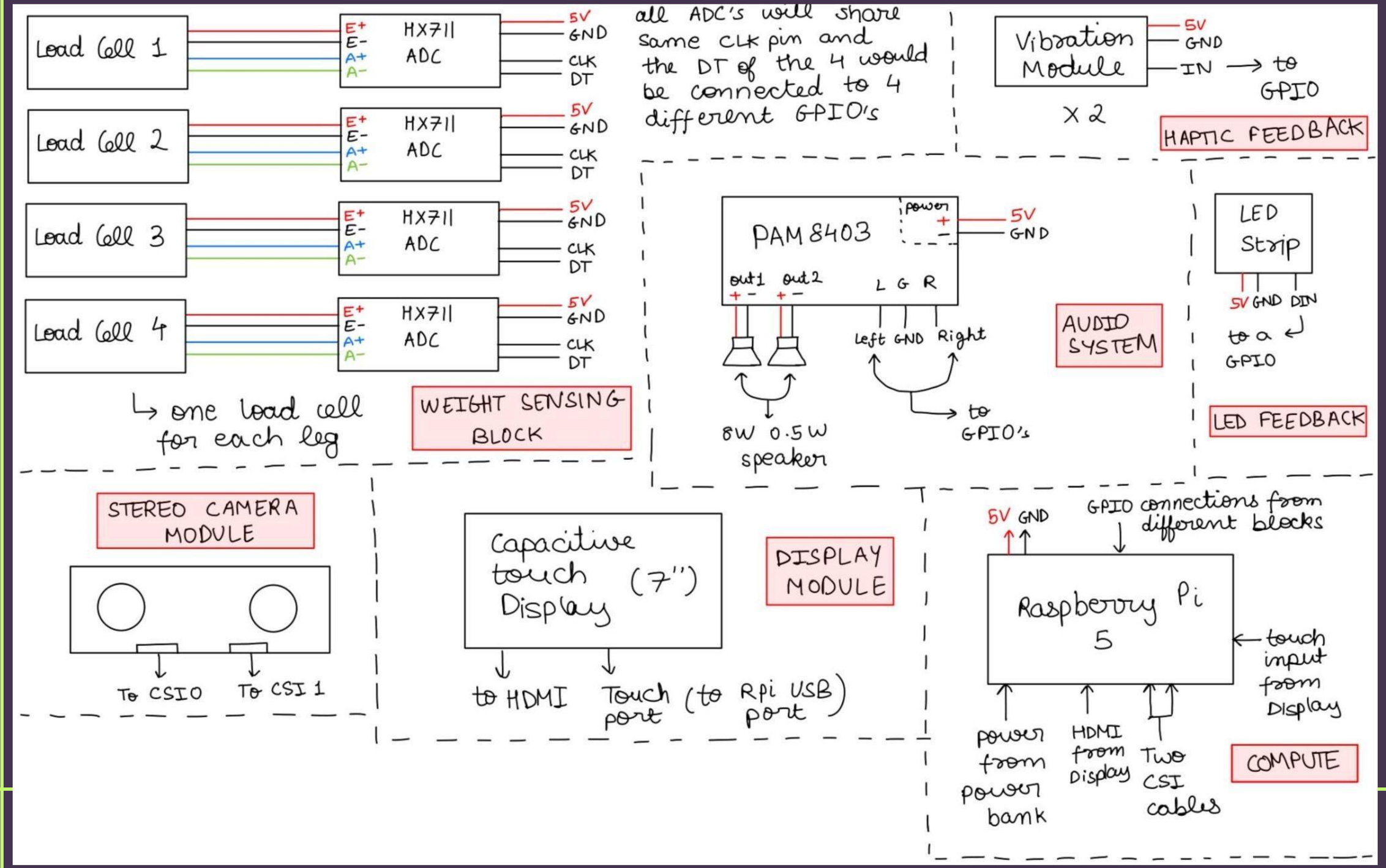
Justification of Component Choices:

- **Load Sensor (613 N)**: Chosen for high accuracy and durability in measuring weight distribution on the walker legs.
- **ADC (HX711):** Selected for its compatibility with load cells and ability to provide precise digital output for weight measurement.
- **Raspberry Pi 5 (8GB)**: It should provide sufficient processing power for real-time data processing and integration of multiple sensors.
- **HDMI Capacitive Touch Display:** Offers an intuitive user interface for real-time feedback and guidance.
- **Stereo Camera Module (IMX219-83)**: Chosen for accurate depth perception and cost-effectiveness compared to depth cameras.

Justification of Component Choices:

- **DC Vibration Motor Module:** Provides tactile feedback to users, enhancing the real-time guidance system.
- **Digital Amplifier Board (PAM8403):** Ensures clear audio feedback with low power consumption.
- **Speaker (8OHM Trumpet):** Delivers loud and clear voice feedback for user guidance.
- **Power Bank (APB-15):** Provides portable and enough power for the entire system.
- **LED Module (WS2812):** Used for visual feedback (e.g., color-coded alerts) to guide users.
- **SD Card (Raspberry Pi Micro SD):** Enables data logging for monitoring user progress over time.
- **Walker:** Acts as the physical base for integrating all components.

Block and Circuit Diagrams



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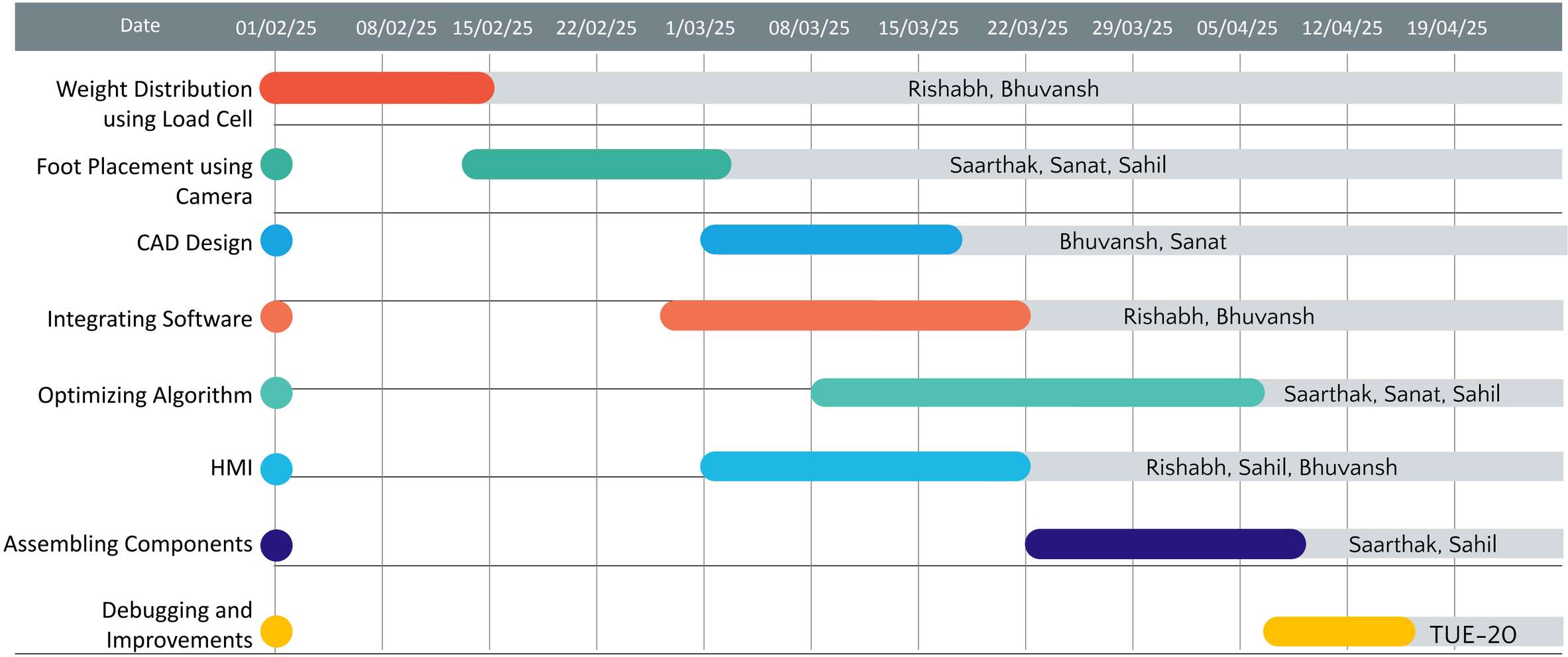
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Weight Distribution using Load Cell
Rishabh, Bhuvansh
Foot Placement using Camera
Saarthak, Sanat, Sahil
CAD Design
Bhuvansh, Sanat
Integrating Software
Rishabh, Bhuvansh
Optimizing Algorithm
Saarthak, Sanat, Sahil
HMI
Rishabh, Sahil, Bhuvansh
Assembling Components
Saarthak, Sahil
Debugging and Improvements
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Key Risks and Mitigation Strategies

Risks:

- Load cells may provide noisy data.
- Integration challenges between hardware and software.
- Stereo Camera calibration error.
- Delay in Feedback.
- R-pi processing limitations.

Mitigations:

- Regularly calibrate load cells to maintain accuracy.
- Test each block individually before integration.
- Perform regular calibration to ensure accurate depth measurements.
- Optimize code for efficiency.

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Deliverables

Expected Outcomes:

- A functional smart walker prototype.
- Real-time feedback system for foot placement and weight distribution.
- Data logging for clinician analysis.
- Documentation (technical report, user manual).

Impact:

- Improved rehabilitation outcomes for patients.
- Potential for commercialization in the healthcare industry.