# Personal AI Trainer Using Smart Mirror And Raspberry-Pi

A project report submitted in partial fulfillment

of the requirements for the degree of

**Third Year Mini Project**
**2B (Sem VI)**

**In**

## Electronics and Computer Science

by


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**University of Mumbai (2023-24)**

# Internal Approval Sheet

## CERTIFICATE

This is to certify that the project entitled "**Personal AI Trainer Using Smart Mirror And Raspberry-Pi**" is a bonafide work of **Ratan Singh (9517), Aarush Wasnik (9517),** and **Krishna Mistry (9755)** submitted to the University of Mumbai in partial fulfilment of the requirement for the term-work submission of Mini project 2B for semester VI in **Electronics and Computer Science**.

Prof. Jayen Modi

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Principal

# Approval Sheet

## Project Report Approval

This project report entitled **"Personal AI Trainer Using Smart Mirror And Raspberry-Pi"** by **Ratan Singh (9517), Aarush Wasnik (9517), and Krishna Mistry (9755)** is approved for the term work submission of Mini project 2B for semester VI in Electronic and Computer Science.

Examiner 1. ___________________

Examiner 2. ___________________

Date:

Place:

# Declaration

We declare that this written submission represents our ideas in our own words. Where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all academic honesty and integrity principles and have not misrepresented, fabricated or falsified any idea/data/fact/source in my submission. We understand that any violation of the above will cause disciplinary action by the Institute and can also evoke penal action from the sources that have thus not been properly cited or from whom proper permission has not been taken when needed.

**Ratan Singh (9511)** _____________

**Aarush Wasnik (9517)** ______________

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Date:

# Abstract

Humans start their day by looking in the mirror at least once before leaving their homes every morning. In addition, they waste considerable time of their busy workload in front of the mirror. To make this time more productive and useful, there ought to be a system that can be readily conducted, user-friendly, and smart according to the constant progress on the Internet of Things. The use of mirrors in fitness and daily routine is not yet desirable, so innovation is needed in that field. Some studies have involved microcontrollers such as Raspberry Pi that have been applied to mirrors, where the innovation through mirrors is increasing. So that the innovations carried out on the Smart Mirror using mirrors of homes, offices, and pages that have a scheduling automation system, turn on video, music, face recognition, and control using Open-CV and MediaPipe which can be integrated with smart mirror technology to customize the normal mirror.

# Acknowledgments

We have great pleasure in presenting the report on "**Personal AI Trainer Using Smart Mirror And Raspberry-Pi**". I take this opportunity to express my sincere thanks to the guide Prof. Jayen Modi, C.R.C.E, Bandra (W), Mumbai, for providing the technical guidelines, and suggestions regarding the line of this work. We enjoyed discussing the work progress with him during our visits to the department.

We thank Dr. Sapna Prabhu, Head of the Electronics and Computer Science department, Principal, and the management of C.R.C.E., Mumbai for encouraging and providing the necessary infrastructure for pursuing the project.

We also thank all non-teaching staff for their valuable support, to complete our project.

**Ratan Singh (9511)** ___________

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Date:

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# Chapter 1

## Introduction

Mirrors have captivated humanity for millennia, offering a glimpse into ourselves and the world around us. Their history is a fascinating journey of innovation, driven by both vanity and practicality. Let's embark on **A Historical Glimpse of Mirrors, A Journey Through Reflection:**

*Early Reflections (3000 BC - 1st Century AD)*: The earliest mirrors were likely made from polished obsidian, a naturally occurring volcanic glass. These were found in Anatolia (present-day Turkey) dating back to 6,000 BC. Around 4000 BC, polished metals like copper and bronze emerged as popular mirror materials in ancient Egypt and Mesopotamia. These were prized possessions of the elite, reflecting both status and a burgeoning interest in self-image.

*The Rise of Glass (1st Century AD - 16th Century AD)*: The Romans are credited with developing the first glass mirrors around the 1st century AD. These were created by backing a thin sheet of glass with a reflective metal layer, typically silver or tin. However, these early glass mirrors were small, expensive, and prone to tarnishing. By the 13th century, Venice emerged as the center of glassmaking and mirror production. Venetian artisans perfected a technique using mercury to create high-quality, large-scale mirrors. These became highly sought-after luxury items throughout Europe, adorning royal palaces and wealthy households.

*Shifting Tides (16th Century AD - 19th Century AD)*: In the 17th century, France challenged Venetian dominance with the development of a more efficient polishing technique. This led to the production of larger and clearer mirrors, further fueling their popularity. The 19th century saw a shift towards mass production of mirrors. The discovery of the Liebig silvering process in 1855 significantly reduced costs and made mirrors more accessible to the middle class.

*Modern Reflections (20th Century AD - Present)*: The 20th century saw the introduction of the float glass process, creating perfectly flat glass sheets ideal for mirror production. Additionally, the use of aluminum for the reflective layer became more common due to its affordability and durability. Today, the mirror industry continues to evolve. Advanced techniques like magnetron sputtering create high-performance mirrors used in telescopes, lasers, and scientific instruments. Smart mirrors with integrated displays and functionalities are emerging, blurring the lines between reflection and technology.

Smart mirrors, also known as digital mirrors or smart displays, represent a significant innovation in the intersection of technology and daily life. They integrate advanced technologies like artificial intelligence (AI), augmented reality (AR), and gesture recognition to enhance the user experience in various settings, from dressing rooms to personal grooming spaces. The core innovation lies in the mirror's ability to augment the reflection with digital elements. For instance, smart mirrors can adjust your image to show different hairstyles, hair colors, or makeup in real-time, providing a realistic augmented reflection. This allows users to experiment with their appearance virtually before making any physical changes. One notable advancement is the BMind smart mirror, which focuses on mental wellness. It uses AI to identify the user's mood and offers personalized recommendations and experiences, such as light therapy sessions and mindfulness exercises, to help manage stress and elevate mood. This mirror was recognized with a 2024 Consumer Electronics (CES) Innovation Award in the smart home category. These innovations in smart mirrors are not just about aesthetics; they also aim to contribute to the user's well-being, making them a part of the broader trend of integrating technology into personal health management.

The evolution of smart mirrors in the realm of fitness commenced in the early 2000s, marked by the amalgamation of digital displays with traditional mirror constructions. Subsequent advancements in display technologies, alongside the advent of artificial intelligence and machine learning algorithms, facilitated the delivery of personalized workout recommendations and real-time performance monitoring. Integration with wearable fitness trackers and virtual fitness platforms further elevated the user experience, while the incorporation of biometric sensors and community engagement features enriched functionality. A refined focus on design aesthetics and user interface accessibility subsequently rendered smart mirrors more widely available and financially viable. As innovation continues, the seamless integration of emerging technologies such as augmented reality and virtual reality promises to redefine the landscape of home fitness solutions, emphasizing convenience, engagement, and efficacy for users across diverse demographics and fitness levels

This project aims to build, modify, and improve an existing mirror to create a multifunctional and interactive user experience. The project used a Raspberry PI, a two-way mirror, with an electronic display behind the front layer of glass. The smart mirror employs cameras to recognize users, enabling personalized interactions based on their preferences. The smart mirror can give real-time feedback to the users.The project also explores the potential application of smart mirrors in various sectors such as an interactive fitness coach by integrating motion and gesture tracking. The mirror guides users through workouts, corrects their form, and provides real-time feedback.

The smart mirror has the potential to reshape human interactions with reflective surfaces, offering an enhanced and personalized user experience that blends the physical and digital worlds. The next chapter will provide an extensive literature review.

# Chapter 2

## Literature Review

By now, you should have a basic understanding of the history of mirrors and the innovations that are taking place in the business. This chapter, which is a literature survey, will explore mirror-based goods, namely those used in the fitness workplace. The list of research work published in various research paper publications and journals is provided in the literature survey table section given below. Let's take a deep dive into this chapter of literature, where we'll acknowledge the work of students and researchers.

| Sr. No. | Project Title | Authors | Summary |
|---|---|---|---|
| 1 | The smart mirror | K. P. Vijaykumar, Yash Tandon, and Vennam Prahasith | This paper aims to create a smart mirror that can function as a regular mirror and display various content like date, news, weather, and time simultaneously. It utilizes a Raspberry Pi to add intelligence and security, enabling real-time data collection, information updates, LCD display, and webcam functionality to enhance the mirror's capabilities. |
| 2 | A Mobile-Programmable Smart Mirror for Ambient IoT Environment | Mohammed Ghazal, Tara al Hadithy,Yyasmina al Khalil, Muhammad Akmal and Hassan Hajjdiab | describes the design and development of an Interactive Smart mirror that offers simplified and customizable services to the home environment. |
| 3 | SmiWork: An Interactive Smart Mirror Platform for Workplace Health Promotion | Oihane Gomez-Carmona | The paper discusses a multi-user Smart mirror that encourages wellness and a healthier lifestyle. Each user has a personalized interface accessible through an RFID reader in their ID card. |

| | | | |
|---|---|---|---|
| 4 | Smart Mirror for Smart Life | Muhammad Mu'izzudeen Yusri, Shahreen Kasim, Zubaile Abdullah | The paper focuses on using a Smart mirror to monitor and control home devices. It employs Sonus technology for voice interaction, where the mirror system accepts voice commands and responds. Sonus is a speech-to-text library that enables the addition of Voice User Interface (VUI) to hardware and software for enhanced human-system interaction. |
| 5 | SMART MIRROR USING VOICE INTERFACE | Roopa Sabri.K, Poornima Urala.A, Gayathri.P, Deepak.D, Mrs. | This project enhances mirror time using a two-way mirror, Raspberry Pi 3B+, and Alexa. The mirror displays information and interacts with users through Alexa. Privacy concerns can be mitigated with a customized user interface, and it |

| | | | |
|---|---|---|---|
| | | S.Pushpalatha, Mrs. Neetha Natesh | can potentially control home appliances with future updates. |
| 6 | The intelligent mirror system | Preeti Rani, Indra Thanaya | This project aims to offer users a user-friendly and interactive smart mirror that serves as a gateway to personalized services, particularly information-related ones, like multimedia and news feeds. It's designed to enhance convenience in both home and commercial settings. |
| 7 | IMPLEMENTATION OF HOME AUTOMATION SYSTEM USING SMART MIRROR | Ravi Kiran | This paper presents an interactive Smart Mirror designed for public and industrial use, leveraging artificial intelligence for ambient home automation. It collects and customizes real-world data, powered by a Raspberry Pi and is equipped with various peripherals. While it offers information through voice commands, privacy remains a concern. Future possibilities include home appliance control. |
| 8 | Design of the Smart Mirror Based on Raspberry PI | K. Jin, X. Deng, Z. Huang and S. Chen | This smart mirror offers features like image control, touch activation, voice conversion, image capture, and facial recognition. It supports information display, voice interaction, security, and entertainment. It can connect to a user's phone for tasks like syncing notes and interacting with the smart home. Additionally, it automatically activates facial recognition when a user approaches. |
| 9 | Smart mirror E-health assistant - Posture analysis algorithm | B. Cvetkoska, N. Marina, D. C. Bogatinoska, and Z. Mitreski | The Smart eHealth Mirror is a new model that acts as a smart assistant using face recognition and posture detection. It guides maintaining proper posture and suggests preventive healthcare measures. The algorithm's analysis significantly improves individuals' posture, with positive results in each evaluation. |

| | | | |
|---|---|---|---|
| 10 | "SmartReflect: A modular smart mirror application platform | Derrick Gold, David Sollinger, Indratmo | The project presents SmartReflect, a software platform for developing smart mirror applications. It offers modularity, extensibility, and freedom from web browser constraints, supporting plugins in various programming languages. The paper describes SmartReflect's design, compares it to other platforms, and highlights its potential applications. |
| 11 | Internet of Things Based Smart Mirrors: A Literature Review | D. A. Alboaneen | The paper explores how IoT facilitates device communication and highlights smart mirrors as a key IoT application. These mirrors function as reflective surfaces and interactive screens, serving purposes like medical training and fitting room assistance. The paper offers an overview of different smart mirror applications. |
| 12 | Implementation and Customization of a Smart Mirror through Facial Recognition Authentication and a Personalized News Recommendation Algorithm | Ivette Cristina Araujo Garcia, Eduardo Rodrigo Linares Salmon, Rosario Villalta Riega, Alfredo Barrientos Padilla | The paper highlights IoT's impact on daily life and suggests integrating a smart mirror into a home automation system to simplify morning routines. The mirror combines reflective glass, an LCD monitor, a Raspberry Pi 3, a camera, and a cloud-based IoT platform, accessing web services and mobile app customization. It incorporates facial recognition for user authentication, delivers personalized news, and employs a news recommendation algorithm based on the Naive Bayes model. |

**2.1 List of Research Papers**

# Chapter 3

## Problem Statement

In this chapter, we venture into a more detailed problem statement about the gaps revealed in the research papers from the previous chapter of the literature learning.

1. Mirror In Daily Life: Every morning, people look in the mirror before leaving their houses. They also spend a significant amount of time in front of the mirror, despite their busy schedule. According to the study, "Average time spent by a human by looking himself in the mirror is 56 minutes."

2. Usage Of Mirrors in Gyms: Mirrors are ubiquitous in gyms for several reasons like Form Checking and Improvement, Motivation and Confidence, Safety and Space Awareness, and Safety and Space Awareness.

3. Fitness Instructor: The cost of the fitness instructor is an issue for a client that calls for consideration and initiative. Additionally, access to qualified instructors and their expertise is curtailed.

### 3.1 Drawbacks of Existing System

1. Cost: The current product's price is too high for middle-class men or fitness center owners to justify buying.
2. Limited Functionality: There isn't a single-stop retailer that can solve all of a client's issues or offer a virtual trainer experience.
3. Lack of Personalisation: Nothing customized Features are accessible to the user. Customers must buy the current product that meets the specified requirements.
4. Space Utilisation: Fostering a sense of spatial awareness and maximizing the most of the space in the gym or in home gyms.

### 3.2 Solution to Above Problem

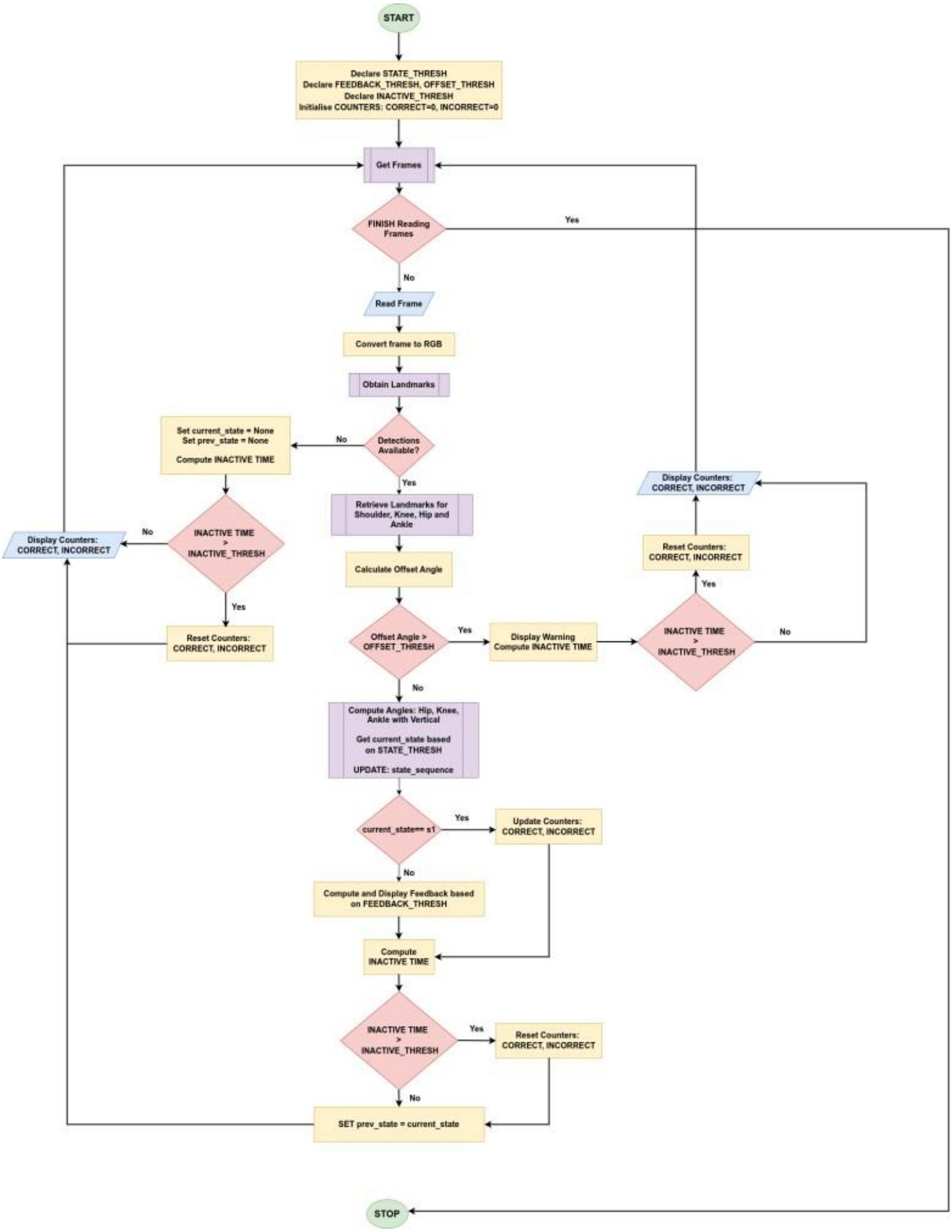
1. The Unique selling point (USP) of the product is the price segment without compromising on the built quality.
2. Real-time Feedback System.
3. Personalization of Exercise i.e. one exercise per product or many exercises per product that varies price range.
4. Beginner and Pro level facility that suits customers.

# Chapter 4

## Project Description

This project aims to build, modify, and improve an existing mirror to create a multifunctional and interactive user experience. This project uses a Raspberry PI, a two-way mirror, with an electronic display behind the front layer of glass. The smart mirror employs embedded cameras to recognize users, enabling personalized interactions based on their preferences. The display will be connected to the Raspberry Pi via an SD Card which potentially runs the Machine learning Algorithm and ensures the posture correct of the user for a particular exercise along with the feedback facility. This project also explores the potential application of smart mirrors in various sectors such as an interactive fitness coach by integrating motion and gesture tracking. The mirror guides users throughworkouts, corrects their form, and provides real-time feedback. The smart mirror has the potential toreshape human interactions with reflective surfaces, offering an enhanced and personalized user experience that blends the physical and digital worlds.

## 4.1 Overview of the project




**4.1 Workflow Chart of Algorithm.**

1. We first declare the following thresholds along with the two counters:
   - **STATE_THRESH**: A set of thresholds that determine the state that each frame belongs to.
   - **FEEDBACK_THRESH**: A set of thresholds to determine the feedback information that needs to be displayed.
   - **OFFSET_THRESH**: Threshold to determine if the person is facing directly toward the camera.
   - **INACTIVE_THRESH**: Threshold to determine inactivity, failing which the counters: CORRECT and INCORRECT are reset.
   - Counters: **CORRECT** and **INCORRECT** to count the number of proper and improper squats, respectively.

2. We read each frame from the webcam/video, pre-process it and pass it through Media Pipe's Pose solution.

3. We then retrieve the desired landmarks for the Shoulders, Nose, Knee, Hip, and Ankle, provided the detection landmarks are available; otherwise, we move on to compute **INACTIVE TIME** (in secs) when there are no detections.
   - If this INACTIVE TIME passes the INACTIVE_THRESH, we reset the counters: CORRECT and INCORRECT.

4. The **offset angle** is calculated for the Nose and Shoulder coordinates.
   - If the offset angle overshoots the OFFSET_THRESH, we display the appropriate warning and compute the INACTIVE TIME as discussed in **Step 3**

5. When the offset angle is within the OFFSET_THRESH, we go on to calculate the following:
   - The angles **shoulder-hip**, **hip-knee**, and **knee-ankle** lines with the verticals.
   - The **current_state** of the frame is calculated based on STATE_THRESH.
   - A list: **state_sequence** is maintained.

6. When the current state is encountered as s1, we update the counters: CORRECT and INCORRECT based on the contents of state_sequence. Otherwise, we compute and display the feedback messages based on FEEDBACK_THRESH and compute the INACTIVE TIME.

7. We assign prev_state with current_state and proceed to fetch the subsequent frames.

### 4.2 Module Description

Module Name/Identifier: Personal AI Trainer Module

Purpose/Objective: The Personal AI Trainer Module is designed to provide users with a virtual fitness and health coach through the integration of a smart mirror and a Raspberry Pi. The objective is to offer personalized workout guidance, health information, and daily wellness tips in a visually engaging manner.

Functionality: This module offers several functionalities, including:

- User identification and personalization.
- Display of the user's image with an overlay of workout instructions.
- Real-time feedback system.

Input Requirements: The module requires input such as:

- User image captured by the smart mirror's camera for facial recognition.

Output: The module displays:

- User's image with overlays of workout instructions.
- Spoken responses to user queries.
- Visual and textual workout routines.

Dependencies: This module relies on the following components:

- Smart mirror hardware (mirror, camera, display).
- Raspberry Pi for processing and communication.

Algorithms/Methods: The module uses facial recognition algorithms for user identification, natural language processing for voice interaction, and data analysis algorithms to generate personalized workout and health recommendations.

Interfaces: It interfaces with the smart mirror's camera and microphone for user interaction, and it communicates with external health devices through wireless protocols. The user interface is primarily visual and voice-based.

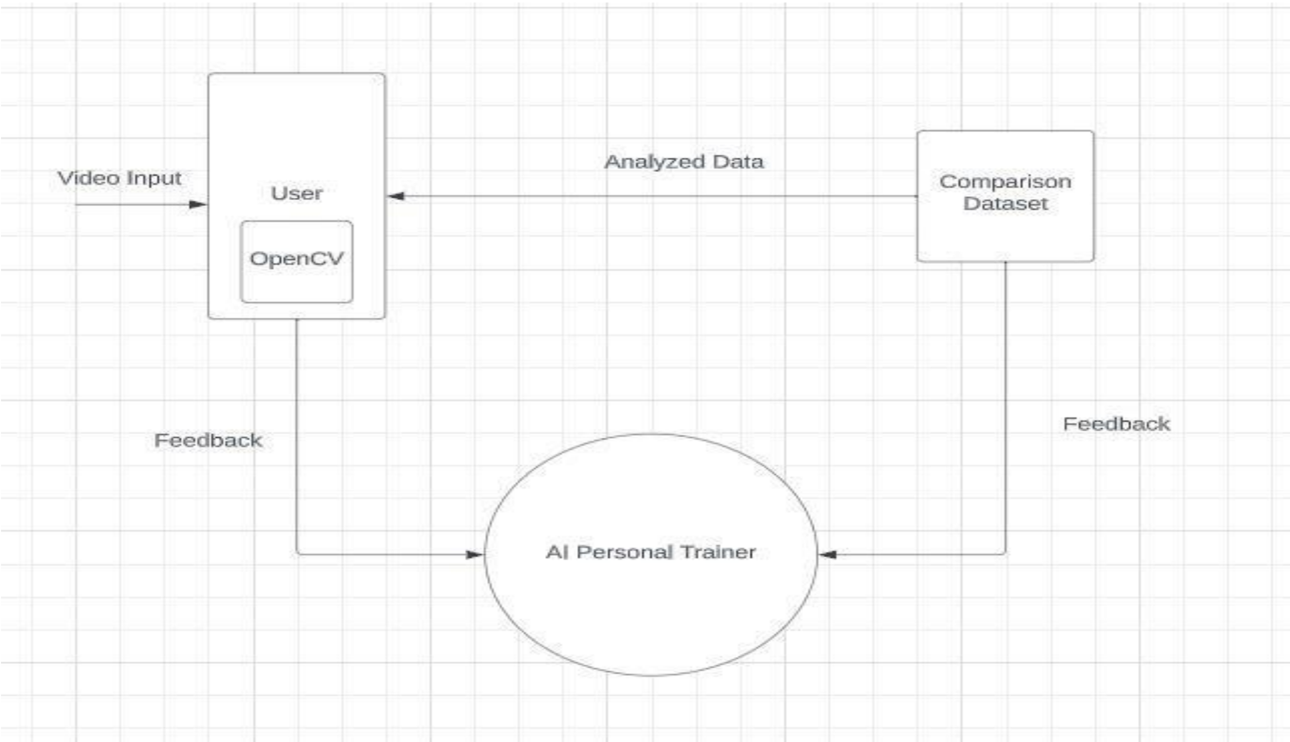
Data Flow: User images and voice commands flow into the Raspberry Pi, which processes the data, connects to online health databases, and then displays the results on the smart mirror's display. Health data from external devices is also integrated and displayed.

Testing and Validation: The module has been tested for facial recognition accuracy, natural language understanding, and the accuracy of health recommendations. Validation includes user feedback and comparison with recognized health guidelines.

Use Cases/Examples: Use cases include a user standing in front of the smart mirror and asking for a workout routine. The mirror displays a personalized workout plan with video demonstrations. The user can also ask questions about nutrition, and the mirror provides dietary recommendations.

Limitations: Limitations include the need for good lighting for facial recognition, potential privacy concerns with facial data, and dependency on external devices for certain health data. Additionally, the module's effectiveness depends on the quality of the underlying health and fitness data sources.

### 4.2.1 Data Flow Diagram




**4.2 Dataflow Diagram**

In this diagram:

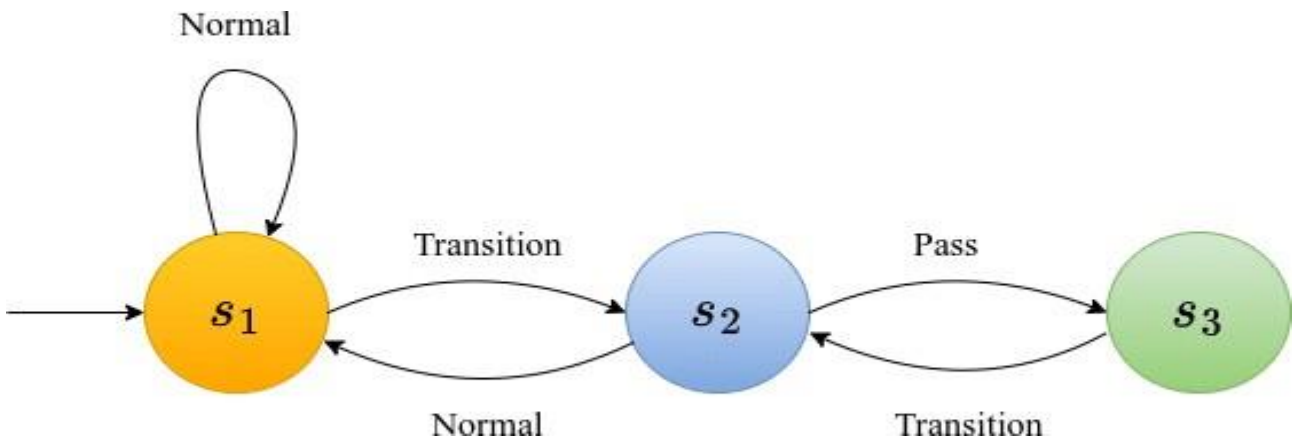
- The "User" provides video input to the "OpenCV" component for analysis.
- OpenCV analyzes the user's input and sends the "Analyzed Data" to the "AI Personal Trainer."
- The "AI Personal Trainer" uses both the "Analyzed Data" and the "Comparison Dataset" foranalysis.
- The "AI Personal Trainer" then provides "Feedback" to the user based on this analysis.
- The "Comparison Dataset" is utilized by an "AI Model" for comparison and analysis.

# Chapter 5

## System Testing

The state transition diagram explains the various states maintained when a squat is performed by considering the angle between the Knees and an Imaginary vertical fall.

### 5.1 Test Cases




**5.1 State Transition Diagram**

We will deal with three states for squat exercise application: s1, s2, and s3.

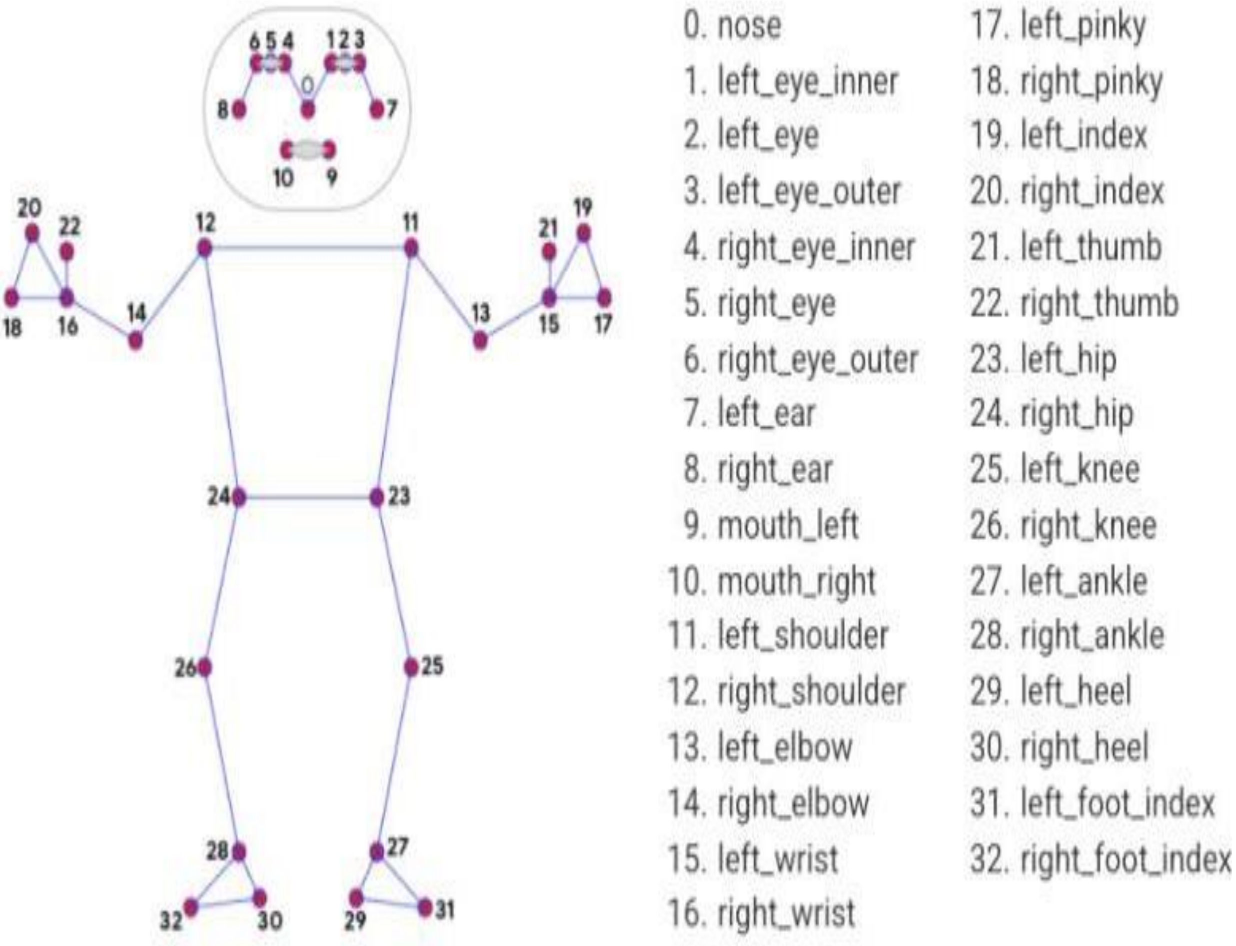
- State s1: If the angle between the knee and the vertical falls within 32°, then it is in the Normal phase, and its state is s1. It is essentially the state where the counters for proper and improper squats are updated.
- State s2: If the angle between the knee and the vertical falls between 35° and 65°, it is in the Transition phase and subsequently goes to state s2.
- State s3: If the angle between the knee and the vertical lies within a specific range (say, between 75° and 95°), it is in the Pass phase and subsequently goes to state s3.

# Chapter 6

## Implementation Details

### 6.1 Methodology

We use human pose estimation using Open-CV to create a Personal AI trainee. OpenPose, AlphaPose, Yolov7, MediaPipe, etc are popular frameworks for predicting human pose. We use the MediaPipe Pose pipeline for calculating human key points because of the insane inference performance on the CPU. MediaPipe Pose is an ML solution for high-fidelity body pose tracking, inferring 33 3D landmarks and background segmentation masks on the whole body from RGB videoframes utilizing the BlazePose, which is a superset of COCO, BlazeFace, and BlazePalm topologies.The pipeline for MediaPipe Pose consists of a two-step detection-tracking pipeline similar toMediaPipe Hands and MediaPipe Face Mesh solutions. The pipeline first locates the person/pose region of interest (ROI) within the frame using a detector. The tracker subsequently predicts the pose landmarks and segmentation mask within the ROI using the ROI-cropped frame as input.




**6.1 Blaze Pose Landmarks**

### 6.1.1 Setting Up Hardware Connections

Introduction

The setup of hardware connections is crucial for the functionality and performance of the smart mirror. This section outlines the step-by-step process for connecting various hardware components to the Raspberry Pi 4, the central processing unit responsible for managing the smart mirror's operations.


Fig 6.2 Raspberry Pi connections

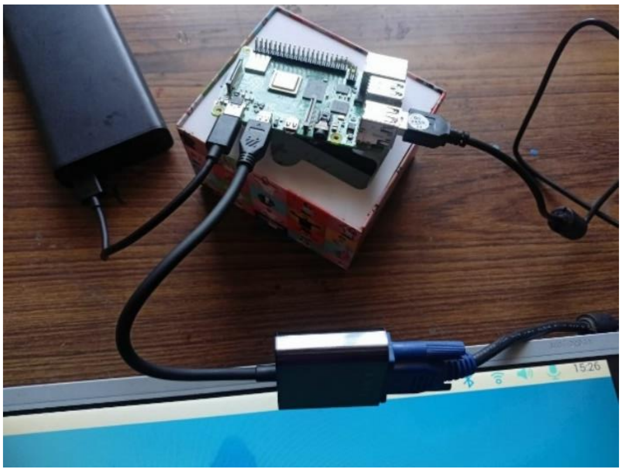


Fig 6.3 HDMI VGA Converter

1. Raspberry Pi 4 Board: The Raspberry Pi serves as the brain of the smart mirror, executing the operating system and coordinating all software applications and functions.
2. Display Screen: Connect the Raspberry Pi to a display screen, typically an LCD monitor. Use HDMI to VGA cables to establish a reliable connection.
3. Power Supply: Power the Raspberry Pi using a USB Type C cable connected to a stable power source, such as a Raspberry Pi Charger or a Power Bank. Ensuring a consistent power supply is essential for uninterrupted operation.
4. Storage (32 GB MicroSD Card): Install the operating system, such as Raspberry Pi OS, and store application files and data on a microSD card inserted into the Raspberry Pi's microSD card slot. Adequate storage capacity is necessary to accommodate software requirements.
5. Input Devices: Connect input devices, such as a USB keyboard and mouse, to the Raspberry Pi's USB ports. These devices facilitate navigation of the interface and interaction with the smart mirror's functionalities.

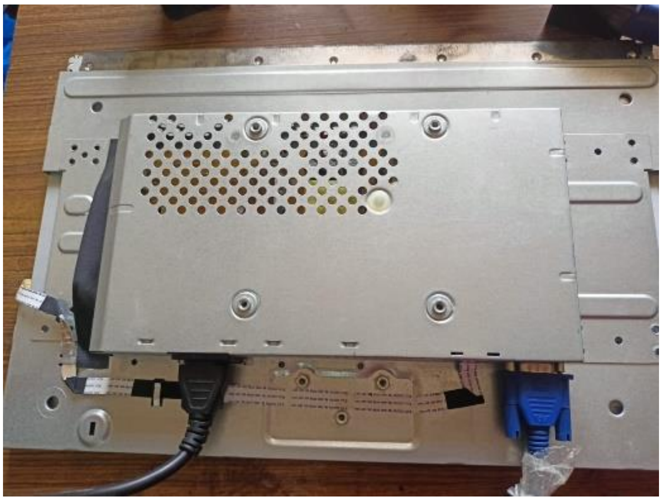


Fig 6.4 Power Cable and VGA

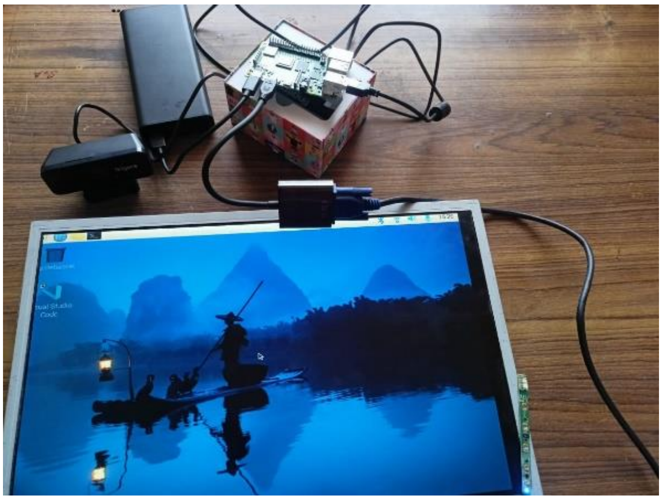


Fig 6.5 Complete setup with all connections

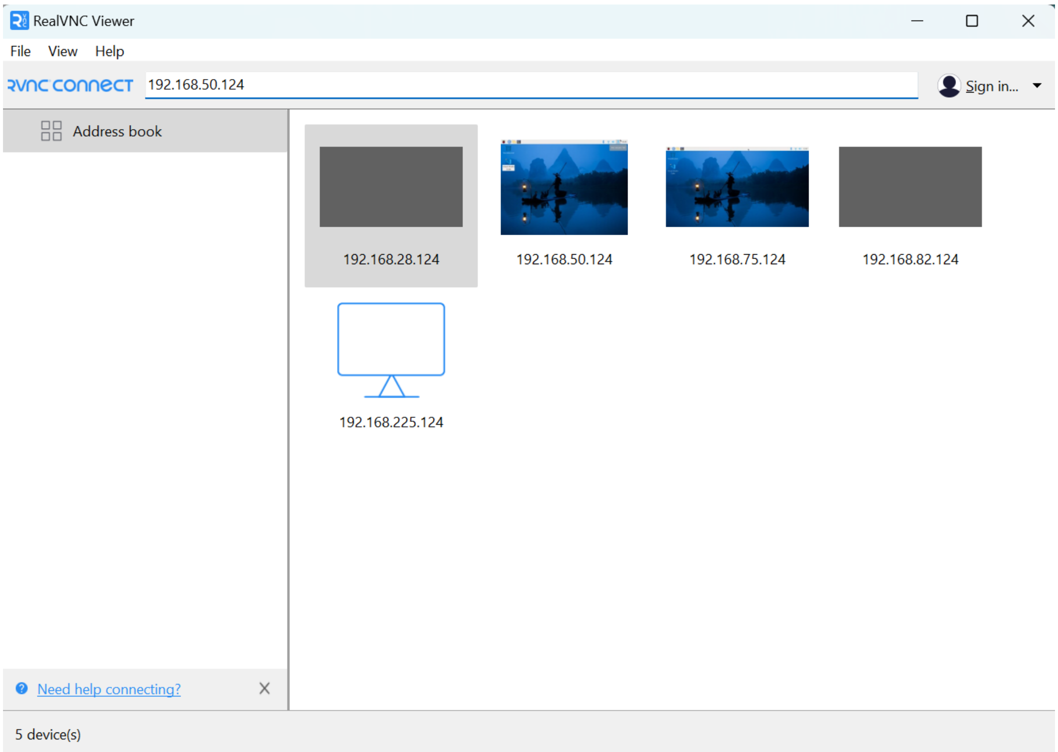
6. USB Camera: Incorporate a camera to give vision to the mirror. Connect the camera to the Raspberry Pi via USB.
7. Internet Connectivity: Establish internet connectivity for the Raspberry Pi to enable access to online services and updates. Connect to Wi-Fi using a Wi-Fi dongle inserted into one of the USB ports or utilize the built-in Wi-Fi module.

Conclusion

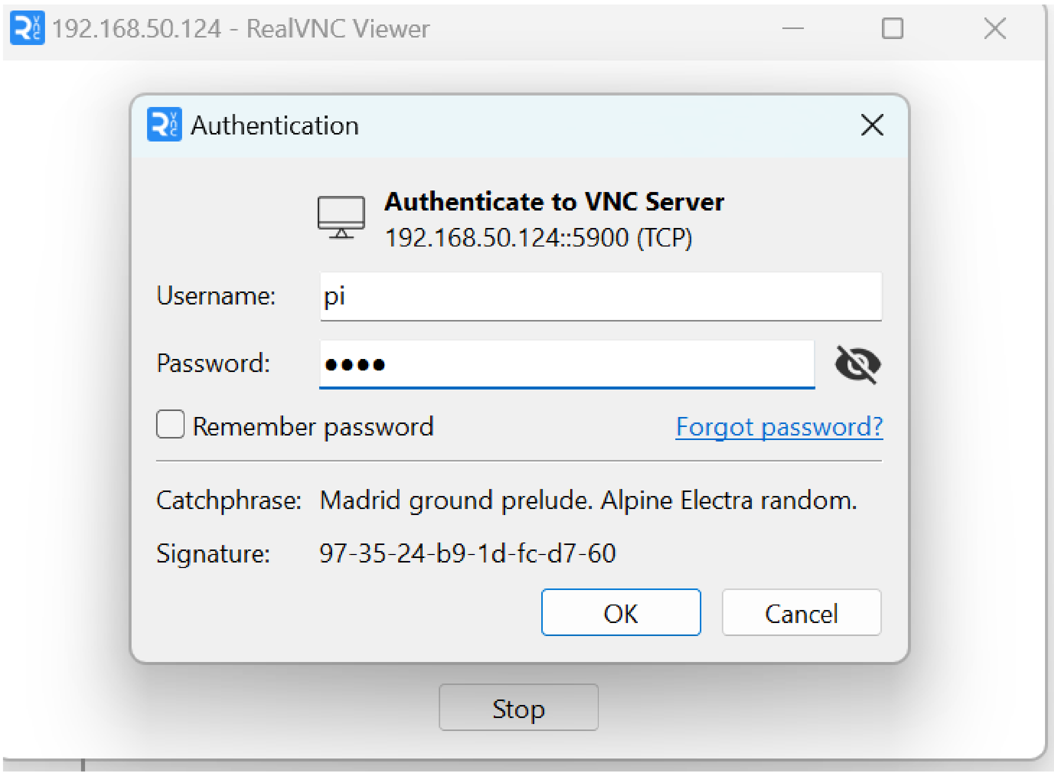
By following these instructions and properly connecting the hardware components to the Raspberry Pi, users can create a fully functional and customizable smart mirror tailored to their specific requirements and preferences. This setup forms the foundation for the subsequent configuration and software integration phases of the smart mirror project

### 6.1.2 Connecting to Raspberry Pi 4 Using VNC Viewer

1. Preparation of Raspberry Pi:
    a. Ensure the Raspberry Pi is connected to the network via Ethernet or Wi-Fi.
    b. Enable VNC access on the Raspberry Pi through the Raspberry Pi Configuration tool or by following the official documentation.
2. Installation of VNC Viewer:
    a. Download and install VNC Viewer on the local computer from the official RealVNC website.
3. Locating Raspberry Pi's IP Address:
    a. Identify the IP address of the Raspberry Pi by accessing the router's admin page or utilizing network scanning tools like Advanced IP Scanner.
4. Initiating VNC Viewer:
    a. Launch VNC Viewer on the local computer.
5. Establishing a Connection with Raspberry Pi:
    a. Input the Raspberry Pi's IP address in the VNC Viewer's address bar and press Enter (see Fig 6.2).
    b. Provide the required credentials (username and password) if prompted (see Fig 6.3).
6. Authentication and Connection:
    a. Upon successful authentication, VNC Viewer establishes a connection with the Raspberry Pi, rendering its desktop interface.
7. Interacting with Raspberry Pi:
    a. Utilize VNC Viewer to interact with the Raspberry Pi's desktop, allowing for control and operation as if physically present.
8. Termination of Connection:
    a. Properly disconnect from VNC Viewer and close the application after completing tasks on the Raspberry Pi.




**6.6 Inputting IP Address into VNC Viewer**




**6.7 Login with credentials**

## 6.2 Innovative aspects of the proposed Methodology: -

MediaPipe Pose is an ML solution for high-fidelity body pose tracking, inferring 33 3D landmarks and background segmentation masks on the whole body from RGB video frames utilising Blaze Pose, which is a superset of COCO, Blaze Face, and Blaze Palm topologies.

The only exercise available in our current Python code is Squarts. For the tasks that will be monitored, we have developed two levels, and the corresponding outputs are as follows:

Newbies: This level is intended for those who are brand-new to the world of exercise. The threshold values are not precisely aligned with the conventional values to ensure proper posture.

Pro: This level is appropriate for individuals who are accustomed to performing this activity daily. The threshold values are precise and match standard values.

# Chapter 7

## Conclusion And Future Enhancements

### 7.1 Conclusion

A Personal AI Trainer utilizing the MediaPipe Pose ML model represents a promising advancementin the field of fitness and wellness. This technology harnesses the power of machine learning and computer vision to provide users with an innovative and personalized fitness experience. It's important to note that there are challenges and considerations to address, such as data privacy, user trust, and the need for continuous model improvement. Additionally, while AI trainers are a powerfultool, they may not fully replace the human touch in fitness coaching, especially for those who value the emotional support and accountability that a personal trainer provides.

### 7.2 Future Enhancements: -

We have used Media Pipe's Pose and leveraged the power of OpenCV and NumPy to build a simple application to analyze fitness. We can further improve it by incorporating more advanced techniques, such as building a Human Action Recognition system using a CNN-LSTM model and training a classifier on some standard dataset. We can also use wearable sensors such as Inertial Measurement Units (IMUs) and perform some time-series analysis.

# References


1. “Smart Mirror using Raspberry Pi” K.P. Vijayakumar, Yash Tandon, Vennam Prahasith in International Journal of Advanced Science and Technology, 29(08), 734 - 741, (2020).
2. "Internet of Things Based Smart Mirrors: A Literature Review" D. A. Alboaneen et al in 3rd International Conference on Computer Applications & Information Security (ICCAIS), 2020.
3. SMART MIRROR USING VOICE INTERFACE” Roopa Sabri.K, Poornima Urala.A, Gayathri.P, Deepak.D, Mrs. S. Pushpalatha, Mrs. Neetha Natesh in International Research Journal of Engineering and Technology (IRJET), Volume 6, Issue 6, ISSN 2395-0056, June 2019.
4. “DESIGN AND DEVELOPMENT OF SMART MIRROR DISPLAYING REAL-TIME SENSOR DATA” Preeti Rani, Mr. Indra Thanaya in International Journal of Engineering Research & Technology (IJERT), Volume 8, Issue 6, June-2019.
5. "Design of the Smart Mirror Based on Raspberry PI" K. Jin, X. Deng, Z. Huang and S. Chenin 2nd IEEE Advanced Information Management, Communicates, Electronic and Automation Control Conference (IMCEC), 2018.
6. "The Smart Mirror" Ramya. S, Saranya. S, Yuvamalini. M in International Journal ofAdvanced Research, Ideas and Innovations in Technology, 2018.
7. “Smart mirror E-health assistant - Posture analyze algorithm” B. Cvetkoska, N. Marina, D. C. Bogatinoska, and Z. Mitreski in 17th IEEE Int. Conf. Smart Technol. EUROCON 2017 - Conf. Proc., no. July, pp. 507–512, 2017.
8. "A Mobile-programmable smart mirror for ambient IoT environments" Mohammed Ghazal, Tara al Hadithy, Yyasmina al Khalil, Muhammad Akmal and Hassan Hajj Diab in 5th international conference on future internet of things and cloud workshops, 2017.
9. "Implementation and Customization of a Smart Mirror through a Facial Recognition Authentication and a Personalized News Recommendation Algorithm" Ivette Cristina Araujo Garcia, Eduardo Rodrigo Linares Salmon, Rosario Villalta Riega, Alfredo Barrientos Padillain 13th International Conference on Signal-Image Technology & InternetBased Systems (SITIS), 2017.
10. "Smart Reflect: A modular smart mirror application platform" Derrick Gold, David Sollinger, Indratmo in 7th Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON), 2016
11. Marr, B. (2020, August 26). The magic of smart mirrors: Artificial intelligence, augmented reality, and the internet of things https://bernardmarr.com/articles/robots-internet-of-things-smart-devices/.
12. Baracoda Daily. (2021, February 23). BARACODA Unveils BMIND Smart Mirror for Mental Wellness https://www.digitaltrends.com/home/baracoda-bmind-smart-mirror-mental-wellness-ces-2024/.
13. Shilov, V. (2020, January 22). This smart mirror uses AI to boost your confidence and mood https://www.zdnet.com/news/62/.
14. Margude, R. (2020, February 24). Reflecting Innovation: Unveiling the Evolution of the Smart Mirror Market https://medium.com/@rajeshmhargude95/reflecting-innovation-unveiling-the-evolution-of-the-smart-mirror-market-c7c19e5a25c5.