Wearable AI Limp Detection with Micro:bit

Combining Sensor Data with Real-Time Analysis

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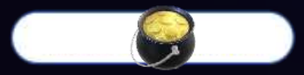
Agenda

- Introduction: The Problem & Our Solution
- Technical Deep Dive: How It Works
- Hardware & Software Components
- AI Model Training & Deployment
- Future Enhancements & Impact
- Meet the Team



The Problem: Unnoticed Limps

Limping can indicate underlying health issues, from injuries to chronic conditions. Often, these subtle changes go unnoticed until they become severe.

Early detection is crucial for timely intervention, preventing further complications and improving quality of life.

Introduction

Most people walk with **symmetry**, meaning their **gait** (how their legs move when they walk) is the same on both sides. For a variety of reasons, including physical injuries like a sprained ankle, or neurological conditions like cerebral palsy, some people might walk with an **asymmetric** gait, or **limp**. For example, someone who has pain in one leg may try put less weight on that leg as they walk, taking shorter, quicker steps with the injured leg and longer steps with the uninjured leg.

A physical therapist might work with someone to help them regain or maintain a symmetric gait. To do this, they may use **gait analysis**, or study how the person walks. This could simply consist of observing the person as they walk, but it could also include filming the person while they walk so the video can be analyzed in more detail, or even using a **motion capture** system to track the person's movements (Figure 1). This analysis can give the physical therapist more detailed information about the person's gait.

Our Solution: Wearable AI Detection

Micro:bit Integration

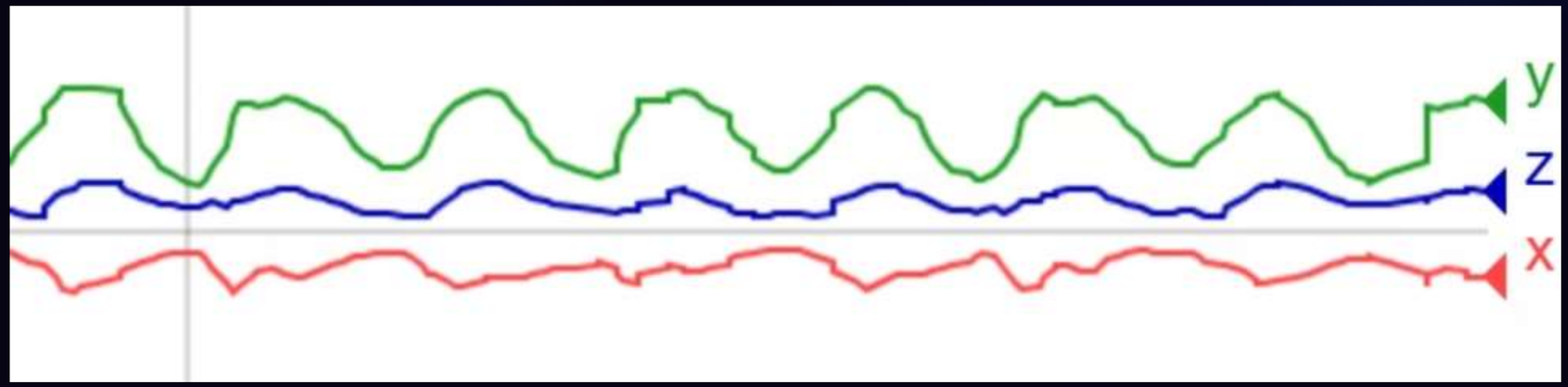
Compact, low-power device for data collection.

AI-Powered Analysis

Machine learning model identifies limp patterns.

Real-time Alerts

Immediate notifications for detected limps.



XYZ acceleromer data recorded while a person was jogging. The horizontal axis of the graph is time and the vertical axis shows the accelerometer values.

Technical Deep Dive: How It Works

Data Collection

The Micro:bit's accelerometer captures gait data (acceleration in X, Y, Z axes).

Preprocessing

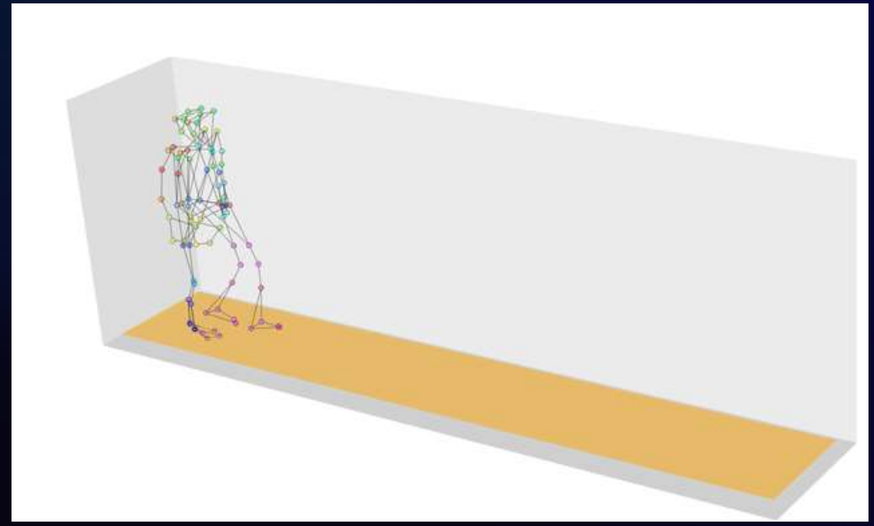
Raw data is cleaned and normalized for AI model input.

Feature Extraction

Key features like peak acceleration, stride time, and symmetry are extracted.

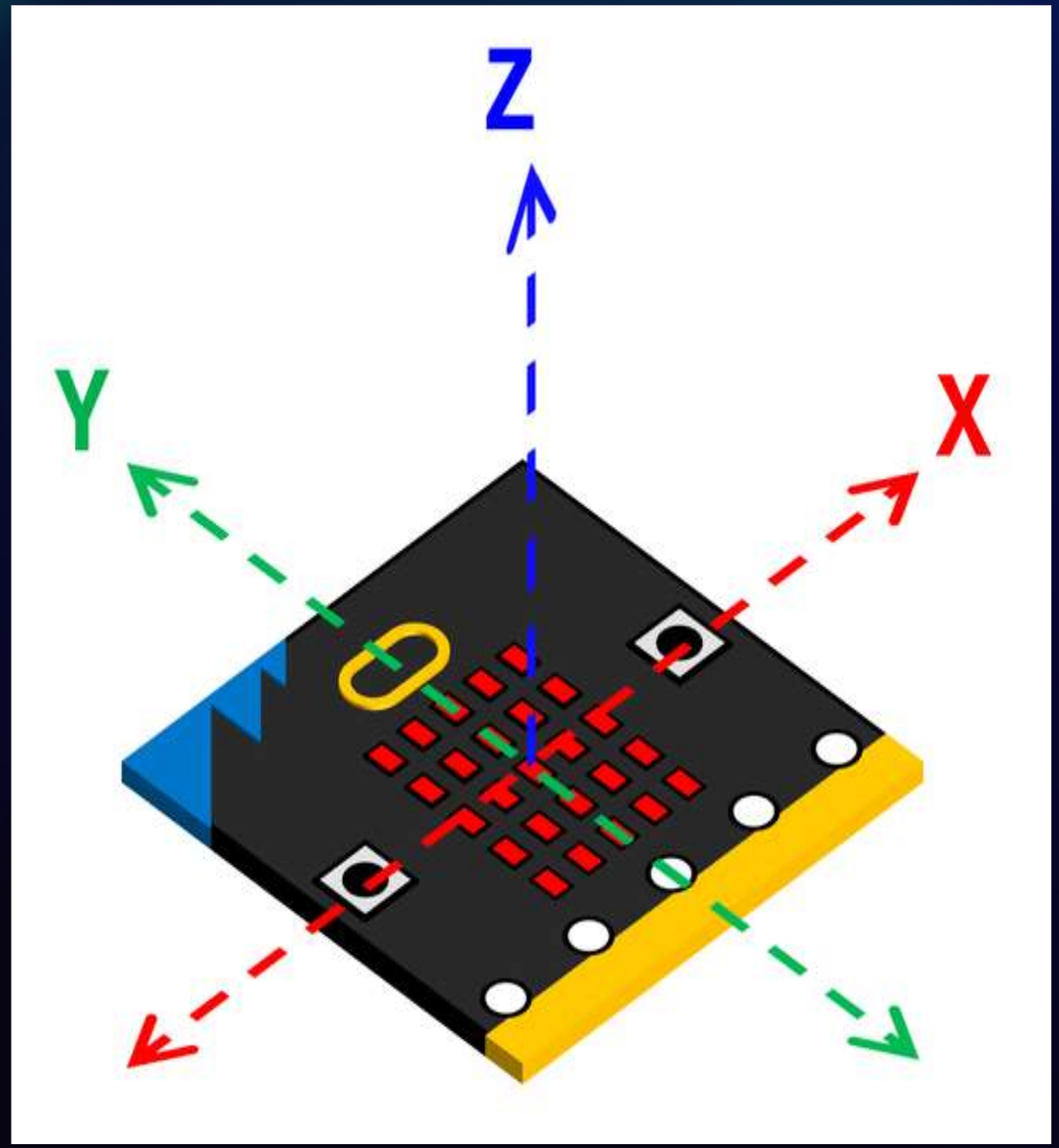
AI Inference

The trained AI model analyzes features to classify gait as normal or limping.



Terms and Concept

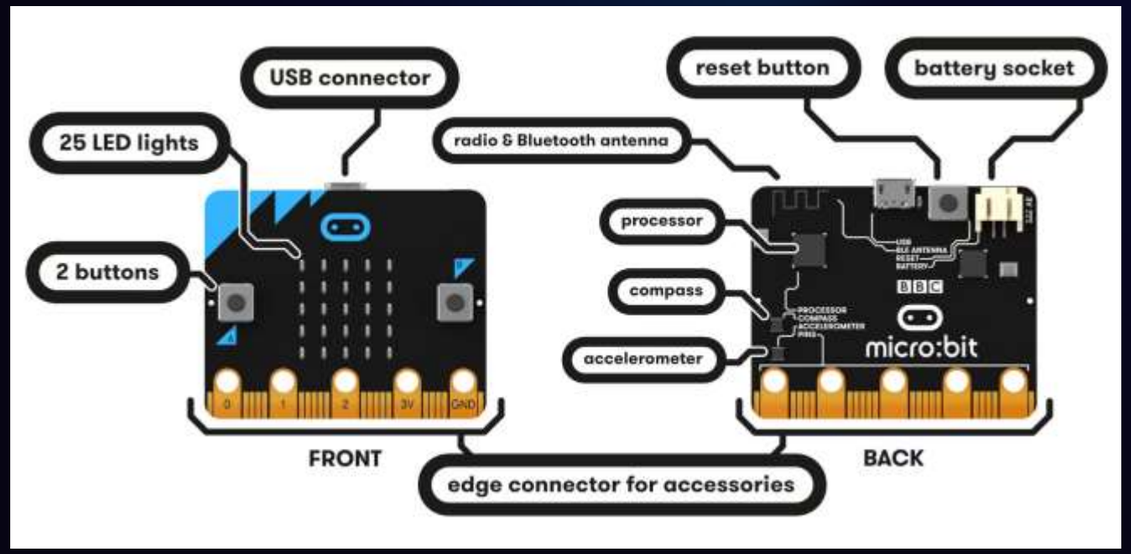
- Symmetry
- Gait
- Asymmetric
- Limp
- Gait analysis
- Motion capture
- Accelerometer
- Sensor
- Acceleration
- Axes
- Machine learning
- Training data
- Model



Hardware & Software Components

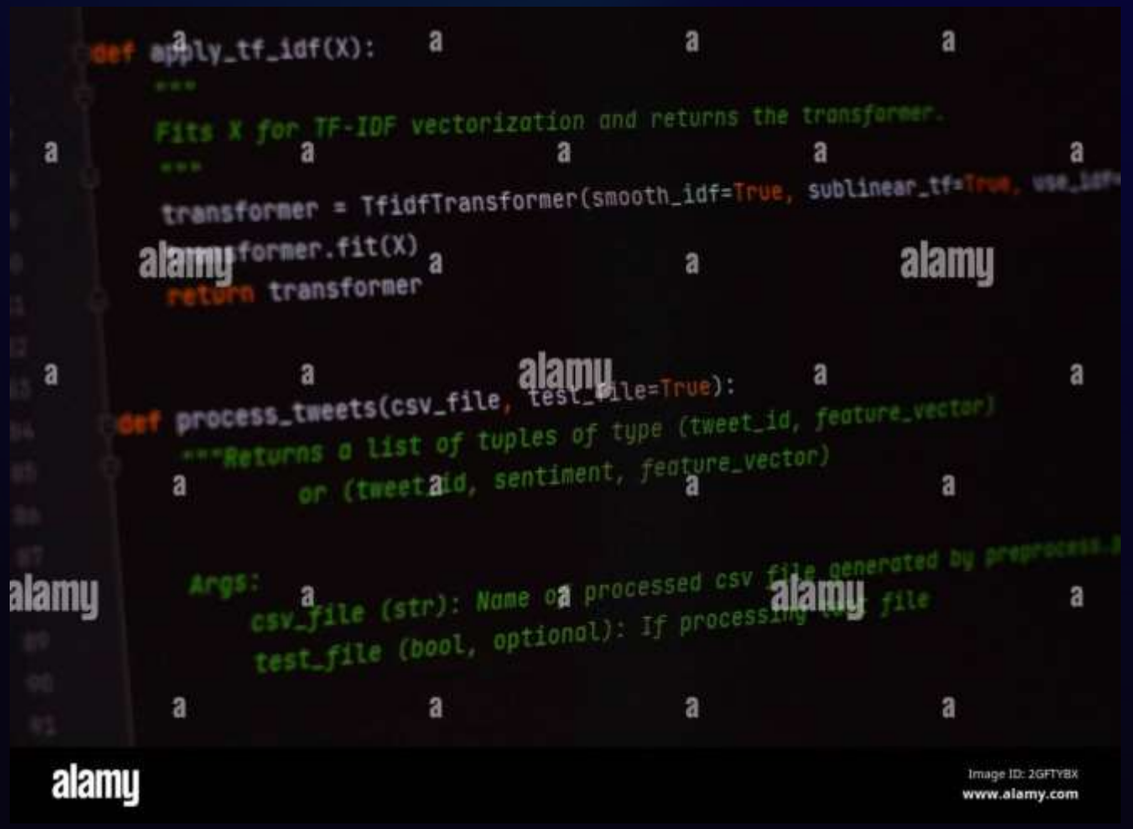
Hardware

- BBC Micro:bit (V2)
- Wearable enclosure/strap
- Power source (battery)



Software

- JavaScript: Block Code
- **IDE**: Microsoft MakeCode
  → Web-based visual editor
- Cloud platform for data storage (optional)



AI Model Training & Deployment

1

Data Collection

Gather diverse gait data from individuals with and without limps.

2

Model Training

Train a lightweight neural network (e.g., CNN or LSTM) on the data.

3

Optimization

Quantize and optimize the model for Micro:bit's limited resources.

4

Deployment

Flash the optimized model onto the Micro:bit.

Our goal is a highly accurate yet resource-efficient AI model for on-device inference.

Future Enhancements & Impact

Future Enhancements

- Mobile app integration for detailed reports
- Cloud connectivity for long-term data analysis
- Integration with other health monitoring systems
- Machine learning on the edge for real-time adaptation

Potential Impact

- Early detection of musculoskeletal issues
- Improved rehabilitation monitoring
- Enhanced athletic performance analysis
- Proactive health management for the elderly

Key Takeaways

Accessible Health Tech

Leveraging Micro:bit for widespread adoption.

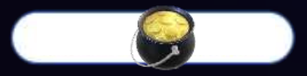
Proactive Monitoring

Enabling early detection of gait abnormalities.

AI-Powered Insights

Transforming raw data into actionable health information.

Our project showcases the power of combining simple hardware with advanced AI for real-world health solutions.



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Thank you for your time! Questions?