DAYANANDA SAGAR UNIVERSITY

KUDLU GATE, BANGALORE – 560068

Bachelor of Technology
in
COMPUTER SCIENCE AND ENGINEERING

Major Project Phase-II Report

(AI Based Virtual Mouse for Carpel Tunnel Syndrome Patients)

By

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(2021-2022)

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CERTIFICATE

This is to certify that the Phase-II project work titled "**AI BASED VIRTUAL MOUSE FOR CARPEL TUNNEL SYNDROME PATIENTS**" is carried out by **G Sai Chandra (ENG18CS0101),M Manish Kumar Guptha (ENG18CS0175),S Jatin (ENG18CS0247),V Krishna Sai (ENG18CS0309)** bonafide students of Bachelor of Technology in Computer Science and Engineering at the School of Engineering, Dayananda Sagar University, Bangalore in partial fulfillment for the award of degree in Bachelor of Technology in Computer Science and Engineering, during the year **2021-2022**.

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Name of the Examiner **Signature of Examiner**

1.

2.

DECLARATION

We, **G Sai Chandra (ENG18CS0101),M Manish Kumar Guptha (ENG18CS0175), S Jatin (ENG18CS0247),V Krishna Sai (ENG18CS0309)** are students of the seventh semester B.Tech in **Computer Science and Engineering**, at School of Engineering, **Dayananda Sagar University**, hereby declare that the phase-II project titled **"AI BASED VIRTUAL MOUSE FOR CARPEL TUNNEL SYNDROME PATIENTS"** has been carried out by us and submitted in partial fulfillment for the award of degree in **Bachelor of Technology in Computer Science and Engineering** during the academic year **2021 2022**.

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LIST OF ABBREVIATIONS

AI	Artificial Intelligence
CV	Computer Vision
CTS	Carpel Tunnel Syndrome
MP	Media-Pipe
Pyauto GUI	Python Automation Library
enum	enumerations
Pycaw	Python Core Audio Windows Library
ctypes	Foreign Function Library for python

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ABSTRACT

The mouse is an indispensable input device that we use daily and often all day. The mouse is one of the wonderful inventions of Human-Computer Interaction (HCI) technology and is used in all modern-day computer systems. Currently, wireless mouse or a Bluetooth mouse still uses devices and is not free of devices completely since it uses a battery for power and a dongle to connect it to the PC. In the proposed AI virtual mouse system, this limitation can be overcome by employing webcam or a built-in camera for capturing of hand gestures and hand tip detection using computer vision. The algorithm used in the system makes use of the machine learning algorithm. Based on the hand gestures, the computer can be controlled virtually and can perform left click, right click, scrolling functions, and computer cursor function without the use of the physical mouse. The algorithm is based on deep learning for detecting the hands. Hence, the proposed system will avoid COVID-19 spread by eliminating the human intervention and dependency of devices to control the computer. There have been many technologies been built in the augmented reality and devices that we use in our daily life are becoming very compact.This paper proposes an AI based virtual mouse where the operations of the mouse are performed based on the gesture movements captured by the camera by using computer vision technology.The main objective is to perform computer mouse cursor functions and scroll function using a web camera or a built-in camera in the computer instead of using a traditional mouse device. Hand gesture and hand tip detection by using computer vision is used as a HCI with the computer. With the use of the AI virtual mouse we can track the fingertip of the hand gesture by using a built-in camera or web camera and perform the mouse cursor operations and scrolling function and also move the cursor with it.

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

Hand Gesture technology is applied in many different fields in today's world of automation, including medical applications, industry applications, IT hubs, banking sectors and so on. This idea is based on the common notion of using hand gestures to manage laptop or computer. There has been tremendous development in budding areas of AR (augmented reality) and other peripheral devices that we use on the daily and many of these devices are getting smaller and portable with the likes of Bluetooth and other wireless technologies. In this paper, the proposition is that we use an Artificial Intelligence based mouse system that can recognize gestures made by hands and detect finger tips for executing mouse functions on a computer using computer vision.

Hand gestures and detection of the finger tips helps communicate with the computer.With this system one can trail the fingertip to indicate cursor movement by making use of the computer's web camera and perform cursor functions and scrolling operations.The hand movements are tracked and the frames are processed by the built-in camera of the computer to detect functions of mouse like scrolling clicking, minimizing, maximizing, etc.In this system, Python programming language which is very popular for Artificial Intelligence projects, Open-CV which is an open-source library for working with image processing and performing computer vision tasks like face-detection and object tracking and other python packages such as AutoPy, Media-Pipe and PyAutoGUI are used to move the cursor around in the application and perform functions of pointing, clicking and scrolling. The accuracy of the model is quite high and functional.The results of the proposed model showed very high accuracy level.The First computer mouse was introduced in the late 1960s and used a rolling ball to track movement. Many decades have passed and there are now quite alternatives in the market. People suffering from CARPAL TUNNEL SYNDROME or other wrist and hand Strain due to gripping a horizontal mouse.

1.1 TYPES OF DISEASES

1.1.1 Carpal Tunnel Syndrome

Carpal tunnel syndrome is a common condition that causes numbness, tingling, and pain in the hand and forearm. The condition occurs when one of the major nerves to the hand — the median nerve — is squeezed or compressed as it travels through the wrist. In most patients, carpal tunnel syndrome gets worse over time. If untreated for too long, it can lead to permanent dysfunction of the hand, including loss of sensation in the fingers and weakness. for this reason, it is important to diagnose and treat carpal tunnel syndrome promptly.

1.1.2 Cubital tunnel syndrome

Cubital tunnel syndrome also known as ulnar neuropathy is caused by increased pressure on the ulnar nerve, which passes close to the skin's surface in the area of the elbow commonly known as the "funny bone. "It develops cubital tunnel syndrome if any Repeatedly lean on your elbow, especially on a hard surface, bend your elbow for sustained periods, such as while talking on a cell phone or sleeping with your hand crooked under your pillow. Sometimes, cubital tunnel syndrome results from abnormal bone growth in the elbow or from intense physical activity that increases pressure on the ulnar nerve.

Baseball pitchers, for example, have an increased risk of cubital tunnel syndrome, because the twisting motion required to throw a slider can damage delicate ligaments in the elbow. Early symptoms of cubital tunnel syndrome include Pain and numbness in the elbow, Tingling, especially in the ring and little fingers. More severe symptoms of cubital tunnel syndrome include Weakness affecting the ring and little fingers, Decreased ability to pinch the thumb and little finger, decreased overall hand grip, Muscle wasting in the hand, Claw-like deformity of the hand

1.1.3 Radial Tunnel Syndrome

Radial tunnel syndrome is caused by increased pressure on the radial nerve, which runs by the bones and muscles of the forearm and elbow. Causes include Injury, Noncancerous fatty tumors (lipomas), Bone tumors, Inflammation of surrounding tissue.

Symptoms of radial tunnel syndrome include: Cutting, piercing, or stabbing pain at the top of the forearm or back of the hand, especially when you try to straighten your wrist and fingers. In contrast to

cubital tunnel syndrome and carpal tunnel syndrome radial tunnel syndrome rarely causes numbness or tingling, because the radial nerve principally affects the muscles. Just as with cubital tunnel syndrome, if you have any of these symptoms, your doctor may be able to diagnose radial tunnel syndrome by physical examination alone. They also may order electromyography to confirm the diagnosis, identify the area of nerve damage, and stage the severity of the condition.

1.2 TYPES OF MOUSES

1.2.1 Roller Bar Mouse

The stationary Design works similar to trackball mouses but across a wide keyboard length surface. This design can be helpful for people who find it hard to grasp a regular mouse, or suffer from wrist or shoulder strain due to the frequent motions of dragging.

1.2.2 Joystick Mouse

Joystick mouse is a stick that forces you to grasp it by assuming a handshake position. Both the forearmand wrist become perpendicular to the desk, resulting in virtually no twisting of the wrist that can pressure the median nerve.

1.2.3 Pen Mouse

A pen mouse is an optical mouse in the shape of a pen, Since it is a pen with hand Resting on its side, there is more than one way to hold a pen mouse, preventing overuse of muscles. There are alternate gripping positions like dynamic tripod, lateral quadruped.

1.2.4 Finger Mouse

A basic Mouse is basically a miniature mouse that doesn’t require any surface to operate. Use Thumb torollover the trackball and other fingers to press the buttons. The biggest reason to choose a finger mouse is that it doesn't require a surface to operate, such as standing.

1.3 BEST APPROACH

As per the above types of the diseases mentioned in 1.1 Types of Diseases there are 3 types of diseases where the diseases cause the person not to hold an object there are several biological reasons where the persons could not hold the objects. For the above mentioned diseases the existing mouse systems cannot be used to used by the users. Say like we have the roller bar mouse where as the grip would not be there he or she cannot hold the mouse and as well as when we look at the joystick mouse it also has the same scenario where the user cannot hold it or cannot have enough grip to hold the mouse to do necessary operations to be performed on the system.

When considered the Pen Mouse and the finger mouse here also we can see there is no enough scope for the users who suffer from the diseases as shown in 1.1 Types of Diseases as there would not be enough grip for the users to hold the mouse to perform the desired mouse approaches.

This paper has proposed the approach where the users operate the system with the help of the hand movements without the use of holding the mouse. Where it gives them approach to use the technology and experience the technology to use the system without the conventional mouses. The hand movements are detected with the help of the camera installed in the systems and are passed to the system with the help of image processing. It enables the users to experience in a new way.

1.4 MOTIVATION

A **virtual mouse** is software that allows users to give mouse inputs to a system without using an actual mouse. To the extreme it can also be called as hardware because it uses an ordinary web camera. A virtual mouse can usually be operated with multiple input devices, which may include an actual mouse or a computer keyboard. Virtual mouse which uses web camera works with the help of different image processing techniques. In this the hand movements of a user is mapped into mouse inputs. There has been extensive research towards novel devices and techniques for cursor control using hand gestures. Besides HCI, hand gesture recognition is also used in sign language recognition, which makes hand gesture recognition even more significant.

The persons having the disability such as Carpel Tunnel Syndrome ,Cubital Tunnel Syndrome,Radial Tunnel Syndrome would not be having chance to experience the technology and they would not be having chance to explore or use the use-cases of the conventional mouse which is been now used widely in various industries.

For such persons we introduce a method where they could experience the new world technology and can experience the functionality as the normal conventional mouse.

To make the persons use the technology we proposed a system virtual mouse where it lets the users to experience and the use the functionalities same as the conventional mouse without the use of holding.Which makes them use the new world technology and experience the same as the conventional mouse. It makes them not to leave behind everyone as everyone has to experience the technology as it evolves.

CHAPTER 2
PROBLEM DEFINITION

CHAPTER 2 PROBLEM DEFINITION

This project is mainly helpful for the people with a syndrome called carpel tunnel syndrome, because people with this condition cannot feel touch and can't have any grip but can move their hands.To make them use computers without any other help, this virtual mouse helps a lot. All they need tounderstand is how they have to move their hand for any particular operation and this can be learned by anyone with some practice. This project can also be used by normal people, who want to experience virtual mouse or who are bored of using regular mouse. To develop a way so that humans can interact with a computer without having any physical contact with the computer. Many ideas were put forward but they all required physical movement of hardware. Another idea put forward was to use the principle of photoelectric effect. But for that a special hardware is needed and it is not economically feasible. So the final decision is to develop a virtual mouse which uses simple image processing techniques. Although it is a simple one, it works very smoothly.

Solution: AI Based Virtual Mouse for Carpel Tunnel Syndrome Patients

CHAPTER 3

LITERATURE REVIEW

CHAPTER 3 LITERATURE REVIEW

As modern technology of human computer interactions become important in our everyday lives, varieties of mouse with all kind of shapes and sizes were invented, from a casual office mouse to a hard-core gaming mouse.

V Krishna Sai:- However, there are some limitations to these hardware as they are not as environmental friendly as it seems. For example, the physical mouse requires a flat surface to operate, not to mention that it requires a certain area to fully utilize the functions offered .Furthermore, some of these hardware are completely useless when it comes to interact with the computers remotely due to the cable lengths limitations, rendering it inaccessible

The current system is comprised of a generic mouse and track pad monitor control system, as well as the absence of a hand gesture control system. The use of a hand gesture to access the monitor screen from a distance is not possible. Even though it is primarily attempting to implement, the scope is simply limited in the virtual mouse field.

This paper presented a brandnew AI virtual mouse method using OpenCv, autopy and mediapipe by the help of fingertip movement interacted with the computer in front of camera without using any physical device. The approach demonstrated high accuracy and highly accurate gesture eliminates in practical applications. The proposed method overcomes the limitations of already existing virtual mouse systems. It has many advantages, e.g., working well in low light as well as changing light condition with complex background, and fingertip tracking of different shape and size of finger with same accuracy. The experimental results shows that the approaching system can perform very well in realtime applications. They also intend to add new gesture on it to handle the system more easily and interact with other smart systems. It is possible to enrich the tracking system by using machine learning algorithm like Open pose. It is also possible to including body, hand and facial key points for different gestures. [1]

S.jatin:-The existing virtual mouse control system consists of simple mouse operations using a hand recognition system, in which we can control the mouse pointer, left click, right click, and drag, and so on. The use of hand recognition in the future will not be used. Even though there are a variety of systems for hand recognition, the system they used is static hand recognition, which is

simply a recognition of the shape made by the hand and the definition of action for each shape made, which is limited to a few defined actions and causes a lot of confusion . As technology advances, there are more and more alternatives to using a mouse. Motion acknowledgment method gives the positive indications for performing different mouse functions. The utilization of YCbCr shading model in research removes the reliance on light power during experiment. This strategy is extremely valuable for disabled individuals, at the hour of show utilizing IP cameras, controlling TV channels and so forth and can be applied to cell phones for quite a long time. Future works will incorporate better techniques for carrying out mouse occasions and diminishing the slack to nearly zero during cursor. [2]

M Manish Kumar:-survey of libraries Media-pipe and Open-CV.one can process images and videos to identify objects, faces, or even handwriting of a human. When it integrated with various libraries, such as NumPy, python is capable of processing the OpenCV array structure for analysis. To Identify image pattern and its various features we use vector space and perform mathematical operations on these features. Mediapipe is a cross-platform library developed by Google that provides amazing ready-to-use ML solutions for computer vision tasks. OpenCV library in python is a computer vision library that is widely used for image analysis, image processing, detection, recognition.Hand tracking is the process in which a computer uses computer vision to detect a hand from an input image and keeps focus on the hand's movement and orientation. Hand tracking allows us to develop numerous programs that use hand movement and orientation as their input.

The main objective of the proposed virtual AI mouse is to furnish an alternative to the conventional physical mouse that provides mouse functions with the help of computer vision enabled computer that houses a web camera which recognizes fingers and hand gestures and processes the captured frames and uses a machine learning algorithm to execute the defined mouse functions like moving the cursor, right click, left click and scrolling function. K. Bharath Reddy et al, International Journal of Computer Science and Mobile Computing, After testing we have come to the conclusion that the proposed virtual mouse system has worked exceedingly well and with greater accuracy when compared to previously proposed models mentioned in the related work and the current system has overcome the drawbacks of the other systems. the system aids in reducing the spread of the Covid-19 virus by eliminating the need to contact high touch surfaces and devices by using hand gestures without using a conventional mouse device.[4]

G Sai Chandra:-survey of libraries PyautoGui and hand tracking module PyAutoGUI is a cross-platform GUI automation Python module for human beings. Used to programmatically control the mouse & keyboard.PyAutoGUI uses the screen coordinates to determine the exact position to perform actions such as clicking, typing, scrolling, pressing, and dragging.Hand tracking is the process in which a computer uses computer vision to detect a hand from an input image and keeps focus on the hand's movement and orientation. Hand tracking allows us to develop numerous programs that use hand movement and orientation as their input.A special sensor (or built-in webcam) can track head movement to move the mouse pointer around on the screen. In the absence of a mouse button, the software's dwell delay feature is usually used. Clicking can also be accomplished with a well-placed switch.

A Web camera is running on the mouse cursor. This will also lead to new levels of human-computer interaction (HCI), which does not require physical contact with the device. This machine can perform all mouse tasks centered on color recognition. This device is capable of being useful for interacting with contactless input modes. For people who don't use a touchpad, it's helpful. The architecture of the device proposed would dramatically change people's interactions with computers. Everyone is compatible with the Webcam, the microphone, and the mouse. It would eliminate the need for a mouse completely. It can also be used in gaming or any other independent application. Free movement, left-click, right-click, drag/select, scroll-up, scroll-down are all operations that can be performed using only gestures in this Multi-Functional system. The majority of the applications necessitate additional hardware, which can be quite costly. The goal was to develop this technology as cheaply as possible while also using a standardized operating system.Various application programmes can be written specifically for this technology in order to create a wide range of applications with minimal resources.[5]

Author	Technology	Draw Backs	Recommendation	Output analysis
Sankha Sarkar, Indrani Naskar	Open cv, AutoPy, Media-pipe, Numpy	Cannot be functioned under low light/draker areas.	Develop an UI based on application.	Cursor Movement– 100% Left click – 95% Right click – 98% Scroll Up – 100% Scroll down – 100%
Shreya Kumari, Joy Guha	Gesture Tracking, Open cv, Media pipe	Right button accuracy is less.	Develop an User fridenly application.	Mouse click – 100% Left click – 100% Right click – 95% Scroll Up – 100% Scroll down – 100%
Gubbala Durga Prasanth	Numpy, Open cv, pyinput.mouse, tkinter	Only Few operations are implemented	Change of hand gestures for each operation	The distance between the fingers of the gesture will change the operations
Jhon Manohar, Bharath reddy	Media Pipe, Open CV	Model cannot be functioned in dark or low light areas	It would be better if virtual mouse is integrated with any hardware	Pointer movement – 100% Left click – 98% Right click – 94% Scroll Up – 98% Scroll down – 99%
Riza Sande, Neha Marathe, Neha Bhegade, Akanksha Lugade	Python, Colour Detection, Open CV, Pyauto GUI	Colour detection is achieved only with three colours	As colour detection is involved so it can be integrated to vending machines.	Centroid detection accuracy is high. Left click, Right Click, Drag/select, Scroll up/down are operated.

Table 3.1 : Research analysis of publications

CHAPTER 4
PROJECT DESCRIPTION

CHAPTER 4 PROJECT DESCRIPTION

4.1 PROPOSED ARCHITECTURE

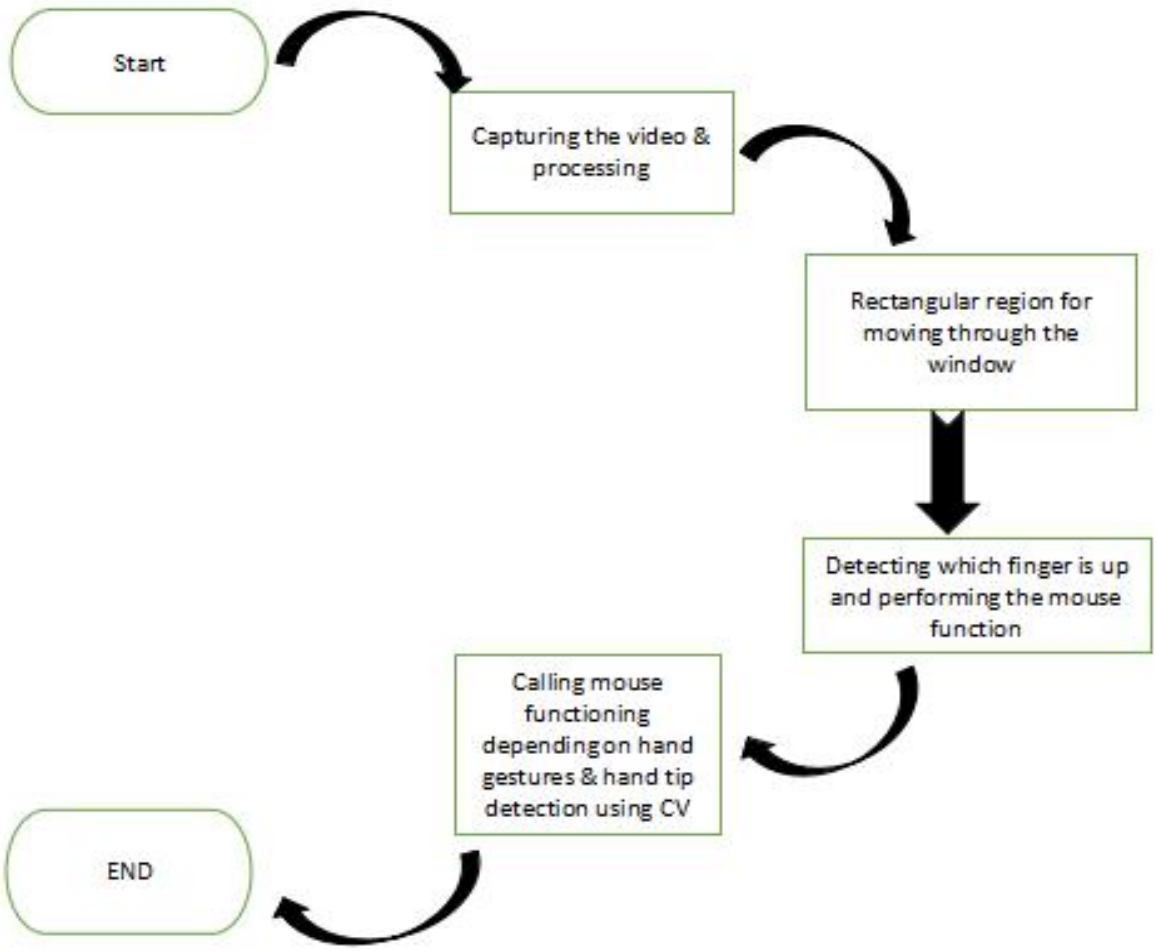


Fig:4.1 .Proposed Architecture for virtual mouse using hand gestures

Data points	Description
0	wrist
1	Thumb_CMC
2	Thumb_MCP
3	Thumb_IP
4	Thumb_TIP
5	Index Finger MCP
6	Index Finger PIP
7	Index Finger DIP
8	Index Finger TIP
9	Middle Finger MCP
10	Middle Finger PIP
11	Middle Finger DIP
12	Middle Finger TIP
13	Ring Finger MCP
14	Ring Finger PIP
15	Ring Finger DIP
16	Ring Finger TIP
17	Pinky MCP
18	Pinky PIP
19	Pinky DIP
20	Pinky TIP

Table:4.2 hand land marks for detection

Data Points	Description
33	V_GEST
34	Two Finger Closed
35	Pinch Major
36	Pinch Minor

Table:4.3 Gesture landmarks for operations

Labels	Description
0	Minor
1	Major

Table:4.4 multiple hands labels for operations

Algorithm and techniques used:

Algorithm:

Step 1: start

Step 2: importing required libraries

Step 3: Initializing Gesture encodings ,extra mapping , and multi handedness labels for hand data points

Step 4: converting media land marks into recognizable gestures.

Step 5: Function to find Gesture Encoding using current finger_state.

Step 6: Locate Hand to get Cursor Position and Stabilize cursor by Dampening

.

Step 7 : Handling Fluctuations due to noise

Step 8: according to gestures the required functions will execute

Step 9: Hold final position for 5 frames to change status

Step 10 : end

For the purpose of detection of hand gestures and hand tracking, the Media-Pipe framework is used, and Open-CV library is used for computer vision. The algorithm makes use of the machine learning concepts to track and recognize the hand gestures and hand tip.

Media-Pipe is a framework which is used for applying in a machine learning pipeline, and it is an open-source framework of Google. The Media-Pipe framework is useful for cross platform development since the framework is built using the time series data. The Media-Pipe framework is multi-modal, where this framework can be applied to various audios and videos. The Media-Pipe framework is used by the developer for building and analyzing the systems through graphs, and it also been used for developing the systems for the application purpose. The steps involved in the system that uses Media-Pipe are carried out in the pipeline configuration. The pipeline created can run in various platforms allowing scalability in mobile and desktops. The Media-

Pipe framework is based on three fundamental parts; they are performance evaluation, framework for retrieving sensor data, and a collection of components which are called calculators , and they are reusable. A pipeline is a graph which consists of components called calculators, where each calculator is connected by streams in which the packets of data flow through. Developers are able to replace or define custom calculators anywhere in the graph creating their own application. The calculators and streams combined create a data-flow diagram; the graph is created with Media-Pipe where each node is a calculator and the nodes are connected by streams.

Single-shot detector model is used for detecting and recognizing a hand or palm in real time. The single-shot detector model is used by the Media-Pipe. First, in the hand detection module, it is first trained for a palm detection model because it is easier to train palms. Furthermore, the non maximum suppression works significantly better on small objects such as palms or fists . A model of hand landmark consists of locating joint or knuckle co-ordinates in the hand region,

Open-CV is a computer vision library which contains image-processing algorithms for object detection. Open-CV is a library of python programming language, and real-time computer vision applications can be developed by using the computer vision library. The Open-CV library is used in image and video processing and also analysis such as face detection and object detection

CHAPTER 5
REQUIREMENTS

CHAPTER 5 REQUIREMENTS

5.1 Functional Requirements.

Libraries	versions
Python	3.8 >= above
Open Cv	4.5.3.56
Media pipe	0.8.6.2
Py auto gui	0.9.53
Py caw	20181226
Com types	1.1.10
Screen-Brightness-control	0.9.0

Table: 5.1 libraries and its versions used

5.2 Interface Requirements

This application communicates with ui & python code with the help of tkinter of python. Tkinter is a python binding to the py gui toolkit. It is the standard python interface to the pygui toolkit and is python's de-facto standard gui. Tkinter is included with standard linux, microsoft windows and mac osx installs of python.

5.3 Hardware Requirements.

Web cam

Ram	4GB above
processing speed	2.1 GHz above
Windows Os	7 above

CHAPTER 6
EXPERIMENTATION

CHAPTER 6 EXPERIMENTATION

6.1 Flow chart

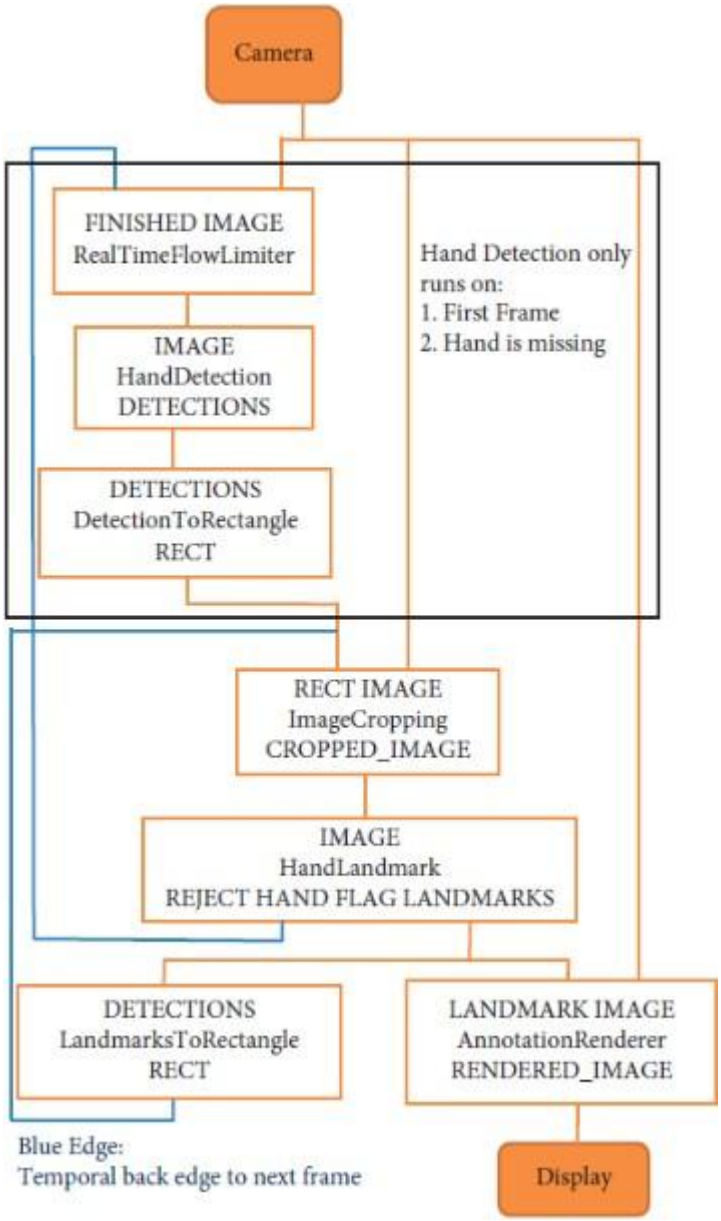


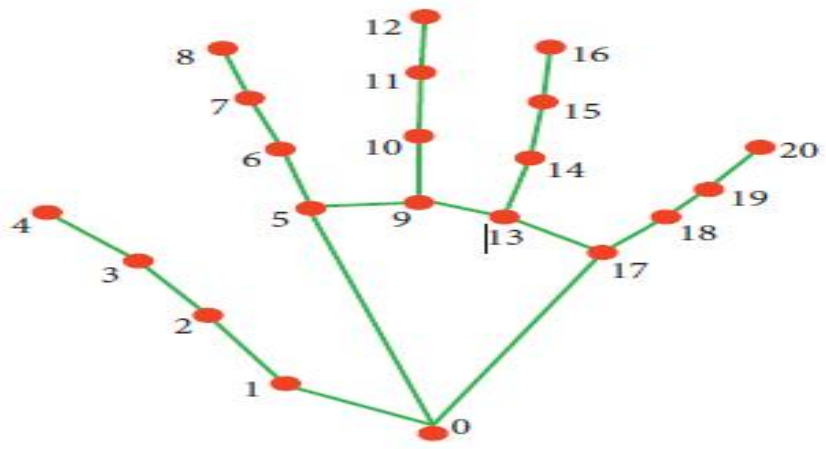
Fig.6.1 Flow of the project

1. We make a AI based Virtual mouse that can make the operations like Scrolling, VolumeUP/DOWN, Zoom IN/OUT.
2. Left and Right clicks and all activities performed with Mouse wheel.
3. The right and left click part is implemented and it is working smoothly
4. It can detect upto 2 hands and it is configurable based on the user.

The various functions and conditions used in the system are explained in the flowchart of the real-time AI virtual mouse system in figure.

Camera Used in the AI Virtual Mouse System. The proposed AI virtual mouse system is based on the frames that have been captured by the webcam in a laptop or PC. By using the Python computer vision library Open-CV, The video frames are processed from BGR to RGB colour space to find the hands in the video frame by frame as shown in the following code:

```
def findHands(self, img , draw = True):
imgRGB = cv2.cvtColor(img , cv2.COLOR_BGR2RGB)
    self.results = self.hands.process(imgRGB)
```



0. WRIST
1. THUMB_CMC
2. THUMB_MCP
3. THUMB_IP
4. THUMB_TIP
5. INDEX_FINGER_MCP
6. INDEX_FINGER_PIP
7. INDEX_FINGER_DIP
8. INDEX_FINGER_TIP
9. MIDDLE_FINGER_MCP
10. MIDDLE_FINGER_PIP
11. MIDDLE_FINGER_DIP
12. MIDDLE_FINGER_TIP
13. RING_FINGER_MCP
14. RING_FINGER_PIP
15. RING_FINGER_DIP
16. RING_FINGER_TIP
17. PINKY_MCP
18. PINKY_PIP
19. PINKY_DIP
20. PINKY_TIP

Fig.6.2 hand landmarks

Rectangular Region for Moving through the Window. The AI virtual mouse system makes use of the transformational algorithm, and it converts the coordinates of fingertip from the webcam screen to the computer window full screen for controlling the mouse. When the hands are detected and when we find which finger is up for performing the specific mouse function, a rectangular box is drawn with respect to the computer window in the webcam region where we move throughout the window using the mouse cursor.

Detecting Which Finger Is Up and Performing the Particular Mouse Function. In this stage, we are detecting which finger is up using the tip Id of the respective finger that we found using the Media-Pipe and the respective co-ordinates of the fingers that are up , and according to that, the particular mouse function is performed.

Mouse Functions Depending on the Hand Gestures and Hand Tip Detection Using Computer Vision For the Mouse Cursor Moving around the Computer Window. If the index finger is up with tip Id = 1 or both the index finger with tip Id = 1 and the middle finger with tip Id = 2 are up, the mouse cursor is made to move around the window of the computer using the AutoPy package of Python,

For the Mouse to Perform Left Button Click. If both the index finger with tip Id = 1 and the thumb finger with tip Id = 0 are up and the distance between the two fingers is lesser than 30px, the computer is made to perform the left mouse button click using the pynput.

Using Open-CV image processing infrastructure has been created in a separate window .

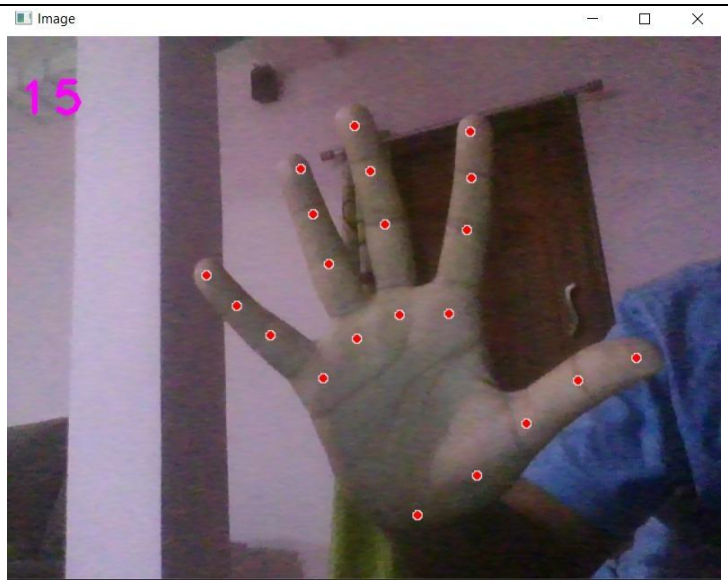


Fig .6.3 detection of hand

palm detection has been detected using media-pipe library and data points are been recognized and detected as red marks in the above fig:6.3.even the moment of hand is detected as video and segregated into continue series of images and data data points are detected in that series of images similarly.

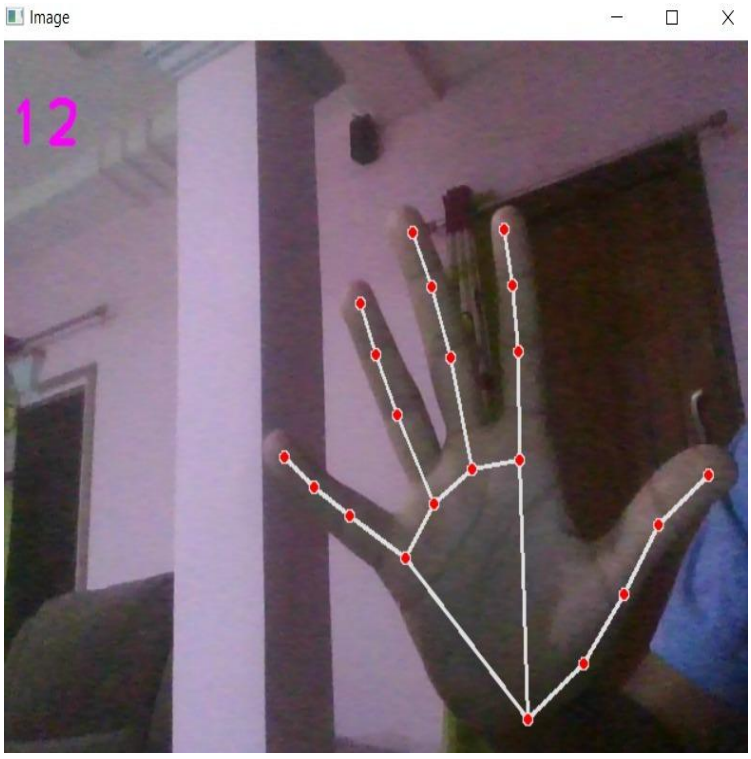


Fig:6.4 detection of land marks

After detecting data points these data points are joined through white lines shown fig:6.4.now its been ready to activate to on certain data points to on certain operation.

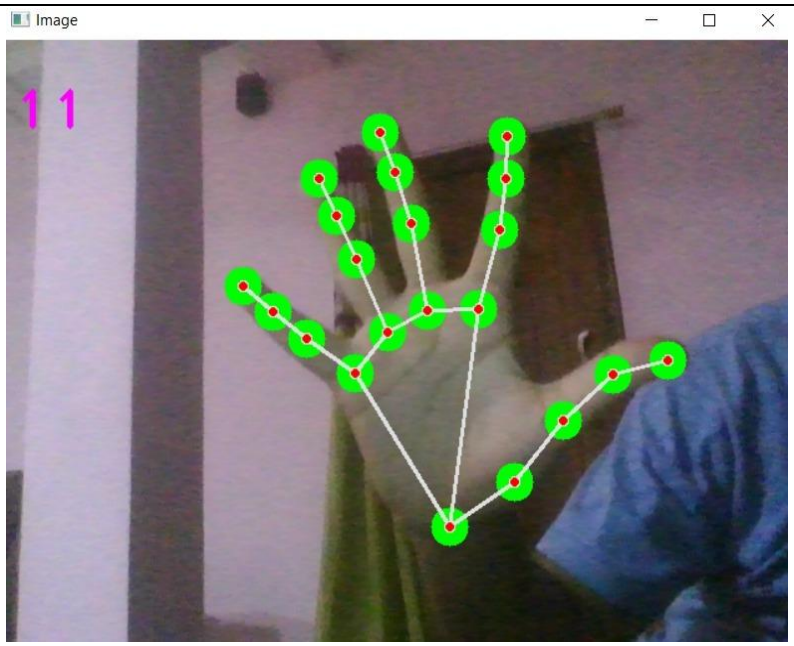


Fig:6.5 feature extraction

Initially after the palm detection the land marks have been labeled as red coloured small dots.next,these dots have been connected with white coloured lines for measuring distances.the above figure says that all land marks on the palm have been activated and represented as green coloured solid circles around red dots.this image has been verified that all data points can be triggered for certain operations.

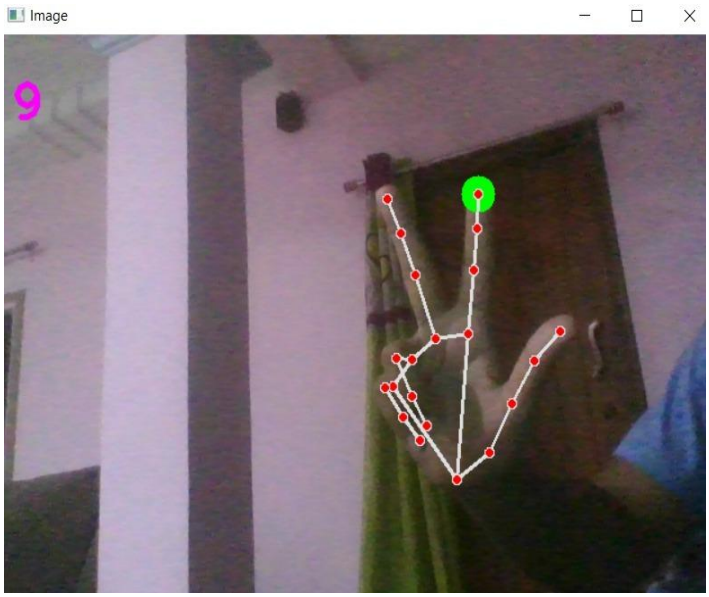


Fig:6.6 image processing

In the above figure,the land mark [8] which has green coloured circle around red dot says that every data point has been specified separately and triggered with respective to operations .

CHAPTER 7

METHODOLOGY

CHAPTER 7 METHODOLOGY

7.1 PHASES OF THE PROJECT :

7.1.1 Phase I – Planning

Stage 1: Initially we have started this project by the idea of making the mouse Virtual, which does not require any physical contact to operate.

Stage 2: Accordingly, we started working on the project by exploring all the libraries and technologies to make this mouse virtual.

Stage 3: After some research we have decided to use python with libraries OpenCV, Mediapipe Pyautogui. OpenCV, Mediapipe for detecting the hand and its landmarks whereas Pyautogui to control the mouse virtually.

7.1.2 Phase II – Implementation

Stage 1: We started working on implementation of code using OpenCV and Mediapipe. Initially the hand detection is done with the help of OpenCV.

Stage 2: Once the hand is detected, landmarks of the hand are plotted with the help of Mediapipe. There are totally 21 landmarks on the hand and some of these help us in operating the mouse.

Stage 3: Now with the help of landmarks, we can control the mouse virtually with the help of Pyautogui. This library takes care of all the mouse operations.

7.1.3 Phase III – Understanding the Depth of the Problem

Stage 1: After referring some research papers we understood that this virtual mouse is more beneficial for the people who are suffering from a syndrome called Carpel Tunnel Syndrome (CTS).

Stage 2: Initially, after planning this project, we were developing it by thinking that all the people who uses mouse will be the users of this virtual mouse. But after understanding this syndrome, Our target users are changed and we had to do some modifications in the project accordingly.

7.1.4 Phase IV – Modifications & Operations

Stage 1: We made the project work for multiple cameras so that along with the existing camera an extra webcam can also be used to perform mouse operations. Now people with CTS Syndrome can access the mouse without even lifting their hand if the webcam is placed over their hand.

Stage 2: Another modification is that we have improved the smoothness of our virtual mouse, which will help the people with CTS to work more smoothly. We used smoothening parameter to do this.

Stage 3: Now this virtual mouse can perform all the operations like right click, left click, double click, drag & drop, scroll, Volume up & down, Brightness controller

7.2 PERFORMANCE ANALYSIS:

In the proposed AI virtual mouse system, the concept of advancing the human-computer interaction using computer vision is given.

Cross comparison of the testing of the AI virtual mouse system is difficult because only limited numbers of datasets are available. The hand gestures and finger tip detection have been tested in various illumination conditions and also been tested with different distances from the webcam for tracking of the hand gesture and hand tip detection. An experimental test has been conducted to summarize the results shown in Table below.

The test was performed 25 times by 4 persons resulting in 600 gestures with manual labelling, and this test has been made in different light conditions and at different distances from the screen, and each person tested the AI virtual mouse system 10 times in normal light conditions, 5 times in faint light conditions, 5 times in close distance from the webcam, and 5 times in long distance from the webcam

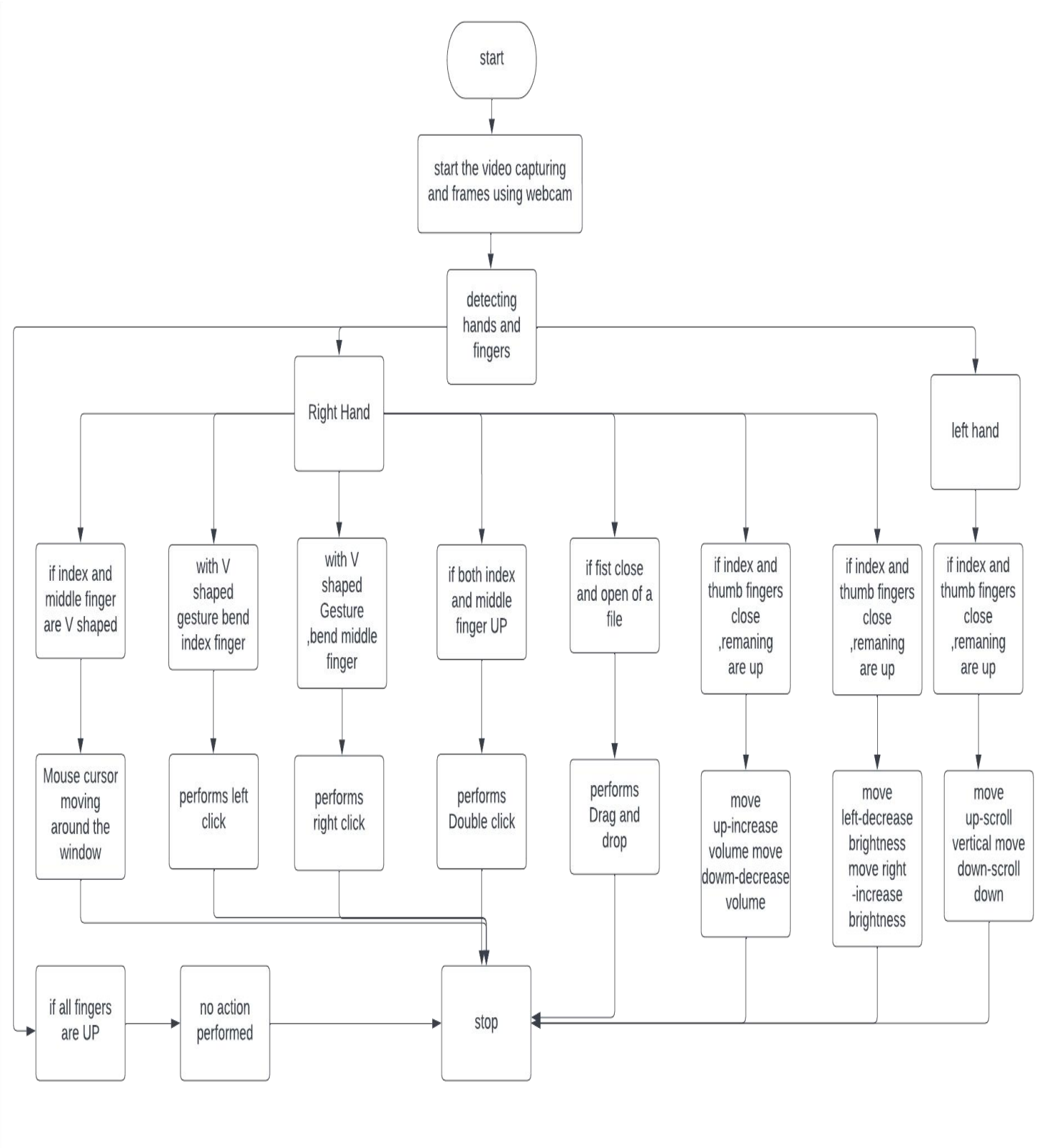


Fig :7.3 Proposed methodology of virtual mouse for carpel tunnel syndrome

7.4 EVALUATION

Mouse function performed	Success	Failure	Accuracy (%)
Mouse movement	100	0	100%
Left button click	98	2	98%
Right button click	99	1	99%
Scroll function	93	7	93%
Brightness control	95	5	95%
Volume control	96	4	96%
No action performed	100	0	100%
Result	681	19	97.28%

Table 7.4 Accuracy Results

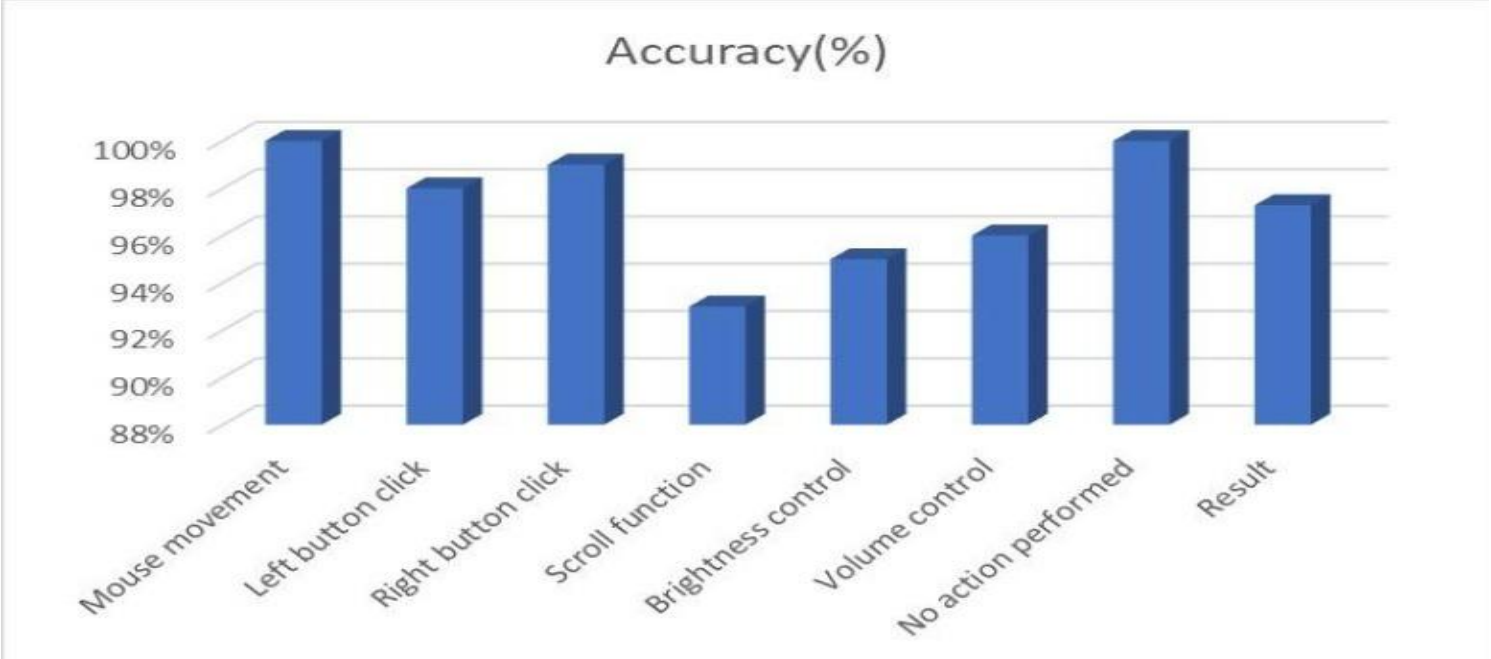


Fig.7.5 accuracy of different oprations

CHAPTER 8
TESTING AND RESULTS

CHAPTER 8 TESTING AND RESULTS

Test case id	Scenario	Boundary Value	Expected Result	Status	Actual Result
1	Used in normal environment.	>90%	In normal environment hand gestures can be recognized easily.	**Passed**	Hand gestures got easily recognized and work properly.
2	Used in bright environment.	>60%	In brighter environment, software should work fine as it easily detects the hand movements but in a more brighter conditions it may not detect the hand gestures as expected.	**Passed**	In bright conditions the software works very well.
3	Used in dark environment	<30%	In dark environment, It should work properly.	**Failed**	In dark environment software didn't work properly in detecting hand gestures.

4	Used at a near distance (15cm) from the web cam.	>80%	At this distance, this software should perform perfectly.	**Passed**	It works fine and all features works properly.
5	Used at a far distance (35cm) from the web cam.	>95%	At this distance, this software should work fine.	**Passed**	At this distance, it is working properly.
6	Used at a farther distance (60cm) from the web cam.	>60%	At this distance, their will be some problem in detecting hand gestures but it should work fine.	**Passed**	At this distance, The functions of this software works properly.

Table**:**8.0 Testing and results

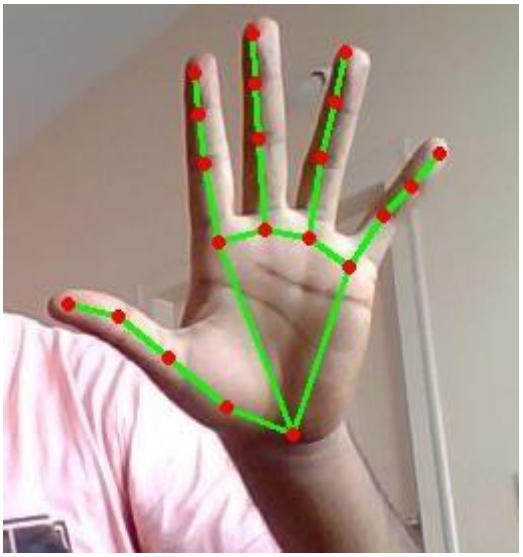


Fig. 8.1 palm land marks

This image represents the palm land marks (0-21) that are used for operating as mouse

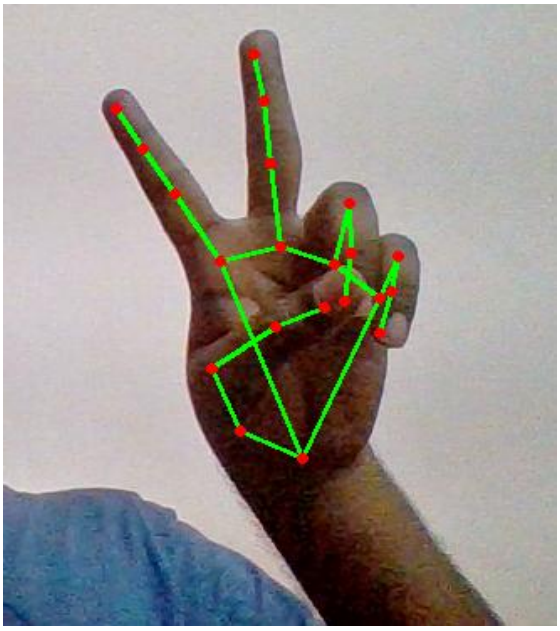


Fig. 8.2 V-shaped gesture

This gesture is V-shaped in which dist1=[8,12] and dist2=[5,9] are identified and distance between them will be calculated and if ratio is in the range(>1.7) and movement of pointer will be observed on the screen.

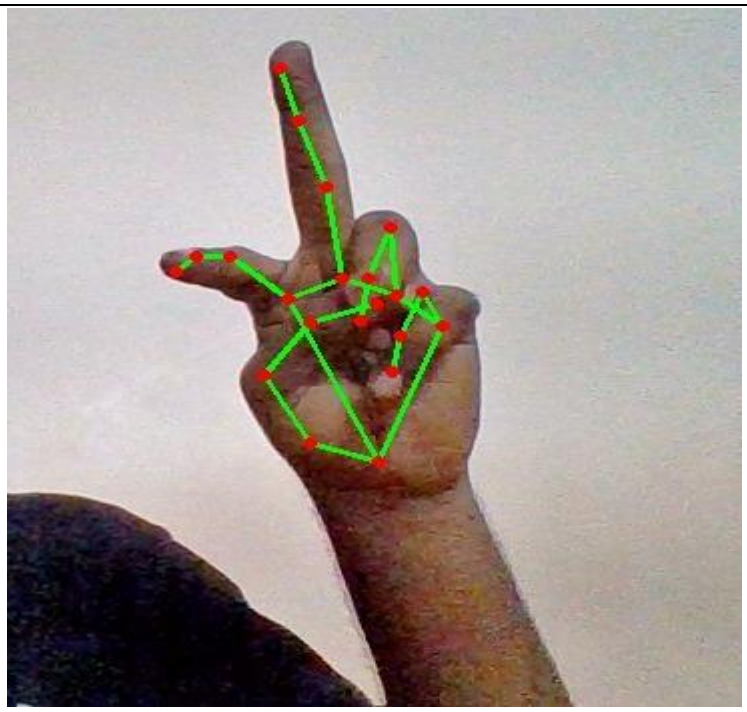


Fig. 8.3 left click

this image represents the left click operation and gesture is bending the index finger so that landmark [8,5,0] will be activated and converting these Media-Pipe landmarks to recognizable gestures, gesture binary encoding is done left operation will be operated on screen

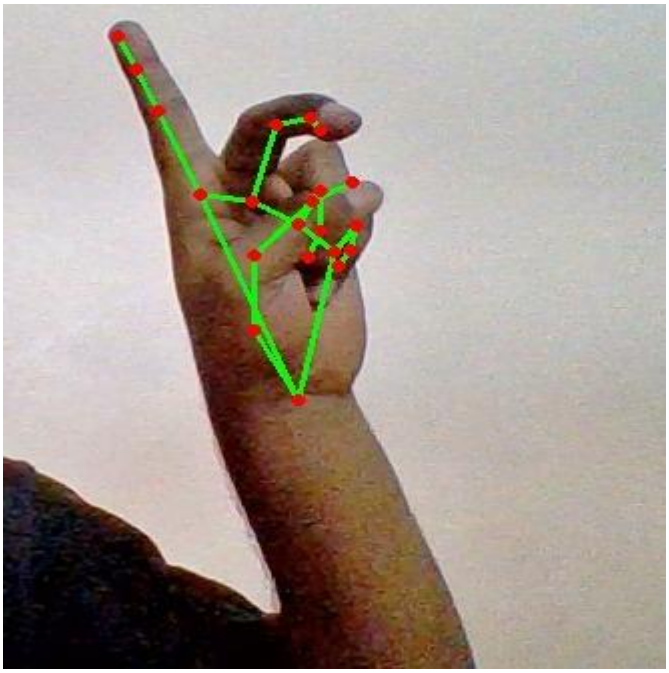
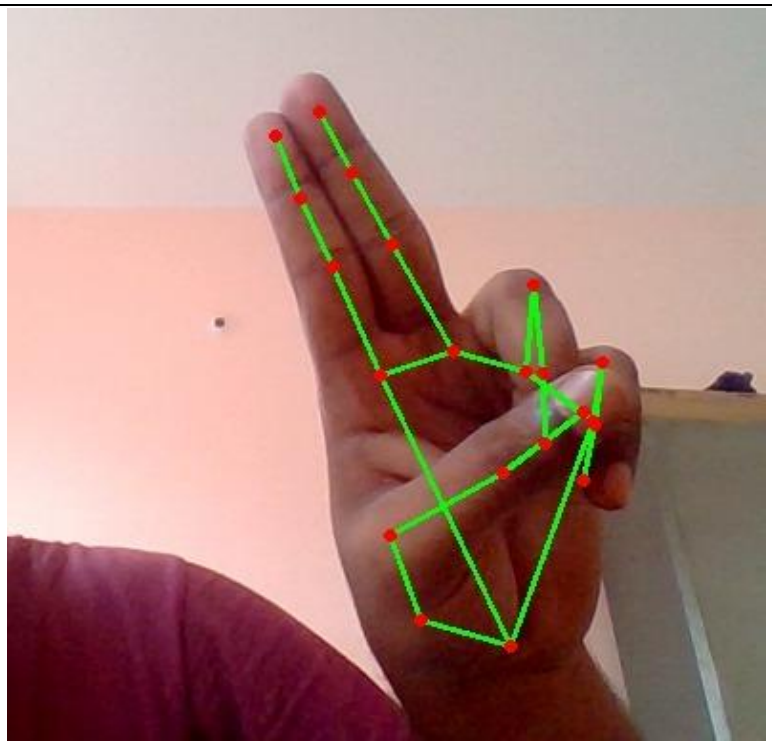


Fig. 8.4 right click

this image represents the right click operation and gesture is bending the middle finger so that landmark [12,9,0] will be activated and converting these Media-Pipe landmarks to recognizable gestures, gesture binary encoding is done left operation will be operated on screen



` **Fig. 8.5** double click

this image represents the double click operation and gesture is get together of index finger and middle finger, dist1=[8,12] and dist2=[5,9] are identified and distance between them will be calculated and if ratio is in the range(<1.7) and operation is double click.

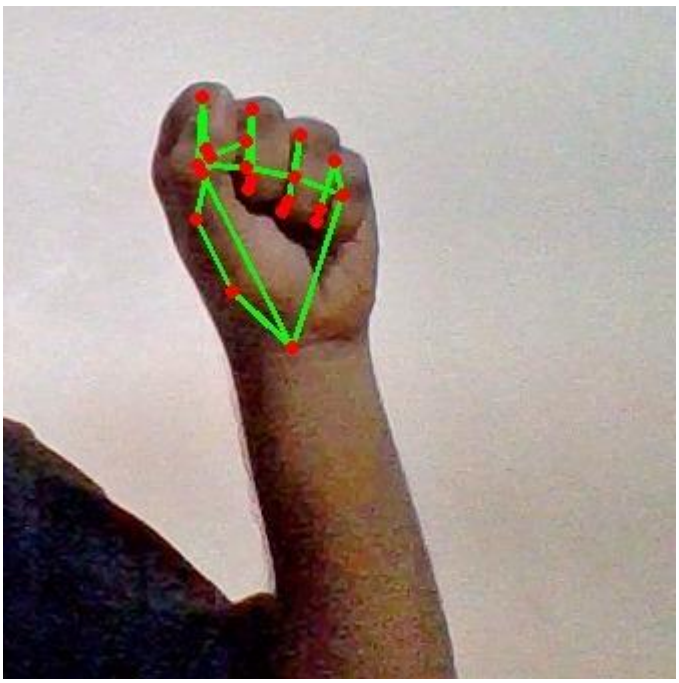


Fig. 8.6 gesture for drag

this image represents the drag and operation and gesture is closed fist dragging the object/file so that landmark [8,5,0] will be activated and converting these Media-Pipe landmarks to recognizable gestures, gesture binary encoding is done left up operation that is drag.

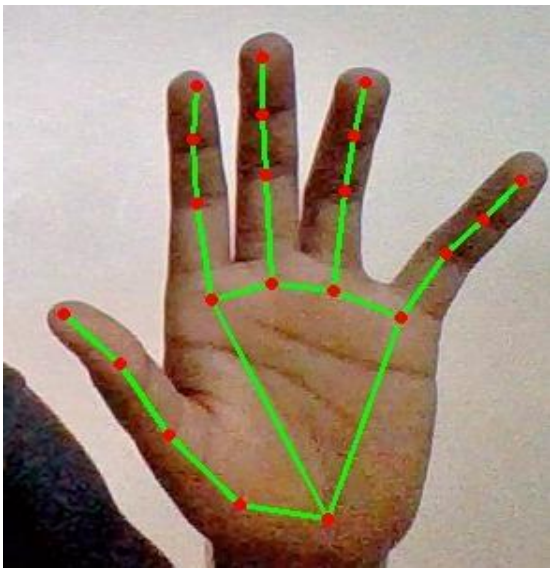


Fig. 8.7 gesture for drop

This gesture is drop operation in which gesture is opening the palm from closed fist and Drag and dropped operation is accomplished by moving closed fist and opened palm gesture is drop operation at different location.

Fig:8.8 gesture for lowering brightness

this image represents the initial state of brightness operation and gesture is contact of index and thumb finger so that landmark [8,4,0] will be activated and converting these Media-Pipe landmarks to recognizable gestures, gesture binary encoding is done then screen brightness will start operating and by moving left brightness will decrease.

Fig:8.9 gesture for increase brightness

this image represents the increase the brightness of screen.by comparing with fig:8.8 the gesture moves right so gesture is contact of index and thumb finger so that landmark [8,4,0] will be activated and converting these Media-Pipe landmarks to recognizable gestures, gesture binary encoding is done then screen brightness increases.

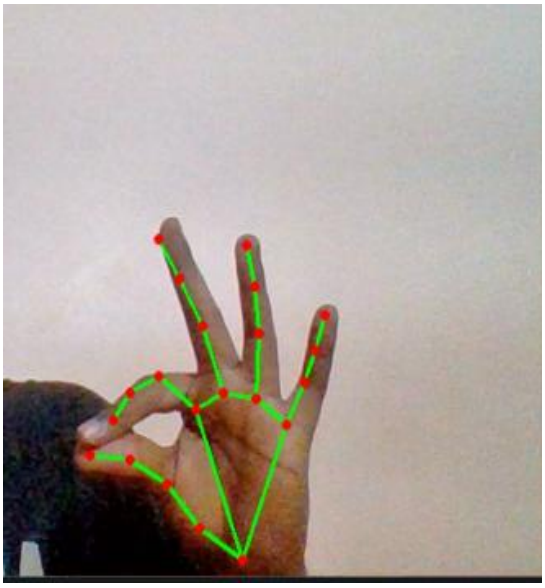


Fig. 8.10 gesture for lowering volume

this image represents the initial state of volume control operation and gesture is contact of index and thumb finger so that landmark [8,4,0] will be activated and converting these Media-Pipe landmarks to recognizable gestures, gesture binary encoding is done then screen brightness will start operating and by moving down volume will decrease.

Fig. 8.11 gesture for increase volume

this image represents the increase the volume control .by comparing with fig:8.10 the gesture moves up so gesture is contact of index and thumb finger so that landmark [8,4,0] will be activated and converting these Media-Pipe landmarks to recognizable gestures, gesture binary encoding is done then screen volume increases.

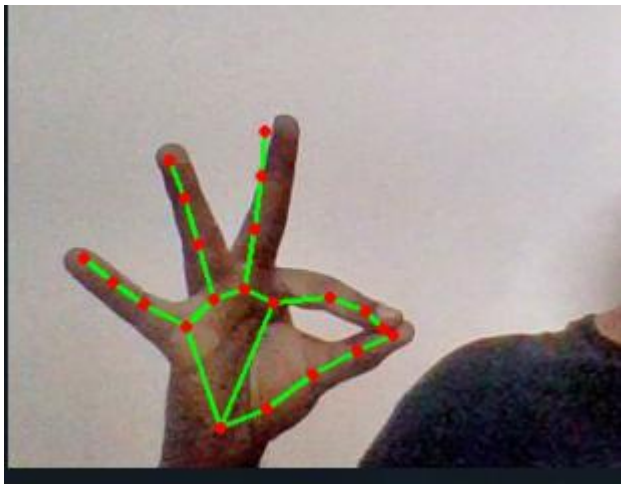


Fig :8.12 vertical scrolling down

Fig:8.13 vertical scrolling up

this image represents the initial state of scrolling operation and gesture is contact of index and thumb finger so that landmark [8,4,0] will be activated.this gesture is from minor hand(left hand). converting these Media-Pipe landmarks to recognizable gestures, gesture binary encoding is done then vertical scrolling will start operating and by moving down gesture the scroll down operation will process.

this image represents the scrolling upwards .by comparing with fig:8.12 the gesture moves up so gesture is contact of index and thumb finger so that landmark [8,4,0] will be activated and converting these Media-Pipe landmarks to recognizable gestures, gesture binary encoding is done then scroll upwards will process.

CHAPTER 9
CONCLUSION AND FUTURE WORK

CHAPTER 9 CONCLUSION

9.1 CONCLUSION

One can achieve the way of using the mouse virtually which would be favourable in many cases for many people. It would make it easy for people to operate the system with their hand gesture movements easily. Other proposed models for virtual mouse, and it has many applications. Amidst the COVID-19 situation, it is not safe to use the devices by touching them because it may result in a possible situation of spread of the virus by touching the devices. The proposed AI virtual mouse can be used to controlthe PC mouse functions without using the physical mouse. AI virtual mouse can be used to play virtual reality- and augmented reality-based games without the wireless or wired mouse devices. Persons with problems in their hands can use this system to control the mouse functions in the computer. Indesigning and architecture, the proposed system can be used for designing virtually for prototyping.

9.2 FUTURE WORK

The model has some limitations such as small decrease in accuracy in right click mouse function and some difficulties in clicking and dragging to select the text. Hence, we will work next to overcome these limitations by improving the finger tip detection algorithm to produce more accurate results

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Git hub- https://github.com/manish3064/AI-Based-Virtual-mouse-.git.