AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH

Faculty of Science and Technology

Project Proposal Cover Sheet

Assignment Title:	Sign Language Recognition		
Assignment No:	01	Date of Submission:	12 March 2022
Course Title:	Machine Learning		
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Semester:	Spring 2021-22	Course Teacher:	**Dr. M M Manjurul Islam**

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Sign Language Recognition

Introduction:

There have been several advancements in technology and a lot of research has been done to help the people who are deaf and dumb. Aiding the cause, Deep learning, and computer vision can be used too to make an impact on this cause. Sign language is the medium of communication for the people who cannot speak. It uses gestures to convey what they want to say. Sign language is a combination of hand-shapes, hand-orientation and hand, arm or body -movement, facial expressions and lip-patterns for conveying messages. American Sign Language (ASL), British Sign Language (BSL), Indian Sign Language (ISL) etc. are some of the common sign languages in the world [1]. As per the census 2011, there are 19,98,535 people with speech disability in India [2]. Communication is a way of exchanging thoughts and feeling and should not be restricted by usage of words or speech. Sign language interpreters (SLI) are required to translate sign language to spoken language [1]. Sign interpreters have been developed in the recent decade and have gained a lot of significance in the field of research and development. Over the years, several hand-movement trackers have been developed, that are different in their performance parameters like accuracy, jitter, drift, and latency [3]. However, generic automated sign interpreter methodologies include the use of sensors such as optical fibers and flex sensors to detect the movement of the palm and the fingers for mapping various letters. Every country has its specific sign language; however, the sign for the same word varies from country to country [4]. Significant research on the sign language interpreters can be noted in countries like USA, UK, Singapore, Canada etc.

This can be very helpful for the deaf and dumb people in communicating with others as knowing sign language is not something that is common to all, moreover, this can be extended to creating automatic editors, where the person can easily write by just their hand gestures.

In this sign language recognition project, we will create a sign detector, which detects numbers from 1 to 10 that can very easily be extended to cover a vast multitude of other signs and hand gestures including the alphabets.

We will develop this project using OpenCV and Keras modules of python. It will be a great project and it has a huge good impact in the society.

Methodology:

Data collection:

I plan to collect the data by taking videos of my hand, as well as hands from other volunteers, as I perform many sign language gestures. The data will first be taken with a clean background for an initial proof-of-concept, but as time permits, clustered backgrounds will be added in to the dataset to create a more realistic scenario.

Algorithm:

Segmenting out the hands is a non-trivial aspect of the project as I will be exploring different segmentation approaches (color, texture, etc.) in order to cluster the ”hand pixels” together. This will then be passed through an unsupervised learning algorithm such as a convolutional neural network to extract features and then use a trained classifier, such as softmax, to recognize specific sign language representations. In order to better classify ASL letters, I am looking into further segmenting the hand into specific fingers using depth and shape information from the 3D camera.

Background:

The CVPR gesture workshop from 2011 provides a great information on modern gesture recognition models as well as how to incorporate different learning algorithms. There is some past work1 related to my project that I will be looking at such as segmentation-robust modeling for sign language recognition [5] and sign language and human activity recognition [6].

Evaluation:

The final measure of my model performance will be based on the ratio of correct classifications out of a prepared validation set (recognition rate), penalized by some factor of false-positive responses to hand transition phases. Histograms of the error rates of different approaches as well as demo images will be used for comparison.

Dataset:

The writing system was built using a Python framework, which took one image of a whole user with the sign every 5 seconds before sending it to the multi-class recognition model to be recognized. The system works as a printing system because it prints the ASL sign and converts it into text. To collect a good dataset, a Python program was written, which took one image of 640 x 480 pixels every 1 second. Help was obtained from six volunteers, each of whom did all the signs in a different background, different lighting, and different viewpoint of the sign. A total of 61.614 images were collected for 28 classes, comprised of 26 alphabets, including J and Z, as well as two classes for space and delete. Table 1 shows the number of classes and how many images were included. Each image of all the signs was done in a different background, different lighting, and different viewpoint of the sign. Previously, the letters J and Z involved motion. To solve this case, each one of the three different viewpoints was taken for each

movement. Namely, the image for the starting movement of the letter was followed by the image for the middle movement, and another for the last movement. Softmax (activation function) was used for the hyper parameter tuning, while the learning rate was (0.0001), the epoch number was 500, the dropout rate was 0.5 and the batch size was 32 to fit the memory.

Table 1. The dataset includes 28 classes, comprised of 26 ASL alphabets, in addition to two classes for space and delete.

Alphabets	Class	number of samples
A	0	2164
B	1	2168
C	2	2063
D	3	2108
E	4	2317
F	5	2209
G	6	2120
H	7	2162
I	8	2283
J	9	2246
K	10	2215
L	11	2147
M	12	2172
N	13	2147
O	14	2445
P	15	2166
Q	16	2182
R	17	2157
S	18	2182
T	19	2284
U	20	2193
V	21	2224
W	22	2201
X	23	2208
Y	24	2207
Z	25	2244
Delete	26	2115
Space	27	2285
28 classes		61614

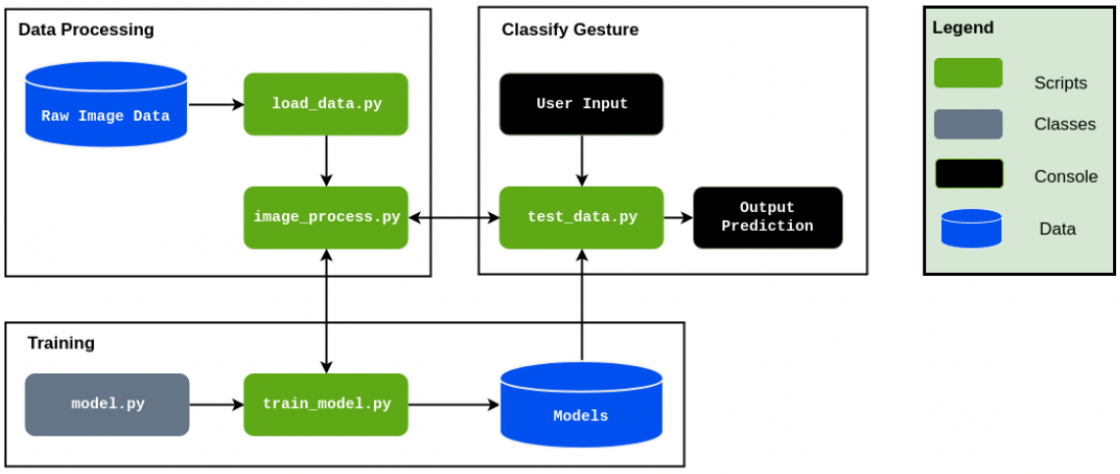

Figure 1: Block Diagram of Software

Result:

A real-time ASL fingerspelling recognition with a CNN algorithm using real colouring images from a PC camera was introduced. In this project, deaf signs are translated into text statements to help creating a writing system that can be used as an input system for a computer using any computer camera. This system will show a good results by taking advantage of a deep learning technique. This section discusses all the results that we expected from the experiment. A multi-class recognition system will built using VGG_Net. CNNs will used as the recognition system, in which each ASL sign was represented as an individual category. The classifier result would be one of 28 classes starting from 0 to 27. As a first step, the system succeeded in recognising 10 ASL letters (A, B, C, D, E, F, G, H, I, J). The system will trained with just 10 labels around 20256 training data for each class to produce less than 2000 images. We expected a better result with a higher accuracy from this system.

Discussion:

Sign language recognition is one of the most popular topics to research. So, it has also some challenges. Most of the treatises rely on the vision-based as well as the depth-based hand detection techniques. The former makes the signer moves freely and do not encumber him with a bunch of sensors and wires. Although, the projection of 3D world in a 2D image may cause the loss of some information. Behind this challenge data collection and creating a personal data set in short time is also a big challenge for us. We will try our best to achieve the success otherwise we will go for a pre made data set.

[1] Nair, A.V. and Bindu, V., “A review on Indian sign language recognition”, International Journal of Computer Applications, 73(22), 2013.
[2] Sailee Brahme, “READING THE SIGNS:SIGNS LANGUAGE”, April 21, 2017, available online at http://forreadingaddicts.co.uk/culture/reading-signs-sign-language/18395
[3] Republic World, Press Trust of India, "India’s First Sign Language Dictionary Released”, Mumbai, March 23, 2018
[4] Lucy Sweeney, “Gloves that convert sign language to speech ‘to empower the deaf community’ ”, ABC News, April 2016.
[5] D. Metaxas. Sign language and human activity recognition, June 2011. CVPR Workshop on Gesture Recognition.
[6] S. Sarkar. Segmentation-robust representations, matching, and modeling for sign language recognition, June 2011. CVPR Workshop on Gesture Recognition, Co-authors: Barbara Loeding, Ruiduo Yang, Sunita Nayak, Ayush Parashar.