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

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Abstract: The rapid growth of digital platforms has trans- formed how individuals connect and interact; however, most existing systems are either socially oriented or professionally driven, lacking a balanced ecosystem that fosters meaningful collaboration,skillexchange,andpersonalgrowth.YugYogisan 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 heavilyonsuperficialconnectionsorstaticprofileattributes,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-basedsimilaritymode lstomatchusers contextually, ensur- ingmoremeaningfulandgoal-orientedconnections.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 recom- mendation 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 presentsthedesign,architecture,coremethodologies,andimpact of YugYog in redefining digital networking by creating a more meaningful, intelligent, and inclusive connection ecosystem [7],[8].

I. INTRODUCTION

Therapidgrowthofdigitalplatformshastransformed howindividualsconnectandinteract.However,mostexisting systems are either socially driven or professionally focused, lacking a unified environment that supports meaningful col- laboration, 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 profileattributes[8] andbasicmatchingtechniques,which do not capture user intent effectively. This limitation reduces engagement quality and prevents users from forming valuable connections.Moreover,thelackoftransparencyinrecommen- dationsystemsfurther affectsusertrustandunderstanding.To addressthesechallenges,YugYogisproposedasanintelligent networking platformthat leverages ArtificialIntelligence(AI), Machine Learning (ML), and Natural Language Processing (NLP) to enable context-aware and personalized connections. The system uses hybrid recommendation techniques and se- mantic analysis to match users based on interests, skills, and goalsratherthanjustsurface-leveldata.Additionally,YugYog emphasizes fairness, transparency, and privacy by incorpo- rating explainable AI and secure data handling mechanisms. The platform also includes real-time interaction features and community-based engagement to promote collaboration and knowledgesharing.Overall,YugYogaimstocreateadynamic and inclusive digital ecosystem that enhances meaningful connectivity and supports continuous learning and growth.

II. LITERATURE REVIEW

Research in digital networking and recommendation sys- temshasfocusedonimprovinghowusersconnectbased 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 recommen- dations. Collaborativefilteringandcontent-basedfilteringare widely used techniques [7],[8] for generating recommenda- tions.

Whilecollaborativefilteringusesuserbehaviorpatterns, content-basedfilteringreliesonprofileattributes.However, bothapproachesfacelimitationssuchasthecold-startproblem and lack of contextual understanding. Hybrid models have been developed to overcome these issues by combining multi- pletechniques.AdvancementsinNaturalLanguageProcessing (NLP)[9],[10]haveimprovedrecommendationsystemsby 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]andclassificationarealsousedtogroupsimilar users and predict preferences, making systems more adaptive. Additionally, fairness-aware algorithms [13] and explainable AI have been introduced to reduce bias and improve trans- parencyinrecommendations.Privacyanddatasecurity[14]re- mainimportantconsiderations,leadingtotheuseofencryption 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 experi- ence.

III. MAJOR ALGORITHMS USED TO SOLVETHE PROBLEM

YugYogintegrates multiple intelligent algorithms to enable personalized, context-aware, and fair user matchmaking. The system combines techniques from NLP, ML, and recommen- dation systems.

A. SemanticProfileRepresentationusingNLP

Eachuserprofileisconvertedintoavectorrepresentation:

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

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

B. CosineSimilarityforUserMatching

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$B$areuservectors.Cosinesimilarityiswidely used in recommendation systems [7].

C. HybridRecommendationSystem

Thefinalrecommendationscoreiscalculatedas:

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

where:

- CF=CollaborativeFilteringscore
- CB=Content-Basedscore
- α=weightingfactor

D. K-MeansClustering

Theclusteringobjectivefunctionis:

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

- μ_i=centroidofcluster

K-meansisastandardclusteringtechnique[11].

E. BehavioralPredictionusingLogisticRegression

Userengagementprobabilityismodeledas:

$$P(y=1|x)=\frac{1}{1+e^{-(\beta_0+\beta_1x_1+\cdots+\beta_nx_n)}} \tag{5}$$

Logisticregressioniswidelyusedforpredictiontasks[12].

F. FairnessConstraint

Toensureunbiasedrecommendations:

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

Fairness constraints help reduce bias [13].

G. TrustScoreCalculation

Thetrustscoreiscomputedas:

$$TrustScore = w_1A + w_2I + w_3F \quad (7)$$

where:

- A=activitylevel
- I= interactionquality
- F=feedbackscore

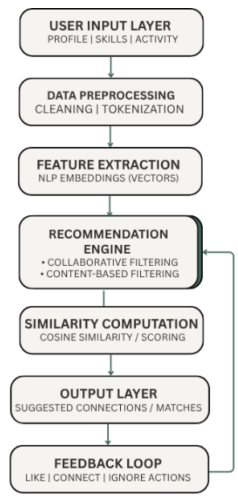

Fig. 1: Overview of YugYog Intelligent Networking and Rec- ommendation Framework

The figure illustrates the core workflow of *YugYog*, high- lighting data processing, semantic analysis, and hybrid rec- ommendation 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 pro- files, including interests, skills, and activities, are transformed intovectorrepresentationsusingembeddingtechniques.These embeddings capturecontextual meaningratherthanrelyingon keyword matching. Cosine similarity is then used to measure the closeness between users, enabling the system to recom- mend connections that are contextually relevant and aligned with user interests.

Toimproverecommendationaccuracy,YugYogemploys a hybrid recommendation model that combines collaborative filtering and content-based filtering. Collaborative filtering identifies patterns from user interactions such as connections andengagement,whilecontent-basedfilteringfocusesonindi- vidualattributeslikeinterestsandskills.Thishybridapproach effectively addresses challenges such as data sparsity and the cold-start problem.

Figure 2 illustrates the strength of personalized recommen- dationsgeneratedbytheYugYogsystem.Thevariationin intensity represents the strength of similarity scores, demon- strating the effectiveness of the recommendation model in capturing nuanced user preferences.

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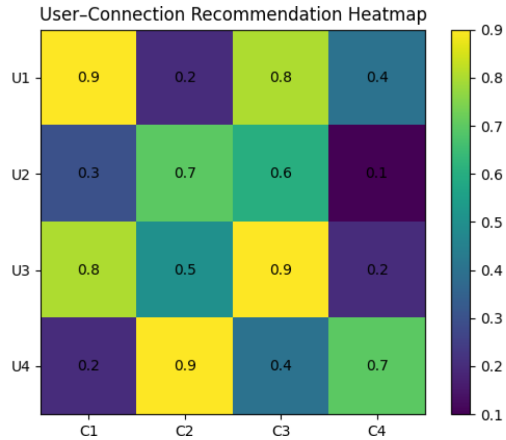

Fig.2:HeatmapRepresentationofPersonalizedUser-to- ConnectionRecommendationScoresinYugYog

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, classificationmodelsareusedtopredictuserengagementand interaction likelihood, allowing the system to prioritize more relevant recommendations. A key challenge in recommenda- tion systems is ensuring fairness. YugYog incorporates bias mitigationtechniquestopreventover-representationofspecific user groups and to promote equitable visibility across the platform.Thisensuresthatrecommendationsremaininclusive 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.Thisfeedbackisusedtodynamicallyupdate 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
SemanticMatching	Matchusersbasedoninterestsandcontext
HybridRecommendation	Generatepersonalizedconnectionsuggestions
Clustering(K-means)	Groupsimilarusersintocommunities
AnomalyDetection	Detectfakeorsuspicioususeractivity
FairnessFilters	Ensureunbiasedandinclusiverecommendations

TABLEI:KeyAlgorithmsUsedinYugYog

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 rec- ommendation platforms, several challenges continue to affect their performance, reliability, and large-scale adoption. Sys- tems like YugYog must address issues such as bias in rec- ommendations, 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. BiasandFairnessinRecommendationSystems

Recommendation systems often rely on historical user in- teraction 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.

Thisimbalancereducesdiversityandaffectsfairness. Designingalgorithmsthatensureequalexposureandunbiased recommendations remains a key challenge.

B. DataPrivacyandSecurity

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 compro-miseusertrust[14].Researchersemphasizetheimportance ofencryption,secureauthentication,andcontrolledaccess mechanisms to protect user information and maintain system integrity.

C. LackofContextualUnderstanding

Traditional systems often rely on keyword-based matching, whichfailstocapturedeepersemanticmeaninganduserintent [10].Asaresult,recommendationsmaynotalwaysberelevant or meaningful. Developing systems that understand context using advancedNLP techniquesisa majorresearchchallenge.

D. Scalability

As the number of users grows, maintaining real-time per- formance becomes increasingly difficult. Large-scale systems musthandlecontinuousdataupdates,interactiontracking,and recommendation generation efficiently. Ensuring scalability without compromising speed or accuracy is a significant technical challenge.

E. ColdStartproblem

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

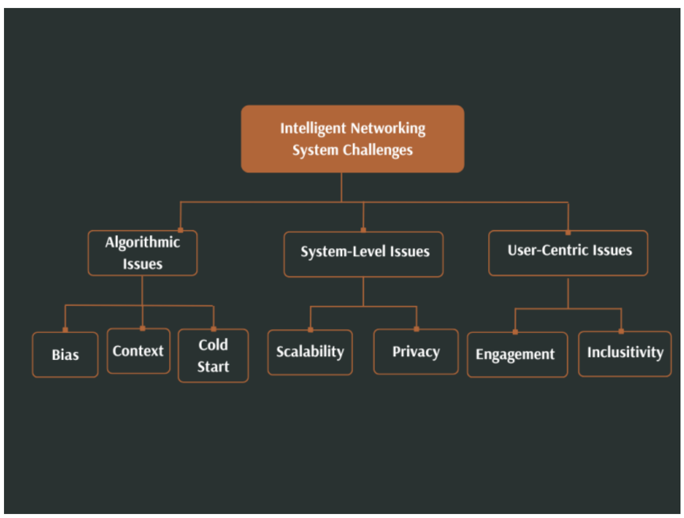

Fig.3:Majorchallengesencounteredinintelligentnetworking systems.

F. UserEngagement

Maintaining long-term user engagement is another chal- lenge.Staticsystemsfailtoadapttoevolvinguserpreferences overtime.Continuouslearningmechanismsarerequiredtoen- surethatrecommendationsremainrelevantandpersonalized.

G. InclusivityandAccessibility

Not all users have equal access to digital platforms due to differencesinconnectivity,devices,ordigitalliteracy.Systems must be designed to be inclusive, offering intuitive interfaces and accessibility features to ensure broader usability.

FromaYugYogperspective,thesechallengesareaddressed through the integration of semantic analysis, hybrid recom- mendation models, fairness-aware algorithms, and adaptive learning mechanisms. Addressing these challenges through semantic modeling, hybrid recommendation strategies, and fairness-aware learning significantly enhances system robust- ness and user trust.

VI. STRATEGIES TO OVER COME CHALLENGES IN INTELLIGENT NETWORKING SYSTEMS

Toimprovetheperformance,fairness,andusabilityofintel- ligentnetworkingplatformslikeYugYog,severalstrategiesare implemented. Thesestrategiesfocusonenhancingrecommen- dationquality,ensuringtransparency,improvingusertrust,and making the system more adaptive to dynamic user behavior.

A. StandardizedUserProfileRepresentation

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

B. Real-TimeInteractionDashboards

Interactive dashboards provide users with visibility into theirnetworkactivity,recommendationquality,andconnection statistics. These dashboards also help monitor system perfor- mance and detect unusual patterns in user engagement. Real- time visualization improves transparency and enhances user trust in the system.

C. ExplainableRecommendationMechanisms

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

D. Fairness-AwareRecommendationFiltering

Fairness mechanisms are applied to ensure that recommen- dations are not biased toward highly active or popular users. Thesystembalancesvisibilityacrossdifferentusergroups by adjusting ranking scores and applying fairness constraints during recommendation generation.

E. AdaptiveLearningfromUserFeedback

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. HybridHuman-AIInteractionModel

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

G. SecureandPrivacy-PreservingDataHandling

To ensure user trust, YugYog incorporates encryption and controlledaccessmechanismsforsensitiveuserdata.Thesys- temminimizesunnecessarydataexposureandfollowsprivacy- 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 systemsstill suffer from several critical limitations that affect their effectiveness, accuracy, and accessibility. Most conventional fitness applications primarily rely on pre-recorded video tuto- rials 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 posturemistakes,increasingtheriskofimproperpractice 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 learningtechniquestodynamicallytrackbodymovements[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 unreli- able feedback. Environmental sensitivity is another challenge.

Existing systems often perform poorly under varying lighting conditions, cluttered backgrounds, or occlusions, which sig- nificantlyimpactsposedetectionaccuracy.Additionally,many applications require high-end hardware or controlled environ- ments, limiting their usability for everyday users practicing at home[6].Accessibilityandusabilityissuesalsopersist.Begin- ners,inparticular,finditdifficulttofollowinstructionswithout 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 correctivefeedback.Thesystemisdesignedtobelightweight, accessible,andcapableofdeliveringpersonalizedguidance, thereby enabling safer and more effective yoga practice.

VIII. PROPOSED SOLUTIONS

A. AI-BasedPoseDetectionandReal-TimeFeedback

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)andComputerVision(CV)techniquesforreal- time pose detection and analysis.

The system utilizes pose estimation models such as MoveNet[2]toextracthumanbodykeypointsfromlivevideo streams. MediaPipeimprovesreal-timetracking[3].Thesekey- points are further processed to calculate joint angles and body alignment. By comparing user posture with predefined ideal referenceposes,thesystemidentifiesdeviationsandgenerates instant corrective feedback.

Highlights:

- Real-timehumanposeestimationusingcomputervision.
- Jointanglecalculationforpostureaccuracyanalysis.
- Instantvisualandtextualcorrectivefeedback.

B. Real-TimePerformanceAnalytics

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-basedaccuracyandgradingsystem.
- Visualizationofuserprogressovertime.
- Data-driveninsightsforpostureimprovement.

C. IntelligentandAccessibleFeedbackSystem

Ensuring usability and accessibility is a key focus of the proposedsystem.YugYogprovidesintelligentfeedbackinboth visualandtextualforms,suchasskeletaloverlays,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 environmentswithminimalhardwarerequirements,making it suitable for home-based users. Additionally, the web-based deployment ensures ease of access without requiring complex installations.

Highlights:

- AI-drivencorrectivesuggestionsbasedondeviationanal- ysis.
- Visualskeletonoverlaywithreal-timeannotations.
- Lightweightandbrowser-basedimplementationforac- cessibility.

Insummary,theintegrationofreal-timeposeestimation, performanceanalytics,andintelligentfeedbackmechanisms

TABLEII:ComparativeAnalysisofYogaPoseDetectionTechniques

Technique	Accuracy(%)	Real-TimeCapability	FeedbackQuality
Video-BasedTutorials	60.5	None	None
BasicLandmarkDetection	72.3	Low	Low
PoseEstimation+AngleAnalysis(YugYog)	92.4	High	Medium
AI-BasedDeviationFeedback(YugYog)	90.1	VeryHigh	High
Analytics-Driven Evaluation (YugYog)	88.6	High	VeryHigh

TABLEIII:SummaryofProposedSolutionsforYugYog

Solution	Description
AI-BasedPoseDetection andFeedback	Real-timedetectionofbodykey-points,angle-basedpostureevalua-tion,andinstantcorrectivesugges-tions.
Real-Time Performance Analytics	Trackingofaccuracy,posedu-ration,andsession-basedperfor-mance metrics.
InteractiveVisualGuid-ance	Skeletonoverlaywithanglean-notationsforintuitiveuserunder-standing.

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

IX. RESULTS AND DISCUSSION

To evaluate the performance of the proposed **YugYog**sys- tem, 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. EvaluationMetrics

The system performance was evaluated using the following metrics:

- Pose Detection Accuracy: Measures how accurately the system detects body keypoints.
- AngleDeviationError:Differencebetweenuserjoint angles and reference pose angles.
- Real-TimePerformance(FPS):Framesprocessedper second.

B. ExperimentalResults

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

TABLEIV:PerformanceEvaluationofYugYogSystem

Metric	Value
PoseDetectionAccuracy	92.4%
AverageAngleError	5.8°

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Real-TimeSpeed	24FPS
UserFeedbackResponseTime	<0.5sec

C. PerformanceAnalysis

The results indicate that the proposed system performs efficiently in real-time scenarios. The use of lightweight pose estimationmodelsenablessmoothexecutionwithoutrequiring 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. GraphicalRepresentationofAccuracy

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

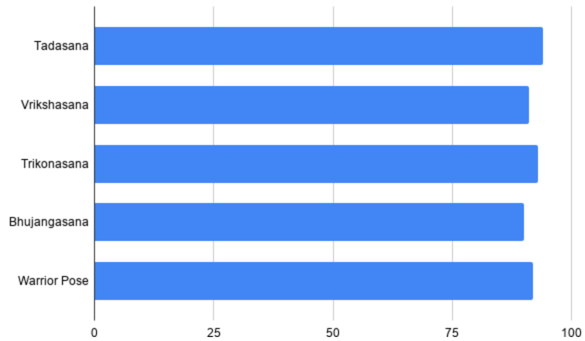

Fig.4:PoseDetectionAccuracyforDifferentYogaPoses

E. Discussion

TheexperimentalresultsdemonstratethatYugYogprovides reliable real-time posture detection and feedback. Comparedto 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

YugYogpresents an effective and innovative solution tothe limitations of traditional yoga training methods by lever- aging 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 im- proving accuracy and reducing the risk of injury during unsupervisedyogasessions.Theproposedplatformbridges 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 toa 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 rangeofusers,includingbeginnerspracticingathome.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-basedevaluationfurthersupportscontinuousimprovementand user motivation. Looking ahead, the system can be extended by incorporating a wider range of yoga poses, improving robustness under varying environmental conditions, and inte- gratingwearablesensorsforenhancedprecision.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].

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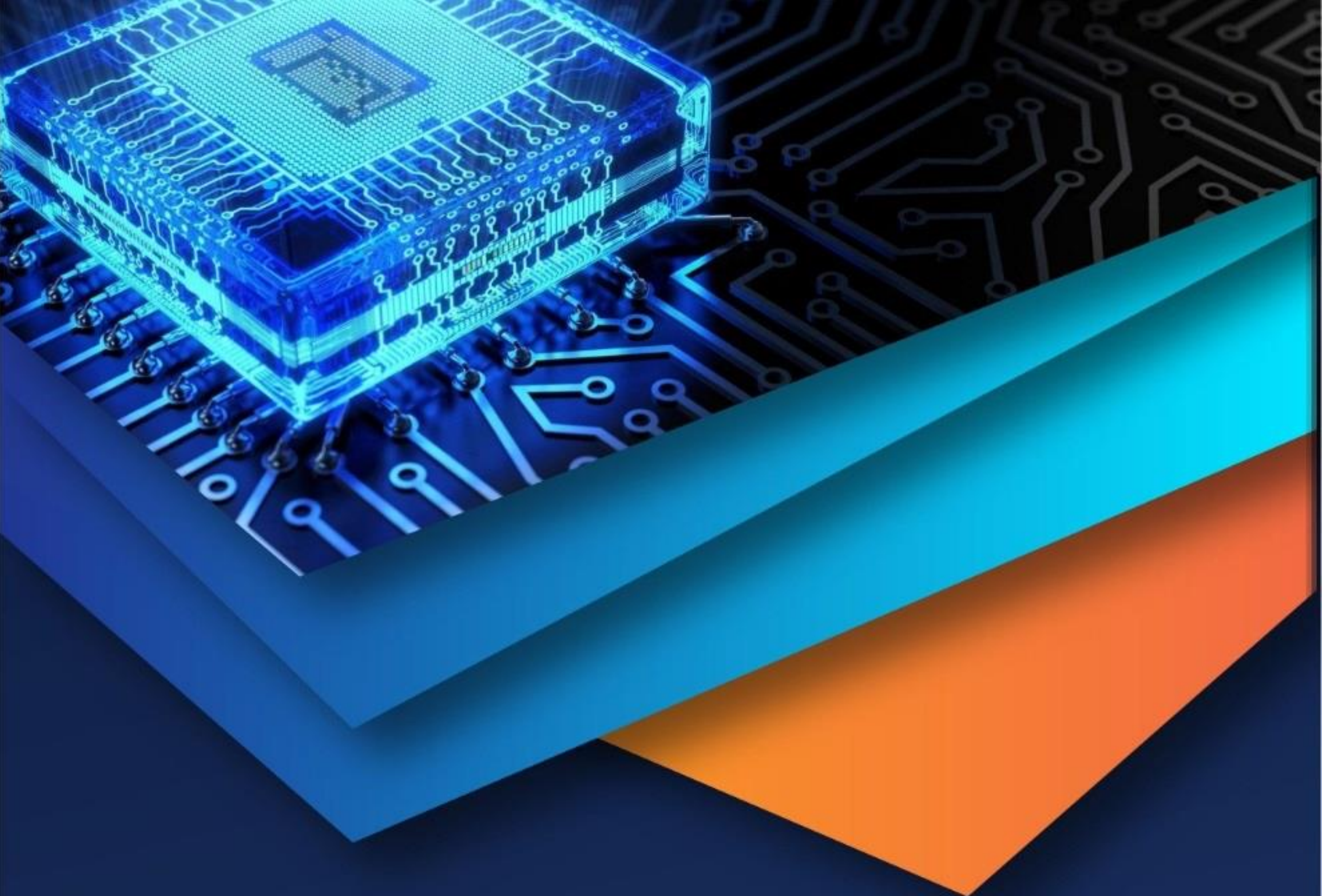

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