A Survey on Virtual Mouse For People With Motor Disabilities

Senthil Kumar V[1], Yuva Prasanth M[2], Ashwin Kumar E[3], Karthikeyan A[4]
[1]Assistant Professor, Dept of Computer Science and Engineering
[2, 3, 4]Dept of Computer Science and Engineering
[1, 2, 3, 4] Kumaraguru College of Technology [anonymous], Coimbatore, Tamilnadu, India

Abstract- *Now a days technology becomes a lot more accessible with the help of wireless technology. Even though there are many technologies still there are some lags for the people who are differently abled or people with motor disabilities. The project is named "Virtual mouse for people with Motor disabilities". This proposed system is about gives a virtual mouse rather than an equipment mouse for individuals who couldn't have the option to control the mouse exercises Since mouse is one of the main parts in a PC and it would be hard for individuals with motor inabilities The fundamental goal of this paper is to beaten this issue by proposes a framework for without hands mouse control utilizing facial signal acknowledgment methods that can help individuals with motor disabled people. The main objective of this paper is to enhance the interaction between computers and human beings (HCI). The proposed system detect the face and it was highly trained by the iBUG-300W dataset which made the system a suitable solution for all conditions. As MachineLearningalgorithmsarebecomingpopulartosolvechallengingand interesting real-world problems around us. The evaluation of experimental analysis shows that the proposed system has extensive performance and never compromises in terms of stability and sensitivity.*

Keywords- Computer vision, Human-Computer interaction, Virtual mouse

I. INTRODUCTION

In the recent decade, the technology played and still playing a vital role in everyone's life. Everyone in this world would tend to access the technology. In that case, in PC's mouse is one of the most important devices to perform main functions. Motor disorders are characterized as a partial or complete loss of control of the leg, hand, or other part of the body. People with physical/motor disabilities can have difficulty interacting with computers the same way as the public does.

For example, people with motor disabilities typically struggle with navigation while using computers or other devices. Since people with physical disabilities do not have the precision that general users of technology do when using a mouse, devices should be designed to be as accurate as possible for users. For people with motor disabilities, buttons with small hit radius that can be difficult to reach, buttons should have larger hit radius, interactions/actions should not be packed close to each other on any device, as disabled users can take the wrong action. Even though these modifications would be much better, a better alternative can be sought for people with motor impairment.

CONCEPTUAL STUDY OF THEPROJECT

Virtual mouse paves way for the motor disabled persons to access the mouse actions much easier. It is to be designed for the people with several syndromes like Carpel Tunnel Syndrome (CTS) and people with pain in the wrist region. The Virtual mouse is based on the detection and interpretation of small head movements and facial gestures of a user. These movements are captured with a standard webcam camera embedded or attached to the computer screen and faced to the user head. As a result of analyzing the data set, it automatically detects the facial landmark of the user even in the low light conditions. It is the main reason why it yields high accuracy even in low light conditions with correct sensitivity. Though the alternatives like air mouse and ergonomic mouse have emerged in, the need for hands limits the use for differently abled people. Finally, the proposed system addresses the drawback with the help of virtual mouse using facial and eye movements that will work with quite a good accuracy and speed.

OBJECTIVES OF THEPROJECT

In this technological world, it is essential for us to find new ways of human computer interaction (HCI).

Today, most devices use touch screens, but it is not so applicable for all situations or applications. Because people with motor disabilities couldn't be able to access the devices. The use of mouse puts the user's hand for too long in a pronation posture that increases inflammation in the wrist and hand and, the need for hand limits the use of computers for

differently abled people. It will lead to a serious condition if it was practiced continuously. So, the objective of this project is to develop a hand free human computer interaction system using computer vision that uses some face gestures captured through webcam and process it with trained data to navigate the cursor across the screen and perform mouse operations.

SCOPE OF THEPROJECT

As future scope of the project,

- People with motor disabilities can use mouse virtually without any complications.
- It helps in preventing a jor problems like Carpel Tunnel Syndrome(CTS).
- It can also work even in low light conditions. So, people can use it even indarkness.
- It yields high accuracy and good sensitivity.

II. PROBLEM DEFINITION

"For most people technology makes things easier. For people with disabilities, however, technology makes things possible. In some cases, especially in the workplace, technology becomes the great equalizer and provides the person with a disability a level playing field on which to compete", said Mary Pat Radabaugh, Former Director of IBM National Support Center for Persons with Disabilities. Even though people with disabilities may benefit greatly from computers, they typically find them inaccessible. Many existing computers are not intended for individuals with physical disabilities and enable them to take measures beyond their capacity. Human-computer interaction (HCI) is a multidisciplinary area that focuses on the design and user interface of computers. Recent human computer interaction technologies designed for disabled people to use a mouse has been shown to have serious trade-off problem between speed and accuracy in the performance based on the environmental conditions. So, the problem here is to develop a human computer interaction (HCI) system to establish a novel way for communication between humans and computers that can work smoothly in all environmental conditions with quite a good high accuracy and low latency.

III. PROPOSEDSYSTEM

The proposed system was trained by the iBUG-300W dataset which is suitable for the facial landmark detection. This system detects the face of a person using a face detection algorithm (HOG) and tracks the eye movement using pre-processing dataset. Which will work even in low light conditions. Then, the control of the mouse pointer position is presented with respect to the movement of human head and face gestures that are mapped with some mouse functionalities. We can toggle between two modes of systems. Either cursor mode enabled or disabled. If it is enabled the cursor will move wherever we tilt our head. If it is disabled it would be locked and ready to do the mouse operations like left-click and right-click. This method doesn't require any special hardware and only requires a webcam, and it is a hand free system that can be used by differently abled people.

3.1 METHEDOLOGY

The main contribution of the proposed system is three components:

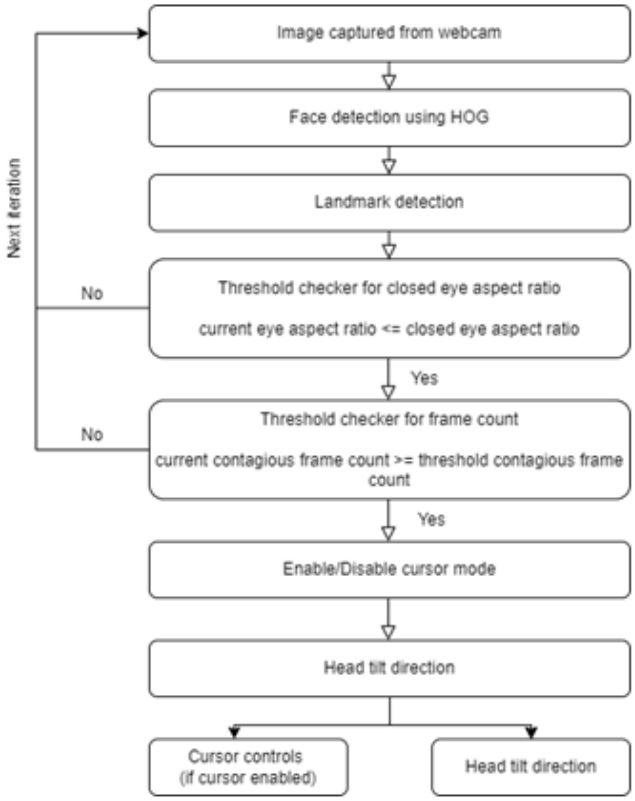
i) Face Detection
ii) Eye detection and cursor operation
iii) Threshold checker and Mouse operation

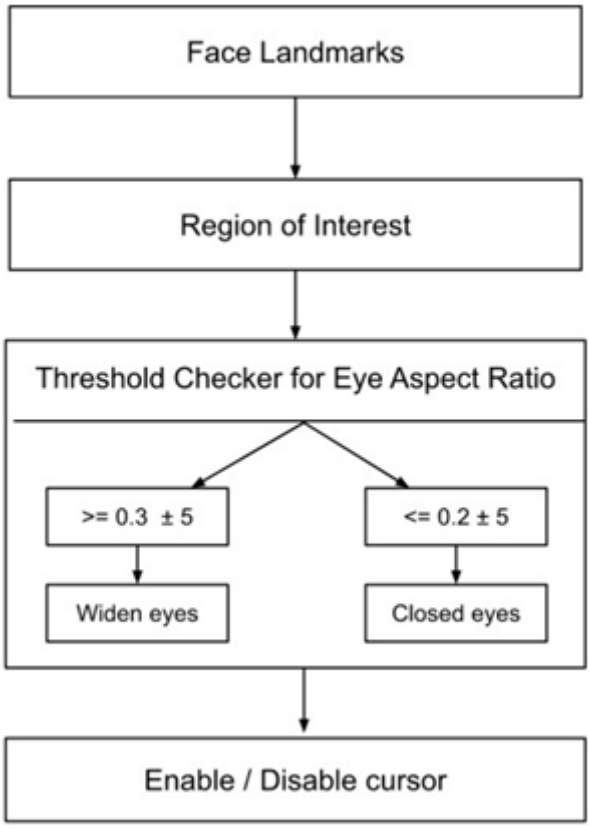
Facial landmark detection is used to detect the key areas like eyes, eyebrows, nose, mouth, chin. If the image was recognized with the key areas, then the shape predictor will localize the key points of the face along with the shape which will be used for cursor control. Initially, this system will detect the face in the picture and locate the landmarks of the face. For this system, we use Histogram of Gradients (HOG) and has been trained by the iBUG-300W face landmark dataset. After that dlib's shape predictor is used to detect the landmarks of the face along with the shape which was trained on iBUG-300W dataset. The dataset contains 68 pairs of integer value where we can easily detect the eyes and nose of the user's face.

After the successful detection user's face, we tend to find the eyes of the user's face. With the help of dlib's shape predictor and the 68 pairs of integers where our facial landmarks are represented as numbers from 1 to 68. The numbers range from 37 to 42 will be for our left eye and the numbers range from 43 to 48 will be for the right eye. Now the shape and main landmarks for mouse control are detected. Using the predicted landmarks of the face, the system detects certain actions like head tilt. With those actions, the movement of the mouse can be programmed according to the direction of the user's action.

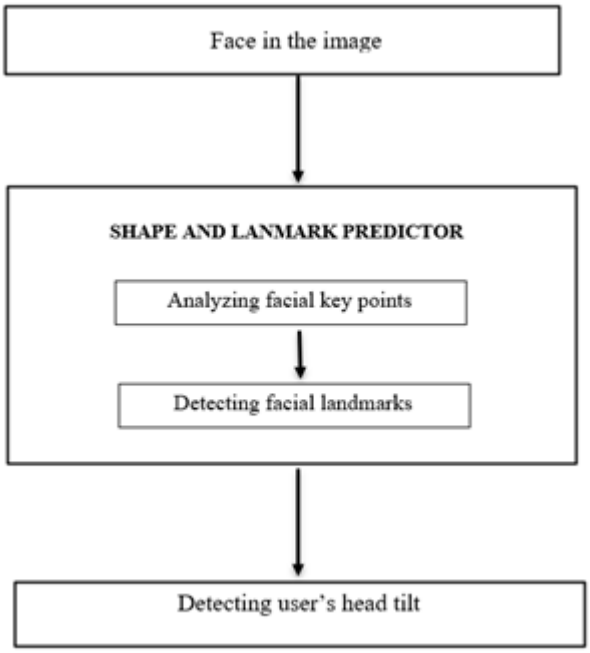
3.2 FLOWDIAGRAM

3.2.1OVERALL ARCHITECTURE OFTHE PROPOSEDSYSTEM





3.2.2 SHAPE PREDICTOR ARCHITECTURE



3.2.3 THRESHOLDCHECKER

3.3 LITERATURE REVIEW

The research strategy is as follows: a brief overview of well-known and existed systems of virtual mouse are investigated. The main objective of the literature survey of these papers to highlight the proposed system of each existing system and demonstrating how they used.

3.3.1 VISUAL OBJECT TRACKING:

This allows the user to navigate the system cursor using their hand bearing color caps or tapes that the computer webcam tracks and perform mouse operations like left-click, right-click, and double click using different hand gestures. This study consists of two methods for tracking the fingers, one is by using colored caps and other is by hand gesture detection. This includes three main steps that are finger detection using color identification, hand gesture tracking and implementation on on-screen cursor.

3.3.2 ACOUSTIC BASED POINTING

This allows the user to navigate the system cursor by receiving the sound through the microphone and converts it into an electrical signal to perform the desired tasks. This resolves the problem for differently abled people[4]. The paper proposes a new HCI mechanism for device-free gesture

recognition on the table using acoustic signal, which can extend the gesture input and interactions beyond the tiny screen of mobile device and allow users to provide input without blocking screen view. Extensive evaluations show our algorithm has a better noise tolerant performance and the system could recognize seven common gestures (click, flip left/right, scroll up/down, zoom in/out) on smart devices with an accuracy of 93.2%.

3.3.3 BRAIN COMPUTER INTERACTION

This allows the user to navigate the system cursor by receiving the signal from the neuron of the human brain through a few electrodes to perform the desired tasks. This resolves the problem of external noise. This paper aimed to design an EEG-based mouse system by using brain-computer interface (BCI) to move a cursor on a computer display. This system to provide an alternative communication or control channel for patients with severe motor disabilities.Then, the final stage of the system detects the angle of inclination of the user's head on the image, and based on the mode, it performs either a mouse cursor movement or mouse click. Such patients might become able to select target on a computer monitor by moving a cursor through mental activity. The user could move [4] the cursor just through imaging his/her hand operation on mouse without any actual action while the movement direction that he/she wanted to choose was lighted in the cue line of four-direction choice circulation. This system used an adaptive algorithm to recognize cursor control patterns in multichannel EEG frequency spectra. The algorithm included preprocessing, feature extraction, and classification.

3.3 ALGORITHMS

3.4.1 K-COSINE ALGORITHM:

K-cosine algorithm is used to detect the fingertip location, based on the hand-contour coordinates. The boundary of an object is first represented into curvature measured by K-cosine. The fingertip location is mapped to RGB images to control the mouse cursor based on a virtual screen.

3.4.2 SUPPORT VECTOR MACHINE:

The unique features in support vector machine (SVM) classifier achieve a high gesture recognition accuracy from the noisy scenarios and mismatched conditions. SVM will be more useful in the noise cancellation so, it will be suitable for acoustic based pointing.

3.4.3 HISTOGRAM OF ORIENTED GRADIENTS:

The Histogram of Oriented Gradients (HOG) is a feature descriptor used in computer vision and image processing applications for the purpose of the object detection. It is a technique that counts events of gradient orientation in a specific portion of an image or region of interest.The HOG descriptor focuses on the structure or the shape of an object. It is better than any edge descriptor as it uses magnitude as well as angle of the gradient to compute the features. For the regions of the image, it generates histograms using the magnitude and orientations of the gradient. HOG algorithm is especially used for human detection in images. Since it operates on local cells, it is invariant to geometric and photometric transformations.HOG focuses on the structure of the object. It extracts the information of the edge's magnitude as well as the orientation of the edges. It uses a detection window of 64x128 pixels, so the image is first converted into (64, 128) shape. The image is then further divided into small parts, and then the gradient and orientation of each part is calculated. It is divided into 8x16 cells into blocks with 50% overlap, so there are going to be 7x15 = 105 blocks in total, and each block consists of 2x2 cells with 8x8 pixels.

IV. INFERENCE

The existing system has a drawback for using external sensors and preprocessing which may result in slower speed. So from the existing system We find that We should not use external sensors as it requires huge pre-processing and using an efficient algorithm based on histogram of oriented gradients and ensemble of regression trees for working in low lighting conditions.

V. DISCUSSION

Virtual mouse is an effective way for people who are differently abled. A technical approach is usually utilized to increase the performance of the algorithm. according to the literature review, several proposed systems are using several algorithms which are efficient and yields high accuracy as well. But even though they are using the efficient algorithms, they have some uncertainties like external sensors, huge algorithm which process slowly. This system has a broad range of applications other than being a virtual mouse for motor disabled people such as the eye aspect ratio checker feature can be used to detect drowsiness of drivers while they are driving and also the head tilt recognition system can be used to analyze students' behavior while they are attending online classes.

VI. CONCLUSION

The mouse assistance for motor disabled people using Computer Vision has been successfully implemented. It has an easy mouse cursor movement using head tilt movements and mouse clicks using facial and eye gestures. This proposed system gives us proper information and details about the virtual mouse. It has an easy mouse control by user's head tilt. So, the proposed system helps the user to navigate the mouse without any complications or without any external sensors. And it also has ability to detect the user's face even low light and low-resolution conditions with high accuracy. This system will be very helpful for motor disabled people for accessing the mouse and perform mouse actions. The experimental results showed that the proposed system is far better than the existing systems and promises to perform better over time. The future work of this research is to enhance the proposed system with more mouse functionality like scrolling and incorporating natural language processing to provide a virtual keyboard interface that will serve as keyboard assistance to the motor disabled.

REFERENCES

[1] Reddy, V. V., Dhyanchand, T., Krishna, G. V., & Maheshwaram, S. (2020, September). Virtual Mouse Control Using Colored Fingertips and Hand Gesture Recognition. In 2020 IEEE-HYDCON (pp. 1-5).IEEE.

[2] Ghosh,P.,Chingtham,T.S.,Ghose,M.K.,&Dutta,R. (2013). A Review of Modern HCI Challenges for Betterment of Differently Abled People. IJCIR, 9(2), 79-88.

[3] Controlling Mouse Motions Using Eye Tracking Using Computer Vision – IC-ICCS – 2020 – Kshitij Meena, Manish Kumar, MohitJangra

[4] HCI on the Table: Robust Gesture Recognition Using Acoustic Sensing in Your Hand - IEEE Access – 2020 – Gan Luo, Panlong Yang, Ping Li, MingshiChen.

[5] Buragohain, S., & Kashyap, K. (2019). Mouse Cursor Controlusing EEG Signal and Machine Learning. International Journal of Computer Sciences and Engineering, 7(5), 1623– 1627.

[6] Vojtech, J. M., Cler, G. J., & Stepp, C. E. (2018). Prediction of optimal facial electromyographic sensor configurations for human–machine interface control. IEEE Transactions on Neural Systems and Rehabilitation Engineering, 26(8),1566-1576.

[7] Real-time virtual mouse system using RGB-D images and fingertip detection – 2020 – Dinh-Son Tran, Ngoc-Huynh Ho, Hyung-Jeong Yang, Soo-Hyung Kim, Guee SangLee.

[8] Fahim, S. R., Datta, D., Sheikh, M. D. R. I., Dey, S., Sarker, Y., Sarker, S. K., Badal, F. R., & Das,S.

[9] Fahim, S. R., Datta, D., Sheikh, M. D. R. I., Dey, S., Sarker, Y., Sarker, S. K., Badal, F. R., & Das,S. K. (2020). A Visual Analytic in Deep Learning Approach to Eye Movement for Human-Machine Interaction Based on Inertia Measurement. IEEE Access, 8, 45924–45937.

[10] Kazemi, V., & Sullivan, J. (2014). One millisecond face alignment with an ensemble of regression trees. In Proceedings of the IEEE conference on computer vision and pattern recognition (pp.1867- 1874).

[11] Shah, H. M., Dinesh, A., & Sharmila, T. S. (2019, February). Analysis of facial landmark features to determine the best subset for finding face orientation. In 2019 International Conference on Computational Intelligence in Data Science (ICCIDS) (pp. 1-4). IEEE.

[12] Mohanty, S., Hegde, S. V., Prasad, S., & Manikandan, J. (2019, November). Design of Real-time Drowsiness Detection System using Dlib. In 2019 IEEE International WIE Conference on Electrical and Computer Engineering (WIECON-ECE) (pp. 1-4). IEEE.

[13] Pereira, C. A. M., Bolliger Neto, R., Reynaldo,A. C., Luzo, M. C. D. M., & Oliveira, R. P. (2009). Development and evaluation of a head-controlled human-computer interface with mouse-like functions for physically disabled users. Clinics, 64(10), 975-981.

[14] Kim, S., Park, M., Anumas, S., & Yoo, J. (2010, October). Head mouse system based on gyro-and opto-sensors. In 2010 3rd International Conference on BiomedicalEngineering and Informatics (Vol. 4, pp. 1503-1506). IEEE.

[15] Panning, A., Al-Hamadi, A., & Michaelis, B. (2011, November). A color-based approach for eye blink detection in image sequences. In 2011 IEEE International Conference on Signal and Image Processing Applications (ICSIPA) (pp. 40-45). IEEE.

[16] Déniz, O., Bueno, G., Salido, J., & De la Torre, F. (2011). Face recognition using histograms of oriented gradients. Pattern recognition letters, 32(12), 1598- 1603.

[17] Dong ming, Yuhuan Zhu, Hongzhi Qi, Yong Hu Study on EEG-based mouse system by using brain- computer interface. IEEE.

[18] I. Habernal, T. Ptáček, and J. Steinberger, "Sentiment Analysis in Czech Social Media Using Supervised Machine Learning," 50(5), 693– 707, 2014.

[19] V. Senthil Kumar, B.Vinoth Kumar, P.Saranya "Normalized pagecount and textbased metric for computing semantic similarity between webdocuments", JARDCS,PP.1865-1875,2017.

[20] V. Senthil Kumar, B.Vinoth Kumar, "Research on Sentimental Analysis Techniques," vol. 8, September, pp. 1263–1269, 2019.