COMP4801 Final Year Project

FYP15027 Project Plan

Internet of Thing Application – TOUCH3

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1. Introduction

Most of the electric devices in home are controlled by remote control with physical buttons. They make us comfortable and convenient to switch the devices with a long distance. Hence, remote-control system plays as a significant role in our daily life. With the advanced technologies, a gesture-control system, MYO armband, is developed. Unlike other system, MYO armband using electromyography to read electrical signals from muscles in forearm [1], so it is able to map the signals to gestures made from hand, and control the connected devices.

The aim of this project is to remotely manipulate robot with MYO armband. Making use of the Internet of Thing technology, this project are going to develop a mobile application, TOUCH3, to control robot by gesture control, so as to achieve a touch-free experience for users and be suitable for scenarios where touch is not preferred. And ultimately, this project will benefits to robot manipulation in the future.

2. Problem Statement

Nowadays, human make use of robots to complete different dangerous and inaccessible tasks though remote-control system. For example, doctors in operating room are required to locate the affected part by controlling the diagnostic imagery. But to avoid any infection, they cannot touch anything with their hand, so more manpower is needed to complete the surgery [2]. With the help of MYO armband, doctors will be able to navigate the diagnostic imagery by gestures. In addition, they

can also interact with other medical devices without nurses' help, so nurses can focus on other duties. As a result, the efficiency and the success rate of surgery will be increased.

Apart from the medical purpose, MYO armband also assists astronauts to complete their mission. Under zero gravity state and wearing space suit, using controllers with physical buttons is not user-friendly to astronauts, and reduces the working efficiency. Therefore, MYO armband is significantly useful. Astronauts can easily control different devices by hand gestures, so they can work faster and reduce the time of exposure to space. Hence, their safety can be secured.

Hence, using MYO armband to remotely control different devices is especially useful under certain scenarios. And this project is trying to show the great potential of MYO armband by developing a mobile application, which can use MYO armband to manipulate robot.

3. Objectives

This project aims to remotely control robots by MYO armband, and aims to develop a user-friendly mobile application, which allows user to monitor robot and define customer gestures. It provides four functionalities:

1. To interconnect MYO armband and robots
2. To map hand gestures to robot's motions
3. To customize user gestures
4. To present the information to the users in a proper manner

First, the mobile application is required to connect MYO armband with robot. Since MYO armband and robot support the Bluetooth Smart (Bluetooth 4.0 Low Energy), they are able to communicate with smart phones having Bluetooth radio. Applying BLE technology, TOUCH3 can exchange information between MYO armband and robot. As a result, TOUCH3 acts as a platform. It is able to handle the data input from MYO armband and data output to robot, so it can accommodate interconnection and intercommunication with MYO armband and robots.

Second, TOUCH3 is to map gestures to robot's motions. An ARM Cortex M4 processor in MYO armband provides strong processing power to recognize muscle activities and sends detected gestures to smart phones. Therefore, TOUCH3 can read the gestures recognizing by MYO armband and then sends commands to robot, so as to control the robot's motions.

Third, this project would like to develop a functionality, which allows users to define their gestures with certain robot's motion. Since MYO armband contains two types of sensors, TOUCH3 can make use of them to detect hand gestures. First, MYO armband has eight medical grade stainless steel electromyography (EMG) sensors, thus it can monitor the electric signal in forearm muscle. Second, it contains a highly sensitive nine-axis inertial measurement unit, which are able to detect the forearm motion in any direction. With the powerful sensors, MYO armband is able to recognize numerous gestures, and provide lots of gestures for user. So TOUCH3 allows users to customize their own gestures, and map to certain robot's motion.

Fourth, TOUCH3 should be able to present different inforomation to users with a proper manner. Therefore, a concise and user-friendly user-interface will be developed and implemented under Android environment. Also, MYO armband contains vibation motor, it is able to product servious types of vibation. TOUCH3 makes use of this feature, and provides haptic feedback to users. Therefore, users are not necessary to hold their phones all the time during controlling robot.

The intermediate goal for this project is to develop a mobile application, which is able to have above four functionalities with a user-friendly user interface. As a result, users are able to remotely control robot with MYO armband.

The ultimate goal is to implement a functionality that robot is able to perform a sequence of complicated action by a simple gesture, so as to enhance the efficiency of gesture-control.

4. Deliverables

Deliverables of phase one (inception)

1. Detail Project Plan
2. Project website
3. User interface of mobile application

After phase one, a detail project plan will be provided with an overview to users what is the project about and the scope. Also, a prototype of the mobile application will be released and a user experience assessment will be conducted for developing a user-friendly application.

Deliverables of phase two (elaboration)

1. Implementation of four functionalities
2. Detailed interim report
3. Modification of UI design

After phase two, an alpha-grade mobile application will be provided with four main functionalities for users testing, robot should be able to perform simple motions with simple gestures. Then, the UI design will be improved with the users' opinion. An interim report will also be provided to assess the progress and the achievement.

Deliverables of phase three (construction)

1. Implementation of beta version application
2. Final report

After phase three, a beta version application will be released with the functionality that robots are able to perform a sequence of complex motions with simple gesture. The project objectives and progress will be evaluted our objectives and a final report will be provided.

5. Approach and Methodology

This project is to develop a mobile application with four main functionalities to control robots by MYO gesture-control system. To elaborate on the system design, an use-case diagram as shown below is designed.

Use Case

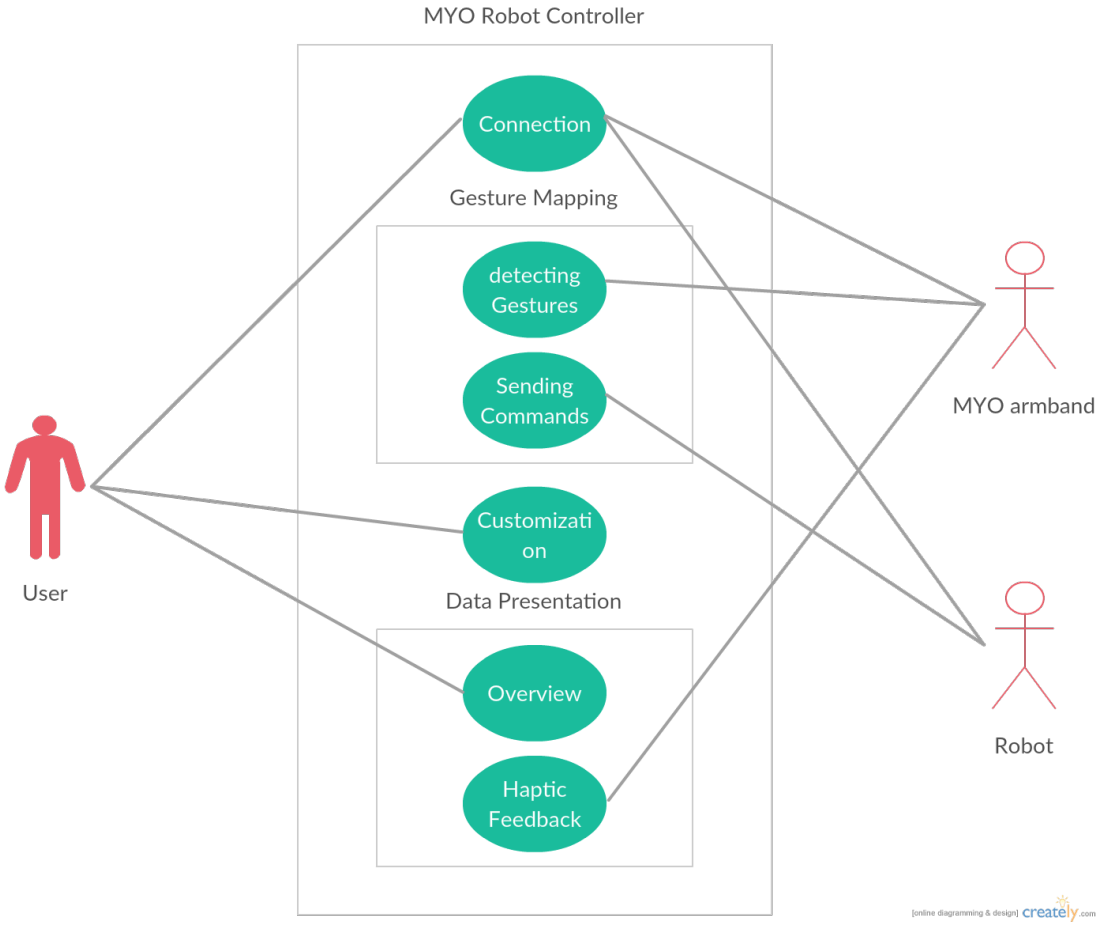

Figure 1: MYO Robot Controller Use-Case Diagram

The primary actor for TOUCH3 is the user. The user is interested in controlling robot by MYO armband, so they would like to perform three functions. They want to connect certain MYO armband with certain robot, so the Bluetooth Low Energy (BLE) technology is applied to interconnect these devices. In this project, BLE supports TOUCH3 acting as a sender or receive of data while connecting with different devices. With the software development kit (SDK) of MYO armband and robot, TOUCH3 forms a platform to handle the communication of two devices. Also, the user would like to define the gesture to certain robot's motion, so TOUCH3 will be developed this functionality with a well-defined Libmyo library. Finally, the user

is able to interact with a concise and user-friendly interface to monitor the robot and MYO armband.

The secondary actors in this use case are MYO armband and robot. MYO armband with a BLE radio is able to send the detected gestures to the smart phones. And also TOUCH3 is able to order the vibration motor in MYO armband, so as to give a haptic feedback to the user. Robot also contains a BLE device, thus it is able to receive the commands from TOUCH3, and performs certain motion.

Mobile Application Flowchart

Once the user opens TOUCH3, he will be able to monitor the application. The flowchart is shown in Figure 2.

At the beginning, the user will be able to search and select target MYO armband and robot. Then TOUCH3 will connect these two devices through the BLE. Next, a customization option will be provided to user. If user clicks into this option, TOUCH3 will provide different hand gestures with different robot's motions. He will be able to map the gestures to certain motions with a drag-and-drop user-interface, and the user definition will be stored. After completing the customization, the user will be allowed to monitor the two devices. He will be able to check the status of the connected devices and the control menu.

With the user's setting, he can start the controller. Once the MYO armband detects the signal of muscle activities, it will send the message to TOUCH3. It

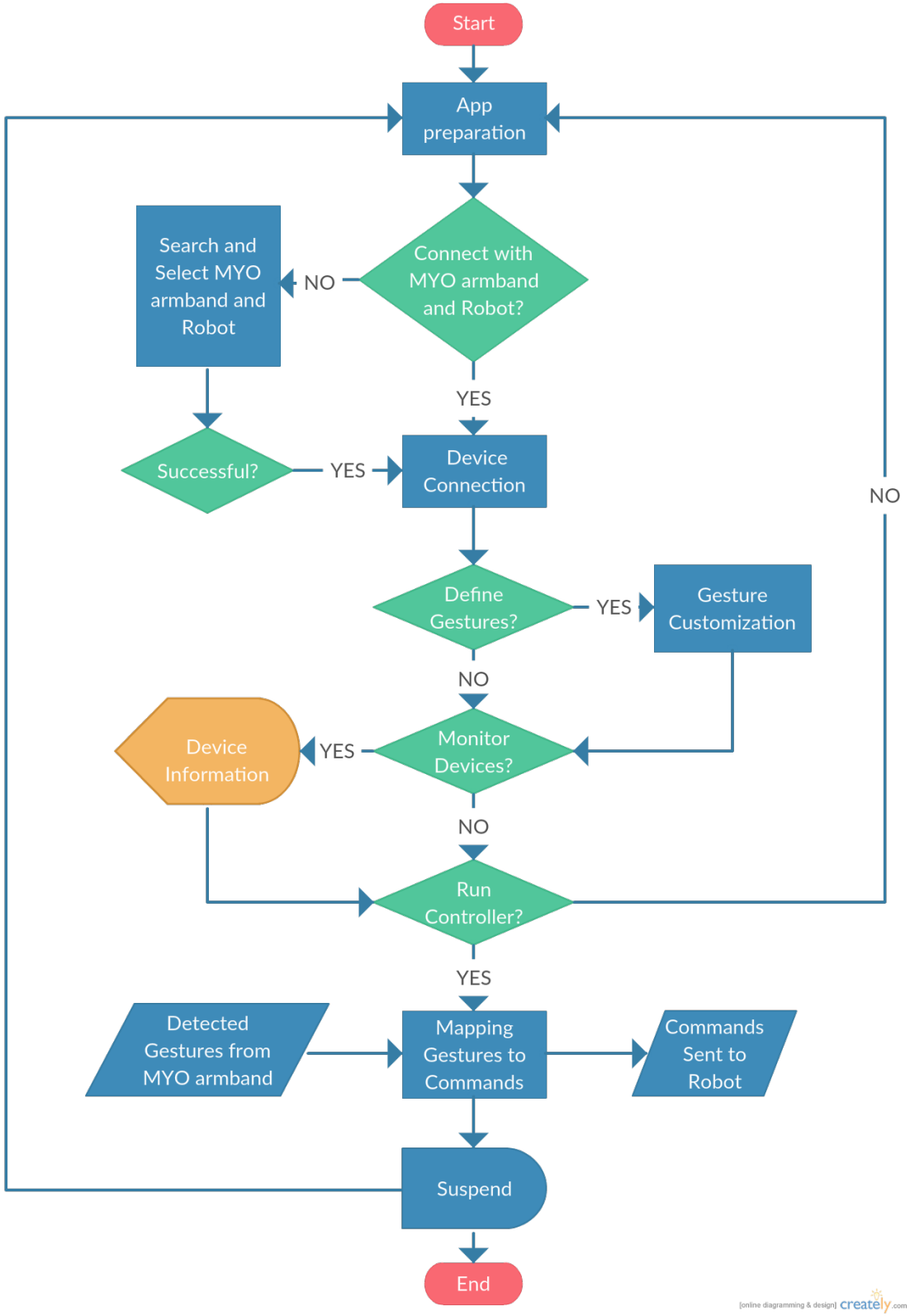

Figure 2: MYO Robot Controller Flowchart

will map the gestures to certain motion from the user definition, and will send a command to robot. Once the robot receives a command, it will perform the motion. The user is allowed to stop the controller anytime, so he can modify the setting or terminate TOUCH3.

6. Risks, Challenges and Mitigation

In this project, there is a big challenge. The current MYO armband applications are mainly using seven gestures to control different devices. But this project is aims to develop a mobile application, which is able to fully and smoothly control the robot. In general, it requires numerous gestures to perform different kinds of motion, so the recognition ability of MYO armband is necessary high [3]. As a result, a deep research for gesture recognition will be conducted to develop a better mechanism. Also, the MYO forum will contribute to solve this problem, because there are many experienced MYO developers who can provide valuable advice. Therefore, the mobile application should be able to provide fully control function.

7. Schedule

Tasks		Due Date
Inception	Project Plan	10/4/2015
	Project Website	
System Design	Review Preliminary	10/11/2015
	Develop UI Prototype	10/18/2015
	Review UI Prototype	10/21/2015
	Review System Architecture	10/25/2015
Elaboration	Implement UI	11/4/2015
	Develop Main Functionalities	12/31/2015
	Review Functionalities	1/4/2016
	Release Alpha-grade application	1/9/2016
	Interim Report	1/20/2016
	Website Maintaining	1/20/2016
Construction	Review UI Design	1/24/2016
	Develop Ultimate Functionality	2/29/2016
	Debugging	3/31/2016
Testing	Release Bate-version application	4/4/2016
	Testing	4/10/2016
Documentation	Project Documents	4/13/2016
	Final Report	4/15/2016
Deployment	Final Checking	4/17/2016
	Release final application	4/17/2016

8. Conclusion

MYO armband is a high potential smart device. Making use of it, different kinds of Internet of Thing applications can be developed. This project try to combine it with robot, the main vision is to provide an unexpected user experience in robot control. And hopefully, it may contribute to the future robot development. Although the development of this project is hard, under Dr. Lau supervision, a fully developed mobile application must be done.

9. Reference

[1] MYO [Internet]. MYO; [cited 2015 Sep 30]. Available from: https://www.myo.com/

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[3] ThalmicLabs [Internet], Myo SDK Manual; [cited 2015 Oct 1]. Available from: https://developer.thalmic.com/docs/api_reference/platform/index.html

[4] Bluetooth [Internet], Bluetooth Smart Technology: Powering the Internet of Things; [cited 2015 Oct 1]. Available from: http://www.bluetooth.com/Pages/Bluetooth-Smart.aspx