Mouse and Webcam Controller

Chetanveer Singh, Harneet Kaur, Ira Gupta, Vansh Sandhir

Problem Statement: The mouse is one of the wonderful inventions of Human-Computer Interaction (HCI) technology. Currently, a wireless mouse or Bluetooth mouse is still used and it requires a battery for power and a dongle to connect it to the PC. In this proposed virtual mouse system, this limitation can be overcome by employing a webcam or a built-in camera to capture hand gestures and hand tip detection using computer vision.

The algorithm used in the system makes use of the Machine learning algorithm. Based on hand gestures, the computer can be controlled virtually and can perform left-click, right-click, scrolling functions, screenshot, and zoom functions without the use of the physical mouse. Also, amidst the COVID-19 situation, it is not safe to use the devices by touching them because it may result in a possible situation of spread of the virus by touching the devices, so the proposed AI virtual mouse can be used to overcome these problems since hand gestures and hand tip detection is used to control the PC mouse functions by using a webcam or a built-in camera.

Objective: This project targets HUMAN-COMPUTER INTERACTION (HCI). The main objective of the proposed virtual mouse system is to develop an alternative to the regular and traditional mouse system to perform and control the mouse functions, and this can be achieved with the help of a web camera that captures the hand gestures and hand tip and then processes these frames to perform the particular mouse function.

The objectives of this project are as follows:

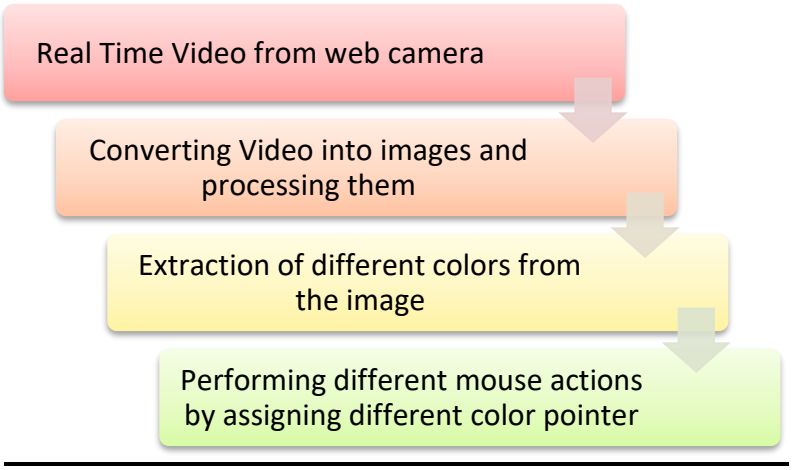
- Control mouse cursor movements
  - Left-click
  - Right-click
  - Scrolling
  - Double tapping
  - Zoom-in and out
  - Screenshot
- WebCam control using hand gesture
  - Flipping image
  - Face gesture recognition
  - Color detection

Scope: This proposed virtual mouse system might have some limitations such as a small decrease in the accuracy of the functions. The model might also have some difficulties in executing clicking and dragging to select the text. These are some of the limitations of this virtual mouse system, and these limitations will be overcome in our future work.

Furthermore, the proposed method can be developed to handle the keyboard functionalities along with the mouse functionalities, virtually which is another future scope of Human-Computer Interaction (HCI).

Project Outcome: Our project targets the following approach:

a) Capturing real-time video using a web camera.
b) Processing the individual image frame.
c) Flipping of each image frame.
d) Detection and extraction of different colors.
e) Tracking the mouse pointer using the system coordinates.



Time completion: We aim to complete this project within a period of 4 months. We started working on it in January 2023 and we aim to complete it by the end of May 2023.

WEEK DISTRIBUTION	OBJECTIVE	
Week 1-4	Planning	During this stage, we identified the scope of our project and got approval from our instructor. We accomplished the following tasks: 1) Determine the system requirements of the software to be developed. 2) List all the features and ideas that will work together to meet the established system requirements.
Week 5-7	Analysis	We plan to create a realistic timeline for the completion of our project. For this we need to: 1) Prioritize the software features. 2) Analyze our resource availability. 3) Evaluate our team capabilities and determine what task we can opt for.

		4) Learn the skills required.
Week 8-11	Design	1. In this stage of development, we will design what our software will look like and how it will function. 2. We will try to consider the software design prototype of the document.
Week 12-14	Development and Testing	1. We will summarize the system's perceived readiness and will try to prepare testing reports of what our model is doing. 2. We will also access the technical and non-technical safeguards to determine the extent of security requirements.
Week 15-16	Deployment	1. At this stage we will perform final end-user testing to make sure the application works as intended in the real world. 2. We will deploy the software to production so that it can be automated as a continuous deployment model. 3. We will also try to use agile methodology to make sure that the deployment can be done even faster.
Forever	Maintenance	We will continue to receive feedback that will include requests for other features and notes about bugs making regular maintenance and a requirement to keep our software as functional as possible for our users.

Challenges: For the detection of hand gestures and hand tracking, the MediaPipe framework is used and the OpenCV library is used for Computer Vision. The proposed algorithm makes use of Machine Learning concepts to track and recognize hand gestures and the hand tip. This was a challenge for us as we have no prior knowledge of the topic and the framework used for the interaction. We strive to learn the skills required for this project within the proposed timeline.

Cross-comparison of the testing of the Virtual mouse system is difficult because only a limited number of data sets were available to us. The hand gestures and fingertip detection will have to be tested in various illumination conditions and also will be tested at different distances from the webcam for tracking.