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Motion Based Cursor For Phocomelia Users

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Abstract: Technology plays an important role in today’s world for the interaction between humans (the users) and computers. Input devices such as mouse, keyboard, track pad etc. are the normally used devices to interact with digital machines, these devices can’t be operated by these disabled people. This project will assist paralyzed people to use technology for whom eye movements and blinks are the only way to communicate with the outside world. To overcome this problem we are using a prebuilt Dlib model with the help of libraries like OpenCV, NumPy, PyAutoGUI, Imutils. It will help physically challenged people to communicate and operate the computer through the movement of the eye and face.

***Keywords* - Physically Challenged, Phocomelia, cursor control.**

I. INTRODUCTION

Phocomelia is a rare deformity in which feet and hands are almost underdeveloped or absent. It was introduced as a sedative drug in late 1950’s. The researchers also proved that it could be used as an effective tranquilizer and painkiller. Some Scientists even referred to it as ‘Wonder Drug’ for insomnia, headache, etc. This syndrome became popular when in late 1950’s more than 15,000 children’s in almost 50 countries were diagnosed with this syndrome. Since then these people have been struggling for everything right from taking care to coping up with the exponentially growing technologies. But some became icons just like “Nick Vujicic”. In our project we have made a motion based cursor for these patients. For the implementation of the proposed methodology we have used machine learning and image processing. We have used these python libraries like NumPy, OpenCV, PyautoGUI, etc. Below you will learn about facial point annotations in detail. In short we used 68 facial points for recognition of the expressions. For comparing dimensions of eyes and mouth we used EAR(Eye-Aspect-Ratio) and MAR(Mouth- Aspect-Ratio). Basically they are used for detection of various facial expressions. Dlib model helps to approximately predict 68 facial annotations with good accuracy.

II. RELATED WORK

Eyeball Movement-Based Cursor Using Deep Learning: Shubham Rane, Nihal Salian
[1] This paper presents a novel HMI system which controls a pointer cursor on the computer screen based on eye movement.

Eye blink detection using facial landmarks: Soukupova, Tereza and Jan Cech
[2] We referred this paper to understand the concept of eye detection using landmarks.

A Face as a Mouse for Disabled Person: Snehal Dongre
[3] They proposed an algorithm that tracks the motion accurately to control the cursor which provides an alternative for mouse and keyboard. The Haar feature technique is used for eye feature extraction. SVM classification method is used for classifying the eye movements.

Eye Gaze Tracking with a Web Camera in a Desktop Environment: Yiu-ming Cheung
[4] They have came up with solution of the eye gaze tracking problem using a low cost and more convenient web camera in a desktop environment, as opposed to gaze tracking techniques requiring specific hardware, e.g., infrared high-resolution camera and infrared light sources. Here they have proposed a three-phase feature-based eye gaze tracking approach by using head pose and eye features information to enhance the accuracy of the gaze point estimation.

Drowsy Driver Detection System Using Eye Blink Patterns: Taner Danisman
[5] Discussed a system that automatically monitors driver’s drowsiness and prevents accidents which happen because of carelessness by using real-time monitoring of eye blinking. This method uses a professional webcam at 110fps with 320x240 resolution for evaluating the horizontal symmetry functionalities which help us to detect visual change in eye blinking.

III. MOTIVATION

The interaction between computers and humans in this evolving world of technologies have became a important part of life. Input devices such as mouse, keyboard, trackpad, etc. are the normally used devices to communicate with digital instruments, this devices cannot be used by these physically challenged people. For these users for whom eye movements and blinks are the only way to interact with the world, this project is helpful for them to use this technology.

IV. LIBRARIES USED

Below are the libraries used to develop the system.

[A] NumPy: NumPy is the library for python programming language, which supports large size of mathematical equations, multidimensional array, etc.

[B] OpenCV: OpenCV is the Open Source Computer Vision Library, contains more than 2500 algorithms, extensive documentation and sample code for real-time computer vision. It works on numerous operating system such as Linux, Windows, Mac OS X, Android, iOS.

[C] PyAutoGUI: PyAutoGUI is the key asset of our system. It allows us to control the mouse and keyboard to automate interactions with other applications. It is compatible with Windows, macOS, and Linux.

[D] Dlib: Dlib is a library based on the programming language C++. This library has various machine learning algorithms and tools used for developing complex software in C++ to solve real world problems.

[E] Imutils: A series of functions to make basic image processing functions such as translation, skeletonization, rotation, resizing, sorting contours, detecting edges, and much more.

V. METHODOLOGY

We have given the details of proposed methodology and descriptions of the applications used for face detection, facial expression details in the following sections.

[A] Detection of Face: So here for the prediction of facial expression we have used the Dlib's model to accurately predict 68 2D facial landmarks. As a result we get predicted landmarks of the face, and using these results we can make useful features that will help us in future to detect various actions.

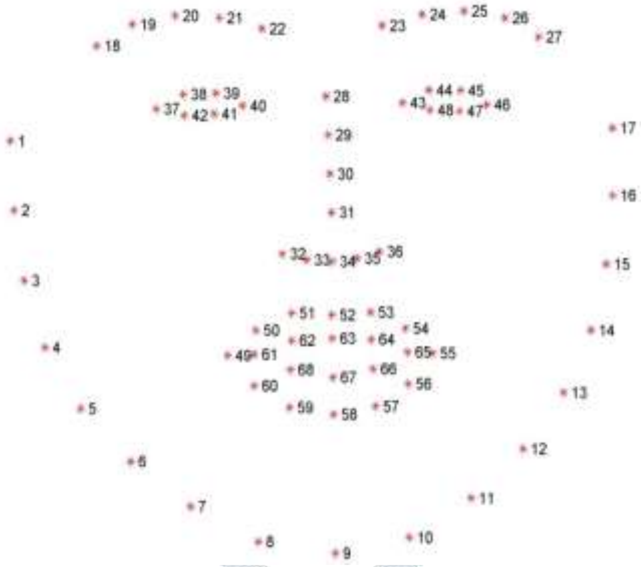


Fig.1: Facial Point Annotations Model

Here we are using eye aspect ratio to detect different eye movements like detect a blink or a wink and using the mouth-aspect-ratio to detect a yawn etc. These actions are programmed as triggers to control the mouse cursor. We have used PyAutoGUI library to control the mouse cursor.

[B] Processing Details: Here we are using a set of five facial expressions and those are:

1.Left eye wink to left click.

2.Right eye wink to right click.

3.Mouth open is used for activating and deactivating cursor movement.

4.Eye squinting to start the scrolling.

5.Head movement up, down, horizontal to move the cursor up, down, left and right respectively.

[C]Implementation:

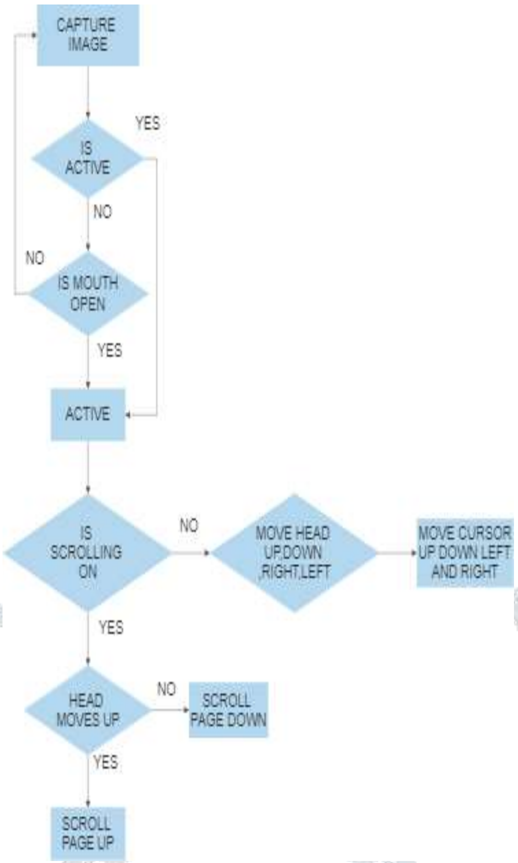


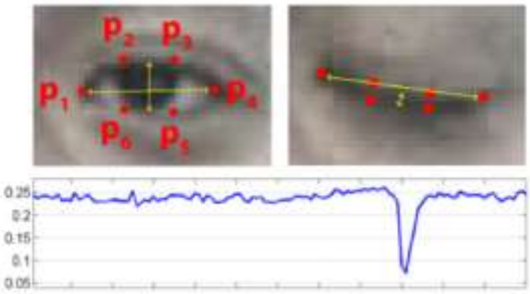
Fig.2: Flowchart

[D] Detection of Eye:

For detection of small parts of an image with the template we have used a Template matching concept. For that we have used a cv2.MatchingTemplate() function in OpenCV. Here we load an input image and a patch image then compare the patch of input image with the given patch and in this way we detect eye movement.

VI. EYE ASPECT RATIO (EAR)

[A] The Eye Aspect Ratio is a value when eye is opened or closed.
[B] When the eye is open it will show constant value.
[C] When the eye is closed it will give 0 value.
[D] 6 points of the eye will determine EAR value.
[E] We define a threshold value of EIR to detect whether the eye is open or not.
[F] If EIR is greater than EIR then we consider it as the eye is open and if less than that we consider it as the eye is closed.

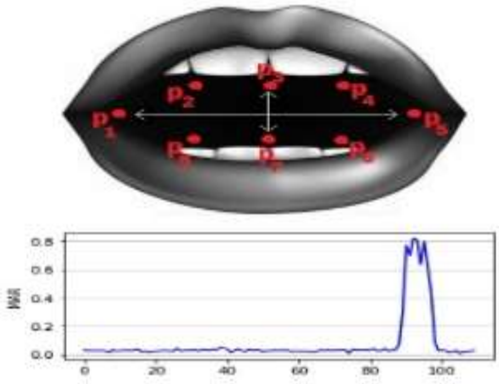


$$\text{EAR} = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|},$$

Fig.3: Eye Aspect Ratio

VII. MOUTH ASPECT RATIO

[A] MAR provides the statues of open or close mouth.
[B] 8 points will determine the MAR value.
[C] The value will increase as mouth opens.
[D] And value will decrease as mouth closes.

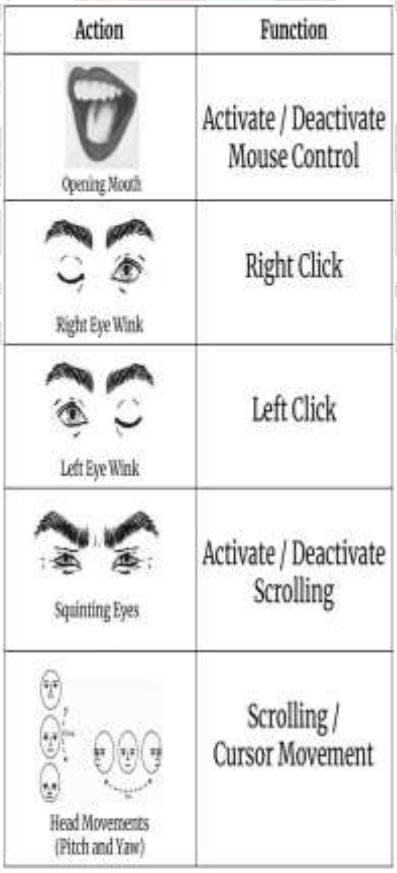


$$\mathrm{MAR} = \frac{\|p_2 - p_8\| + \|p_3 - p_7\| + \|p_4 - p_6\|}{2\,\|p_1 - p_5\|}$$

Fig.4: Mouth Aspect Ratio

VIII. RESULTS

We aim to control the cursor with the help of movements, which will be based on the face and eyes. The results of our system will be as follow.



Action	Function
Opening Mouth	Activate / Deactivate Mouse Control
Right Eye Wink	Right Click
Left Eye Wink	Left Click
Squinting Eyes	Activate / Deactivate Scrolling
Head Movements (Pitch and Yaw)	Scrolling / Cursor Movement

Fig.5: Actions and their functions

[A] While Reading Input

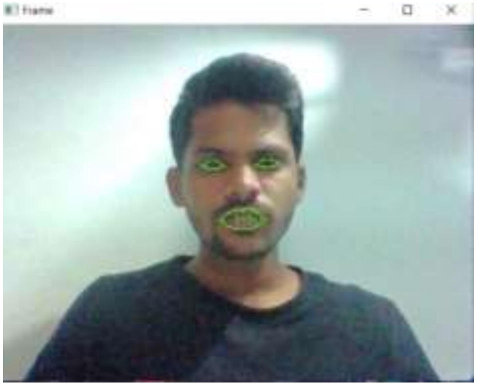
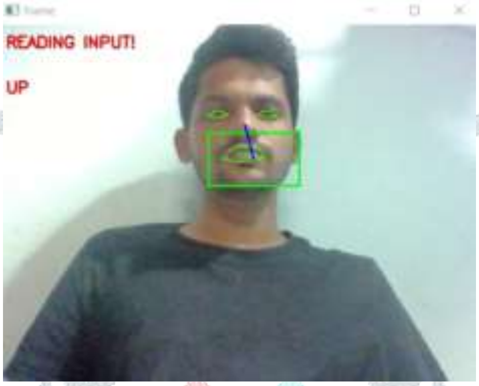


Fig.6: Reading Input

[B] Upside Movement of Cursor

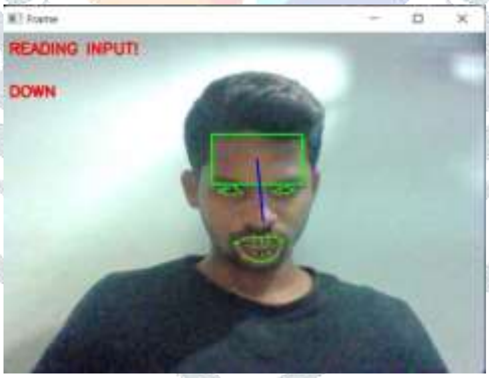


READING INPUT!

UP

Fig.7: Upside Movement

[C] Downside Movement of Cursor

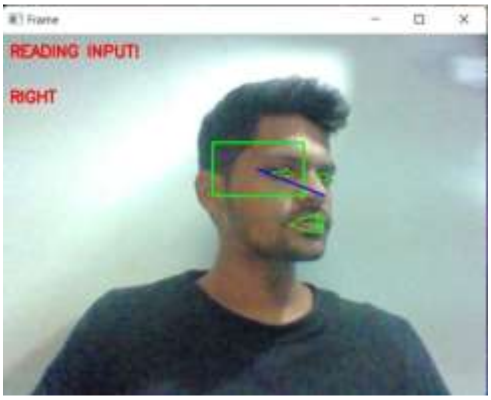


READING INPUT!

DOWN

Fig.8: Downside Movement

[D] Rightside Movement of Cursor

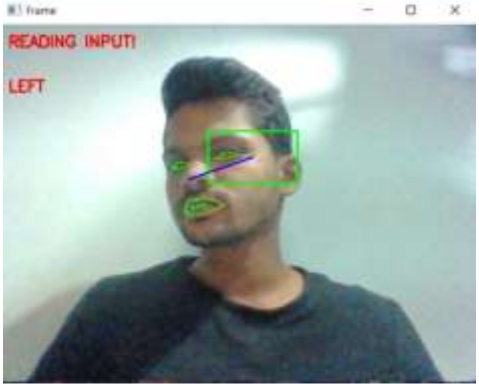


READING INPUT!

RIGHT

Fig.9: Rightside Movement

[E] Leftside Movement of Cursor

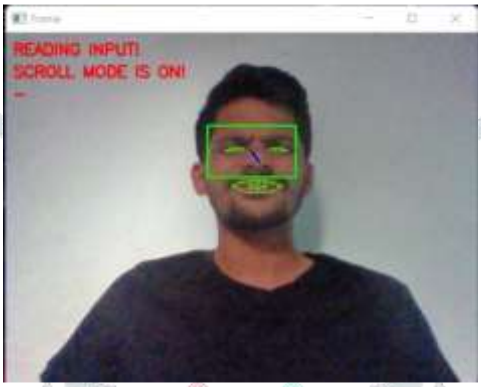


READING INPUT!

LEFT

Fig.10: Leftside Movement

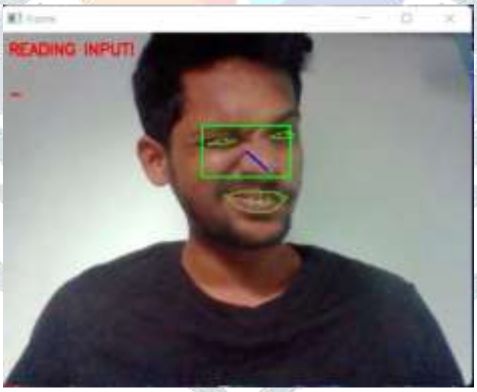
[F] Activating Scroll Mode



READING INPUT!
SCROLL MODE IS ON!

Fig.11: Scroll Mode

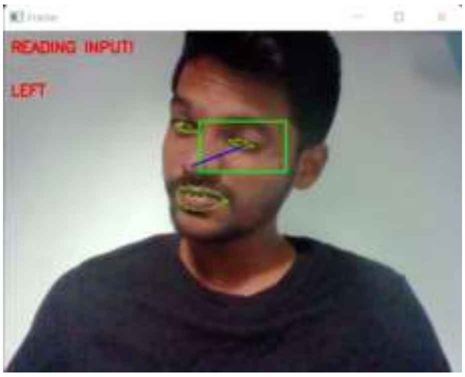
[G] Right Click



READING INPUT!

Fig.12: Right Click

[H] Left Click



READING INPUT!

LEFT

Fig.13: Left Click

IX. APPLICATIONS

[A] This project focuses on Motion based Cursor which will help Phocomelia users to use computers more efficiently.

[B] This system is also useful for the physically challenged people.

[C] This system provides the solution for physically challenged people who were unable to operate and perform computer activities.

X. CONCLUSION

The interaction between humans (the users) and computers plays an important role in today's world. Input devices such as keyboard, mouse etc. are the normally used devices to interact with digital instruments, these devices cannot be operated by these physically challenged people. This system is specially designed for Phocomelia (Thalidomide) Users. Which allows such users to interact with the computer, and perform with the help of a cursor which will be totally controlled by the user. With the help of face recognition and eye ball movement the system is developed in such a way that physically challenged users can access the computer just by the facial part of their body.

XI. FUTURE PROSPECTS

[A] Improving Accuracy

[B] More functions based on Movements

[C] Implement a Windows / Mac based Application

[D] Improvement in more user friendly

XII. ACKNOWLEDGEMENT

We would like to express our special thanks to our guide Prof. S. B. Kone (Sinhgad Academy Of Engineering, Pune) who helped us in every possible way and resolved the problems we faced.

XIII. REFERENCES

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