PAPER PRESENTATION -2

Course: Pattern Recognition

CSE-424

Presented by
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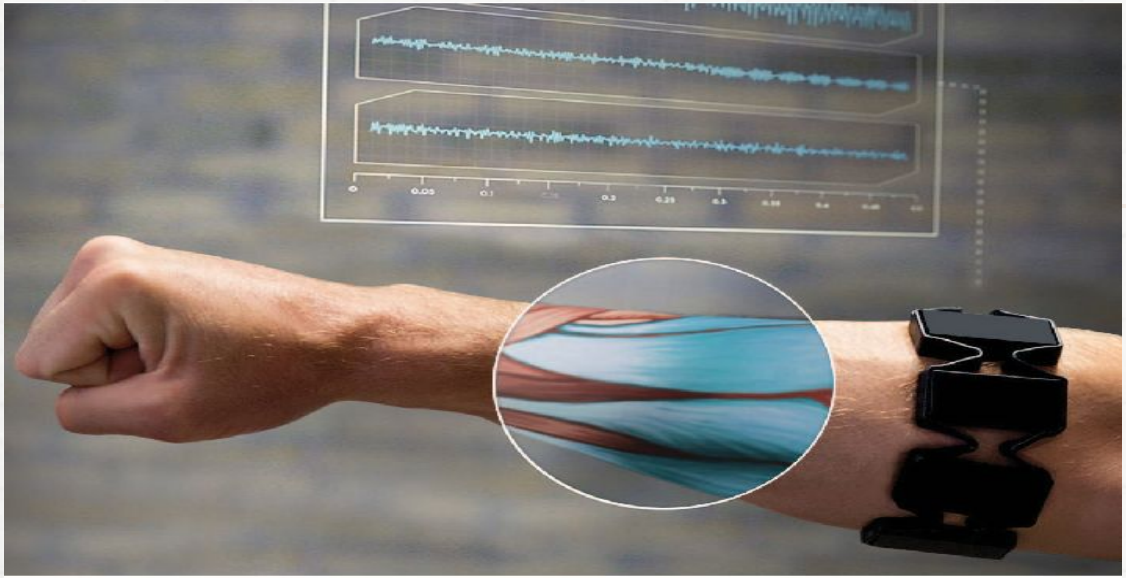
Section : 01

PAPER TITLE

Real-time Pattern Recognition for Hand Gesture Based on ANN and Surface EMG



The OUTLINE

- Summary

  1.1. Motivation

  1.2. Contribution

  1.3. Methodology

  1.4. Conclusion

- Limitation
- Synthesis

1. A Brief Summary of the paper :

01 Method using surface electromyographic (sEMG) signals on the forearm

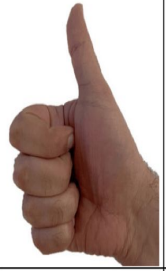
02 Sliding window to observe signal segments

03 Artificial neural network (ANN) classifier

04 Data acquisition using the Myo Armband

1.1 Motivation

- Applications in Diverse Fields
- Real-Time Requirement
- Existing Approaches and Technologies
- Benchmarking Against Previous Studies
- Advantages of sEMG Signals

1		Thumbs up	2		Extension of index and middle fingers, flexion of others	3		Flexion of ring and little fingers, extension of others
4		Thumb opposing base of little finger	5		Abduction of all fingers	6		Fingers flexed together in fist
7		Pointing index	8		Adduction of extended finger	9		Wrist extension with closed hand

1.2 Contribution

- Real-Time Gesture Recognition Method
- Feature Extraction and ANN Classification
- Threshold-Based Gesture Identification
- Experimental Validation with Myo Armband
- Comprehensive System Blocks

1.3. METHODOLOGY

- Data Acquisition
- Preprocessing
- Feature extraction
    - Mean Absolute Value (MAV)

$$\mathrm{MAV} = \frac{1}{N}\sum_{k=1}^{N}\left|s(k)\right|$$

    - Root Mean Square (RMS)

$$\mathrm{RMS} = \sqrt{\frac{1}{N}\sum_{k=1}^{N}s(k)^2}$$

- Slope Sign Changes (SSC)

$$\mathrm{SSC} = \sum_{k=2}^{N-1} \left| \left(s(k) - s(k-1) \right) \times \left(s(k) - s(k+1) \right) \right| \quad (3)$$

- Waveform Length (WL)

$$\mathrm{WL} = \sum_{k=2}^{N} \left| s(k) - s(k-1) \right|$$

- Hjorth Parameters (HP)

- Classification

Experimental Results

The overall recognition rate is 96.7%, with "Wave In" at 90% accuracy and "Wave Out" achieving 100%. Table I outlines the activity and response times for hand gestures. In Table II, the proposed model utilizes both preprocessed signal values and results from the bag of functions separately.

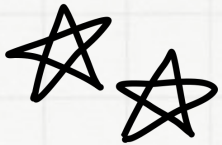
TABLE I. HAND GETURES ACTIVITY TIME AND RESPONSE TIME

Gesture	Activity(ms)	Response (ms)
Fist	915.0	174.5
Wave In	871.0	206.3
Wave Out	1245.0	292.3
Fingers Spread	1050.0	289.2
Double Tap	930.0	292.5

TABLE II. THE PROPOSED MODEL COMPARED WITH OTHER MODELS

Model	Accuracy (%)	Response (ms)
Evaluated models:		
Proposed model	96.7	233.4
Model using only the preprocessed signals values	92.0	238.0
Model only using only the results from the bag of functions	95.3	227.6
Other methods with Myo armband sensors		
Model using k-NN with DTW [9]	83.1	X
Myo Armband method [10]	86.0	X

1.4. Conclusion



- Proposed real-time recognition for five gestures using Myo armbands EMG signals.
- Demonstrated practicality with real-time Bluetooth transmission.
- Preprocessed signals via Butterworth filter, extracted time-domain features.
- Used sliding window and forward propagation ANN for classification.
- Achieved 96.7% accuracy with an improved threshold method.

2. Limitations

Limited Gesture Variety:

The study concentrates on recognizing five specific hand gestures, potentially limiting its applicability to a broader range of gestures commonly used in diverse contexts.

Dependency on Myo Armband:

The methodology relies on the Myo Armband for data acquisition, potentially limiting accessibility and affordability. Assessing its performance with various sEMG devices could enhance its versatility.

3. Synthesis

- Enhanced Human-Computer Interaction (HCI)
- Prosthetic Control Advancements
- Gaming and Virtual Reality Immersion
- Medical and Assistive Innovations

Thank you!