Proposal for Controlling Robotic Hand

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Abstract

This project is aiming to help out disabled people where user can have real experience with things and can live as a normal human with assistive arm. This arm will automatically detect the user arm movements that the user wants to do by detecting EMG signals by MYO armband device, MYO is a device detect EMG signals and another type of signals and send it via Bluetooth to computer to start the analysis and learning phase, but we are facing many problems as we are going in this project one of them is the accuracy of the testing data of EMG signals .We have at least 10 Movment on our system.

1 Introduction

1.1 Background

According to a newspaper in Indonesia, one of biggest public hospitals in Jakarta named Rumah Sakit Cipto Mangunkusumo (RSCM) has statistical data about 35 percent of diabetics that end with amputation. There are nearly 2 million people living with limb loss in the United States [11]. Approximately 185,000 amputations occur in the United States each year [12]. In 2009, hospital costs associated with amputation totaled more than 8.3 billion dollar[13]. So, we decided to take challenge to help this people to feel normal again with an assistive limb.

1.2 Motivation

There are a lot of people will get benefit from arm so they won't feel that they are useless. We trying make their life more easy and smooth. Some of them got damaged EMG signals and it will be challenge to help them control the hand, but others can be detecting EMG signals. The system will recognize EMG Signals and analyses the signals with machine learning and make classification on it. Then we will use MYO device to send signals to the robotic arm. But there

is a challenge in that like the accuracy of the hand movements and detection to move in the real time.
Build the dataset: using MYO to get the signals and train the machine by the output of this data.
Feature extraction: using Root Mean Square (RMS) to make pre-processing on the data to get important data.
Upon survey we had done to see if the market really wants our product or not:

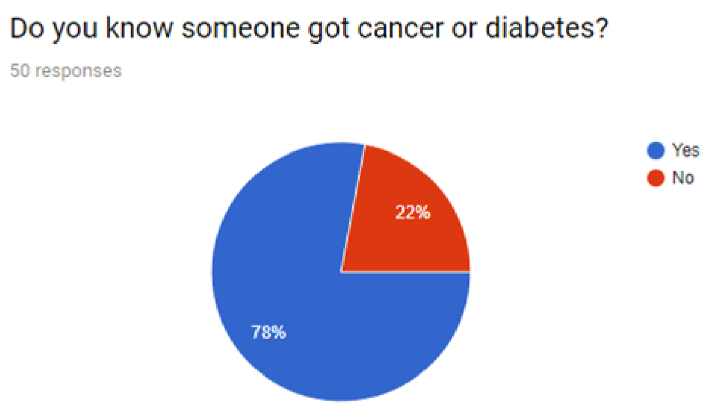

Figure 1: Survey Questions

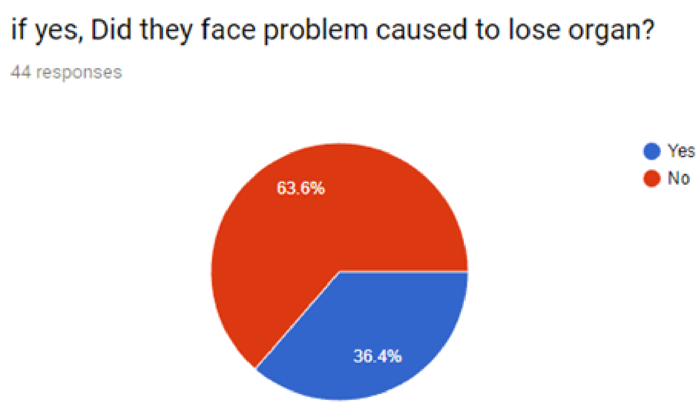

Figure 2: Survey Questions

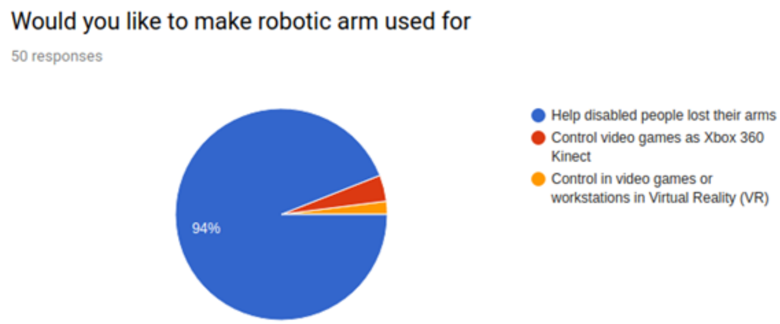

Figure 3: Survey Questions

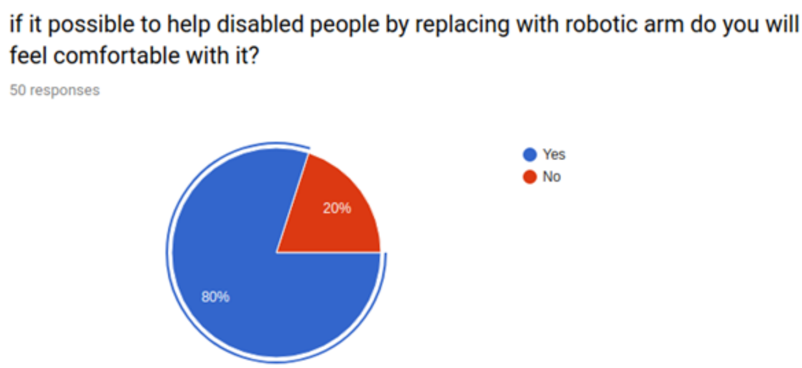

Figure 4: Survey Questions

1.3 Problem Definitions

This project is aiming to help disabled people by integrating between some software and hardware to make them use their arms or if we couldnt afford the hardware of the arm we could use a virtual arm developed by unity to control it using machine learning and EMG bracelet and transmitter to send data to the processing unit to process it through our machine learning algorithm then send the result to the robotic or virtual arm.

2 Project Description

Represent the MYO device while detecting EMG signals from muscular movement. Then applying on the signals noise removal, feature extraction and classifier then send the movement to the arm to make the move and works smoothly.

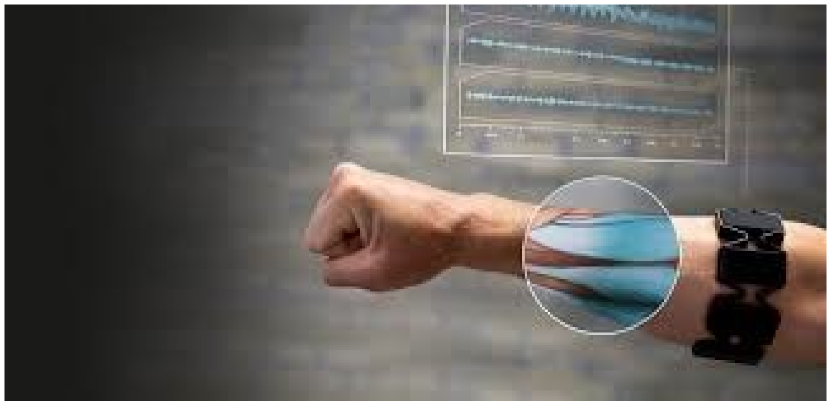

Figure 5: MYO Device

2.1 Scope

System will learn from signals according to each user.
1. Remove noise from signal.
2. Extract the features to reach high accuracy.
3. Classify the signal to know which action will do.

2.2 Project Overview

as shown in figure 6, we will start with building our Data set from different persons then we apply the noise removal and feature extraction alogrithms as preproccessing step,then we apply classification alogrithms finaly evalutae our system.

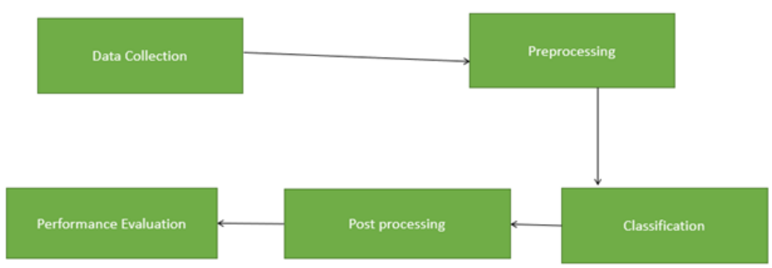

Figure 6: project overview digram

3 Similar System Information

3.1 Similar System Description

Bebionic arm its programmable arm with certain number of movements 14 exactly and its cost 11,000 dollar and the other similar system its using electrodes only to detect the signals but don't use them to control arm or hand its can detect 10 movements.

Development of a hybrid motion capture method using MYO armband with application to teleoperation
In this paper, they were developed a motion capture method based on data collected by MYO armband. The method can be applied on any healthy operator wearing two MYO armbands on both upper and lower arms, respectively. The first MYO armband is worn near the center of the operator's upper arm, the other is worn near the center of the forearm. MYO armband has built-in eight bioelectrical sensors as well as a 9-axis IMU. The IMU sensors of the MYO are used to detect and reconstruct physical motion of shoulder and elbow joints, while the bioelectrical sensors are used to collect electromyography (EMG) signals associated with wrist motion and they used hybrid method enables us to fully capture the motion of the 6-DOF (degree of freedom) of the arm. To test the proposed method, hardware-in-loop simulations studies are performed, with both physiological and physical signals received and processed in MATLAB/Simulink via a low-power Bluetooth interface. [9]

A classification method of hand EMG signals based on principal component analysis and artificial neural network
In This paper, presents a classification method for multi-class classification of electromyography (EMG) signals from eight hand movements. The data were collected from 15 subjects. The EMG signals were extracted using 16 time-domain feature extraction methods. The 16 features are reduced using principal component analysis (PCA) to enhance the classification accuracy. they used the features results from PCA are classified using artificial neural network (ANN). The classification using ANN result to the training accuracy of 85.7percent and the testing accuracy of 81.2 percent. [1]

A Survey of Approaches for Recognizing Hand Gestures Using EMG Signal
In this paper they negotiate the detecting of hand gestures using EMG signal. The signal of EMG sensor can be measured on a human skin surface. There are two approaches to recognizing hand gestures. One approach is to fuse EMG sensor with others sensors. It is possible to extract various motion features. Other approach uses algorithms that improve the recognition accuracy. They survey two approaches for detecting hand gestures. [8]

Evaluation of the MYO armband for the classification of hand motions
Pattern recognition-based control systems have been widely investigated in pros-

theses and virtual reality environments to improve amputees' quality of life. Most of these systems use surface electromyography (EMG) to detect user movement intentions. [7]

Arm Motion Estimation Algorithm Using MYO Armband

In this paper, they propose an algorithm to estimate the overall arm motion using the MYO armband attached to the upper arm. Thus, we can get EMG data of biceps and triceps when the human stretch or bend his/her arm. The motion of the lower arm is estimated through the EMG signal of the upper arm. The motion of the upper arm is detected through the IMU sensor. To increase the reliability of the data, experimental environment is set up and process of filtering and initialization are performed before motion estimation. Finally, we propose an algorithm with average, sum and rate sequence based on the signals measured on 8 EMG channels of MYO. [5]

EMG pattern classification to control a hand orthosis for functional grasp assistance after stroke

Wearable orthoses can function both as assistive devices, which allow the user to live independently, and as rehabilitation devices, which allow the user to regain use of an impaired limb. To be fully wearable, such devices must have intuitive controls, and to improve quality of life, the device should enable the user to perform Activities of Daily Living. In this context, we explore the feasibility of using electromyography (EMG) signals to control a wearable exotendon device to enable pick and place tasks. We use an easy to don, commodity forearm EMG band with 8 sensors to create an EMG pattern classification control for an exotendon device. With this control, we are able to detect a user's intent to open, and can thus enable extension and pick and place tasks. In experiments with stroke survivors, we explore the accuracy of this control in both non-functional and functional tasks. Our results support the feasibility of developing wearable devices with intuitive controls which provide a functional context for rehabilitation. [6]

Techniques of EMG signal analysis and classification of Neuromuscular diseases

Artificial intelligence techniques are being used effectively in medical diagnostic tools to increase the diagnostic accuracy and provide additional knowledge. Electromyography (EMG) signals are becoming increasingly important in clinical and biomedical applications. Detection, processing and classification of EMG signals are very desirable because it allows a more standardized evaluation to discriminate between different neuromuscular diseases. In this paper reviews a brief explanation of the different features extraction and (classification techniques for classifying EMG signals used in literatures. Wavelet Transform WT), Principle Component Analysis (PCA), and Independent Component Analysis (ICA) are different feature extraction techniques. Literature presents different techniques to classify EMG data such as probabilistic neural network (PNN), Support Vector Machine (SVM), Artificial Neural Networks (ANN), etc. In this paper neuromuscular disease classification from electromyography (EMG) signals are proposed based on different combination of features extraction methods and types of classifiers. Combination of WT and SVM improved the classification accuracy than other combinations such as DWT with ANN, ICA with MLPN, PCA with ANN and DWT with PNN. [4]

3.2 Comparison with Proposed Project

Points of comparisons	Algorithm Used	Accuracy Achievement %	Movements	Cost
bebionic arm	Programmable	Up to 85%	14 Movements	11,000$
Toward improved control of prosthetic fingers using surface electromyogram (EMG) signals	KNN and SVM	Classification accuracy 90%	10 Movements	1600$
Our proposed system	CNN and SVM	-	At least 10 movements	200$ + Arm price

Figure 7: table of Comparisons

3.3 Screenshots from previous systems

3.3.1 Commercial similar system

Figure 8: Bebionic Arm

3.3.2 Academic similar system

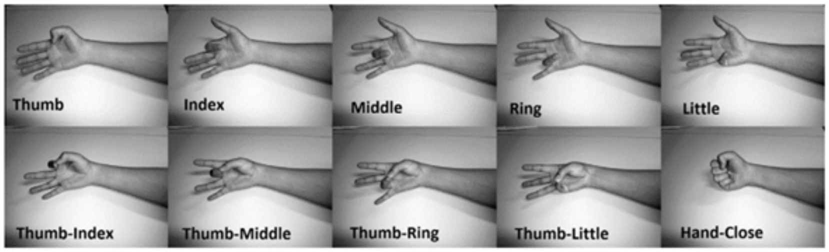

Figure 9: Detecting signals with electrodes

4 Project Management and Deliverables

4.1 Tasks and Time Plan

PROJECT PHASE	STARTING	ENDING
RECIVING PROPOSALS AND IDEAS FROM DR'S AND STUDENTS	2 July 2017	15 July 2017
ANNOUNCE PROPOSALS FOR STUDENTS	16 July 2017	22 July 2017
1. LECTURE PRESENTATION SKILLS	26 July 2017	
REGISTER STUDENTS TO PROJECTS	26 July 2017	27 July 2017
2. LECTURE WRITING PROPOSAL	2nd Aug 2017	
1 PROPOSAL EVALUATION	26 Sep 207	27 Sep 2017
3. LECTURE WRITING SRS	16 October	
2 SRS EVALUATION	3 Days after Mid term	
PROF. JIRO TANAKA	3 Dec 2017	11 Dec 2017
4. LECTURE WRITING SDD	13 Dec	
3 SDD EVALUATION	3 Days after Final Exam	

PROJECT PHASE	STARTING	ENDING
4 EVALUATION IMPLEMENTATION	After Mid Term by 3 days End of march	
5. LECTURE FINAL THESIS AND WRITING PAPER	Before Spring Break	
DELIVERYING 6 PAGES PAPER	3 days after Spring Vacation	
5 TECHNICAL EVALUATION	1 week of may	
6. LECTURE WRITING CV	Beginning of May	
6 FINAL THESIS (R 325)	After final exam by 2 weeks	
CERMONEY (OOA)	1 day after Final thesis	

Figure 10: Time Plan Table

4.2 Budget and Resource Costs

MYO armband device will cost 200 dollar.

4.3 Supportive Documents

Person-specific gesture set selection for optimized movement classification from EMG signals
Movement classification from electromyography (EMG) signals is a promising vector for improvement of human computer interaction and prosthetic control. Conventional work in this area typically makes use of expert knowledge to select a set of movements a priori and then design classifiers based around these movements. The disadvantage of this approach is that different individuals might have different sets of movements that would lead to high classification accuracy. The novel approach we take here is to instead use a data-driven diagnostic test to select a set of person-specific movements. This new approach leads to an optimized set of movements for a specific person with regards to classification performance. [3]

MyoLearn: Using a multimodal armband sensor for vocational safety problem identification
This project looks at using the MYO armband and machine learning techniques to detect irregularities when performing a vocational assembly task. A Lego car assembly task is performed while MYO data are collected, which include accelerometer, gyroscope, magnetometer, and EMG. Principal Component Analysis is then used to reduce dimensionality and discover if long-term deviations from the assembly task can be detected, indicating a potential health and safety risk. [2]

5 References

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