AMERICAN SIGN LANGUAGE RECOGNITION

510: Intro to visual computing

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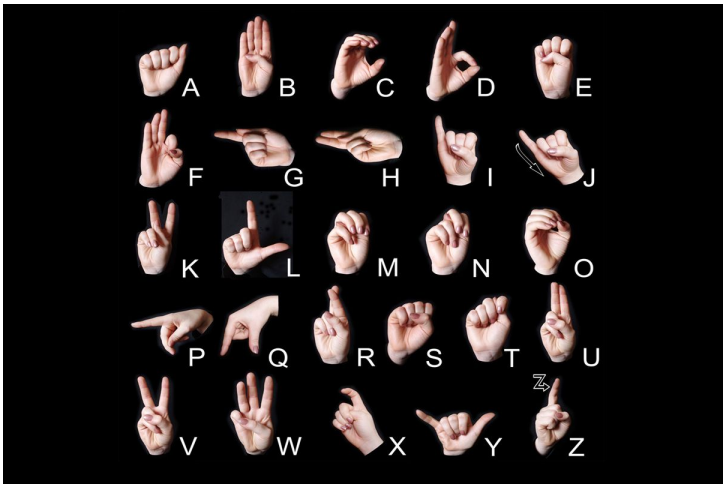
I. INTRODUCTION

Developed system of conversion of ASL to text using python and OpenCV. Various methods are employed for gesture recognition-Wired gloves. Project goal - extract human hand gesture for sign language in real-time using camera and implement solution into stand-alone application.



II. WORKING ENVIRONMENT

Tools: OpenCV 3.2.0, Python 3.2
Environment: Python IDLE
Experiment Platform: Linux based platform(Ubuntu 17.10 OS)

III. IMPLEMENTATION

Image is first being captured from Camera.
Then is being Converted Image to Grey-scale. This helps identifying the portion of the image that is import for processing -hand gesture. Next Gausian blur the image. This is for smoothing, to reduce noise and unwanted details of the image.

Thresholding is the next step which is used to segment the image and isolate foreground from the background.

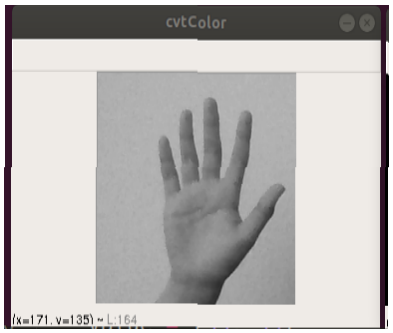


Image1: Grey-scale.

Image2: Threshold image

The next step is Convex hull-Framework enclosed around the object.
Contour Analysis being further step - outline to rec

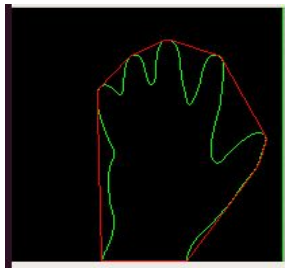


Image3: Contour Analysis

Hand and the fingers are identified using OpenCV built-in functions which finds and

identifies the Contours.The function returns an array of co-ordinates of contour that is formed

Convex points- tip of the fingers.

Data from contour identification is manipulated to obtain convexity defects

Convexity defects-point of deviation of the contour or any irregularities in the contour.

Based on the convexity defects we can identify how many fingers are present and further match the same with the corresponding letter

Calculating the convexity defects:

Compute a triangle with let's say sides 'a', 'b' ,'c'. The way the triangle is formed is: starting, ending and the farthest point of the contour- a, b, and c. Cosine rule-angle of defects between the fingers.

$$a^2 = b^2 + c^2 - 2bc\cos A \qquad \cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

$$b^2 = a^2 + c^2 - 2ac\cos B \qquad \cos B = \frac{a^2 + c^2 - b^2}{2ac}$$

$$c^2 = a^2 + b^2 - 2ab\cos C \qquad \cos C = \frac{a^2 + b^2 - c}{2ab}$$

IDENTIFYING THE LETTERS:

Letter A: difference between area of circle and that of contour is used to calculate the.
Since there is little difference between the two areas, A stands out when the circle is obtained by bounding the contour

Letter B: Contour area is calculated since it has the largest area among the other letters.
Letters V,C,L,Y: If the number of convexity defects are equal to 1, the angle is calculated. The orientation of the overall figure is obtained based on the values of the angles.

Letters F and W: These are the only two alphabets in ASL which have only 2 convexity defects. And it's identified by comparing the angles.

Letters D,J, H,I,U: Combination of parameters are used to identify these letters: Aspect Ratio and angles.

ANALYZING THE CONTOUR PROPERTIES:

Different Contour properties are computed to identify the letter:

Aspect Ratio-ratio of width to height;
Perimeter and Area of Contour;
Equivalent Diameter of Contour Area;
Number of Convexity Defects;
Angles;

CONCLUSION:

The main goal of the project was to design an algorithm for identifying and extracting the features of the hand gesture in real-time. And further identifying equivalent alphabet from the image.

The advantage of this solution is that, it's implemented in real-time and does not require any special inputs or devices.