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PLAYFIT – AI Based Virtual Trainer

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***Abstract*—The increasing prevalence of sedentary lifestyles and the high cost of fitness services have created significant barriers to maintaining a healthy, active lifestyle, especially in rural or less urbanized areas. PlayFit is an innovative solution that addresses these challenges by merging physical fitness with interactive gaming. Using artificial intelligence (AI) and computer vision technology, PlayFit provides users with a unique platform that offers real-time posture correction and guidance while exercising at home. The system ensures that exercises are performed correctly, reducing the risk of injury, and enhancing the effectiveness of workouts, much like having a personal trainer. The platform transforms traditional gaming into a full-body experience, making physical activity more engaging and enjoyable. By incorporating full-body movement into gaming, PlayFit encourages users, especially younger generations, to stay active while playing their favourite games. It is designed to be accessible and affordable, targeting a broad demographic, including those in rural areas, homemakers, and individuals who struggle with conventional fitness routines.**

***Index Terms*—Computer vision, Media Pipe, OpenCV, virtual trainer**

I.INTRODUCTION

Physical fitness is paramount for both women and individuals in rural areas, each facing unique challenges and reaping distinct benefits from regular activity. Women, statistically more prone to osteoporosis (with 1 in 2 women over 50 at risk of fracture according to the National Osteoporosis Foundation) and mental health issues, benefit significantly from weight-bearing exercise for bone density and mood-boosting physical activity. Exercise also aids hormonal balance and reduces risks of chronic diseases like heart disease and type 2 diabetes, major health concerns for women. The World Health Organization (WHO) recommends at least 150 minutes of moderate or 75 minutes of vigorous aerobic activity weekly for adults, yet CDC data shows only about 20% of US women meet this.

II. METHODOLOGY

The AI Trainer is developed using a combination of advanced web-based technologies, AI tools, and computer vision frameworks to create an engaging and interactive fitness platform. The Development process is highly structured, ensuring the platform is user-friendly, efficient, and capable of delivering accurate real-time feedback. The block diagram of system is shown in Fig 1

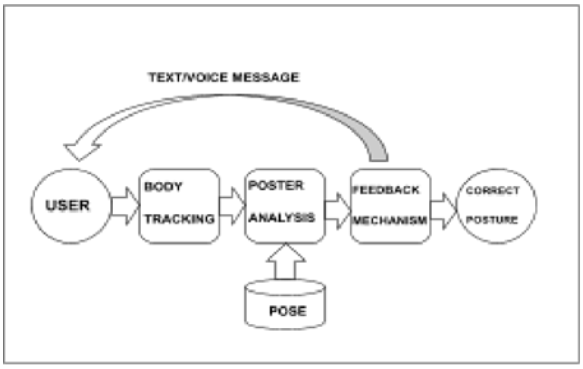

Fig -1: AI based virtual trainer block diagram

The Core functionality of AI Trainer relies on OpenCV and MediaPipe, which enable precise body movement detection and posture analysis. These technologies work together to monitor users in real time: The key components of AI system are Body Tracker,Posture analyzer and Feedback Mechanism.

Body Tracker: MediaPipe maps key body points, including joints, limbs, and facial landmarks, creating a skeleton model of the user.

Posture Analyzer: Assess body alignment and detects errors in exercise (posture) form, such as improper squats or misaligned lunges.

Feedback Mechanism: Mistakes are highlighted immediately, and corrective instructions are delivered via text-to-speech (TTS) functionality. This ensures users perform exercises safely and effectively without requiring a human trainer.

Depiction of the data flows through the different stages of system is shown in Fig 2.

1. The client captures video frames.
2. Frames are pre-processed and sent to the server.
3. The server uses MediaPipe to estimate the user's pose.
4. Angles are calculated and compared to ideal angles in the Pose Database.
5. Feedback is generated (text and audio).
6. Feedback is sent to the client.
7. 7.The client plays the audio feedback to the user.

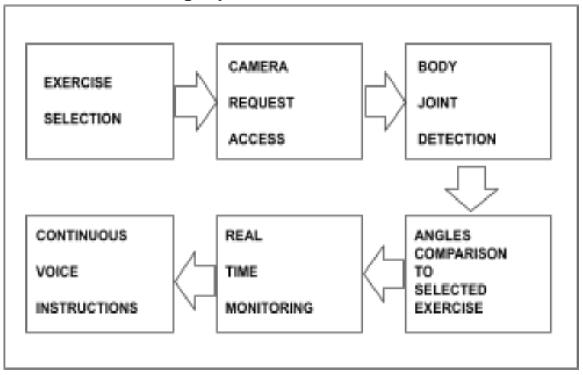

Fig 2: Data Flow Diagram of AI Virtual Trainer

III. IMPLEMENTATION

Camera Module: Accesses the device camera and captures video frames.

- Frame Preprocessing: Resizes and formats frames for efficient transmission. o Network Module: Sends frames to the server and receives feedback.
- Audio Module: Plays voice instructions using a text-to-speech (TTS) engine.
- User Interface: Displays video feed and optional visual feedback.

Server-Side:

Frame Receiver: Receives video frames from the user "Your knee should be at 90 degrees."

"Hold the pose for 5 more seconds." o MediaPipe Pose

Estimation: Uses MediaPipe to detect key body landmarks (joints).

- Angle Calculation: Calculates angles between relevant joints based on the detected landmarks.
- Pose Analysis: Compares calculated angles with predefined ideal angles for yoga pose. o Feedback Generation: Generates text and audio feedback based on the analysis:

▪ Your knee should be at 90 degrees

▪ Hold the pose for 5 more seconds o Text-to-Speech (TTS) Engine: Converts text feedback into audio.

Network Module: Sends feedback to the user o Pose Database: Stores ideal angles and feedback for various yoga poses

MediaPipe is a framework or platform for constructing machine learning pipelines for handling and processing time-series data like audio, video, etc. MediaPipe offers various machine-learning solutions like face detection, object detection along with pose. MediaPipe Pose is one of the ML solutions in the MediaPipe framework. MediaPipe Pose is a bottom-up multi-person pose estimation model. It can detect 33 anatomical landmarks.

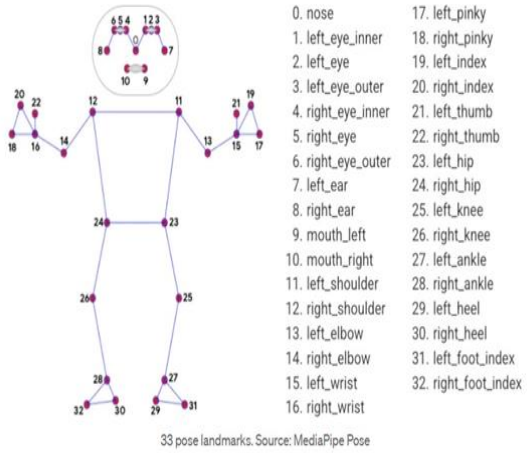

Fig -3: Landmarks detected on human body using MediaPipe

The functionalities provided by MediaPipe are:

(1) Angle between two lines with one common point

Consider two lines A and B. Let line A be defined between points point1, and point2. Let line B be defined between points point2, and point3. Then, the angle between the two lines A and B with a common point point2 is calculated

(2) Angle between a line and horizontal

Consider a line between points point1, and point2. Then, the angle between the line and the horizontal (X-axis) is calculated

(3) Euclidean distance between two points

Consider two points point1, point2. Then, the euclidean distance between the points is calculated

Point position from a line

Consider a point and a line. The position of the point (i.e. right or left) from the line is calculated.

For warrior pose detection in the play fit virtual trainer first two functionalities have been implemented.
With its potential to revolutionize home fitness and make professional-grade training accessible to everyone, this application represents a significant advancement in the fitness technology landscape.

IV. RESULTS

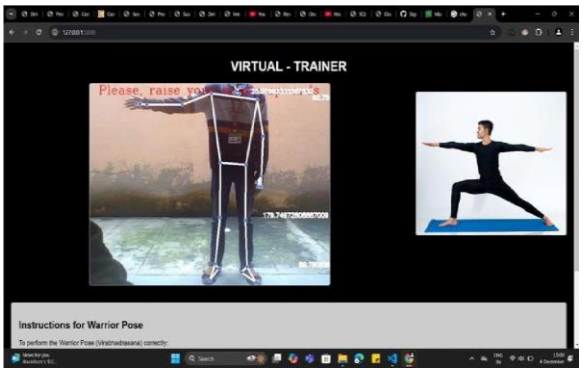

Fig -4: Initial Position the person takes while standing in front of camera

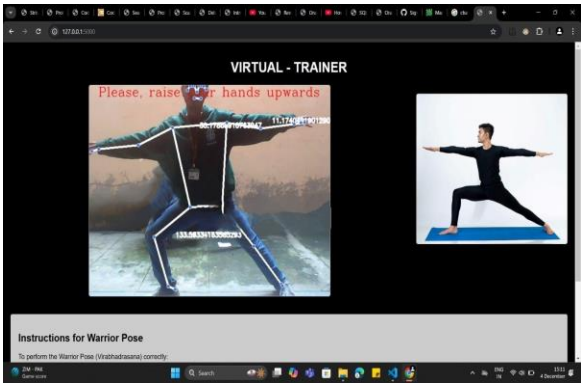

Fig -5: The Second position signifies that, we are yet to achieve the final posture

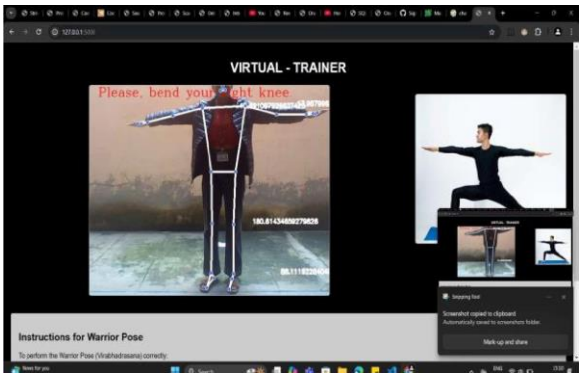

Fig -6: Represents Progress but yet to achieve final posture

Fig -7: Represents the correct accurate posture

V. CONCLUSION

The proposed AI-powered exercise trainer application combines advanced computer vision and AI technologies to deliver real-time feedback, personalized workout plans, and improved safety. This system bridges the gap between traditional instruction-based fitness apps and the demand for interactive, accurate, and adaptive training. By offering users real-time guidance and tailoring exercises to their fitness levels and goals, the application ensures a more effective and engaging fitness experience while reducing injury riskst of camera with its potential to revolutionize home fitness and make professional-grade training accessible to everyone, this application represents a significant advancement in the fitness technology landscape.

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