Hand gestures recognition system to control the device's screen

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ABSTRACT

The Covid-19 pandemic has highlighted the urgent need for innovative solutions that prioritize public health and safety, especially in shared spaces. As a response to this need, touchless screen control systems based on hand gestures have emerged as a crucial technology, offering a way to interact with digital screens without physical contact, thus reducing the risk of viral transmission.

By leveraging libraries like OpenCV, Mediapipe, NumPy, and PyAutoGUI within a Jupyter notebook environment, the proposed Hand Gesture Recognition system aims to detect and respond to detected gestures using a camera. These systems boast several advantages, including reduced physical space requirements compared to traditional mouse control setups. This aspect makes them particularly suitable for environments with space constraints or mobile applications.

Furthermore, hand gesture-based screen control systems can play a vital role in enhancing public health safety, especially in the context of the Covid-19 pandemic or any other unknown pandemic in future. By enabling contactless interaction with screens, they help minimize the risk of viral transmission, aligning with broader public health efforts to combat infectious diseases. Beyond immediate concerns, this technology signifies a shift in how humans interact with computers, envisioning a future where digital interfaces seamlessly integrate into everyday life, accommodating individuals with various abilities and preferences.

Through an exploration of their features and practical applications, this thesis underscores the potential of hand gesture-based screen control systems in creating a cleaner, more accessible, and interconnected world. By prioritizing user experience and inclusivity, these systems lay the groundwork for a future where technology enhances both safety and convenience, ushering in a new era of human-computer interaction.

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CHAPTER 1 Project Background

In chapter 1, the background, project scope and motivation of the project will be explained.

1.0 Introduction

In light of the Covid-19 pandemic's persistent challenges, there's a heightened urgency to adopt measures that prioritize public health and safety in communal settings. Hand gesture-based screen control systems have emerged as a pivotal solution, offering a touchless interface for navigating digital screens and minimizing the risk of viral transmission. These systems not only enhance hygiene standards by eliminating the need for physical contact but also revolutionize human-computer interaction through intuitive hand gestures as input commands. Their versatility extends across diverse sectors, from retail and education to healthcare, making them instrumental in promoting a safer and more accessible environment amidst the ongoing pandemic.

Looking beyond immediate concerns, the implementation of hand gesture-based screen control systems signifies a fundamental shift in how we interact with technology. By prioritizing user experience and inclusivity, these systems pave the way for a future where digital interfaces seamlessly integrate into daily life, catering to individuals with diverse abilities and preferences. Through an examination of their functionalities and real-world applications, we'll explore the transformative potential of this technology in shaping the landscape of human-computer interaction and advancing towards a more hygienic, accessible, and interconnected world.

1.1 Problem Statement

- **<u>Required physical space.</u>**

  When utilizing physical hardware for device control, particularly with traditional mouse setups, adequate physical space is necessary. Placing the mouse requires a dedicated surface, typically a desk, which can sometimes be inconvenient or ineffective due to space constraints.

- **<u>Insufficiency of public health safety awareness</u>**

  When multiple individuals share the same screen, it heightens the risk of disease transmission through physical contact, especially with mouse-based or touch screen interactions. Furthermore, insufficient sanitation practices exacerbate this risk, emphasizing the potential harm posed to individuals.

- **<u>Insufficiency in Environmental Sustainability</u>**

  Traditional mice contribute significantly to electronic waste, as they often require periodic replacement due to wear and tear or obsolescence. This insufficiency in environmental sustainability is a growing concern, as the ongoing production, disposal, and eventual accumulation of these devices exacerbate the global issue of e-waste, putting additional strain on environmental resources and waste management systems.

1.2 Project Objectives

The aim of the project is to propose a Hand Gesture Recognition system that detects, and acts based on the detected gestures using a camera. This involves utilizing libraries such as OpenCV (cv2), Mediapipe, NumPy, and PyAutoGUI within a Jupyter notebook environment.

- **To reduce physical space requirements.**

  Hand gesture-based screen control systems require less physical space compared to traditional mouse control setups, as they do not necessitate a dedicated surface area for mouse movement or the use of external peripherals, making them ideal for environments with limited space constraints or mobile applications.

- **To enhance public health safety.**

  Contactless screen control systems contribute to enhancing public health safety by minimizing the potential for viral transmission. In the context of the Covid-19 pandemic, where maintaining physical distance and avoiding contact with contaminated surfaces are crucial preventive measures, these systems offer a proactive solution. By enabling users to interact with screens using hand gestures, without the need for physical touch, they help create safer environments for both customers and employees. This purpose aligns with broader public health initiatives aimed at reducing the spread of infectious diseases and safeguarding community well-being.

- **To Improve the Environmental Sustainability**

  By reducing the dependency on physical devices, hand gesture detection systems address this insufficiency, offering a more sustainable solution. This technology supports environmental sustainability by lowering electronic waste, decreasing the need for resource-intensive hardware, and aligning with eco-friendly practices in digital interaction.

1.3 Project Scope

The primary objective of this project is to develop and implement a hand gesture detection system aimed at assisting users in controlling devices through intuitive hand gestures. The main focus is to provide a contactless method for controlling screens, thereby enhancing public health safety by minimizing physical contact with surfaces and reducing the potential spread of diseases. Additionally, the system aims to bring convenience to users by eliminating the need for physical interaction with screens or devices, ultimately reducing physical space requirements in public settings. Also, the system is aimed to improve the environmental sustainability by try to minimize the electronic waste. By enabling users to control screens through gestures, the project seeks to promote a safer and more hygienic interaction experience while enhancing accessibility and usability for individuals across various environments.

I. When the user run the system, the device will be asked for permission of Camera.

II. When the system gets the access to use the camera, the user’s device will prompt up a frame for letting user know that the system is currently running.

III. At the first of the system, there will be a “Hand Gesture Dictionary”, to let the user know what hand gestures will represent the relative actions.

IV. When the system detects any hand of the camera, the “Hand Gesture Dictionary” will be gone, and it will allow the user to start using the system.

V. The system will detect the hand gestures and react some relative actions that is being set in the hand gestures dictionary.

VI. While the system is not detecting any hand that is in the camera, the screen will be appearing the cat animation for user interaction.

1.4 Contributions

Compared to traditional hardware-based methods, touch-based screen control entails increased direct physical interaction, elevating the risk of disease transmission, especially in shared or public settings. Hence, the integration of hand gesture detection systems becomes imperative for society, offering a solution to mitigate disease spread while providing users with added convenience. These systems enable users to interact with screens using gestures, eliminating the need for direct touch, and reducing the potential for pathogen transmission. By allowing users to navigate interfaces from a distance without physical contact, hand gesture detection systems enhance hygiene, accessibility, and user experience across various environments, including public kiosks and interactive displays. Ultimately, their implementation not only addresses health concerns but also fosters a safer and more user-friendly interactive experience in modern society.

1.5 Report Organization

The research details are outlined in the subsequent chapters. Chapter 2 delves into related backgrounds, examining the strengths and weaknesses of AutoVu™ LPR and Sunway License Plate Detection System, given their similarity to hand gesture recognition systems in their recognition functions. Chapter 3 elucidates the utilization of the agile methodology, providing a succinct overview of each stage's progression including planning, design, development, testing, release, and feedback. Moving forward, Chapter 4 elaborates on the undertaken tasks and elucidates the hand gesture dictionary, clarifying the correspondence between gestures and their associated functions for user comprehension. Additionally, Chapter 5 encapsulates the report's conclusion, presenting the final outcomes and delineating future considerations for FYP2.

CHAPTER 2 Literature Review

2.1 Previous Works on the system of hand gestures recognition

2.1.1 AutoVu™ LPR

Figure 2.1 AutoVu™ LPR

AutoVu™ LPR, developed by Genetec, is a powerful vehicle plate recognition (LPR) system utilized in various industries for real-time detection, capture, and recognition of license plates from vehicles. The system offers features such as vehicle identification, checking through the blacklisting/whitelisting, real-time alerts, data logging, and integration with other security systems. It utilizes high-resolution cameras to capture images and extract vehicle plate characters for analysis. However, it is not only containing the strengths but also weaknesses as well.

<u>Strength</u>

- AutoVu™ LPR provides flexibility in camera compatibility and deployment options, supporting various camera types and locations such as highways, parking lots, and toll plazas. It also seamlessly integrates with other security systems, such as video management systems and access control systems, allowing for easy integration into existing infrastructure. This flexibility enables users to customize their license plate recognition solution to suit their specific requirements, enhancing their security operations.

- AutoVu™ LPR is designed for high accuracy in license plate detection and recognition, even in challenging conditions like low light, varying weather, and different plate types/fonts. This ensures reliable performance with minimal false positives or negatives.

Weaknesses

- Privacy concerns arise from the fact that images and records captured by LPR systems are stored, which raises potential misuse or data theft concerns. Individuals may be apprehensive about their whereabouts being recorded in these footages and potentially misused by unauthorized parties with malicious intentions.

- Challenges with lighting and weather conditions, such as low light or glare, as well as adverse weather conditions like rain or snow, can impact the accuracy of LPR systems, resulting in lower detection and recognition rates.

2.1.2 Sunway License Plate Detection System

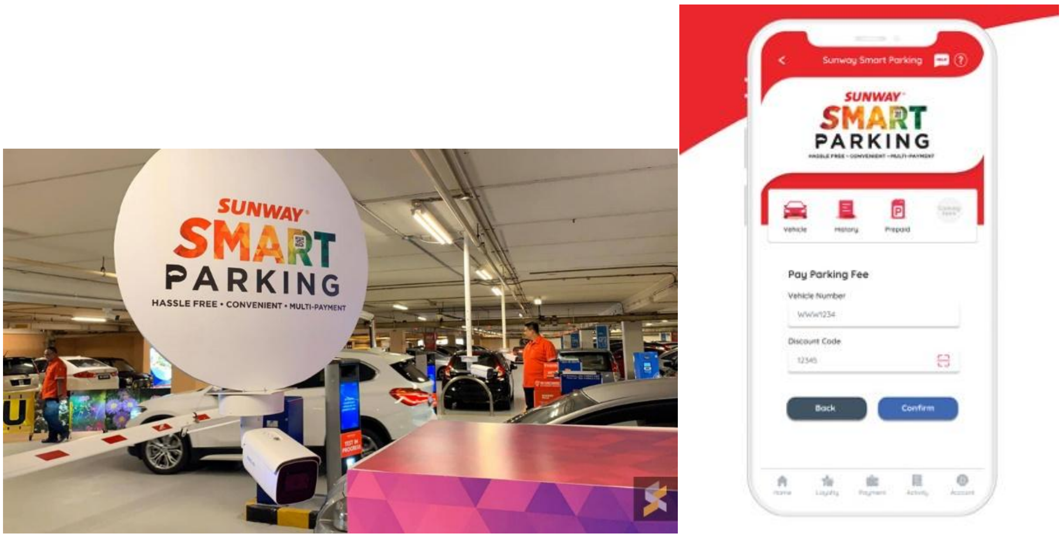


Figure 2.2 Sunway License Plate Detection System

Sunway License Plate Detection System, developed by Sunway Communication, is an advanced license plate recognition (LPR) system used in toll collection, parking management, and traffic monitoring. It automatically detects and captures license plates from vehicles in real-time, utilizing high-resolution cameras and advanced image processing algorithms for accurate recognition.

<u>Strength</u>

- Felix Zheng Ya Fei, the general manager of overseas sales and marketing at Jie Shun, the technology provider for the license plate recognition system, reported that the system has undergone testing under local conditions and has attained an impressive 95% recognition success rate across a diverse range of number plates. [3].

Weaknesses

- Automatic license plate recognition (LPR) systems may face challenges in adverse weather conditions or when there are hindrances that affect their effectiveness. In such cases, security measures of the system may be compromised, and manned surveillance may be required as a backup. This underscores the importance of considering potential limitations and system vulnerabilities and having appropriate contingency plans in place to ensure reliable and effective security measures.

License plate recognition (LPR) systems can be vulnerable to tampering or vandalism, compromising their integrity. Deliberate covering or altering of license plates, as well as damaging cameras or other system components, can lead to inaccurate or incomplete data, reducing the effectiveness and reliability of the system.

2.1.3 GestIC by PNI Sensor

Figure 2.3 GestIC by PNI Sensor

GestIC by PNI Sensor is a capacitive touch-based gesture recognition technology designed to enable intuitive control of devices through hand gestures. It uses a specialized sensor module to detect and interpret gestures made within its sensing range. This technology is often integrated into devices such as automotive controls, consumer electronics, and industrial systems, providing a touchless interface that can enhance user interaction and convenience [5].

Strength

- Provides a touchless interface for gesture-based control, which can be beneficial in applications where physical contact with the device is undesirable or impractical.
- Can be integrated into a wide range of devices and applications, including automotive controls, consumer electronics, and industrial systems, making it versatile for various use cases.

Weakness

- The sensor has a limited range and requires gestures to be performed within a specific proximity. This can restrict the flexibility and usability of the gesture interface.
- The cost of the GestIC sensor module might be higher compared to using a standard camera.

Processing is done within the sensor module, which might limit the amount of data you can analyze or the type of processing you can perform.

CHAPTER 3 System Methodology/ Approach

3.0 Introduction

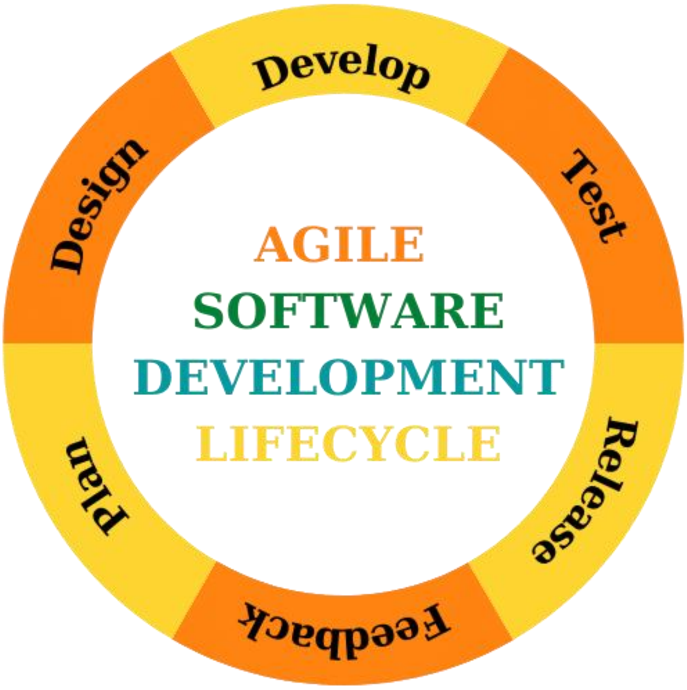


Figure 3.0 Agile Software Development Lifecycle

This report delves into the methodology of hand gesture recognition for controlling the mouse cursor to perform as a virtual mouse. The methodology is divided into several stages, each serving a crucial purpose in the development and deployment of the system. These stages include:

1. **Planning**: In this stage, the scope and objectives of the project are defined. This includes identifying the key functionalities of the hand gesture recognition system, such as tracking hand movements, interpreting gestures, and mapping these gestures to mouse functions. User stories and requirements are also gathered to ensure the system meets user needs.
2. **Design**: The design phase focuses on creating the architecture and user interface of the system. This includes selecting the appropriate libraries (e.g., OpenCV,

MediaPipe), designing the gesture recognition algorithms, and planning the user interaction flow. Prototyping may also occur in this stage to visualize the end product.

3. **Development**: During the development stage, the system's components are implemented according to the design specifications. This involves coding the gesture detection and recognition algorithms, integrating the hand gestures with mouse controls, and refining the user interface. Iterative development and continuous integration practices are followed to ensure that features are built incrementally.
4. **Testing**: Testing is critical to ensure that the system functions as intended. Unit tests, integration tests, and user acceptance tests are conducted to identify and resolve bugs. The system is evaluated for accuracy in gesture recognition, responsiveness, and user experience. Feedback from testing is used to make necessary adjustments.
5. **Release**: Once testing is complete and the system meets the required standards, it is prepared for release. This stage includes packaging the software, creating the necessary documentation, and deploying the system. In the context of this project, the release might involve saving the system as a zipped file, including cat_sprites, images, and FYP.ipyb files, which users can download and set up on their Jupyter Notebook environment.
6. **Feedback Gathering**: After the release, feedback is collected from users to assess the system's performance in real-world scenarios. This feedback is essential for identifying areas of improvement and planning future iterations. Continuous feedback gathering ensures that the system evolves to better meet user needs over time.

CHAPTER 4 System Design

4.1 Stage 1: Planning

The ultimate goal of this system is to entirely replace the traditional computer mouse with hand gestures, thereby providing a more intuitive and natural means of interacting with computing devices.

The hardware involved in this project includes computers or any mobile devices equipped with a camera. The camera will detect hand gestures and trigger actions set within the system, such as left-click, right-click, scrolling, and word selection. Any devices that are having a camera can be used as for testing and deploying this hand gestures recognition system.

4.1.1 Hardware Requirements

Hardware Component	Description
Camera	High-resolution camera capable of capturing clear images of hands with good detail. A webcam or a camera integrated into a device can be used.
Processor	A capable processor with sufficient processing power to run the gesture recognition algorithms in real-time. Multi-core processors are preferred for parallel processing.
Memory (RAM)	Adequate RAM to store and process image data efficiently. At least 4GB RAM is recommended for real-time processing.
Graphics Processing Unit (GPU)	Optional, but can significantly accelerate image processing tasks, especially for deep learning-based models. Suitable GPU models include NVIDIA GeForce, AMD Radeon, or equivalent.
Display	A monitor or display screen to visualize the camera feed and the output of the gesture recognition system.
Input Devices	Optional input devices such as keyboards or mice for user interaction, although the system primarily interacts with hand gestures.
Connectivity	Necessary connectivity options such as USB ports for connecting the camera and other peripherals, as well as internet connectivity if the system requires online resources or updates.

Table 4.1.1 Hardware Requirements

4.1.2 Software Requirements

<u>OpenCV (Open-Source Computer Vision Library)</u>

OpenCV offers a range of techniques for object detection in images or video streams, including popular methods like Haar cascades, HOG (Histogram of Oriented Gradients), and deep learning-based approaches such as YOLO (You Only Look Once) and SSD (Single Shot MultiBox Detector). These methods enable real-time or near real-time object detection, making OpenCV a powerful tool for building object detection systems. Furthermore, OpenCV supports multiple programming languages, including C++, Python, and Java [4].

4.1.3 User story for Hand Gesture Recognition System

1. As a user, I would like to have a guidance at the first of the system in order to guide me on how to use the system.
2. As a user, I would like to have a scrolling function on the hand gesture recognition system in order to scrolling up or down to view the pages with more effectively.
3. As a user, I would like to have a clicking function on the hand gesture recognition system in order to click on the specific texts/images/pages for viewing purpose.
4. As a user, I would like to have a dictionary for me to view, in case I forget on the specific hand gesture.
5. As a user, I would like to have a selecting text function on the hand gesture recognition system in order to help me to select the specific text and do the relative action on it.

4.2. Stage 2: Design

4.2.1 System Architecture Diagram

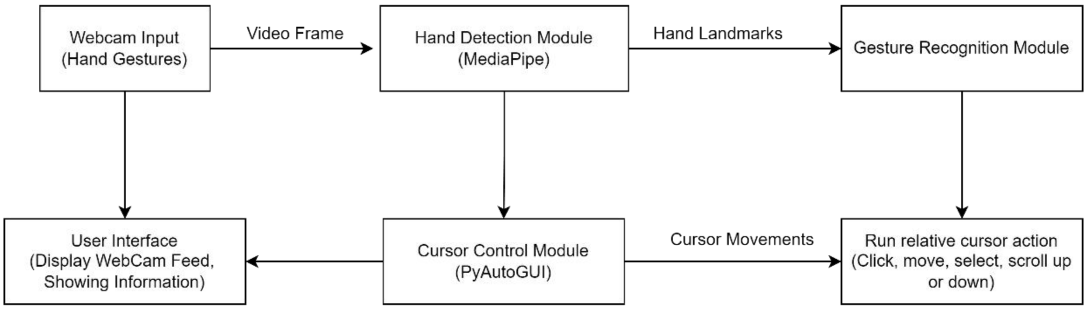


Figure 4.2.1 System Architecture Diagram

The system comprises several interconnected components to enable hand tracking, gesture recognition, and cursor control functionalities.

1. **Webcam Input:**

- This component captures video frames from the webcam in real-time.
- The captured frames serve as input for subsequent processing by the Hand Detection Module.

2. **Hand Detection Module (MediaPipe):**

- Implemented using the MediaPipe library, this module analyzes the video frames captured by the webcam input.
- It detects and tracks landmarks on the hand, including fingertips, knuckles, and palm points.
- The detected hand landmarks are extracted and forwarded to the Gesture Recognition Module.

3. **Gesture Recognition Module:**

- Upon receiving hand landmarks from the Hand Detection Module, this module interprets them to recognize specific gestures.
- It contains logic to identify gestures such as open fingers, pinching, or specific hand shapes.

- The recognized gestures are then used for subsequent actions, such as cursor control.

4. **Cursor Control Module (PyAutoGUI):**

- Utilizing the PyAutoGUI library, this module translates recognized gestures into corresponding cursor movements and clicks on the screen.
- It interacts with the operating system to control the position and behavior of the mouse cursor based on the recognized gestures.

5. **User Interface:**

- The User Interface component displays the webcam feed in real-time, overlaid with tracking information.
- It shows the detected hand landmarks and recognized gestures to provide visual feedback to the user.
- Implemented using OpenCV (cv2.imshow()),it serves as the primary interface for users to interact with the system.

In short, the system architecture consists of interconnected components that work together to enable hand tracking, gesture recognition, and cursor control functionalities. The Webcam Input captures video frames, which are then processed by the Hand Detection Module to detect hand landmarks. The Gesture Recognition Module interprets these landmarks to recognize gestures, and the Cursor Control Module translates recognized gestures into cursor movements and clicks. Finally, the User Interface provides visual feedback to the user by displaying the webcam feed with tracking information.

4.2.2 Flowchart

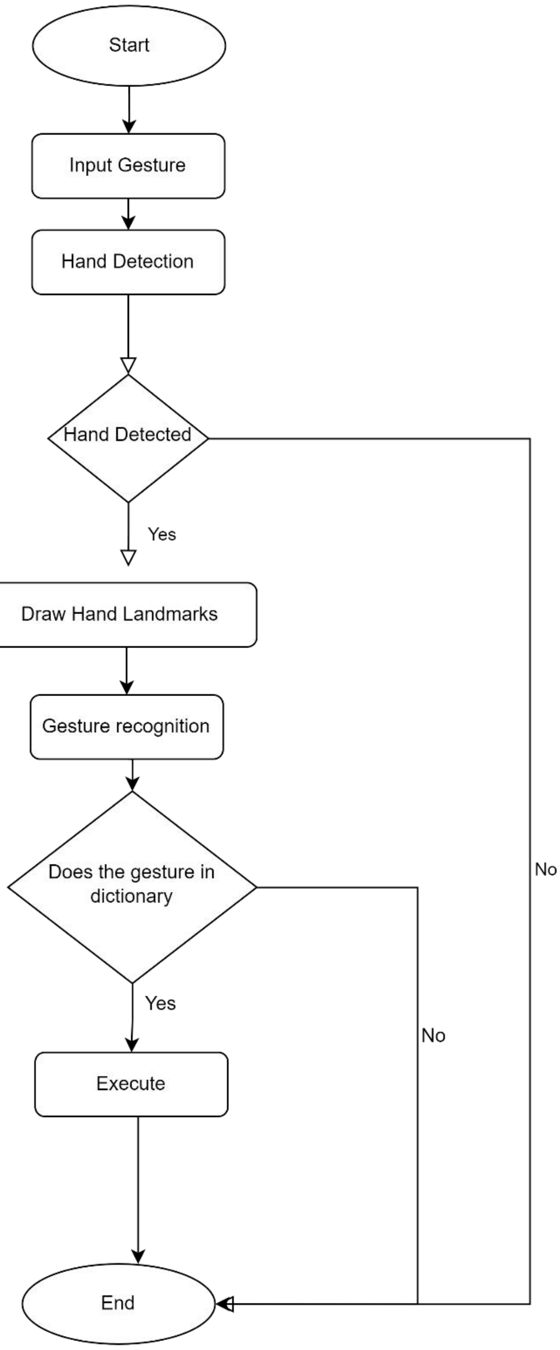


Figure 4.2.2 Flowchart diagram

Flow Description:

Start: Program execution begins.

Input Gesture: The program captures a frame from the webcam.

Hand Detection: The Hand Detection Module detects hand landmarks in the frame using MediaPipe.

Draw Hand Landmarks: Detected landmarks are drawn on the frame for visualization.

Gesture Recognition: The program analyses hand landmarks/gestures.

Does the gesture in dictionary: The program will check if the gesture means any action or perform.

Execute: Displays the relative action or perform.

End: The program continues to loop until the 'q' key is pressed, capturing and processing frames in real-time.

4.2.3 Hand landmarks

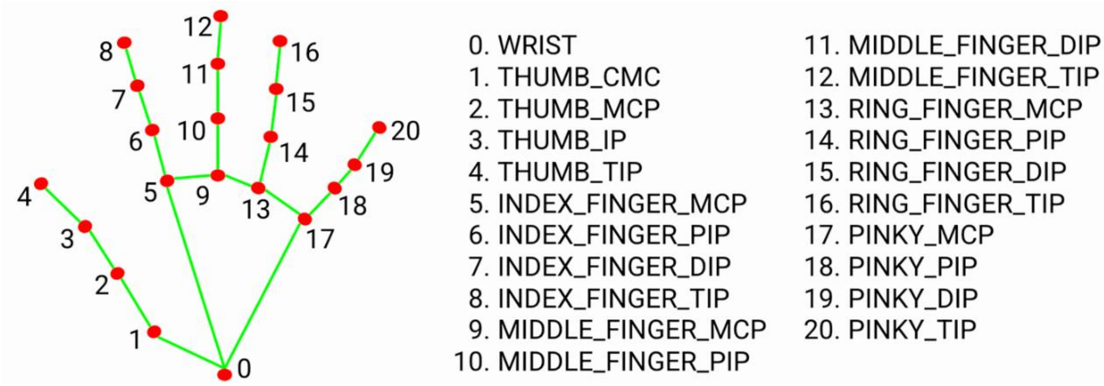


Figure 4.2.3 Hand Landmarks

Hand landmarks are specific points on the user's hand that are detected and tracked by the hand detection module. These points, like fingertips and thumb tips, help the system understand where the hand is and how it's moving. The module works by analyzing the video from the webcam, finding and following these landmarks as the user moves their hand. These landmarks are shown on the screen, giving users feedback on their hand movements. They're crucial for recognizing gestures, like open fingers or pinching. The accuracy of finding these landmarks is vital for the system to work well and respond correctly to the user's actions.

4.2.4 Hand Gesture Dictionary

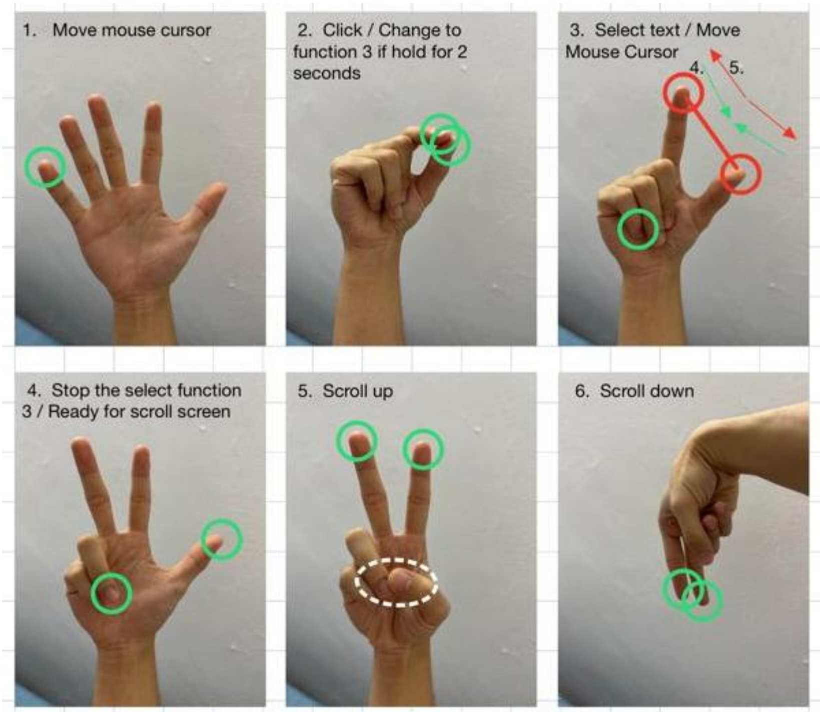


Figure 4.2.4 Hand Gestures Dictionary

1. **Move Mouse Cursor**: When all the fingers are open, the mouse cursor will follow the pinky finger's movement.
2. **Click**: When the index finger and thumb click for once, it will click on the screen for once.

2.1 **Change to Function 3 if hold for 2 Seconds**: When the index finger and thumb hold the gesture for 2 seconds, it will trigger the function 4.

3. **Select Text & Move Mouse Cursor**: The pinky will become control the mouse cursor, there is a line between index finger and thumb, when the red circles of index finger and thumb touch, it will trigger the function of mouse down, which can click/select the word.

3.1 **Stop Selecting Text**: If want to stop selecting, let the distance of index finger and thumb become far.

4. **Stop Select Function**: To stop the function 3, the middle finger has to be raised up.

4.1 **Ready For Scroll Up the Screen**: At the same time, the green circle will be shown at the thumb and ring finger.

5. **Scroll Up**: When the thumb touches the ring finger the green circle will be transfer to the middle and index fingers and the screen will be scroll up. If the gesture is being hold, the screen will keep on scrolling up.
6. **Scroll Down**: When the middle and index fingers put downwardly, the screen will scroll down.

4.2.5 System User Interface Design

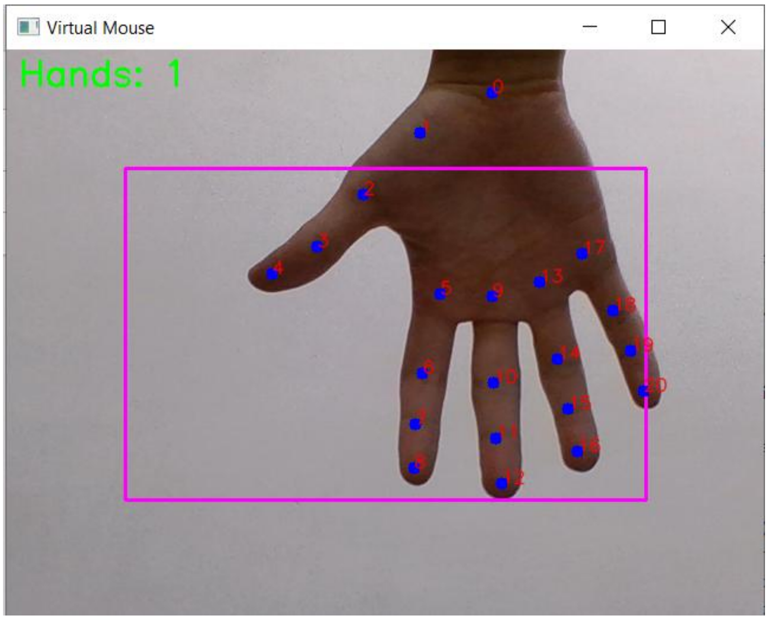


Figure 4.2.5 System User Interface Design

The interface design will display a frame and only allow the user to perform gesture actions within the frame. This is to prevent the user from having to move their hand to the border of the camera, which could cause the hand detection to be lost. Additionally, in the top left corner, the interface will show the count of detected hands.

CHAPTER 5 System Implementation

5.0 Stage 3: Development

The development stage commenced with the installation of Jupyter Notebook, serving as the development environment. To ensure all necessary libraries are available, execute the following command to download and install the required packages:

Command: pip install notebook

Command: pip install opencv-python mediapipe numpy pyautogui pillow

With the environment set up, key functionalities were then developed:

i. **Guidance of Using the system**: Showing the hand gesture dictionary at the first of the system in order to help the user know how to use the system.

ii. **Cursor Movement**: When all five fingers are raised and the system will automatically track the pinky tip to move the mouse cursor accurately. Cursor movement is disabled when other fingers are closed.

iii. **Clicking Functionality**: When only the index and middle fingers are being raised, users can trigger clicking actions by touching the index finger and thumb together.

iv. **Text Selection & Move Mouse Cursor:** Text selection is initiated by touching the tips of index finger to the thumb for two seconds. This action will call the lock_cursor function, allowing text selection. Unlocking the cursor requires separating the thumb and index finger more than 50 pixels. Also, the Pinky tip is enabled to control the cursor on when this function is being called.

v. **Scrolling Up:** Raising the index and middle fingers while touching the thumb to the ring finger triggers upward scrolling.

vi. **Scrolling Down:** Lowering the index and middle fingers initiates downward scrolling.

vii. **Showing Hand Gesture Dictionary:** When the system detects two hands for 2 seconds, the hand gesture dictionary will appear for 5 seconds to help the user refresh their memory.

viii. **Interaction with user**: Showing a cat animation on the screen if the system did not detect hand for 5 seconds.

5.1 Implementation Issues and Challenges

During the implementation process, several challenges were encountered:

1. **Logical Issues with Hand Gesture Recognition**: Some hand gestures were not identified accurately, leading to unintended actions being triggered. This issue was primarily due to limitations in gesture recognition accuracy, which sometimes resulted in misinterpretation of gestures and activation of incorrect functionalities.

2. **Screen Size and Hand Movement**: The large screen size of the device posed a challenge, as users had to move their hands to the corners of the camera's view in order to move their mouse cursor to the corner of the divice. This setup made it difficult for users to estimate distances accurately and manoeuvre the cursor precisely, impacting overall usability and user experience.

3. **Difficulty in Tracking Specific Fingers**: The system faced issues in reliably tracking the user's hands, particularly in distinguishing the index finger from other fingers. This challenge affected the system's ability to correctly interpret gestures and perform actions based on finger-specific movements, leading to errors in gesture recognition and control functionalities.

4. **Repeated Triggering of Click Function**: The system struggled with performing the click function correctly because it continually detected gestures, leading to multiple, unintended clicks. Once the system recognized the gesture for clicking, it kept calling the click function repeatedly as long as the gesture was detected, resulting in an excessive number of clicks and a frustrating user experience.

5.2 Solution Found:

1. **Refining Gesture Detection**: Use different fingers for specific actions to ensure that each gesture is assigned to a distinct finger. Additionally, introduce more conditions for hand gestures to ensure that functions are only triggered under precise circumstances. For example, ensure that the scroll-up function is only called when only the index and middle fingers are raised.

2. **Enhanced User Interface**: Integrate a frame into the camera window to provide users with a clearer view of their hand movements. This will help users better estimate where their fingers are positioned and ensure that all actions are performed within the frame. Actions outside the frame will be ignored to prevent unintended behavior.

3. **Finger Landmark Identification**: Implement a system of hand landmarks to accurately track each finger's position. For instance, use specific markers for different parts of the index finger—such as tip, dip, and MCP joints—to enhance gesture recognition accuracy and ensure precise functionality.

4. **Controlled Click Function**: Introduce a click_enabled boolean to manage the click function. Set this boolean to false by default and change it to true when the click gesture is detected. After the click function is executed, reset the boolean to false to prevent multiple unintended clicks. This approach will help effectively manage and avoid issues related to multiple clicks.

CHAPTER 6 System Evaluation and Discussion

6.0 Stage 4: Testing

At this stage, the focus will be on evaluating the performance and accuracy of the developed hand gesture recognition system. Key activities will include:

- **Testing Gesture Recognition**: Validate that the system correctly identifies and interprets hand gestures according to the implemented functionalities. This includes ensuring accurate detection of gestures for cursor movement, clicking, scrolling, and other actions.

- **Functionality Verification**: Check if all the relative functions (e.g., cursor movement, clicking, scrolling, scroll up and down) work as intended and respond accurately to the detected gestures. Verify that conditions and specific gestures trigger the appropriate actions without unintended side effects.

- **User Interaction Evaluation**: Assess the user experience to ensure that the system is intuitive and responsive. This includes evaluating the effectiveness of the visual frame, the accuracy of finger tracking, and the overall ease of use.

- **Error Handling and Refinement**: Identify and address any issues or bugs discovered during testing. Refine the system based on feedback and test results to improve its reliability and performance.

This stage aims to ensure that the hand gesture recognition system meets the desired functionality and user experience standards before moving to deployment.

6.1.1 Testing case 01 - Guidance for user (Hand Gesture Dictionary)

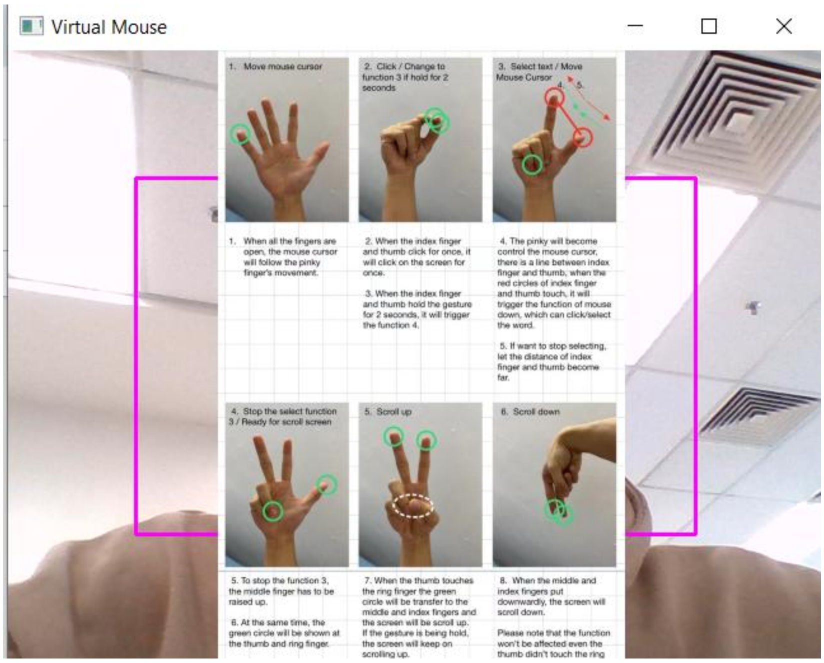


Figure 6.1.1 Guidance for user (Hand Gesture Dictionary)

Guidance for user: When the system starts, the hand gesture dictionary will be displayed to guide users on how to use the hand gesture recognition system

6.1.2 Testing case 02 - Control Cursor Movement

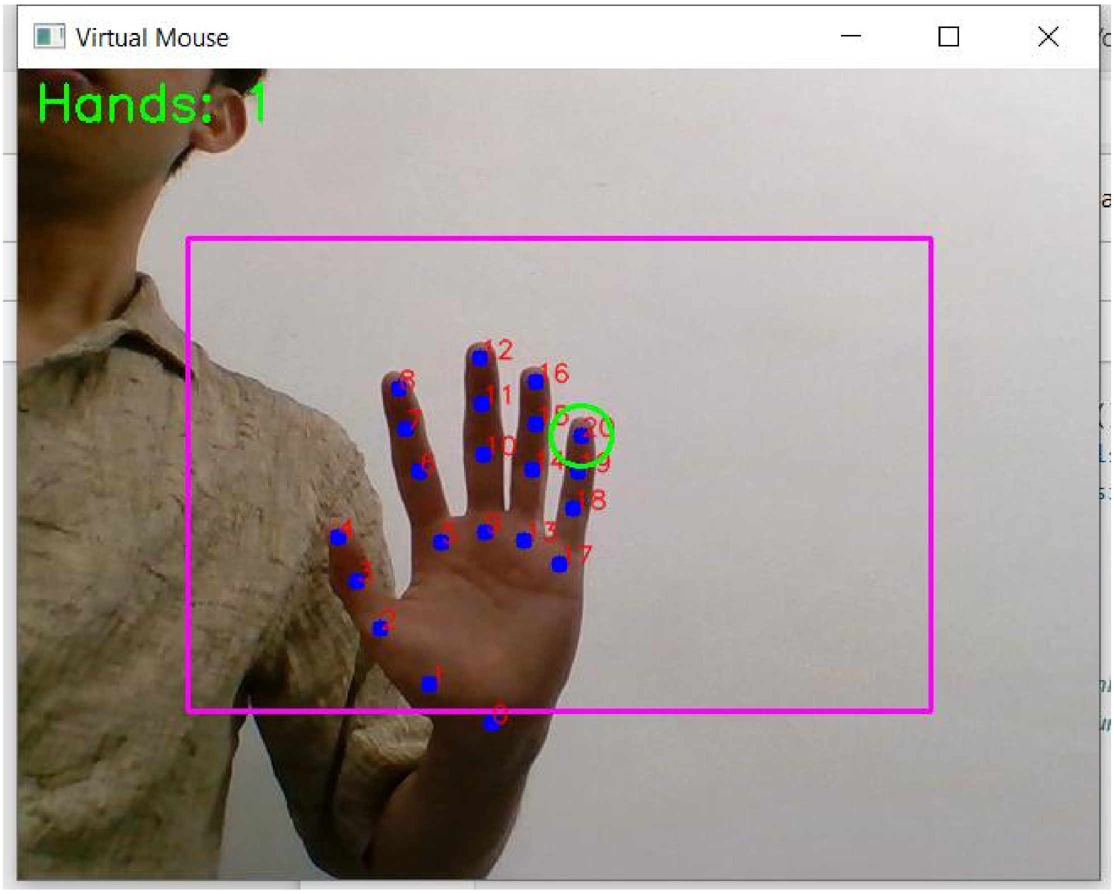


Figure 6.1.2 Control Cursor Movement

Control Cursor Movement: When all of the fingers are opened, there will be a green circle on the Pinky tip and the cursor will be follow the Pinky tip to move.

6.1.3 Testing case 03 - Clicking Functionality

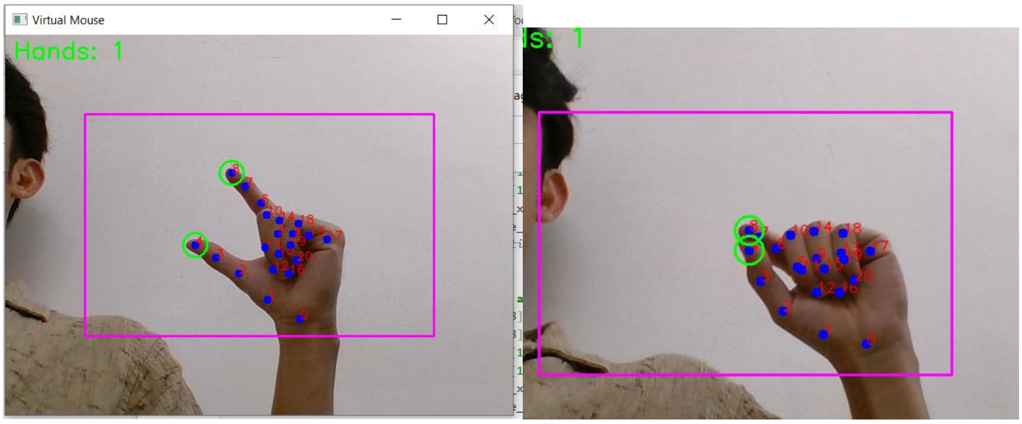


Figure 6.1.3 Clicking Functionality

Clicking Functionality: When the green circle of thumb and index tip touched each other, the click function will be called.

If these two circles are touched for 2 seconds, it will cause the lock_cursor and call the function of 3.4.3, which is to enable the **Text Selection.**

6.1.4 Testing case 04 & 05 & 06- Text Selection & Move Mouse Cursor

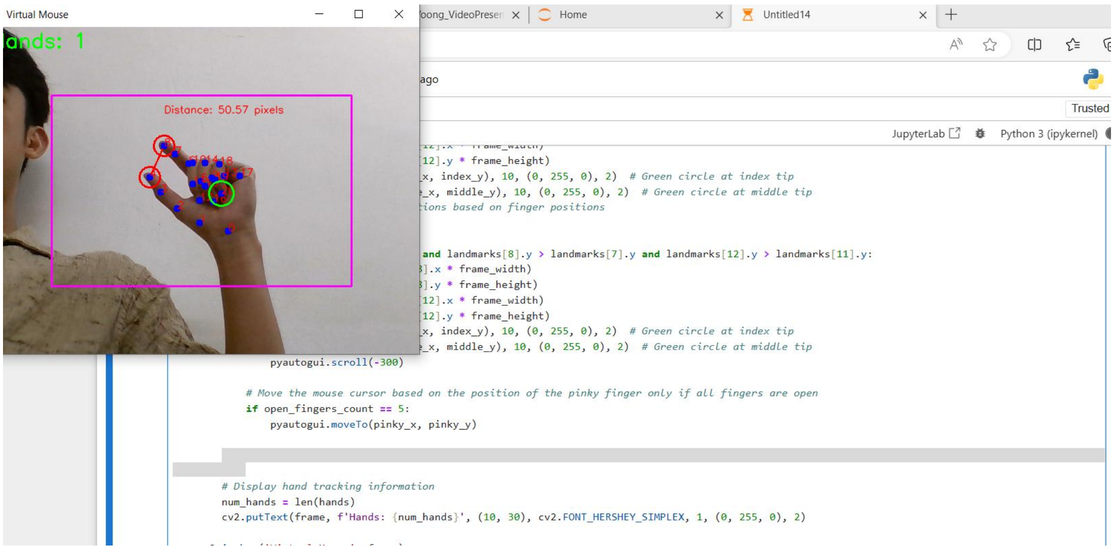


Figure 6.1.4.1 Text Selection & Move Mouse Cursor

Test Case 04: Then **Text Selection** is being called, the tip of Pinky will be able to control the mouse circle again, and as long as the distance between the tip of thumb and index are not more than 50 pixels, it will allow the user to selecet the texts by moving the Pinky tip.

Test Case 05: When the distance between the tip of thumb and index are more than 50 pixels, cursor unlocks for text selection

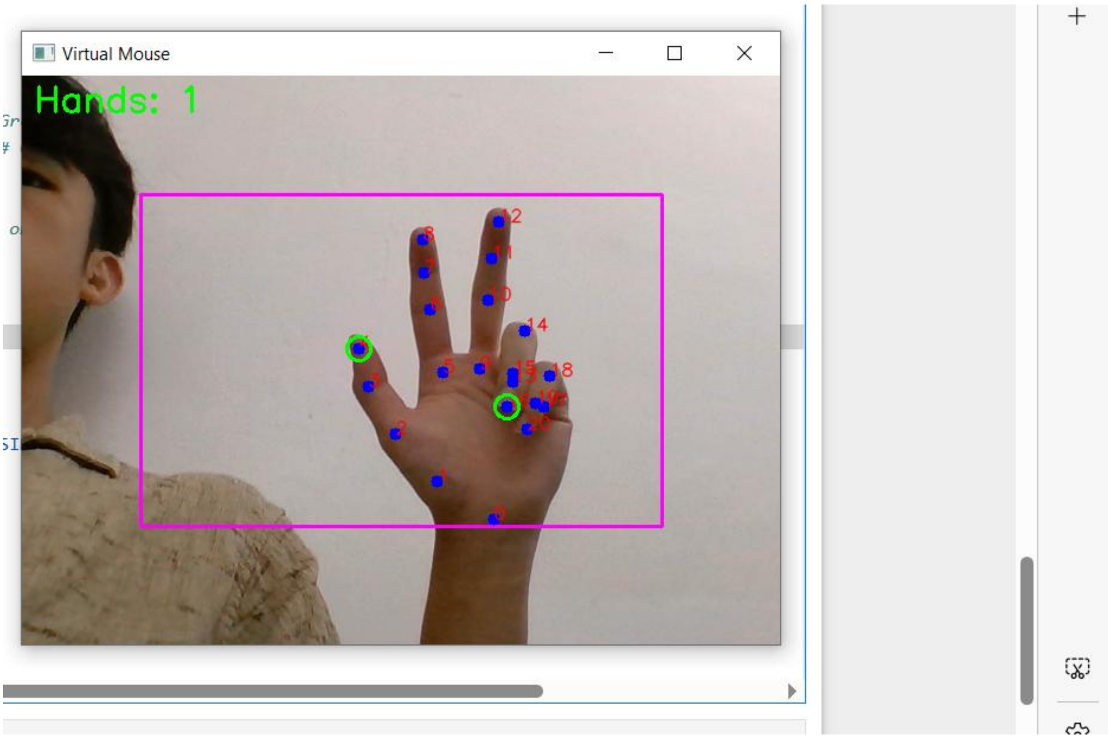


Figure 6.1.4.2 Text Selection & Move Mouse Cursor

Test case 06: If user wishes to cancel the **Text Selection function**, which is to "Unlock" the cursor, they can perform the gesture like image above and it will show two circles on the thumb and ring tips, which means that it is ready to the function of 6.1.5, which is **Scroll Up** Function**.**

6.1.5 Testing case 07 - Scroll Up

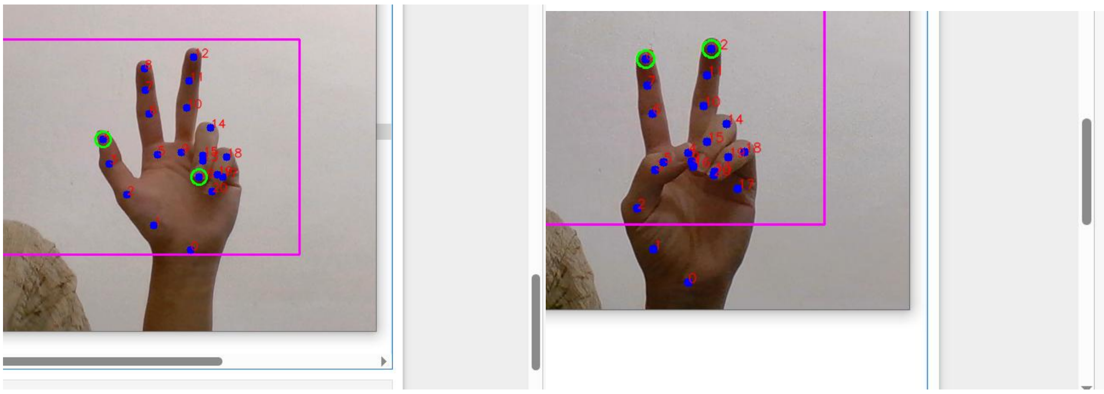


Figure 6.1.5 Scroll Up

When the index and the middle fingers are raised and the circles of thumb and ring touch, it will call the function of scroll up, and scroll the relative page up.

6.1.6 Testing case 08 - Scroll Down

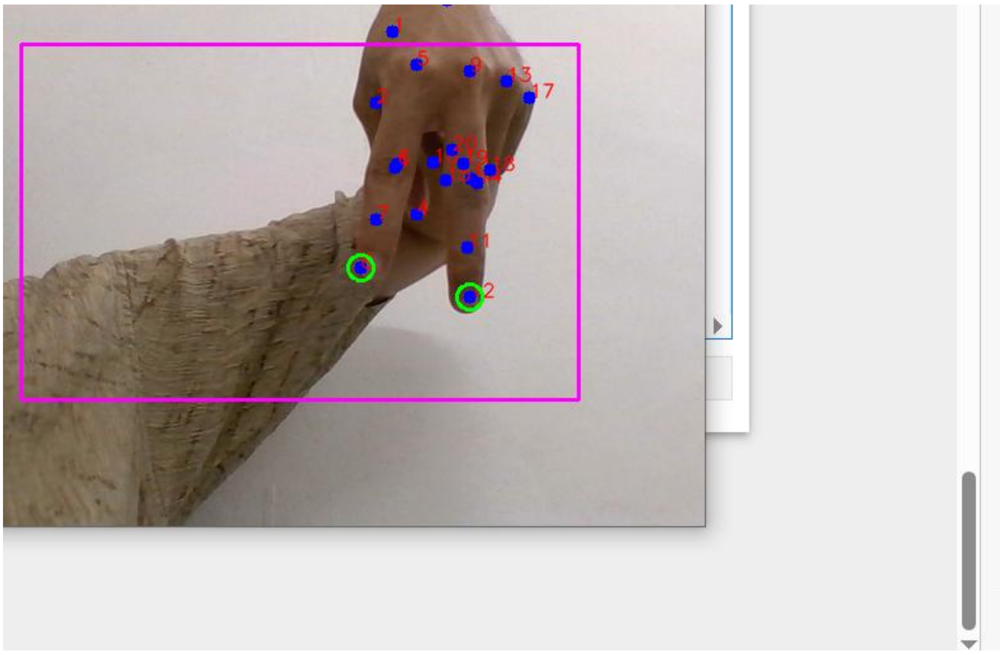


Figure 6.1.6 Scroll Down

If the tip of index and middle are raised and put downwardly, the scroll down function will be called and scroll the page down.

6.1.7 Testing case 09 - Showing the Hand Gesture Dictionary

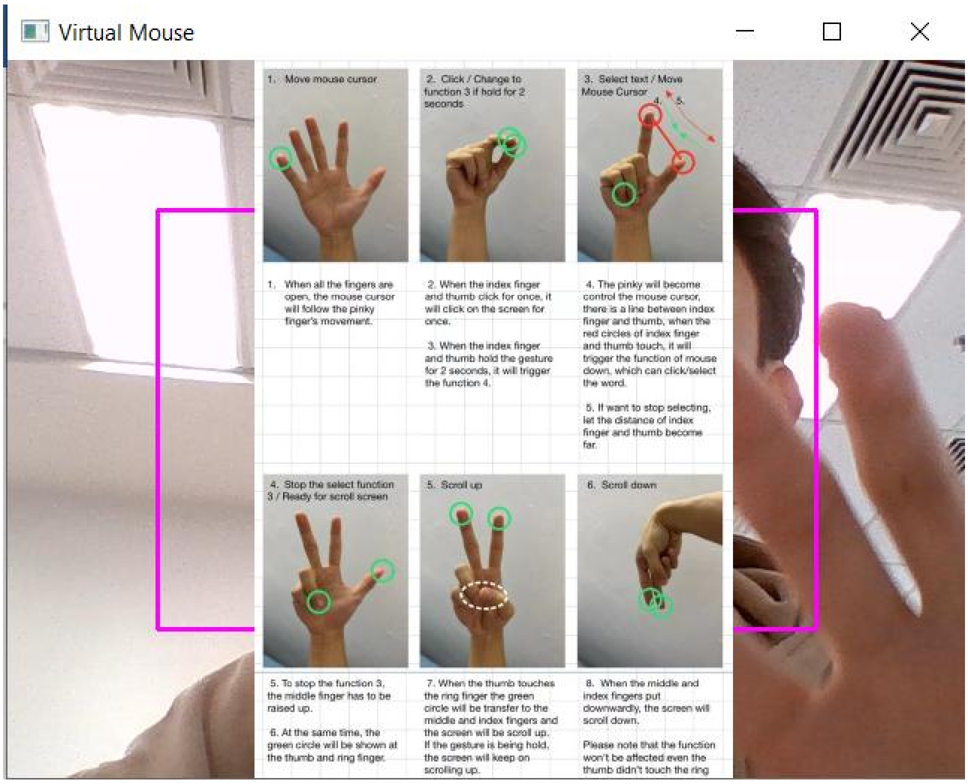


Figure 6.1.7 Showing the hand Gesture Dictionary

When the system is detected two hands in the camera for 2 seconds, the hand dictionary will be called and stay or 5 seconds in order to guide user to use the system.

6.1.8 Testing case 10 - No Hand Detected

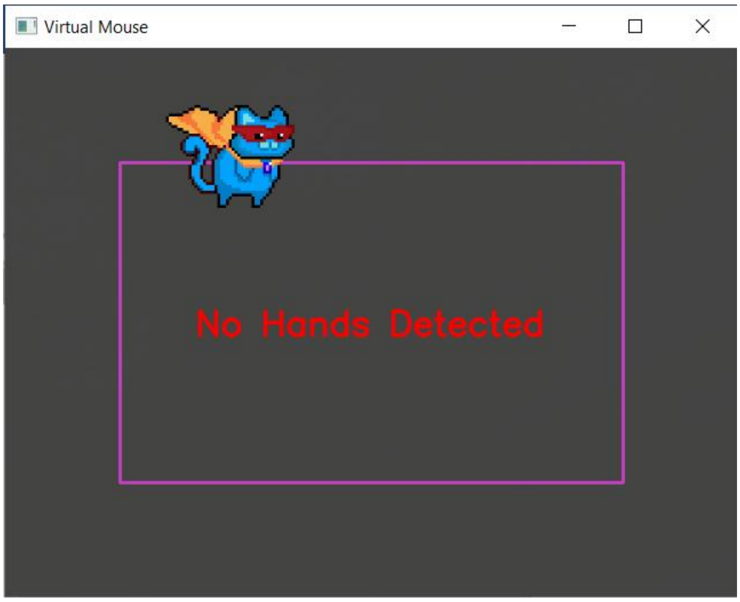


Figure 6.1.8 No Hand Detected

When there is not hand detected for 5 seconds, the system will show a notification on the screen frame to tell that that is no hand detected for now and there will be a cat animation flying around to increase the user interaction.

6.1.9 Testing case 11 – Break the system

When the thumbs, middle and pinky tip are touching each other for 0.5 seconds, the system will be break automatically.

6.2 Testing Table

Test Case ID	Description	Expected Result	Actual Result	Pass/Fail	Notes
TC01	Display hand gesture dictionary	Dictionary is displayed at startup	Dictionary was displayed on startup	Pass	-
TC02	Detect all five fingers raised	Cursor movement is active	Cursor movement is being triggered	Pass	-
TC03	Detect index and thumb touching	Click function is triggered	Click function was triggered	Pass	-
TC04	Touch index and thumb for 2 seconds	Text selection is enabled	Text Selection was Enavled	Pass	-
TC05	Separate index and thumb by 50 pixels	Cursor unlocks for text selection	Cursor unlocks for text selection was triggered	Pass	-
TC06	Raise thumb, index and middle fingers	Text selection is enabled	Text selection was enabled	Pass	-
TC07	Raise index and middle fingers, touch thumb to ring finger	Scroll up function is triggered	Scroll up function was triggered	Pass	-
TC08	Lower index and middle fingers	Scroll down function is triggered	Scroll down function was triggered	Pass	-
TC09	Detect two hands for 2 seconds	Hand gesture dictionary is shown for 5 seconds	Hand gesture dictionary was shown	Pass	-
TC10	No hand detected for 5 seconds	Cat animation is displayed	Cat animation was displayed	Pass	-
TC11	Break the system	The system will be stopped	The system was stopped	Pass	-

CHAPTER 7 System Release and Feedback

7.1 Stage 5: Release

The release phase in the Agile Software Development Lifecycle marks the transition from development to delivery. For the hand gesture recognition system, this involves packaging the necessary files and resources to ensure the user can seamlessly download, access, and run the system.

7.1.1 File Packaging and Distribution

The system's core files, including the cat_sprites, relevant images, and the FYP.ipynb notebook, are compressed into a single zipped file. This zipped file simplifies the process of transferring and deploying the system, making it easy for users to download and set up the environment on their local machines.

7.1.2 User Access and Deployment

To facilitate user access, the zipped file is made available through the Jupyter Notebook interface. Users can download the file directly within the notebook environment. Upon downloading, users can easily unzip the file using standard file extraction tools, which will unpack the files into the necessary directories for the system to function properly.

This method of distribution ensures that all users have access to the latest version of the system, complete with the necessary resources to run it effectively. By leveraging the Jupyter Notebook environment, the release process is streamlined, allowing users to quickly set up and interact with the hand gesture recognition system.

7.2Stage 6: Feedback

The feedback stage is a crucial part of the Agile Software Development Lifecycle, as it provides valuable insights into the user experience and system functionality. For the hand gesture recognition system, feedback will be solicited from a targeted group of IT professionals and students, including the supervisor and IT students from UTAR. This feedback will be collected via a survey form with the download link inside.

7.2.1 Survey Structure and Respondent Interaction

To ensure comprehensive feedback, the survey is divided into two sections:

1. **Demographics**:
   This section gathers basic information about the respondents, including their UTAR email, gender and age range. This data helps categorize responses and understand the diversity of the user base.

2. **Feedback on the Hand Gesture Recognition System**:
   This section focuses on the users' experiences with the system.
   Key questions:
   i. Have you downloaded and used the system?
   ii. Did the hand gesture dictionary show at the first helps you to understand on how to use the hand gesture recognition system?
   iii. If no, why:
   iv. Which of the function(s) is/are useful when you are using the system?
   v. How long did you take to familiar with the gestures to use the system?
   vi. Did you notice that a cat animation appears when no hand is detected for 5 seconds?
   vii. Do you think it is necessary for the cat animation to improve user interaction?
   viii. Do you think the developed functions are enough for a hand gesture recognition system to perform as a virtual mouse?
   ix. If no, what kind of function to you think it could be added for?
   x. Does the system effectively avoid physical contact between you and the device?
   xi. How many marks would you give to the system?

7.2.2 Survey Overview

After the survey has been released, conducted until September 10, 2024, was executed through a survey that gathered responses from 21 participants, which are including IT professionals and students from UTAR.

Key Findings:

1. **System Accessibility and Initial Guidance**:
    - All respondents successfully downloaded the system, and the majority found the initial hand gesture dictionary effective in helping them understand how the system operates.
2. **Functionality Usage**:
    - **Most Useful Functions**:
        - 100% of respondents identified the scrolling up, scrolling down, and mouse cursor control functions as the most useful features.
    - **Least Useful Function**:
        - The option to show the hand gesture dictionary again was deemed less useful, with only 47.6% of respondents finding it necessary. Many users felt that once they became familiar with the gestures, they no longer needed to refer back to the dictionary.
3. **Familiarization Time**:
    - A significant portion of respondents (71.4%) reported that it took them between 11-20 minutes to become familiar with the gestures to use the system.
4. **User Interaction**:
    - 90.5% of respondents noticed the cat animation after the system did not detect hands for 5 seconds, and 76.2% believed that this feature effectively increased user interaction.

5. **Suggestions for Additional Functions**:
   - 28.6% of respondents suggested that more functions could be added, such as zoom in/out and copy/paste features, to enhance the system's capabilities.
6. **Physical Contact Avoidance**:
   - All respondents (100%) agreed that the system effectively prevents physical contact with the device, achieving one of the primary goals of the project.
7. **Overall Satisfaction**:
   - Most respondents (61.9%) rated the system with 4 out of 5 marks, indicating a high level of satisfaction.

CHAPTER 8 Conclusion

The hand gesture recognition system represents a significant advancement in the realm of human-computer interaction, offering a novel and intuitive way to control devices without the need for physical contact. Throughout the development process, the system has been designed to prioritize user experience, ease of use, and functionality. The core features, such as scrolling, mouse cursor control, and the interactive cat animation, have been successfully implemented and tested. These features have proven to be highly effective, as evidenced by the positive feedback from users, who have found the system both practical and engaging.

The initial goal of the project was to create a system that could accurately interpret hand gestures and translate them into corresponding actions on a digital screen. This objective has been largely achieved, with the system demonstrating reliable performance across various scenarios. The inclusion of the hand gesture dictionary at the start has been particularly beneficial, helping users quickly grasp how to interact with the system. Additionally, the interactive elements, such as the cat animation, have enhanced user engagement, making the system not only functional but also enjoyable to use.

However, while the current version of the system is robust and fulfills its primary purpose, there is always room for improvement and expansion. Feedback from users has highlighted areas where the system could be further enhanced. In response to this feedback, future iterations of the system will include additional features, such as zoom in/out and copy/paste functions. These enhancements will increase the system's versatility, allowing it to meet a broader range of user needs and further solidifying its place as a comprehensive hand gesture recognition tool.

In conclusion, the hand gesture recognition system has successfully achieved its initial objectives, providing a functional, user-friendly, and innovative solution for hands-free device control. The system has laid a strong foundation for future development, and the planned enhancements will only serve to strengthen its capabilities. As it stands, the system is a testament to the potential of gesture-based interfaces and their ability to transform how we interact with technology. With ongoing improvements, the system is poised to become an even more powerful tool, offering users a seamless and efficient way to control their digital environments.

REFERENCES

[1] ResearchGate. (2018). Increasing trends in total registered vehicles and road accidents in Malaysia. Retrieved from https://www.researchgate.net/figure/Increasing-trends-in-total-registered- vehicles-and-road-accidents-in-Malaysia-67_fig1_299472158 (accessed April 25, 2023).

[2] YourStory. (n.d.). License Plate Recognition Software: The Pros & Cons. Retrieved from https://yourstory.com/mystory/license-plate-recognition- software-the-pros-cons-a (accessed April 20, 2023).

[3] Paul Tan's Automotive News. (2019, October 30). Sunway Smart Parking System with Plate Recognition previewed - multiple e-wallet options, Q1 2020 roll-out. paultan.org. Retrieved from https://paultan.org/2019/10/30/sunway- smart-parking-system-with-plate-recognition-previewed-multiple-e-wallet- options-q1-2020-roll-out/ (accessed April 25, 2023).

[4] Rosebrock, A. (2017, September 11). Object detection with deep learning and OpenCV. PyImageSearch. Retrieved from https://pyimagesearch.com/2017/09/11/object-detection-with-deep-learning- and-opencv/ (accessed April 25, 2023).

[5] Microchip. (2024, February). Machine-learned wearable sensors for real-time hand-motion recognition: toward practical applications from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10776364/

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S2	**Study week no.: 1**
Student Name & ID: WONG JIAN YOONG 20ACB04987	
Supervisor: Shakiroh Binti Khamis	
Project Title: Hand gestures recognition system to control the device's screen	

1. WORK DONE

Done the FYP1 and created a survey ready for Supervisor to check whether the questions are suitable.

2. WORK TO BE DONE

Correct the relative questions and add some more questions that is related to the student's demographics

3. PROBLEMS ENCOUNTERED

-

4. SELF EVALUATION OF THE PROGRESS

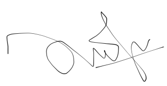
So far So Good

Supervisor's signature

Student's signature

Trimester, Year: Y3S2	Study week no.: 2
Student Name & ID: WONG JIAN YOONG 20ACB04987	
Supervisor: Shakiroh Binti Khamis	
Project Title: Hand gestures recognition system to control the device's screen	

1. WORK DONE Modified the survey questions and also the UIUX of the system
2. WORK TO BE DONE Increase some user interaction while there is no hand detected.
3. PROBLEMS ENCOUNTERED -
4. SELF EVALUATION OF THE PROGRESS So far so good.



Supervisor's signature

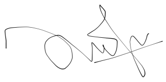
Student's signature

Trimester, Year: Y3S2	Study week no.: 4
Student Name & ID: WONG JIAN YOONG 20ACB04987	
Supervisor: Shakiroh Binti Khamis	
Project Title: Hand gestures recognition system to control the device's screen	

1. WORK DONE Added for the user interaction with the cat animation.
2. WORK TO BE DONE Add more hand gesture to trigger the hand gesture dictionary, in order to let the user can see the dictionary as they wanted to.
3. PROBLEMS ENCOUNTERED **-**
4. SELF EVALUATION OF THE PROGRESS So far so good.

Supervisor's signature

Student's signature



Trimester, Year: Y3S2	Study week no.: 7
Student Name & ID: WONG JIAN YOONG 20ACB04987	
Supervisor: Shakiroh Binti Khamis	
Project Title: Hand gestures recognition system to control the device's screen	

1. WORK DONE
Added all the hand gesture and function to the system.
2. WORK TO BE DONE
To create a poster and find the respondents to use and feedback to the system.
3. PROBLEMS ENCOUNTERED
-
4. SELF EVALUATION OF THE PROGRESS
So far so good.

Supervisor's signature Student's signature

Trimester, Year: Y3S2	Study week no.: 8
Student Name & ID: WONG JIAN YOONG 20ACB04987	
Supervisor: Shakiroh Binti Khamis	
Project Title: Hand gestures recognition system to control the device's screen	

1. WORK DONE Created the poster and released to the online social media platform.
2. WORK TO BE DONE Collect the feedback from the users.
3. PROBLEMS ENCOUNTERED -
4. SELF EVALUATION OF THE PROGRESS So far so good

Supervisor's signature

Student's signature

Trimester, Year: Y3S2	Study week no.: 9
Student Name & ID: WONG JIAN YOONG 20ACB04987	
Supervisor: Shakiroh Binti Khamis	
Project Title: Hand gestures recognition system to control the device's screen	

1. WORK DONE Analyzed the feedback from the user and keep on modify the system in order to enhance the user experiences.
2. WORK TO BE DONE Modify the system.
3. PROBLEMS ENCOUNTERED -
4. SELF EVALUATION OF THE PROGRESS So far so good.

Supervisor's signature

Student's signature

Trimester, Year: Y3S2	**Study week no.: 11**
Student Name & ID: WONG JIAN YOONG 20ACB04987	
Supervisor: Shakiroh Binti Khamis	
Project Title: Hand gestures recognition system to control the device's screen	

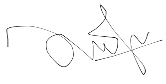
1. WORK DONE Tried to add the zoom in/out functions but encountering some errors.
2. WORK TO BE DONE Keep on figuring the zoom in/out functions
3. PROBLEMS ENCOUNTERED Unable to implement the function of zoom in/out.
4. SELF EVALUATION OF THE PROGRESS So far so good.

Supervisor’s signature

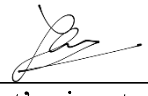
Student’s signature

Trimester, Year: Y3S2	**Study week no.: 12**
Student Name & ID: WONG JIAN YOONG 20ACB04987	
Supervisor: Shakiroh Binti Khamis	
Project Title: Hand gestures recognition system to control the device's screen	

1. WORK DONE Found that the zoom in function can be used in the Google Browser, so decided to not implement it.
2. WORK TO BE DONE Collect and analysis the feedback.
3. PROBLEMS ENCOUNTERED **-**
4. SELF EVALUATION OF THE PROGRESS So far so good.



Supervisor's signature



Student's signature

Trimester, Year: Y3S2	**Study week no.: 13**
Student Name & ID: WONG JIAN YOONG 20ACB04987	
Supervisor: Shakiroh Binti Khamis	
Project Title: Hand gestures recognition system to control the device's screen	

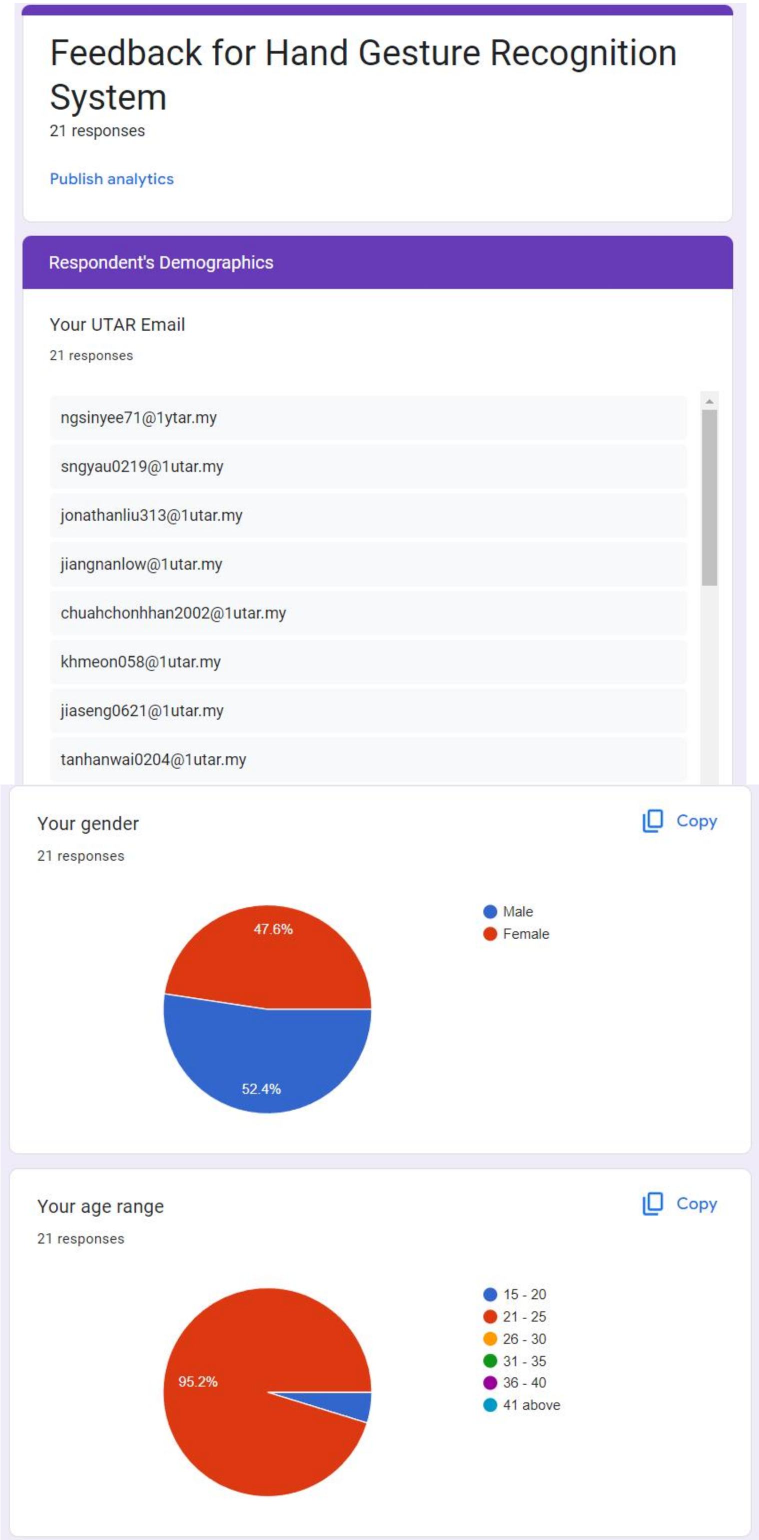
1. WORK DONE The analysis is almost done and the system was modified completely.
2. WORK TO BE DONE Keep on checking to the system whether there is any error.
3. PROBLEMS ENCOUNTERED **-**
4. SELF EVALUATION OF THE PROGRESS So far so good.

Supervisor's signature

Student's signature

APPENDIX

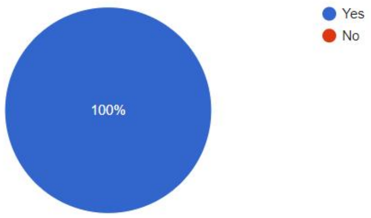
Raw Data from the survey.



Feedbacks of the Hand Gesture Recognition system

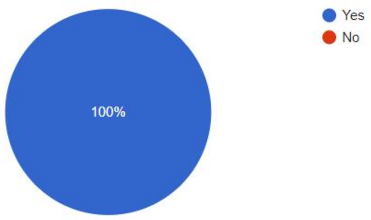
Have you downloaded and used the system?

21 responses



Did the hand gesture dictionary show at the first helps you to understand on how to use the hand gesture recognition system?

21 responses



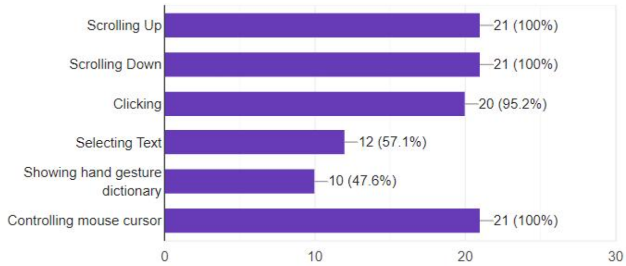
If no, why:

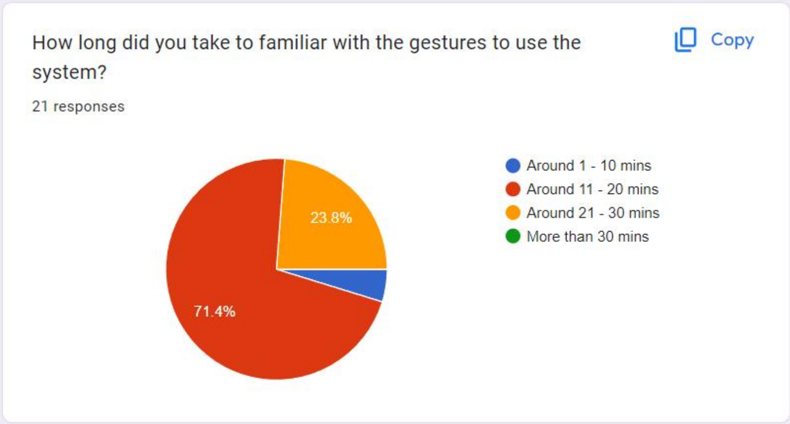
0 responses

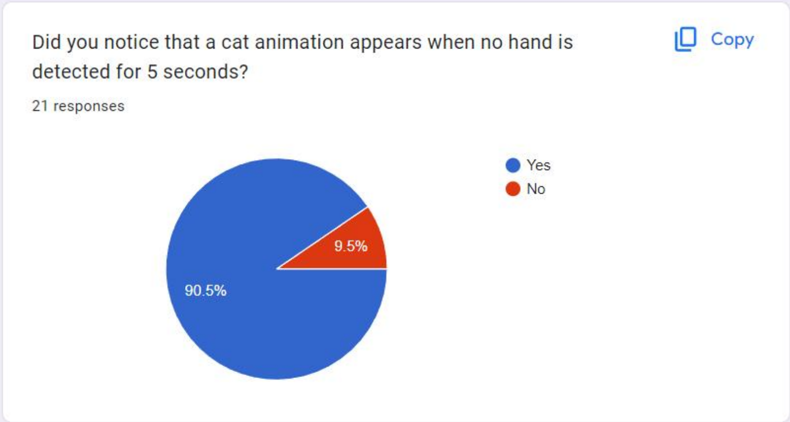
No responses yet for this question.

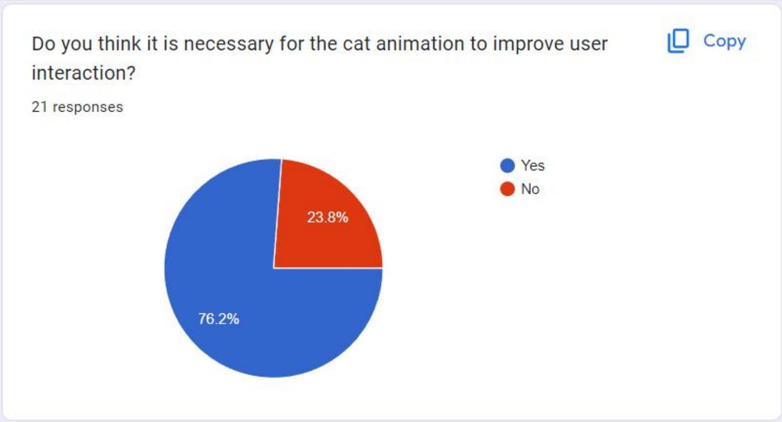
Which of the function(s) is/are useful when you are using the system?

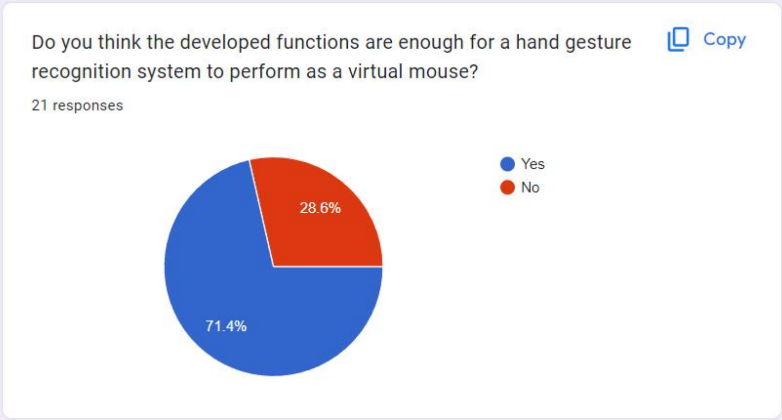
21 responses




How long did you take to familiar with the gestures to use the system?
21 responses
Copy
Around 1 - 10 mins
Around 11 - 20 mins
Around 21 - 30 mins
More than 30 mins
23.8%
71.4%


Did you notice that a cat animation appears when no hand is detected for 5 seconds?
21 responses
Copy
Yes
No
9.5%
90.5%


Do you think it is necessary for the cat animation to improve user interaction?
21 responses
Copy
Yes
No
23.8%
76.2%


Do you think the developed functions are enough for a hand gesture recognition system to perform as a virtual mouse?
21 responses
Copy
Yes
No
28.6%
71.4%

If no, what kind of function to you think it could be added for?

7 responses

Zoom In and Out function could be added

Could add the zoom in & out function and the right click function.

Zoom in function would be more effective if it has been added.

Copy and paste, and Zoom in and out functions

Function of enlarging the screen size

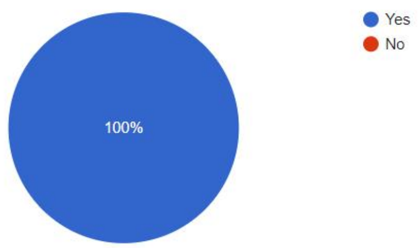
Zoom in and zoom out

Zoom in function

Does the system effectively avoid physical contact between you and the device?

Copy

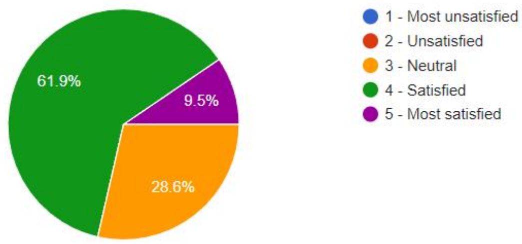
21 responses



How many marks would you give to the system?

Copy

21 responses



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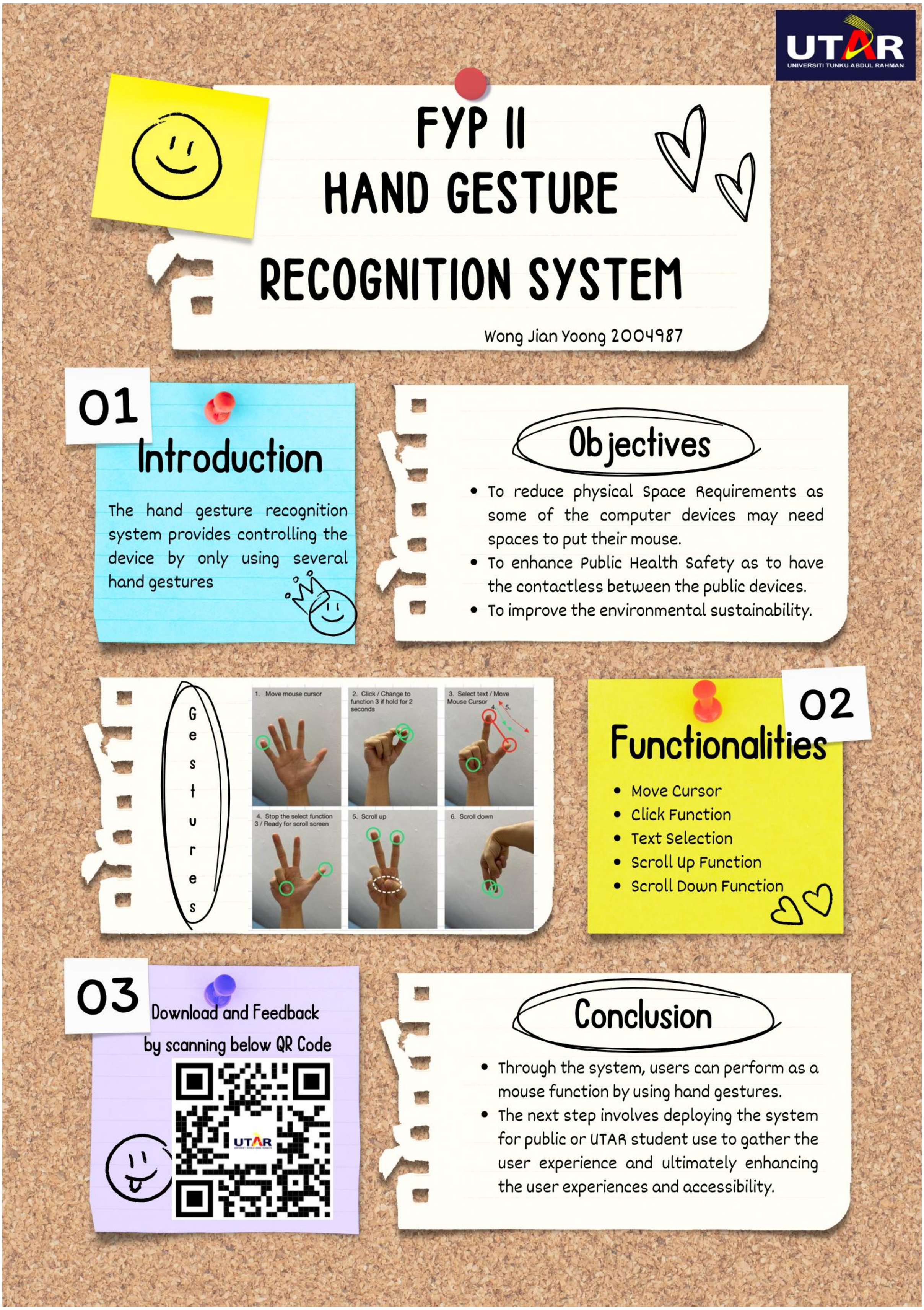
UTAR
UNIVERSITI TUNKU ABDUL RAHMAN
FYP II
HAND GESTURE
RECOGNITION SYSTEM
Wong Jian Yoong 2004987
01
Introduction
The hand gesture recognition system provides controlling the device by only using several hand gestures
Objectives
• To reduce physical Space Requirements as some of the computer devices may need spaces to put their mouse.
• To enhance Public Health Safety as to have the contactless between the public devices.
• To improve the environmental sustainability.
Gestures
1. Move mouse cursor
2. Click / Change to function 3 if hold for 2 seconds
3. Select text / Move Mouse Cursor
4. Stop the select function 3 / Ready for scroll screen
5. Scroll up
6. Scroll down
02
Functionalities
• Move Cursor
• Click Function
• Text Selection
• Scroll Up Function
• Scroll Down Function
03
Download and Feedback
by scanning below QR Code
Conclusion
• Through the system, users can perform as a mouse function by using hand gestures.
• The next step involves deploying the system for public or UTAR student use to gather the user experience and ultimately enhancing the user experiences and accessibility.

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ID Number(s)	2004987
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