VISVESVARAYA TECHNOLOGICAL UNIVERSITY

JNANA SANGAMA, BELAGAVI, KARNATAKA-590018

INTERNSHIP REPORT

on

“AI BASED VIRTUAL MOUSE”

Submitted by

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(USN: 4DM21EC023)

Under the guidance of

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Assistant Professor, Dept. of ECE

In partial fulfillment of the requirements for the award of the degree of

BACHELOR OF ENGINEERING

In

ELECTRONICS AND COMMUNICATION ENGINEERING

YENEPOYA INSTITUTE OF TECHNOLOGY

N.H. 13, THODAR, MOODBIDRI-574225, MANGALORE, D.K

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YENEPOYA INSTITUTE OF TECHNOLOGY

THODAR, MIJAR POST, MOODBIDRI-574225

(Affiliated to Visvesvaraya Technological University, Belagavi)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CERTIFICATE

This is to certify that the Internship/Professional Practice Report entitled **"AI BASED VIRTUAL MOUSE"** is an authentic record of the work carried out by **MOHAMMED MUSAIB (4DM21EC023)**, a student of 4th semester, in partial fulfillment of requirements for the award of Bachelor's Degree in Electronics and Communication Engineering prescribed by Visvesvaraya Technological University, Belagavi during the academic year 2022-23. It is certified that all corrections/suggestions indicated for assessment have been incorporated in the report. The internship report has been approved as it satisfies the academic requirements in respect of internship work prescribed by the University.

Mr. Harsha C J	**Ms. Pavithra S. G**	**Dr. Prasanna Kumar C**
(Internal Guide)	**(Internship Coordinator)**	**(Head of Department)**

Date: 2nd November 2022

INVIHUB TECHNOSOLUTIONS PVT. LTD.

Bangalore, Karnataka, India

TO WHOM IT MAY CONCERN

This is to certify that **MOHAMMED MUSAIB (4DM21EC023)**, a student of Electronics and Communication Engineering, Yenepoya Institute of Technology, Moodbidri, has successfully completed his Internship (From 11th October 2022 to 29th October 2022) on **"AI Based Virtual Mouse & Computer Vision Systems"** at Invihub Technosolutions Pvt. Ltd., Bengaluru.

During his internship period, **MOHAMMED MUSAIB** displayed exemplary professional traits, executed assigned engineering modules diligently, and was found to be punctual, hardworking, and inquisitive.

For, Invihub Technosolutions Pvt. Ltd.

_____

Dr. Shashank M Gowda
(Director)

DECLARATION

I, **MOHAMMED MUSAIB (4DM21EC023)**, student of 4th semester Bachelor of Engineering in Electronics and Communication Engineering, Yenepoya Institute of Technology, Moodbidri, hereby declare that the internship work entitled **"AI BASED VIRTUAL MOUSE"** submitted to Visvesvaraya Technological University, Belagavi during the academic year 2022-23, is an authentic record of work done by me during my internship under the guidance of **Mr. Harsha C J**, Assistant Professor, Department of ECE, YIT.

This report is submitted in partial fulfillment of the requirements for the award of the degree of Bachelor of Engineering.

MOHAMMED MUSAIB
(4DM21EC023)

ACKNOWLEDGEMENT

The successful completion of any work would be incomplete without mentioning the people who made it possible. I extend my sincere gratitude to all the individuals who supported me during my internship program.

I express my sincere thanks to **Invihub Technosolutions Private Limited, Bangalore** for providing this internship opportunity, and to **Dr. Shashank M Gowda**, Director, Invihub Technosolutions Private Limited, for his invaluable technical guidance during the training.

It is my great fortune that I have got an opportunity to carry out this internship work under the guidance of **Mr. Harsha C J**, Assistant Professor, Department of Electronics and Communication Engineering, YIT. I express my sincere thanks for his constant support, unparalleled guidance, and limitless encouragement.

I am deeply thankful to our Internship Coordinator, **Ms. Pavithra S.G**, Assistant Professor, Department of ECE, for her continuous monitoring, support, and concern throughout the tenure.

I wish to convey my gratitude to **Dr. Prasanna Kumar C**, Head of the Department of Electronics and Communication Engineering, for his support and encouragement.

I am indebted to the Principal, **Dr. R. G. D'Souza**, and the Management of Yenepoya Institute of Technology, Moodbidri for providing an academic environment with state-of-the-art facilities that helped me complete the internship smoothly.

Lastly, I take this opportunity to convey my heartfelt thanks to all the teaching and non-teaching staff of the Department of ECE for their direct and indirect support.

MOHAMMED MUSAIB
(4DM21EC023)

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LIST OF ABBREVIATIONS

ABBREVIATION	FULL FORM
AI	Artificial Intelligence
HCI	Human-Computer Interaction
CV	Computer Vision
FPS	Frames Per Second
HSV	Hue, Saturation, Value
RGB	Red, Green, Blue
ROI	Region of Interest
API	Application Programming Interface
OS	Operating System

CHAPTER 1

COMPANY PROFILE

Company Name:	Invihub Technosolutions Private Limited
Registered Address:	#125 Ward No. 01, Byrapatana, 1st Cross Chekkere Gate, Malur Post, Channapatna, Bengaluru, Karnataka - 562160, India
Branch / Lab Office:	L-06, Yenepoya Institute of Technology, Moodbidri, Mangalore
Contact Number:	+91 7022149521 / +91 9036524034
Website:	https://invihub.com
Company Type:	Private Limited (Technology Start-up)

1.1 ABOUT THE COMPANY

INVIHUB TECHNOSOLUTIONS PRIVATE LIMITED is a dynamic technology start-up recognized by the Government of India and the Ministry of Micro, Small and Medium Enterprises (MSME). The company focuses on cutting-edge engineering domains including Artificial Intelligence, Computer Vision, Embedded Systems, Internet of Things (IoT), Automation, PCB Design, and 3D Printing technologies.

Operating with research hubs and industry collaboration units, Invihub Technosolutions bridges the gap between academic learning and industrial prototyping, providing state-of-the-art exposure to students and engineering professionals.

1.2 VISION AND MISSION

Vision: Applying advanced computational techniques and hardware technologies in product development, automation, AI vision systems, and modern prototyping services to create intuitive human-technology solutions.

Mission: To provide customized, high-value technical solutions tailored to application-specific demands while fostering hands-on technical skill development through structured internships, research projects, and corporate technology workshops.

1.3 COMPANY HISTORY AND OPERATIONS

Invihub Technosolutions Private Limited was incorporated on 28th September 2018 (CIN: U74999KA2018PTC117017). Since its inception, the company has expanded its domain from basic 3D prototyping into intelligent automation, computer vision solutions, AI-driven human-computer interfaces, and IoT hardware deployment.

CHAPTER 2

TASKS PERFORMED & TECHNOLOGY STACK

2.1 INTRODUCTION TO COMPUTER VISION & AI INTERFACING

During the internship, the core focus was extended from conventional embedded hardware to intelligent software-driven Human-Computer Interaction (HCI) systems. Computer Vision (CV) combined with Artificial Intelligence enables machines to interpret visual data from cameras and translate physical human gestures into computer software control commands without physical touch devices.

2.2 OPENCV LIBRARY INTEGRATION

OpenCV (Open Source Computer Vision Library) is an open-source computer vision and machine learning software library. It provides thousands of optimized algorithms to capture video frames, manipulate image matrices, convert color spaces, filter noise, and detect objects in real time.

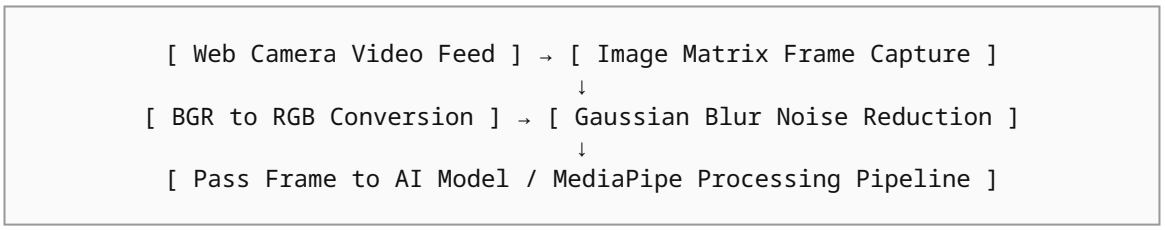

Fig 2.1: OpenCV Frame Processing Pipeline

2.3 MEDIAPIPE FRAMEWORK & HAND TRACKING

Google MediaPipe is a cross-platform framework providing tailored ML solutions for live streaming media. The MediaPipe Hand Tracking pipeline consists of two primary models:

- **Palm Detector Model:** Scans the full input image frame to locate and crop hand bounding boxes regardless of orientation.
- **Hand Landmark Model:** Processes cropped hand regions and predicts 21 3D hand keypoint coordinates (X, Y, Z coordinates) with high precision.

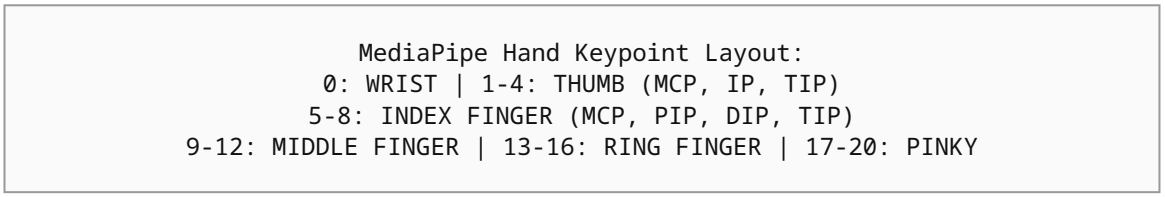

Fig 2.2: MediaPipe 21 Hand Landmark Map Structure

2.4 PYAUTOGUI & SYSTEM AUTOMATION

PyAutoGUI is a Python automation module used to programmatically control mouse movement, button clicks, and keyboard presses. It enables software scripts to simulate user interactions directly on the host Operating System graphics display.

CHAPTER 3

PROJECT: AI BASED VIRTUAL MOUSE

3.1 INTRODUCTION & PROBLEM STATEMENT

Conventional physical mouse devices require flat surface contact, physical hardware wear-and-tear, and direct hand placement. In modern computing, touchless and contactless human-computer interfaces are essential for hygienic environments (e.g., medical operating rooms), touchless public kiosks, and ergonomic hands-free interaction.

The **AI Based Virtual Mouse** utilizes a standard webcam to capture hand gestures in real-time, processes key landmarks using MediaPipe and OpenCV, and maps finger position and Euclidean distances between keypoints into OS-level mouse pointer controls (Cursor Movement, Left Click, Right Click, Double Click, and Scrolling).

3.2 SYSTEM ARCHITECTURE

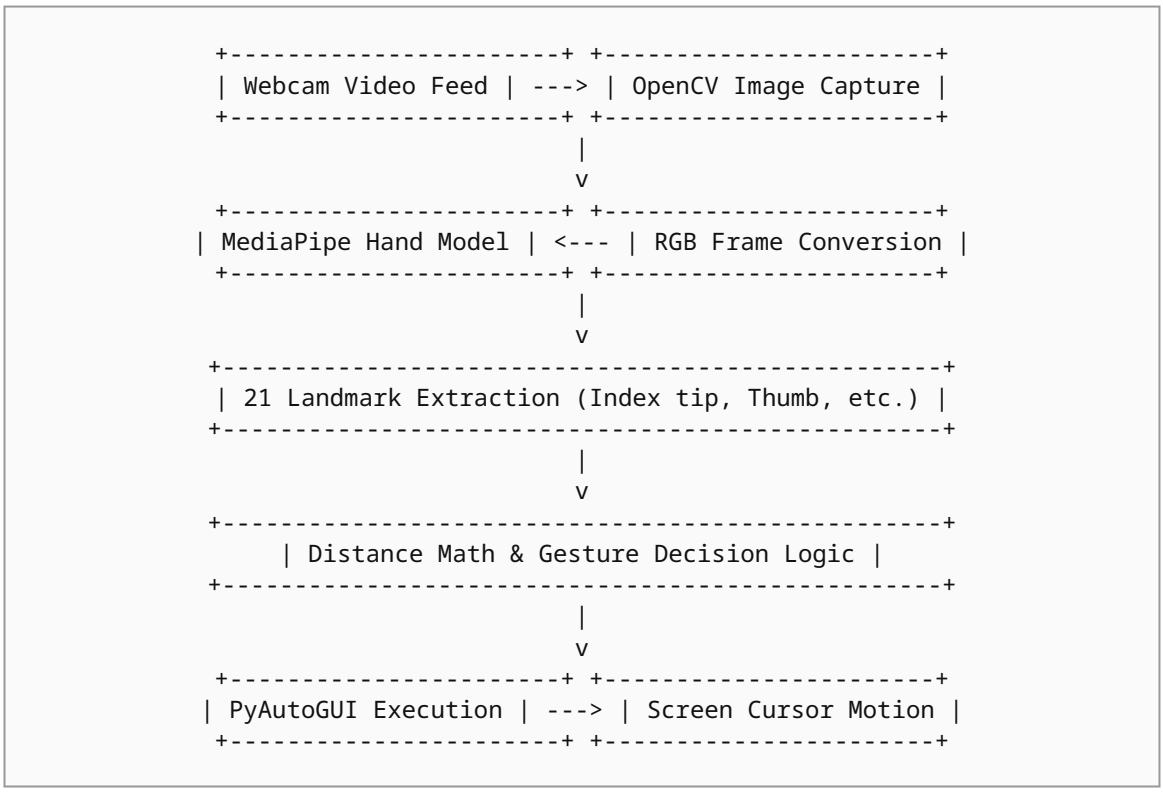

Fig 3.1: Complete Architecture Block Diagram of AI Virtual Mouse

3.3 GESTURE MAPPING LOGIC

Gesture Mode	Finger Configuration	Action Triggered
Cursor Movement	Index Finger UP, Middle Finger DOWN	Mouse pointer moves dynamically mapped to screen frame coordinates

Gesture Mode	Finger Configuration	Action Triggered
Left Click	Index Finger UP & Middle Finger UP (Distance < Threshold)	Simulates mouse left-click event
Right Click	Index Finger UP & Thumb UP (Distance < Threshold)	Simulates mouse right-click context menu
Scrolling Mode	Index Finger & Middle Finger UP & Moved Vertically	Scrolls page up or down based on vertical displacement vector

3.4 SOURCE CODE STRUCTURE

```
import cv2
import mediapipe as mp
import pyautogui
import math

# Initialize MediaPipe Hands & Camera
mp_hands = mp.solutions.hands
hands = mp_hands.Hands(max_num_hands=1, min_detection_confidence=0.7)
mp_draw = mp.solutions.drawing_utils
cap = cv2.VideoCapture(0)
screen_w, screen_h = pyautogui.size()

while cap.isOpened():
    success, frame = cap.read()
    if not success: break
    frame = cv2.flip(frame, 1)
    h, w, _ = frame.shape
    rgb_frame = cv2.cvtColor(frame, cv2.COLOR_BGR2RGB)
    results = hands.process(rgb_frame)

    if results.multi_hand_landmarks:
        for hand_landmarks in results.multi_hand_landmarks:
            mp_draw.draw_landmarks(frame, hand_landmarks, mp_hands.HAND_CONNECTIONS)
            lm = hand_landmarks.landmark
            index_x, index_y = int(lm[8].x * w), int(lm[8].y * h)
            thumb_x, thumb_y = int(lm[4].x * w), int(lm[4].y * h)

            # Screen Cursor Positioning
            cursor_x = int(lm[8].x * screen_w)
            cursor_y = int(lm[8].y * screen_h)
            pyautogui.moveTo(cursor_x, cursor_y)
```

```
            # Click Gesture Detection (Euclidean Distance)
            dist = math.hypot(index_x - thumb_x, index_y - thumb_y)
            if dist < 30:
                pyautogui.click()
                cv2.putText(frame, "CLICK", (50, 50), cv2.FONT_HERSHEY_SIMPLEX, 1,
(0,255,0), 2)

    cv2.imshow("AI Virtual Mouse Feed", frame)
    if cv2.waitKey(1) & 0xFF == ord('q'): break

cap.release()
cv2.destroyAllWindows()
```

CHAPTER 4

CONCLUSION & REFERENCES

4.1 CONCLUSION

During the internship, hands-on experience was gained in implementing Computer Vision and Artificial Intelligence algorithms to solve human-machine interaction challenges. The **AI Based Virtual Mouse** system successfully replaces physical input hardware by leveraging real-time camera tracking, hand landmark detection, and programmatic OS event triggering.

The system achieved smooth cursor response, minimal latency, and reliable gesture triggering under optimal lighting conditions. This project established a strong foundation in modern Python AI libraries, image processing concepts, and automated control systems.

4.2 REFERENCES

1. OpenCV Official Documentation & Tutorials: *https://docs.opencv.org/*
2. Google MediaPipe Framework Guides: *https://mediapipe.dev/*
3. PyAutoGUI Documentation: *https://pyautogui.readthedocs.io/*
4. Invihub Technosolutions Training Repository & Practical Lab Manuals.