

Intuitive Presentation Using Hand Gestures: A Vision Based Approach

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Abstract. Human-machine interaction for current presentation techniques heavily relies on external controllers like clickers and remotes. While these traditional methods eliminate the need for manual device control, they still require physical interaction to manage presentation slides, disrupting the presenter's flow. This paper introduces a novel hand gesture recognition system aimed at reducing the reliance on external controllers and enhancing overall smoothness and accuracy, thereby improving the audience and user experience during presentations. Our approach utilizes real-time image processing through machine learning, integrated with deep learning modules, to identify and recognize hand gestures for performing various tasks and controlling the presentation.

Keywords: Hand gesture recognition · Machine Learning · Deep learning · Enhancing performance

1 INTRODUCTION

Imagine yourself attending a captivating and engaging presentation. The speaker is charismatic, the content is engaging, but then... they fumble with a bulky

clicker, the lights flicker as they switch slides, and precious momentum is lost. The immersion is lost as frustration ripples through the audience caused by the outdated technology. Unfortunately, this scenario is all too common in the present world.

"Slides are crutches, but crutches can become prisons if you rely on them too much." - Garr Reynolds, author of "Presentation Zen"

No matter how much the technology improves, all presentation methods need physical involvement with the clickers and keyboard shortcuts. Reynolds cites research showing that audiences tend to remember only 10% of the information presented on slides, highlighting the need for more dynamic and interactive presentation methods.

Presentations are used almost everywhere like in education, business, public speaking etc. Therefore, it's very important that we use right methods to present our case. Using intuitive methods can help keep the engagement between the audience and the presenter without killing momentum by the clicker-flicker and keyboard shortcut interruptions.

In today's world where AI is taking over almost everything which makes things easier and engaging. We decided to make our approach based on Machine Learning. Our system uses machine learning to control the presentation flows without the need of any physical controlling devices like clickers and keyboard, using only our hand gestures to control the navigation of the presentation slides. This approach helps us by avoiding all the disadvantages of the traditional presentation techniques.

Our system using image recognition to take real time image processing to interpret the hand gestures performed by the presenter. In our current system, we use left and right swipes to navigate between slides and specific finger configurations to trigger additional functionalities like using two-finger gesture to trigger an independent pointer and single-finger gesture which works as a free-style marker.

There exist projects which use hand gesture recognition to do simple commands like swiping your hand over your phone to wake it up etc. but all these projects use hand gestures to do simple tasks which is not fully exploring the potential of using hand gestures. Through this project we also hope to explore the boundaries of what we can achieve with simple hand gestures, hopefully expanding it to beyond presentation in the future.

In conclusion using this method we can smoothly transition between controlling our presentation slides and giving our speech. In future, we hope to integrate AI so we can effectively tell when the presenter is using hand gesturing to emphasize his speech and when he is using hand gestures to control the presentation. We also hope to use the same hand gesture to go beyond the presentation software and control some simple computer commands without the use of mouse or keyboard.

So effectively after the full completion of this project we can give a seamless presentation where we give our speech while the slides change with just a small

flicker of our hand movement without interrupting our lecture or killing the momentum and engagement of the audience.

2 Existing work

In the ever-changing IT industry, there are a slew of methods being discussed to enhance the functionalities of presentation software and also the presentation techniques. All these studies however don't deal in using hand gestures for presentation, they are mainly focused on improving functionalities in presentation software using AI and latest feature, UI improvements.

A thorough analysis of the present studies and methods gives you a plethora of presentation methods. Some even use voice commands to control the presentation flow. Several significant methods are being discussed which involve various technologies to make the presentation techniques easier. Some presentation controls used in the present world are:

2.1 Keyboard Shortcuts

- You can move through slides in most presentation software using keyboard shortcuts.

2.2 Mouse/Clicker

- Using a mouse or a presentation clicker/remote control is a common method. Clicking the left mouse button or using the clicker's buttons typically advances to the next slide, and right-clicking or using other buttons might move to the previous slide.

2.3 Navigation Panel

- Many presentation tools have a navigation panel or slide sorter view that allows you to see all the slides at once. You can click on a specific slide in the panel to jump directly to it.

2.4 Presenter View

- Advanced presentation software often includes a "Presenter View" that shows different information on the presenter's screen compared to what the audience sees. It typically includes slide thumbnails, speaker notes, and a timer. The presenter can navigate through slides independently of what the audience sees.

2.5 Voice Commands

- Some presentation software supports voice commands for navigation. This allows presenters to verbally instruct the software to move to the next or previous slide.

2.6 Interactive Features

- In some modern presentation tools, especially for online or interactive presentations, you might have interactive features like clickable links or buttons within the slides that control navigation.

2.7 Remote Control Apps

- For presentations conducted on tablets or smartphones, remote control apps can be used to control slide navigation. These apps turn your device into a remote control, allowing you to move through slides.

2.8 Custom Animation and Transitions

- You can set up custom animations and transitions between slides to control the flow of information. This is often used for adding visual effects or revealing content gradually.

Always familiarize yourself with the specific features and functionalities of the presentation software you are using, as the methods for controlling slide navigation can vary between tools. Popular presentation software includes Microsoft PowerPoint, Google Slides, Apple Keynote, and others.

Despite the advances made in the field, problems remain. Using all the existing methods gives us Limited Interactivity, Lack of engagement, Dependency on equipment, Limited accessibility, Difficulty in collaboration, lack of presenter feedback, compatibility issues. By expanding on previous studies, we hope to improve our understanding of these problems. We hope to solve these problems by using our software which uses physical hands gestures to control the presentation.

We will elaborate on our methodology in the following sections of this paper, detailing the application of the algorithms used. we hope to provide a thorough and forward-thinking contribution to the subject presentation control methods.

3 Algorithms

Using cutting edge machine learning algorithms is essential for precise control, enhanced interaction and efficient development. The cvzone.HandTracking module in the system, uses various algorithms for hand detection, including skin color segmentation as a preliminary step and also blob analysis with landmark detection. Let's delve into some potential methods used.

3.1 Skin Color Segmentation

Skin Color Segmentation is threshold based on pre-defined skin color range in HSV or YCbCr color space. It also does adaptive threshold based on local statistics to handle lighting variations and skin chrominance model using CrCb space and skin region thresholds.

- Skin color segmentation is the process of identifying and separating skin pixels from other pixels in an image.
- HSV stands for hue, saturation, and value. Hue represents the color itself, saturation represents the intensity of the color, and value represents the brightness of the color.
- Skin colors typically have a hue in the range of 0-30 degrees, a saturation in the range of 0.2-0.8, and a value in the range of 0.3-1.0.

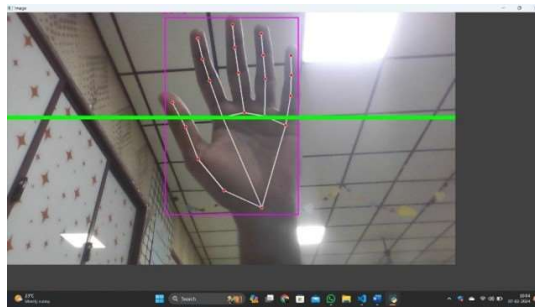


Fig. 1. Hand Gesture Recognition

3.2 blob Analysis

Blob Analysis is a computer vision technique used to identify and extract features from connected regions of pixels in an image. And these blobs are typically define as regions of pixels that are brighter or darker than their surroundings.

Blob analysis can be used to identify and track objects in a video sequence, or to count the number of objects in an image. The blob analysis can be applied directly or in-directly using the following concepts

Keypoint Detection Keypoint Detection uses feature detections like Harries corners or DoG to identify potential landmark location

Key to the success of this vision-based approach is the utilization of feature detectors such as Harris corners or Difference of Gaussians (DoG). These detectors play a crucial role in identifying potential landmark locations on the human hand, enabling the system to recognize and interpret various gestures accurately.

- Harris Corners: Harris corner detection is a widely-used technique in computer vision. It identifies points in an image where there are variations in intensity in multiple directions, making it ideal for locating key features in an image. In the context of hand gesture recognition, Harris corners can be

employed to pinpoint distinctive landmarks on the hand, facilitating precise tracking and gesture interpretation.

- Difference of Gaussians (DoG): DoG is another powerful feature detection technique that involves taking the difference between blurred versions of an image. This method is particularly effective for identifying keypoints in images with varying levels of intensity. In the context of hand gesture recognition, DoG can be applied to detect subtle variations in hand movements, enhancing the system's ability to interpret intricate gestures accurately.

4 Tools and libraries

4.1 Python

Python is a popular high-level, interpreted, dynamically typed programming language that is easy to understand and use. Applications including web development, data analysis, automation, artificial intelligence, and machine learning make extensive use of its versatility. Python's clear and simple syntax prioritizes readability of code, which lowers program maintenance costs.

4.2 CvZone

Pandas is an open-source Python toolkit for data manipulation and analysis. The Data Frame, a two-dimensional table used to store structured data, is essential to pandas. It offers essential data structures, such as Data Frame and Series, that facilitate effective data analysis and manipulation. Pandas is a flexible tool for data loading because it can read data from a variety of file formats, including Excel and CSV.

4.3 NumPy

An open-source Python library for numerical computation is called NumPy. It offers mathematical functions to manipulate these arrays as well as necessary tools for working with sizable, multi-dimensional arrays and matrices. NumPy is a core Python library for scientific computing and data processing, with an emphasis on performance and economy.

4.4 Streamlit

With the help of the open-source Python library streamlit, online applications for data science and machine learning may be quickly and easily created. It makes the process of creating interactive web apps out of data scripts easier. Streamlit's simple and intuitive API makes it easy for users to create web apps fast and effectively. Automatic widget creation, real-time updates, and the seamless integration of interactive elements like tables and charts are some of the key features.

4.5 Mediapipe

MediaPipe is a tool for analyzing sensory data mostly visual data. It is an open-source, cross-platform framework used for building machine learning pipelines that process various media inputs to accomplish tasks like real-time hand tracking, facial recognition, and pose detection. MediaPipe provides in-built machine learning tools for building custom pipelines. There are three prebuilt libraries for vision, text, audio. Based on the app that uses, import vision, text, or audio library. For hand gesture detection the MediaPipe Tasks vision module needs to be imported

4.6 Aspose.slides module

Aspose.slides is a class library that enables to read or write any PowerPoint documents. Aspose.slides offers various unique features such as:

- Loading, opening, and viewing presentations
- Editing the presentations
- Converting presentations to PDF, Word, JPG, PNG, HTML, GIF, and many other formats
- Rendering and Printing presentations
- Encrypting and Manipulating presentation

5 Flow Chart

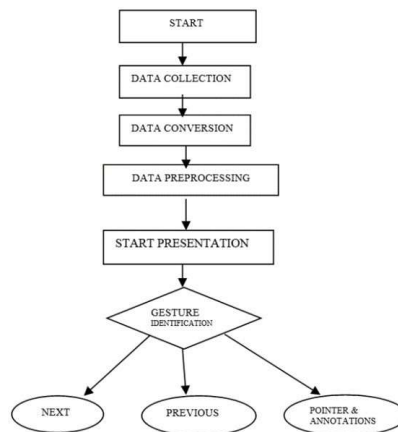


Fig. 2. Flow chart hand gesture controlled presentation

In various establishments, conferences, and other domains, the customary mode of presentation involves utilizing a remote apparatus to control the progression of slides. However, this method enables users to manipulate the slides by means of hand signals or gestures, as well as to incorporate annotations and written content onto said slides through the use of hand gestures. This particular approach serves to enhance the interaction between humans and machines.

5.1 Data Collection

The data that has been gathered takes the form of visual data. This visual data is inputted into the system through the integrated camera or an external webcam, among other sources. The cvzone's hand tracking module facilitates the inputting of this data and continuously captures the visual data in the form of video. In this scenario, the hand's information is tracked in real-time.

5.2 Data Conversion

In the context of this data conversion process in presentation control system, the primary objective is to carry out the conversion of the uploaded presentation file which is in .PPTx format into an array of images that are in the PNG format, or as well as potentially in other different file formats such as JPG or JPEG formats.

5.3 Data Preprocessing

In order to prepare data for analysis and model training, a python module is imported which is MediaPipe, it is a machine learning integrated library which analyzes the sensory data and process it by creating pipelines for it. The real time hand tracking, and pose detection in order to understand the behavior of the hand and its pose.

6 Implementation

6.1 Designing User-Interface

It is not practical to execute the code multiple times for each execution and in order to address such conflicts, a user-friendly interface is employed. To implement the suggested theory, the most straightforward approach for creating the user interface (UI) is by utilizing a Python library known as Streamlit. By employing this library, we will have the capability to develop web applications that are driven by data. The following figure illustrates a basic web-based UI designed for intuitive control of presentations.



Fig. 3. Streamlit user-interface

6.2 Gestures for interaction with presentation

The incorporation of gestures is a pivotal stage in managing the delivery of a presentation. A solitary gesture fulfills a designated function, exemplifying the subsequent gestures employed to regulate a presentation.

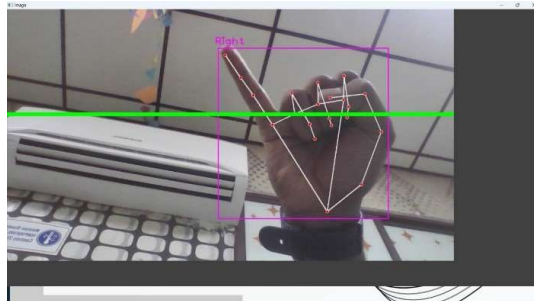


Fig. 4. Hand gesture control presentation to change slide to next

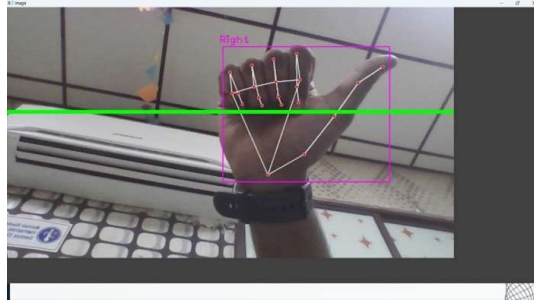


Fig. 5. Hand gesture control for presentation to change slide to previous

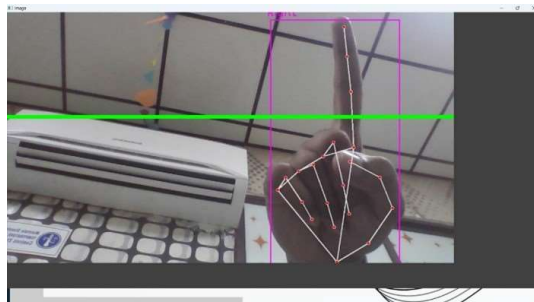


Fig. 6. Hand gesture for controlling pointer during presentation

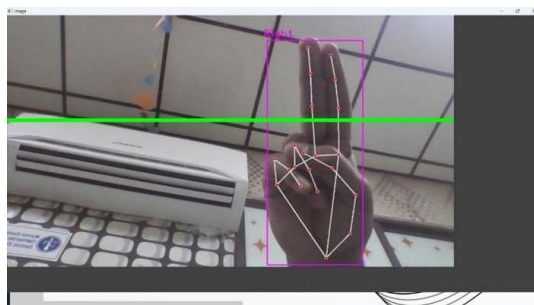


Fig. 7. Hand gesture to draw annotations on the slide

7 Conclusion

A Vision-Based Approach represents a transformable leap in the realm of presentation dynamics. The utilization of computer vision, specifically through key-point detection using feature detectors like Harris corners and DoG, marks a significant departure from traditional control methods. By incorporating hand gestures as an intuitive interface, the system not only enriches user experience but also eliminates the need for conventional input devices, fostering a more natural and engaging interaction with presentation content.

The integration of sophisticated algorithms, such as those facilitating gesture mapping, real-time feedback, and user authentication, contributes to the system's adaptability, versatility, and security. Its scalability and compatibility across different platforms ensure widespread applicability, and seamless integration with popular presentation software streamlines the user experience. Beyond the realm of convenience, this project promotes inclusivity by providing a user-friendly and accessible means of presentation control.

The incorporation of user training and onboarding features ensures a smooth transition for presenters, making the technology approachable and easy to adopt. In essence, "Intuitive Presentation Control using Hand Gestures: A Vision-Based Approach" not only represents the current pinnacle of technology but also sets the stage for future advancements in human-computer interaction, promising more intuitive and immersive presentation experiences.

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In essence, "Intuitive Presentation Control using Hand Gestures: A Vision-Based Approach" not only represents the current pinnacle of technology but also sets the stage for future advancements in human-computer interaction. It promises a more intuitive and immersive era of presentation experiences, where the fusion of vision-based control and user-centric design creates a seamless and captivating presentation environment.

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