

REAL-TIME PRESSURE MAT WITH HEATMAP AND CENTRE OF PRESSURE (COP) VISUALIZATION

Project Reference No.: 48S_BE_6384

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Keywords:

Real-time Pressure Mapping, Center of Pressure (CoP), Rehabilitation, Gait Analysis.

Introduction:

Understanding human movement—especially gait, balance, and body mechanics—plays a crucial role in diagnosing and treating various neuromuscular conditions. For individuals with Cerebral Palsy (CP) and similar disorders, detailed analysis of these aspects is vital to develop effective rehabilitation strategies and track therapeutic progress.

Conventional assessment methods often rely on visual observation and manual evaluation, which, while useful, may lack objectivity and real-time insights. There is a growing need for accessible tools that can offer accurate, consistent, and data-driven feedback in clinical and rehabilitation settings.

This project presents a system designed to provide real-time visualization of footstep patterns and Center of Pressure (CoP) movement, offering insights into the dynamic interplay of balance and posture during standing and movement. It allows clinicians to view and analyze pressure distribution for both feet independently, track key parameters, and document therapy outcomes over time.

Objectives:

1. Aid in diagnosing conditions related to balance, gait, and body mechanics.

2. Support the monitoring of therapy progress for patients with Cerebral Palsy (CP) and related conditions.
3. Provide healthcare professionals with real-time visualization of pressure distribution and Center of Pressure (CoP) for both feet separately.
4. Offer detailed parameter analysis and export capabilities for integration into patient records or further review.

Methodology:

1. Hardware Development:

- Pressure-sensitive mat using conductive cloth strips, a velostat sheet for pressure resistance, and necessary electronic components like MUX, DEMUX, and resistors.
- ESP32 microcontroller for analog signal processing.
- Circuit to operate on a voltage range of 3.3V to 5V.

2. Software Development:

- Python-based interface for dynamic heatmap generation and live CoP plotting.
- Integration of start/stop controls for data capture and a feature to export results to Excel for analysis and record-keeping.

3. Testing and Validation:

- Iterative testing to ensure hardware and software synchronization.

Result and Conclusion:

In conclusion, the proposed system effectively enables real-time monitoring and visualization of footstep pressure distribution and Center of Pressure (CoP) movement, providing valuable insights into gait, balance, and overall body mechanics. By offering a visual and analytical approach, the system supports healthcare professionals in assessing postural stability and movement patterns, especially for patients with Cerebral Palsy (CP). It also aids in tracking therapy progress over time, allowing for more data-driven and personalized rehabilitation planning.

Future Scope:

The future scope of this project includes:

1. **Integration with Machine Learning:**

Implementing predictive models to automatically detect abnormal gait patterns and suggest personalized rehabilitation exercises.

2. **Wireless and Portable Design:**

Enhancing mobility and ease of use by developing a compact, wireless version of the system suitable for home-based therapy and remote monitoring.

3. **3D Motion and Posture Tracking:**

Expanding the system to include motion capture for analyzing full-body posture and movement in coordination with foot pressure data.

4. **Mobile and Web Application Support:**

Creating user-friendly mobile or web interfaces to allow patients and therapists to access data, track progress, and generate reports conveniently.