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Yoga Tutor: AI based Real-Time Yoga Pose Recognition and Correction System for Enhanced Yoga Practice

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Abstract

Yoga is a 5000-year-old practice developed in ancient India by the Indus-Sarasvati civilization. The word yoga means deep association and union of mind with the body. Yoga can be practiced in yoga centres, through personal tutors, and can also be learned on one's own with the help of the Internet, books, recorded clips, etc. In fast-paced lifestyles, many people prefer self-learning because the abovementioned resources might not be available all the time. But in self-learning, one may not find an incorrect pose. Existing techniques for Yoga pose recognition build classifiers based on sophisticated handcrafted features computed from the raw inputs captured in a controlled environment. These techniques often fail in complex realworld situations and thus, pose limitations on the practical applicability of existing Yoga pose recognition systems. In this project, an AI-based techniques are developed to detect incorrect yoga posture and gives feedback or suggestions to correct yoga poses in real-time video using Two-Stream Networks. The main idea is to build and train YogaNet model that can correctly classify a user's yoga pose by training it on a dataset of yoga images using Convolutional Neural Networks (CNNs) and OpenPose. By using OpenPose, the system generates a 3D joint map of the person's body, which is then used as input for linear regression to detect the individual yoga pose. The proposed system is suitable for real-time applications, and is expected to be used in fitness centres, yoga studios, and even for personal use. Additionally, the system can also be used to track the progress of yoga practitioners, allowing them to analyse their performance and improve their practice. Furthermore, the proposed system is expected to benefit the yoga industry by providing a low-cost, efficient, and accurate means to detect poses and alert them.

INTRODUCTION

OVERVIEW

Yoga is essentially a spiritual discipline based on an extremely subtle Science which focuses on bringing harmony between mind and body. It is an art and science for healthy living. The word "Yoga" is derived from the Sanskrit root *yuj* meaning "to join", "to yoke" or "to unite". According to Yogic scriptures, the practice of Yoga leads to the union of individual consciousness with universal consciousness. According to modern scientists, everything in the universe is just a manifestation of the same quantum firmament. One who experiences this oneness of existence is said to be "in Yoga" and is termed as a yogi who has attained a state of freedom, referred to as Mukti, nirvāna, kaivalya or moksha. "Yoga" also refers to an inner science comprising of a variety of methods through which human beings can achieve union between the body and mind to attain self-realization. The aim of Yoga practice (sādhana) is to overcome all kinds of sufferings that lead to a sense of freedom in every walk of life with holistic health, happiness and harmony.

There are six main branches of traditional yoga. In each of these, the goal of unity is achieved through different yoga practices. Each of these different aspects of yoga will resonate differently with practitioners based on their disposition, skill, and ability.
These are:

1. Raja (the royal path) – focuses on meditation practices
2. Karma (the path of action) – focuses on action and service in daily life
3. Jnana (the path of knowledge) – focuses on discriminative wisdom and self-inquiry
4. Bhakti (the path of devotion) – focuses on devotion to God
5. Tantra (the path of ecstasy) – focuses on ritual and initiation
6. Hatha (the forceful path) – focuses on energy and movement of the body

SYSTEM ANALYSIS

EXISTING SYSTEM

The existing system of Yoga practice has its roots in ancient Indian philosophy and is a holistic approach to achieving physical, mental, and spiritual well-being. Here are key aspects of the existing system of Yoga practice:

- **Guru-Disciple Tradition**

In the guru-disciple tradition, the relationship between teacher and student is deeply revered, emphasizing the direct transmission of knowledge, wisdom, and spiritual guidance from the guru to the disciple. This sacred bond fosters a close, personal connection where the guru imparts not only theoretical knowledge but also practical insights and experiential wisdom. Through this intimate mentorship, the disciple gains a profound understanding of the deeper aspects of yoga, including its philosophy, practices, and transformative power. The guru serves as a spiritual guide, offering personalized instruction, encouragement, and support on the disciple's spiritual journey, ultimately leading to spiritual awakening and self-realization.

- **Ashram Environment**

Traditionally, yoga learning takes place within the serene and spiritually charged atmosphere of an ashram or spiritual community. These sacred spaces provide an ideal environment for immersive study, practice, and self-discipline. Surrounded by like-minded individuals and immersed in the teachings of yoga, students experience a deep sense of spiritual immersion and transformation. Ashrams offer a structured daily schedule that includes meditation, yoga practice, philosophical teachings, and seva (selfless service), fostering spiritual growth, inner peace, and self-discovery. The tranquil surroundings, away from the distractions of modern life, create a conducive atmosphere for deep introspection, contemplation, and inner exploration, facilitating profound spiritual experiences and personal transformation.

- **Yoga Training Centers**

In modern times, yoga learning has evolved to adapt to the structure of Yoga Training Centers, providing a supportive and inclusive environment for individuals to embark on their yogic journey. These centers offer a wide range of yoga programs, workshops, and teacher training courses, catering to practitioners of all levels, from beginners to advanced students. Led by experienced yoga teachers and experts, these programs combine traditional teachings with contemporary methodologies, integrating asana (physical postures), pranayama (breath control), meditation, and yogic philosophy. Yoga training centers serve as hubs of learning,

community, and holistic wellness, fostering a sense of belonging, camaraderie, and shared purpose among practitioners. Through systematic training, mentorship, and guidance, individuals deepen their understanding of yoga, develop their practice, and cultivate a balanced and harmonious lifestyle conducive to health, well-being, and spiritual growth.

Existing Algorithms

- **Support Vector Machines (SVM)**

SVMs are used for classification tasks, including yoga pose recognition. Features extracted from images are used to train the SVM model, which can then classify new images into different yoga poses.

- **Random Forests**

Random Forests can be employed for pose recognition by training on features extracted from images. They are known for their versatility and can handle both image and non-image features.

- **OpenPose**

OpenPose is a library that uses a combination of computer vision and machine learning to detect and track human body keypoints in real-time. It's commonly used for yoga pose recognition by analyzing the key joint positions.

Disadvantages

- Limited accessibility and scalability.
- Reliance on oral transmission, risking inconsistencies.
- Dependency on qualified gurus' availability and expertise.
- Limited robustness in real-world scenarios.
- High computational complexity.
- Difficulty in handling variations in lighting and body types.
- Inadequate adaptation to individual differences in pose execution.

PROPOSED SYSTEM

The proposed system for the Yoga Tutor project encompasses several key components aimed at enhancing the yoga practice experience through real-time pose recognition and feedback.
Here's an overview of the proposed system:

1. **Yoga Tutor Web Application**
    - The core of the system is a web application built using technologies such as Python, Flask, MySQL, and Bootstrap.
    - The web app provides users with an intuitive interface to interact with the system's features and functionalities.
2. **YogaNet Model**
    - The system employs a custom-built deep learning model called YogaNet, trained using Convolutional Neural Networks (CNNs).
    - YogaNet is trained on a dataset of yoga images, enabling it to accurately recognize various yoga poses.
    - The model is continuously refined and updated to improve its accuracy and performance.
3. **Pose Recognition**
    - The system utilizes the trained YogaNet model to perform real-time pose recognition.
    - Users can input their live poses using a webcam, and the system provides instant feedback on the correctness of their posture.
    - Pose recognition algorithms analyze key body landmarks to determine the accuracy of the user's pose.

4. **Feedback Mechanism**
    - Upon recognizing a user's pose, the system provides feedback or alerts if any incorrect posture is detected.
    - Users receive actionable suggestions to correct their poses, enhancing their yoga practice and reducing the risk of injury.
    - Feedback mechanisms are personalized based on the user's progress and proficiency level.

Thus, the proposed system aims to revolutionize the way yoga is practiced by leveraging AI technology to provide real-time pose recognition and feedback, ultimately enhancing the effectiveness and safety of yoga practice.

Advantages

- Real-time feedback for immediate pose correction.
- Personalized guidance tailored to individual proficiency levels.
- Convenient access to yoga practice anywhere, anytime.
- Cost-effective alternative to traditional yoga classes.
- Accurate pose recognition using AI technology.
- Improved yoga practice with instant feedback.
- Increased accessibility for all user demographics.
- Time-saving convenience with at-home practice.
- Cost savings compared to traditional classes.

PROJECT DESCRIPTION

The Yoga Tutor Web App is designed to facilitate interactive yoga practice sessions. Built using a robust stack of technologies including Python, Flask, MySQL, Wampserver, and Bootstrap, the app leverages the power of TensorFlow, Pandas, Scikit Learn, Matplotlib, NumPy, Seaborn, Pillow, and OpenCV to provide advanced features such as real-time pose recognition, personalized feedback, and progress tracking. With an intuitive user interface crafted on Bootstrap, users can seamlessly interact with the app, enhancing their yoga practice experience. The User Authentication module ensures secure access to personalized features, safeguarding user data while maintaining privacy. Within the User Profile Management module, users can create and customize their profiles, including personal information and progress tracking data, tailoring the experience to their individual needs. The Pose Input Interface offers a seamless platform for users to input their yoga poses through live video using webcam, while the Real-Time Pose Feedback provides instant correction suggestions, fostering correct posture alignment during practice. Administrators benefit from the Admin Panel, facilitating system management tasks such as user management and model training. The YogaNet Training Interface empowers administrators to refine the model's accuracy and performance continuously. System Notifications and Alerts keep users and administrators informed about important updates and issues, ensuring smooth operation of the platform. The End User Dashboard further enhances the user experience by providing functionalities tailored for both administrators and regular users. The Admin Module allows administrators to securely access the dashboard, import datasets for model training, train the YogaNet model, and manage user accounts. The User Module enables new users to register accounts, securely log in to access personalized features, input live poses using their webcam, and receive alerts for incorrect poses, aiding in posture correction and injury prevention. Build and Train section, various modules facilitate the construction and training of the YogaNet model. From importing and pre-processing datasets to feature extraction, classification, model building, training, and deployment into the web app, each step ensures the model's accuracy and efficiency in realtime pose recognition tasks. Moreover, the Yoga Pose Recognition modules enable users to input poses using their webcam, while advanced techniques like Two Stream Networks enhance the accuracy of pose recognition by considering both spatial and temporal information. Finally, the Alert System modules provide users with immediate feedback on incorrect poses, allowing them to make timely adjustments for improved posture and practice.

TEST CASES

1. **Test Case ID: YTTC_001**
   Input: Admin attempts to log in with valid credentials.
   Expected Result: Admin successfully logs in and gains access to the admin dashboard.
   Actual Result: Admin login is successful, and the admin dashboard is accessible. **Status:** Pass

2. **Test Case ID: YTTC_002**
   Input: Admin attempts to log in with invalid credentials.
   Expected Result: Admin login fails, and an error message is displayed.
   Actual Result: Admin login fails, and the system displays an error message prompting the user to enter valid credentials.
   Status: Pass

3. **Test Case ID: YTTC_003**
   Input: Admin navigates to the "Import Dataset" feature and uploads a yoga pose dataset.
   Expected Result: Dataset is successfully imported into the system for model training.
   Actual Result: Dataset is uploaded successfully, and it is available for model training.
   Status: Pass

4. **Test Case ID: YTTC_004**
   Input: Admin initiates the training process for the YogaNet model.
   Expected Result: Model training begins, and progress is displayed on the admin dashboard.
   Actual Result: Model training starts, and the admin dashboard shows the progress of the training process.
   Status: Pass

5. **Test Case ID: YTTC_005**
   Input: User attempts to register a new account with valid credentials.
   Expected Result: User account is successfully registered in the system.
   Actual Result: User account registration is successful, and a confirmation message is displayed.
   Status: Pass

6. **Test Case ID: YTTC_006**
   Input: User attempts to log in with valid credentials.
   Expected Result: User successfully logs in and gains access to the user dashboard.
   Actual Result: User login is successful, and the user dashboard is accessible. **Status:** Pass

7. **Test Case ID: YTTC_007**
   Input: User performs live pose using webcam.
   Expected Result: System accurately detects the user's pose and provides real-time feedback.
   Actual Result: System accurately recognizes the user's pose and displays relevant feedback. **Status:** Pass

8. **Test Case ID: YTTC_008**
   Input: User performs an incorrect pose using the webcam.
   Expected Result: System detects the incorrect pose and provides an alert or corrective feedback.
   Actual Result: System detects the incorrect pose and promptly alerts the user with corrective feedback.
   Status: Pass

TEST REPORT

Introduction: The Yoga Tutor System is a web-based application designed to provide realtime yoga pose recognition and correction feedback to users. This test report documents the functional testing conducted on the system to validate its correctness and effectiveness. **Test Objective:** The objective of this test is to verify that the Yoga Tutor System functions as intended, accurately recognizing yoga poses, providing feedback on correct and incorrect poses, and facilitating user interaction seamlessly.

Test Scope: The scope of this test includes testing the core functionalities of the Yoga Tutor System, including user authentication, pose recognition, feedback generation, and user interaction features. The test focuses on both admin and user perspectives to ensure comprehensive coverage.

Test Environment:

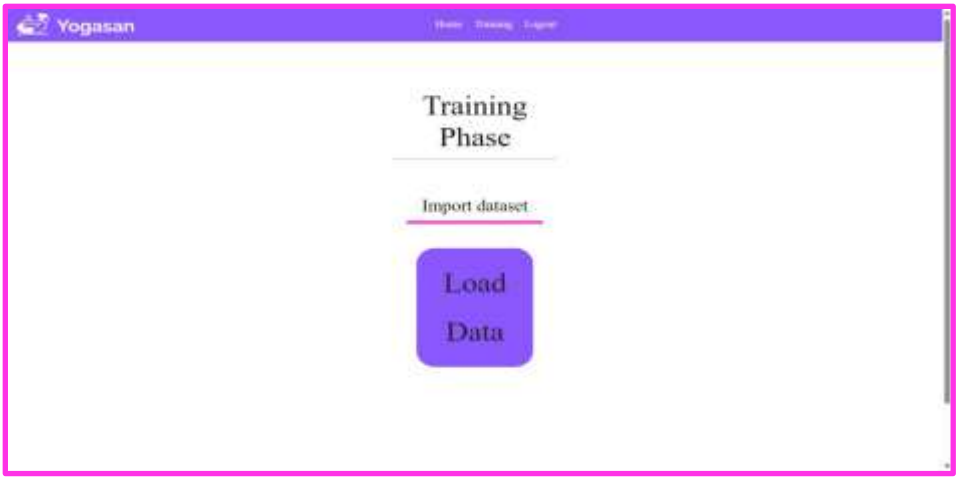
- Operating System: Windows 10
- Web Browser: Google Chrome, Mozilla Firefox
- Test Devices: Desktop, Laptop

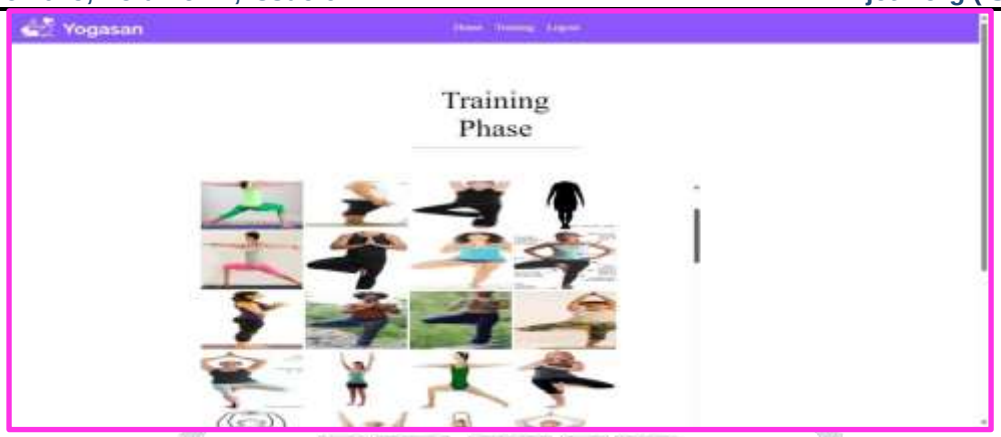
Test Result: The Yoga Tutor System has undergone rigorous functional testing, and the test results are as follows:

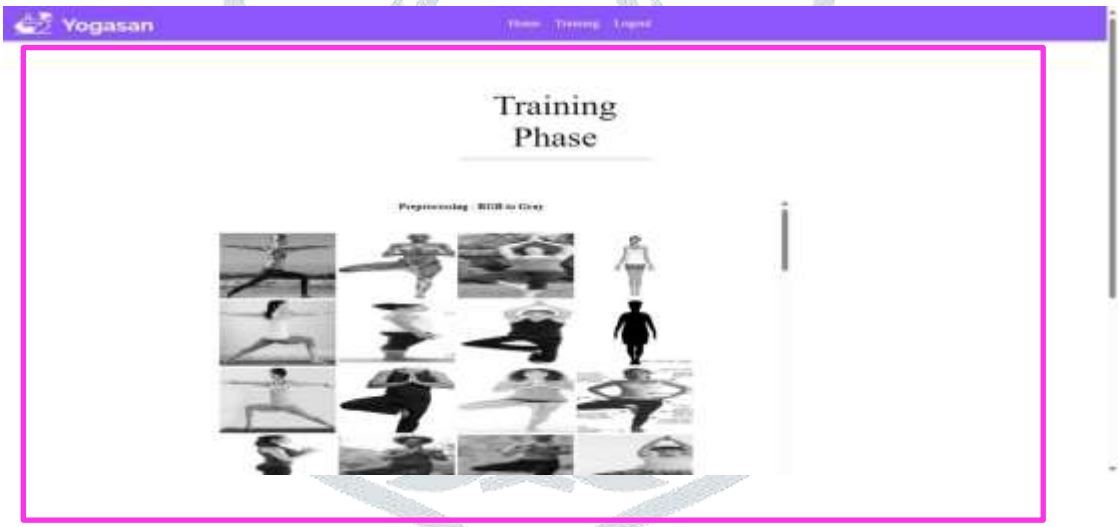
- All core functionalities, including user authentication, pose recognition, and feedback generation, performed as expected.
- User registration, login, and live pose detection features were successfully tested without any issues.
- Admin functionalities such as importing datasets and training the YogaNet model were also verified to work correctly.
- The system accurately recognized a variety of yoga poses and provided timely feedback on correct and incorrect poses.
- User interaction features, including the user interface and alert generation for incorrect poses, were intuitive and responsive.

Test Conclusion: Based on the test results, it can be concluded that the Yoga Tutor System has successfully passed functional testing. The system demonstrates robustness, accuracy, and usability, meeting the intended objectives and requirements. Any identified issues were promptly addressed and resolved, ensuring the system's reliability and effectiveness for endusers.

SCREEN LAYOUTS







CONCLUSION

In conclusion, the development and implementation of the Yoga Tutor System mark a significant milestone in the realm of yoga practice enhancement through technology. Throughout the project lifecycle, from conceptualization to deployment, several key observations and outcomes have emerged. Firstly, the system's architecture, built on a robust stack of technologies including Python, Flask, MySQL, TensorFlow, and OpenCV, provides a solid foundation for its functionality. The choice of these technologies enables efficient data processing, real-time pose recognition, and seamless user interaction. The success of the system lies in its ability to accurately recognize a wide range of yoga poses in real-time. The integration of deep learning techniques, particularly Convolutional Neural Networks (CNNs) and Two Stream Networks, enables the system to analyze live video streams from webcams and provide immediate feedback on the user's pose alignment. This functionality is pivotal in helping users maintain correct posture and prevent injuries during their yoga practice. Furthermore, the user interface design plays a crucial role in ensuring a smooth and intuitive experience for both administrators and users. Features such as user authentication, dataset import, model training, and live pose detection are seamlessly integrated into the interface, enhancing usability and accessibility. The system's comprehensive testing process, covering unit testing, integration testing, system testing, user acceptance testing, and performance testing, has played a vital role in ensuring its reliability and effectiveness. Through meticulous testing, issues and bugs were identified and resolved, resulting in a stable

and robust system. In conclusion, the Yoga Tutor System represents a transformative solution for enhancing yoga practice through AI-driven pose recognition and feedback. Its ability to provide personalized guidance, track progress, and foster correct posture alignment makes it a valuable tool for both novice and experienced practitioners alike. As the system continues to evolve and adapt to user feedback and technological advancements, it holds the promise of revolutionizing the way yoga is practiced and taught in the modern age.

BIBILOGRAPHY

REFERENCES

1. Malik MLK, "A Deep Learning Framework for Classifying and evaluating Yoga exercises", *J Comput Sci*, vol. 19, no. 2, pp. 229-241, 2023.
2. A.S. Talaat, "Novel deep learning models for yoga pose estimator", *SN Appl. Sci.*, vol. 5, no. 341, 2023.
3. W. -C. Huang, C. -L. Shih, I. T. Anggraini, N. Funabiki and C. - P. Fan, "OpenPose Technology Based Yoga Exercise Guidance Functions by Hint Messages and Scores Evaluation for Dynamic and Static Yoga Postures", *2023 4th International Conference on Information Technology and Education Technology (ITET 2023)*, May 2023.
4. S. Aftab, S. F. Ali, A. Mahmood and U. Suleman, "A boosting framework for human posture recognition using spatio-temporal features along with radon transform", *Multimedia Tools Appl.*, vol. 8, pp. 42325-42351, Aug. 2022.
5. Chasmai M et al., "A view Independent Classification Framework for Yoga postures", *SN Comput Sci*, vol. 3, no. 6, 2022.