TOBB UNIVERSİTY OF ECONOMICS AND TECHNOLOGY

ELE 495 SENIOR DESIGN PROJECT

REPORT-1-

Eye Blinking Communcation	
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Prenstation Link:	https://www.youtube.com/watch?v=_GLyxjixq20

CONTENTS

1.) Abstract

Amyotrophic Lateral Sclerosis (ALS), known as motor neuron disease, is a disease that does not impair the mental functions of the patient, but grdually loses muscle control. However, the eyelids of the patient do not lose their function for a long time. For this reason, blink communcation is a recommended solution for ALS patients. Our aim in this project is making one system, which can detect ten words from the number of blinking eye. Our system uses the facial landmarks and their distance between each other and detects eyeblinking after that it dedice the meaning of eye command from the number of blinks.

2.) Literature Analysis

The area of computer vision is first started in 1960s aiming to make small amount of image analysis. Before this application many applications are applied manualy such as there were not any system, which can analysis x-rayses. In the beginning of this process, the computer vision algorithms are not satisfactory. As computing power increased, algorithm started to solve individual tast. Until the development in deep learning, the improvement rate is not enourmous but after application with deep learning , the improvement rate in computer vision is improvent signifficantly.

As you know, there are a lot of tool with computer vision system for example, self driving car, radar systems and Infraded detection. The main aim of all these systems is improving human life quality.[1]

One of the important application in computer vision is eyeblinking detector**.** Eyeblinking detection is very important topics in the area of computer vision systems. It is based on main image processing operation. Eye Blinking detection has a great number of appications in an area human-computer interaction such as eye typing applications, mouse control application, google glass.

3.) Method

a.) Hardware Design :

In my project, it is planned to using Rasbery Pi 3 b plus, Raspberry Camera V2.1, Raspberry Pi LCD Screen , SunDisk (32 GB) and Mikro USB charger.

Power requirement of the Raspberry pi b is 5V/2,5 A power and it has 1.4 GHZ 64-bit quad-core processor, dual-band wireless LAN, Bluetoothth 4.2/BLE, fast Ethernet and power over Ethernet support withe separete PoE HaT, extended 40-pin GPIO header, Full-size HDMI, 4 USB 2.0 ports, CSI camera port for connecting a Raspberry Pi camera, DSI display port for connecting a Raspberry Pi touchschreen display, 4- pole streo output and composite system and stroing data.[2]

b.) Software Design:

In our system, Raspbian operating system is installed on Raspberry Pi micro controller and our system is planned to find facial landmarks and finding eye blinking movement from facial landmarks. When we are finding facial landmarks, we used Dlib library to detect facial landmarks. In the tast of facial landmarks, our goal is detect facial structures on the face using shape prediction methods. Dlib library applied pre-trained HOG + Linear SVM object detector for the task of face detection. The pre-trained facial landmark detector inside the dlib library is used to estimate the location of 68 (x,y)-cordinates that map to facial structures on the face. You can see dlib face detection landmark in figure 4.b.1.[3]

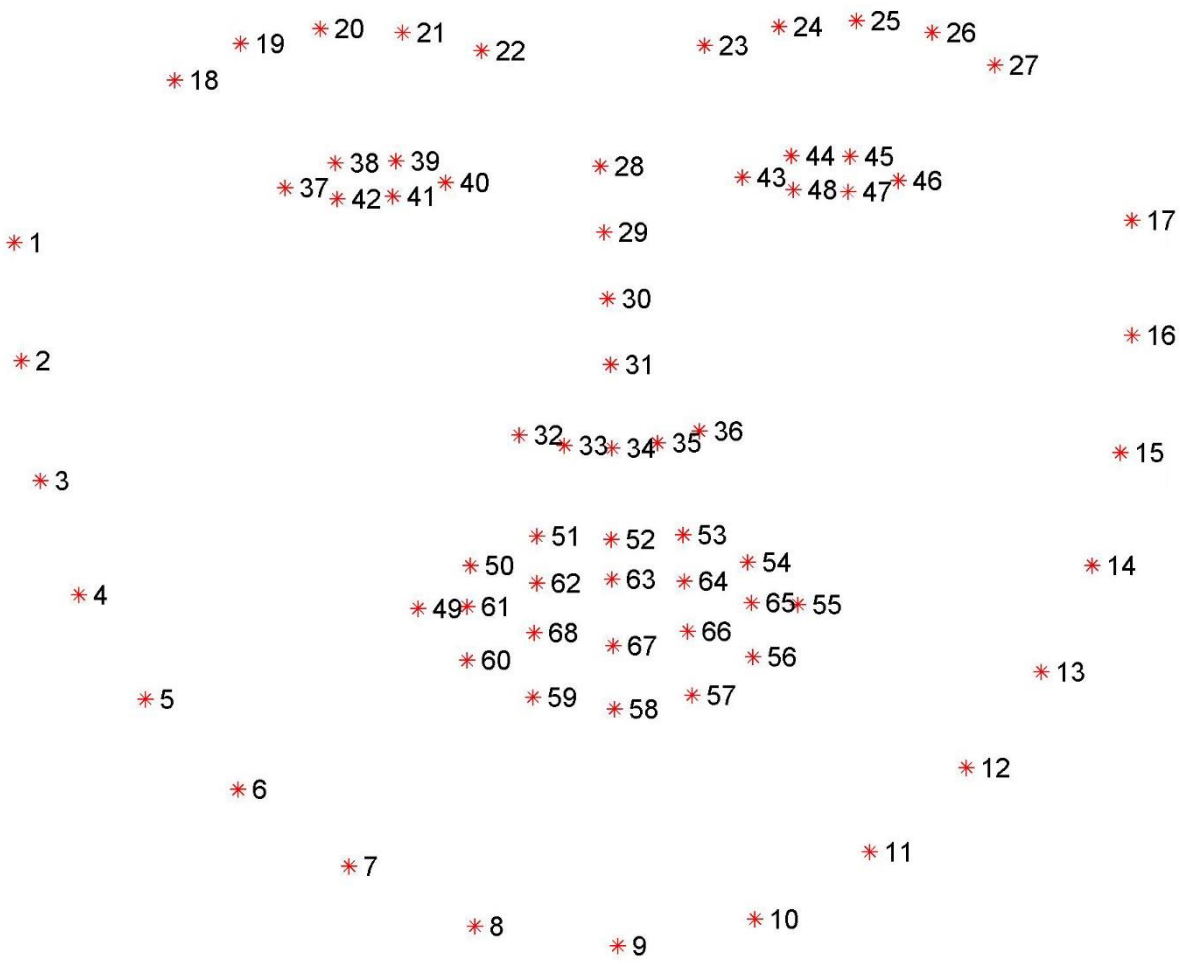
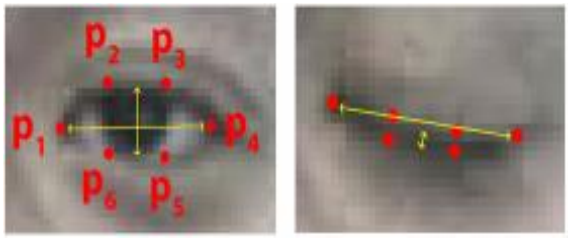


Figure 4.b.1: (Facial Landmarks)

For detecting blink, it is applied one mathematical method basing on distance. In figure 4.b.2 you can see open and closed eyes with land marks.[4]



Figüre 4.b.2 (Open and closed eye with Facial Landmarks)

Our mathematical method for detecting blink eye based on the calculation of below. First we calculate eye aspect ratio as in equation 4.b.1 for left and right eye.

$$EyeAspectRatio = (P2 - P6) \qquad (4.b.1)$$

After finding eye aspect ratio for left and right eye. The average of them is calculated as in equation 4.b.2

$$AverageEyeAspectRatio = \frac{EyeAspectRatioleft}{2} + \frac{EyeAspectRatioRight}{2} \qquad (4.b.2)$$

After finding AverageEyeAspectRatio, we threshold our system for one value and we detect whether our eye is open or close. After finding our threshold value, it is understood wheter the eye is open or not. You can see our Threshold in equation 4.b.3 and equation 4.b.4

$$AverageEyeAspect\ Ratio > Treshold\ value \qquad Eye\ Open \qquad (4.b.3)$$

$$AverageEyeAspect\ Ratio < Treshold\ value \qquad Eye\ Close \qquad (4.b.3)$$

The number of blinking is counted in ten second and then the system is supposed to output desired word in LCD monitor connected to Raspberry Pi.

4.) Time Plan:

May 1st to 5th	Hardware Design
May 5st to 10th	Software Design
May 10st to 15th	Writing Project programs in Linux
May 15st to 17th	Loading code in Microcontroller
May 17st to 20th	Completing the introductory report and presentation
May 20st to 30th	Test process
June 1st to 3th	Second Project Report and Presentation
June 4st to 6th	Test process
June 7st to 8th	Final Project Report and Presentation
June 9th	Project Demo

5.) Refrrance :

1.) https://hackernoon.com/a-brief-history-of-computer-vision-and-convolutional-neural-networks-8fe8aacc79f3

2.) https://www.raspberrypi.org/products/raspberry-pi-3-model-b-plus/

3.) https://www.pyimagesearch.com/2017/04/03/facial-landmarks-dlib-opencv-python/

4.) http://vision.fe.uni-lj.si/cvww2016/proceedings/papers/05.pdf