Feasibility Study of using MyoBand for Learning Electronic Keyboard

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- MyoBand
- Feature and Algorithm Selection
- Myo Keyboard Finger Press Data
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Introduction

Online learning platform has been globally accepted for STEM

The factors to be considered in adopting an online system for learning finger based musical instruments include

- Finger Key Press
- Duration Of Key Press
- Sequence of Finger Press

An alternate and an original method, which is not derived from other domain needs to be found for learning different forms of music at an individual level.

The paper aims to introduce an automated music learning assessment system to understand the intricacies of playing music notes, and possibly apply to all finger based musical instruments.

Finger press triggers the muscle movements which are detected at the surface of the forearm in the form of surface Electromyography (sEMG) signals. sEMG signals extracted during finger press helps in identifying and evaluating ones learning performance

Musical Electronic Keyboard

- Four or Five Octaves
- Seven white and Five black keys - Octave
- Single Key Press (Leads) and Multiple Keys Press (Chords)
- Two Hands and Five fingers

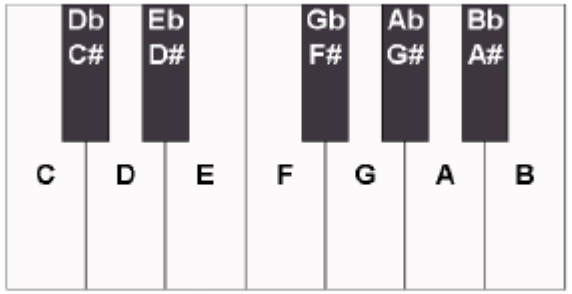


Fig. 1. An octave of an Electronic keyboard represented in Western music [8].

TABLE I
C MAJOR LEAD WITH FINGER REPRESENTATION.

C Major	C	D	E	F	G	A	B	C
Right Hand	T	I	M	T	I	M	R	L

MyoBand

- The musical instrument playing heavily relies on sequence or combination of finger key press on the instrument.
- MyoBand, being wireless and positioned at forearm provides convenience and does not hinder user from playing instrument.
- Most of the larger finger muscles originate close to elbow joint that helps to track finger movements precisely.

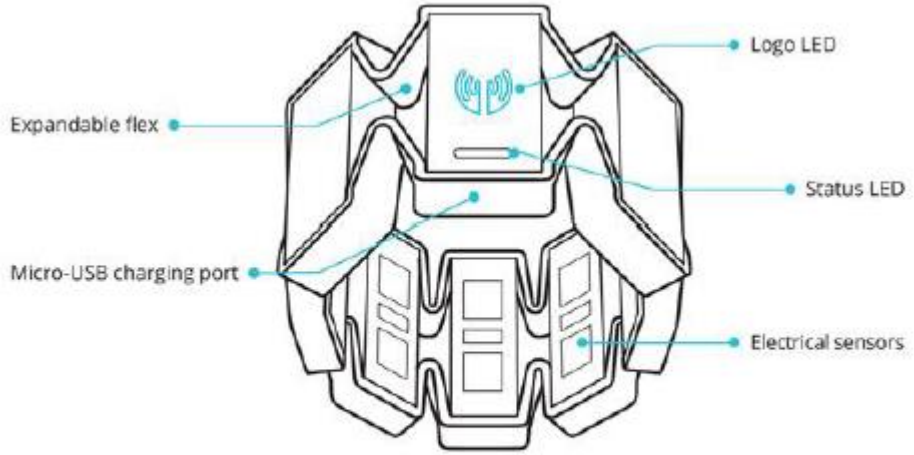
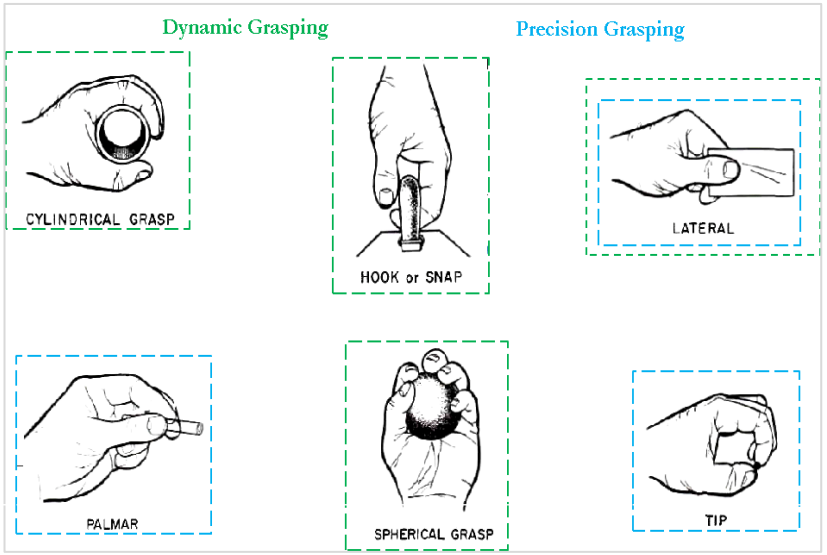
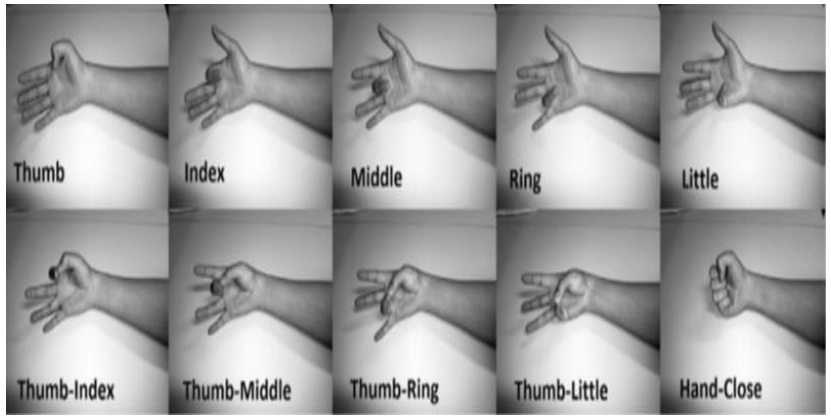


Fig. 3. Diagram of MyoBand and its components, captured from [27]

Feature & Algorithm Selection





Data Set	People / Subjects	#Times	Time / Experiment
1 [Ref 16]	5 (2 M / 3 F)	30	6 sec
2 [Ref 17]	1	300 (100/day)	5 sec
3 [Ref 14]	8 (6M /2F)	6	5 Sec

Feature Set Extraction

Dimensionality Reduction

Classification

TABLE II
PROPOSED FEATURES FOR sEMG SIGNAL CLASSIFICATION ALGORITHM.

	Proposed Features
1	RMS of the signal
2	Mean Average
3	Variance
4	Standard deviation
5	Skew
6	Kurtosis
7	Standard error
8	Mean absolute deviation
9	Waveform Length
10	Mean Frequency of the signal
11	Median frequency of the signal

Table TC4.1: Feature Set Selection

Data	FeatureSet1	FeatureSet2
Data1	69.44	**80.96**
Data2	75.97	**79.17**

FeatureSet1 [Ref 10] – 3 Time and 2 Frequency Domain
FeatureSet2 [Ref 25] – 5 + 6 Time Domain

MyoBand Key Press Data

Fig. 9. Image showing electrode numbering in a MyoBand device.

Fig. 6. Posterior and anterior view of the subject's right hand wearing MyoBand device.

Time	10 Sec
Hand	Right
Position	Seated Arm Perpendicular to ForeArm
Software	MyoBand Data Capture Windows

Lead Key To Finger Mapping

C	**D**	**E**	**F**	**G**
T	**I**	**M**	**R**	**L**

TABLE VI
CHORDS DEFINED BY KEY PRESS AND ITS SUBSEQUENT FINGER MAPPING.

Chords	Keys	Fingers
C Major	C,E,G	T,M,L
D Major	D,$F^{\#}$,A	I,R,L
E Major	E,$G^{\#}$,B	T,R,L
F Major	F,A,C	T,I,L
G Major	G,B,D	T,I,M
A Major	A,$C^{\#}$,E	T,I,R
B Major	B,$D^{\#}$,$F^{\#}$	T,M,R

Experiment Results

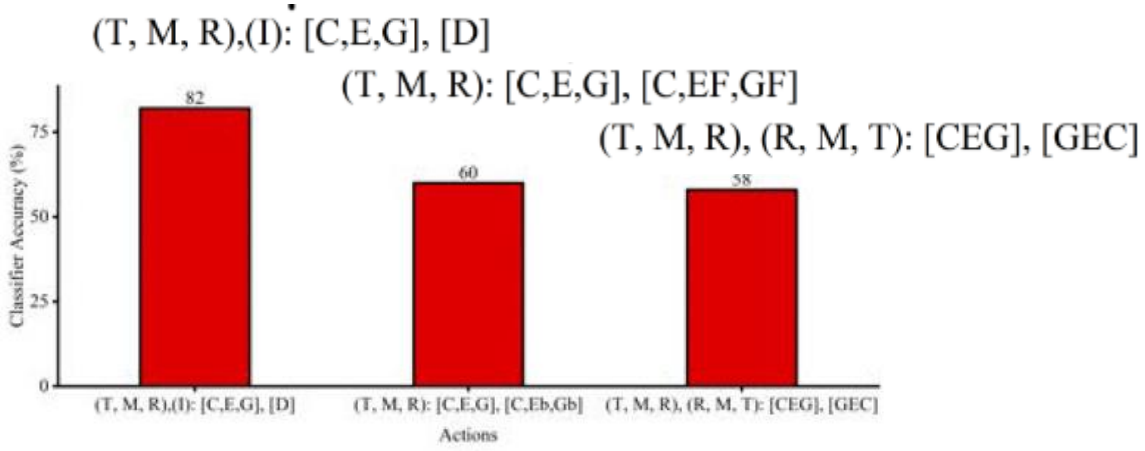


Fig. 5. Classifier accuracy for two class experiments using MyoBand

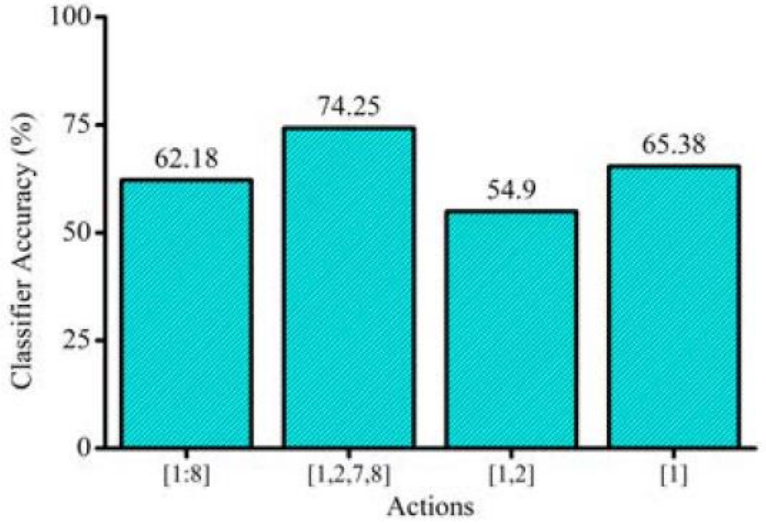


Fig. 7. Classifier accuracy for five finger key press using different electrodes of MyoBand device.

Experiment Results

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CHORDS DEFINED BY KEY PRESS AND ITS SUBSEQUENT FINGER MAPPING.

Chords	Keys	Fingers
C Major	C,E,G	T,M,L
D Major	D,$F^{\#}$,A	I,R,L
E Major	E,$G^{\#}$,B	T,R,L
F Major	F,A,C	T,I,L
G Major	G,B,D	T,I,M
A Major	A,$C^{\#}$,E	T,I,R
B Major	B,$D^{\#}$,$F^{\#}$	T,M,R

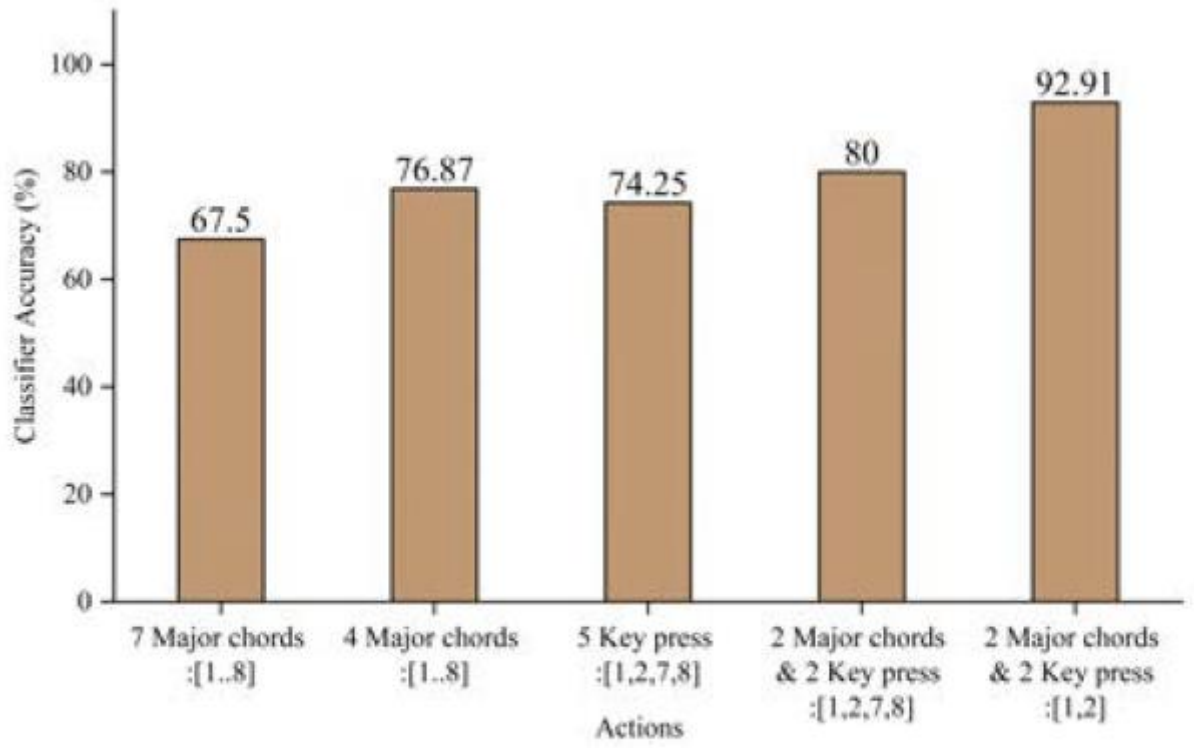

Fig. 8. Classifier accuracy for different actions using MyoBand.

Experiment Results

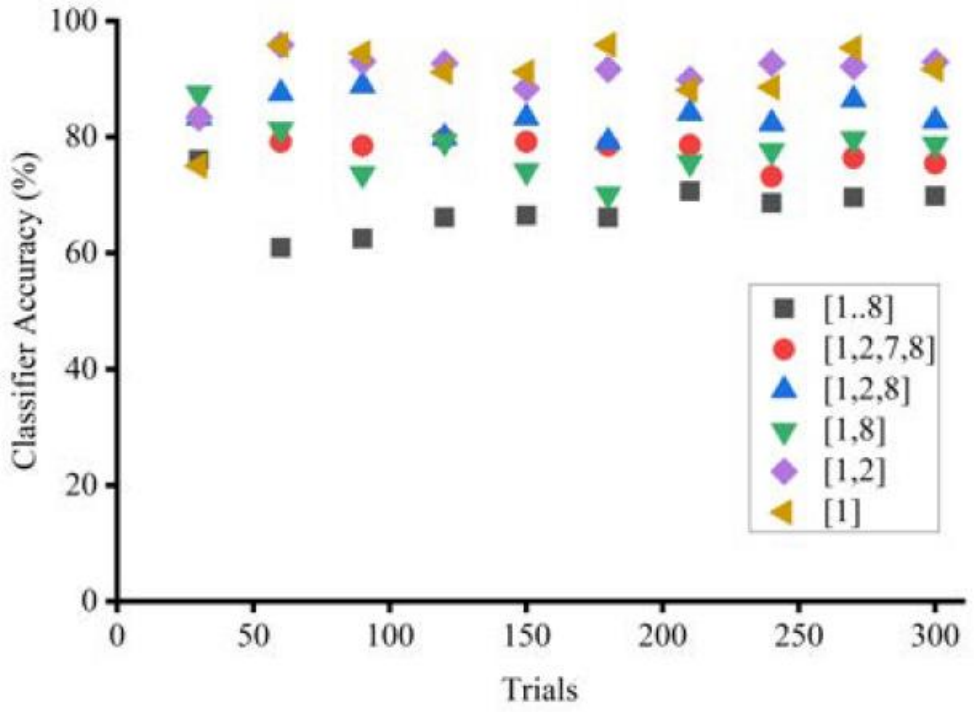

Fig. 10. Classifier accuracy over number of trials.

- Over a series of trials, the optimal position of electrode at 1 and 1, 2 is highly suitable to classify two chords and two finger events.
- The accuracy over number of trials also steadies in the range of 88% to 95.83% , which is adequately high for musical instrument learning assessment.
- Four class accuracy involving distinguishing C Major chord, or D Major chord, or C note, or G note is found to be 95.83% using selected features on LDA pre-processed RF classifier algorithm, which is considerably high and original for music assessment and self-learning application.

THANK YOU!