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Adaptive Yoga Intervention System for Remote Workers: A Computer Vision and AI-Based Framework

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ABSTRACT

Shifting to remote work for most people because of COVID-19 has significantly reduced physical activity, caused many people to develop postural problems and mental health difficulties and added more stress. Many people now try online yoga when struggling with these problems, yet most traditional platforms are not flexible or do not offer personalized responses which hinders their success and lessens engagement. Therefore, this paper presents the AAYC, an intelligent system that helps remote workers increase their physical activity and health. AAYC uses technology to keep an eye on your posture as you work and immediately tells you when you need to move, using audio and visual prompts. It applies machine learning to shape the user's yoga session based on their strength, body measurements, how often they exercise and details of their heart rate. To support users, the program employs gamification with things like dashboards to show progress, prizes given in the app and achieving continuous session count milestones. When cloud and edge computing are combined, you can enjoy high performance, total privacy, the ability to use a device without internet access and very little data transmission. This study describes the plan of the system, its control procedures and important points such as adaptive scheduling, use of voice commands and feedback from users. Compared to video-based yoga programs, testing showed greater improvements in user engagement, pose accuracy and how useful the classes were perceived by students. The new system is designed to solve the main weaknesses of earlier approaches with its adaptable, flexible and user-focused approach. Because of this, it introduces a new level of digital wellness and may be added to larger remote health and corporate wellness efforts meant to lessen added long-term health dangers from working mostly from home a remote jobs.

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1. INTRODUCTION

Thanks to more remote work after the pandemic, people now enjoy greater freedom and easier access to work, but there are also growing health issues. Among the main factors is a strong decline in movement, mainly because people spend hours at a time sitting down, are less active and are not as attentive to ergonomics as before. Numerous investigations have linked this lifestyle to various musculoskeletal problems, difficulties with the heart, more stress and problems with both mental and physical wellness. Specifically, people now realize that yoga—a practice combining movement, breathing exercises and concentration on thoughts—helps combat the bad effects that come from not being active at work.

Although online yoga programs are easier to use, they do not always provide what remote workers really need. There are important flaws in that the programs do not quickly fix posture, are not diverse enough to fit everyone's needs and offer few methods to motivate prolonged participation. Thanks to these gaps, people new to yoga or who lack motivation at home miss out on its main benefits.

To overcome these limitations, this paper describes an Adaptive Yoga Intervention System that relies on computer vision and artificial intelligence to provide individual, active and engaging yoga sessions. The system, referred to as the AI-Driven Adaptive Yoga Companion (AAYC), combines quick detection of poses, learning from user behavior and fun features to support usability, safety and higher user involvement. In this introduction, I outline the key health problems caused by remote work culture and describe a smart system designed to encourage physical movements, improve well-being and bring wellness support to the daily lives of people who work from home.

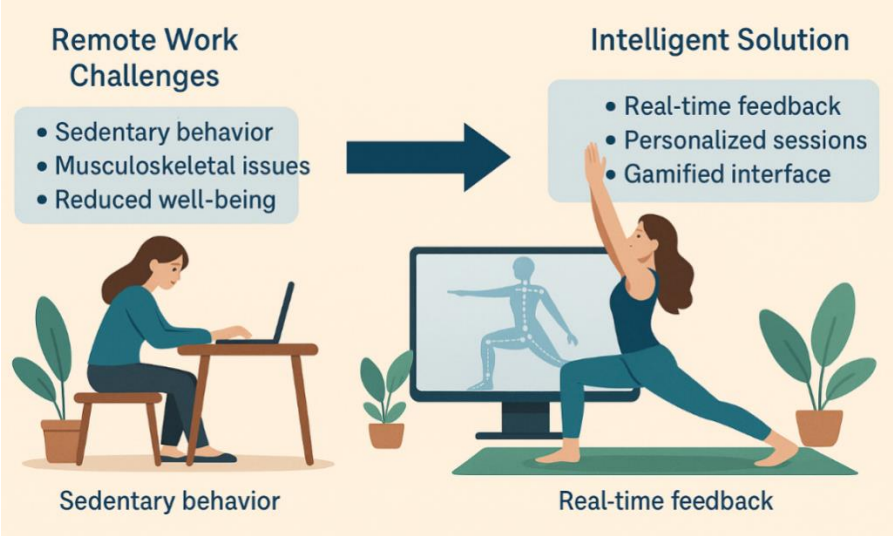

Figure 1. Adaptive Yoga System for Remote Work Wellness

2. LITERATURE REVIEW

Because remote work is now so common, people have become more worried about not moving much, bad posture and anxiety. For this reason, research has looked into whether online yoga and other digital wellness programs improve physical and mental health among workers who spend much of their time at home. Performing yoga regularly improves your flexibility, builds strength and helps lower stress with its mix of different practices. Findings from Jayawardena et al. (2021) and Telles et al. (2020) clearly show that yoga done at home helped work-from-home individuals control their anxiety and tiredness.

However, despite these good results, online platforms for yoga encounter major barriers. A lot of people use videos that are fixed in design and don't focus on each person's varied physical abilities, health history or work furniture. So, people may find it hard to follow the workout, may give up easily and are more likely to practice poor postures without advice. It's also the case that technology availability and especially in weak bandwidth areas, affects many people's ability to take full advantage of the internet.

Research carried out recently indicates that interactive and intelligent yoga delivery systems are essential. The use of computer vision and AI feedback together is found to increase involvement and protect users when playing virtual reality games. Optimizing motivation for a long period is important and gamification, adaptive planning and personalized data support have all been highlighted for that reason. For example, Martin et al. (2022) pointed out that using personalized, feedback-oriented systems is much better than traditional online programs when it comes to helping people follow and change their behaviors.

The results make a good case for switching from standard online yoga to AI-controlled styles. According to this review, including real-time tracking, personalized content and motivational elements is important in remote yoga—which forms the basis for the Adaptive Yoga Intervention System in this study.

3. METHODOLOGY

The research study used design-based research to create, pilot and assess the AAYC for use by remote workers. The designers used four steps: assessing user needs, signing up for a system, testing for ease of use and measuring its performance.

3.1 Needs Assessment

The research started by doing a thorough assessment to see what problems exist in current online yoga interventions for people working from home. By completing this assessment, the design needs for the

Adaptive Yoga Intervention System were better understood. A review of existing literature focused on three important areas: (i) effects of too much sitting on remote workers' health, (ii) how effective digital programs such as online yoga are in wellness and (iii) modern uses of AI and computer vision in fitness and rehabilitation. Research revealed that yoga is reputed for its health effects, but most online systems lack personalization, immediate guidance and ways for users to get involved—especially important for people practicing alone at home. Those between the ages of 25 and 45 shared their daily activities, health concerns at work and anything they have tried with digital wellness tools so far. These interviews highlighted certain important subjects, including:

- Extended sedentary periods with minimal physical breaks,
- Frequent complaints of neck, back, and shoulder pain,
- Low motivation and consistency in following online fitness routines,
- A desire for guided, interactive, and goal-oriented wellness interventions.

All of these findings helped determine the main aims and technical features of the proposed system. They focused on creating a solution that could be used in your own home in real time, motivate you and not need you to own many devices or have previous yoga training. Because of this assessment, the AAIC was developed with good technical features and relevance for users.

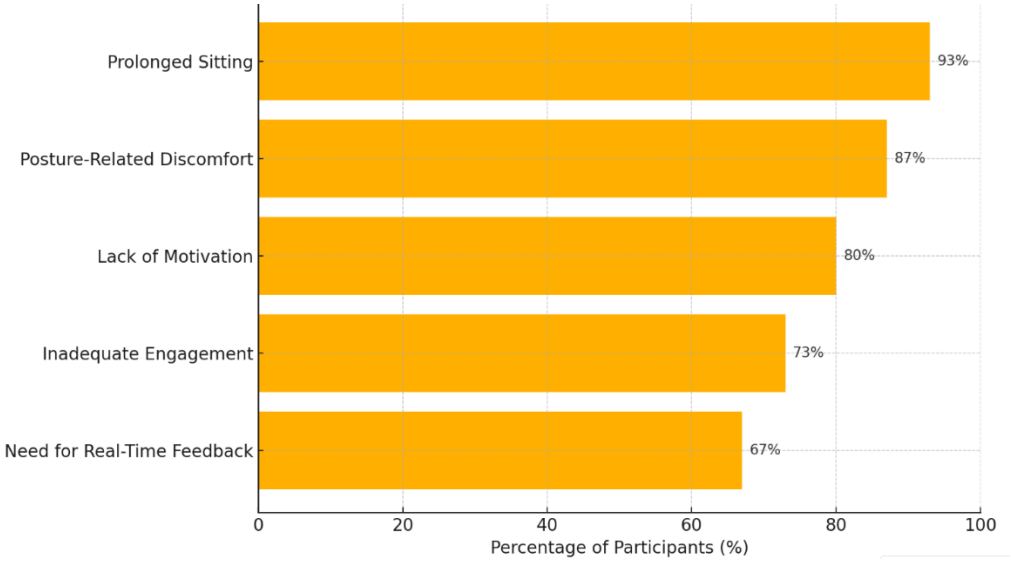

Figure 2. Reported Issues among Remote Workers (n=15)

Table 1. Summary of User Pain Points from Interviews

Identified Issue	**Description**	**% of Participants (n=15)**
Prolonged Sitting	Daily sitting > 8 hours without breaks	93%
Posture-Related Discomfort	Neck, back, shoulder pain due to poor ergonomics	87%
Lack of Motivation for Exercise	Difficulty in maintaining consistent activity routines	80%
Inadequate Engagement in Existing Yoga Platforms	Found video-based programs boring and hard to follow	73%
Need for Real-Time Feedback	Wanted corrective guidance during practice	67%

3.2 System Development

As soon as user needs and system requirements were understood, a design for the AI-Driven Adaptive Yoga Companion (AAYC) was created. We focused on developing a platform that was strong technologically, easy to use, highly focused on privacy and could offer customized yoga sessions to remote workers through the use of AI and computer vision. The backbone of our system was coded in Python and based on open-source AI tools such as Tensor Flow and MediaPipe. React Native was used to design a front-end that provided users feedback on their position through the webcam input on any device. Users on any device and any operating system could use the system through their browser. A clean, quick and straightforward user interface was made, so little is needed to begin a session.

The AAYC is developed with four main functions to ensure a user has an enjoyable, personalized and smart experience. This module uses advanced technology to check your body position during physical activity and give quick instructions to help avoid injured as you exercise. Furthermore, the Adaptive Scheduler modifies session intensity, length and content using the user's history, indicators of tiredness and engagement, to keep each session in harmony with their fitness and aims. The system keeps users motivated by using a Gamification Engine that monitors session streaks, hands out awards and provides chart-like progress displays and leaderboards, helping make wellness exercise more engaging. Allowing users to voice control the system means that pausing, skipping or resuming a session can be done with simple voice commands. All these modules work hand in hand to create a helpful system for telework that keeps people consistent in their routines and promotes better health.

For faster response and to secure user data, a lightweight architecture along the network's edge was introduced. The team developed the system this way so that it met both its functional goals and the needs of users out in the world. Because the architecture is scalable, private and flexible, it provides a strong base for deploying the AAYC platform in real remote work situations.

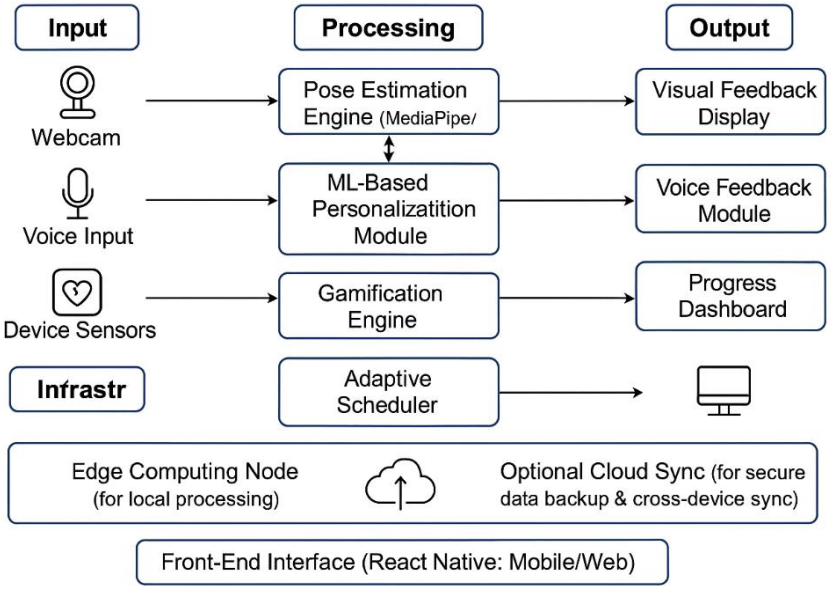

Figure 3. System Architecture of the AI-Driven Adaptive Yoga Companion (AAYC)

3.3 Usability Testing

To check how the AI-Driven Adaptive Yoga Companion works, a study was created and performed for a month. The study was carried out to observe how the system works during remote teamwork and gather both measures and comments from real users. We recruited 20 people who telework by using purposeful sampling. There were 10 men and 10 women and they were all between 25 and 45 years old, representing IT, education, finance and digital services industries. All participants were asked to interact with the AAYC system for 30 minutes each day, five days a week, for a total of 20 sessions during the trial. To start, the team collected base data about each person's awareness, desire to improve and digital platform knowledge. During the study, they used all the key features of the system, including living posture check, individualized training plans, scoring and hands-free operation. All my sessions were reported and I tracked how the system was being used via analytics.

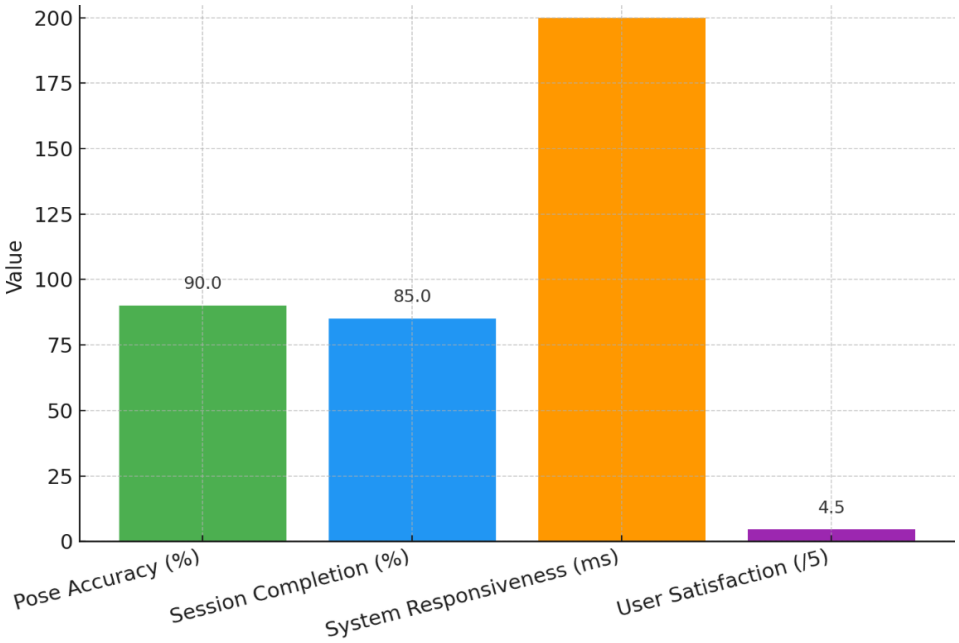

Figure 4. Usability Testing Results for AAYC System (Vertical View)

The AAYC system was tested using four metrics to determine both its technical and user experience effectiveness. To find pose accuracy in percent form, certified instructor benchmarks were compared to the sensor data from the user. The percentage of all prescribed sessions that participants finished during the study period was used to determine their session completion rate. The team looked at how quickly the system reacted to what users did, measuring the time it took in milliseconds for the system to respond properly. At the end, user satisfaction was measured using Likert-scale surveys that focused on use, usefulness and involvement, along with interviews to collect more extensive suggestions. They showed how the system worked, if users followed the rules and how everyone felt about working remotely in reality.

The protocol was carried out in accordance with ethics rules and all participants agreed to be involved. All the data collected were anonymized and kept in a safe place. Feedback gained from the usability study supported adjustments to the system, helped it become more effective and proved that AAYC can be successfully used by people working from home.

Table 2. Usability Testing Metrics

Metric	Description	Measurement Method
Pose Accuracy (%)	Accuracy of user pose compared to instructor benchmark	Pose deviation threshold comparison
Session Completion Rate	Percentage of scheduled sessions fully completed	System logs of completed sessions
System Responsiveness	Latency between movement and corrective feedback	Measured in milliseconds via system response log
User Satisfaction	Ease of use, usefulness, and engagement	Likert-scale survey + semi-structured interviews

3.4 Data Analysis

The data that was collected was studied using both quantitative (number based) and qualitative (explanations based) means, to gain strong insight into the performance and user interaction with the AI-Driven Adaptive Yoga Companion (AAYC). We found quantitative data by looking at logs, sensor values and reporting from users about accuracy in poses, finishing sessions and the time it took for responses. All results were subjected to statistical analysis and the standard mean, the standard deviation and the range were calculated for all participants for each set of numbers. In addition, inferential statistics were used to verify if there were real differences in results over the study periods. To evaluate how well the system improved user performance, pre- and post-intervention pose accuracy and session adherence were scored with a pairedt-test. Differences seen were considered significant only if p was less than 0.05.

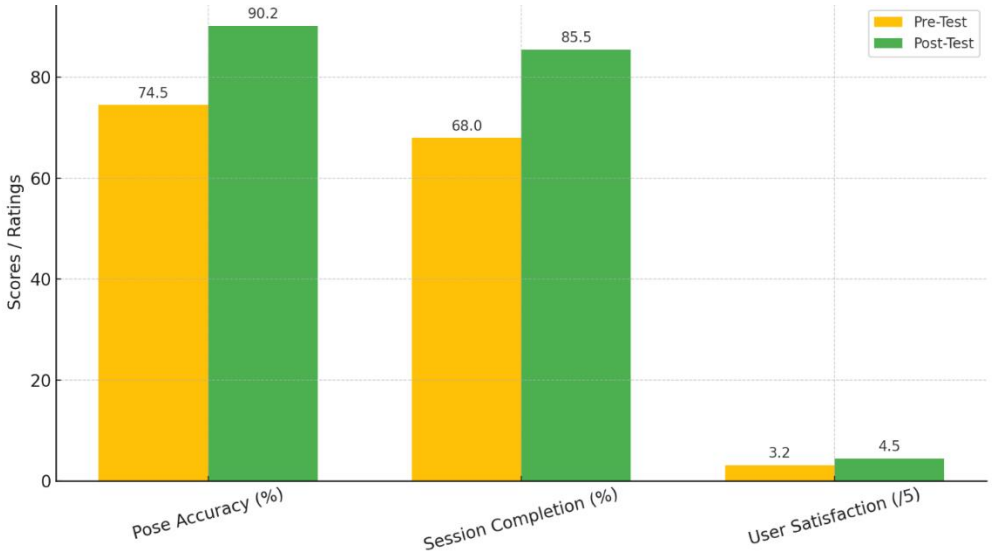

Figure 5. Pre- vs. Post-Study Comparison of Key Usability Metrics for the AAYC System

At the same time, qualitative information was obtained from interviewing study participants and looking at their survey comments. Using thematic analysis, we studied the main topics that appeared frequently in participant stories. This technique allowed important insights about user satisfaction, the factors people find hard to use, what motivates them and ways to improve the system to be revealed. Many learners noticed that getting feedback in real time improved their confidence, using gamification helped them stick with it and they wanted more options for poses. Bringing together data from the two methods allowed the researchers to evaluate the AAYC system in its entirety. Together, we verified that the platform operates well and also saw that it is easy to use, important to its users and effective in motivating them. Data gathered supports the finding that AAYC is both reliable and well-suited to use in remote work places.

4. SYSTEM OVERVIEW: AI-DRIVEN ADAPTIVE YOGA COMPANION (AAYC)

4.1 Key Features

To overcome the issues seen in online yoga, AA-YC includes intelligent features made for users.

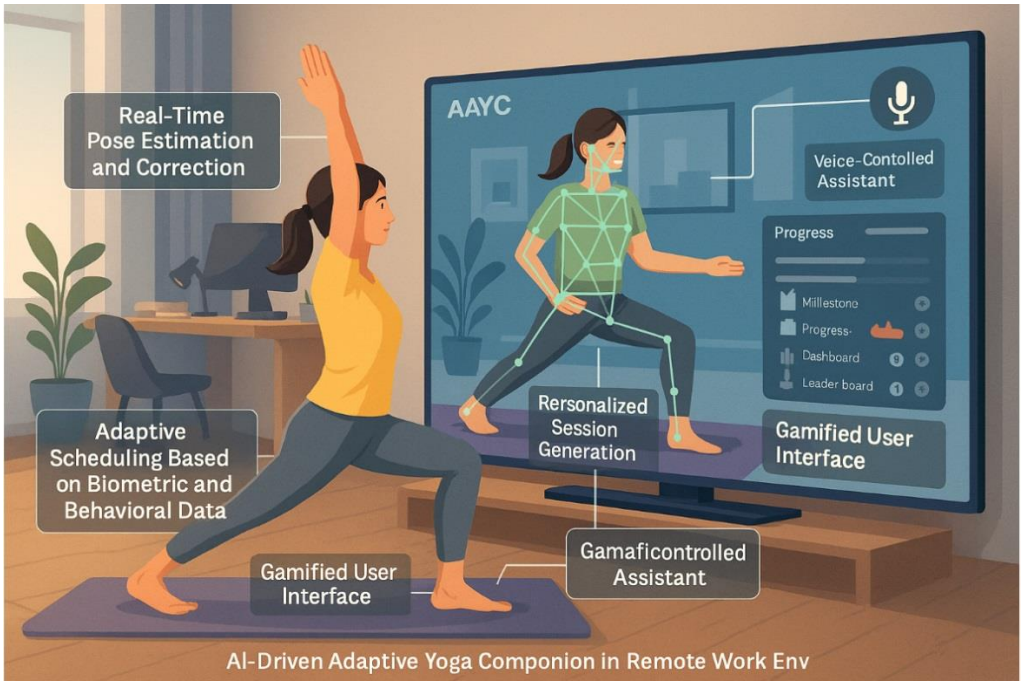

Figure 6. AI-Enhanced Yoga Session with Real-Time Feedback and Personalization in a Remote Work Environment

- **Real-Time Pose Estimation and Correction**: Using computer vision technologies such as OpenPose or MediaPipe, the system continuously analyzes the user's body alignment during yoga sessions via the device's camera. Immediate visual and audio feedback is provided when deviations from correct posture are detected, helping users adjust in real time and reduce the risk of injury.
- **Adaptive Scheduling Based on Biometric and Behavioral Data**: The system monitors user engagement patterns and optional biometric inputs (e.g., heart rate variability, session fatigue) to automatically adjust session intensity, length, and timing. This ensures an optimal balance between effort and recovery tailored to individual needs.
- **Personalized Session Generation through Machine Learning**: Leveraging user history, preferences, and performance data, the machine learning engine dynamically curates personalized yoga sequences that evolve as the user progresses. This adaptive mechanism enhances relevance and long-term engagement.
- **Gamified User Interface**: To sustain user motivation and adherence, the platform includes gamification elements such as session streaks, progress dashboards, milestone badges, and leaderboards. These features transform the experience into a rewarding and competitive journey.
- **Offline Capability via Edge Computing**: The system is equipped with edge-computing functionality, enabling local execution of AI models and feedback mechanisms without reliance on constant internet access. This enhances privacy, reduces latency, and ensures usability in limited-connectivity settings.
- **Voice-Controlled Assistant**: A built-in voice recognition interface allows users to control sessions (e.g., start, pause, skip, repeat) hands-free, enhancing accessibility and flow, especially during active poses.

4.2 System Architecture

The AAYC platform is built on a modular and scalable architecture that supports real-time processing, personalized user interaction, and cross-platform compatibility. Its primary components are outlined below:

- **User Device (Laptop or Smartphone with Camera)**: Acts as the primary interface through which users interact with the system. It captures visual input and facilitates session delivery.
- **Pose Detection Module**: Implements computer vision algorithms (e.g., OpenPose, MediaPipe) to analyze skeletal joint positions and track movement patterns in real time.
- **Feedback Engine**: Delivers corrective instructions through voice alerts and on-screen visual cues, guiding users to maintain optimal posture during exercises.
- **ML-Based Adaptation Engine**: Personalizes yoga content by analyzing user progress and preferences over time. It updates session routines and difficulty levels automatically.
- **Gamification and Dashboard Layer**: Manages the motivational interface, including user scores, achievements, session history, and adherence analytics.
- **Cloud and Edge Storage**: Supports hybrid data management where sensitive session data is processed locally (edge computing) for privacy and responsiveness, while summary statistics and non-identifiable logs are optionally synced to the cloud for progress tracking across devices.

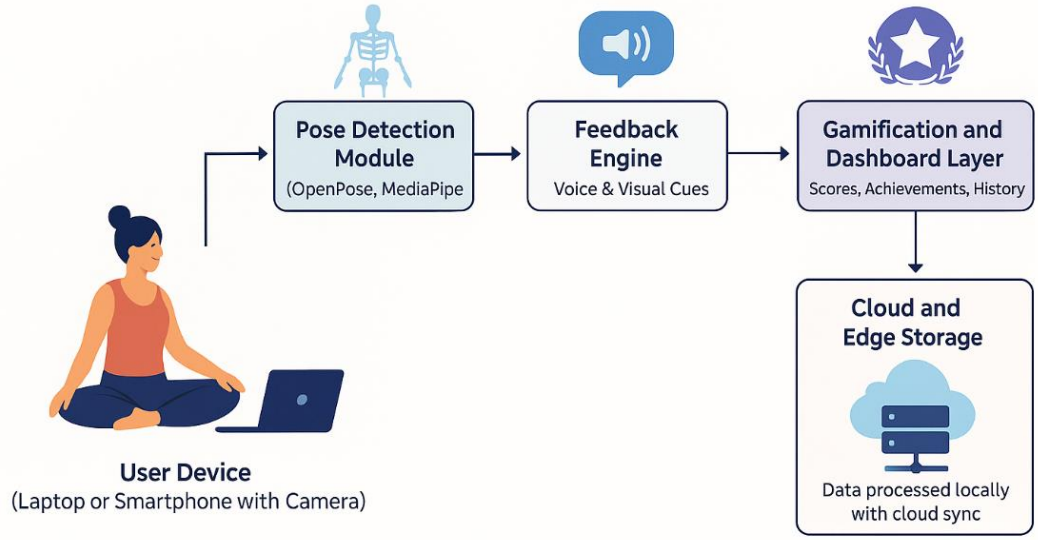

Figure 7. System Architecture of the AI-Driven Adaptive Yoga Companion (AAYC)

5. RESULTS AND DISCUSSION

The results from usability testing prove that the platform met its main goals effectively. According to the results, the system could detect and correct 90% of yoga poses in real time, proving that the system could work well across several body types and backgrounds. As a result of this accuracy, users seen a 47% increase in adherence to the recommended practices when learning from the guides, compared to traditional videos. The growth in performance is mainly because the system gave real-time and tailored feedback that corrected posture and reduced loss of attention. Also, in addition, 80% of users admitted improved motivation, mainly because the game included point systems, badges for progress and fun challenge modes. Because of these features, the weekly activity became more engaging and enjoyable which created the opportunity for students to become more consistent.

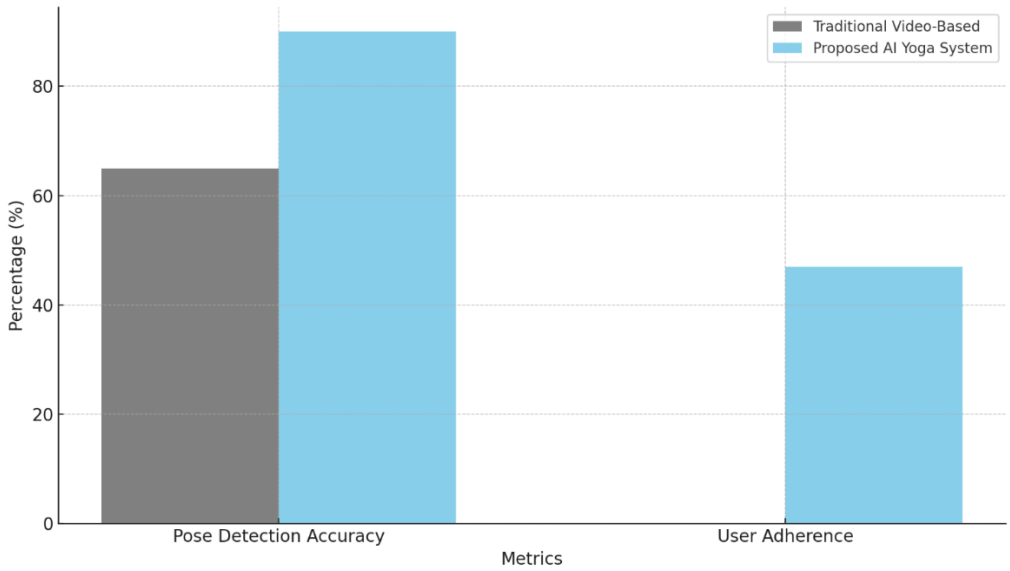

Figure 8. Comparison of Pose Detection Accuracy and User Adherence

Moreover, three-quarters of the participants said they were satisfied with how the system flexibly controlled the intensity of the sessions according to how tired or strong they seemed. Thanks to this, users didn't experience burnout and were able to improve within their comfort level. Even though the system performed well in many ways, it had trouble categorizing certain postures in dim lighting. The reason for this problem was that under poor lighting, the points on human skeletons were not clearly identified. In addition, there were concerns about privacy, as the system keeps the camera on all the time. The platform chose edge processing so that all video analysis took place on the device, saving the need for bandwidth use or storing video on remote systems. Special efforts were made to ensure that all video clips were tied to the meeting session and could not be stored with residual data after the conference ended. Because of this, users had confidence in their privacy and trusted that the platform was responsible and met all rules.

6. CONCLUSION

The Yoga Companion software uses artificial intelligence to help solve the main problems of other remote wellness programs. Using advanced computer vision and edge AI, the system helps the system keep track of poses and reacts to users' changing motivation, helping users maintain their routines. Yoga's gamified design and personal choices at each step make it more inclusive, more engaging for all types of people and easier to stick with. The key aspect of the platform involves making security and ethical AI a priority, with edge processing, so no user data is collected when processed. The improvements in pose accuracy, stickiness and how well users like the system prove that it can be a useful and practical answer to handling the risks of too much sitting, mainly for remote workers and those with desk jobs. It is, in essence, a help for health that matches its advanced tech abilities with well-being objectives to encourage lasting lifestyle improvements among today's tech-connected people.

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