Yoga Pose Detection and Guidance Through an AI-Enhanced Chatbot

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ABSTRACT

Yoga is a widely practiced form of exercise and meditation with numerous physical and mental health benefits. In recent years, the integration of technology into yoga practice has gained momentum, with applications ranging from virtual classes to personalized coaching. One such application is the automated detection and correction of yoga poses using machine learning techniques. This project focuses on developing a yoga pose detection system using transfer learning with the VGG19 convolutional neural network architecture. Transfer learning leverages the knowledge gained by pre-training models on large-scale datasets and adapts it to new tasks with smaller datasets, making it suitable for our pose classification problem. The VGG19 model, pre-trained on the ImageNet dataset, serves as a feature extractor for yoga pose images, capturing hierarchical visual representations. The workflow involves collecting a diverse dataset of yoga pose images, preprocessing them for uniformity, and annotating them with corresponding pose labels. We then fine-tune the pre-trained VGG19 model on the annotated dataset, replacing the final classification layers to suit our multi-class yoga pose classification task. Training the model involves optimizing hyperparameters and monitoring performance metrics to ensure effective learning. Evaluation of the trained model is performed using standard metrics such as accuracy, precision, recall, and F1 score on a separate validation or test dataset. The model's performance is assessed in terms of its ability to accurately classify various yoga poses under different conditions, including variations in pose, lighting, and background. The developed yoga pose detection system holds promise for assisting yoga practitioners and instructors in achieving correct pose alignment, providing real-time feedback, and tracking progress over time. Additionally, it serves as a foundation for further research and development in the intersection of machine learning and yoga practice, contributing to the advancement of technology-enhanced wellness solutions.

Keywords: *VGG19, CNN, MACHINE LEARNING, ENHANCED-AI*

INTRODUCTION

The project aims to develop a yoga pose detection system using machine learning, specifically transfer learning with the VGG19 architecture. This system provides real-time feedback on pose alignment, benefiting practitioners at all levels. It bridges traditional yoga teachings with modern technology, enhancing accessibility and safety. The implications extend beyond individual practice to include instruction quality, community building, healthcare, research, and entertainment. However, ethical considerations like data privacy and cultural sensitivity must be addressed. The system holds promise for personalized instruction, remote learning, and immersive experiences in virtual environments. Its development signifies a fusion of ancient wisdom and cutting-edge innovation. The tool aims to democratize access to yoga's transformative benefits while preserving its integrity. It aids rehabilitation efforts by providing objective assessments and facilitates research on movement patterns and therapeutic effects. As technology advances, it is crucial to approach its integration with mindfulness and respect for tradition. In summary, the project seeks to enhance the practice of yoga through technology while upholding its core principles of mindfulness, compassion, and unity.

Objectives:

The project aims to develop a yoga pose detection system using transfer learning with VGG19. Objectives include implementing transfer learning, designing a pose detection model, ensuring real-time performance, evaluating system accuracy, integrating a user-friendly interface, and deploying the system widely. Ethical considerations such as data privacy and cultural sensitivity are prioritized. The system aims to empower practitioners with real-time feedback on posture alignment, aiding in their yoga practice. Through achieving these objectives, the project seeks to enhance practitioners' confidence and mindfulness in experiencing yoga's transformative benefits.

Problem Statement:

The project aims to develop a yoga pose detection system to provide real-time feedback on alignment during practice. Challenges include accommodating pose variation, ensuring data variability, and maintaining real-time performance. Addressing these challenges requires a multidisciplinary approach combining computer vision, machine learning, and yoga instruction expertise. The system aims to enhance the quality of yoga practice by providing objective feedback and promoting safer, more effective sessions.

Motivation:

The motivation behind the AI-enhanced chatbot project for yoga pose detection and guidance lies in addressing the need for real-time feedback and alignment assistance during yoga practice. By leveraging AI, practitioners can receive immediate guidance, enhancing their understanding and execution of poses. The project aims to democratize access to personalized yoga instruction, catering to practitioners of all levels and abilities. Additionally, it seeks to promote safety and prevent injuries by providing accurate posture corrections. Through seamless integration with existing platforms, the chatbot enhances the accessibility and convenience of yoga practice, fostering a deeper connection to mind-body wellness.

DATAFLOW DAIGRAMS:

Dataflow diagrams can be used to provide the end user with a physical idea of where the data they input ultimately has an effect upon the structure of the whole system from order to dispatch to restock how any system is developed can be determined through a dataflow diagram

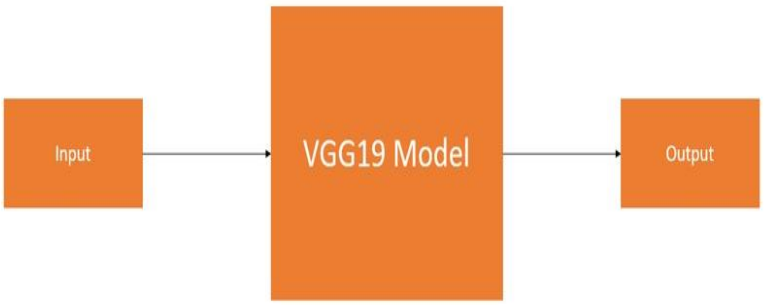


Figure 4.2: data flow diagram level 0

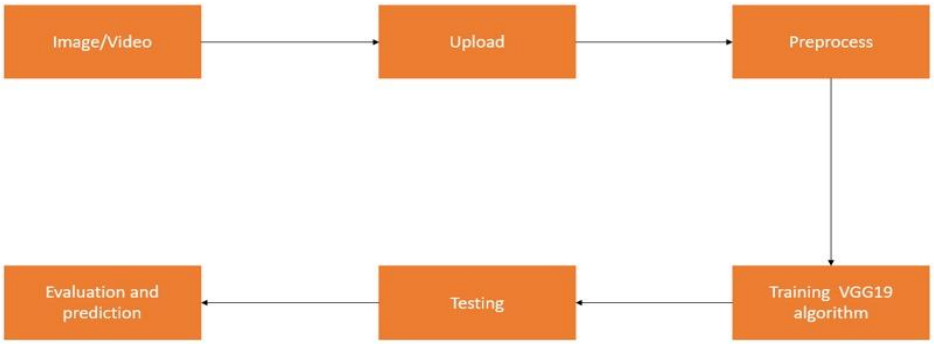
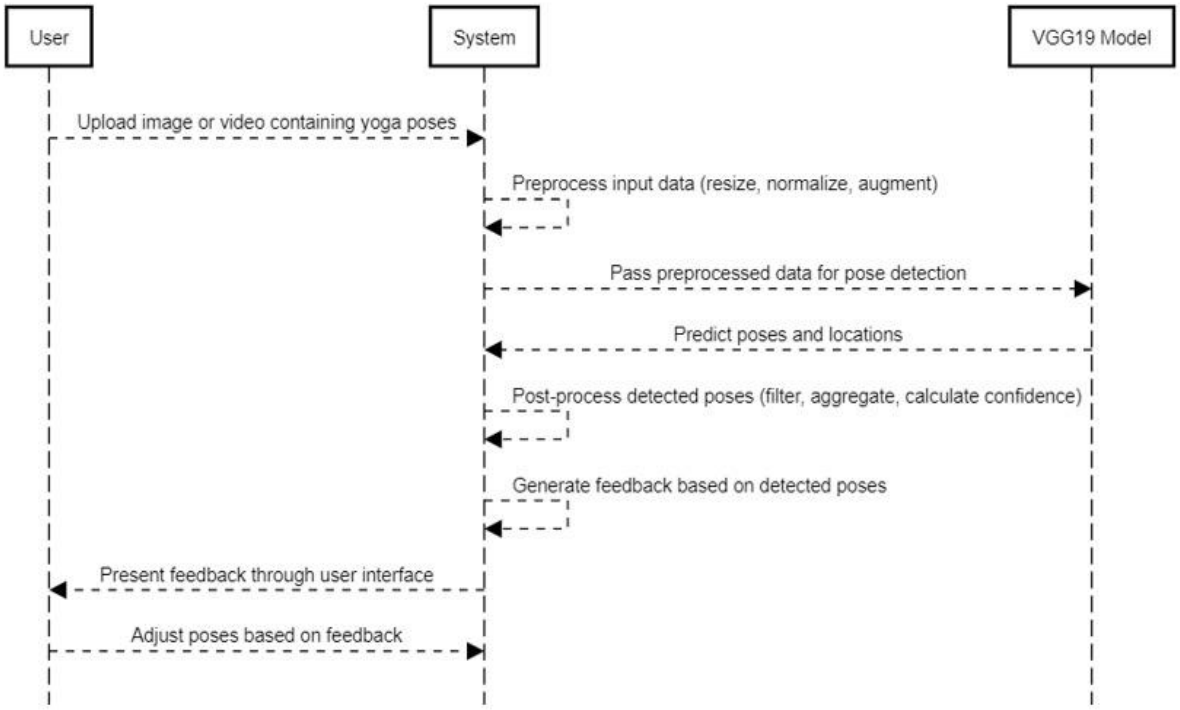


Figure :4.3 dataflow diagram level 1

Figure 1. Data Flow Diagrams

Sequence Diagrams:

Sequence diagram consists of 5 different blocks namely user, processor, memory, Model and labels as shown in the above figure User will provide the input image through the file's already saved image is being taken in consideration which is been captured and sent to the processor where preprocessing of data is done which is resizing, reshaping and other parameters and after that those are stored in the memory unit.



LITERATURE SURVEY

[1] Implementation of Machine Learning Technique for Identification of Yoga Poses Yash Agrawal; Yash Shah; Abhishek Sharma

In recent years, yoga has become part of life for many people across the world. Due to this there is the need of scientific analysis of y postures. It has been observed that pose detection techniques can be used to identify the postures and also to assist the people to perform yoga more accurately. Recognition of posture is a challenging task due to the lack availability of dataset and also to detect posture on real Time bases. To overcome this problem a large dataset has been created which contain at least 5500 images of ten different yoga pose and used a tf-pose estimation Algorithm which draws a skeleton of a human body on the real-time bases. Angles of the joints in the human body are extracted using the tf-pose skeleton and used them as a feature to implement various machine learning models. 80% of the dataset has been used for training purpose and 20% of the dataset has been used for testing. This dataset is tested on different Machine learning classification models and achieves an accuracy of 99.04% by using a Random Forest Classifier.

[2] Recognition Of Yoga Poses Using EMG Signals From Lower Limb Muscles Pradchaya Anantamek, Narit Hnoohom

Exercise with yoga postures is very popular nowadays because yoga exercises can help to increase flexibility and muscle strength and improve the respiratory system. However, the correctness of the yoga postures is difficult to check, and thus practitioners may not be able to benefit from the exercises fully. This paper presents a yoga posture recognition system to verify the correctness of the lower muscle movements while practicing yoga. The study included ten subjects, five males and five females. Data were collected during five yoga postures. This paper focuses on the use of Electromyography signals for analysing the motion of four lower-limb muscles of both legs. Recognition was performed with three machine learning algorithms. The results showed that the Random Forest Decision Tree algorithm has the highest accuracy in recognizing yoga postures in comparison with other algorithms and that the yoga posture recognition model is accurate at 87.43 percent.

[3] Real-Time Yoga Pose Detection using Machine Learning Algorithm Jothika Sunney

Yoga is an ancient art that provides physical and mental fitness. Yoga incorporates self-learning, but incorrect postures can cause serious muscle and ligament damage. During Covid-19, the importance of self-learning yoga practices has increased, and many people include yoga as part of their routines. A yoga pose detection system based on human pose estimation techniques and Machine Learning can assist people in practicing yoga correctly by themselves. The major challenge with current yoga pose detection methods is that most of them are computationally expensive and unsuitable for real-time applications. This research proposes a computationally inexpensive approach for real-time yoga pose detection by combining the Mediapipe Framework and Classification algorithms. An artificial intelligence based system was built based on Mediapipe's Blazepose model and XgBoost Classifier to predict yoga postures in real-time. A publically available dataset of Five Yoga poses was analyzed in this study (down-dog pose, goddess pose, tree pose, plank pose, and warrior pose).

[4] Yoga Posture Recognition By Detecting Human Joint Points In Real Time Using Microsoft Kinect Muhammad Usama Islam , Hasan Mahmudy, Faisal Bin Ashrafz, Iqbal Hossainx and Md. Kamrul Hasan

Musculoskeletal disorder is increasing in humans due to accidents or aging which is a great concern for future world. Physical exercises can reduce this disorder. Yoga is a great medium of physical exercise. For doing yoga a trainer is important who can monitor the perfectness of different yoga poses. In this paper, we have proposed a system which can monitor human body parts movement and monitor the accuracy of different yoga poses which aids the user to practice yoga. We have used Microsoft Kinect to detect different joint points of human body in real time and from those joint points we calculate various angles to measure the accuracy of a certain yoga poses for a user. Our proposed system can successfully recognize different

[5] Real-time Yoga recognition using deep learning Santosh Kumar Yadav , Amitojdeep Singh, Abhishek Gupta, Jagdish Lal Raheja

An approach to accurately recognize various Yoga asanas using deep learning algorithms has been presented in this work. A dataset of six Yoga asanas (i.e. Bhujangasana, Padmasana, Shavasana, Tadasana, Trikonasana, and Vrikshasana) has been created using 15 individuals (ten males and five females) with a normal RGB webcam and is made publicly available. A hybrid deep learning model is proposed using convolutional neural network (CNN) and long short-term memory (LSTM) for Yoga recognition on real-time videos, where CNN layer is used to extract features from keypoints of each frame obtained from OpenPose and is followed by LSTM to give temporal predictions. To the best of our knowledge, this is the first study using an end-to-end deep learning pipeline to detect Yoga from videos. The system achieves a test accuracy of 99.04% on single frames and 99.38% accuracy after polling of predictions on 45 frames of the videos. Using a model with temporal data leverages the information from previous frames to give an accurate and robust result. We have also tested the system in real time for a different set of 12 persons (five males and seven females) and achieved 98.92% accuracy. Experimental results provide a qualitative assessment of the method as well as a comparison to the state-of-the art.

[6] Yoga Asana Identification: A Deep Learning Approach Josvin Jose, Shailesh S

Yoga is a healthy practice that originated from India, to rejuvenate a man in his physical, mental, and spiritual wellness. Moving with the brisk technology advancements, there is a vast opportunity for computational probing in all social domains. But still, the utilization of artificial intelligence and machine learning techniques for applying to an interdisciplinary domain like yoga is quite challenging. In this work, a system that recognizes a yoga posture from an image or a frame of a video has been developed with the help of deep learning techniques like convolutional neural networks (CNN) and transfer learning. We have considered images of 10 different asanas for training the model as well as evaluating the prediction accuracy. The prediction model backed with transfer learning shows promising results with 85% prediction accuracy and this system can be considered as an initial step to build an automated yoga image and video analysis tool.

Methodology

- Data Collection and Preprocessing: Gather annotated yoga pose images or videos and preprocess them to standardize sizes, remove noise, and augment data as necessary.
- Model Selection and Training: Choose VGG19 for transfer learning, loading pre-trained weights and replacing final layers. Train the modified model on annotated data using SGD or Adam optimization.
- Evaluation and Validation: Assess model performance using metrics like accuracy, precision, recall, and F1 score. Validate effectiveness through user testing on a separate dataset.
- Real-Time Pose Detection: Implement real-time pose detection using the trained model and integrate with input sources like webcams for live sessions.
- User Interface Design: Design a user-friendly interface for capturing input data and visualize pose analysis results including detected poses and feedback.
- Accessibility and Customization: Ensure system accessibility for diverse users and provide customization options for input settings and feedback parameters.
- Deployment and Integration: Deploy the system on web apps, mobile apps, or desktop software and integrate with existing yoga platforms for enhanced user experience.
- Testing and Iteration: Conduct thorough testing to identify and address bugs or errors, iterating based on user feedback and emerging requirements.
- Documentation and Support: Document system details including architecture and dependencies, providing user documentation and support resources.
- Ethical Considerations: Ensure compliance with ethical principles regarding data privacy, fairness, and consent, addressing biases in design and deployment.

RESULTS

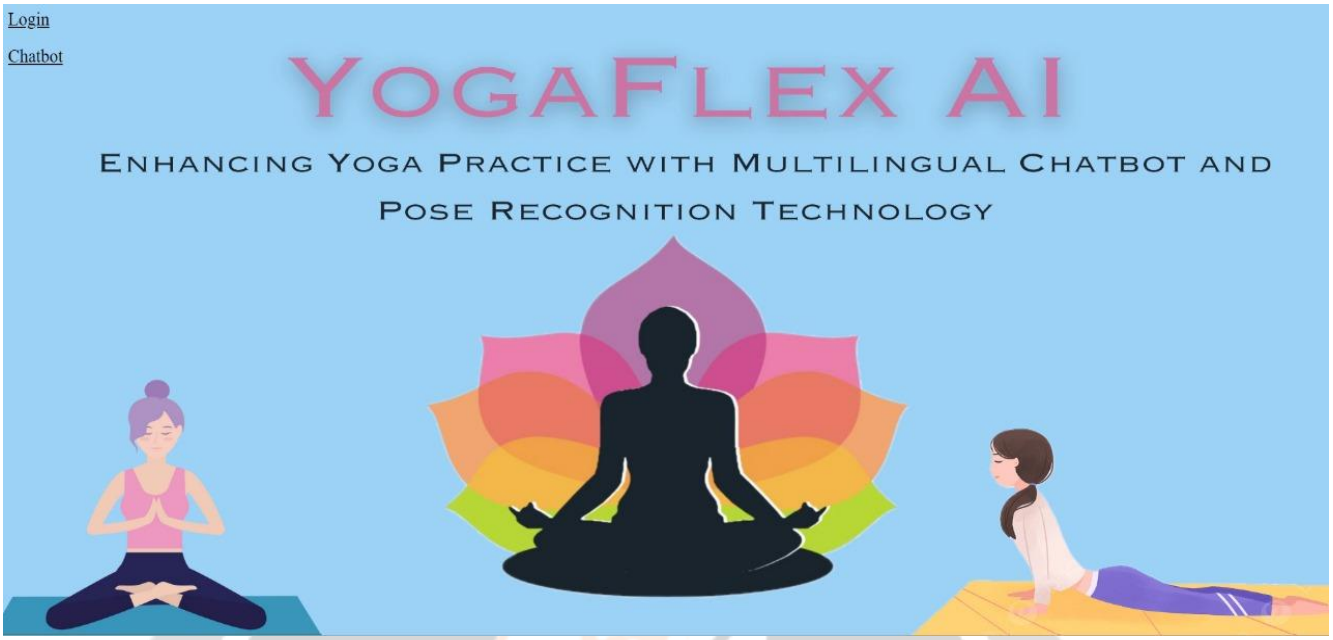


Fig1.User Interface

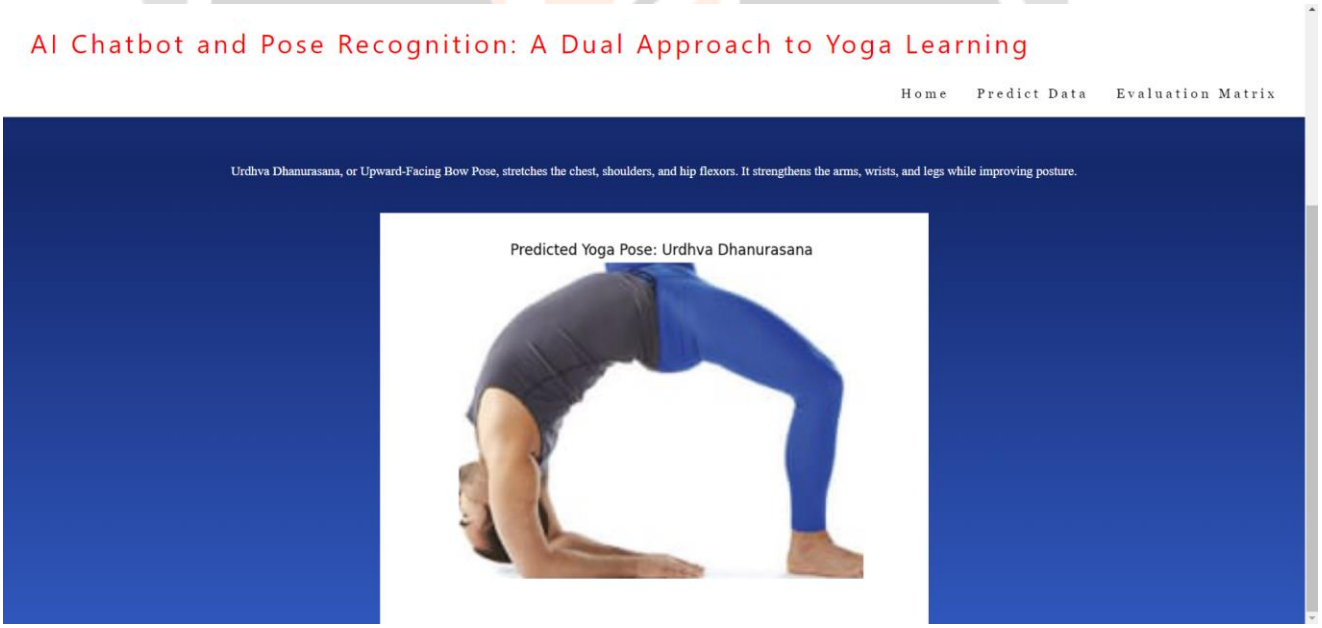


Fig2.Description of yoga pose

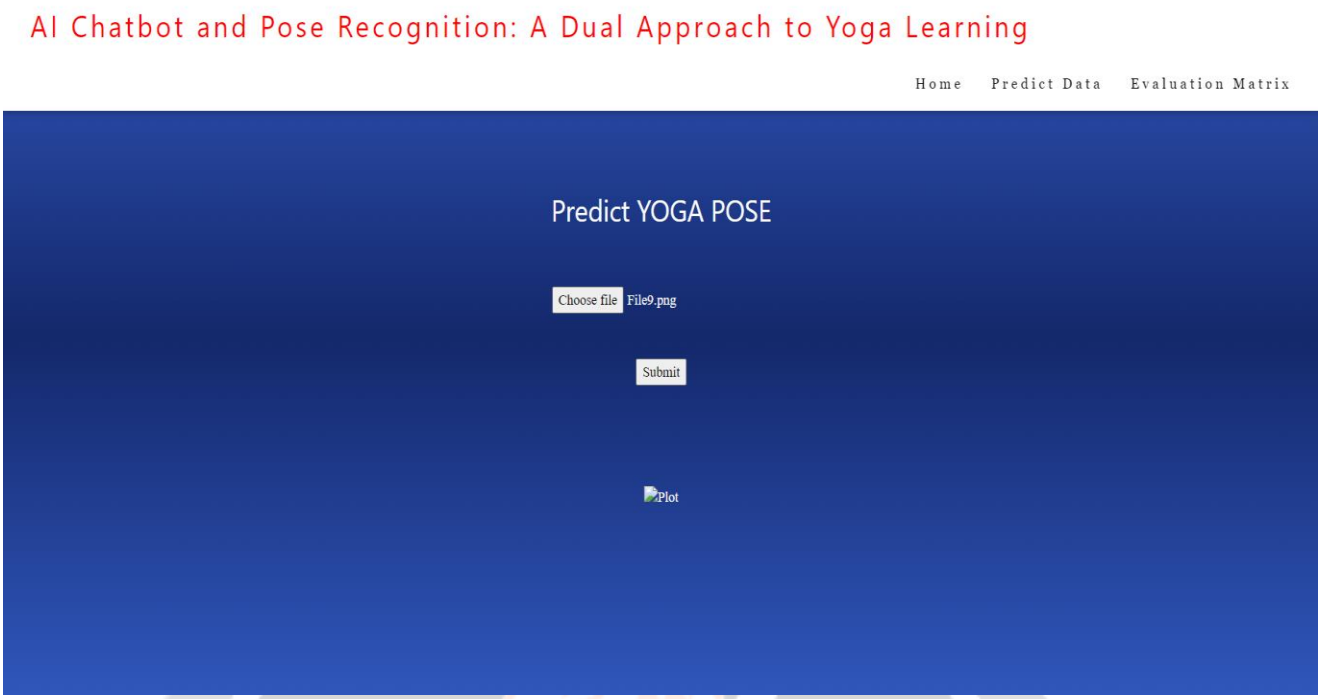


Fig3.Predict Yoga pose

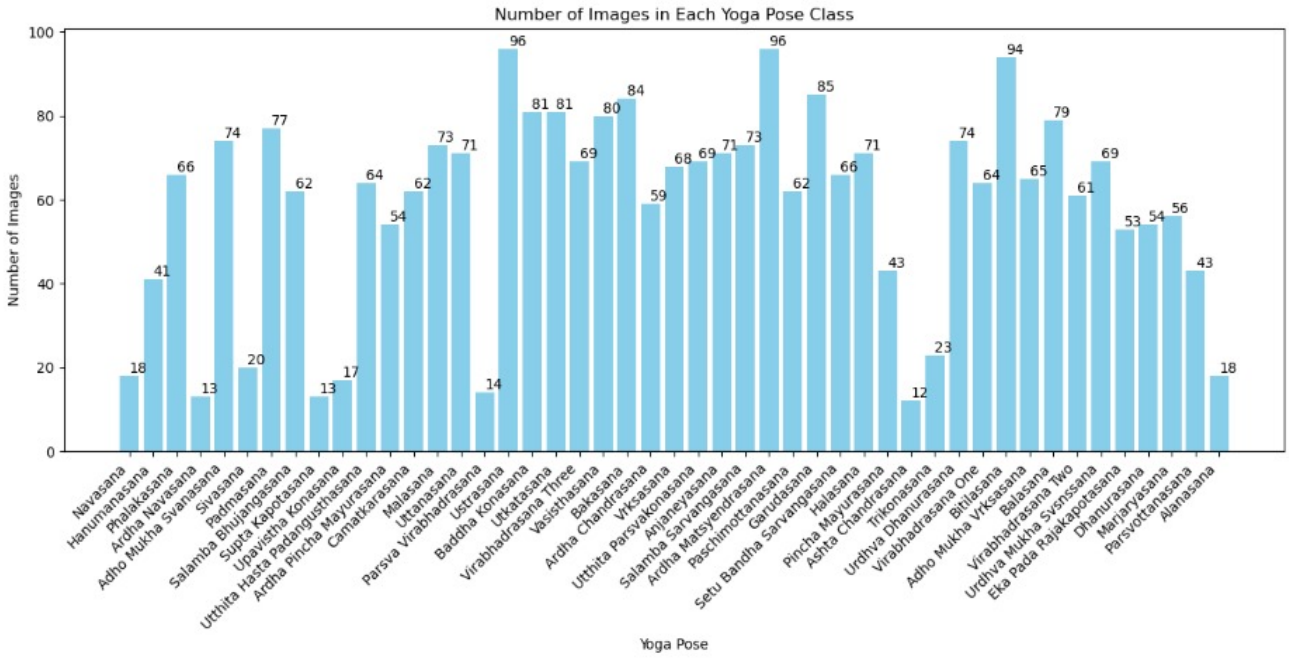


Fig4.Number of images in each class

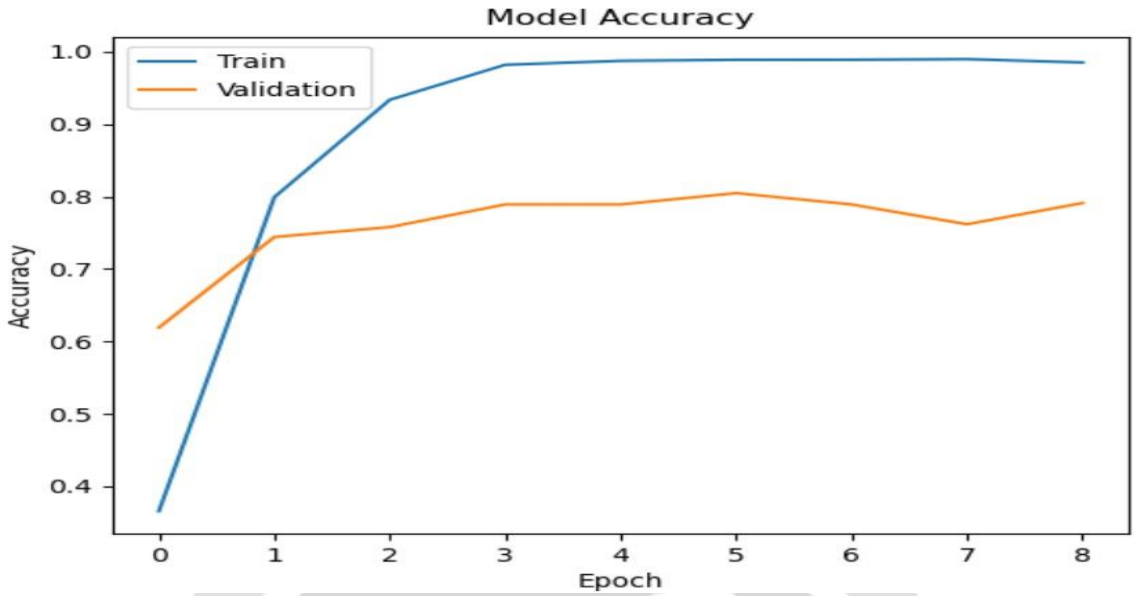


Fig5.Model Accuracy

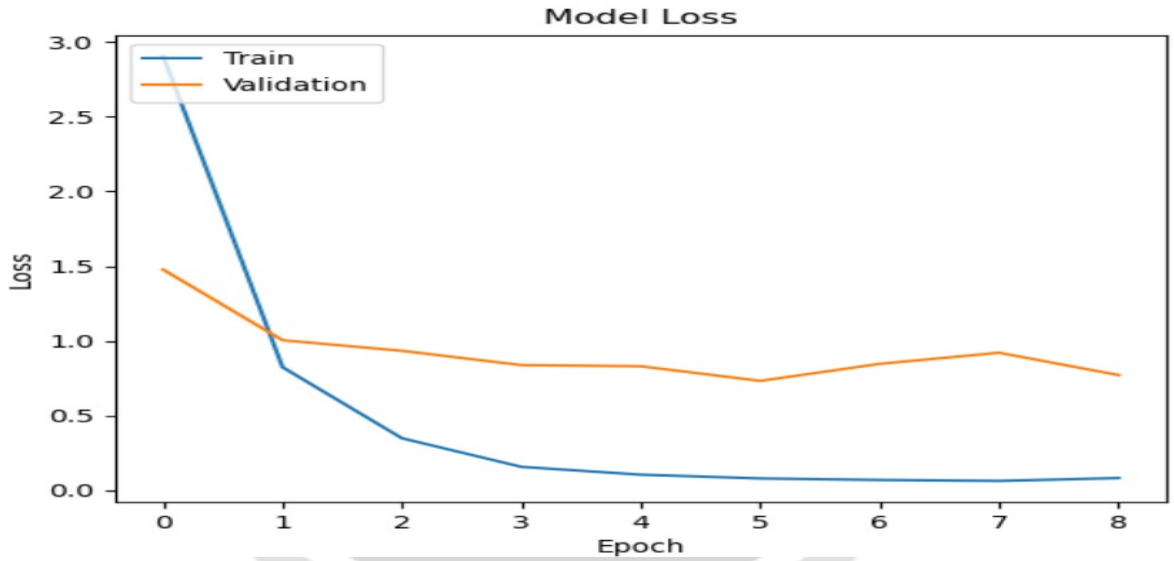


Fig6.Model loss

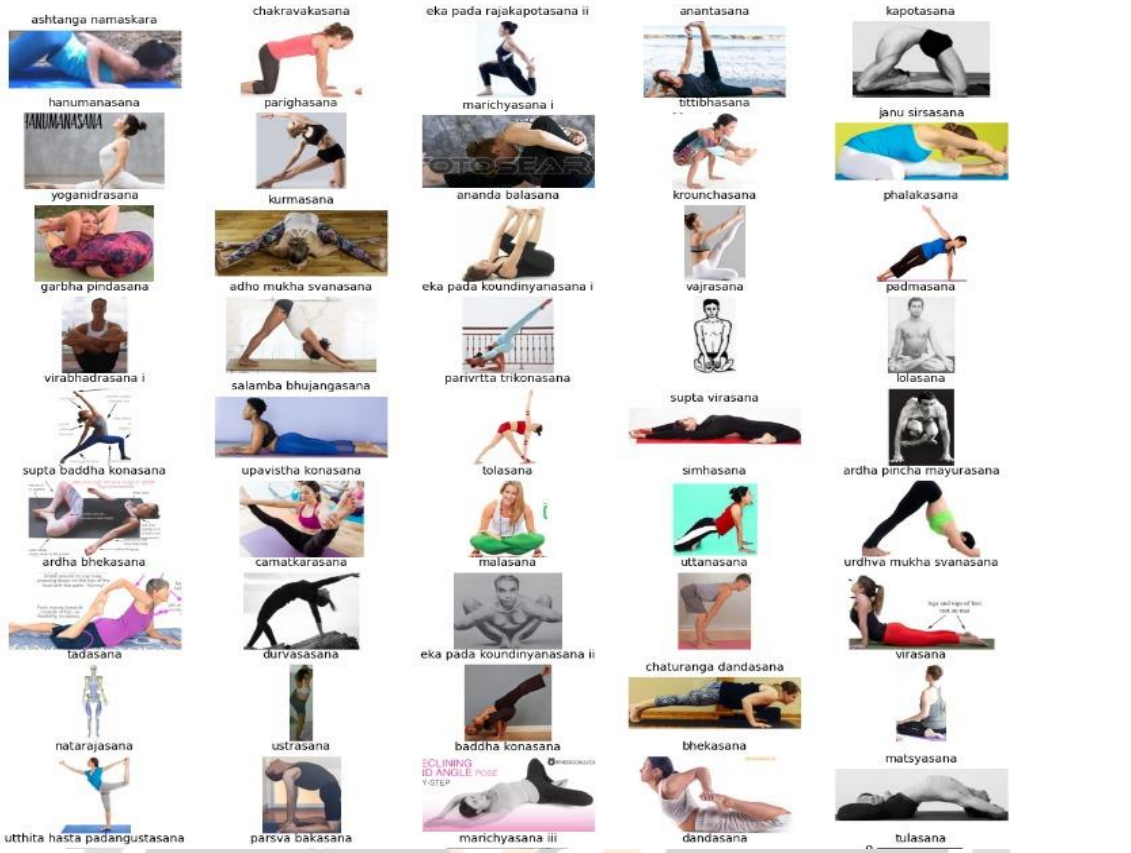
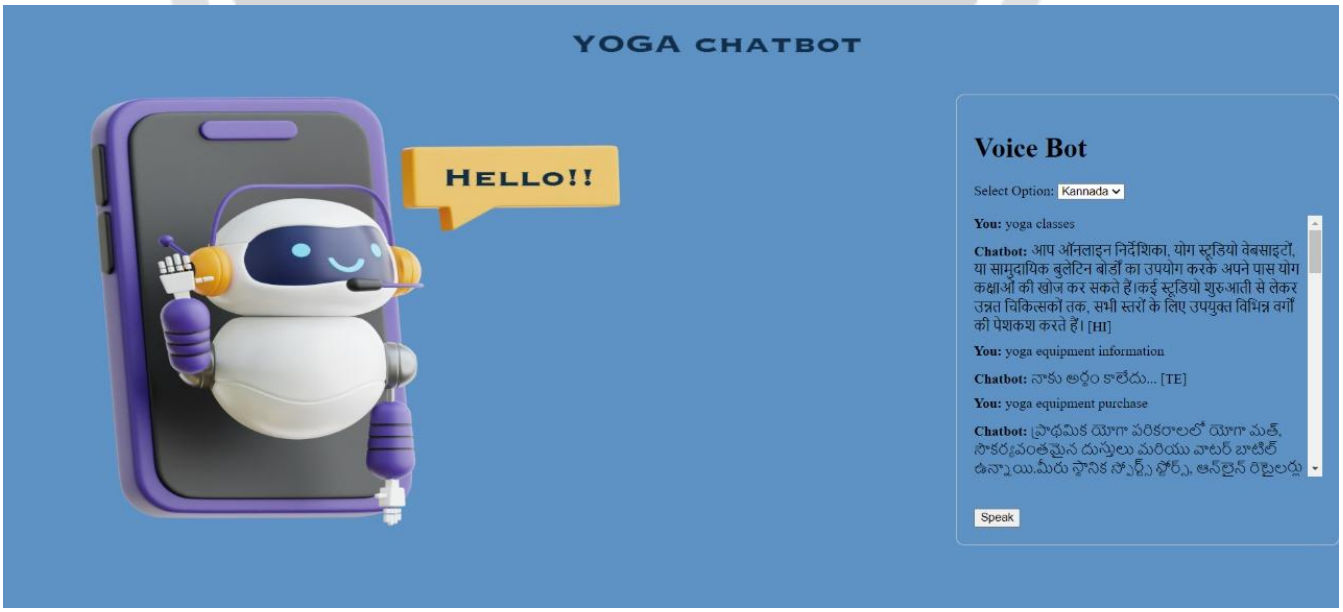


Fig7.Number of classes



CONCLUSION

the development of a yoga pose detection system using transfer learning with the VGG19 convolutional neural network architecture represents a significant step towards modernizing and enhancing the practice of yoga.

Through the integration of advanced machine learning techniques with traditional yoga principles, this system offers practitioners a powerful tool for improving their posture alignment, deepening their practice, and experiencing the transformative benefits of yoga with greater confidence and mindfulness.

By leveraging the pre-trained weights of the VGG19 model and fine-tuning it on a dataset of annotated yoga pose images, we harness the wealth of knowledge captured in the model's learned features and adapt it to the specific task of pose detection. The resulting model demonstrates promising performance in accurately classifying and localizing yoga poses within input images or video frames, providing practitioners with real-time feedback on their practice.

Furthermore, the proposed system prioritizes user experience and accessibility through intuitive user interfaces, customizable feedback options, and ethical considerations. By addressing user needs and concerns, we ensure that the system is not only effective and reliable but also inclusive, respectful, and user-centric.

As we continue to refine and iterate on the system, guided by user feedback, usability testing, and emerging advancements in machine learning, we envision a future where technology seamlessly integrates with yoga practice to enrich the lives of practitioners worldwide. Through collaboration, innovation, and a deep commitment to holistic well-being, we strive to empower individuals to cultivate balance, harmony, and vitality in mind, body, and spirit through the transformative practice of yoga.

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