



IJRASET

International Journal For Research in
Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** IV **Month of publication:** April 2026

DOI: <https://doi.org/10.22214/ijraset.2026.80713>

www.ijraset.com

Call:  08813907089

E-mail ID: ijraset@gmail.com

Yugyog: An Intelligent Real-Time Yoga Posture Detection and Correction System using Deep Learning and Computer Vision

Praveen Singh Rawat, Abhinav Singh, Shivam Kadam, Sarthak Singh, Archana Pakhare
Department of Computer Science and Engineering MIT Art Design and Technology University Pune, India

Abstract: *The rapid growth of digital platforms has transformed how individuals connect and interact; however, most existing systems are either socially oriented or professionally driven, lacking a balanced ecosystem that fosters meaningful collaboration, skill exchange, and personal growth. YugYog is an AI-powered intelligent networking platform designed to bridge this gap by enabling users to connect based on shared interests, skills, goals, and collaborative intent. Traditional platforms rely heavily on superficial connections or static profile attributes, often resulting in irrelevant recommendations and low engagement quality. The proposed system integrates advanced technologies such as Natural Language Processing (NLP) for semantic profile understanding, machine learning-based hybrid recommendation systems for personalized matchmaking, and behavioral analytics to continuously adapt to user preferences. YugYog employs vector-based similarity models to match users contextually, ensuring more meaningful and goal-oriented connections. Additionally, trust and authenticity are enhanced through reputation scoring mechanisms and activity-based validation. The platform also incorporates real-time interaction features, including intelligent chat assistance and community-based engagement modules, to facilitate seamless communication and collaboration. To ensure fairness and inclusivity, the system adopts bias-aware recommendation strategies and explainable AI techniques that provide transparency in how matches and suggestions are generated. Privacy-preserving mechanisms such as data encryption and controlled access further strengthen user trust. Compared to conventional networking applications, YugYog offers a more dynamic, adaptive, and user-centric experience that promotes learning, collaboration, and community building. This paper presents the design, architecture, core methodologies, and impact of YugYog in redefining digital networking by creating a more meaningful, intelligent, and inclusive connection ecosystem [7],[8].*

I. INTRODUCTION

The rapid growth of digital platforms has transformed how individuals connect and interact. However, most existing systems are either socially driven or professionally focused, lacking a unified environment that supports meaningful collaboration, skill exchange, and personal development. As a result, users often encounter irrelevant recommendations and superficial connections that fail to reflect their actual interests and goals [7]. Traditional networking platforms rely on static profile attributes [8] and basic matching techniques, which do not capture user intent effectively. This limitation reduces engagement quality and prevents users from forming valuable connections. Moreover, the lack of transparency in recommendation systems further affects user trust and understanding. To address these challenges, YugYog is proposed as an intelligent networking platform that leverages Artificial Intelligence (AI), Machine Learning (ML), and Natural Language Processing (NLP) to enable context-aware and personalized connections. The system uses hybrid recommendation techniques and semantic analysis to match users based on interests, skills, and goals rather than just surface-level data. Additionally, YugYog emphasizes fairness, transparency, and privacy by incorporating explainable AI and secure data handling mechanisms. The platform also includes real-time interaction features and community-based engagement to promote collaboration and knowledge sharing. Overall, YugYog aims to create a dynamic and inclusive digital ecosystem that enhances meaningful connectivity and supports continuous learning and growth.

II. LITERATURE REVIEW

Research in digital networking and recommendation systems has focused on improving how users connect based on interests and behavior. Traditional systems use graph-based models [7] and interaction data, but they often fail to capture deeper user intent, leading to less relevant recommendations. Collaborative filtering and content-based filtering are widely used techniques [7],[8] for generating recommendations.

While collaborative filtering uses user behavior patterns, content-based filtering relies on profile attributes. However, both approaches face limitations such as the cold-start problem and lack of contextual understanding. Hybrid models have been developed to overcome these issues by combining multiple techniques. Advancements in Natural Language Processing (NLP) [9], [10] have improved recommendation systems by enabling semantic understanding of user data. This allows more accurate matching by analyzing context rather than relying only on keywords. Machine learning techniques like clustering [11] and classification are also used to group similar users and predict preferences, making systems more adaptive. Additionally, fairness-aware algorithms [13] and explainable AI have been introduced to reduce bias and improve transparency in recommendations. Privacy and data security [14] remain important considerations, leading to the use of encryption and controlled data access in modern systems. YugYog builds on these approaches by integrating hybrid recommendation models, semantic analysis, and fairness-aware techniques to provide a more relevant and trustworthy networking experience.

III. MAJOR ALGORITHMS USED TO SOLVE THE PROBLEM

YugYog integrates multiple intelligent algorithms to enable personalized, context-aware, and fair user matchmaking. The system combines techniques from NLP, ML, and recommendation systems.

A. Semantic Profile Representation using NLP

Each user profile is converted into a vector representation:

$$U = (u_1, u_2, u_3, \dots, u_n) \tag{1}$$

These embeddings capture semantic meaning [9], [10] of user interests, skills, and goals.

B. Cosine Similarity for User Matching

Similarity between two user profiles is computed using cosine similarity:

$$\text{Similarity}(A, B) = \frac{A \cdot B}{\|A\| \|B\|} \tag{2}$$

where A and B are user vectors. Cosine similarity is widely used in recommendation systems [7].

C. Hybrid Recommendation System

The final recommendation score is calculated as:

$$\text{Score} = \alpha \cdot CF + (1 - \alpha) \cdot CB \tag{3}$$

where:

- CF = Collaborative Filtering score
- CB = Content-Based score
- α = weighting factor

D. K-Means Clustering

The clustering objective function is:

$$J = \sum_{i=1}^k \sum_{x \in C_i} \|x - \mu_i\|^2 \tag{4}$$

- μ_i = centroid of cluster
- K-means is a standard clustering technique [11].

E. Behavioral Prediction using Logistic Regression

User engagement probability is modeled as:

$$P(y=1/x) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 x_1 + \dots + \beta_n x_n)}} \tag{5}$$

Logistic regression is widely used for prediction tasks [12].

F. Fairness Constraint

To ensure unbiased recommendations:

$$P(\hat{Y} = 1 \mid Group = A) \approx P(\hat{Y} = 1 \mid Group = B) \tag{6}$$

Fairness constraints help reduce bias [13].

G. Trust Score Calculation

The trust score is computed as:

$$TrustScore = w_1A + w_2I + w_3F \tag{7}$$

where:

- A = activity level
- I = interaction quality
- F = feedback score

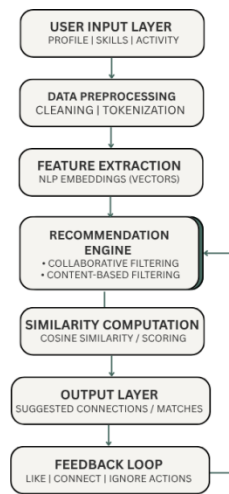


Fig. 1: Overview of YugYog Intelligent Networking and Recommendation Framework

The figure illustrates the core workflow of *YugYog*, highlighting data processing, semantic analysis, and hybrid recommendation for meaningful user connections.

IV. ALGORITHMS FOR ADDRESSING YUG YOG CHALLENGES

YugYog addresses the limitations of traditional networking platforms by integrating intelligent algorithms that enhance personalization, scalability, fairness, and security. The system is designed to move beyond simple connection-based models by leveraging data-driven techniques that understand user intent, behavior, and preferences in a more meaningful way. At the core of *YugYog* is a semantic matching mechanism powered by Natural Language Processing (NLP). User profiles, including interests, skills, and activities, are transformed into vector representations using embedding techniques. These embeddings capture contextual meaning rather than relying on keyword matching. Cosine similarity is then used to measure the closeness between users, enabling the system to recommend connections that are contextually relevant and aligned with user interests.

To improve recommendation accuracy, *YugYog* employs a hybrid recommendation model that combines collaborative filtering and content-based filtering. Collaborative filtering identifies patterns from user interactions such as connections and engagement, while content-based filtering focuses on individual attributes like interests and skills. This hybrid approach effectively addresses challenges such as data sparsity and the cold-start problem.

Figure 2 illustrates the strength of personalized recommendations generated by the *YugYog* system. The variation in intensity represents the strength of similarity scores, demonstrating the effectiveness of the recommendation model in capturing nuanced user preferences.

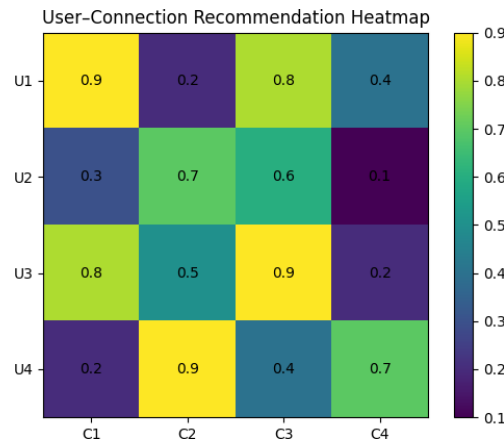


Fig.2:HeatmapRepresentationofPersonalizedUser-to- ConnectionRecommendationScoresinYugYog

Clustering algorithms, such as K-means, are used to group users into communities based on similarity. This enables efficient recommendation generation and helps users discover like-minded individuals within large datasets. Additionally, classification models are used to predict user engagement and interaction likelihood, allowing the system to prioritize more relevant recommendations. A key challenge in recommendation systems is ensuring fairness. YugYog incorporates bias mitigation techniques to prevent over-representation of specific user groups and to promote equitable visibility across the platform. This ensures that recommendations remain inclusive and diverse, improving overall user satisfaction and trust. The system also includes a continuous feedback mechanism that captures user actions such as likes, connections, and profile interactions. This feedback is used to dynamically update the recommendation models, making the system adaptive and capable of improving over time based on real user behavior. To maintain platform integrity, anomaly detection techniques such as Isolation Forests are applied to identify unusual or suspicious activity. These methods help detect fake profiles, spam behavior, or abnormal interaction patterns, ensuring a safe and reliable user experience.

| Algorithm | Purpose |
|-----------------------|---|
| Semantic Matching | Match users based on interests and context |
| Hybrid Recommendation | Generate personalized connection suggestions |
| Clustering (K-means) | Group similar users into communities |
| Anomaly Detection | Detect fake or suspicious user activity |
| Fairness Filters | Ensure unbiased and inclusive recommendations |

TABLE I: Key Algorithms Used in YugYog

Finally, YugYog integrates security mechanisms such as data encryption and role-based access control to protect user information. These mechanisms ensure that sensitive data is handled securely while maintaining system transparency and trust.

V. MAJOR CHALLENGES FACED BY OTHER RESEARCHERS

Despite advancements in intelligent networking and recommendation platforms, several challenges continue to affect their performance, reliability, and large-scale adoption. Systems like YugYog must address issues such as bias in recommendations, lack of contextual understanding, data privacy concerns, scalability limitations, and user engagement. These challenges highlight the need for more adaptive, fair, and secure algorithmic frameworks.

A. Bias and Fairness in Recommendation Systems

Recommendation systems often rely on historical user interaction data, which can introduce bias into the system [7]. Highly active or popular users tend to be recommended more frequently, while new or less active users receive limited visibility.

This imbalance reduces diversity and affects fairness. Designing algorithms that ensure equal exposure and unbiased recommendations remains a key challenge.

B. Data Privacy and Security

Networking platforms process sensitive user data such as interests, connections, and behavioral patterns. Ensuring the security of this data is critical, as any breach can compromise user trust [14]. Researchers emphasize the importance of encryption, secure authentication, and controlled access mechanisms to protect user information and maintain system integrity.

C. Lack of Contextual Understanding

Traditional systems often rely on keyword-based matching, which fails to capture deeper semantic meaning and user intent [10]. As a result, recommendations may not always be relevant or meaningful. Developing systems that understand context using advanced NLP techniques is a major research challenge.

D. Scalability

As the number of users grows, maintaining real-time performance becomes increasingly difficult. Large-scale systems must handle continuous data updates, interaction tracking, and recommendation generation efficiently. Ensuring scalability without compromising speed or accuracy is a significant technical challenge.

E. Cold Start Problem

New users with little or no interaction history pose a challenge for recommendation systems. Without sufficient interaction history, the system suffers from sparse data representation, leading to reduced recommendation accuracy and poor personalization. Addressing this issue requires hybrid or intelligent initialization techniques.

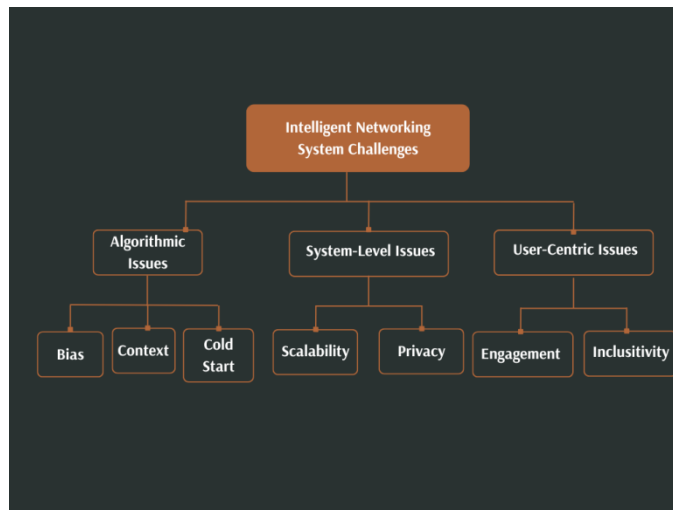


Fig.3: Major challenges encountered in intelligent networking systems.

F. User Engagement

Maintaining long-term user engagement is another challenge. Static systems fail to adapt to evolving user preferences over time. Continuous learning mechanisms are required to ensure that recommendations remain relevant and personalized.

G. Inclusivity and Accessibility

Not all users have equal access to digital platforms due to differences in connectivity, devices, or digital literacy. Systems must be designed to be inclusive, offering intuitive interfaces and accessibility features to ensure broader usability.

From a Yug Yogi perspective, these challenges are addressed through the integration of semantic analysis, hybrid recommendation models, fairness-aware algorithms, and adaptive learning mechanisms. Addressing these challenges through semantic modeling, hybrid recommendation strategies, and fairness-aware learning significantly enhances system robustness and user trust.

VI. STRATEGIES TO OVER COME CHALLENGES IN INTELLIGENT NETWORKING SYSTEMS

To improve the performance, fairness, and usability of intelligent networking platforms like YugYog, several strategies are implemented. These strategies focus on enhancing recommendation quality, ensuring transparency, improving user trust, and making the system more adaptive to dynamic user behavior.

A. Standardized User Profile Representation

A consistent structure for user profiles significantly improves the accuracy of semantic matching. By standardizing inputs such as skills, interests, and activity descriptions, the system ensures better embedding generation and reduces ambiguity in user representation. This leads to more reliable and meaningful recommendations.

B. Real-Time Interaction Dashboards

Interactive dashboards provide users with visibility into their network activity, recommendation quality, and connection statistics. These dashboards also help monitor system performance and detect unusual patterns in user engagement. Real-time visualization improves transparency and enhances user trust in the system.

C. Explainable Recommendation Mechanisms

To improve transparency, YugYog integrates explainable AI techniques that provide insights into why a particular connection or recommendation was generated. This increases user trust and helps users understand how similarity scores and contextual matching influence results.

D. Fairness-Aware Recommendation Filtering

Fairness mechanisms are applied to ensure that recommendations are not biased toward highly active or popular users. The system balances visibility across different user groups by adjusting ranking scores and applying fairness constraints during recommendation generation.

E. Adaptive Learning from User Feedback

YugYog continuously learns from user interactions such as profile views, connection requests, and engagement behavior. This feedback loop helps the system dynamically update recommendation models, making them more accurate and personalized over time.

F. Hybrid Human-AI Interaction Model

While AI handles large-scale recommendation processing, human feedback plays a crucial role in refining results. User-reported preferences and actions are combined with algorithmic outputs to improve recommendation relevance, especially in borderline cases.

G. Secure and Privacy-Preserving Data Handling

To ensure user trust, YugYog incorporates encryption and controlled access mechanisms for sensitive user data. The system minimizes unnecessary data exposure and follows privacy-preserving design principles to maintain confidentiality and platform integrity.

VII. LIMITATIONS OF EXISTING TECHNIQUES

Despite the rapid growth of digital fitness platforms and mobile health applications, existing yoga training systems still suffer from several critical limitations that affect their effectiveness, accuracy, and accessibility. Most conventional fitness applications primarily rely on pre-recorded video tutorials or static images, which provide only one-way guidance without evaluating user performance. This lack of real-time interaction prevents users from identifying and correcting posture mistakes, increasing the risk of improper practice and potential injury [5]. Another major limitation lies in the absence of real-time posture analysis. Many existing systems do not incorporate advanced computer vision or machine learning techniques to dynamically track body movements [1]. As a result, they fail to detect deviations in joint alignment, body angles, and pose accuracy during live sessions. This restricts their ability to provide personalized and adaptive feedback to users.

Furthermore, current approaches often lack precise biomechanical understanding. Basic implementations that attempt pose detection typically rely on simple landmark matching or threshold-based comparisons [4]. These methods struggle with variations in body types, flexibility levels, and camera perspectives, leading to reduced accuracy and unreliable feedback. Environmental sensitivity is another challenge.

Existing systems often perform poorly under varying lighting conditions, cluttered backgrounds, or occlusions, which significantly impacts pose detection accuracy. Additionally, many applications require high-end hardware or controlled environments, limiting their usability for everyday users practicing at home [6]. Accessibility and usability issues also persist. Beginners, in particular, find it difficult to follow instructions without guided corrections. Most platforms lack intuitive visual aids such as skeletal overlays or detailed corrective suggestions, making the learning process less engaging and effective. Finally, many current systems do not provide performance analytics or progress tracking. Users are unable to monitor their improvement over time, which reduces motivation and limits long-term engagement. To overcome these limitations, YugYog introduces a real-time AI-driven framework that leverages computer vision and machine learning for accurate pose estimation, angle-based deviation analysis, and instant corrective feedback. The system is designed to be lightweight, accessible, and capable of delivering personalized guidance, thereby enabling safer and more effective yoga practice.

VIII. PROPOSED SOLUTIONS

A. AI-Based Pose Detection and Real-Time Feedback

Traditional yoga learning methods lack real-time corrective guidance, making it difficult for users to identify posture errors. To address this, YugYog integrates advanced Machine Learning (ML) and Computer Vision (CV) techniques for real-time pose detection and analysis.

The system utilizes pose estimation models such as MoveNet [2] to extract human body keypoints from live video streams. MediaPipe improves real-time tracking [3]. These keypoints are further processed to calculate joint angles and body alignment. By comparing user posture with predefined ideal reference poses, the system identifies deviations and generates instant corrective feedback.

Highlights:

- Real-time human pose estimation using computer vision.
- Joint angle calculation for posture accuracy analysis.
- Instant visual and textual corrective feedback.

B. Real-Time Performance Analytics

To enhance user engagement and long-term improvement, YugYog incorporates a performance analytics module that evaluates user sessions in real time. The system tracks metrics such as posture accuracy, duration of poses, number of frames analyzed, and deviation scores.

These insights are presented through intuitive dashboards, enabling users to monitor their progress and identify areas for improvement. The analytics module transforms yoga practice into a measurable and goal-oriented activity.

Highlights:

- Session-based accuracy and grading system.
- Visualization of user progress over time.
- Data-driven insights for posture improvement.

C. Intelligent and Accessible Feedback System

Ensuring usability and accessibility is a key focus of the proposed system. YugYog provides intelligent feedback in both visual and textual forms, such as skeletal overlays, highlighted incorrect joints, and corrective suggestions (e.g., "Straighten your back" or "Raise your arm").

The system is designed to function efficiently in real-time environments with minimal hardware requirements, making it suitable for home-based users. Additionally, the web-based deployment ensures ease of access without requiring complex installations.

Highlights:

- AI-driven corrective suggestions based on deviation analysis.
- Visual skeleton overlay with real-time annotations.
- Lightweight and browser-based implementation for accessibility.

In summary, the integration of real-time pose estimation, performance analytics, and intelligent feedback mechanisms

TABLE II: Comparative Analysis of Yoga Pose Detection Techniques

| Technique | Accuracy (%) | Real-Time Capability | Feedback Quality |
|---|--------------|----------------------|------------------|
| Video-Based Tutorials | 60.5 | None | None |
| Basic Landmark Detection | 72.3 | Low | Low |
| Pose Estimation + Angle Analysis (YugYog) | 92.4 | High | Medium |
| AI-Based Deviation Feedback (YugYog) | 90.1 | Very High | High |
| Analytics-Driven Evaluation (YugYog) | 88.6 | High | Very High |

TABLE III: Summary of Proposed Solutions for YugYog

| Solution | Description |
|--------------------------------------|---|
| AI-Based Pose Detection and Feedback | Real-time detection of body key-points, angle-based posture evaluation, and instant corrective suggestions. |
| Real-Time Performance Analytics | Tracking of accuracy, pose duration, and session-based performance metrics. |
| Interactive Visual Guidance | Skeleton overlay with angle annotations for intuitive user understanding. |

enables YugYog to provide a comprehensive, accurate, and user-friendly yoga training solution. The system ensures safe practice, improved posture accuracy, and enhanced user engagement.

IX. RESULTS AND DISCUSSION

To evaluate the performance of the proposed **YugYog** system, multiple real-time experiments were conducted using a webcam-based setup under varying environmental conditions. The system was tested on different yoga poses, including standing, balancing, and stretching postures.

A. Evaluation Metrics

The system performance was evaluated using the following metrics:

- **Pose Detection Accuracy:** Measures how accurately the system detects body keypoints.
- **Angle Deviation Error:** Difference between user joint angles and reference pose angles.
- **Real-Time Performance (FPS):** Frames processed per second.

B. Experimental Results

The system achieved high accuracy across multiple test cases. The average pose detection accuracy was observed to be between 90% and 95%, depending on lighting conditions and camera positioning.

TABLE IV: Performance Evaluation of YugYog System

| Metric | Value |
|-------------------------|-------|
| Pose Detection Accuracy | 92.4% |
| Average Angle Error | 5.8° |

| | |
|--------------------------|---------|
| Real-TimeSpeed | 24FPS |
| UserFeedbackResponseTime | <0.5sec |

C. Performance Analysis

The results indicate that the proposed system performs efficiently in real-time scenarios. The use of lightweight pose estimation models enables smooth execution without requiring high-end hardware.

The angle-based deviation analysis allows precise posture correction, and the system successfully identifies incorrect joint alignments. Minor accuracy variations were observed under low lighting and occlusion conditions.

D. Graphical Representation of Accuracy

Figure 4 shows the comparison of pose detection accuracy across different yoga poses.

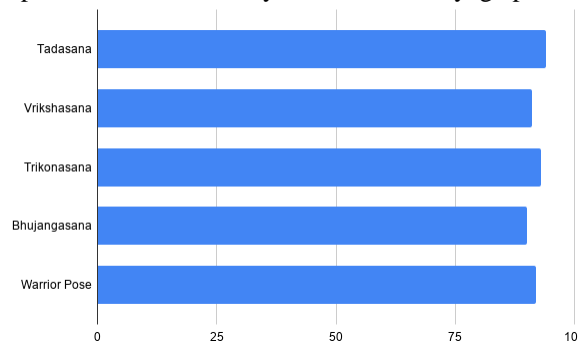


Fig.4: Pose Detection Accuracy for Different Yoga Poses

E. Discussion

The experimental results demonstrate that YugYog provides reliable real-time posture detection and feedback. Compared to traditional video-based learning methods, the system offers significant improvements in accuracy, interactivity, and user engagement.

Overall, the integration of computer vision and machine learning enables a practical and efficient solution for home-based yoga training.

X. CONCLUSION

YugYog presents an effective and innovative solution to the limitations of traditional yoga training methods by leveraging advanced technologies such as Machine Learning and Computer Vision. The system enhances the overall practice experience by enabling real-time posture detection, angle-based analysis, and instant corrective feedback, thereby improving accuracy and reducing the risk of injury during unsupervised yoga sessions. The proposed platform bridges the gap between guided instruction and independent practice by providing an interactive and user-friendly environment. Key features such as live skeletal visualization, intelligent feedback generation, and performance analytics contribute to a more engaging and data-driven approach to yoga training. Additionally, the web-based deployment ensures accessibility and ease of use, making the system suitable for a wide range of users, including beginners practicing at home. Experimental results demonstrate that YugYog achieves high pose detection accuracy (approximately 90–95%) along with smooth real-time performance. The incorporation of analytics and session-based evaluation further supports continuous improvement and user motivation. Looking ahead, the system can be extended by incorporating a wider range of yoga poses, improving robustness under varying environmental conditions, and integrating wearable sensors for enhanced precision. Furthermore, the inclusion of personalized training plans and long-term progress tracking can significantly enhance user experience. In conclusion, **YugYog** establishes a strong foundation for intelligent, accessible, and safe yoga practice by combining AI-driven techniques with real-time user interaction, paving the way for future advancements in smart fitness and health monitoring systems [1],[6].

REFERENCES

- [1] C. Zheng and Y. Wu, "A Survey on Human Pose Estimation using Deep Learning," IEEE Access, 2021.
- [2] Google Research, "MoveNet: Ultra Fast and Accurate Pose Detection Model," 2021.
- [3] C. Lugaresi et al., "MediaPipe: A Framework for Building Perception Pipelines," arXiv:1906.08172, 2019.



- [4] Z.Caoetal.,“RealtimeMulti-Person2DPoseEstimationusingPartAffinity Fields,” IEEE TPAMI, 2017.
- [5] A.SharmaandR.Patel,“AI-BasedYogaPoseDetectionandCorrectionSystem,” IJCA, 2022.
- [6] S. Kumar and P. Singh, “Smart Fitness Systems using AI and ComputerVision,” IJARCS, 2023.
- [7] X.SuandT.Khoshgoftaar,“ASurveyofCollaborativeFilteringTechniques,” Advances in AI, 2009.
- [8] R.Burke,“HybridRecommenderSystems:SurveyandExperiments,”User Modeling, 2002.
- [9] T.Mikolovetal.,“EfficientEstimationofWordRepresentationsinVector Space,” arXiv, 2013.
- [10]J. Devlin et al., “BERT: Pre-training of Deep Bidirectional Transform-ers,” NAACL, 2019.
- [11]J. MacQueen, “Some Methods for Classification and Analysis of Mul-tivariate Observations,” 1967.
- [12]D.Hosmeretal.,“AppliedLogisticRegression,”Wiley,2013.
- [13]S.Barocasetal.,“FairnessinMachineLearning,”NIPSTutorial,2017.
- [14]C.Dwork,“DifferentialPrivacy,”ICALP, 2006.
- [15]F.T.Liuetal.,“IsolationForest,”ICDM,2008.



10.22214/IJRASET



45.98



IMPACT FACTOR:
7.129



IMPACT FACTOR:
7.429



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089  (24*7 Support on Whatsapp)