architecture design and section 4 describes experimental results of virtual robotic arms. These procedures are also carried out to demonstrate their features.

2 Motivation and Related Research

The proposed system gets data from electromyography, gyroscope and accelerometer and analyzes them to understand the wrist gesture by measuring which part of forearms muscles electro activated.

2.1 EMG and Myo sensor

Most gesture-control systems still detect movements with cameras, which can be thrown off by poor lighting conditions, distance, and simple obstructions. By drawing gesture information directly from your arm muscles instead of a camera, Myo circumvents all these problems and also works with devices that don't have a camera in the first place [2].

EMG is an electro-diagnostic technique for evaluating and recording the electrical activity produced by skeletal muscles. Electromyography detects the electrical potential generated by muscle cells when these cells are electrically or neurologically activated. The signals can be analyzed to detect medical abnormalities, activation level, or recruitment order or to analyze the biomechanics of human movement [3].

Fig.1. Myo armband to control devices and games.

3 Architecture design

This section shows Myo armband which has eight different blocks and each of them contains a medical-grade EMG sensor. The armband also has a three-axis gyroscope and three-axis accelerometer.

Section 3.1 shows the architectural design for controlling a virtual robotic arm.

Fig. 2. Five hand gestures and their functions.

Fig. 3. Myo armband and the number of sensors.

3.1 Design of virtual robotic arm

Figure 4 shows the whole process of controlling a virtual robotic arm in Unity 3D.

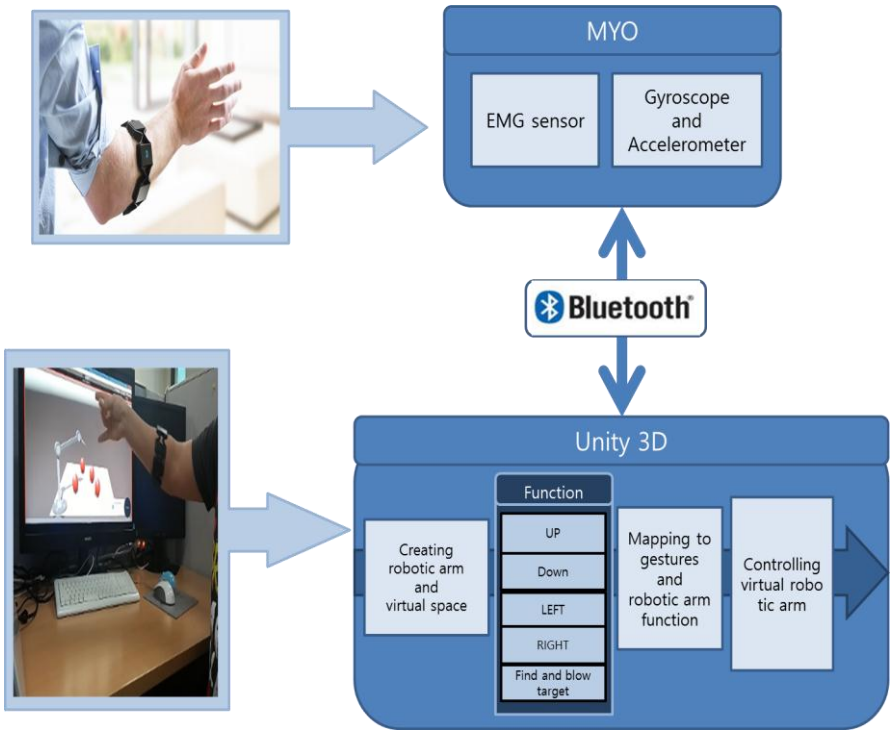
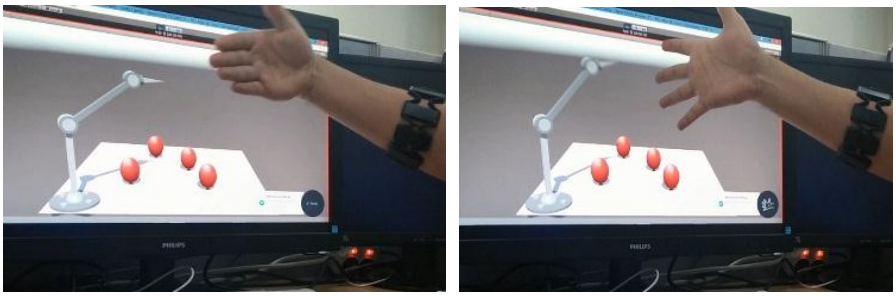


Fig. 4. Architecture of the proposed virtual robotic arm.

4 Experimental results

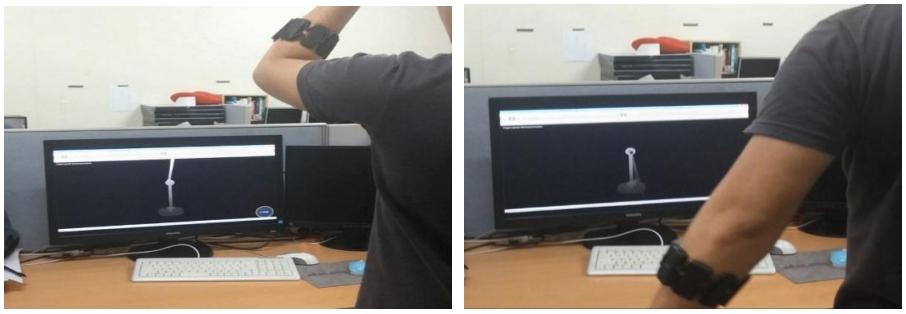


(a) Wave left (b) Fingers spread

Fig. 5. Controlling robotic arm with gestures using EMG sensor.

Figure 5 is an example of controlling virtual robotic arm by EMG sensors. In this case, five gestures: wave left for turning left robotic arm, wave right for turning right, fingers spread for raising up, fist puts down and double tap with fingers are for

automatically finding balloons and blow them. It is because EMG can detect minute activities generated tension and relaxation of forearm muscles [4].



(a) Rising up (b) Putting down

Fig. 6. Control of robotic arm by gyroscope and accelerometers data in X, Y, Z directions.

Figure 6 represents the control of virtual robotic arm by using gyroscope and accelerometer. In this case, robotic arm moves in X, Y and Z directions.

5 Conclusion

Nowadays, the fields of electromyography (EMG) and Electroencephalogram (EEG) are still actively studied. Also, frequency of practical use for rehabilitation and nursing becomes high. The study mostly is used for purposes of curing and rehabilitation. Among living body signals like EEG, the field of EMG which has high accessibility to measure and analysis is more vigorous than other fields.

This paper showed how to control a virtual robotic arm that prototype was built in Unity 3D by using electromyography, gyroscope and accelerometer sensors. Because of EMG sensors, we could get clear and important data and we used them to control a virtual robotic arm. By comparing virtual robotic arms based on EMG, and gyroscope and accelerometer, we judged which type of virtual robotic arm is suitable for hand amputee. Experimental results show the control a virtual robotic arm based on gyroscope and accelerometer. It should go with dynamic movement of whole arm. On the other hand, a virtual robotic arm based on EMG needs only specific muscles activities [5]. Therefore, a virtual robotic arm based on EMG is more helpful to use in case of hand amputee.

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