A
Project Report
On
"GESVOC"

Prepared by
20CS065 Kishan Prajapati
20CS068 Pruthvi Raj

Under the guidance of

Asst. Prof. Bela Shah

Submitted to

Charotar University of Science & Technology

Degree of Bachelor of Technology

in Computer Science & Engineering

CS357 : Software Group Project-IV

Of 6th Semester of B.Tech

Submitted at

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Faculty of Technology & Engineering, CHARUSAT

Chandubhai S. Patel Institute of Technology

At: Changa, Dist: Anand – 388421

April 2023

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Accredited with Grade A+ by NAAC

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Faculty of Technology & Engineering, CHARUSAT

Chandubhai S. Patel Institute of Technology

At: Changa, Dist: Anand – 388421

April 2023

DECLARATION BY THE CANDIDATES

We hereby declare that the project report entitled "**GESVOC**" submitted by us to Chandubhai S. Patel Institute of Technology, Changa in partial fulfilment of the requirements for the award of the degree of **B.Tech Computer Science & Engineering**, from Department of Computer Science & Engineering, CSPIT, FTE, is a record of bonafide CS357 Software group Project-IV carried out by us under the guidance of **Asst. Prof**. **Bela Shah**. We further declare that the work carried out and documented in this project report has not been submitted anywhere else either in part or in full and it is the original work, for the award of any other degree or diploma in this institute or any other institute or university.

Signature of the candidate
(Kishan Prajapati-20CS065)

Signature of the candidate
(Pruthvi Raj-20CS068)

This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

Asst. Prof. Bela Shah
Department of Computer Science & Engineering,
Chandubhai S Patel Institute of Technology (CSPIT)
Faculty of Technology (FTE)
Charotar University of Science and Technology (CHARUSAT) - Changa.

CHARUSAT
CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

CERTIFICATE

This is to certify that the report entitled "**GESVOC**" is a bonafied work carried out by **Kishan Prajapati (20CS065)** under the guidance and supervision of **Asst. Prof. Bela Shah** for the subject **Software Group Project - IV (CS357)** of 6th Semester of Bachelor of Technology in **Computer Science & Engineering** at Faculty of Technology & Engineering (C.S.P.I.T.) – CHARUSAT, Gujarat.

To the best of my knowledge and belief, this work embodies the work of candidate himself, has duly been completed, and fulfills the requirement of the ordinance relating to the B.Tech. Degree of the University and is up to the standard in respect of content, presentation and language for being referred to the examiner.

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CERTIFICATE

This is to certify that the report entitled "**GESVOC**" is a bonafied work carried out by **Pruthvi Raj (20CS068)** under the guidance and supervision of **Asst. Prof. Bela Shah** for the subject **Software Group Project - IV (CS357)** of 6th Semester of Bachelor of Technology in **Computer Science & Engineering** at Faculty of Technology & Engineering (C.S.P.I.T.) – CHARUSAT, Gujarat.

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ABSTRACT

This system aims to provide a more intuitive and natural way for users to interact with their PCs by integrating gesture recognition and voice commands. By using hand gestures, users can perform various actions and additionally, users can issue voice commands to perform tasks such as opening applications, searching the web and much more. The system utilizes advanced Python libraries to come up with an innovative solution of interacting with your desktop device in a more interactive and engaging manner.

ACKNOWLEGEMENT

We are privileged to have this opportunity to express our gratitude and acknowledge everyone's never ending support and valuable contributions for our project.

Prima facie, we would like to express my sincere thanks and gratitude to my Lab in charge Asst. Prof. Bela Shah, for the continuous support of our project study and related research, for her patience, motivation, and immense knowledge

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CHAPTER – 1 INTRODUCTION

1.1. PROJECT SUMMARY

The system aims to provide a more intuitive and natural way for users to interact with their PCs by integrating gesture recognition and voice commands. By using hand gestures, users can perform various actions and additionally, users can issue voice commands to perform tasks such as opening applications, searching the web and much more, making interaction with desktop device more interactive and engaging.

1.2. SCOPE

The scope of the above project is to develop a software system that integrates gesture recognition and voice commands to provide users with a more intuitive and natural way of interacting with their PCs. The system will require the use of advanced python libraries to interpret hand gestures and voice commands.

The project scope will include the following:

- Development of the software system for gesture recognition and voice command integration.
- Implementation of various hand gestures for performing different actions.
- Implementation of a wide range of voice commands for performing various tasks.
- Testing and debugging of the software system.
- User interface design and user experience optimization.

1.3. OBJECTIVE

The project has the potential to improve the user experience of PC use, particularly for individuals who prefer a more intuitive and natural way of interacting with technology. The system can also have applications in various industries, including healthcare, education, and entertainment, where hands-free operation and interactive interfaces are increasingly in demand.

1.4. TECHNOLOGY AND LITERATURE REVIEW

The tools and technologies used for developing this project are given as follows:

- Tools**:** VS code, Google APIs
- Technology: Python and its libraries such as Speech Recognition, MediaPipe, NumPy, WebBrowser etc.

CHAPTER - 2 PROJECT MANAGEMENT

2.1. PROJECT PLANNING

2.1.1. Project Development Approach and Justification

For the above project, the Agile software development lifecycle can be used. The Agile methodology is suitable for software projects that require frequent changes and improvements throughout the development process.

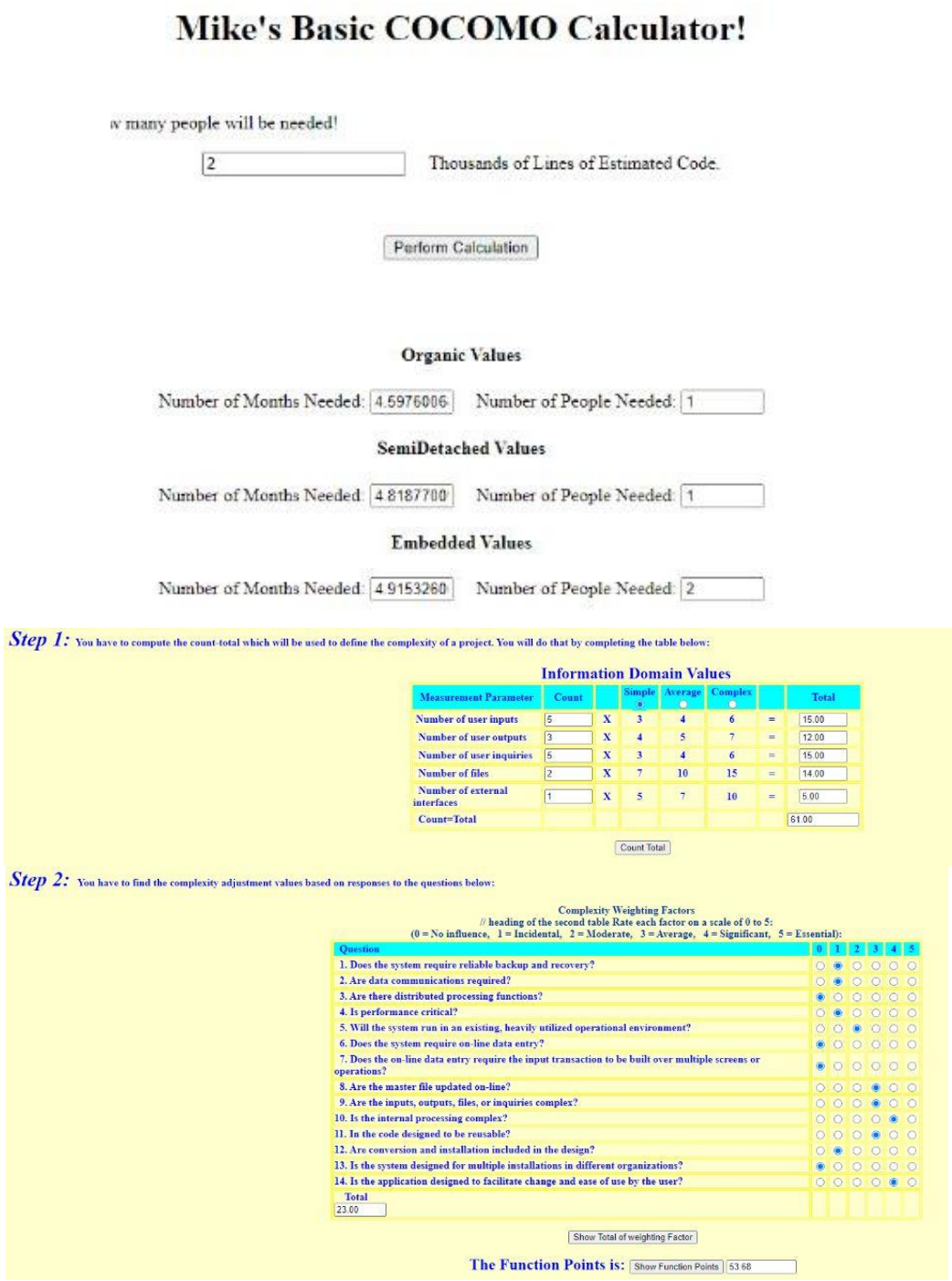
Here are some justifications for using the Agile methodology for this project:

- Flexibility: The Agile methodology allows for flexibility and adaptability to changes and requirements throughout the project. This is crucial for a project that integrates gesture recognition and voice commands, where there may be constant iterations and updates to improve the user experience.
- Customer satisfaction: The Agile methodology is customer-centric, focusing on delivering a product that meets the customer's needs and requirements. The frequent feedback loops and communication channels between the development team and the customer ensure that the end product is tailored to the customer's needs.
- Continuous improvement: The Agile methodology emphasizes continuous improvement and collaboration within the development team. The team can constantly reflect and improve upon their work, making the necessary changes and adjustments to meet the project's goals.
- Time-to-market: The Agile methodology is known for its ability to deliver working software quickly and frequently. This is beneficial for a project such as gesture recognition and voice commands integration, where time-to-market is crucial to staying ahead of the competition.

Overall, the Agile methodology is a suitable choice for this project as it allows for flexibility, customer satisfaction, continuous improvement, and quicker time to market.

2.1.2. Project Effort and Time, Cost Estimation

- **Calculations**



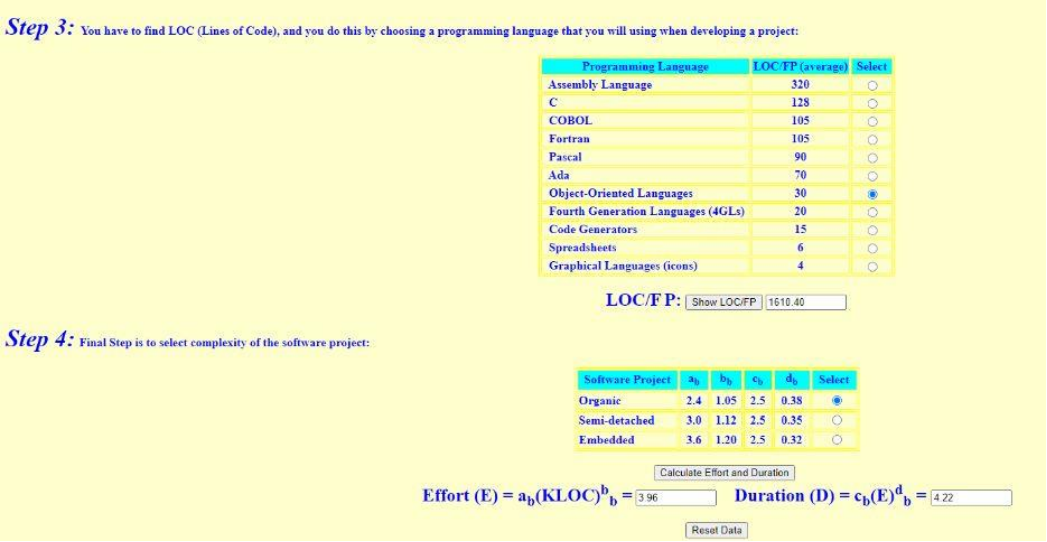


Fig 2.1 Effort Time Cost Estimation

Suppose the average monthly salary of each software developer is Rs. 40,000. Total Cost of the project is = Rs. 40,000 * 2 People * 4 Months = Rs. 3,20,000.

2.1.3. Roles and Responsibilities

Member Name	Responsibility	E-Mail
Kishan Prajapati	Gesture Recognition module	20cs065@charusat.edu.in
Pruthvi Raj	Voice Command module	20cs068@charusat.edu.in

Table 2.1 Roles and Responsibilities

2.2. PROJECT SCHEDULING

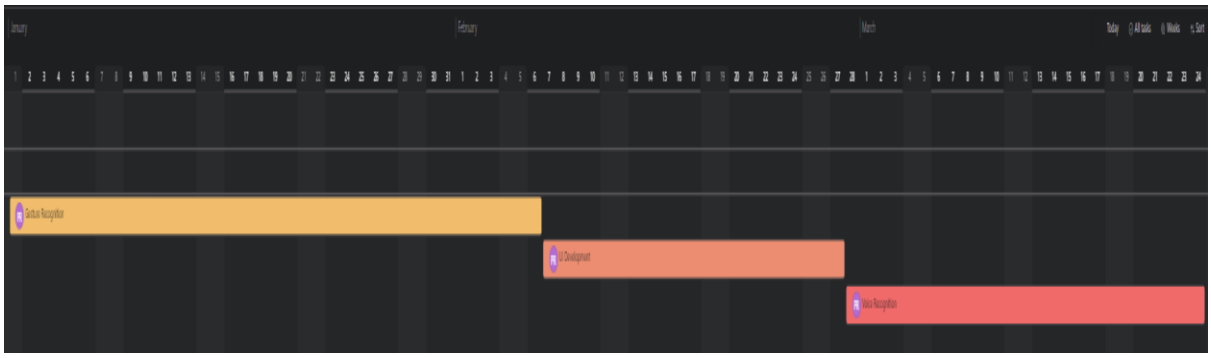


Fig 2.2 Gantt Chart

CHAPTER - 3 SYSTEM REQUIREMENT STUDY

3.1. USER CHARATERISTICS

The intended audience for the system that integrates gesture recognition and voice commands would be anyone who uses a personal computer, particularly those who prefer a more intuitive and natural way of interacting with their technology. The system can have wide applications across various industries, including healthcare, education, and entertainment.

- Individuals with physical disabilities or limitations that make it difficult to use a keyboard or mouse.
- Gamers who prefer a more immersive and interactive gaming experience.
- Students and teachers who use computers for online learning and presentations.
- Healthcare professionals who need to access patient records and medical software while maintaining a sterile environment.
- Office workers who spend long hours on their computers and can benefit from a more ergonomic and natural way of interacting with their technology.

In summary, the intended audience for the system that integrates gesture recognition and voice commands is anyone who wants a more natural and intuitive way of interacting with their computer. The system can benefit users across various industries and demographics, particularly those who prefer a hands-free and interactive interface.

3.2. HARDWARE AND SOFTWARE REQUIRMENT

Here are some general minimum requirements which will be needed for this system:

3.2.1. Software Requirements

- Operating System: Windows 10 (64-bit) or higher
- Gesture Recognition Software: OpenCV, MediaPipe.
- Voice Recognition Software: Speech recognition python package.
- Development Environment: Integrated Development Environment (IDE) such as Visual Studio or Eclipse for coding and debugging.

3.2.2. Hardware Requirements

- Processor: 2.0 GHz or higher processor (multi-core recommended)
- RAM: 4 GB or higher (8 GB recommended)
- Graphics card: Integrated graphics card with 1 GB VRAM (for 3D gesture recognition)
- Webcam: At least 480p resolution (for gesture recognition)
- Microphone: Built-in or external microphone (for voice commands)

3.3. ASSUMPTIONS AND DEPENDENCIES

Assumptions and dependencies are critical factors that can affect the success of a system that integrates gesture recognition and voice commands. Here are some assumptions and dependencies for this system

3.3.1. Assumptions

- Users have the necessary hardware and software components to run the system.
- The system's gesture recognition and voice commands are accurate and responsive, providing a seamless user experience.
- Users are familiar with the hand gestures and voice commands used by the system.
- The system is designed to work with a specific operating system, such as Windows 10.

3.3.2. Dependencies

- The system depends on hardware components such as a webcam, microphone, and graphics card to function correctly.
- The system depends on software components such as gesture recognition and speech recognition APIs to interpret user input accurately.
- The system's accuracy and responsiveness depend on the quality of the user's webcam and microphone.
- The system's success depends on user acceptance and adoption of the technology

CHAPTER – 4 SYSTEM ANALYSIS

4.1. STUDY OF CURRENT SYSTEM

There are current few systems available that integrate gesture recognition and voice commands. Here are some examples:

- Microsoft Kinect: Microsoft Kinect is a motion-sensing input device that uses a depth sensor and microphone array to recognize voice commands and hand gestures. It was originally developed for the Xbox gaming console but has since been adapted for other applications, such as healthcare and education.
- Intel RealSense: Intel RealSense is a suite of 3D cameras and depth sensors that enable gesture recognition and facial recognition for a variety of applications, such as gaming, virtual reality, and robotics.
- Google Home: Google Home is a voice-activated smart speaker that allows users to control their smart home devices, play music, and search the internet using voice commands.

4.2. PROBLEM AND WEAKNESS IN CURRENT SYSTEM

While current systems that integrate gesture recognition and voice commands have come a long way in providing a more natural and intuitive way of interacting with technology, they still face some challenges and weaknesses. Here are some problems and weaknesses of the current systems.

- Compatibility: Many systems are designed to work with specific hardware or software configurations, making it difficult to use them across different devices or platforms.
- User Interface: The user interface of current systems may not be intuitive or user-friendly, making it difficult for new users to learn and use the system effectively.
- Cost: Some systems, such as Microsoft Kinect or Intel RealSense, can be expensive, making them inaccessible to some users or industries.

4.3. REQUERMENT OF NEW SYSTEM

4.3.1. Functional Requirements

Input

- Webcam: The system will require a webcam to capture hand gestures and movements.
- Microphone: The system will require a microphone to capture voice commands and speech.
- Gesture Recognition API: The system will require a gesture recognition API to analyze and interpret hand gestures and movements.

- Speech Recognition API: The system will require a speech recognition API to analyze and interpret voice commands and speech.
- User Input Guide: The system will require a guide that shows users the hand gestures and voice commands that they can use to interact with the system.

Output

- On-screen cursor: The system will display an on-screen cursor that responds to hand gestures, allowing users to control their computers without a mouse or touchpad.
- Feedback: The system will provide feedback in response to user input, such as confirming a command or providing search results

Process

- Gesture Recognition: The system will analyze the hand gestures captured by the webcam to interpret user input and perform actions, such as scrolling or clicking.
- Speech Recognition: The system will analyze the voice commands captured by the microphone to interpret user input and perform actions, such as opening applications or searching the web.
- Integration: The system will integrate the inputs from gesture recognition and speech recognition to provide a seamless user experience.

4.3.2 Non-function Requirement

Non-functional requirements describe the characteristics of a system that are not related to its specific functionality, but rather to its overall performance, security, reliability, usability, and other factors that affect the user experience.

- Performance: The system should respond quickly and accurately to user input, without delays or lag time. The response time should be within acceptable limits, typically measured in milliseconds.
- Accuracy: The system should accurately recognize and interpret hand gestures and voice commands, with a high degree of precision and minimal errors.
- Reliability: The system should be reliable and consistent, with a low probability of crashes, errors, or malfunctions.
- Security: The system should be designed to protect user data and privacy, with appropriate security measures such as encryption and authentication.
- Usability: The system should be user-friendly and intuitive, with clear instructions and a simple, easy-to-use interface. It should be accessible to users of all skill levels and abilities.

4.3.3 Feasibility Study

Operational Feasibility

The operational feasibility of a system refers to the extent to which it meets the requirements and expectations of its intended users. In the case of our system operational feasibility will depend on several factors, such as user acceptance, compatibility, accessibility and reliability.

Technical Feasibility

Technical feasibility refers to the extent to which a system can be developed using available technology and resources. In the case of our system the technical feasibility will depend on factors such as availability of technology, interaction of technologies and complexity.

Economic Feasibility

Economic feasibility refers to the financial viability of a system, taking into account the costs and benefits associated with its development and operation. In the case of our system the economic feasibility will depend on factors such as development cost, operating cost, benefits and return on investment.

4.4. CLASS DIAGRAM

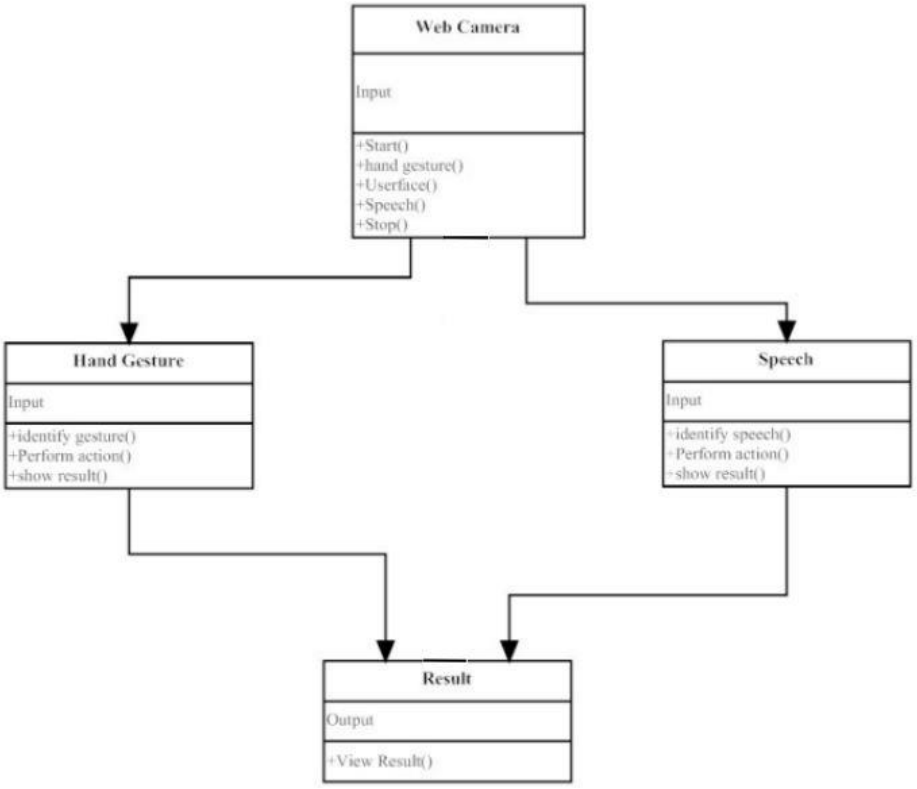


Fig 4.4

4.5. SYSTEM ACTIVITY USE CASE DIAGRAM

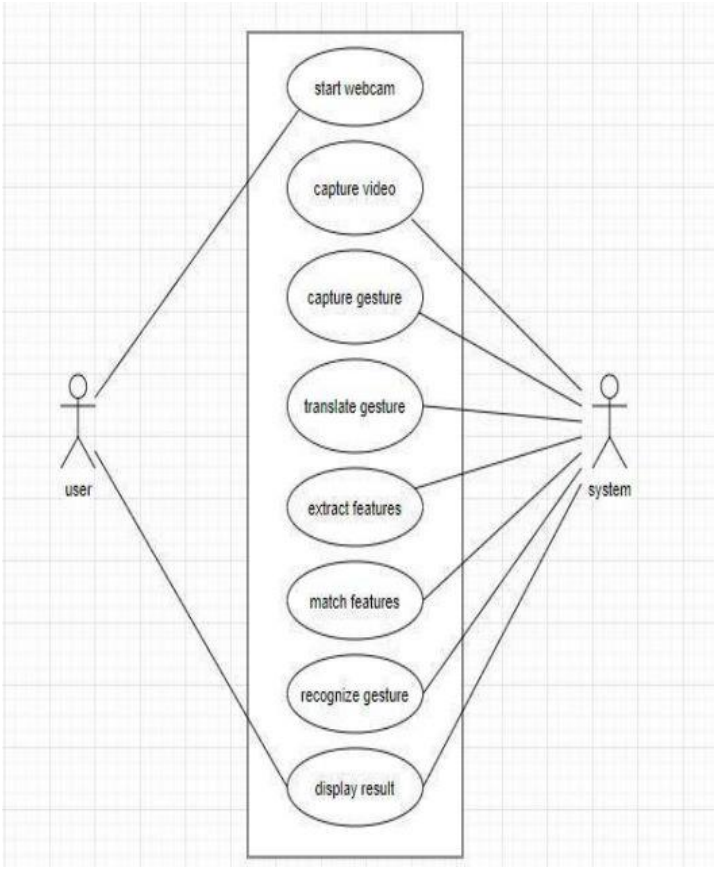


Fig-4.5

4.6. SEQUENCE DIAGRAM

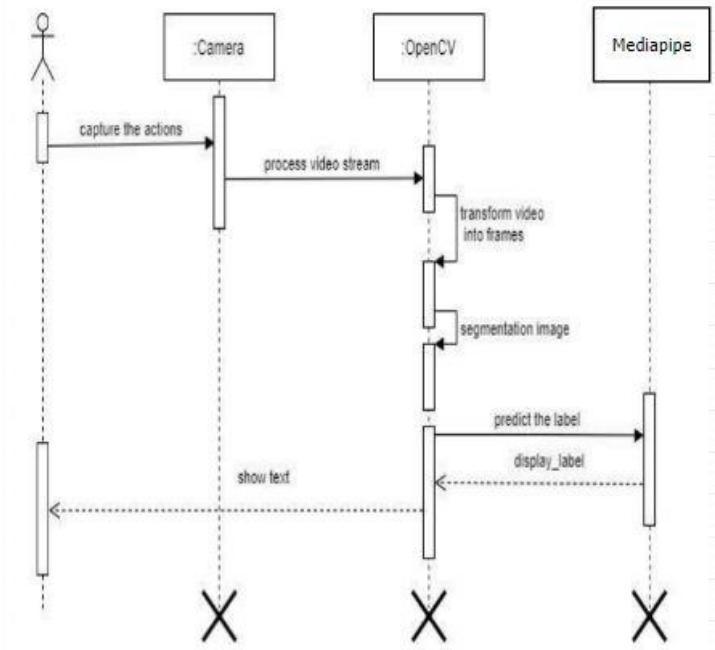


Fig 4.6

4.7. SELECTION OF HARWARE AND SOFTWARE JUSTIFICATION

Here are some potential justifications for hardware and software selection for our system:

Hardware Selection:

- Camera device: The system requires good camera that is able to capture the hand gestures well for high accuracy and depth sensing capabilities.
- Microphones: The system also requires high-quality microphones for speech recognition. USB or Bluetooth headsets are popular choices for voice input in PC applications due to their high-quality audio capture.
- Processing power: The system requires significant processing power to perform real-time gesture recognition and speech recognition. A decent CPU, such as Intel Core i5 can provide the necessary computing power for real-time analysis.

Software Selection:

- Gesture recognition libraries: There are several open-source gesture recognition libraries available, such as OpenCV and MediaPipe, which provide robust and accurate hand tracking and gesture recognition algorithms.
- Speech recognition APIs: There are several speech recognition APIs available, such as Python Speech Recognition which provide accurate and real-time speech-to-text conversion.

CHAPTER – 5 SYSTEM DESIGN

5.1 SYSTEM APPLICATION DESIGN

The system design for our PC system that integrates gesture recognition and voice commands should take into consideration the functional and non-functional requirements of the system. Here are some potential design considerations:

- Architecture: The system architecture should be designed to handle real-time input from both gesture recognition sensors and voice recognition microphones. The system should have multiple modules for gesture recognition, speech recognition, and action generation.
- Gesture Recognition: The gesture recognition module should include an algorithm for hand tracking and gesture recognition. The gesture recognition algorithm can use depth camera to detect hand position and movements. The module should also include a set of predefined gestures and the ability to customize new gestures.
- Speech Recognition: The speech recognition module should include an algorithm for detecting voice commands. The algorithm should be capable of real-time processing of speech input and be able to handle different accents and speech patterns.
- Action Generation: The action generation module should convert the recognized gestures and voice commands into specific actions. The module should be able to interact with the underlying operating system and applications to perform actions such as opening files, launching applications, and performing keyboard or mouse actions.
- User Interface: The user interface should provide visual feedback for recognized gestures and voice commands. The interface should also allow users to customize gestures and voice commands and provide feedback on the accuracy of the recognition.
- Error Handling: The system should include robust error handling to provide clear feedback to users when gestures or commands are not recognized or when errors occur.

5.2 INPUT/OUTPUT AND INTERFACE DESIGN

5.2.1 State diagram

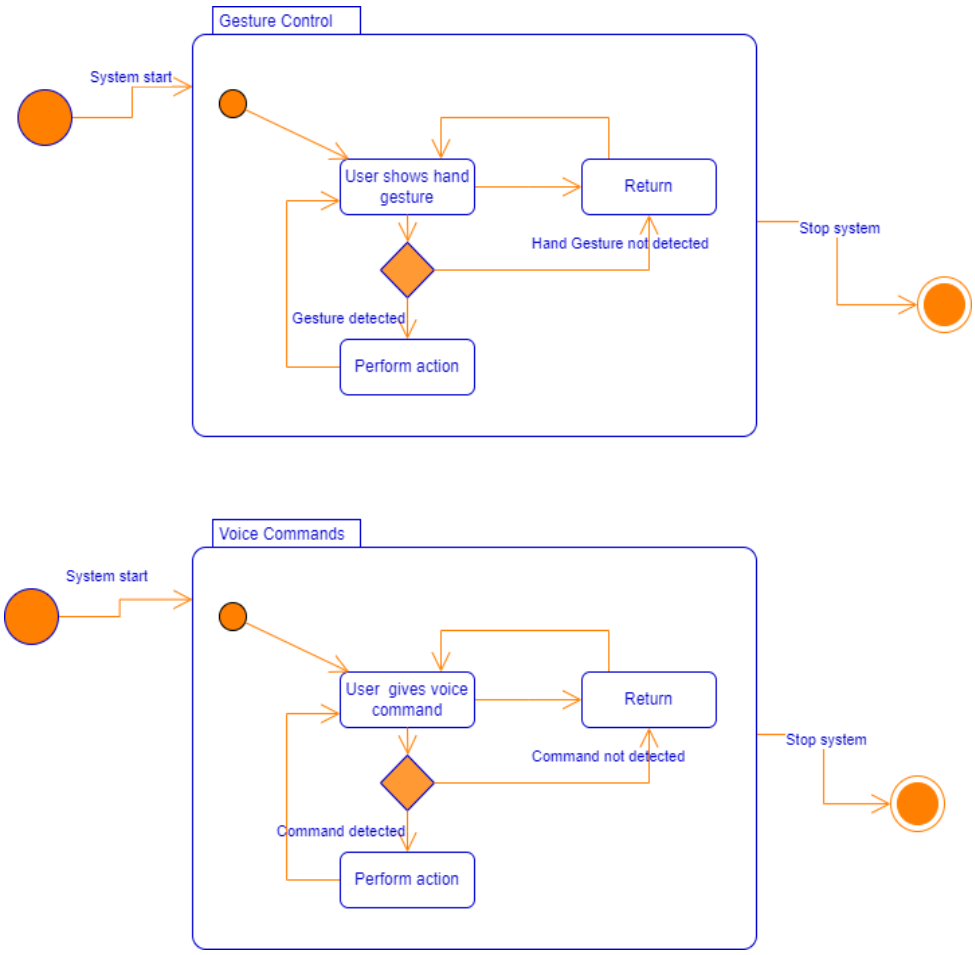


Fig 5.2

5.3. SAMPLE OF INTERFACE

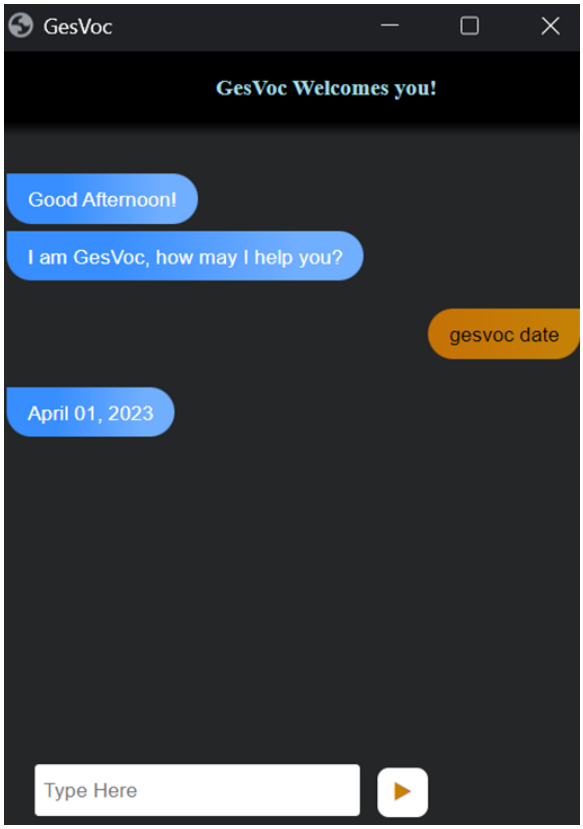


Fig 5.3.1

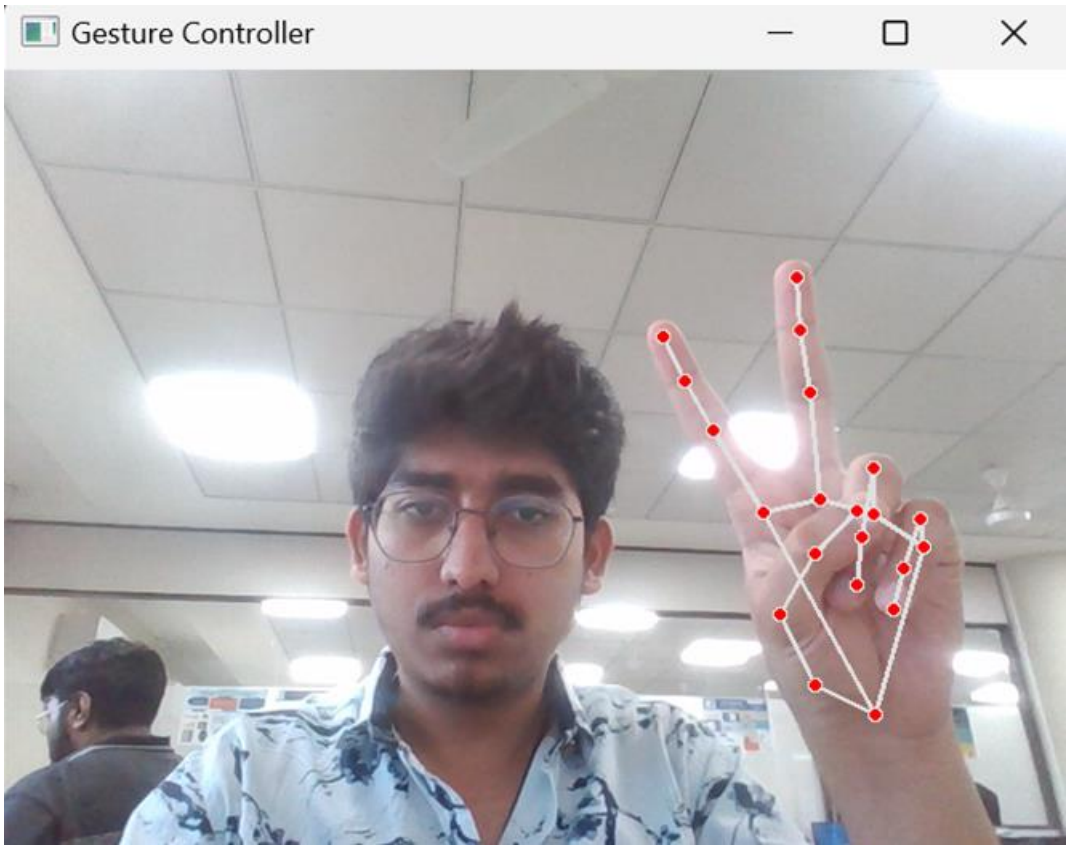


Fig 5.3.2

CHAPTER – 6 IMPLEMENTATION PLANNING

6.1 IMPLEMENTATION ENVIRONMENT

Implementation is the stage in the project where the theoretical design is turned into a working system and is giving confidence on the new system for the users that it will work efficiently and effectively. It involves careful planning, investigation of the current system and its constraints on implementation, design of methods to achieve the changeover, an evaluation of change over methods. Apart from planning major task of preparing the implementation are education and training of users.

6.2 MODULE SPECIFICATION

Here are the module specifications for our system that integrates gesture recognition and voice commands:

Gesture Recognition Module:

- The gesture recognition module should include an algorithm for hand tracking and gesture recognition.
- It should be able to detect a predefined set of gestures.
- The module should be optimized for speed and accuracy and be able to handle real-time input from the camera.

Speech Recognition Module:

- The speech recognition module should include an algorithm for speech-to-text conversion.
- It should be optimized for speed and accuracy and be able to handle real-time processing of speech input.
- The module should be extract relevant commands.

Action Generation Module:

- The action generation module should convert the recognized gestures and voice commands into specific actions.
- It should be able to interact with the underlying operating system and applications to perform actions such as opening files, launching applications, and performing keyboard or mouse actions.
- The module should be optimized for speed and accuracy and be able to handle real-time input from the gesture and speech recognition modules.

6.3 SECURITY FEATURES

If we explore the side of security features, then the system should provide clear feedback to users when error occurs such as unrecognized gesture or voice commands.

6.4 CODING STANDARDS

- Proper and consistent indentation is important in producing easy to read and maintainable programs. Indentation should be used to:
- Emphasize the body of a control statement such as a loop or a select statement
- Emphasize the body of a conditional statement
- Emphasize a new scope block
- Variable shall have mnemonic or meaningful names that convey to a casual observer, the intent of its use. Variables shall be initialized prior to its first use.

CHAPTER - 7 TESTING

7.1. TESTING PLAN

As the part of system testing we execute the program with the intent of finding errors and missing operations and also a complete verification to determine whether the objectives are met and the user requirements are satisfied. The ultimate aim is quality assurance. Tests are carried out and the results are compared with the expected document. In the case of erroneous results, debugging is done. Using detailed testing strategies a test plan is carried out on each module. The various tests performed are unit testing, integration testing and user acceptance testing.

7.2. TESTING STRATEGY

7.2.1. Unit Testing

The software units in the system are modules and routines that are assembled and integrated to perform a specific function. As a part of unit testing we executed the program for individual modules independently. This enables, to detect errors in coding and logic that are contained within each of the three module. This testing includes entering data that is filling forms and ascertaining if the value matches to the type action performed the various controls are tested to ensure that each performs its action as required.

7.2.2. Integration

Data can be lost across any interface, one module can have an adverse effect on another, sub functions when combined, may not produce the desired major functions. Integration testing is a systematic testing to discover errors associated within the interface. The objective is to take unit tested modules and build a program structure. All the modules are combined and tested as a whole. Here the hand gesture and voice command module are integrated and tested. This testing provides the assurance that the application is well integrated functional.

7.2.3. User Accepting Testing

User acceptance of a system key factor for the success of any system. The system is thoroughly tested by users who are going to use this system and the issues faced have been solved in the process.

7.3. TESTING METHOD

There are various testing methods which can be taken into consideration for our system like: Functional Testing, Usability Testing, Performance testing, Security Testing and Compatibility testing. Overall, a combination of these testing methods can be used to ensure that our PC system that integrates gesture recognition and voice

commands is robust, reliable, and meets the requirements and expectations of its intended users.

7.4. TEST CASES

Gesture Recognition

Purpose: Perform action based on gesture.
Required Input: Any already defined hand gesture.
Expected Output: The system will detect the hand gesture and perform necessary action.

Voice Commands

Purpose: Perform action based on voice command.
Required Input: Any already defined voice command.
Expected Output: The system will detect the voice command and perform necessary action.

Voice Command not detected

Purpose: Alert user.
Required Input: Any invalid voice command.
Expected Output: The system will alert you that it is not able to perform the action.

CHAPTER – 8 CONCLUSION

8.1. SELF ANALYSIS

In conclusion, this system has the potential to revolutionize how users interact with their computers. This system can provide a more intuitive and user-friendly interface, making it easier and more productive to use computers. The system has potential to makes user use pc with almost no direct contact. However, the success of such a system depends on its ability to accurately recognize gestures and voice commands. A rigorous testing are therefore essential to ensure the system's reliability and effectiveness. Overall, this system can enhance the user experience and increase productivity.

8.2. PROBEM ENCOUNTERED AND POSSIBLE SOLUTIONS

While development of voice recognition we faced some issue of the system not being able to capture voice well which was solved by adding updated version of python library. Also deciding how to integrate gesture control and voice command was a big task but we came to the conclusion by calling the commands from each other.

8.3. SUMMARY

The proposed project involves the development of a PC system that integrates gesture recognition and voice commands to make computer use easy and fun. The system will used advanced Python to accurately interpret user input, while modern hardware software ensures that the system is powerful, responsive, and secure. Additionally, the system is designed with an intuitive interface and user-friendly controls to ensure it is easy to use and understand. By carefully considering these factors and implementing effective strategies we were able to overcome potential challenges while the development phase of this project.

CHAPTER – 9 LIMITATION AND FUTURE ENHANCEMENT

Here are some potential limitations and future enhancements of our proposed system.

9.1. Limitations:

- Environmental Constraints: The system may struggle to accurately recognize user input in certain environmental conditions, such as low lighting or noisy environments.
- Limited Range of Gestures: The system may only be able to recognize a limited range of gestures, which may limit its functionality.
- Limited Vocabulary: The system may struggle to recognize complex or nuanced language input, which can limit its effectiveness.

9.2. Future Enhancements:

- Improved Accuracy: The system can be further refined to improve the accuracy of gesture and voice recognition, potentially by incorporating more advanced algorithms or machine learning techniques.
- Expanded Gesture and Voice Commands: The system can be enhanced by incorporating more complex and nuanced gesture and voice commands, increasing its range of functionality.
- Integration with Additional Devices: The system can be expanded to integrate with additional devices, such as mobile phones or smart home assistants, increasing its versatility.

Overall, while our system has the potential to be a useful and innovative tool, it is important to consider its limitations and potential for future enhancements to ensure its continued effectiveness and usability.