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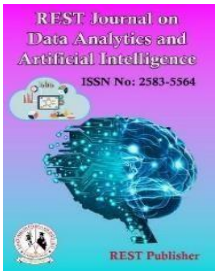

Media Pipe Based Virtual Fitness Assistance

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Abstract. *In this modern world, almost every service is expected in online mode. Fitness Service is one among them. To satisfy the demand, many mobile and web applications were developed and deployed for public access. All the applications give the information on exercises, but do not verify whether user is performing them or not. Along with providing information about various exercises, this project introduces a novel approach of using pre-trained human pose estimation model named "Pose" of Google's Media Pipe library, integrated with a web application, to capture live video feed from the user device, estimate user pose and perform numerical computations to find angle between joints selected as per exercise chosen, determining whether user is really performing exercise or not.*

Keywords: *computer guidance, Authentication System, web application, Module design and Organization, Artificial Intelligence.*

1. INTRODUCTION

According to a survey conducted by RxResource.org, two in three (66%) do not perform physical activity that is recommended for a week and only one in five (20%) have "Areas" for physical activity like park, gym, etcetera within a half-mile. The report also projects that by 2030, 50% of United States of America population will be obese [1]. All these stats indicate that there is a necessity to perform physical activity on regular basis to stay healthy [2]. The Modern lifestyle with irregular sleep and food patterns, reduced importance to physical activity, increased screen time and other parameters like daily routine, free time available, economic status adversely affect the chance of performing physical activity [4]. A simple and interactive web application addressing queries on What, why and how to perform exercises and also tracking user movements like a "Gym trainer" would be beneficial and can be a powerful tool in turning people "physically active" [5], [8]. Understanding the demand for online fitness training, many mobile and web applications were developed [6], [17]. All the existing applications give information about exercises but do not track whether user is really performing them or not, ultimately resulting in poor outcomes [1], [12].This project "Fitness DevLovePer", along with providing information about exercises, also tracks the user movements, estimate the user pose and determine whether user is really performing it or not, promising better outcomes than existing systems [9], [14]. The project's functionality is achieved through its tech stack. The web application is developed using "Django" – a python-based web application framework and integrated with a human pose estimation model "Pose" of Google's Media Pipe library [10]. The end user can interact with project through web app's UI and can select the exercise that user would like to perform. Once exercise is chosen, the live camera feed is sent to web app's backend and user pose is estimated. Depending upon the exercise chosen, until user pose satisfies the conditions to consider as "Correct", rep count is not incremented, forcing user to really perform exercise [3].

2. BACKGROUND

Data Flow Diagram: A Data flow diagram can help us visualize how the data flows through the system and how various components interact with each other [4][15]. This is a high level representation and real systems may involve more complexity. The components in the system could include a user interface, a database and essential activities like sign in, sign up, performing exercises etcetera [7][13].

Module Design and Organization: The project has been divided into modules where each module has some special functionality. The modules are organized one into another with directory-subdirectory architecture [9, 12].

Technology Used: The tech stack is chosen in such a way that project objectives are achieved in efficient and effective manner [14], [17].

Webcam / Camera Module: Captures the real-time video feed required for pose detection and movement analysis [2] and [7].

Challenges and Future Directions: Testing and Validation plays an important role in developing and debugging the application. [17]. Taking the target audience into consideration, components of the project and practical real world scenarios test cases are designed to check functionality of the application [9].

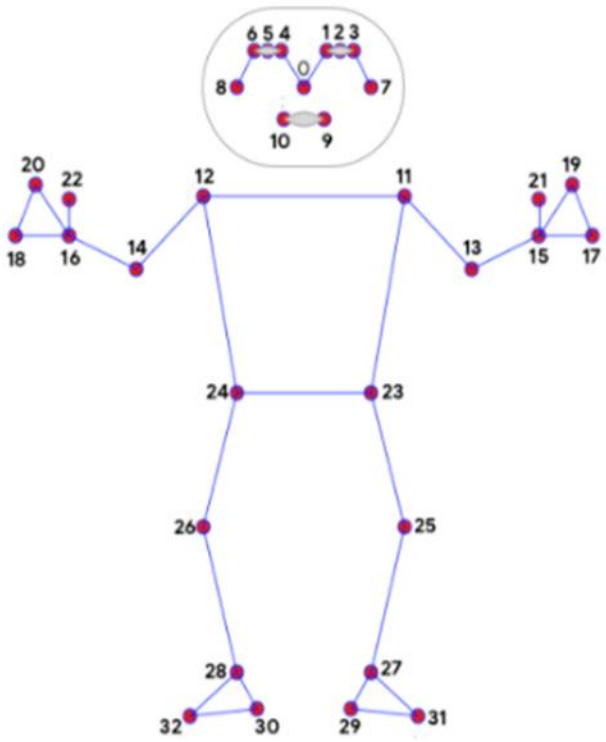

FIGURE 1. 33 Node points of human according to pose estimation model

3. LITERATURE REVIEW

TABLE 1. Literature Review

Year	RF.NO	Method	Dataset	Metric	Result
2022	[4]	AI Fitness Tracker	Kinect & Physiological Sensors	Accuracy	96%
2024	[1]	AR-Based Fitness Assistance	Senior Fitness Test Dataset	Precision	88%
2024	[2]	Fitness Evaluation	Senior Fitness Test Dataset	Recommendation Accuracy	92%
2022	[5]	Yoga Pose Detection Using Deep Learning Models	Kinect & Physiological Sensors	Accuracy	85%
2023	[3]	Virtual Running Assistance with AI	Senior Fitness Test Dataset	Precision	91%
2023	[6]	AI-chatbot Powered Personalized Workout	Kinect & Physiological Sensors	Recommendation Accuracy	87%

4. FINDINGS AND LIMITATIONS

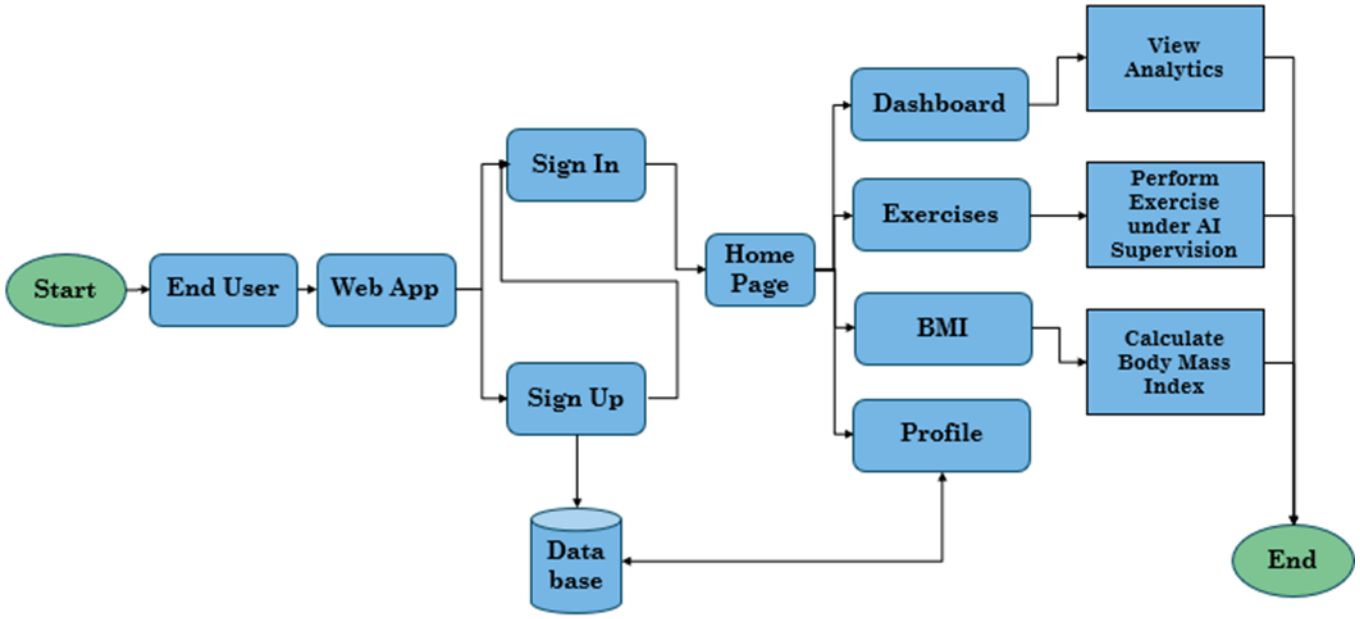

FIGURE 2. Data Flow Diagram

Even though the existing system seems performing well, there are still limitations for them. The following list gives the limitations of previously mentioned existing systems. No agent which interacts with user is embedded in the existing systems. While performing a complex task like exercise, it is usual that user may have queries [1]. In the existing systems, there is no mechanism to answer/assist with the queries. Due to this, user may perform exercise without understanding it properly creating a severe risk of injury [6].Existing systems do not have complete information about each exercise. Dangerous exercises which mandatorily require human coach presence are not included due to the high-risk factor. This makes existing systems incomplete in terms of exercises available to

perform and not suitable for all the exercises [9, 14]. Methodologies that were proposed in mentioned research papers use deep learning models which run GPUs consuming high computational power. The lack of high computation facilities makes models inaccessible to users with limited resources [17].All the existing systems either give information about exercises or accept user pose to classify correctness statically. There is no dynamic system which captures live video feed and validates the correctness of pose [8].Figure 2, illustrates the architecture of the proposed system. Due to advent of technology and improved awareness of technical devices, many web and mobile applications were developed and deployed. To solve the problem of providing fitness services through online mode, a simple web application which has authentication system, gives information about various exercises and guides user in performing them would be a powerful tool and high business valued product due to the demand [12], [17].Even, good user interface and integration with deep learning model would be better feasible through a web application.

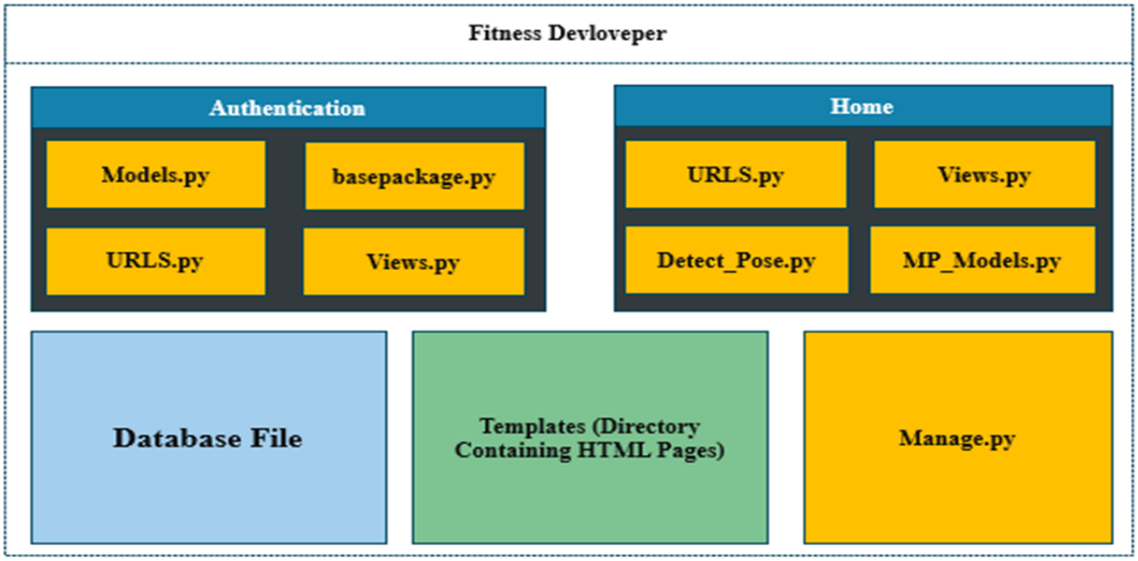

FIGURE 3. Organization and structures of modules

The proposed system follows Client-Server architecture and runs on web browsers. The client here is end-user who performs exercise and Server is web application which accepts live video feed of user and tracks the movements to validate correctness of user exercise. The web application is developed using a python-based web application framework called “Django”. The choice here is “Django” because, integration with other modules would be easy due to common programming language used. The web application essentially acts as the server in our project and runs on web browser. The web application has the following components in its backend.

Future Scope: The current version of project uses Django as web application framework and Google media pipe’s deep learning model “Pose” for human pose estimation. Now, user can perform three exercises but it would be beneficial if more exercises are added without degrading the application’s performance. A complete voice-based chat bot which takes queries through audio and answers through audio would eliminate the problem of inaccessibility of current chat bot, when device is placed far. Along with Body Mass Index, new parameters such as number of active hours, etcetera, which indicate change in fitness can be added, tracked and visualized in the profile dashboard, encouraging user to perform exercises. The front end and user interface (UI) of web app can be improved further and integrated with dynamic frameworks for better user experience (UX). The application can give error messages and guide user to correct the errors, be it in pose or any other. A deep learning model which enhances the image frame quality can be an asset to tackle poor resolution of device’s camera. More interactive and community collaborative exercises can be added to make performing exercises more enjoyable.

5. CONCLUSION

A robust web application with a user-friendly interface, which gives information about three exercises – Bicep Curls, Shoulder Press and Squats, guide how to perform them via animations and track user movements to validate whether user is performing exercise or not, is developed. The python's web application framework, "Django" and Google's Media pipe library play key roles in this project. With the authentication system developed, an end user can create an account securely and can access features that are facilitated by application. The end user can also choose an exercise, watch animation on how to perform it and start performing it. The live camera feed is sent to application's backend to extract landmarks through pose estimation model and perform numerical computations to calculate the angle between selected joints. If pre-set conditions are satisfied, then only rep counter is incremented which forces user to really perform exercise to complete the exercise. This application can be a powerful tool in encouraging people to perform exercise with guidance from computer at no cost making it accessible to majority of target audience. The chat bot integrated with the application can take queries on exercises from user and answer them, turning the project into an interactive application.

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