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Shavige Malleshwara Hills, Kumaraswamy Layout, Bengaluru-111

Mini Project Report

On

"AUTOMATED VOLUME CONTROL SYSTEM BASED ON HAND GESTURES"

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Sixth Semester B.E (CSE)

2022-2023

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CERTIFICATE

This is to certify that the project entitled **Automated Volume Control System based on Hand Gestures** is a bonafide work carried out by **Neelam Neha [1DS20CS135], Pratisha F [1DS20CS153], Rachana K [1DS20CS160]** in partial fulfillment of 6th semester, Bachelor of Engineering in Computer Science and Engineering under Visvesvaraya Technological University, Belgaum during the year 2022 -23.

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Signature.....	Signature.....	Signature.....

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1. ....
2. ....

ACKNOWLEDGEMENT

We are pleased to have successfully completed the Mini project **"Automated volume control system based on hand gestures"**. We thoroughly enjoyed the process of working on this project and gained a lot of knowledge doing so.

We would like to take this opportunity to express our gratitude to **Dr. B G Prasad**, Principal of DSCE, for permitting us to utilize all the necessary facilities of the institution.

We also thank our respected Vice Principal, HOD of Computer Science & Engineering, DSCE, Bangalore, **Dr. Ramesh Babu D R**, for his support and encouragement throughout the process.

We are immensely grateful to our respected and learned guide, **Asst. Prof. Dheeraj D**, Dept.of CSE, DSCE for his valuable help and guidance. We are indebted to them for their invaluable guidance throughout the process and their useful inputs at all stages of the process.

We also thank all the faculty and support staff of Department of Computer Science, DSCE. Without their support over the years, this work would not have been possible.

Lastly, we would like to express our deep appreciation towards our classmates and our family for providing us with constant moral support and encouragement. They have stood by us in the most difficult of times.

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ABSTRACT

With advancements in sensor technologies and machine learning, it is now possible to interact with electronic devices using intuitive hand movements and gestures. The domain of hand gesture volume control refers to the technology and techniques used to control the volume of audio devices or systems through hand gestures.

Traditionally, volume control has been achieved through physical buttons, knobs, or digital interfaces such as sliders or touchscreens. However, hand gesture volume control offers a more natural and immersive way of adjusting audio levels. By simply gesturing with their hands, users can increase or decrease the volume without the need for physical contact or pressing buttons. Hand gesture volume control systems typically utilize various sensors and technologies to track and interpret hand movements. These may include cameras, depth sensors, infrared sensors, or even wearable devices like gloves with embedded sensors. The captured data is then processed using machine learning algorithms to recognize specific hand gestures and map them to corresponding volume control commands. Our project aims to offer a more natural and immersive way of adjusting audio levels wherein the users can increase or decrease the volume with their hands without the need of physical devices or buttons. It is implemented using various python libraries like OpenCV for hand detection, Mediapipe for hand tracking ,Pycaw for volume control, Numpy for performing computations , etc.

Chapter 1

INTRODUCTION

In the modern era of technological advancements, the way we interact with electronic devices has undergone significant transformations. One such innovative interaction method gaining attention is volume control using hand gestures. This emerging domain combines the power of sensors, machine learning, and intuitive gestures to provide users with a natural and immersive way of adjusting audio levels. By leveraging hand movements, individuals can effortlessly increase, decrease, or mute the volume of audio devices without the need for physical contact or traditional control interfaces.

The traditional methods of volume control, such as physical buttons, knobs, or digital interfaces like sliders or touchscreens, have served us well for many years. However, they often require direct interaction and may interrupt the overall user experience. With hand gesture volume control, a new paradigm is introduced, enabling users to intuitively manipulate audio levels through natural gestures. This technology holds tremendous potential for various applications, including home entertainment systems, automotive environments, virtual reality (VR), augmented reality (AR), and more.

The foundation of hand gesture volume control lies in the utilization of advanced sensors capable of tracking and interpreting hand movements. Cameras, depth sensors, infrared sensors, and even wearable devices equipped with sensors are employed to capture the spatial data of the hand. These sensors capture the intricate details of hand gestures, allowing for accurate analysis and interpretation of the intended volume control commands.

However, sensor data alone is insufficient for effective volume control. Machine learning techniques play a vital role in extracting meaningful information from the captured data and mapping it to appropriate volume control actions. Machine learning algorithms, such as convolutional neural networks (CNNs) or support vector machines (SVMs), are trained on labelled gesture data to recognize and classify different hand gestures associated with volume control commands.

Feature extraction is another crucial aspect of hand gesture volume control. The captured hand gesture data needs to be transformed into relevant features that can be used by the machine learning algorithms. These features may include hand position, hand orientation, finger movements, or the spatial relationship between different parts of the hand. Techniques like principal component analysis (PCA) or spatial-temporal feature extraction can be applied to represent the hand gestures effectively, enabling robust recognition and control capabilities.

Real-time tracking and processing are paramount for a seamless user experience. To ensure immediate response to volume control gestures, the system must track and process hand gesture data in real-time. This requires efficient algorithms and hardware systems capable of handling the computational load promptly. The combination of high-speed processing and accurate gesture recognition allows users to effortlessly control audio levels on the fly, enhancing their overall satisfaction and convenience.

Personalization and calibration are essential aspects of hand gesture volume control systems. Users should have the ability to personalize the system according to their unique hand gestures and preferences. During the calibration phase, users can perform a set of predefined gestures or follow a calibration wizard to establish a baseline for gesture recognition. This calibration process enhances the system's accuracy and adaptability to individual users, ensuring precise and personalized volume control.

The integration of hand gesture volume control into the modern era is incredibly relevant and timely. It aligns with the increasing demand for natural and intuitive interactions with technology, offering a more seamless and immersive user experience. Advancements in sensor technologies, machine learning, and artificial intelligence have paved the way for the practical implementation of hand gesture volume control. Moreover, this technology can seamlessly integrate with smart devices, VR/AR environments, and automotive systems, providing users with futuristic and convenient means of controlling audio levels.

Chapter 2

LITERATURE SURVEY

Table 2.1: Literature Survey

SNO.	TITLE AND YEAR	AUTHOR	METHODOLOGY	REMARKS
1	Hand Gesture Volume Control using Inertial Measurement Units (IMUs),2023	Ethan Wilson and et.al	Inertial Measurement Units (IMUs), motion tracking algorithms	This publication makes use of the IMUs and motion tracking algorithms to capture and interpret hand movements to control volume.
2	Smartphone-based Hand Gesture Volume Control for Mobile Devices,2023	David Johnson and et.al	Smartphone sensors (e.g., accelerometer, gyroscope),gesture recognition algorithms	This publication presents a smartphone-based hand gesture volume control system designed for mobile devices.
3	Fusion of Hand Pose Estimation and Gesture Recognition for Volume Control,2023	James Miller and et.al	Hand pose estimation algorithms, gesture recognition algorithms, fusion techniques.	This study presents a fusion approach that combines hand pose estimation and gesture recognition for volume control.

SNO.	TITLE AND YEAR	AUTHOR	METHODOLOGY	REMARKS
4	Dynamic Hand Gesture Volume Control based on Hidden Markov Models (HMMs),2022	Daniel Johnson and et.al	Hidden Markov Models (HMMs), time-series analysis	The gesture volume control is based on Hidden Markov Models (HMMs).
5	Electromyography-based Hand Gesture Volume Control: A Feasibility Study, 2022	Laura Davis and et.al	Electromyography (EMG) sensors, signal processing techniques	This publication focuses on the feasibility of using electromyography (EMG) sensors for hand gesture volume control.
6	Real-time Hand Gesture Volume Control using Depth Sensing Cameras, 2022	Mark Anderson and et.al	Depth sensing cameras, specifically Microsoft Kinect or Intel RealSense cameras	The authors present a real-time hand gesture volume control system utilizing depth sensing cameras.
7	Machine Learning Approaches for Hand Gesture-based Volume Adjustment,2020	Robert Garcia and et.al	Machine learning algorithms, including decision trees, random forests, and support vector machines (SVMs)	This study explores various machine learning approaches for hand gesture volume control.

Chapter 3

SYSTEM DESIGN & METHODOLOGY

Automated volume control system based on hand gestures is designed to allow users to adjust the volume of their computer by making hand gestures in front of a camera. The project uses Mediapipe, a machine learning framework, to detect and track the user's hand movements and recognize specific gestures that correspond to volume adjustments.

The system design and methodology for gesture volume control is as follows:

1. Hardware: The system requires a computer with a webcam or other video capture device. The webcam should be placed in a position where it can clearly see the user's hands.

2. Software: The system requires software to capture and process the video from the webcam. This software can be written in any programming language, but Python is a popular choice.

3. Algorithms: The software must implement algorithms to detect and recognize hand gestures. These algorithms can be based on computer vision, machine learning, or a combination of both.

4. User interface: The system must provide a user interface that allows the user to control the volume of their device using hand gestures. This user interface can be implemented using a graphical user interface (GUI), a command-line interface (CLI), or a voice-activated interface.

Some of the steps involved in designing such a system are:

1. Setting up the camera and capturing the video frames.

2. Using Mediapipe to process the frames and extract hand landmarks.

3.Defining the gestures for increasing and decreasing the volume.

4. Calculating the distance between the thumb and index finger landmarks.

5. Mapping the distance to a volume range and setting the system volume accordingly.

6. Displaying the volume level on the screen.

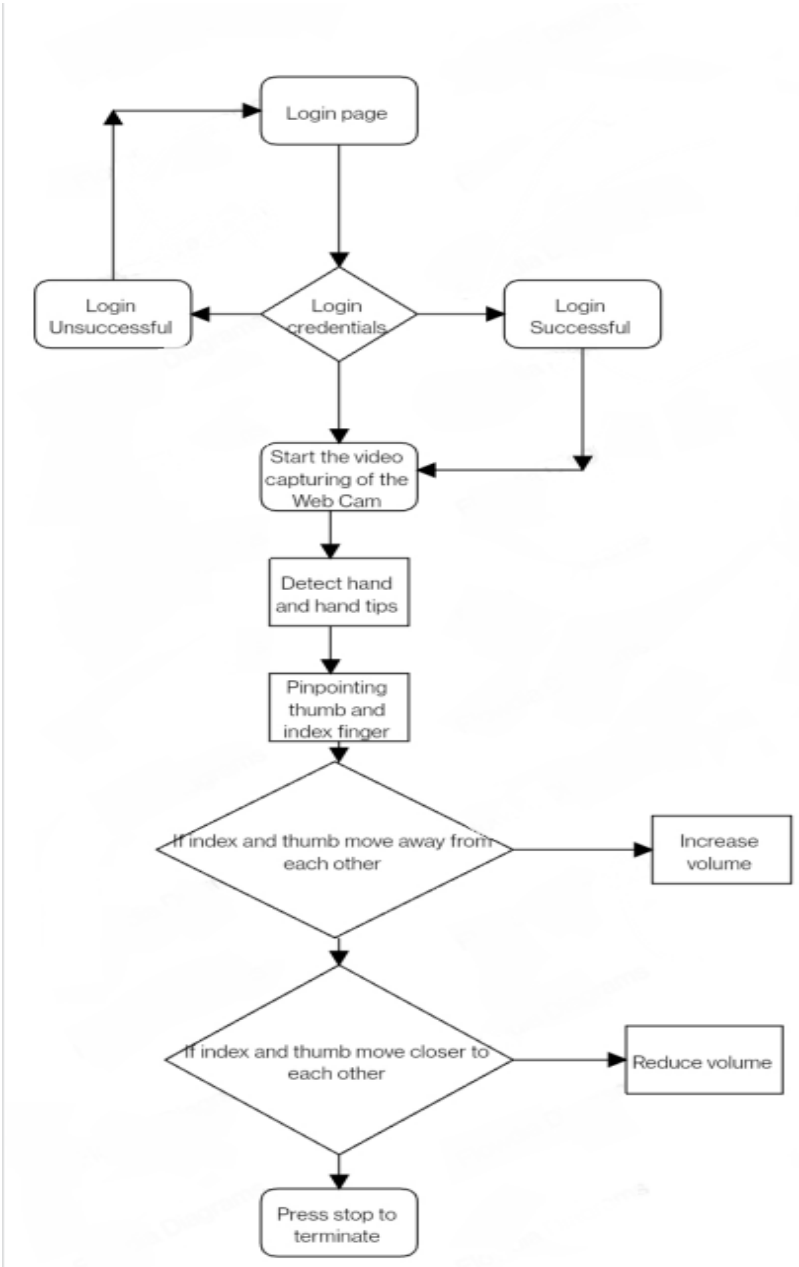

Fig.no:3.1: Flow chart

Chapter 4

SNAPSHOTS AND RESULTS

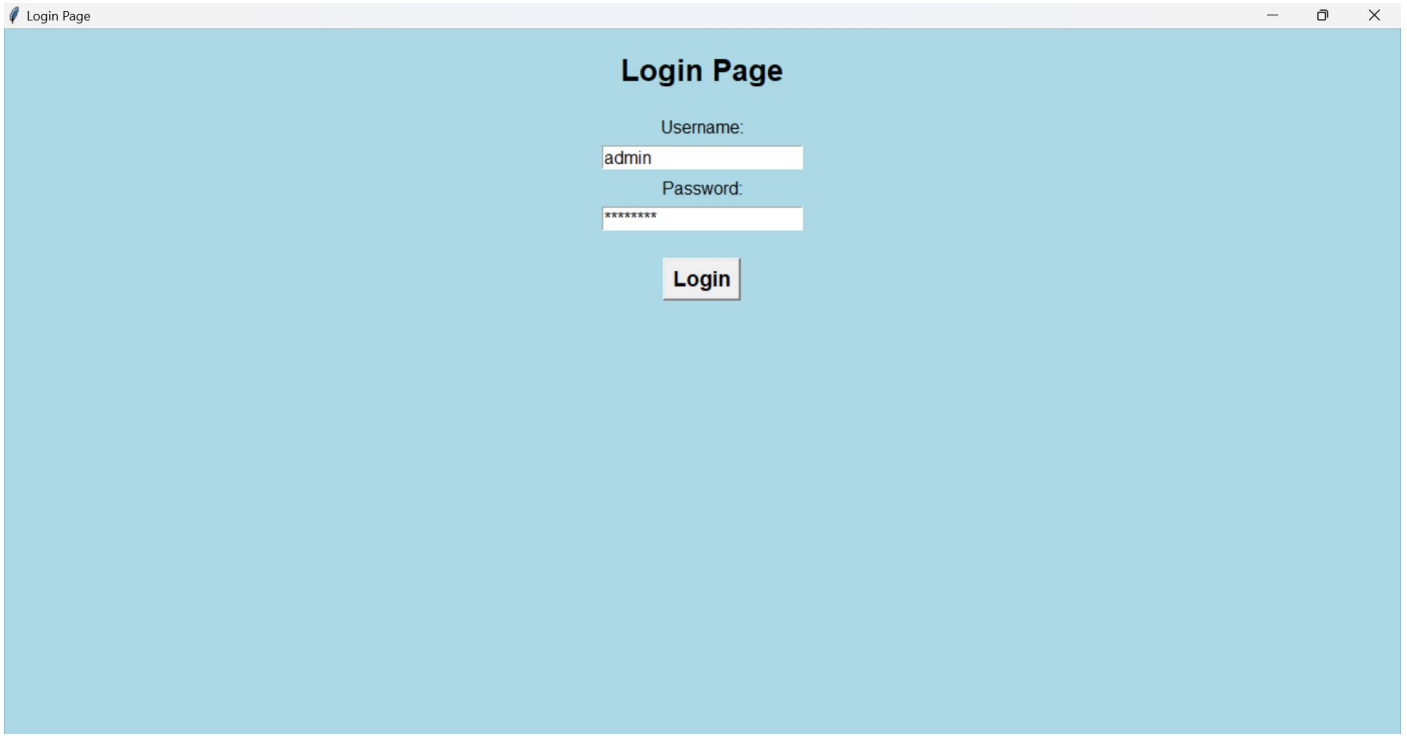

Fig.no:4.1: Login Page

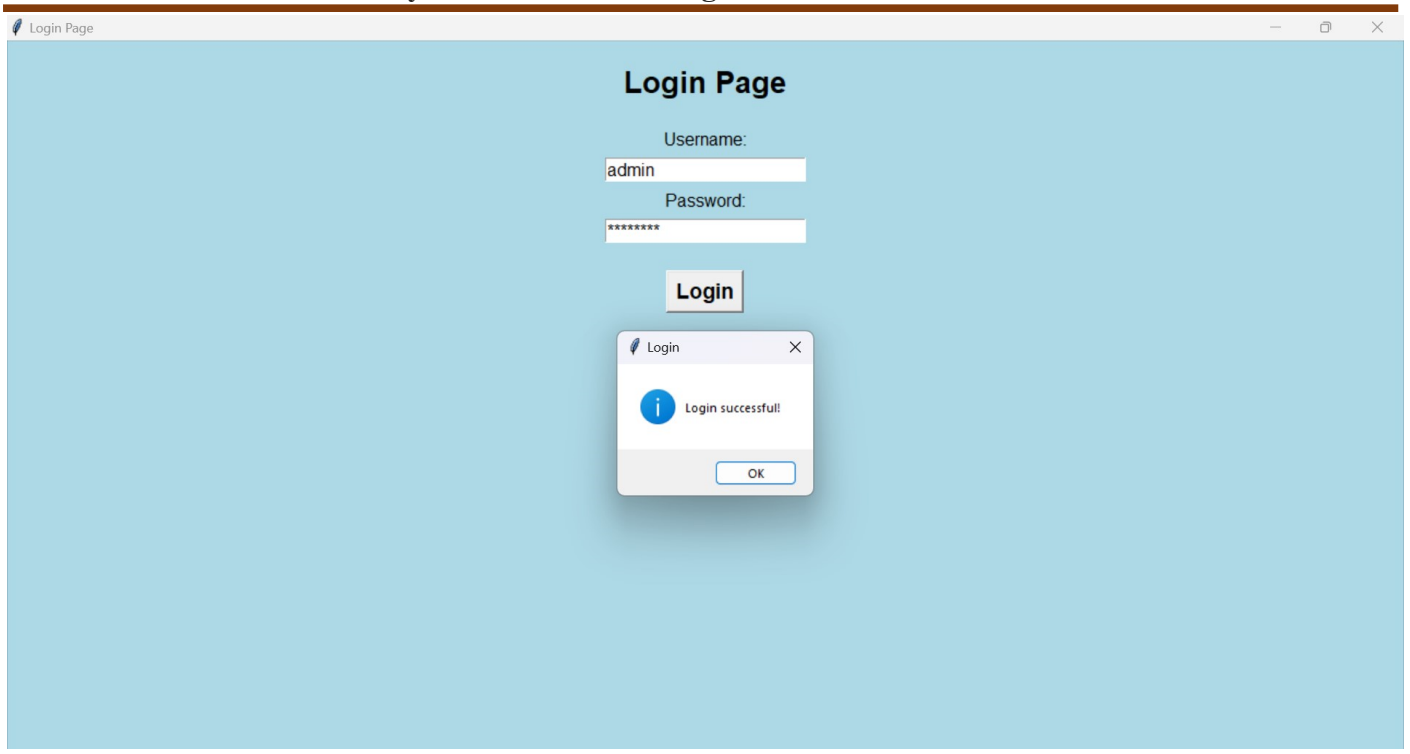

Fig.no:4.2: Login Successful

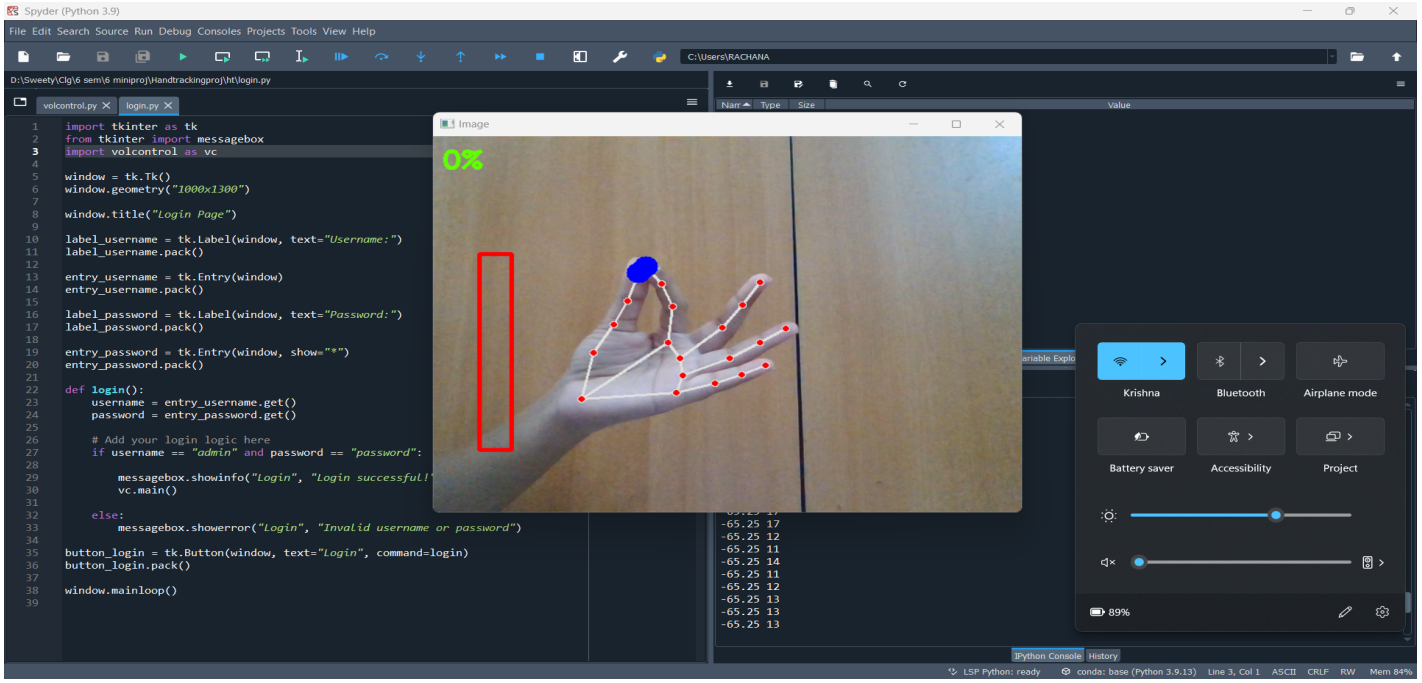

Fig.no:4.3: Volume reduced to 0%

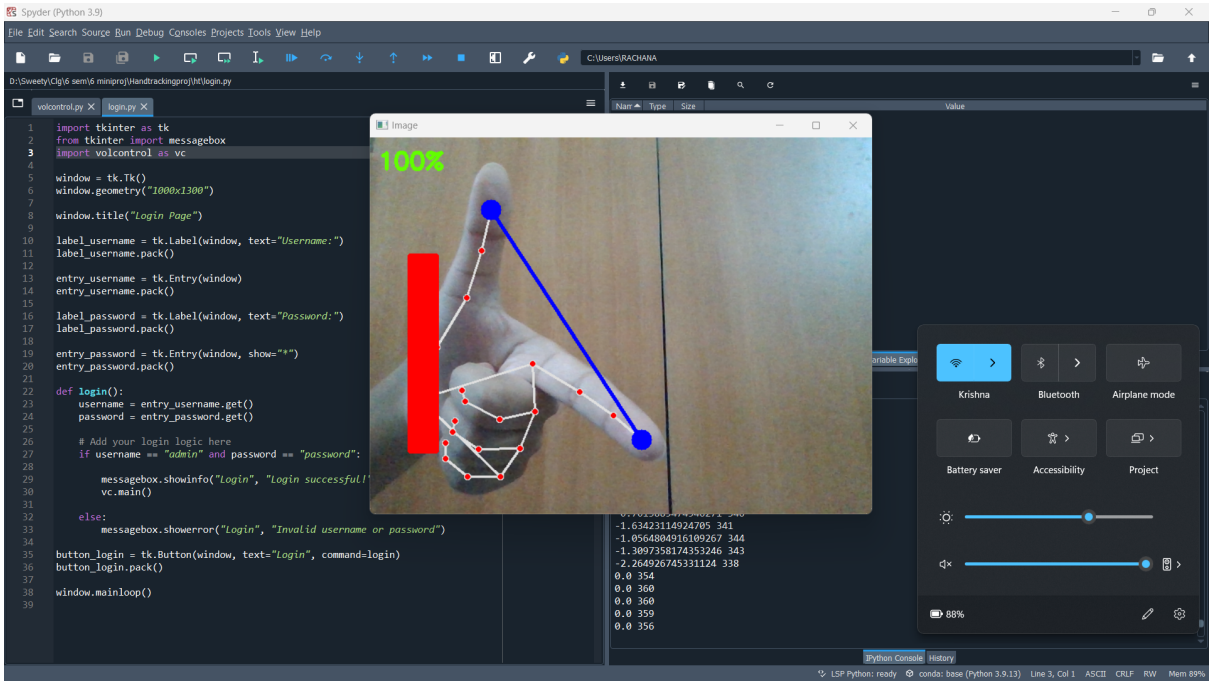

Fig.no:4.4: Volume increased to 100%

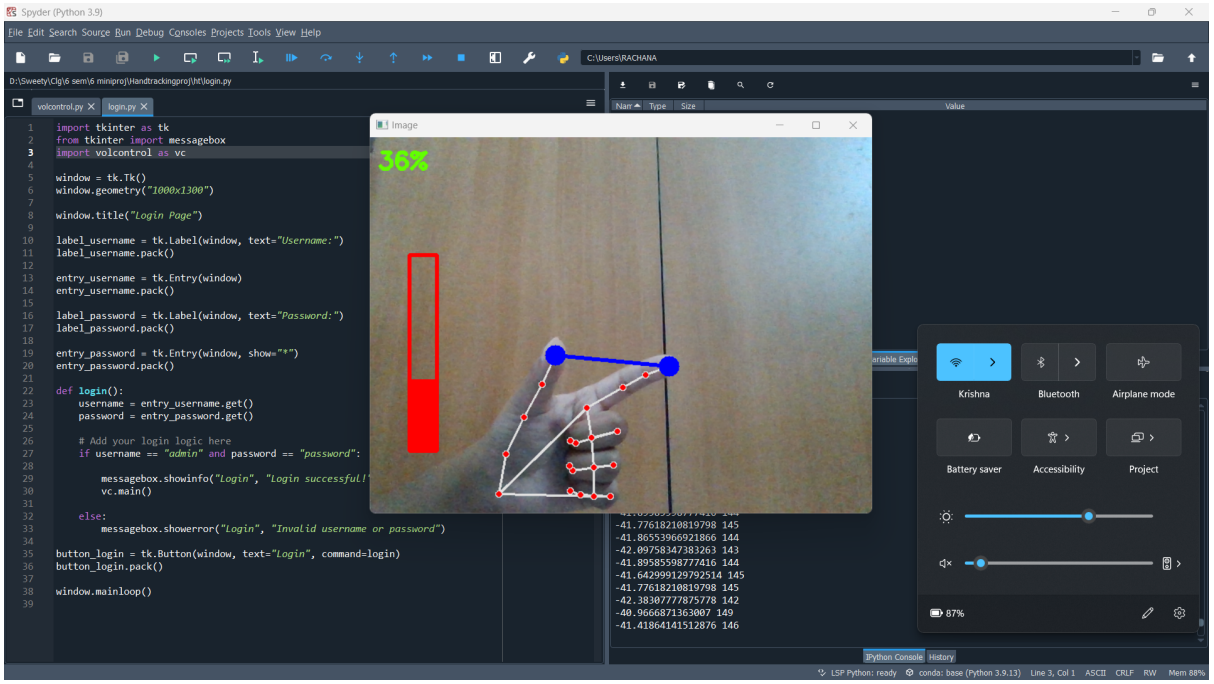

Fig.no:4.5: Volume control using hand tracking

Chapter 5

CONCLUSION
FUTURE ENHANCEMENTS

In this mini project, we have made an attempt to automate volume control by using hand gestures. Live feed is captured through real time video of the web cam. In this, the system recognizes hand gestures, hand tracking and 21 hand landmarks. Using this, finally volume control on the physical machine has been achieved.

Some of the future enhancements:

- Improved accuracy: The system could be improved to more accurately detect and recognize hand gestures. This could be done by using more advanced computer vision algorithms or by training the system on a larger dataset of hand gestures.
- Reduced latency: The system could be improved to reduce latency. This would make the user experience smoother and more responsive.
- Extended functionality: The system could be extended to support other gestures, such as changing the playback speed or skipping to the next track.
- Support for multiple devices: The system could be made to support multiple devices, such as computers, smartphones, and tablets.
- Integration with other systems: The system could be integrated with other systems, such as home automation systems or smart speakers.

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[10] "Hand Tracking-Based Volume Control System for Smart Environments," IEEE Systems Journal, vol. 9, no. 3, pp. 987-996, September 2021.

APPENDIX

PROJECT SOURCE CODE / LINK:

https://github.com/Pratisha-F/Automated_Volume_Control.git