SAHAYOG : An EMG Interface for SCI Patients

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Problem Statement

SCI (spinal cord injury) patient suffers from numbness so they face difficulties in controlling everyday devices by themselves. We propose an EMG (electromyogram)-based input interface using machine learning for people with physical disabilities of the extremities. For the initial stage, we're proposing an EMG-based electric wheelchair prototype that moves based on hand gestures.

Objectives

Data acquisition: Collect raw EMG data from individuals.

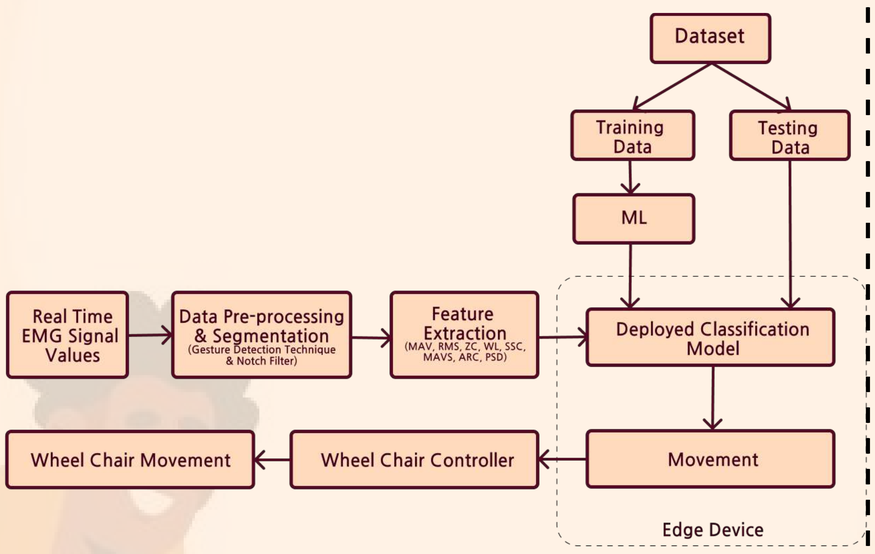
Data pre-processing & segmentation: Removing noises and segmenting data into required window size.

Feature extraction:
Extract 8 handcrafted features from this data.

Classification method: Train an ANN model to classify the gestures.

Edge deployment & Real-time HGR recognition: Deploying model in Raspberry Pi and controlling the wheelchair using hand gestures.

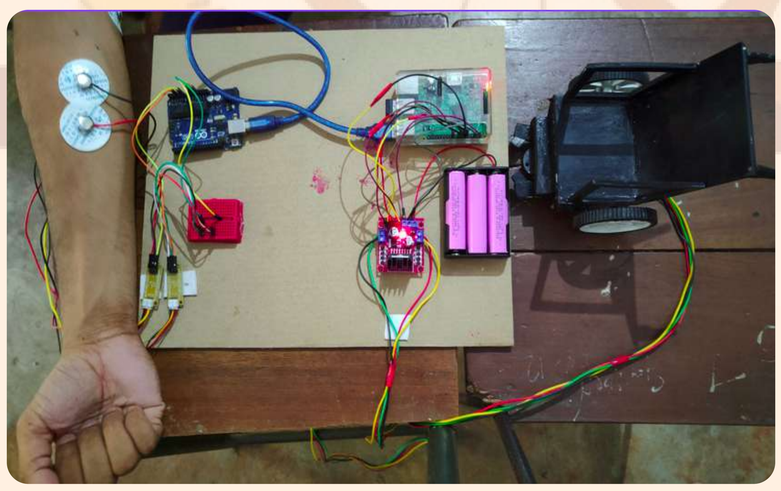
Proposed EMG Based Interface Architecture



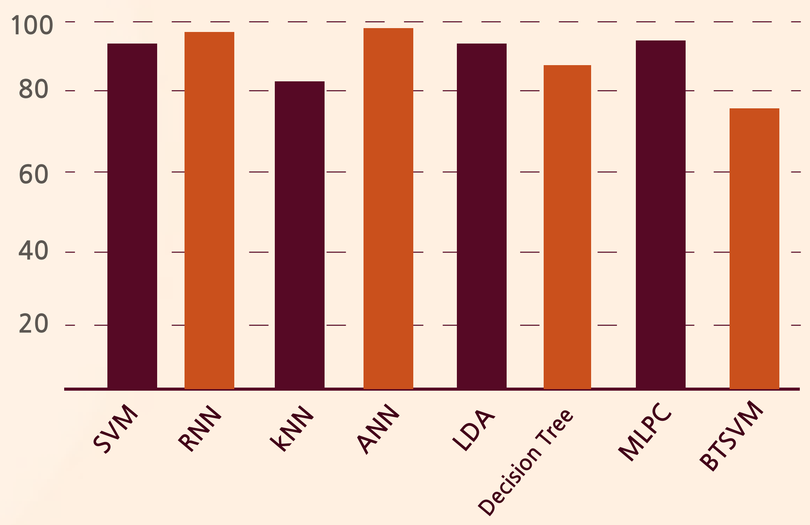
Proposed System

The SAHAYOG project developed a real-time hand gesture recognition system for individuals with spinal cord injuries. Using two EMG sensors and a well-crafted set of features, combined with an optimized ANN model, the system achieved an impressive 98% accuracy in classifying hand gestures. Deployed on a Raspberry Pi 3 model B, the system enables immediate recognition and control of an electric wheelchair based on detected gestures. The integration of DC motors, along with the L298 motor driver, ensures smooth and accurate wheelchair motion. This project has significant potential to enhance mobility and independence for individuals with spinal cord injuries through an affordable and intuitive interface.

Final Prototype of Proposed System



Model Comparison



BTSVM - 75.66 Decision Tree - 88.82 LDA - 96.05
RNN - 97.37 ANN - 98.03 MLPC - 96.71
kNN - 82.24 SVM - 96.71

Tools

- Muscle BioAmp Candy
- Raspberry Pi 3 Model B
- Arduino UNO
- DC and Servo Motors
- L298 Motor Driver
- Arduino Ide

Future Works

Possible future work for the SAHAYOG project includes expanding the dataset to include more subjects and additional hand gestures, exploring advanced deep-learning algorithms for improved accuracy and robustness, and investigating the integration of additional sensors for enhanced wheelchair control and navigation capabilities. Also extending the interface to other daily life systems.

Conclusion

The SAHAYOG created a precise, cost-effective hand gesture recognition system using EMG sensors and an optimized ANN model. It empowers individuals with spinal cord injuries, enhancing mobility and independence through intuitive control of electric wheelchairs.