IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 7, May 2023

Computer Vision Based Virtual Mouse and Keyboard System

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Abstract: *Gesture recognition is a technology that uses computer algorithms to interpret human gestures as commands for a computer or other device. A virtual mouse and keyboard project that uses gesture recognition would involve creating a system that can recognize specific hand or body movements and translate them into actions on the computer, such as moving the cursor or typing on a virtual keyboard. The abstraction for this project would involve developing the algorithms and programming necessary to detect and interpret the gestures, as well as designing the user interface and integrating the system with the computer's operating system.*

Keywords: Defects, Image Processing, Frame Extraction.

I. INTRODUCTION

Gesture recognition technology is becoming an increasingly popular way for people to interact with their devices. While traditional input methods such as keyboard and mouse are still prevalent, there is a growing interest in using natural human movements, such as hand and eye gestures, to interact with computers. The use of gesture-based interaction has many potential benefits, including increased accessibility for people with disabilities, improved efficiency for tasks that require multiple inputs, and a more intuitive and natural way of interacting with digital devices. In this project, we propose to develop a virtual mouse and keyboard using gesture recognition technology.

The system will be able to recognize specific hand or eye movements and translate them into actions on the computer, such as moving the cursor or typing on a virtual keyboard. The goal of this project is to design and implement a gesture recognition system that is accurate, responsive and easy to use. We will be using visual gesture recognition, where the system uses cameras or other imaging devices to detect and interpret hand or eye movements. The project will involve researching and evaluating different image processing and computer vision techniques, as well as developing and testing a user interface that is intuitive and easy to use. Once the gesture recognition system and user interface have been developed, the final step will be to integrate the system with the computer's operating system. The end result of this project will be a virtual mouse and keyboard that allows users to control their computer using natural hand and eye movement.

II. RELATED WORK

1.Abhinavraj Prasad and Ayush Mishra, "CURSOR MOVEMENT BY HAND GESTURE" International Research Journal of Modernization in Engineering Technology and Science, 2022.[1]

The system that works with the aid of a webcam that uses system transformation algorithms, and it moves from the webcam screen to the computer window full screen with the help of fingers to control the mouse. Converts coordinates. When fingers are detected, it discovers which finger is up to carry out a particular mouse function, a square field is drawn with respect to the pc window withinside the webcam location in which we are able to use the mouse cursor. It is basically a system that uses image processing, technique to control the position of the cursor with the bare hands without using any electronic device.

2.Mr. Rachit Puri, "GESTURE RECOGNITION BASED MOUSE EVENTS" International Journal of Computer Science and Information Technology, 2021.[2]

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This paper presents the manoeuvre of mouse pointer and performs various mouse operations such as left click, right click, double click, drag etc using gestures recognition technique. Recognizing gestures is a complex task which involves many aspects such as motion modelling, motion analysis, pattern recognition and machine learning. Keeping all the essential factors in mind a system has been created which recognizes the movement of fingers and various patterns formed by them. Color caps have been used for fingers to distinguish it from the background color such as skin color. Thus, recognizing the gestures various mouse events have been performed. The application has been created on MATLAB environment with operating system as windows.

3.Mr. Muhammad jehanzeb and Mr. Umair Hassan, "A NEW 3D VIWER SYSTEM BASED ON HAND GESTURE RECOGNITION FOR SMART INTERACTION" International Conference on Computing and Information Technology, 2020.[3]
The visualization of the 3D models is a scorching topic in computer vision and human-computer interaction. The demands for 3D models have been increased due to high involvement in animated characters, virtual reality and augmented reality. To interact with 3D models with the help of mouse and keyboard is a very hectic, less efficient and complex process because of multiple types of operations required by the models to view properly in all sides. So it is essential to improve the user interaction with the 3D system. In this paper, a new method is introduced by using the Microsoft Kinect v2 to detect the human body and joints. First, we trained the Kinect to understand the specific gestures, and then recognize to perform the specific task on an object in the proposed environment.

4.Mr. Saransh Sharma and Mr. Samyak Jain, "A STATIC HAND GESTURE AND FACE RECOGNITION SYSTEM FOR BLIND PEOPLE" 6th International Conference on Signal Processing and Integrated Networks, 2019.[4]
This presents a recognition system, which can be helpful for a blind person. Hand gesture recognition system and face recognition system has been implemented in this paper using which various tasks can be performed. Dynamic images are being taken from a dynamic video and is being processed according to certain algorithms. In the Hand gesture system Skin color detection has been done in YCbCrcolor space and to discover hand convex defect character point of hand is used where different features like fingertips, angle between fingers are being extracted. According to gesture Recognized, various tasks can be performed like turning on the fan or lights. While in face recognition, Haar Cascade Classifiers and LBPH recognizer are being used for face detection and recognition respectively. With the help of OpenCV, the research has been implemented. Various hand gestures and human faces have been detected and identified using this system. The hand gesture was recognized with an accuracy of 95.2% was achieved and facial recognition was done with an accuracy of 92%.

III. SYSTEM ARCHITECTURE OF VIRTUAL MOUSE AND KEYBOARD

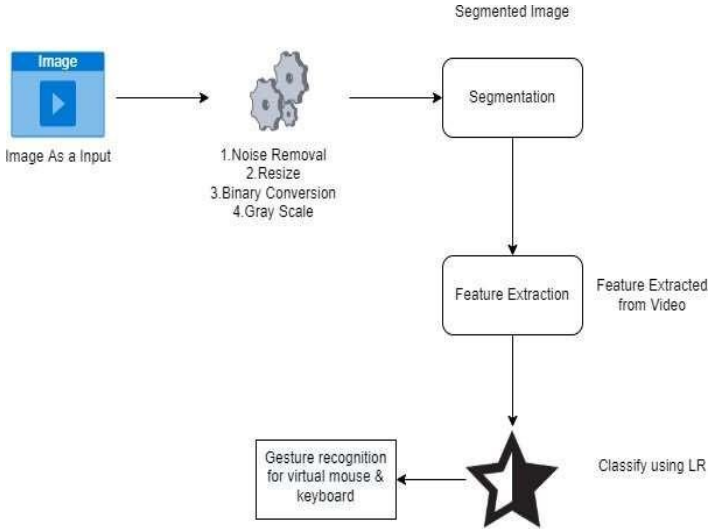

Fig No1: System Architecture of Virtual Mouse and Keyboard

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- The first step is to set up the hardware required for the project, which typically includes a camera or a depth sensor. The choice of camera depends on the accuracy and speed of hand tracking required. Next, the required software needs to be installed. This includes the operating system, software libraries such as OpenCV, and any necessary drivers for the camera.
- Once the hardware and software are set up, the next step is to detect the user's hand or finger. This is done using computer vision techniques Haar cascade. Once the hand is detected, its position and movement can be tracked.
- After detecting the hand, the system needs to recognize the gestures made by the user. For example, a click can be detected when the user closes their hand into a fist, and a drag can be detected when the user moves their hand while keeping it closed. The recognition of gestures is achieved through linear regression algorithm.
- Once the gestures are recognized, the system needs to map them to corresponding mouse and keyboard inputs. For example, a click gesture can be mapped to a left mouse click, and a drag gesture can be mapped to mouse movement. This mapping can be achieved through software or hardware emulation of the mouse and keyboard events.
- Once the mapping is done, the system needs to be integrated with the operating system to enable the user to control the computer using hand movements. This can be done by emulating mouse and keyboard events using operating system-specific APIs
- Finally, the system needs to be tested thoroughly and refined to improve its accuracy and speed of response. This can be done by collecting feedback from users and making necessary changes to the system. The success of the project depends on the accuracy and speed of hand tracking and gesture recognition, as well as the ease of use for the end-users.

IV. METHODOLOGY

A computer vision-based virtual mouse and keyboard system project involves using computer vision techniques to track the user's hand or finger movements and translating them into corresponding mouse and keyboard inputs.

Flow of Process: -

1.Collect Training Data:

- Record eye movement coordinates for virtual mouse system.
- Record finger movement coordinates for keyboard system.
- Collect corresponding gesture labels for both systems.

2. Pre-processData:

- Normalize the input data to have zero mean and unit variance.
- Shuffle and split the data into training and testing sets.

3.Train the Model:

- Initialize linear regression model with appropriate parameters
- Train the model on the training data

4.Test the Model:

- Use the trained model to predict gesture labels on the testing data
- Calculate accuracy, precision, recall and f1-score

5.Use the Model to Control Computer

- Continuously capture eye and finger movement coordinates
- Normalize the coordinates and feed them to the trained model
- Use the predicted gesture label to perform the corresponding action on the computer (e.g., left click, right click, scroll up, scroll down, type a specific key)

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V. MATHEMATICAL MODEL

A mathematical model of a computer vision-based virtual mouse and keyboard system can also use linear regression and Haar cascade models for hand detection and tracking. Here's how these models can be used:

Mathematical Model: -

Let 'S' be the Whole system S = {I, P, O}

- Input(I): I = (Finger Movements, Eye Movements)
- Procedure (P): P= (I, Using I System perform operations and like pre-processing,feature Extraction, Classification, etc. and Gesture is Recognize forMouse and Keyboard System is calculated).
- Output(O): O = (System detects type of Gesture Recognized for Mouse andKeyboard prediction)

- **Hand Detection using Haar Cascade Model:** The Haar cascade model is a machine learning-based algorithm used for object detection. In this case, it can be used to detect the user's hand by training the model on a dataset of hand images. The Haar cascade model uses a set of features called Haar-like features that are used to detect the object's edges and shapes.

- **Hand Tracking using Linear Regression Model:** Once the hand is detected, a linear regression model can be used to track its position and movement over time. Linear regression is a statistical method used to find the relationship between two variables and helps in identifying the gesture or hand movement.

- **Gesture Recognition:** To recognize the user's hand gestures, a machine learning-based linear regression algorithm The algorithm can be trained on a dataset of hand gestures to recognize the user's hand movements.

- **Mapping to Mouse and Keyboard Inputs:** Once the gestures are recognized, a mathematical model can be used to map them to corresponding mouse and keyboard inputs. This can involve using a lookup table or a mathematical function to convert the hand movements into mouse and keyboard actions.

- **Final Outcome:** The gestures are identified and after identification of gestures the particular action will be taken and action will reflect in either the cursor movement or in keyboard typing.

VI. RESULT

1.Recognized using keyboard:

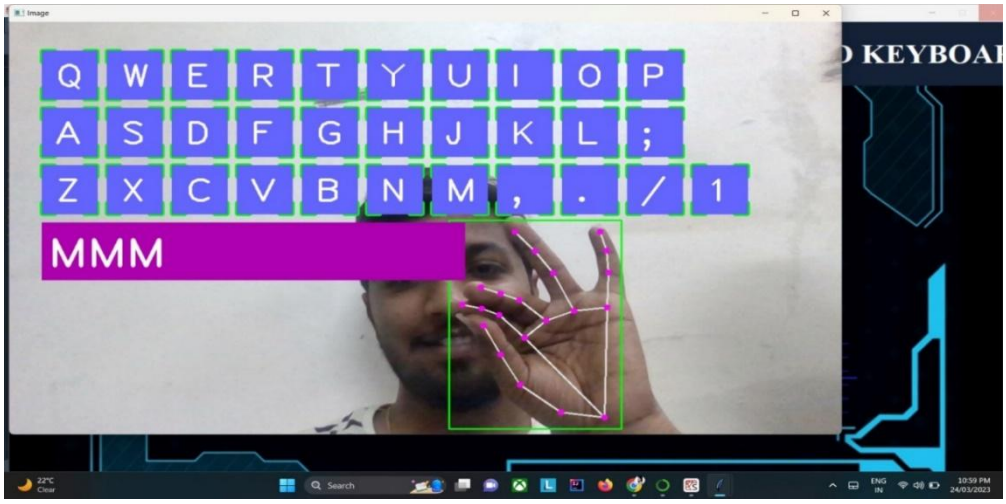

Fig No2:Recognised using keyboard

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- When user select the keyboard gesture option, then webcam access pop-up window appears.
- After giving the access the webcam gets open and keyboard get displayed on screen.

2. Recognized using Mouse:

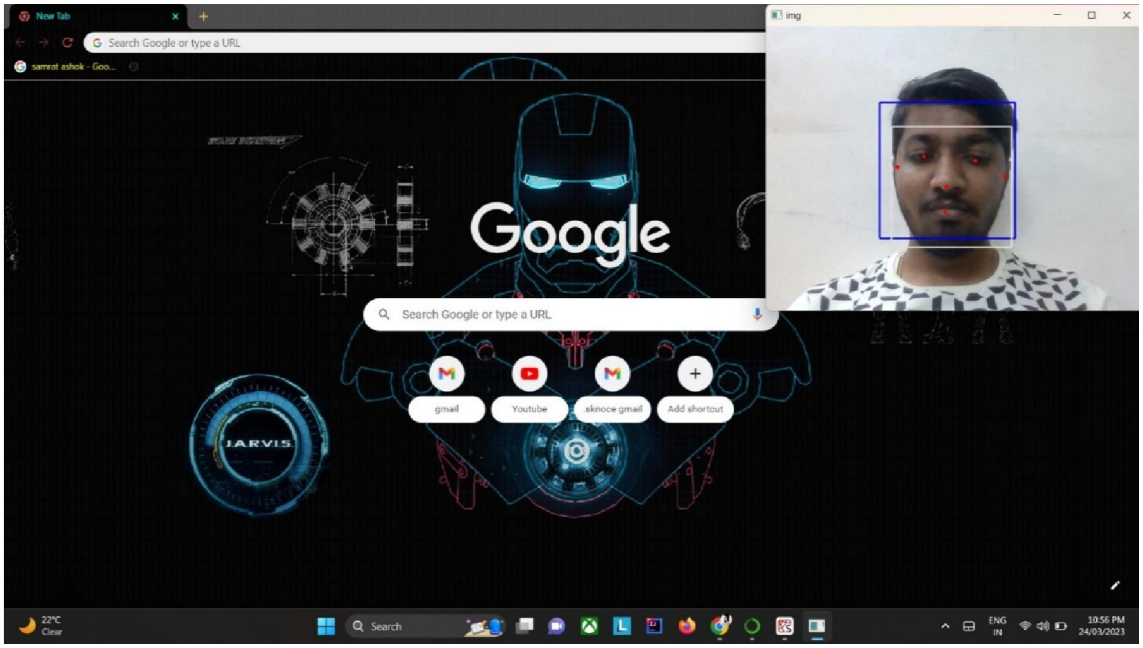
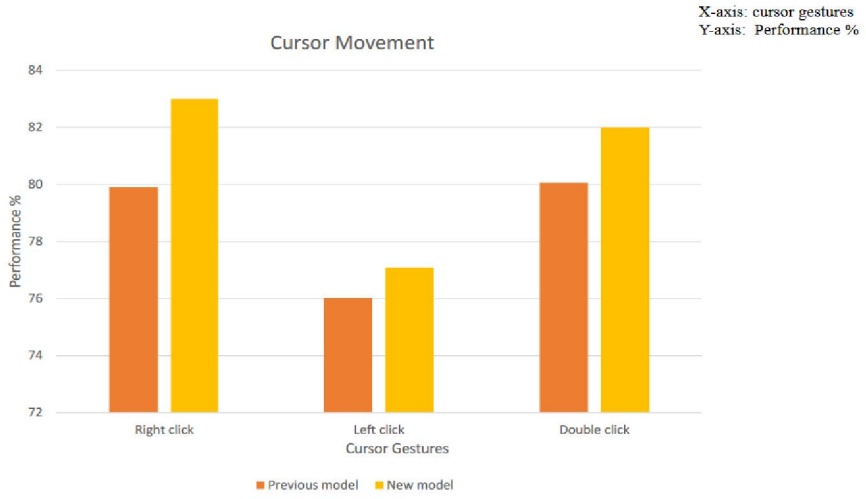


Fig No3: Recognized using Mouse

- When user select the Mouse gesture option, then webcam access pop-up window appears.
- After giving the access, the webcam gets open and mouse get displayed on screen.

Comparison Bar Graph:



The accuracy of the new cursor model for right click, left click and for double click is increased by 2 to 2.5 % than previous model.

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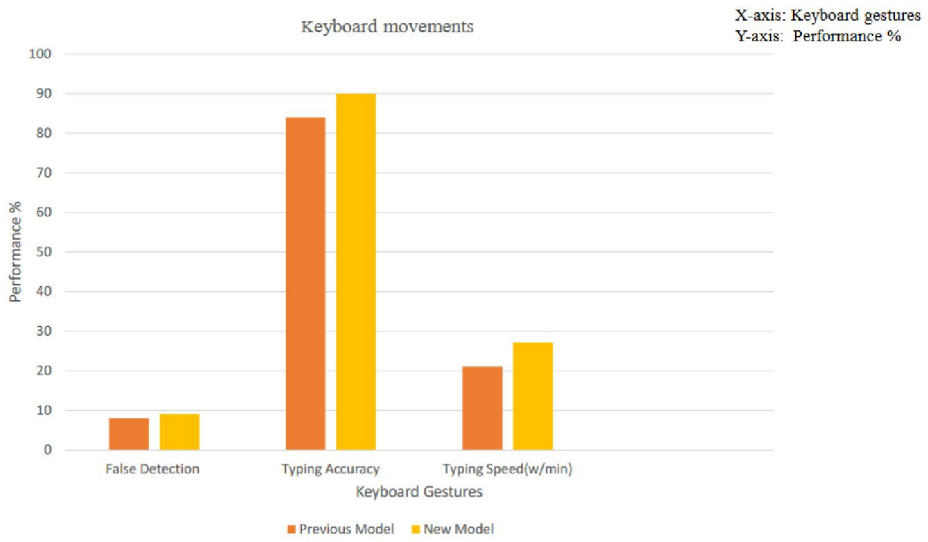

The accuracy of new keyboard model in terms of false detection remains same while the accuracy of typing and its speed is increased by 2 to 3 %.

VII. CONCLUSION

The system is developed to recognize the hand gesture and replace the mouse and keyboard function. That includes the movement of the mouse cursor, the drag and click with the keyboard features like printing alphabets and other keyboard functions. The process of skin segmentation is utilized to separate the colour/image of hand with its background. In general, by recognizing hand gesture, it can operate mouse and keyboard features and also create a real-world user interface.3d printing, Architectural drawings and even doing medical operations from anywhere to everywhere.

VIII. FUTURE SCOPE

Improving Accuracy and Reliability: While existing systems have shown promise, there is still room for improvement in terms of accuracy and reliability.

Enhancing Usability: Future work could focus on designing interfaces that are more intuitive and user-friendly, and on developing more natural and intuitive ways for users to interact with their computers.
Extending capabilities: There is potential to extend the mouse and keyboard capabilities to include more complex tasks, such as gesture recognition or voice commands.

Adapting to Different Environments: Future work could focus on developing systems that are more robust and adaptable to different environments.

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