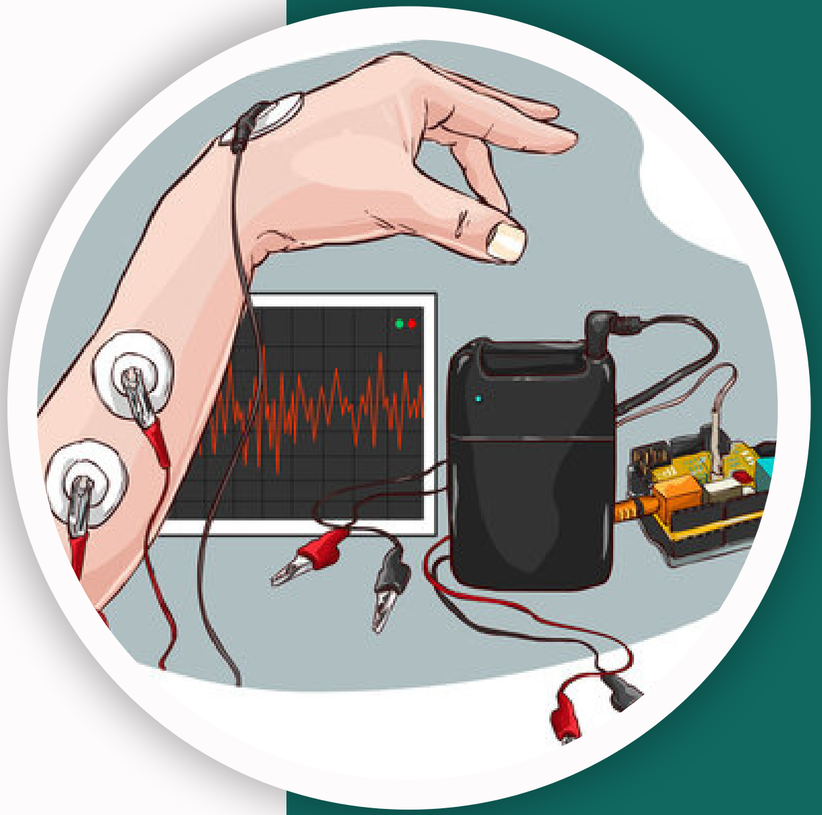
EN2091 – LABORATORY PRACTICE AND PROJECTS

STEM

EMG Device



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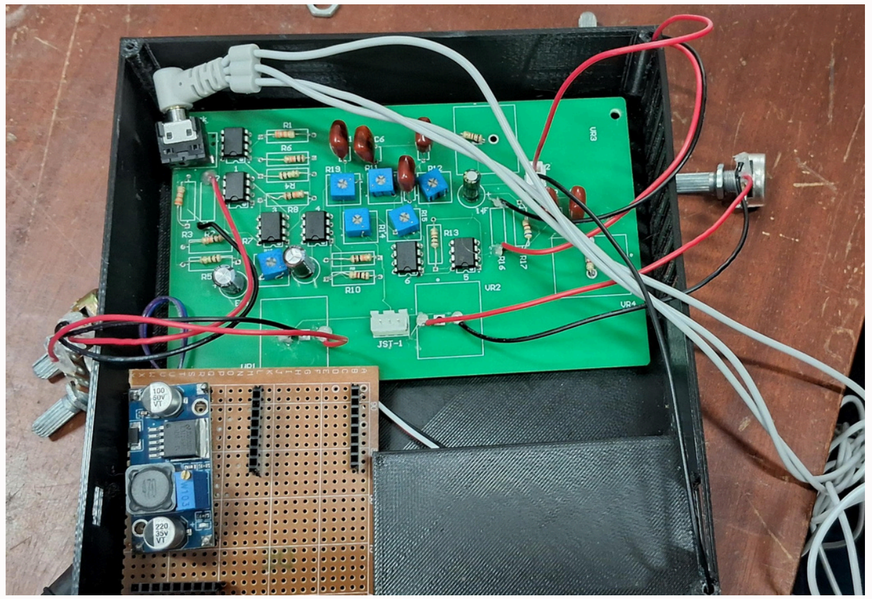
Introduction

- We have designed a **EMG device** to monitor muscle activity.
- It can be used in rehabilitation, sports, and prosthetics.
- Our goal is to support clinical rehabilitation, optimize athletic training, and enhance muscle performance through a user-friendly solution.

Product Overview

- Traditional EMG devices are often expensive, bulky, and complex, limiting accessibility for muscle monitoring.
- What we have designed is a **cost-effective, portable EMG device**.
- It bridges the gap between high-cost systems and everyday needs.



Market Analysis

1. Target Audience
   - Healthcare Sector, Prosthetics & Assistive Tech, Sports & Fitness.
2. Market Demand
   - Increasing cases of stroke, spinal injuries, and muscular disorders.
   - Rising adoption of prosthetics in Sri Lanka.
   - Growing focus on sports injury prevention and recovery.
3. Competitive Edge
   - Current EMG devices are imported, expensive, and bulky.
   - Our device offers affordability, portability, and ease of use.

Market Analysis

4. Stakeholder Benefits
   - Patients: Affordable, at-home rehabilitation.
   - Physiotherapists & Doctors: Simplified diagnosis and monitoring.
   - Athletes: Optimized training & injury prevention.
5. Opportunities
   - Collaborations with rehab centers, sports clubs, and NGOs.
   - Education & awareness campaigns to demonstrate product value.

Design and Development

Background research

- Studies highlight the need for affordable diagnostic tools in developing countries.
- Advances in microcontrollers and signal processing enable cost-effective solutions.

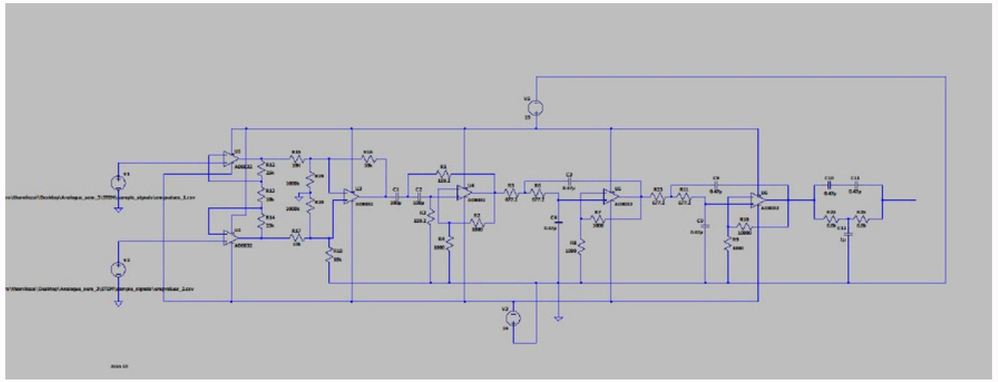
Challenges

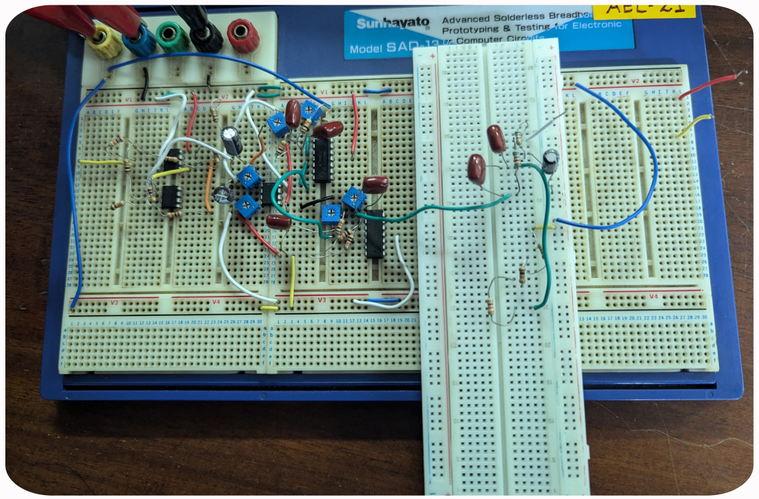
- Only few research papers specified in this domain.
- We have to convert what was applied to related domains and start fresh if none is available.

Design and Development

Prototyping

Initially the circuit was realized in LTSpice to ensure there are no defects



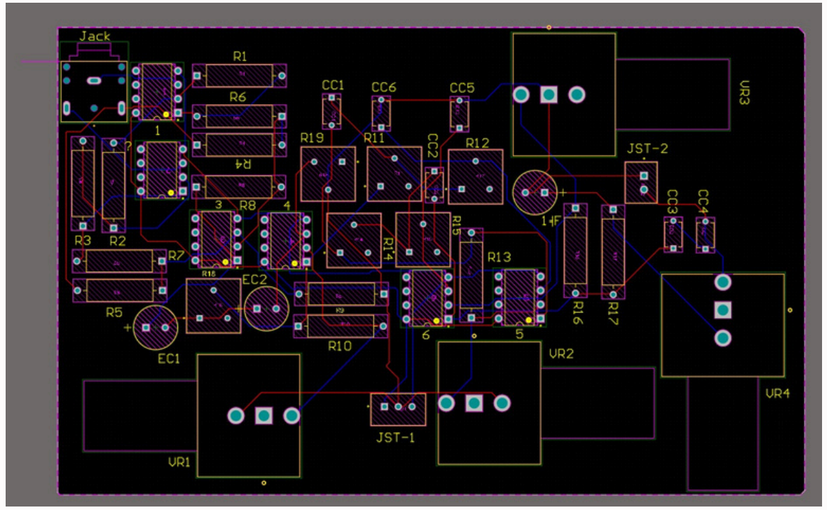


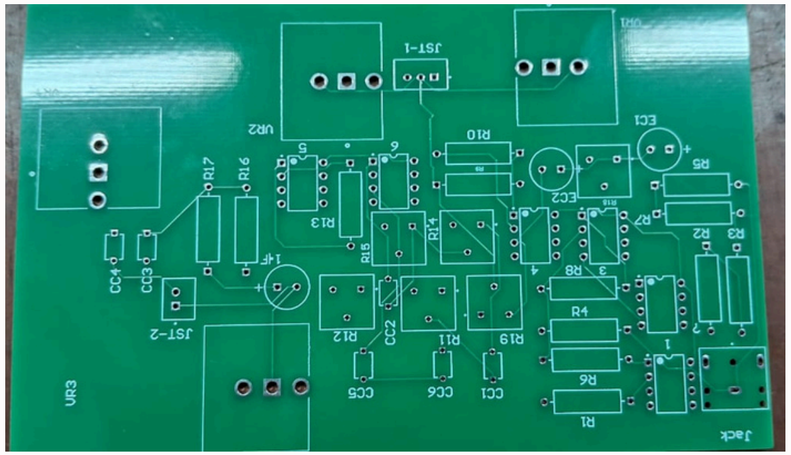
After finding necessary components, we tested out in protoboards

Design and Development

PCB Design

The final PCB was completed using Altium.



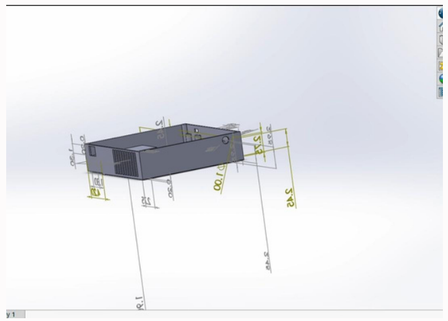


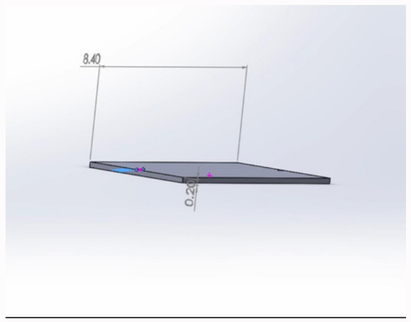
There was an additional PCB for the power circuit.

Design and Development

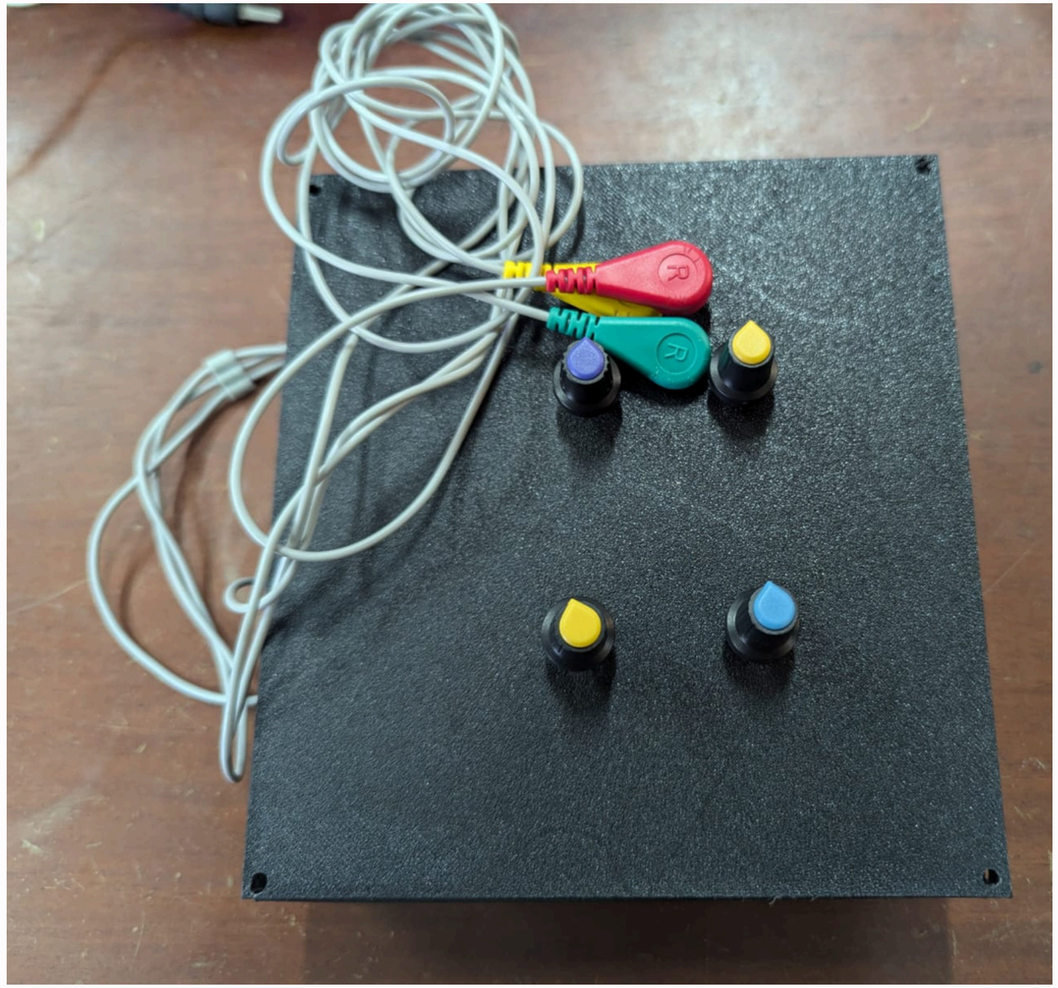
Enclosure and Finishing

After the device was complete, for the protective part we chose PLA enclosure which provided whether and physical protection



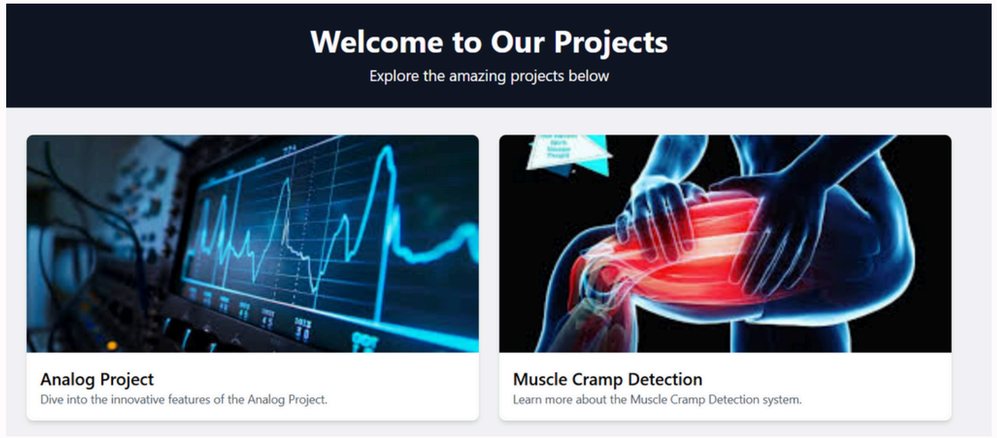


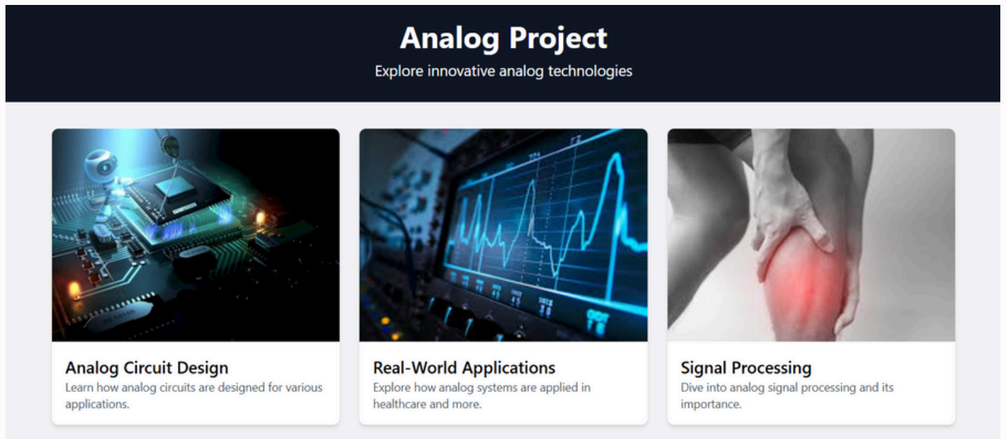
Design and Development



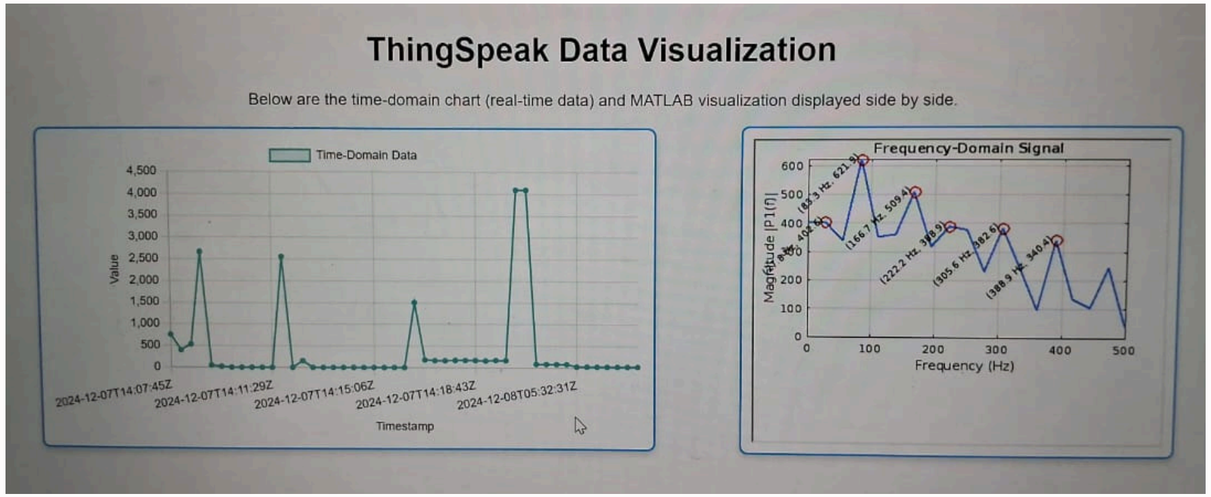
Design and Development

Webpage





The results of the EMG scan is readily availabe in our webpage within 15 seconds



Technical Details

Components

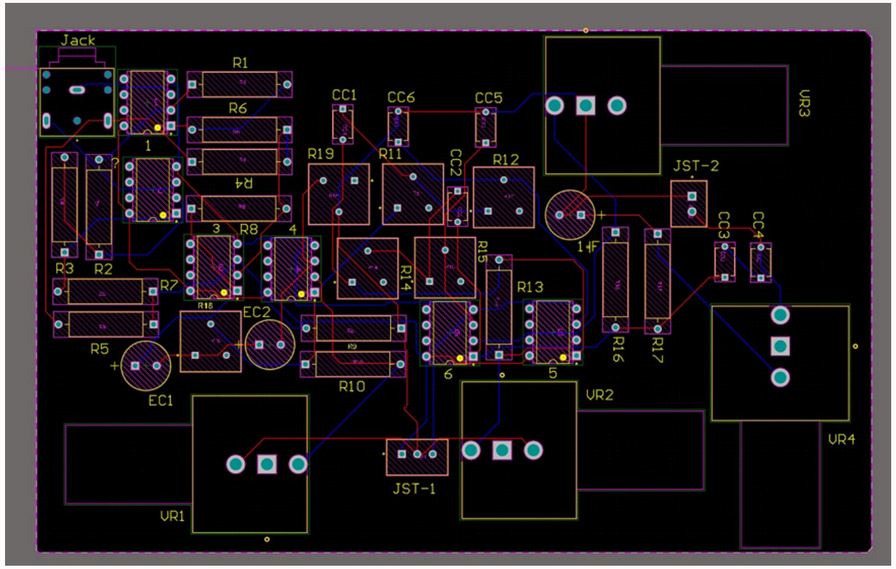
TL074 operational amplifier

- The TL074 is a quad low-noise operational amplifier (op-amp) widely used for signal processing applications. It is known for its low power consumption, low noise characteristics, and high input impedance, making it suitable for audio and instrumentation purposes.

Potentiometer

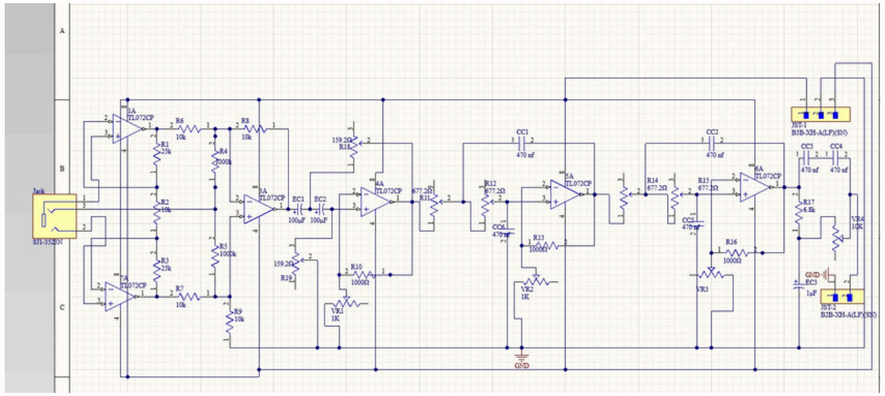
- The 3006 Series Trimpot Potentiometer is a single-turn adjustable resistor ideal for precise resistance calibration in circuits. It offers a resistance range of 10Ω to 5MΩ with ±10% tolerance and a 0.5W power rating at 70°C. The compact design allows for top or side adjustment and operates across a temperature range of -55°C to +125°C, making it versatile for various applications.

Technical Details

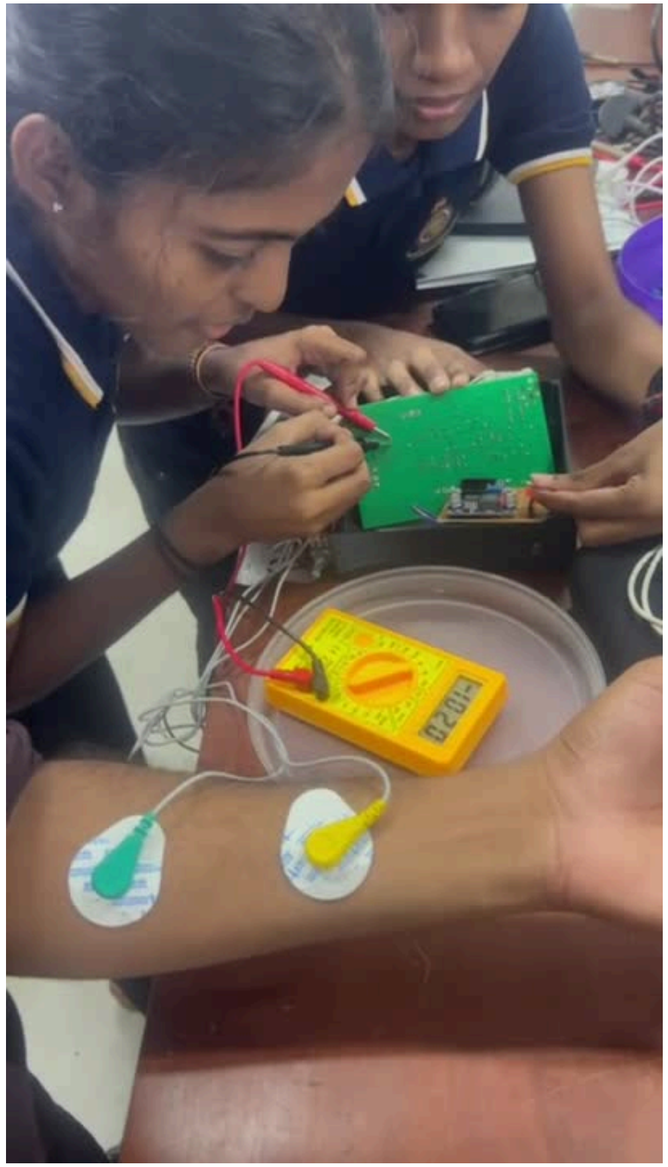


Circuit Diagram

LTSpice Schematic



Demonstration



Captured when testing the input jack

Cost Analysis

1. Development Costs
   - Material Costs: Sensors, microcontroller, wires, casing, and battery – LKR 12,000.
   - Prototyping Costs: PCB fabrication and 3D printing – LKR 8,000.
   - Software Tools: Free development platforms – LKR 0.
   - Labor Costs: Team contribution (self-funded) – LKR 0.
2. Production Costs (Projected)
   - Bulk manufacturing cost per unit: LKR 6,000.
   - Assembly cost per unit: LKR 1,000.

Cost Analysis

3. Cost Comparison
   - Existing EMG devices: LKR 50,000 - 100,000.
   - Our device: Estimated retail price LKR 15,000.
4. Total Project Cost
   - Total expenses for development: LKR 20,000
5. Pricing Strategy
   - Affordable price to ensure accessibility while maintaining a profit margin

Limitations and Future Enhancements

Current Limitations

- Performance may vary depending on environmental noise.
- Limited Features
- Requires basic knowledge for setup and operation.

Potential Enhancements

- Improved Signal Processing
- Expanded Features
- User-Friendly Interface

Conclusion

- Achievements: Developed an affordable, portable EMG device for healthcare, prosthetics, and sports. Demonstrated applications in rehabilitation, performance analysis, and assistive tech.
- Impact: Offers an affordable alternative to costly EMG devices, aiding patients, athletes, and researchers in muscle monitoring. Enhances local accessibility in Sri Lanka.
- Future Outlook: Potential for wireless features, AI integration, and enhanced data visualization. Opportunities for partnerships in healthcare, sports, and prosthetics.
- Final Thought: A step toward innovation, improving healthcare and tech accessibility for all.

Our Team and Task allocation

Sivamynthan

Circuit design
Matlab and Arduino
Documentation

Thusajiny

Enclosure Design
Circuit Testing

Thamilezai

Device Implementation
Website Development
R & D
Circuit design

Mathujan

PCB Design
Soldering
Circuit implementation