IMPLEMENTATION OF EYE-CONTROLLED ELECTRIC WHEELCHAIR

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ABSTRACT: *The interaction of humans and computers within a few years has developed quite rapidly. Nowadays, many devices have been controlled automatically. However, not everyone can interact with an automated device easily like people with impairment. Automated devices such as the electric wheelchair are one of the most essential requirements for people with impairments in social life, so they can do mobility easily. In its development, people with foot impairment can use a joystick or a remote to interact with a device. But these media are useless for people with hand-foot impairment. To overcome the problems, there should be other ways that can overcome these limitations. Eyes could be a choice that is used for communication between users and an automated device. The proposed system involves the face and eye detection, image processing, and sending control signals to the wheelchair. The eye movement is detected by using a head-mounted camera. The images of the eye will be sent to the laptop where the images will be processed. The corresponding output signals are then sent to the motor driving circuit which controls the motors through a rf transmitter.*

***Keywords**:* Eye Detection, Image processing, RF module.

1. INTRODUCTION

Locomotive disability is a common ailment that affects people all around the globe. It may be of several reasons such as paralysis or due to loss of organs in an accident. Around 90% of people suffering from locomotive disability are living in underdeveloped countries, the disability for poor is a curse. They require assistance to move and perform all other everyday tasks. They use wheelchairs to move around, and they take aid of others to move the wheelchair which makes them dependent on others for their work and lack of privacy as well. There is a need to develop smart solutions for these people using technology so that their problems can be put to an end. This project introduces a system that tries to remove the difficulties faced by locomotive disabled people in navigation and make them self- dependent to do their daily chores. The project implements a electrical wheelchair which is controlled with eye movements. The wheelchair is both fully automated and manipulated manually. It is simple to maintain, inexpensive, and quite comfortable to use. The power consumption is low, and it is simple to operate. Above all, as compared to the cost of a caretaker, the wheelchair is a bargain. The wheelchair is also less expensive to maintain because only the batteries are needed to be charged occasionally.

2. METHODOLOGY

This project is based on eye movements of the user which are collected using a webcam and controlling a two-wheeled wheelchair prototype. The eye movements of the user are detected using webcam and python code, which uses two software modules that are OpenCV and Dlib modules. Eye movements are captured from the webcam of the system from the OpenCV module. OpenCV records the live video of the user and divides the videos into multiple frames; in our case it will divide them into 20 frames per second. The obtained image is sent to Dlib module to track the eye movements. The Dlib library module provides two functions that can be used for face detection. The first one is Dlib HOG combined with linear SVM algorithm another one is Dlib MMOD CNN. In our project we use Dlib HOG + Linear SVM face detector function. Dlib module will track the eye movements and classify them into different direction like left, right, centre. Eye movements are sent to our wheelchair prototype through Zigbee pair module. The prototype is controlled using Arduino Uno and it has an ultrasonic sensor to detect obstacles in its path.

3. RESULTS AND DISCUSSIONS

The proposed model is capable of accurately detecting the eye movements of the user in the good lighting conditions and send the commands to the hardware Arduino Uno using through RF module and based on the received signal the wheelchair proto type will move.

3.1. EYE MOVEMENTS DETECTION:

Fig-3.1.1: Face Detection

Fig-3.1.1 shows the detected face in the green box by using the dlib module function face_detector. The detected movement (Left, right, Forward) of the each eye is shown on the top edges of the GUI displayed when the program is executed.

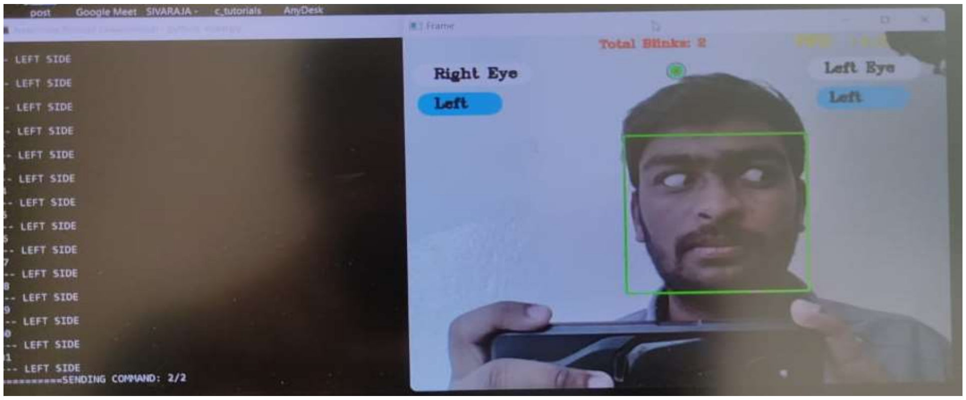

Fig 3.1.2: Left Eye Movement

Fig 3.1.2 shows the detection of left movement as the user see in the left direction as the both the eyes movements displaying widget is highlighted using blue colour.

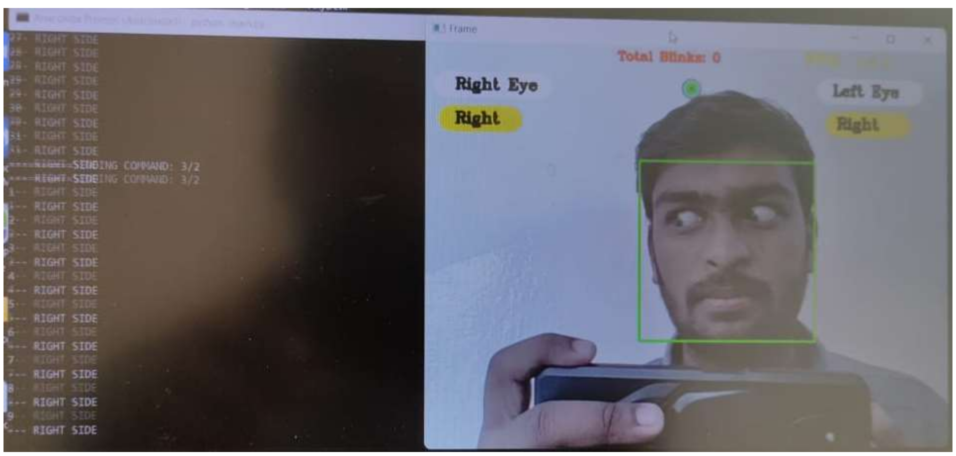

Fig-3.1.3: Right Eye Movement

Fig-3.1.3 shows the detection of right movement as the user see in the right direction as the both the eyes movements displaying widget is highlighted using yellow colour.

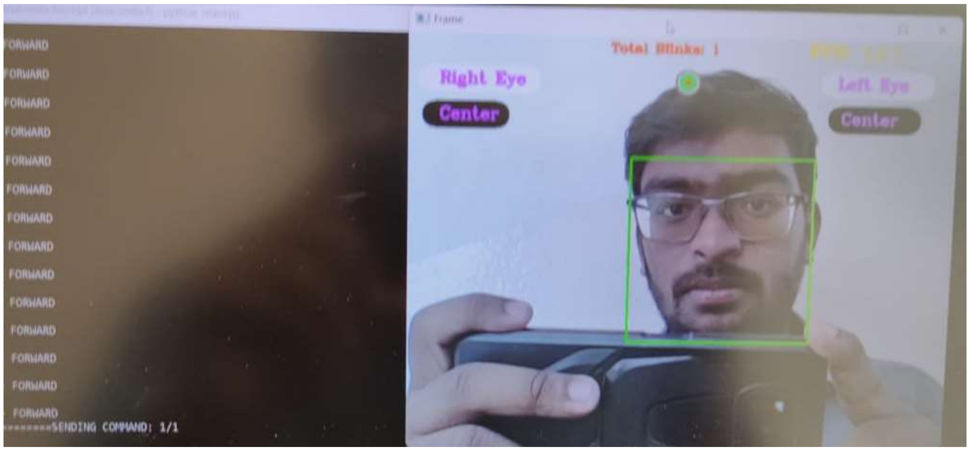

Fig-3.1.4 Center

Fig-3.1.4 shows the detection of forward movement as the user see in the center as the both the eyes movements displaying widget is highlighted using black colour.

3.2. COMMAND SELECTION:

The Proposed model select the command i.e1,2,3 based on the eye movements using the if else condition in the python code and send it to the hardware setup.

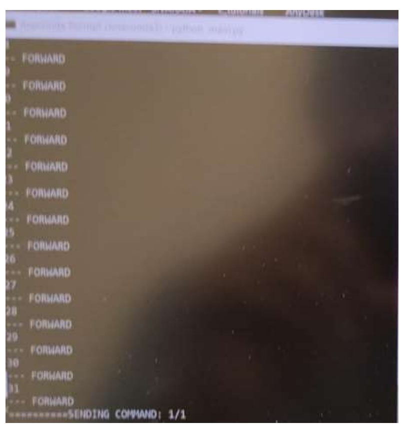

Fig-3.2.1 Forward Command

Fig-3.2.1 shows the forward in the command prompt output when the model detects the command as 1.

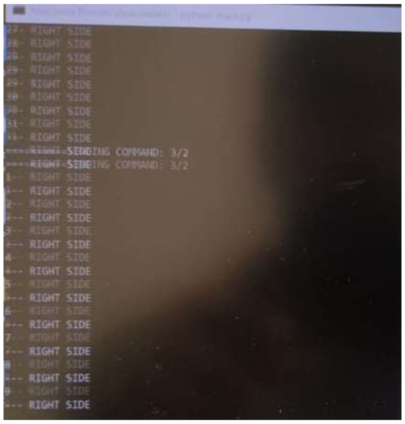

Fig-3.2.2 Right Command

Fig-3.2.2 shows the right in the command prompt output when the model detects the command as 2.

Fig-3.2.3: Left Command

Fig-3.2.3 shows the left in the command prompt output when the model detects the command as 3.

3.3 OBSERVATIONS

The following are the results of observations performed by placing the obstacle at different distances and at different angles from the prototype

Distance and angle of obstacle from the prototype	Ultrasonic sensor output	DC motors output
50cm, 30 degrees	HIGH	STOPS
20cm, 45 degrees	HIGH	STOPS
50cm, 30 degrees	LOW	ROTATES
800cm, 30degrees	LOW	ROTATES

Table 1: Observation 1

The table below shows the observations of the movement of wheels according to the eye movements

Eye movement	Left Wheel	Right Wheel
Looking Center	Rotates in Clockwise direction	Rotates in Clockwise direction
Looking Left	Rotates in Anti-Clockwise direction	Rotates in Clockwise direction
Looking Right	Rotates in Clockwise direction	Rotates in Anti-Clockwise direction

Table 2: Observation 2

4. CONCLUSION:

The system consists of eye tracking webcam, microcontroller, motor, chair image processing unit and associated circuits. The system works by tracking the motion of eyeball using a webcam. The image is processed with the help of Python software and corresponding movement is obtained. This set up is meant for paralyzed people and person having loco-motor disabilities. The hardware along with the software is great tool which makes the life of paralytic people independent. A wheelchair prototype incorporating the above mentioned specifications was designed and found to be working successfully. Though our prototype performs satisfactorily, but a lot of work needs to be done before making the product commercially viable. The criticality of the application is so high, lot of safety precautions need to be incorporated. It needs to be made sure that the system is not fatal to the health of the person. A lot of testing needs to be done before making such a product a reality.

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