**MAST: Myo Armband Sign-Language Sign Translator**

**Project Proposal**

**(Capstone Design Project (SWE3028-41) Sungkyunkwan University)**

-Team 1-

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1. **Introduction**

Sign language is a language through which communication is possible without the means of audible sounds. Instead, sign language relies on sign patterns, i.e., body language, orientation and movements of the arm to facilitate the understanding between people. There are perhaps more than two hundred sign languages in use around the world today. Moreover, there are a lot of Sign language users. In fact, between 90 and 100 million people have hearing impairment in the world.

Keeping this in mind, we aim to build a sign language translator that uses Myograph sensor and artificial arms. To be more specific, we will be tracking the user’s hands’ movements (gestures) and analyze it. With enough data, we will train the machine learning model that returns data translated from sign language to text or image. In addition, we will implement text to sign language translator if time is enough. This goal can be achieved with artificial arms and Arduino as the text that is mapped by myographs turn on the motors in Arduino and finally artificial arms connected the motors will present sign language to the disabled.

1. Myo:

Myo is a wearable device that tracks the movements of arm’s muscles with 8 sensors made by Thalmic Labs in 2013. It uses Bluetooth that send data to computer and provides an open source to utilize it.

1. Artificial arms:

Artificial arms are made by a 3D printer. It contains cartilage-like materials between each joint to make it flexible. Each finger has a hole to control finger independently with threads.



의류이(가) 표시된 사진

자동 생성된 설명

<picture 1. Myo device and graphs> <picture 2. Artificial arms>

1. **Related Work and their Limitations:**

This section will focus on describing the related work that has been done in this area. It is really essential to mention that most of the research that has targeted this field is either dependent on Statistical Machine Translation (SMT) or Neural Network based Computer Vision. Although, at a first glance those solutions might seem to be accurate and efficient however in section 4 we will discuss the details of why our suggested solution has an upper hand and how novel our approach is.

One of the most notable works that has been done in this area was published by the University of Guelph in an IEEE conference under the title of “ Sign Language Translator and Gesture Recognition” in which they proposed a custom sign language translation system which uses a specialized glove programmed with an SMT algorithm to translate certain gestures into written text with an accuracy of 96%. On the other hand, the practicality of such glove is debatable as it is only able to translate 20 gestures to 20 English letters rather than phrases or sentences which in fact is inconvenient. Another similar SMT based system was introduced in the paper “Statistical Sign Language Translation” which had the same limitations but with a slight improvement of targeting simple word in the German Language.

Another Interesting paper that was suggested in the previously mentioned conference by the University of Wisconsin; “Real-time Sign Language Translation based on Neural Network Architecture”. In this paper, the researchers suggested a very similar approach but instead of using SMT and a glove they built their mechanism based on computer vision technology where the mute people have to do some gestures Infront of a camera so that it can be translated. On the other hand, this approach has three main flaws:

1. The limited ability of translating English letters rather than more useful sentences or phrases.
2. The high latency that is due to the workflow of the suggested architecture where pictures are first captured then stored and after that a CNN (Convolutional Neural Network) is applied.
3. The limitation due to the requirement of having a very clear picture under perfect lighting condition.

That being said, newer papers have suggested better approaches using advanced CNNs. On the other side of the spectrum, the usability of such techniques is questionable as there are more than 240 different sign languages in the world and all the suggested papers focus on one of these sign languages. So even if the approach and accuracy is 100% the usability case of these mechanisms is very limited. For example, in the journal of computational and theoretical nanoscience, a paper was suggested to translate simple phrases from Portuguese sign language to English written text. While another paper under the title “Vision-based sign language translation device” generated similar results but for the Indian sign language. From a practical viewpoint, such implementations have very limited applications in real world as it is only helpful for people who are familiar with the Portuguese sign language. In our approach, instead of focusing on a single limited language we are trying to build a more comprehensive general translation system which focuses on the medical field and the smart hospitals equipped with MYO bands programmed with pre-trained custom gestures that will help any mute disabled person to easily use the gestures’ manual to convey their issue to the doctors without the need of a third part interpreter.

1. **Pros / cons of our project:**

This section will focus on the pros and cons of our project. Like any other projects, our project has pros and cons which indicate the relatively small or big differences to other projects and papers

1. Pros:
2. Since we are using Myo band and artificial hands, our project will have a higher accuracy than other computer vision-based projects. Moreover, the machine learning model will learn sign language more quickly.
3. Another difference between this project and other projects is that this project’s second aim is to also translate text into sign language using artificial hands. This thing has not been done or researched until now.
4. There are several projects that focus on the use of sign language translator in normal, casual situations. But there aren’t any projects that translators which target the medical field.
5. Currently, research works have focused mainly on the recognition signs from images or video sequences that have been recorded under controlled conditions. Because light and shadow can create differences in the processed image, so we need to control the environment. But with Myo sensor, we do not take image or video thus our results are independent of such factors.
6. Cons:
7. Myo is a device that uses electrical signals and movements through muscles in the arm. Therefore, unwanted actions could occur by unnecessary gestures that may hinder our mechanism.
8. There are so many kinds of sign languages and their subfields, but we think that we do not have enough time to implement all of them. So, we are going to focus on translating hospital related gestures.
9. Sign languages are not fully understood just by recognizing hand gestures. A fully understood sign language include hand gesture, movements of eyebrows, mouth movements and so on.
10. Lack of large data set can become a problem. When training a machine learning model, we need a big amount of data set. But currently there are not many data sets that are related to hand gestures in hospitals.