

A
PROJECT REPORT
ON
“Meet U”

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UNDER THE GUIDANCE OF
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MASTER OF COMPUTER APPLICATIONS



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CERTIFICATE

This is to certify that **Mr. NEERAJ R. PRAJAPATI** has successfully completed the project on "**Meet U**" as a partial fulfilment of his **Master of Computer Applications (MCA)** under the curriculum of **Savitribai Phule Pune University, Pune** for the academic year 2022-23.

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Acknowledgment

The success and final outcome of this project required a lot of guidance and assistance from many people and we are extremely privileged to have got this all along the completion of our project. All that we have done is only due to such supervision and assistance and we would not forget to thank them.

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1 Introduction:

"Meet U" is designed to facilitate real-time video communication between users, enabling them to interact effortlessly from one PC to another. Whether it's connecting with friends and family across the globe or conducting virtual business meetings, the application offers a user-friendly and intuitive interface, making video calls accessible to users of all levels of technical expertise.

One of the standout features of "Meet U" is its advanced hand gesture recognition capability. In the quest for making video calls more interactive and engaging, the application leverages computer vision techniques to detect and interpret hand gestures made by participants during a call.

1.1 Problem Definition:

The present video calling applications do not cater to the unique communication needs of the deaf community, leading to communication barriers and limited expressiveness. Deaf users encounter challenges due to the absence of specialized features for sign language and the inability to interact naturally during video calls. Conventional applications lack the technology to recognize and interpret hand gestures used in sign language, hindering effective communication. To address these issues, "Meet U" sets out to introduce an intelligent hand gesture recognition system, enabling users to interact with the application in a more intuitive and fluid manner.

1.2 System Overview:

"Meet U" is a Python-based PC-to-PC video calling application with a hand gesture recognition system designed for the deaf community. Leveraging Python's versatility, the application provides seamless video calls between PCs. The heart of "Meet U" lies in its sophisticated machine learning model trained to interpret hand gestures used in sign language. Utilizing the PC's webcam, the system captures and analyzes user hand movements, enabling natural and expressive sign language communication during video calls. Through this innovative approach, "Meet U" aims to bridge communication gaps, empowering the deaf community also empowers the deaf community with intuitive interactions, including user registration, contact management, video calling, and call handling, fostering inclusive and meaningful video communication experiences.

1.3 Definitions, Acronyms and Abbreviations:

1. ML Model: Abbreviation for "Machine Learning Model." In the context of the project, the ML model is trained using Scikit-learn and OpenCV to recognize various hand gestures based on image data.
2. Anaconda: An open-source distribution of Python for data science and machine learning tasks.
3. Firebase FireStore Database: An NoSQL Free Cloud Database server.
4. Webcam: A webcam is a type of digital camera that is built into or connected to a computer, laptop, or other devices, typically through a USB port.
5. Machine Learning: Machine learning is a subset of artificial intelligence (AI) that involves developing algorithms and statistical models that enable computers to learn and improve their performance on a specific task without being explicitly programmed.
6. CNN: Convolutional Neural Network, a type of deep learning model commonly used for image related tasks
7. Hand Gesture Recognition: The process of using computer vision and machine learning techniques to interpret and understand the gestures made by a user's hand. In the "Meet U" project, hand gesture recognition enables deaf users to communicate using sign language during video calls.
8. OpenCV: Abbreviation for "Open Source Computer Vision Library." OpenCV is an open-source library of computer vision and image processing functions used in the "Meet U" project for hand gesture recognition.
9. Deaf: An individual who has a hearing impairment, relying on sign language and visual communication for interaction.
10. Socket Programming: The process of establishing network communication between two computers over the internet. In the project, socket programming facilitates real-time video calling between users.

1.4 Project Functionalities:

"Meet U" boasts a comprehensive set of functionalities designed to elevate the video calling experience and cater to the unique needs of the deaf community:

1. User Registration and Login: The application offers a user-friendly registration and login process, allowing users to create accounts and securely access personalized video calling environments.
2. Contact Management: Users can seamlessly add new contacts to their list and remove existing ones, simplifying the process of connecting with friends, family, and colleagues.
3. Video Calling: "Meet U" establishes real-time video calls between users, facilitating seamless audio and video connections for face-to-face communication.
4. Hand Gesture Recognition: The heart of "Meet U," the hand gesture recognition system, empowers users to communicate using sign language during video calls. The machine learning model accurately interprets hand gestures, enabling natural and expressive interactions.
5. Call Handling: Users have the option to accept or decline incoming video calls, granting them control over their communication preferences and availability.

1.5 Operating Environment:

1. Hardware Requirement:

CPU: A modern multicore processor is essential for running image processing and machine learning algorithms efficiently. Higher clock speeds and more cores can improve the system's performance.

- RAM: 8GB
- Hard Disk: 512GB
- Processor: CORE i5, AMD Ryzen 5
- Web Camera: Supported on system

RAM: Adequate RAM is required to store and process images, especially when working with high-resolution video streams or multiple face detection instances simultaneously.

Webcam and mic: For Video Calling, a webcam and mic is necessary to capture images or video streams for processing.

2. Software Requirement:

- **Operating System:** The project can be developed and deployed on various operating systems, including Windows, macOS, and Linux. The required libraries and dependencies are compatible with the chosen OS.
- **Python:** Python is the primary programming language for many computer vision and deep learning projects. Install Python and ensure it is set up correctly.
- **Python Libraries:** Installed the necessary Python libraries for project such as,
 - a) **OpenCV:** Open-Source Computer Vision Library is an open-source computer vision and machine learning software library. It provides a wide range of tools, algorithms, and functions for various computer vision tasks.
 - b) **TensorFlow:** TensorFlow is an open-source machine learning framework developed by the Google Brain team. It is widely used for building and training various machine learning models, especially deep learning models like convolutional neural networks (CNNs).
 - c) **Keras:** Originally developed as a standalone deep learning library, Keras is now part of the TensorFlow ecosystem. Keras offers a high-level API for building and training neural networks, making it easy to quickly prototype models.
 - d) **PyQt5:** PyQt5 is a set of Python bindings for the Qt application framework, which allows developers to create cross-platform desktop applications with a graphical user interface (GUI).

2 Proposed System:

2.1 Proposed System:

The "Meet U" project presents an innovative video calling application designed to cater specifically to the deaf community, empowering them with seamless and expressive interactions through sign language. The proposed system encompasses the following key components:

1. User Interface:

The User Interface (UI) of "Meet U" will be intuitively designed to ensure ease of use and accessibility for all users, including the deaf community. The UI will feature clear and visually descriptive elements, making it straightforward for users to navigate through various functionalities, such as registration, contact management, and video calling. Additionally, the hand gesture recognition feature will be seamlessly integrated into the UI, allowing deaf users to communicate naturally during video calls using sign language.

2. Database:

The proposed system will leverage Firebase Firestore as the database to store user profiles, contact lists, and other relevant information securely. The database will be structured to optimize data retrieval and storage, further enhancing the application's overall performance.

3. Hand Gesture Recognition:

At the core of the proposed system lies the Hand Gesture Recognition feature, powered by a machine learning model trained to interpret sign language gestures. The model will capture and analyze hand movements from the user's webcam during video calls, translating them into meaningful commands within the application. This technology will enable deaf users to communicate fluently using sign language, fostering inclusive and expressive interactions during video calls.

4. Real-Time Communication:

The proposed system will implement WebRTC (Web Real-Time Communication) to facilitate real-time audio and video communication between users.

5. User Authentication and Security:

User authentication will be implemented to ensure secure access to the application's features.

2.2 Objectives of the System:

The key objectives of the "Meet U" system are as follows:

1. Enhancing Deaf Communication: The primary goal of the proposed system is to enhance communication for the deaf community by providing a platform that recognizes and interprets sign language gestures during video calls.
2. Inclusivity and Accessibility: "Meet U" aims to be an inclusive and accessible video calling application, allowing deaf users to communicate naturally and meaningfully with others, irrespective of geographical boundaries.
3. Seamless User Experience: The system seeks to provide a seamless user experience by offering features like user registration, contact management, and efficient call handling, ensuring users can connect effortlessly with their peers.

2.3 Feasibility Study:

A comprehensive feasibility study will be conducted to assess the technical, economic, and operational viability of the proposed system. This study will analyze the technological capabilities of the application, cost-effectiveness of development, and potential user acceptance. It will also address any potential risks and challenges that may arise during the development and implementation phases.

2.4 User Requirement Specification:

The User Requirement Specification (URS) outlines the specific needs and preferences of the target user group, the deaf community, to ensure that the "Meet U" video calling application effectively addresses their communication expectations. The URS comprises the following key subheadings:

1. Communication Accessibility:

The application should provide a user-friendly interface that enables easy navigation and seamless communication for the deaf community.

The hand gesture recognition feature must accurately interpret a variety of sign language gestures, allowing users to express themselves naturally during video calls.

Real-time communication with low-latency audio and video streaming is essential for smooth and uninterrupted interactions.

2. Inclusivity and Expressiveness:

The "Meet U" application should promote inclusivity by catering specifically to the needs of deaf users, enabling them to communicate effectively and expressively through sign language.

The hand gesture recognition system must be capable of recognizing a wide range of sign language gestures to ensure that users can communicate naturally and expressively with others.

3. User Registration and Account Management:

The application should offer a seamless user registration process, allowing users to create accounts and access personalized video calling environments securely. Users should be able to manage their profiles and update personal information easily.

4. Contact Management:

The "Meet U" application should allow users to add new contacts to their list and remove existing ones effortlessly.

The contact management feature should enable users to organize and categorize their contacts for convenient access.

5. Video Calling Functionality:

Users should be able to initiate video calls with their contacts easily and efficiently.

The application should support real-time video streaming with high-quality audio and video for a smooth video calling experience.

6. Call Handling:

Users should have the option to accept or decline incoming video calls, giving them control over their communication preferences and availability.

The application should provide clear and intuitive call handling features for easy call management during video calls.

7. Data Security and Privacy:

User data, including personal information and call history, should be stored securely and protected from unauthorized access.

The application should employ encryption and security protocols to ensure the privacy and confidentiality of user data.

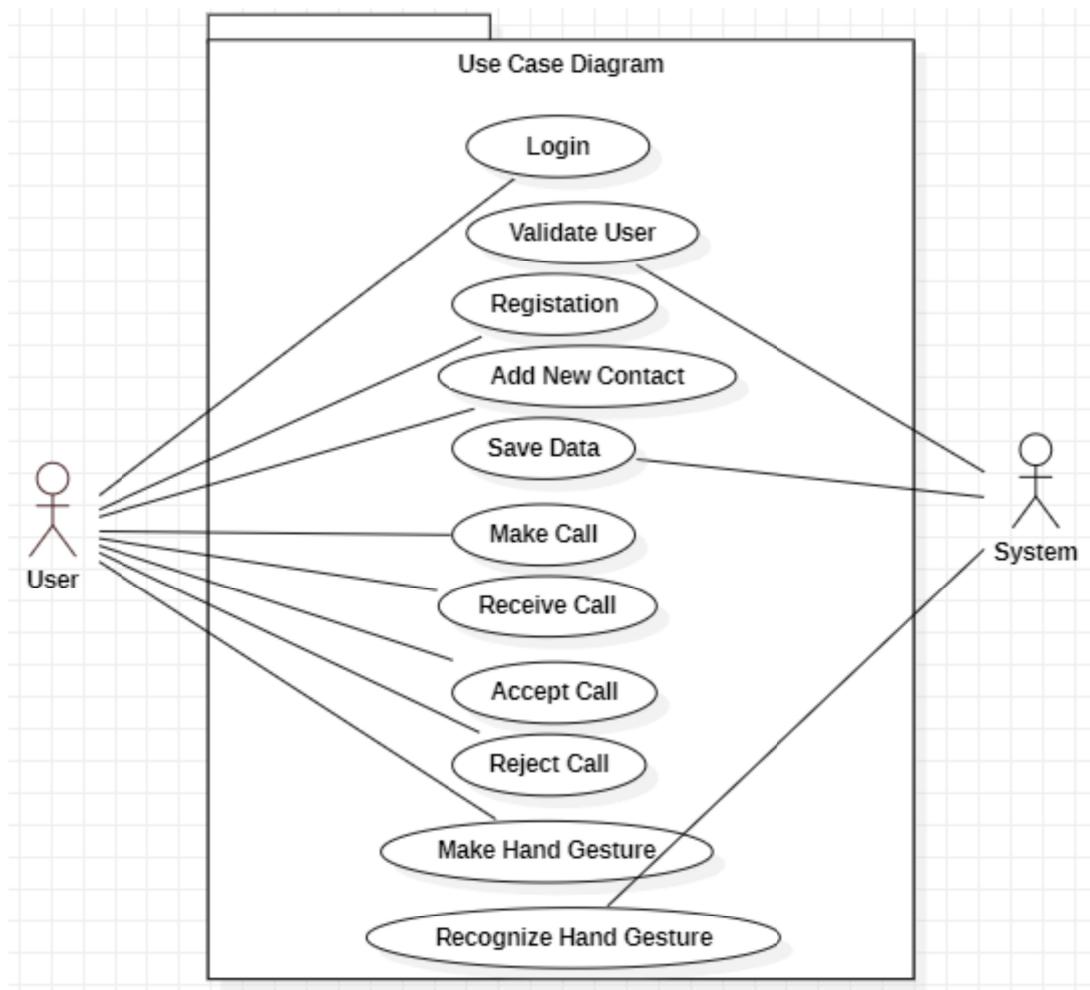
8. Scalability and Performance:

The application should be designed to handle a growing user base and increasing demand for video calling services without compromising performance.

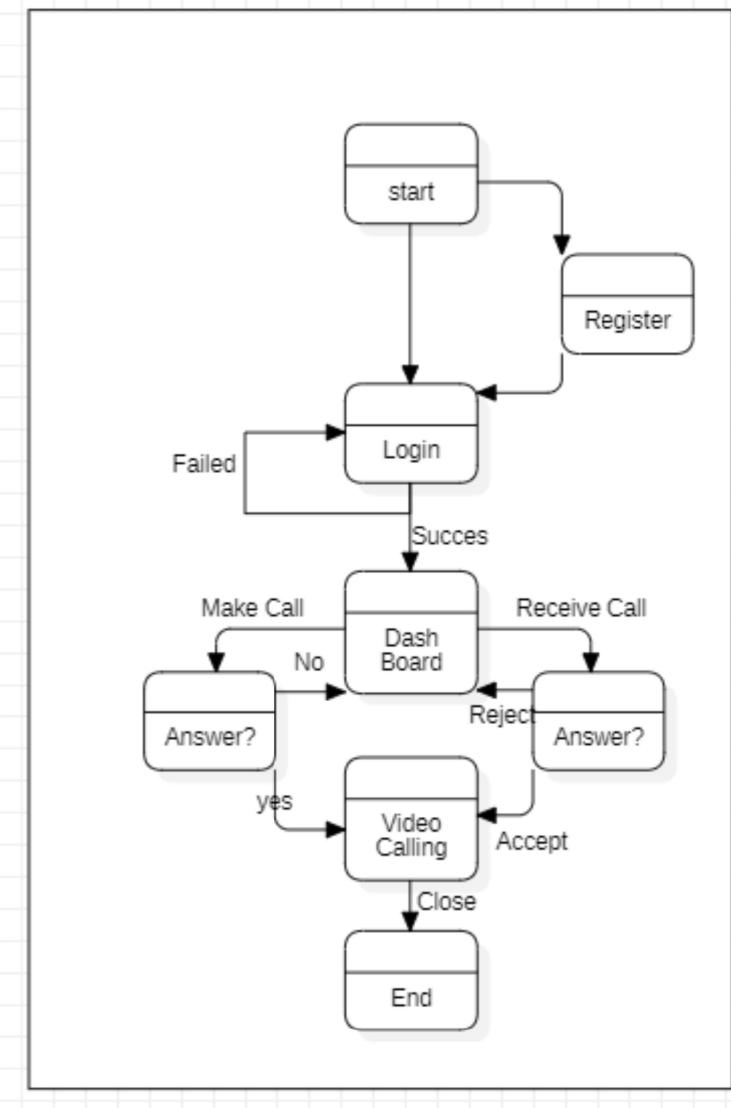
Performance optimization techniques should be implemented to ensure smooth video calling experiences, even during peak usage.

3 System Analysis & Design

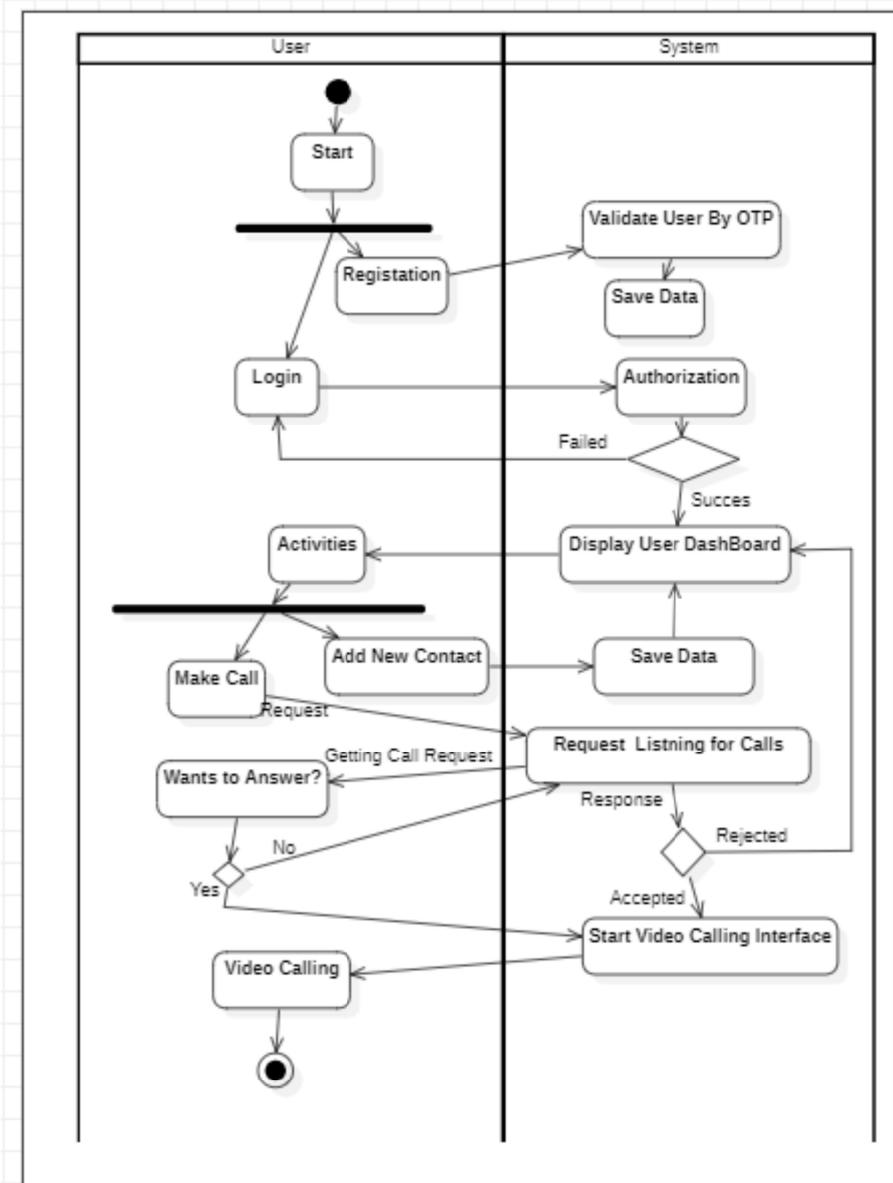
3.1 Use Case Diagram:



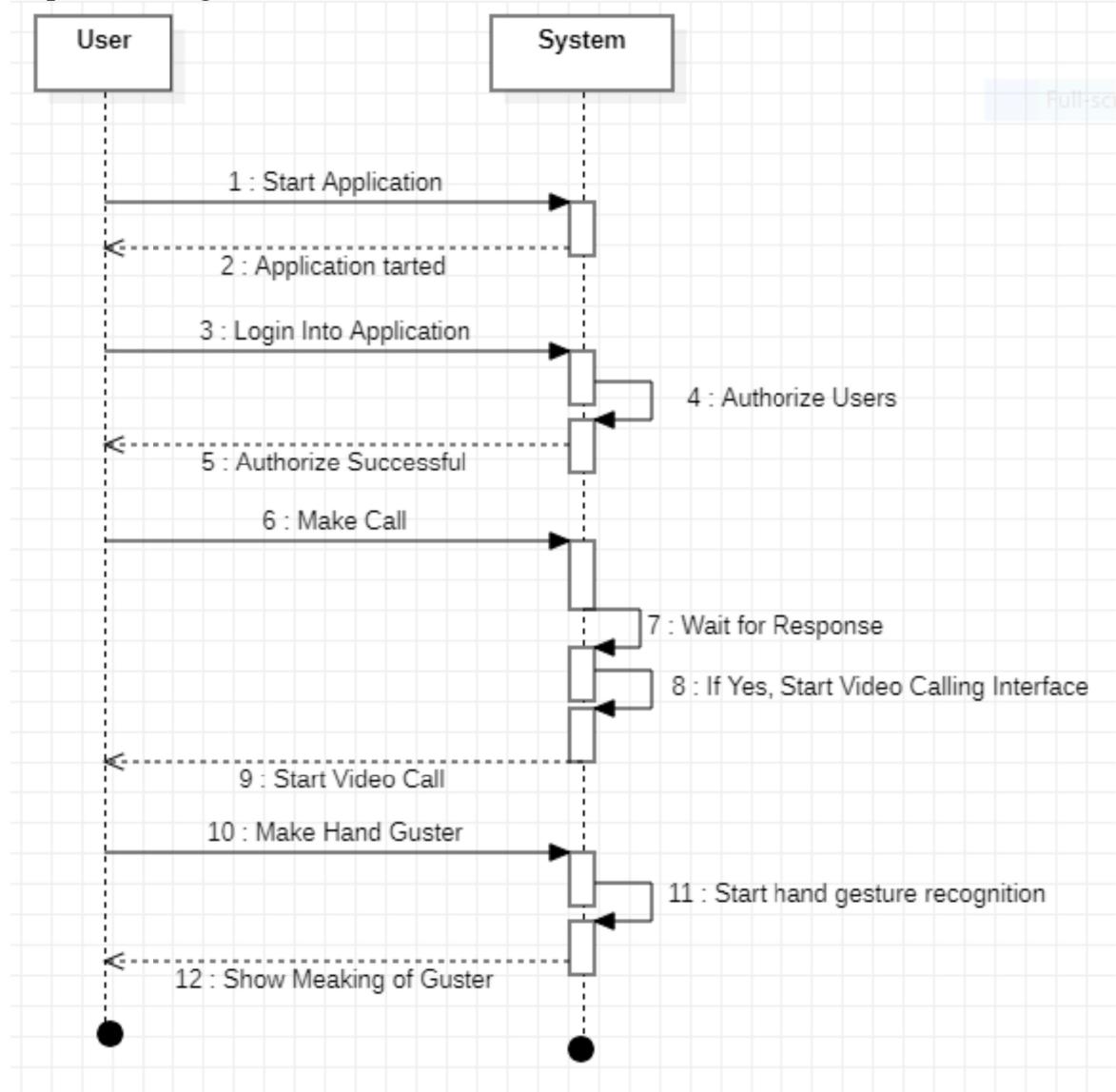
3.2 Data Flow Diagrams



3.3 Activity Diagram



3.4) Sequence Diagram



3.5) Database Structure:

The screenshot shows the Google Cloud Firestore interface for a database named "MEET U". The left sidebar shows a collection named "Users". A specific document under "Users" is selected, which corresponds to the email address "neerajrp1999@gmail.com". This document has several fields:

- IPAddress: "192.168.13.67"
- contact (array field):
 - 0: neerajrp1999.2@gmail.com: "radhe"
 - name: "Neeraj R Prajapati"
 - password: "1234"

4 User Manual

4.1 Operational Instructions:

1. Registration:

- Go to the Login/Registration Page.
- Fill in the required information, such as your email, and password.
- Confirm Email Id by OTP Verification.
- Click "Registration" to create your account.

2. Login:

- Go to the Login/Registration Page.
- Enter your registered Email and password.
- Click "Login" to access your account.

3. Dashboard:

- After logging in, you will be redirected to your personalized dashboard.
- Explore the different sections and options available to call another users and fill new contact info.

4. Call Another User:

- On dashboard, In Contact List, You can see your all contact info.
- On Contact List, Click On Call Button On your friend contact for calling.

5. Accept/Reject Call:

- When You will receive call , You get notify and get option of Yes And NO.
- For Accept Call , click on Yes and for Rejecting Call Click on No.

6. Add New Contact Info:

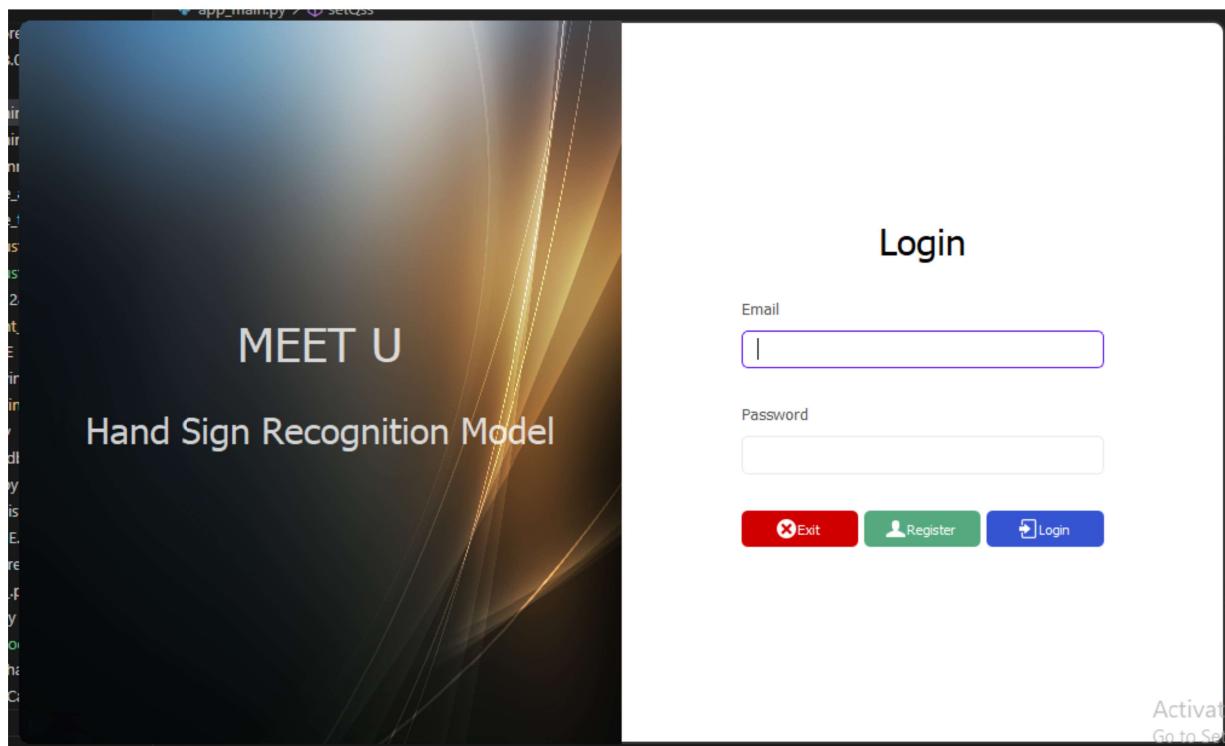
- For Adding new Contact Info, Go to “Add New Contact” section on dashboard.
- Add All Info and Click Add Button.

7. Logout:

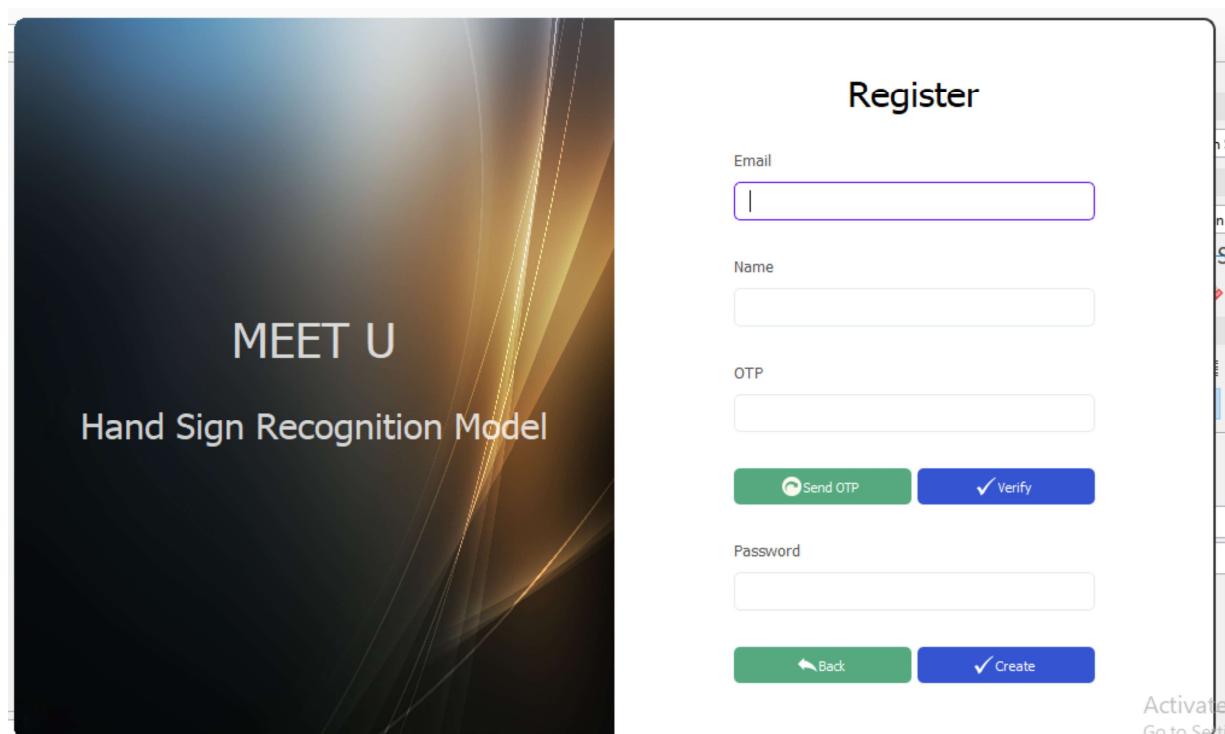
- To log out of your account, locate the "Logout" option, usually available in the account menu.
- Click on the option to securely log out of your account.

4.2 Input/Output Screen

Login Screen:



Registration Page:



Home Page:

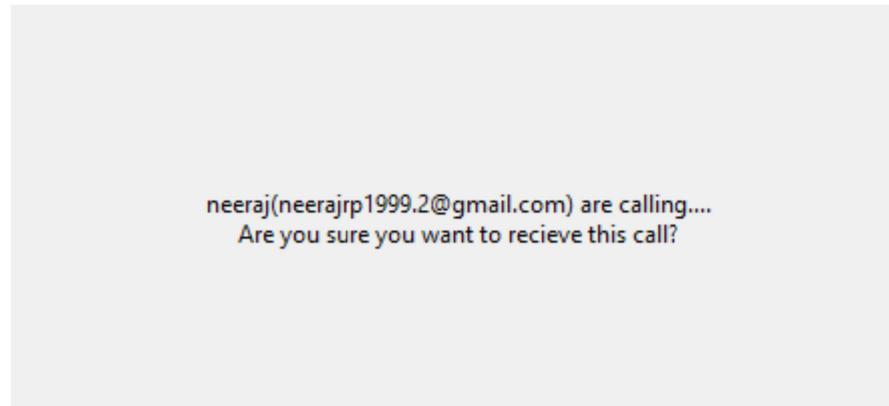
The screenshot shows the 'MeetU' application's home page. On the left is a dark sidebar with a yellow key icon at the top, followed by 'Contact List' and 'ADD New Contact' buttons, and a 'Logout' button at the bottom. The main area has a search bar with 'Search' and 'Refresh' buttons. A table displays a single contact entry:

ID	Name	G-Mail	Call	Delete
1	radhe	neerajrp1999.2@gmail.com		

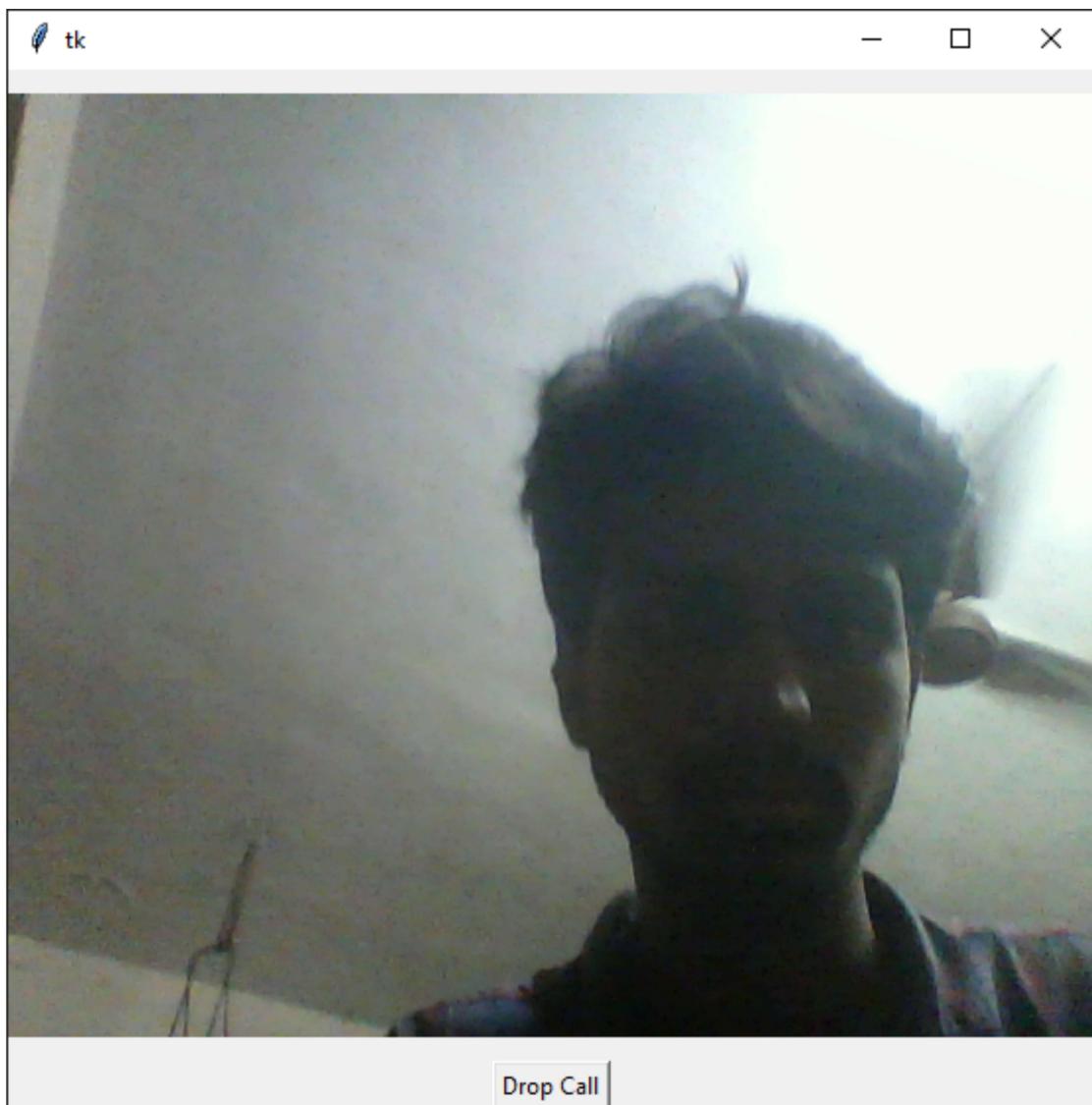
Add New Contact Page:

The screenshot shows the 'MeetU' application's 'ADD NEW CONTACT' page. The left sidebar is identical to the home page. The main area features a form titled 'ADD NEW CONTACT' with fields for 'Name' and 'G-Mail ID'. Below the form are three buttons: 'Reset' (green), 'Verify User' (blue), and 'ADD' (green).

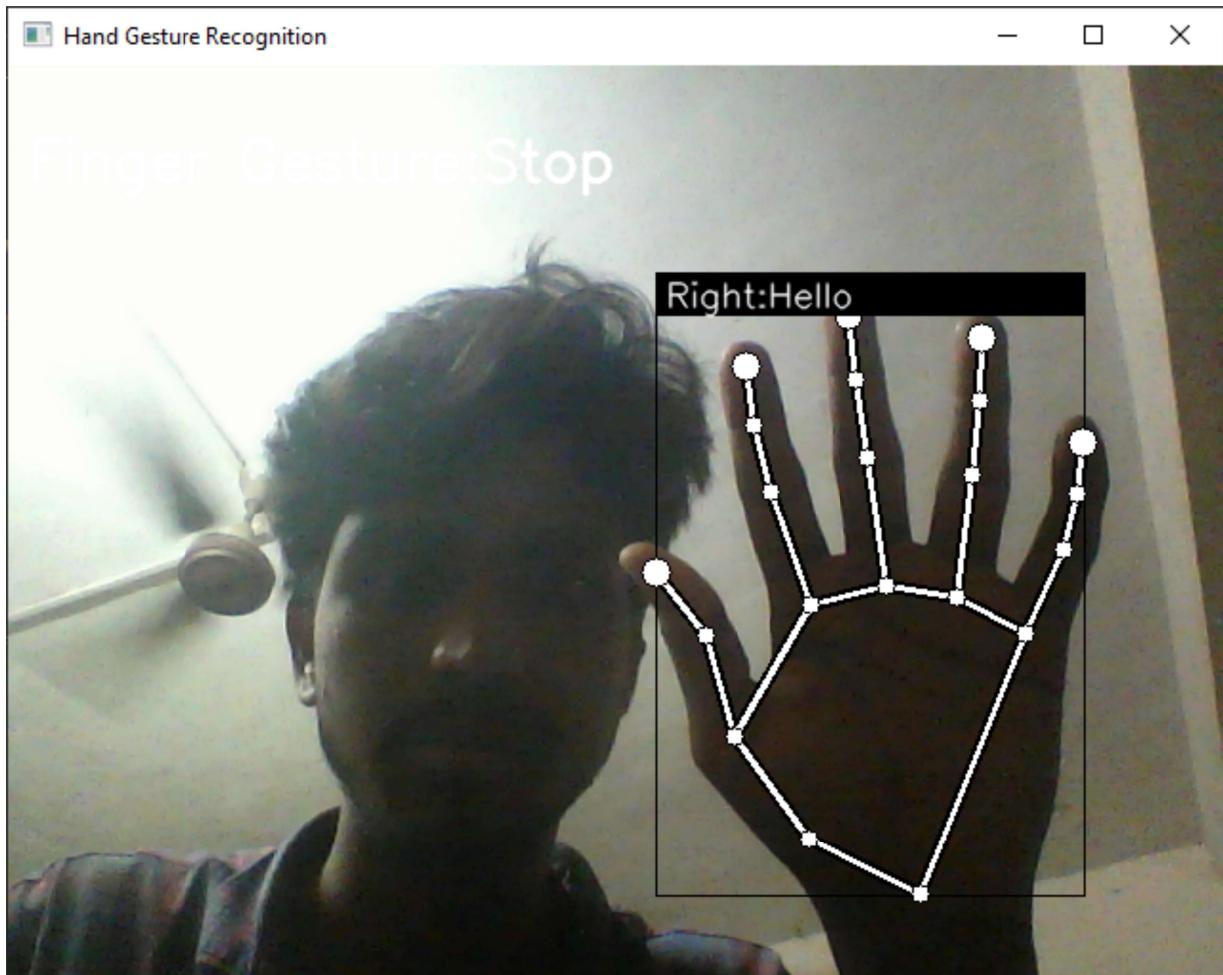
Call Receive:



Video Calling:



Hand Gesture Recognition:



5. System Limitations

The "Meet U" project, aimed at empowering the deaf community with an innovative video calling experience, demonstrates remarkable potential. However, it is essential to recognize and address certain system limitations that may impact its performance. The following are some notable limitations:

1. Slow Performance: The system's performance may be affected by factors like complex hand gesture recognition algorithms and real-time video processing, leading to potential delays or lags during video calls.
2. Limited Hand Gesture Recognition: While the machine learning model is trained to recognize a diverse set of hand gestures, rare or regional sign language gestures may not be accurately interpreted, limiting the system's vocabulary.
3. Socket-based Video Calling: The utilization of socket for video calling introduces inherent limitations, such as network reliability concerns, firewall restrictions, and potential latency issues.
4. Internet Dependency: The application's effectiveness heavily relies on a stable and fast internet connection. Slow or unstable internet connections may hinder the real-time video and audio streaming experience.
5. Hardware Requirements: The system's hand gesture recognition feature requires a capable PC with a high-resolution webcam. Lower-end hardware may impact gesture recognition accuracy.
6. User Training: Users may need time to adapt to the hand gesture recognition system, necessitating user training and practice for optimal communication.
7. Resource Utilization: The application's resource-intensive processes, such as video streaming and machine learning, may lead to higher CPU and memory usage on resource-constrained systems.
8. Each system limitation presents an opportunity for improvement and refinement. By addressing these challenges, "Meet U" can evolve into a more robust and user-friendly platform, delivering a more satisfying experience for its users.

6. Future Enhancement

1. Faster Performance: Make the application run smoother and quicker during video calls by using better technology.
2. More Gesture Recognition: Teach the application to understand more sign language gestures accurately.
3. Better Internet Handling: Improve the application's ability to work well with slow internet connections.
4. User-Friendly Design: Make the app easier to use for deaf users when registering, managing contacts, and handling calls.
5. Offline Features and History: Allow some parts of the application to work without internet and show past video call history.
6. Support for Different Devices: Make the app work on different devices like tablets and phones.
7. User Feedback and Improvements: Ask users for their opinions and use their feedback to make the app better.
8. Connect with Sign Language Resources: Link the app to sign language dictionaries and learning tools.

7. Conclusion

The "Meet U" project is a significant step towards making video calling inclusive and accessible for the deaf community. Using Python, VS Code, and Anaconda, we created a system that recognizes sign language gestures during video calls, allowing deaf users to communicate naturally. The features like login, registration, contact management, and call handling make the app user-friendly.

While the project has some limitations, such as slow performance, limited gesture recognition, and the need for fast internet, it sets a strong foundation for future improvements. Storing data in Firebase Firestore ensures secure data management. With ongoing efforts, we aim to optimize performance, expand gesture recognition, and improve the user interface.

In conclusion, "Meet U" showcases the potential of technology in fostering inclusivity. By addressing limitations and embracing future enhancements, we hope to empower the deaf community with an enriched video calling experience, promoting meaningful connections and communication.

8. Bibliography

The successful development of the "Meet U" project was made possible with the help of various resources and references that played a crucial role in shaping and enriching the project. Here is a list of references used in the development and creation of the website:

Python Documentation: <https://www.python.org/doc/>

Python GUI (PyQt5): <https://www.riverbankcomputing.com/static/Docs/PyQt5/>

Anaconda Documentation: <https://docs.anaconda.com/>

Firebase Database: <https://firebase.google.com/docs>

OpenCV: <https://docs.opencv.org/>

Scikit-learn: <https://scikit-learn.org/stable/documentation.html>

Socket Programming: Online resources and guides that assisted in establishing socket connections for real-time video calling, enhancing the application's functionality.