

# **Developer's Manual for Project: Toward Hand Gesture Recognition for Sign Language Communication**

## **Table Of Contents:**

<b>Dependencies</b>	<b>2</b>
<b>Files</b>	<b>2</b>
<b>Letters</b>	<b>3</b>
<b>How to Add Images to Database</b>	<b>4</b>
<b>How To Run</b>	<b>5</b>
Step 1:	5
Step 2:	5
Step 3:	5
Step 4:	5
Step 5:	6
Step 6:	6
Step 7:	7
<b>Changing Threshold Values</b>	<b>7</b>

## 1. Dependencies

Python 3.6  
Pip 18.0  
Numpy 1.14.5  
Matplotlib 2.2.2  
Pandas 0.23.3  
Opencv-python 3.4.2.17  
Python-dateutil 2.7.3  
Scikit-image 0.14.0  
Scikit-learn 0.19.2

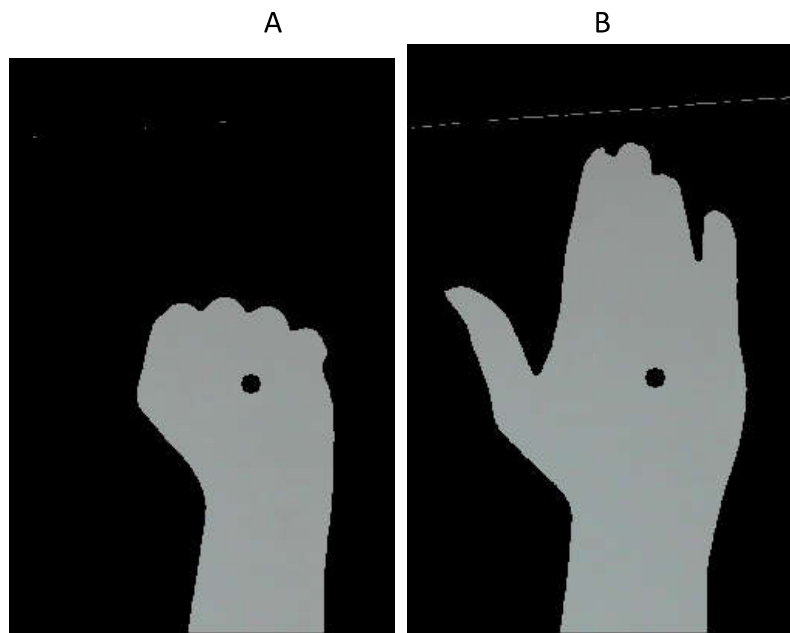
**Note:** Some above libraries may need other libraries for installation. The easiest way to install all of the libraries is to install pip and then type: `pip install <name_of_library>`

## 2. Files

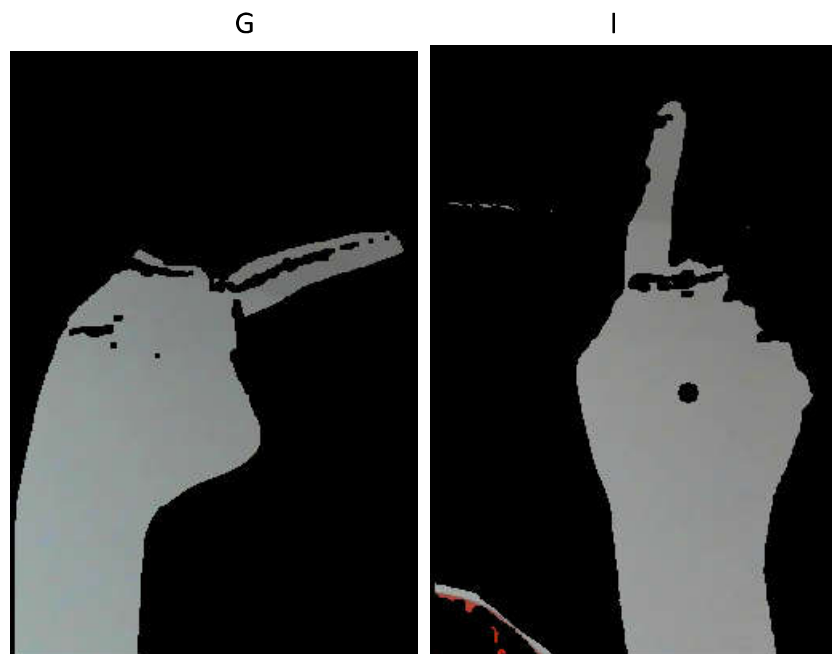
There is a source file (*project2.py*) containing the commented code and there is a database file containing the images of the database.

Database file contains masked images of 5 different American Sign Language letters (A, B, G, I, Y). Note that there is more than one image for each letter in order to train the program to work with different hand sizes.

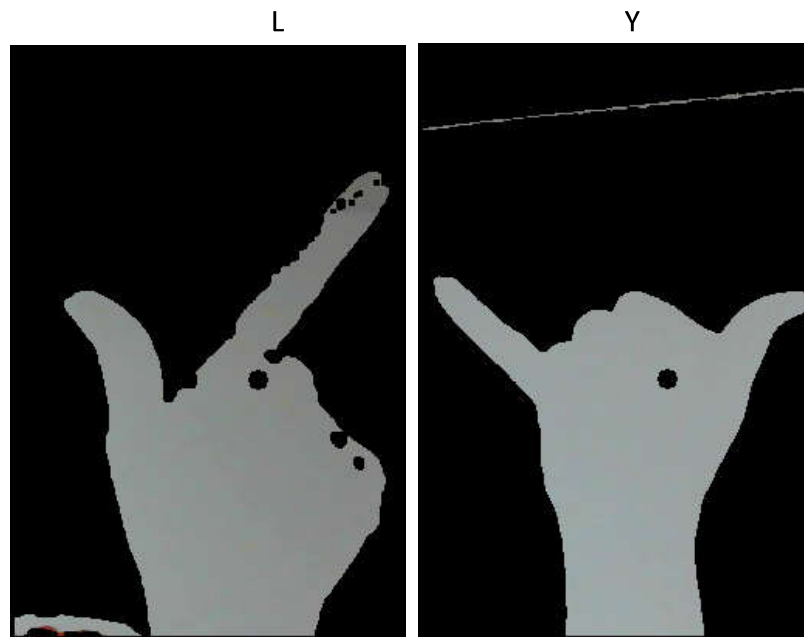
### 3. Letters



*Figure 1: Masked images of letter A (left) and B (right)*



*Figure 2: Masked images of letter G (left) and I (right)*



*Figure 3: Masked images of letter L (left) and Y (right)*

#### 4. How to Add Images to Database

In order to add more data to the database the developer can run the code the same way and save the “mask.png” image for each hand gesture, rename and add it to the database folder. This eliminates the need for resizing during the comparison and allows the developer to use the background subtraction function `cv2.BackgroundSubtractorMOG2` as it only works for video footages not for images. It is recommended to save several images of the same hand gesture but with different hand sizes and with varied distances from the camera.

## 5. How To Run

### Step 1:

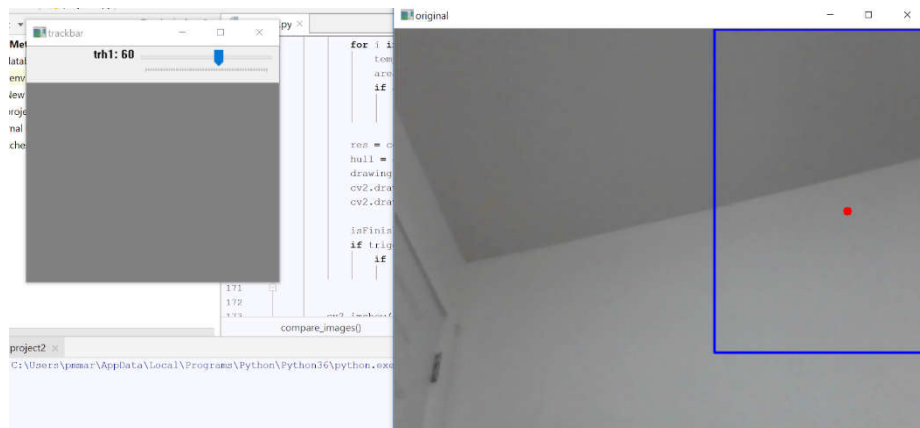
Open the *project2.py* Python file, either place the “database” folder in the same directory as *project2.py* or update the path for database (line 163) as where you saved the “database” folder.

### Step 2:

For running the program, you can either open the *project2.py* script using a Python environment like Pycharm and click on the run button, or add Python to your computer path and open the command line in the project directory and type: `python project2.py`.

### Step 3:

The window of the live video streaming will pop up after you run the program as shown below:



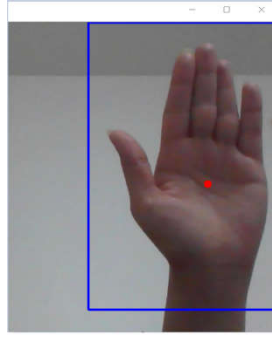
**Figure 4: Video streaming window**

Notes:

Don't change the threshold value as the same value was used for the database threshold. Try to get a white or free of object background only for the rectangle part.

### Step 4:

Place your hand within the rectangle in a way the red dot is almost the center of your hand as shown in the figure below:

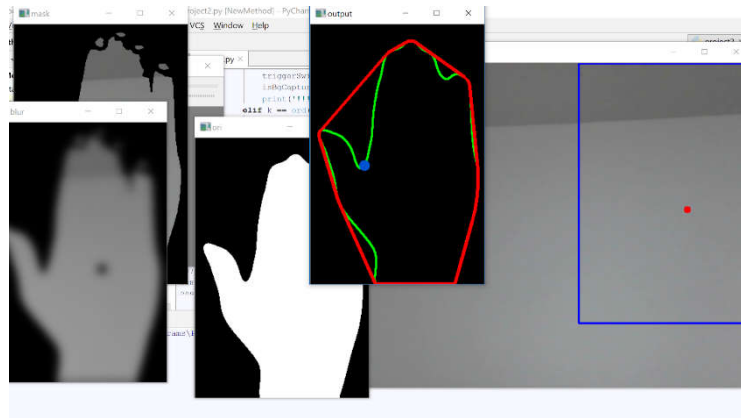


**Figure 5: Correct positioning of hand**

## Step 5:

When you are ready press the letter “B” , which captures the background and shows the masked, blurred, and contour and convex hull of the hand (shown in Figure 6).

Be careful to not shake or move the camera and after your hand is captured move your hand out of the camera’s view to get a clear hand shape.

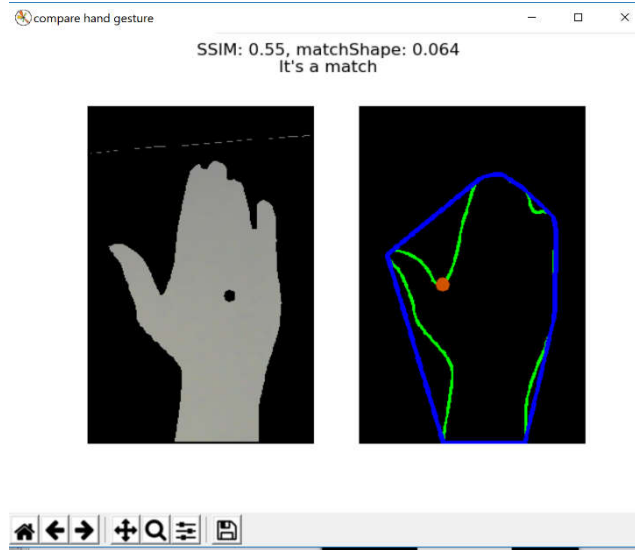


**Figure 6: Video streaming along with masked, blurred, binary threshold and contour of the hand gesture**

If the hand is not cleared, you can place your hand within the rectangle again and press “B” again to get a new frame.

## Step 6:

Then you need to press “ESC” and then the program will loop over the database to find a match. An example is shown in Figure 7.



**Figure 7: Compare hand gesture window**

If it doesn't show this window means, there is no match (also printed). Click on the exit/close button of the comparison window in Figure 7.

Note that sometime the program finds more than one match for the hand gesture which is fine as long as they show the same letter.

## Step 7:

You need to terminate the program and run it again if you want to try the hand gesture recognition again.

# 6. Changing Threshold Values

The threshold value for comparing the contours of the shape of the hand gestures using `cv2.matchshape` function and the threshold value for the Structural Similarity Index (SSIM) are set after several trial and errors. They can be changes in the function `compare_images`.