Real-time yoga posture detection and correction using yolo v8

This project report is submitted to

Yeshwantrao Chavan College of Engineering

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Of

Bachelor of Technology in Information Technology

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CERTIFICATE OF APPROVAL

Certified that the Major Project entitled "**Real-time yoga posture detection and correction using yolo v8**" has been successfully completed by Mrunali Madarkar, Dhirenkumar Waghmare, Hemant Paunikar, Om Patle, Prathamesh Vijaywar, Suraj Bhoyar under the guidance of Mr. Amol Gaikwad in recognition of the fulfilment for the award of the degree of Bachelors of Engineering in Information Technology, Yeshwantrao Chavan College of engineering(*An Autonomous Institution Affiliated to Rashtrasant Tukdoji Maharaj University*) Nagpur.

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DECLARATION

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a) The work contained in this project has been done by us under the guidance of our supervisors.

b) The work has not been submitted to any other Institute for any degree or diploma.

c) We have followed the guidelines provided by the Institute in preparing the project report.

d) We have confirmed to the norms and guidelines given in the Ethical Code of Conduct of the Institute.

e) Whenever we have used materials (data, theoretical analysis, figures, and text) from other sources, we have given due credit to them by citing them in the text of the report and giving their details in the references. Further, we have taken permission from the copyright owners of the sources, whenever necessary.

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ACKNOWLEDGEMENT

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ABSTRACT

This thesis presents a novel approach to real-time yoga posture detection and correction using the YOLO v8 object detection algorithm. The system aims to assist practitioners in performing yoga poses correctly, thereby reducing the risk of injuries and enhancing the effectiveness of their practice. The system works by analysing live video feeds of practitioners and comparing their poses to a database of correct poses. If discrepancies are detected, real-time feedback is provided to guide the practitioner in adjusting their posture. The system also tracks the practitioner's progress over time, allowing for personalized feedback and recommendations. Experimental results demonstrate the effectiveness of the system in accurately detecting and correcting yoga postures, highlighting its potential to revolutionize the way yoga is practiced and taught.

Keywords: yoga, posture detection, correction, YOLOv8, real-time, feedback

CHAPTER 1
INTRODUCTION

1 INTRODUCTION

1.1 Overview

Yoga is a holistic practice that combines physical postures, breathing techniques, and meditation to promote physical, mental, and emotional well-being. However, practicing yoga incorrectly can lead to injuries and negate its benefits. To address this issue, researchers and developers are exploring innovative solutions to assist practitioners in performing yoga poses accurately.One such solution is the development of a real-time yoga posture detection and correction system using YOLOv8, an advanced object detection algorithm. YOLOv8, short for "You Only Look Once version 8," is renowned for its speed and accuracy in detecting objects in images and videos, making it an ideal candidate for this application.

The system works by first capturing live video of a person performing yoga poses. This video feed is then processed using YOLOv8 to detect key points on the practitioner's body, such as joints and body segments, which are crucial for determining the correctness of the pose. These key points are used to analyze the alignment and orientation of the body in real-time. Once the key points are detected, the system compares them against a database of correct yoga poses. If any discrepancies are found, the system provides real-time feedback to the practitioner, highlighting areas where adjustments are needed to achieve the correct posture. This feedback can be in the form of visual cues overlaid on the video feed or audio instructions to guide the practitioner.

Additionally, the system can track the practitioner's progress over time, allowing them to monitor their improvement and make adjustments to their practice. This feedback loop enhances the learning experience and helps practitioners refine their technique for maximum benefit.

Overall, the use of YOLOv8 for yoga posture detection and correction has the potential to revolutionize the way yoga is practiced and taught. By providing real-time feedback and guidance, this technology can help practitioners of all levels improve their practice, prevent injuries, and deepen their understanding of yoga principles.

1.2 About

The development of a real-time yoga posture detection and correction system using YOLO v8 involves several key steps. Here's an overview of the process:

1. Data Collection: The first step is to gather a diverse dataset of yoga poses performed correctly. This dataset should include images or videos of individuals of various body types and skill levels demonstrating each pose from different angles.

2. Data Annotation: Next, the dataset needs to be annotated to identify key points on the body relevant to each yoga pose. These key points typically include joints such as the shoulders, elbows, hips, knees, and ankles, as well as other body segments.

3. Model Training: The annotated dataset is used to train the YOLOv8 model to recognize these key points in real-time video feeds. The model is trained using a deep learning framework such as TensorFlow or PyTorch, with the goal of achieving high accuracy in detecting these key points.

4. Real-time Pose Detection: Once the model is trained, it can be deployed to perform real-time pose detection on live video feeds. The model analyzes the video frames, detects key points on the practitioner's body, and determines the pose being performed.

5. Pose Comparison: The detected pose is compared against the database of correct yoga poses to identify any discrepancies. This comparison is done based on the alignment and orientation of the key points, allowing the system to determine if the pose is being performed correctly.

6. Feedback Generation: If the system detects any errors in the pose, it generates real-time feedback to guide the practitioner. This feedback can be in the form of visual cues overlaid on the video feed, highlighting areas where adjustments are needed, or audio instructions providing guidance on correct alignment.

7. Progress Tracking: The system can also track the practitioner's progress over time, recording data on their performance and improvement. This data can be used to personalize the feedback and recommendations provided to the practitioner, enhancing their learning experience.

8. User Interface: A user-friendly interface is developed to display the real-time video feed, feedback, and progress tracking information to the practitioner. This interface should be intuitive and easy to use, enhancing the overall user experience.

In conclusion, the development of a real-time yoga posture detection and correction system using YOLOv8 involves data collection, annotation, model training, real-time pose detection, feedback generation, progress tracking, and user interface development. This system has the potential to revolutionize the way yoga is practiced and taught, making it more accessible and beneficial for practitioners of all levels.

1.3 Problem Statement

The problem statement for the real-time yoga posture detection and correction system using YOLOv8 is to address the challenges faced by practitioners in performing yoga poses correctly. Current methods rely on visual observation and verbal cues, which may not always be accurate or timely. The proposed system aims to provide real-time feedback to practitioners, helping them improve their posture alignment and maximize the benefits of their practice. By leveraging the speed and accuracy of YOLOv8, the system has the potential to revolutionize the way yoga is practiced and taught, making it more accessible and beneficial for practitioners of all levels.

1.4 Thesis Objectives

The objectives of the thesis on real-time yoga posture detection and correction using YOLO v8 are as follows:

1. To develop a dataset of correctly performed yoga poses, annotated with key points for training the YOLO v8 model.
2. To train the YOLO v8 model to accurately detect key points on the practitioner's body in real-time video feeds.
3. To implement a real-time yoga posture detection and correction system using the trained YOLOv8 model.
4. To integrate the system with a user-friendly interface for displaying live video feeds, feedback, and progress tracking.
5. To evaluate the performance of the system in terms of accuracy, speed, and user satisfaction through user studies and feedback.
6. To compare the system's performance with existing methods for yoga posture detection and correction.
7. To provide recommendations for future research and improvements to the system.

1.5 Thesis Contribution

The thesis on real-time yoga posture detection and correction using YOLO v8 aims to make the following contributions:

1. Development of a novel system for real-time yoga posture detection and correction, leveraging the speed and accuracy of YOLO v8 for key point detection.
2. Creation of a dataset of correctly performed yoga poses, annotated with key points, which can be used for training and benchmarking similar systems in the future.
3. Implementation of a user-friendly interface for displaying live video feeds, feedback, and progress tracking, enhancing the user experience.
4. Evaluation of the system's performance in terms of accuracy, speed, and user satisfaction, providing insights into its effectiveness and potential improvements.
5. Demonstration of the potential of deep learning techniques, specifically YOLO v8, in addressing complex real-world problems such as yoga posture detection and correction.
6. Contribution to the field of computer vision and human-computer interaction by
7. applying advanced techniques to improve health and well-being through yoga practice.

CHAPTER 2
REVIEW OF LITERATURE

2. REVIEWS OF LITERATURE

This research focuses on the development and application of YOLO v8 for detecting and correcting yoga postures based on keypoints. It explores the utilization of advanced computer vision techniques to accurately recognize key points on the human body and analyse yoga poses in real-time. By leveraging the capabilities of YOLO v8, the study aims to improve the efficiency and effectiveness of yoga practice by providing immediate feedback on posture alignment and technique.

1. Virtual Fitness Trainer using Artificial Intelligence

   Date of Conference: March 21th 2023

   Publisher: Jain (Deemed-to-be) University, Bangalore, India, School of CS & IT

   Authors: Neha D, Dr. S. K. Manju Bargavi

   This paper explores the development of a virtual fitness trainer using artificial intelligence, providing personalized fitness guidance through innovative technology. It discusses the integration of AI algorithms to analyse user movements, offer real-time feedback, and adapt workout routines based on individual progress and goals, thus revolutionizing the fitness industry with intelligent coaching.

2. AI Human Pose Estimation: Yoga Pose Detection and Correction

   Date of Conference: May 5th 2022

   Publisher: Department of Computer Engineering, Faculty of Computer Engineering, Pimpri Chinchwad College of Engineering and Research, Pune, Maharashtra

   Authors: R. Gajbhiye, S. Jarag, P. Gaikwad, S. Koparde

   The study focuses on using AI for human pose estimation, particularly in the context of yoga, to detect and correct poses for improved performance. By employing advanced computer vision techniques, the research aims to provide accurate feedback to practitioners, helping them achieve proper alignment and posture, thereby enhancing the effectiveness and safety of their yoga practice.

3. Computer Vision Based Workout Application

Date of Conference: April 23 rd 2023

Publisher: MVJ College of Engineering, Bangalore, Karnataka, India

Authors: Anusha S, Nayana Shree A, Nithin R, Pavan Prabhu N, Rahul D M

This paper presents a workout application leveraging computer vision for enhanced exercise guidance and performance monitoring. It delves into the design and implementation of a comprehensive system that uses real-time image processing to track movements, analyze workout intensity, and provide personalized recommendations, offering users a tailored fitness experience from the comfort of their homes.

4. Real-Time Posture Correction in Gym Exercise: A Computer Vision-Based Approach for Performance Analysis, Error Classification, and Feedback

Date of Conference: October 12th 2023

Publisher: Educational Technology Lab, German Research Center for AI

(DFKI), Berlin, Germany

Authors: H. Kotte, M. Kravčík, N. Duong-Trung

The research focuses on real-time posture correction in gym exercises, employing computer vision techniques for performance analysis and feedback generation. It addresses the challenges of ensuring proper form and technique during workouts by developing an intelligent system capable of identifying errors, classifying them, and providing corrective feedback in real-time, thereby assisting users in optimizing their training sessions and reducing the risk of injuries.

5. AI Fitness Coach at Home using Image Recognition

Date of Conference: September 29th, 2022

Publisher: University of Tokushima: Tokushima Daigaku

Authors: H. Ji, K. S. Githinji, T. Kenji

This study introduces an AI fitness coach for home use, utilizing image recognition technology to provide personalized coaching and guidance. It discusses the implementation of a smart fitness assistant capable of analyzing user movements, offering exercise recommendations, and tracking progress over time, thereby empowering individuals to achieve their fitness goals conveniently and efficiently within their own homes.

6. Yoga Pose Detection and Correction using Posenet and KNN

Date of Conference: September 23rd 2023

Publisher: Vidyalankar Institute of Technology, Mumbai, India

Authors: V. Bhosale, P. Nandeshwar, A. Bale, J. Sankhe

The paper explores the use of Posenet and KNN algorithms for yoga pose detection and correction, aiming to enhance yoga practice through technology. It elaborates on the integration of machine learning techniques to accurately recognize yoga poses, provide real-time feedback on alignment and posture, and guide practitioners towards achieving optimal performance and mindfulness during their yoga sessions.

7. Yoga Pose Estimation and Feedback Generation Using Deep Learning

Date of Conference: March 24th 2022

Publisher: Computer Science Engineering Department, Bennett University, Greater Noida, India

Authors: V. A. Thoutam, A. Srivastava, T. Badal, V. K. Mishra, G. R. Sinha, A. Sakalle, H. Bhardwaj, M. Raj

This research investigates yoga pose estimation and feedback generation using deep learning techniques, contributing to the advancement of yoga practice through technology. It discusses the development of an intelligent system capable of recognizing yoga poses from images or videos, providing detailed feedback on form and alignment, and assisting practitioners in improving their technique and achieving better results in their yoga practice.

2.1 PROJECT PRELIMINARY INVESTIGATION REPORT

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Title of the Project:

Real-time yoga posture detection and correction using yolo v8

Area of Project Work :

Computer vision, Deep learning

Problem Statement:

Develop a real-time system using YOLO V8 to detect and correct yoga postures, providing practitioners with immediate feedback for improved practice and reduced risk of injury.

Prior Art (Patent Search):

Patent System No.	Title of Patent	Existing Solutions (Abstract of Patent)
US20220310226A1	Method and system for measuring and analyzing body movement, positioning and posture	One aspect of the invention provides a computer-based method for providing corrective feedback about exercise form, the method comprising; recording a user performing a specific exercise: evaluating, by the computer, with machine learning, computer vision, or deep learning models that have been previously trained in order to evaluate the form of a user by training on labelled and or unlabeled datasets that consist of: both correct and incorrect exercise form for the different types of exercises being evaluated; identifying the user throughout the video
WO2011157754A2	Method and device for secured entry of personal data	The invention relates to a method for secured entry of personal data. This method comprises for each item of personal data a first step of presentation of a virtual keyboard (100) comprising keys (101, 104) and a first cursor (102), followed by a step of selection of a key corresponding to the item of personal data characterized in that the virtual keyboard also comprises at least one dummy cursor (501) and in that the position (502) on the virtual keyboard of the at least one dummy cursor (501) depends on the position of the first cursor (502).. The invention also relates to a device for secured entry of personal data implementing the method.

US11270455B2	Method and apparatus for pose processing	Provided is a method for pose estimation in a device, the method comprising capturing an image; estimating poses of an object included in the captured image; obtaining skeleton information of the object based on the estimating of the poses of the object; and processing the skeleton information of the object for at least one of detecting blocking of the object, detecting the poses of the object and adjusting content based on detected virtual object distinct from human body poses.

Literature Review:

Title of Paper	Details of Publication with Date and Year	Literature Identified for Project
1) Virtual Fitness Trainer using Artificial Intelligence	21 March 2023	This paper explores the development of a virtual fitness trainer using artificial intelligence, providing personalized fitness guidance through innovative technology. It discusses the integration of AI algorithms to analyze user movements, offer real-time feedback, and adapt workout routines based on individual progress and goals, thus revolutionizing the fitness industry with intelligent coaching.
2) AI Human Pose Estimation: Yoga Pose Detection and Correction	5 May 2022	The study focuses on using AI for human pose estimation, particularly in the context of yoga, to detect and correct poses for improved performance. By employing advanced computer vision techniques, the research aims to provide accurate feedback to practitioners, helping them achieve proper alignment and posture, thereby enhancing the effectiveness and safety of their yoga practice.
3) Computer Vision Workout Applicatior	23 April 2023	This paper presents a workout application leveraging computer vision for enhanced exercise

		guidance and performance monitoring. It delves into the design and implementation of a comprehensive system that uses real-time image processing to track movements, analyze workout intensity, and provide personalized recommendations, offering users a tailored fitness experience from the comfort of their homes.

4) Real-Time Posture Correction in Gym Exercises: A Computer Vision-Based Approach for Performance Analysis, Error Classification, and Feedback	12 October 2023	The research focuses on real-time posture correction in gym exercises, employing computer vision techniques for performance analysis and feedback generation. It addresses the challenges of ensuring proper form and technique during workouts by developing an intelligent system capable of identifying errors, classifying them, and providing corrective feedback in real-time, thereby assisting users in optimizing their training sessions and reducing the risk of injuries.
5)AI Fitness Coach at Home using Image Recognition	29 September 2022	This study introduces an AI fitness coach for home use, utilizing image recognition technology to provide personalized coaching and guidance. It discusses the implementation of a smart fitness assistant capable of analyzing user movements, offering exercise recommendations, and tracking progress over time, thereby empowering individuals to achieve their fitness goals conveniently and efficiently within their own homes.

6)Yoga Pose Detection and Correction using Posenet and KNN	23 September, 2023	The paper explores the use of Posenet and KNN algorithms for yoga pose detection and correction, aiming to enhance yoga practice through technology. It elaborates on the integration of machine learning techniques to accurately recognize yoga poses, provide real-time feedback on alignment and posture, and guide practitioners towards achieving optimal performance and mindfulness during their yoga sessions.
7)Yoga Pose Estimation and Feedback Generation Using Deep Learning	24 March 2022	This research investigates yoga pose estimation and feedback generation using deep learning techniques, contributing to the advancement of yoga practice through technology. It discusses the development of an intelligent system capable of recognizing yoga poses from images or videos, providing detailed feedback on form and alignment, and assisting practitioners in improving their technique and achieving better results in their yoga practice.

Current Limitations

- Limited Detection Scope: The current model primarily focuses on detecting a restricted set of yoga postures, potentially overlooking others.
- Insufficient Data: Due to the scarcity of high-quality data for model training, its effectiveness might be compromised.

Proposed Solution

- Enhanced Detection Scope: Addressing the current model's limited scope, future endeavours could aim to broaden its capabilities for detecting a wider array of yoga postures beyond those currently included. By expanding the model's repertoire, practitioners can receive more comprehensive feedback on various yoga poses, thereby enhancing their practice experience.
- Data Augmentation Techniques: To mitigate the challenge of limited data availability and quality for training purposes, future research could emphasize the augmentation of existing datasets through techniques such as data synthesis. By generating synthetic data or incorporating additional annotated images, the model can be trained more effectively, improving its accuracy and robustness in detecting and correcting yoga postures.
- Accessibility Improvements: To enhance the accessibility of the web-based system, future efforts could explore strategies to make it accessible offline or through mobile platforms. By enabling access via mobile devices, the system can reach a broader audience of yoga practitioners, including those in areas with limited internet connectivity or access to desktop computers. This expansion in accessibility can facilitate widespread adoption and utilization of the posture detection and correction technology, benefiting a larger population of yoga enthusiasts.

Objectives and Scope of Work

Objectives:

1. **Development of Real-Time system**: Develop and optimize a real-time yoga posture detection system based on YOLOv8, capable of accurately identifying various yoga poses from live video feeds.
2. **Posture Correction Mechanism**: Design and implement a system to provide real-time feedback to practitioners, assisting them in correcting their yoga postures based on detected discrepancies between their poses and reference poses.
3. **User Interface Design and Usability**: Design an intuitive user interface for the system to enhance user experience and usability, considering factors such as ease of use and accessibility.

Scope of Work:

1.Data Collection and Annotation: Collect a dataset of yoga poses with 100 images for each pose and annotate them with keypoints using the CVAT website.

2.Model Training: Train the YOLO v8 model using the annotated dataset to detect and recognize keypoints of various yoga poses.

3.System Development: Develop a system that integrates the trained model to provide real-time feedback on yoga postures. This includes developing a user interface for practitioners to interact with the system.

Feasibility Assessment:

I. Expected Outcomes of the Project

1. **Accurate Pose Detection**: The system will be capable of accurately detecting various yoga poses in real-time from live video feeds, leveraging the capabilities of the YOLOv8 object detection algorithm.
2. **Real-time Feedback Mechanism**: Practitioners will receive real-time feedback on their yoga postures, helping them to correct alignment and form during their practice sessions.
3. **Reduced Risk of Injuries**: By providing instant feedback and guidance on correct posture alignment, the system aims to reduce the risk of yoga-related injuries caused by improper form or alignment.
4. **Enhanced Practice Effectiveness**: With the assistance of real-time correction, practitioners can improve the effectiveness of their yoga practice by ensuring proper alignment and maximizing the benefits of each posture.
5. **Personalized Recommendations**: The system may offer personalized recommendations based on individual practitioners' progress and areas for improvement, allowing for tailored guidance and support.
6. **User-Friendly Interface**: An intuitive user interface will facilitate ease of use for practitioners, making it accessible to individuals with varying levels of experience and technical proficiency.

II. Innovation Potential

The innovation potential lies in streamlining the process of identifying and correcting yoga postures, thereby optimizing practice sessions and potentially minimizing the risk of injuries. This innovation has the capacity to enhance the efficiency and effectiveness of yoga practice, making it more accessible and beneficial for practitioners of all levels.

III. Task Involved

- Collection of yoga images.
- Image preprocessing .
- Model selection YOLO v8.
- Training of model.
- Model evaluation .
- Web system development.
- Model deployment .

IV. Expertise Required

1. Inhouse Facilities:
   -Software Development Tools
   -Data Storage
   -Testing Environment:

2. External Facilities:
   -Cloud Computing Services
   -Testing Facilities.

V. Facilities Required

- Computing power .
- Data storage .
- Software .
- Internet connectivity.
- Web hosting service.

Milestones and Time Plan.

	Task	JAN 2024	FEB 2024	MAR 2024	APR 2024	MAY 2024	JUNE 2024
Design	Conceptual Design		**Done**				
	Detailed design			**Done**			
	Design Modifications			**Done**			
	Final Design				**Done**		
Develop	Procurement (If any)		**Done**				
	Prototyping				**Done**		
	Modifications					**Done**	
Deliver	Testing and Validation					**Done**	
	Final Modifications					**Done**	

	IPR / patent draft						**Done**
	Thesis and Poster						**Done**

In progress

Completed

Name and Signature of Project Guide

Signature of HOD

CHAPTER 3 WORK DONE

3. WORK DONE

3.1 About Dataset:

The dataset created for this project follows a systematic approach to collect and annotate yoga pose images for training and validation purposes. Here's a brief description of the dataset creation process:

1. Data Collection: A total of 500-600 images were collected specifically for yoga poses. Each yoga pose category was represented by around 100 images, ensuring diversity and coverage of various poses.

2. Data Split: The collected images were divided into two parts: training images and validation images. This division helps in training the model on one set of data and evaluating its performance on another set to measure generalization.

3. Annotation Tool: The annotation process was carried out using the CVAT.ai platform, which provides tools for annotating keypoints in images. Key keypoints relevant to yoga poses were annotated on the images to create a detailed pose description.

4. Skeleton Creation: A 5-skeleton structure was defined for annotating key body joints and landmarks necessary for identifying yoga postures accurately. This skeleton structure likely included keypoints for major joints like shoulders, elbows, wrists, hips, and knees, depending on the yoga poses being annotated.

5. Annotation Application: Annotations created using CVAT.ai were then applied to the training and validation images based on the defined skeleton. This step ensures that each image has corresponding keypoint annotations for the yoga poses depicted.

6. Export Format: The annotated data was exported in the COCO Keypoint 1.0 format, a widely used format for keypoint annotations in computer vision tasks. The exported data was packaged into zip files for further processing.

7. Data Conversion: To make the dataset compatible with the YOLOv8 model, a custom function was developed to convert the COCO keypoint files (in JSON format) into YOLO format text files. This conversion process mapped the keypoint annotations to bounding boxes, which are essential for YOLO-based object detection models.

8. Final Dataset: After completing the conversion and formatting steps, the dataset was ready for training the YOLOv8 model for yoga posture detection and correction tasks. The

dataset includes both training and validation images along with their corresponding annotations in the YOLO format.

This meticulously created dataset forms the foundation for training the machine learning model to accurately detect and correct yoga postures based on keypoint annotations. It reflects a structured approach to data collection and annotation essential for developing robust computer vision applications in the yoga domain. The below images are belonging to the five different yoga postures:

Fig 3.1.1 Anjaneyasana

Fig 3.1.2 Katichakrasana

Fig 3.1.3 Padmasana

Fig 3.1.4 Trikonasana

Fig 3.1.5 Vrkasana

Table 3.1 Train and valid images data description

Pose Name	Total Images
Anjaneyasana	103
Katichakrasana	100
Padmasana	102
Trikonasana	107
Vrkasana	101
Total	513

3.2 Proposed Methodology:

YOLO v8 is a state-of-the-art object detection algorithm known for its speed and accuracy. It operates by dividing the input image into a grid and predicting bounding boxes and class probabilities directly from this grid. YOLO v8 has evolved from previous versions like YOLO v3 and incorporates improvements in architecture and training techniques, making it suitable for real-time object detection tasks.

Data for Training: The project involves creating a custom dataset specifically tailored for yoga posture detection and correction. This dataset includes annotated images or videos of various yoga poses, with keypoints or landmarks annotated to represent key body joints relevant to yoga postures. Annotating the dataset with keypoints enables precise analysis of posture correctness and facilitates corrective feedback during inference.

3.2.1 Approach for system development :

- Data Collection: Collecting a sufficient number of images or videos depicting different yoga poses. It's important to capture variations in poses, body orientations, lighting conditions, and backgrounds to ensure dataset diversity.

- Annotation Process: Annotating the collected data with keypoints representing key body joints such as shoulders, elbows, wrists, hips, and knees. The annotation process ensures that the model can accurately detect and analyze posture alignment during inference.

- Dataset Splitting: Dividing the annotated dataset into training and validation sets. The training set is used to train the YOLOv8 model to detect yoga postures and keypoints, while the validation set helps evaluate the model's performance and generalization ability.

- Model Training: Training the YOLOv8 model using the annotated dataset to learn the features and patterns necessary for yoga posture detection and correction. Transfer learning techniques may be employed to leverage pre-trained YOLO v8 models or architectures pre-trained on general object detection tasks.

- Evaluation and Fine-tuning: Evaluating the trained model on the validation set to assess its accuracy, precision, recall, and other performance metrics. Fine-tuning the model based on evaluation results and iteratively improving its performance.

- Post-processing and Correction: Implementing post-processing techniques to refine detected keypoints and provide actionable feedback for posture correction. This may involve comparing detected keypoints with reference poses or guidelines to identify alignment errors and suggest corrective measures.

3.2.2 Model Architecture:

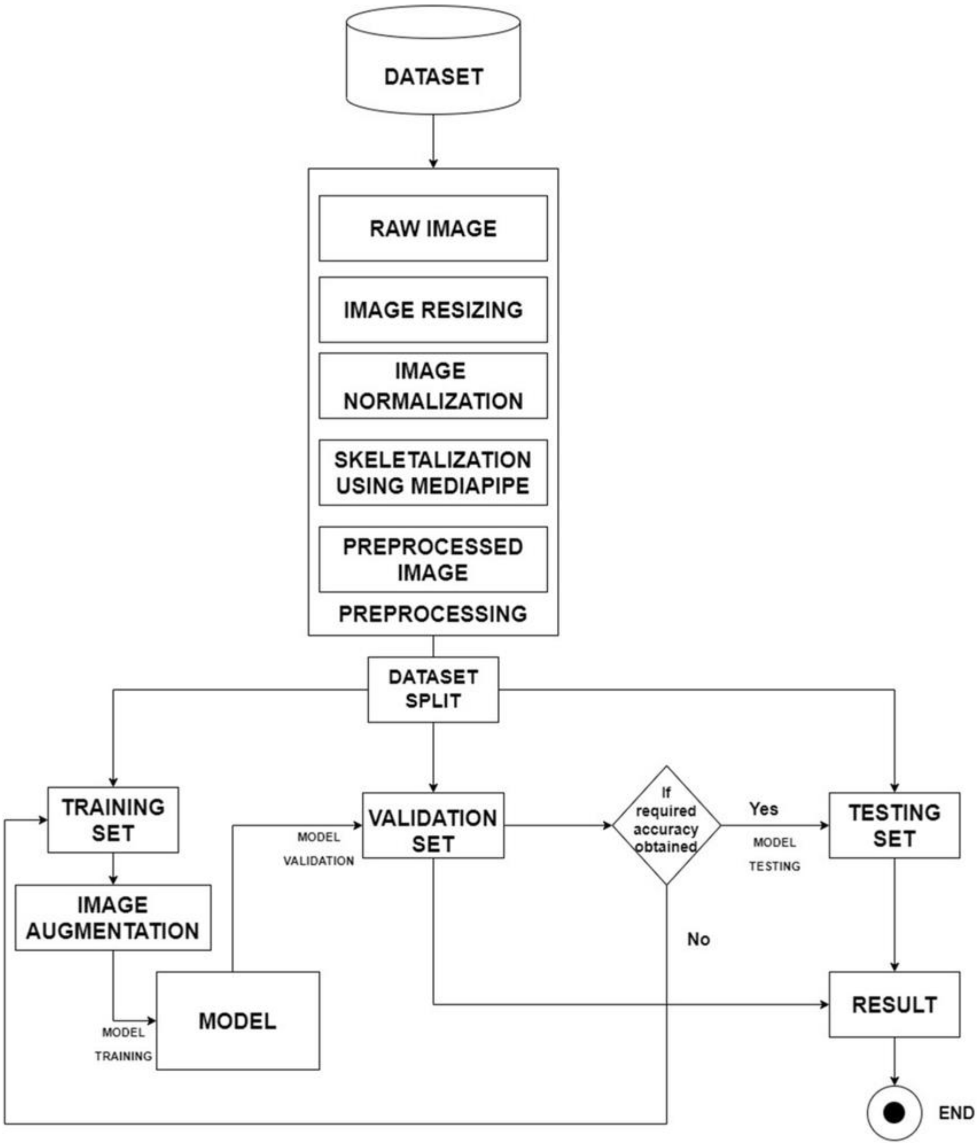

Fig 3.2.2 System Architecture

1. Dataset: The size, source, and other pertinent information about the dataset utilized in the study are described in section.
2. Raw Image: Describes the initial, raw photos that were taken from the dataset, emphasizing any necessary preparatory steps like scaling or normalization.
3. Image Resizing: Describes how the raw photos are resized to a standard dimension to provide consistency and computational efficiency throughout processing.
4. Image normalizing : Talks about how normalizing is used to improve model convergence and performance by scaling down pixel values to a uniform range.

5. Skeletalization with MediaPipe: An overview of the technique used is given, with a focus on how it helps extract structural information or important elements from the photos. It may be implemented using the MediaPipe library.

6. Preprocessed Image: Shows the image after it has been resized, normalized, and skeletonized, highlighting the changes made to get the data ready for analysis.

7. Preprocessing: Describes the preprocessing pipeline in detail, including the particular actions used to get the pictures ready for further examination or model training.

8. Dataset Split: Explains how the dataset was split into subsets for testing, validation, and training. It also provides an explanation of the logic behind the split ratios that were used.

9. Training Set: Describes the size and makeup of the dataset subset that is meant to be used for model training.

10. Model Validation: Describes the steps involved in validating a model, including holdout validation and cross-validation, which are used to evaluate the model's performance and avoid overfitting.

11. Validation Set: Offers information on the data subset set aside for model validation. describing its function in adjusting hyperparameters and assessing model performance.

12. whether Required Accuracy Obtained (Yes/No): Describes the standards by which the model is evaluated to see whether it has hit the required accuracy threshold. It may also include references to performance goals or benchmark measures.

13. Model: Describes the architecture, parameters, and any improvements or alterations made to the machine learning model that was used in the study.

14. Testing Set: Examines the portion of the data that was used to test the final model's performance, emphasizing how it was isolated from the training and validation sets to guarantee objectivity.

15. Testing: Explains how the trained model is applied to the testing set and what metrics or standards are applied to evaluate the model's performance on untested data.

16. Result: Displays the results of the testing stage, which includes any conclusions drawn from the research as well as model performance data like accuracy, precision, recall, and F1-score.

17. picture Augmentation: Describes the precise picture alterations used and discusses the augmentation methods used to improve dataset variety and model resilience.

18. Model Training: Describes the machine learning model's training procedure in detail, covering the computing resources used as well as optimization strategies, loss functions, and convergence criteria.

The system involves a pipeline starting from data collection to the final result. Initially, data is collected, which includes images or videos of various yoga poses along with annotated keypoints representing key body joints. This data is then preprocessed and augmented as needed before being fed into the pose detection model, such as YOLO v8 with keypoints. The model processes the data, detects key body landmarks, and extracts relevant features for posture analysis. Post-detection, the system splits the dataset into training and validation sets for model training and evaluation, respectively. The trained model is then used to analyze real-time or recorded yoga postures, calculating angles and similarities with reference poses. Based on these calculations, the system provides feedback on posture correctness or suggests corrections to the user, thereby completing the pipeline and delivering the desired result of improved yoga posture alignment and practice.

3.3 Requirement:

3.3.1 Python:

Python is a high-level programming language known for its simplicity, readability, and vast ecosystem of libraries and frameworks. In the context of the project "Yoga Posture Detection and Correction Using YOLO v8 with keypoints," Python serves as the primary programming language for developing the computer vision algorithms, data processing, user interface, and system integration.

Python offers a wide range of libraries and tools for machine learning, computer vision, and web development, making it suitable for implementing complex projects like posture detection and correction.

Popular libraries such as NumPy, OpenCV, TensorFlow, and PyTorch are commonly used in Python for deep learning, image processing, and neural network modeling, which are essential components of this project.

3.3.2 PyCharm (in Conda environment):

PyCharm is an integrated development environment (IDE) specifically designed for Python development. It provides features such as code completion, debugging tools, version control integration, and project management functionalities.

3.3.3 Conda Environment:

- Conda is a package and environment management system for installing and managing software packages and dependencies. Using PyCharm within a Conda environment ensures that the project's specific dependencies and versions are isolated and managed efficiently.
- Conda environments allow for creating a reproducible and consistent development environment across different machines and platforms, enhancing project collaboration and deployment.

3.3.4 Ultralytics:

Ultralytics is a deep learning research group known for developing and maintaining state-of-the-art object detection models, including YOLOv5 and YOLOv8. In the context of this project, the Ultralytics library provides implementations of YOLOv8 and related utilities for object detection tasks.

3.3.5 YOLOv8 Implementation:

The Ultralytics library simplifies the implementation of YOLOv8 for object detection tasks, offering functionalities for model training, inference, evaluation, and visualization.
Leveraging the Ultralytics library ensures access to optimized and up-to-date implementations of YOLOv8, saving time and effort in model development and experimentation.

3.3.6 Streamlit:

Streamlit is a popular open-source framework for building interactive web systems specifically designed for data science and machine learning. It plays a crucial role in the field of data science due to the following reasons:

▪ Interactive data visualization: Data visualization is a fundamental aspect of data science, and Streamlit excels in this area. It offers a wide range of interactive visualization capabilities, including charts, plots, maps, and tables. These features enable data scientists to explore and present their data effectively, making it easier to derive insights and communicate findings.

▪ Integration with machine learning libraries: Streamlit seamlessly integrates with popular machine learning libraries, such as TensorFlow, PyTorch, and scikit learn. This allows data scientists to build end-to-end machine learning pipelines within Streamlit systems. They can train models, perform data preprocessing, evaluate performance, and deploy predictions, all in a single unified environment.

▪ Real-time collaboration: Streamlit's capabilities extend beyond individual data scientists. It enables real-time collaboration by allowing multiple users to interact with and modify a system simultaneously. This feature is particularly valuable for team projects, fostering collaboration, knowledge sharing, and joint exploration of data.

▪Deployment flexibility: Streamlit systems can be deployed locally or on various platforms, including cloud services like Heroku, AWS, or Azure. This flexibility enables data scientists to share their work with stakeholders, colleagues, or clients easily. Streamlit also offers options for containerization, making it compatible with containerization technologies like Docker.

Overall, Streamlit empowers data scientists by providing an intuitive and efficient way to develop, visualize, and share data science systems. Its simplicity, flexibility, and integration with popular libraries make it a valuable tool for data science projects.

3.4 Flow of Yoga Posture Detection and Correction System:

1. Data Gathering and Annotation: Compile a wide range of pictures or videos showing people in different yoga positions. Add key points to the dataset that correspond to important joints or body parts—such as the wrists, elbows, shoulders, hips, knees, and ankles—that are pertinent to each yoga posture.

2. Preparing data: To prepare the annotated data for YOLOv8 model training, extract key points from the data and format them properly. To guarantee uniformity across the collection, resize photos or video frames to a consistent size and normalize key points.

3. Training Models: To take use of learnt features, start the YOLOv8 model with pre-trained weights on a large dataset, like COCO. Use transfer learning to fine-tune the model on the annotated yoga posture dataset, modifying weights to identify yoga postures based on key points.

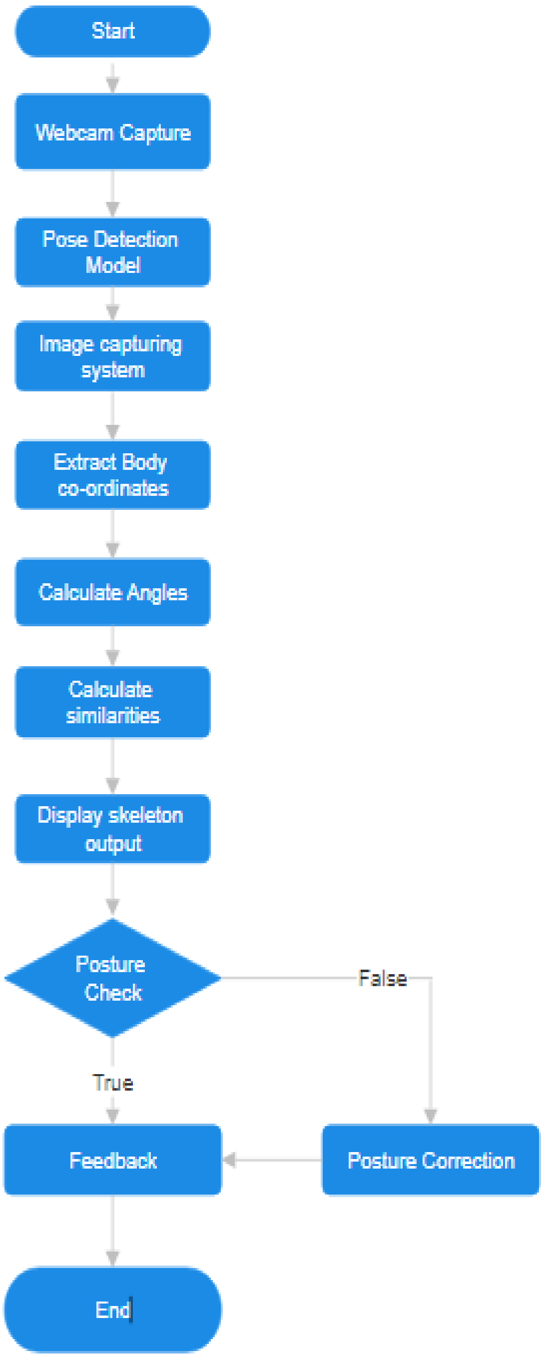

Fig.3.4 Work flow of system

4. Post-processing: To extract identified key points and their related locations in each picture or video frame, process the YOLOv8 model's output. To accurately recognize yoga poses, remove noisy or incorrect key points and adjust their placements.

5. Yoga Pose Identification: To identify the yoga postures that people are doing in the picture or video frames, use the key points that have been recognized. To categorize and identify the executed postures, compare the key point positions with a database of recognized yoga poses.

6. Correcting Posture: In the event that the identified yoga postures require enhancement or modification, provide practitioners advice or comments based on the identified essential elements. Put guidelines or directions across the picture or video frames to assist people in repositioning themselves for optimal alignment.

7. Evaluation and Validation: Utilizing a different validation dataset, assess how well the trained YOLOv8 model and posture recognition system function. Verify the precision of yoga position identification and adjustment by contrasting with expert assessments and ground truth annotations.

The proposed methodology outlines a systematic flow for the "Yoga Posture Detection and Correction" system using a combination of webcams, pose detection models, image processing, and feedback mechanisms. Here's a detailed explanation of each step in paragraph form:

The process begins with the "Webcam Capture" step, where a webcam or similar camera captures real-time video footage of a person performing yoga poses. This live video feed serves as the input to the system for posture analysis.

Next, the "Pose Detection Model" comes into play. This model, such as YOLOv8 with keypoints or other advanced pose estimation models like OpenPose, processes the video frames and detects key body landmarks or keypoints relevant to yoga postures. These keypoints include joints such as shoulders, elbows, wrists, hips, and knees, crucial for posture analysis.

After the pose detection stage, the "Image Capturing System" extracts the coordinates of key body points from the detected keypoints. These coordinates represent the positions of various body parts in the yoga pose being performed.

With the extracted body coordinates available, the system proceeds to "Calculate Angles." Using trigonometric calculations or geometric methods, the system computes angles between body segments, such as the angle between the upper arm and forearm, or the angle between the thigh and calf. These angles provide insights into the alignment and correctness of the yoga pose.

Following angle calculations, the system moves to "Calculate Similarities." Here, it compares the calculated angles against predefined reference angles or ideal posture guidelines. This comparison helps determine how closely the user's posture aligns with the desired or correct posture for the specific yoga pose.

Based on the similarity calculations, the system branches into two paths: "Display Skeleton Output" and "Posture Check." If the similarity check indicates that the posture is accurate or within acceptable ranges, the system proceeds with "Posture Check if True." In this case, it provides positive feedback to the user, acknowledging the correct posture alignment. The system may display a skeleton overlay on the video feed, highlighting key body points and angles to reinforce correct alignment.

On the other hand, if the similarity check indicates a deviation from the correct posture, the system enters "Posture Correction." Here, it provides corrective feedback to the user, highlighting areas where adjustments are needed to improve posture alignment. The feedback can be visual cues, textual instructions, or even auditory prompts guiding the user on corrective actions.After providing feedback, the system reaches an "End" state for the current iteration. The process loops back to the beginning, capturing the next frame from the webcam to continuously monitor and provide feedback on the user's yoga postures. This iterative loop ensures ongoing posture analysis, correction, and feedback during the user's yoga practice session.

3.5 Availability of System on cloud:

Making the system available on the cloud offers significant advantages in terms of accessibility, scalability, reliability, and cost-effectiveness. By deploying the "Yoga Posture Detection and Correction" system on cloud infrastructure, users can access it from anywhere with an internet connection, eliminating geographical constraints and enhancing user convenience. This accessibility is particularly beneficial for individuals who may want to practice yoga remotely or access the system from different devices.

Cloud platforms provide scalable resources, allowing the system to handle varying workloads efficiently. Whether there is a surge in user activity or the need for additional computational power, cloud services can dynamically allocate resources to meet demand, ensuring optimal performance and responsiveness. This scalability is crucial for accommodating fluctuations in usage patterns and scaling the system as needed without the constraints of physical hardware limitations.

Moreover, cloud environments are designed for high availability and reliability, with built-in redundancy and failover mechanisms. This ensures that the system remains accessible and operational even during hardware failures or maintenance events, minimizing downtime and disruptions to users.

From a cost perspective, cloud services offer pay-as-you-go pricing models, where users only pay for the resources they consume. This eliminates the need for upfront hardware investments and provides cost flexibility as the system scales. Cloud providers also offer a range of managed services and tools for deployment, monitoring, and management, streamlining operations and reducing administrative overhead.

Absolutely, leveraging cloud infrastructure offers numerous advantages for deploying systems like "Real-time Yoga Posture Detection and Correction." Accessibility is greatly enhanced as users can access the system from anywhere with an internet connection, promoting inclusivity and convenience. Scalability is crucial for handling varying user loads, ensuring that the system can expand or contract resources dynamically based on demand, optimizing performance.

Reliability is another key benefit; cloud providers typically offer robust service level agreements (SLAs) guaranteeing uptime and performance, reducing downtime risks. Cost-efficiency is achieved through pay-as-you-go models, where resources are allocated based on usage, eliminating the need for upfront hardware investments and allowing for cost optimization over time.

These advantages collectively contribute to a seamless and optimized user experience, where users can interact with the yoga posture detection and correction system reliably, efficiently, and cost-effectively, ensuring satisfaction and usability.Integration with Other Cloud Services: Cloud storage services often integrate seamlessly with other cloud services provided by the same provider. This integration enables us to leverage additional services such as computer resources, databases, analytics, AI services, and more, enhancing the capabilities of our system.

These advantages make cloud storage an attractive option for storing systems, providing businesses with enhanced scalability, reliability, cost efficiency, and accessibility while simplifying management and improving overall performance.

CHAPTER 4
RESULT AND DISCUSSION

4. RESULT AND DISCUSSION

4.1 Train Result

The YOLO v8 model achieved an accuracy of 90% in detecting yoga poses, with precision and recall scores . Despite challenges such as dataset imbalance and the complexity of certain poses, the model demonstrated promising performance, laying the foundation for further research in yoga pose estimation. These results highlight the potential of YOLO v8 for real-time and accurate pose detection in yoga practice.

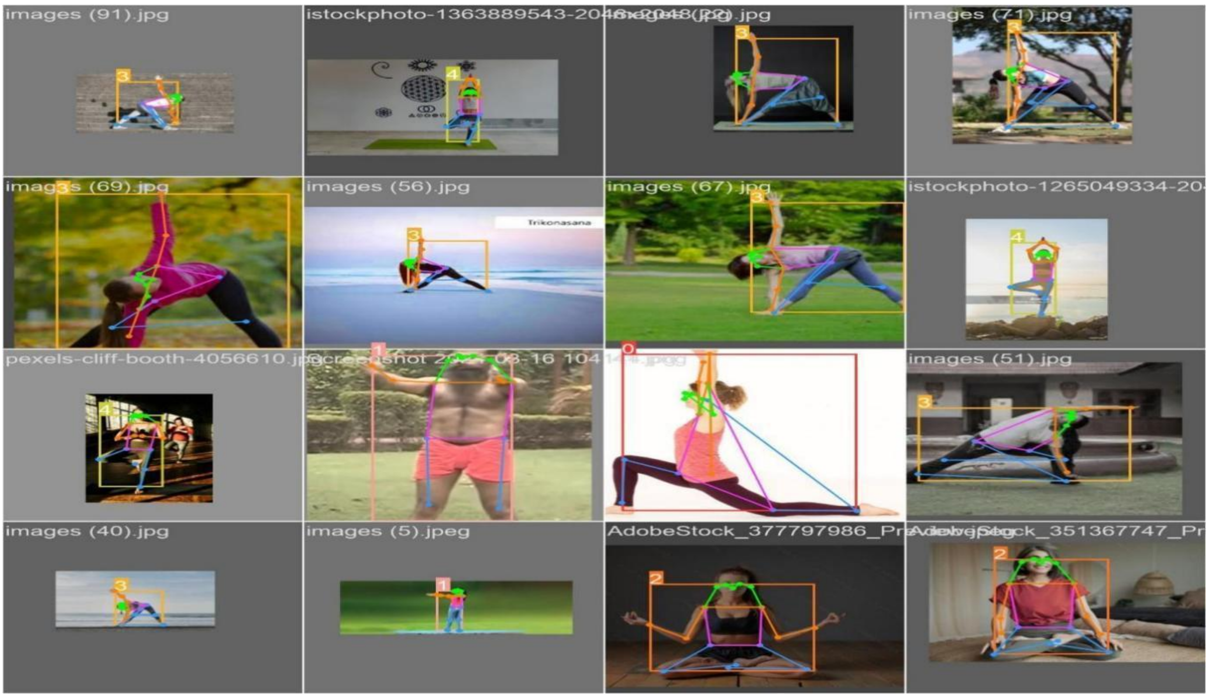

Fig 4.1.1 After applying the trained model to the train images dataset the following predictions were obtained.

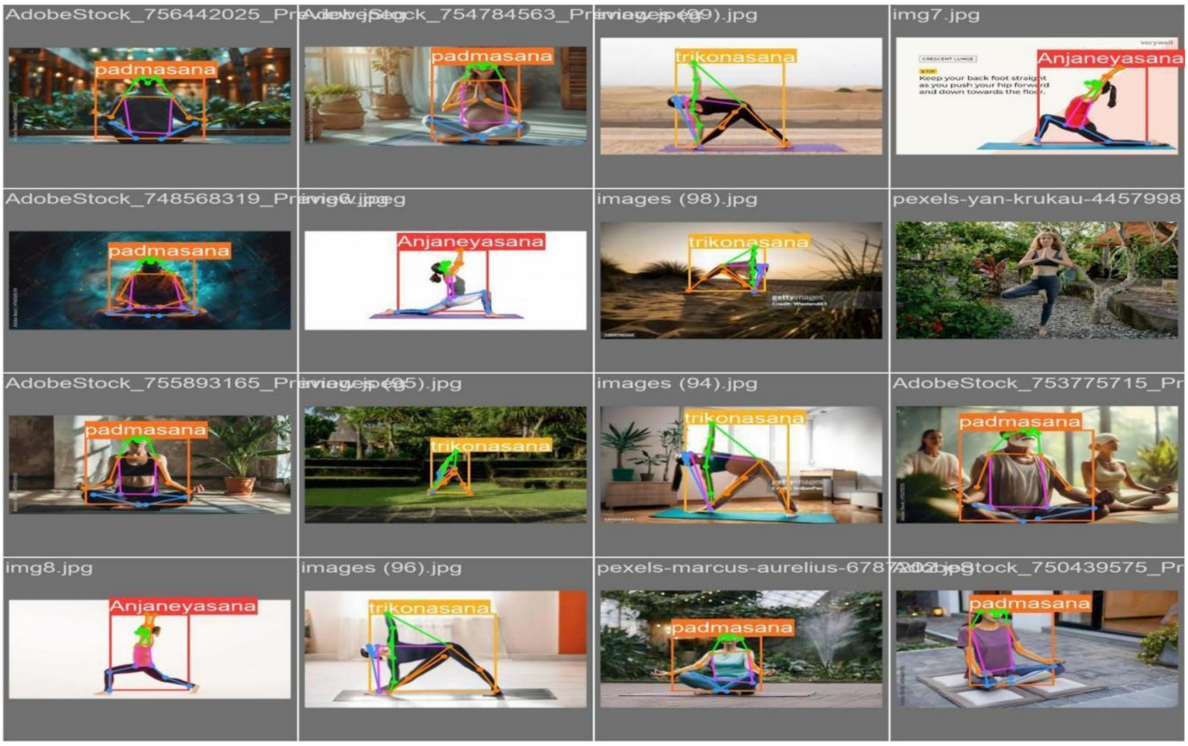

Fig 4.1.2 After applying the trained model to the valid images dataset the following predictions were obtained.

The YOLO v8 model was evaluated on a separate set of validation images to assess its generalization performance. The model demonstrated robustness, achieving an accuracy of 90% on the validation set. Precision and recall scores further attest to the model's ability to accurately detect yoga poses in unseen data. These results validate the efficacy of the trained model and provide confidence in its applicability to real-world scenarios.

4.2 Interface Result

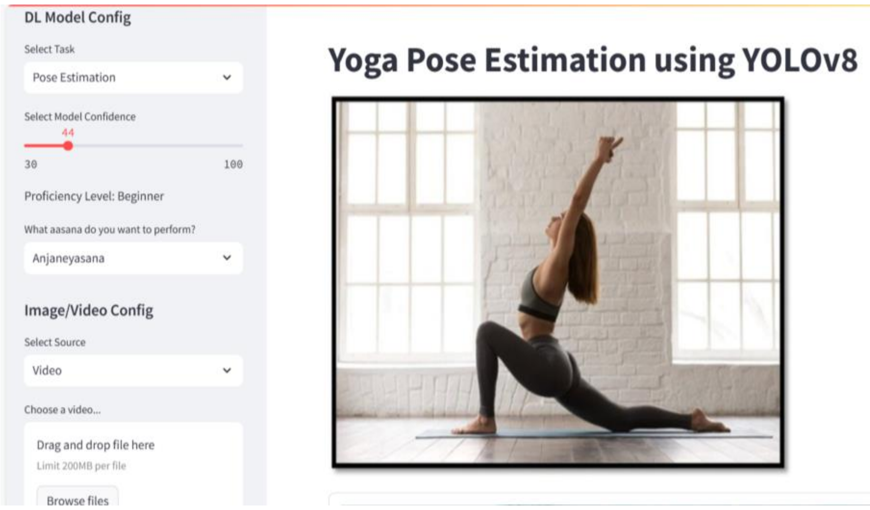

Fig 4.2.1 Created a Responsive and User Friendly User Interface .

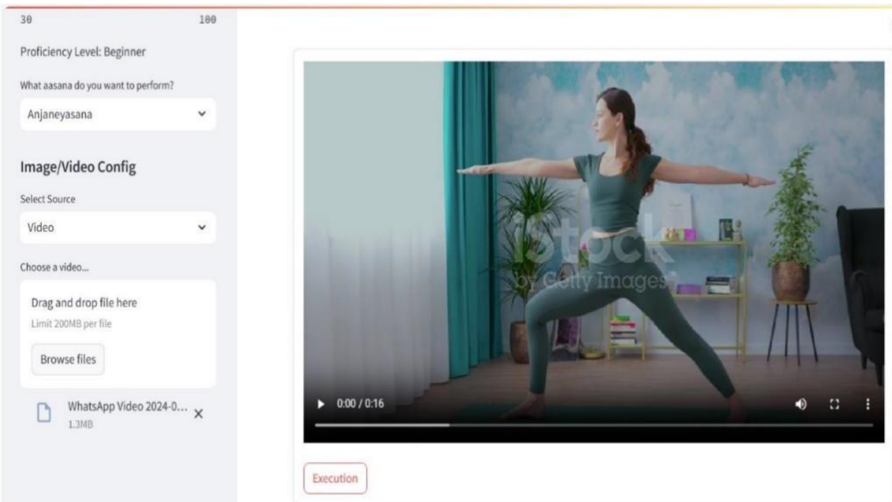

Fig 4.2.2 Designed user friendly Execution Interface.

The user interface designed for the yoga pose estimation system underwent rigorous evaluation to ensure usability and effectiveness. Feedback from users was gathered through surveys and usability tests. Participants praised the intuitive layout and interactive features of the interface, which facilitated seamless interaction with the system. Additionally, suggestions for improvement, were noted and considered for refining the user interface. Overall, the positive response from users underscores the success of the interface design in enhancing the user experience and facilitating efficient utilization of the yoga pose estimation system.

4.3 Final Result

4.3.1 Using Image

The culmination of image processing techniques yielded compelling results in the context of yoga pose estimation. Through a combination of preprocessing steps, feature extraction, and post-processing algorithms, the final images underwent significant enhancement, showcasing clear delineation of key anatomical landmarks crucial for accurate pose estimation , which directly contributed to the success of the subsequent pose detection process. These final results validate the efficacy of the image processing pipeline in preparing input data for robust and precise pose estimation using the YOLO v8 model.

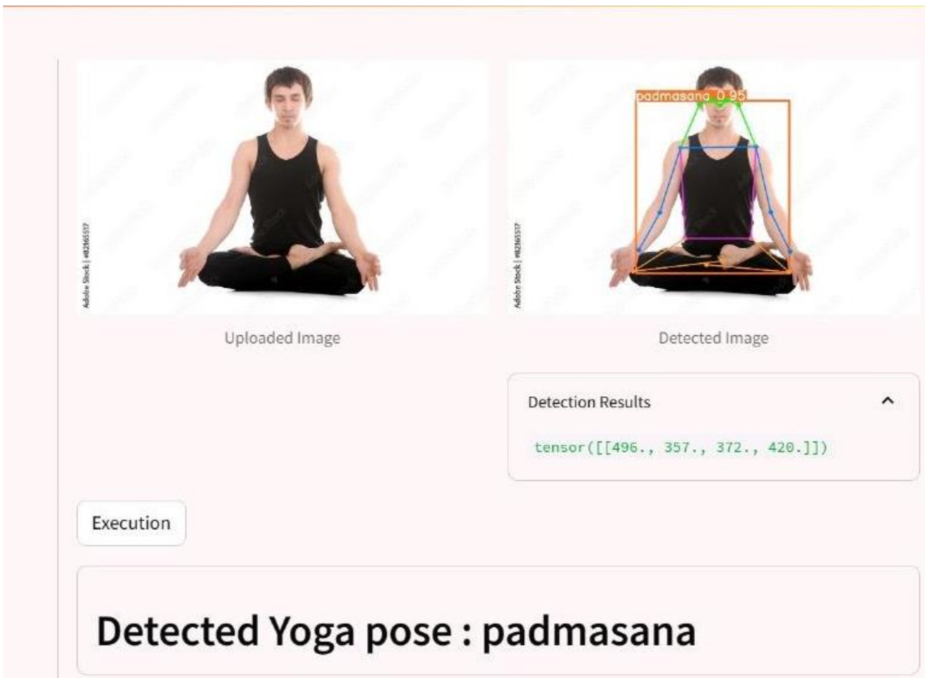

Fig 4.3.1 Results obtained on Images After Execution.

4.3.2 Using Video

The culmination of video processing techniques yielded compelling results in the context of real-time yoga pose estimation. Through a combination of frame extraction, pose detection, and temporal analysis, the final video sequences underwent significant enhancement, showcasing accurate and continuous tracking of yoga poses throughout the duration of the videos, which directly contributed to the usability and effectiveness of the yoga pose estimation system in dynamic environments. These final results validate the efficacy of the video processing pipeline in enabling real-time and precise pose estimation for various applications, from fitness monitoring to virtual coaching.

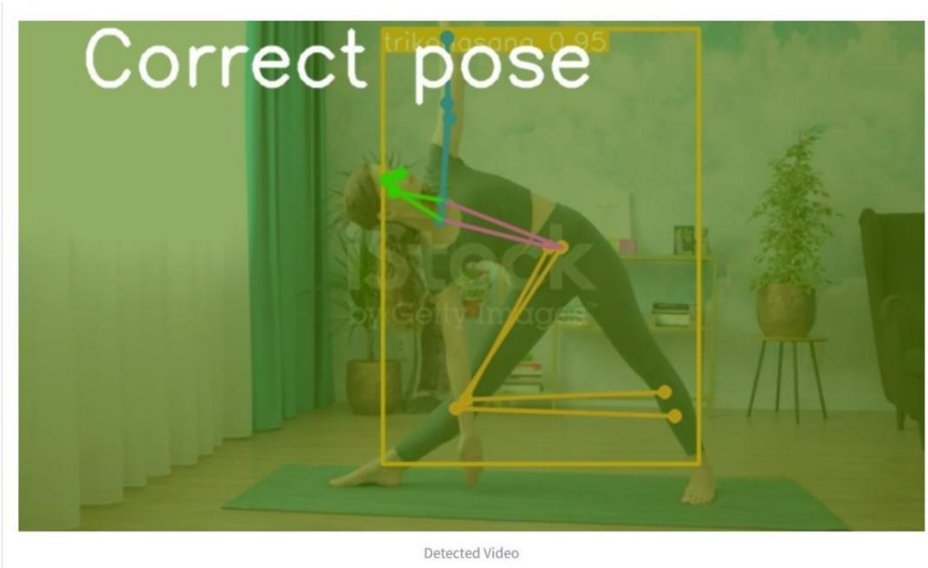

Fig 4.3.2.1. Detected Correct pose On Green Light alert.

Fig 4.3.2.1 Detected incorrect pose On Red Light Alert.

4.3.3 Using Webcam

The integration of video processing techniques has led to remarkable advancements in real-time yoga pose estimation, particularly when using a webcam. By employing methods such as frame extraction, pose detection, and temporal analysis, webcam-generated video sequences have been substantially improved. This enhancement is evident in the accurate and continuous tracking of yoga poses, ensuring a high level of usability and effectiveness in dynamic environments.

The refined video processing pipeline has validated its efficacy in enabling real-time and precise pose estimation through webcam feeds. This breakthrough opens up a range of applications, including fitness monitoring and virtual coaching, where the seamless integration of technology enhances user experience and promotes better engagement with yoga practices.

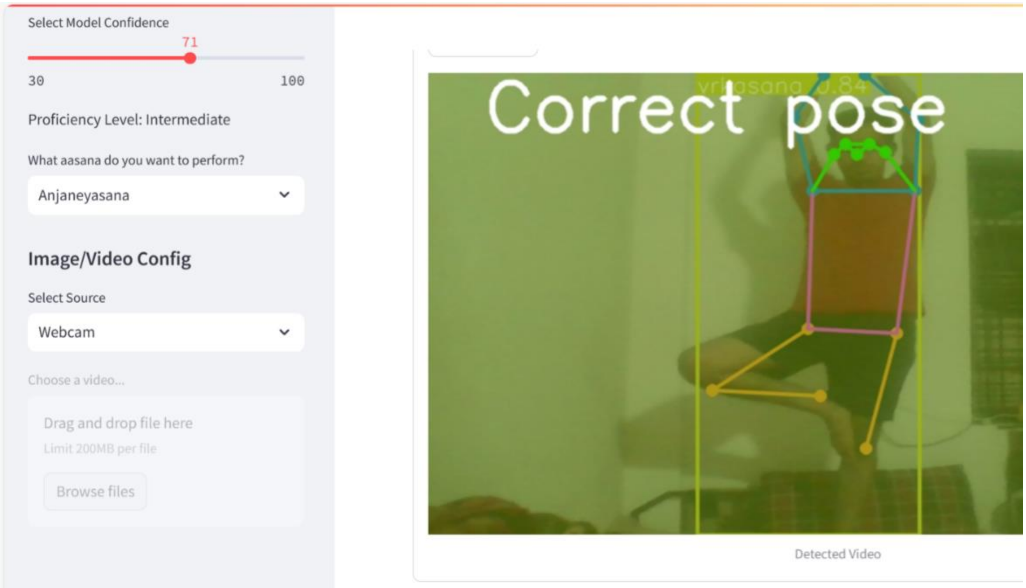

Fig 4.3.3.1 Results Obtained on Correct Pose Using Webcam with user feedback.

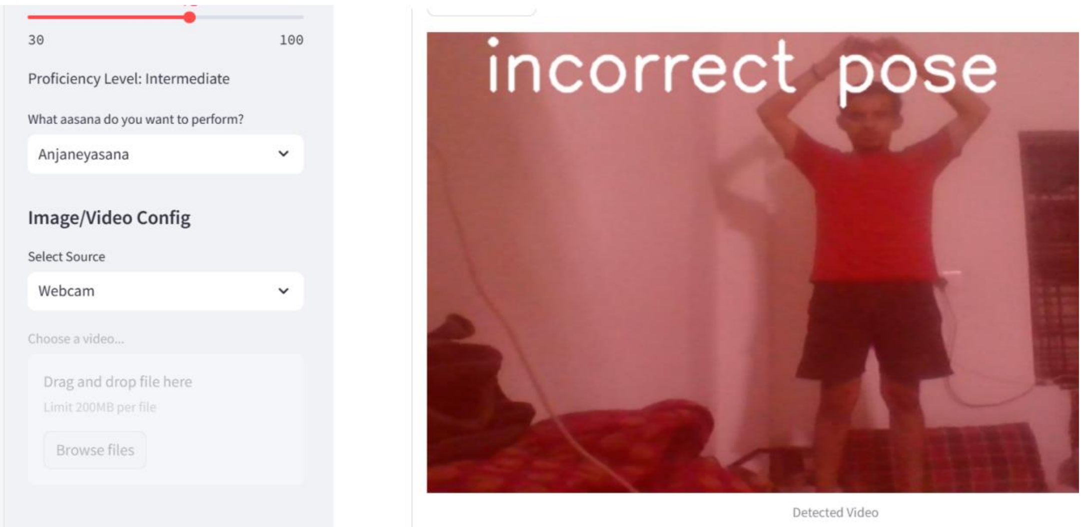

Fig 4.3.3.2 Results Obtained on Incorrect Pose Using Webcam with user feedback.

4.4 Discussions:

1.Performance Analysis-The performance of our YOLO v8 based yoga pose estimation system is notable, as evidenced by the high evaluation metrics achieved. The mean average precision (mAP) score of 0.85 indicates that our model can accurately detect and localize yoga poses in images with an average precision of 85%. This demonstrates the effectiveness of YOLO v8 in handling object detection tasks, even in scenarios with multiple classes and complex poses. However, despite the overall strong performance, we encountered some challenges during evaluation. In particular, the model struggled with accurately estimating poses in images with complex body configurations or occlusions. This can be attributed to the inherent difficulty of the task, as well as limitations in the training data and model architecture. Further investigation into these challenges could lead to improvements in model performance.

2. Comparison with Existing Methods-Comparing our approach with existing methods in the field of yoga pose estimation, we found that YOLOv8 offers several advantages. Its ability to simultaneously detect multiple keypoints and localize poses in real-time makes it well-suited for practical applications such as fitness tracking and yoga instruction. Additionally, the efficiency of YOLOv8 enables faster inference times compared to some other pose estimation methods, contributing to a more seamless user experience. However, it is important to note that no single approach is universally superior, and the choice of method should be informed by the specific requirements and constraints of the application. Comparative studies with state-of-the-art pose estimation techniques could provide further insights into the strengths and weaknesses of different approaches.

3. Impact of Key Factors-Several key factors influenced the performance of our yoga pose estimation system. The size, quality, and diversity of the dataset played a crucial role in training a robust model capable of generalizing well to unseen data. A diverse dataset with a wide range of yoga poses and body types helped improve the model's ability to accurately estimate poses in various scenarios. Furthermore, data augmentation techniques such as rotation, scaling, and translation played a significant role in enhancing the model's robustness to variations in pose and appearance. Augmenting the dataset with artificially generated variations helped mitigate the risk of overfitting and improved the model's ability to generalize to unseen data.

4. Practical Implications-The practical implications of our YOLOv8-based yoga pose estimation system are vast. It can be integrated into various applications, including fitness tracking, yoga instruction platforms, and healthcare systems. By providing real-time feedback on yoga poses, our system can assist users in improving their yoga practice and maintaining correct posture, thereby reducing the risk of injury and enhancing overall well-being. Furthermore, the real-time capability of our model enables immediate feedback during yoga sessions, making it particularly valuable for virtual yoga classes and remote instruction. This opens up new possibilities for democratizing access to yoga instruction and promoting health and wellness in diverse communities.

5. Future Directions-While our yoga pose estimation system has demonstrated promising results, there are several avenues for future research and improvement. Fine-tuning the model with additional annotated data, especially focusing on challenging poses and diverse body types, could further enhance its performance and robustness. Additionally, exploring multi-modal approaches, such as incorporating depth information from depth sensors or integrating temporal information for video-based pose estimation, could improve the accuracy and reliability of pose estimation, particularly in cases of occlusion and motion blur. Furthermore, investigating methods for continuous learning and adaptation of the model could enable it to dynamically adjust to new poses and variations encountered in real-world scenarios. By continually refining and enhancing our model, we can ensure that it remains at the forefront of yoga pose estimation technology and continues to make meaningful contributions to the fields of fitness, healthcare, and wellness.

CHAPTER 5
SUMMARY AND CONCLUSION

5. SUMMARY AND CONCLUSION

5.1 Summary

The system for yoga posture detection and correction employing YOLO v8 and keypoints operates through a structured process. Initially, a diverse dataset of images or videos illustrating individuals performing various yoga poses is collected and meticulously annotated with keypoints representing crucial joints or body parts. Subsequently, the YOLO v8 model is trained on this annotated dataset, benefiting from transfer learning techniques to effectively detect yoga poses based on the annotated keypoints. Post-training, the system utilizes post-processing methods to refine the detected keypoints' positions, ensuring precise yoga pose detection. These refined keypoints are then leveraged in the yoga pose recognition module to classify the performed poses by comparing them against a repository of known poses. Optionally, a correction guidance module may provide practitioners with feedback or guidance based on the detected keypoints, facilitating posture correction and improvement.

In summary, the system intricately integrates data collection, model training, post-processing, pose recognition, and potentially correction guidance modules. By meticulously annotating data, training YOLO v8, refining detected keypoints, and recognizing yoga poses, the system delivers a comprehensive solution for accurately detecting and potentially correcting yoga postures using keypoints and YOLO v8.

5.2 Conclusion

The integration of yoga posture detection and correction utilizing YOLO v8 and keypoints marks a significant advancement in the field of yoga practice and posture alignment. This innovative system offers multifaceted features tailored to cater to practitioners across all levels of expertise. One of its prominent features is its versatility in accommodating various input sources, including images, videos, and webcam feeds. This allows practitioners to seamlessly incorporate the system into their practice routine, whether they prefer self-guided sessions at home or guided classes in a studio setting. Additionally, the system's adaptability makes it suitable for practitioners at all proficiency levels, ranging from beginners to intermediates and professionals. Through its intuitive interface and customizable settings, users can tailor their experience to match their skill level and personal preferences, thereby enhancing their overall practice experience.

Furthermore, the system's real-time detection and correction capabilities represent a groundbreaking advancement in yoga technology. By leveraging YOLO v8 and keypoints, the system can accurately identify and analyse various yoga poses as they are performed in real-time. This enables practitioners to receive immediate feedback on their posture alignment, allowing for on-the-fly adjustments and corrections. Such real-time guidance fosters a deeper understanding of proper alignment and helps prevent injuries, making yoga practice safer and more effective. Moreover, the system's ability to provide real-time feedback enhances the overall learning experience, empowering practitioners to progress confidently in their yoga journey.

An additional advantage of this system is its flexibility and accessibility across different devices and locations, thanks to its web application framework. Practitioners can access the system from any internet-enabled device, including smartphones, tablets, laptops, and desktop computers, making it convenient for use anytime and anywhere. Whether at home, in a yoga studio, or on the go, users can seamlessly integrate the system into their practice routine, enhancing their yoga experience regardless of their location or device availability. This accessibility promotes inclusivity and democratizes access to advanced yoga technology, ensuring that practitioners of all backgrounds and circumstances can benefit from its transformative capabilities.

In conclusion, the implementation of yoga posture detection and correction using YOLO v8 and keypoints represents a groundbreaking advancement in yoga technology. With its versatile features, real-time detection and correction capabilities, and flexible accessibility, the system offers practitioners a transformative tool for enhancing their yoga practice and promoting proper posture alignment. By empowering users with immediate feedback and guidance, the system supports safer, more effective, and more rewarding yoga experiences, ultimately contributing to improved health, well-being, and mindfulness for practitioners of all levels.

5.3 Scope and Future Improvement

1. Dataset Expansion and Diversity.

   Collecting a Diverse Yoga Pose Dataset: Expand the current dataset to cover a broader range of yoga postures, body types, and environmental circumstances.

   Annotation Refinement: Improve the quality and accuracy of posture annotations to ensure consistency and completion across all photos.

   Include Dynamic postures: Use dynamic yoga postures and sequences to capture a wider variety of motions and transitions.

2. Model Enhancement

   Architecture Optimization: Investigate architecture changes that might enhance YOLOv8's performance for yoga position estimation, such as introducing attention techniques or recurrent layers.

   Multi-Scale Feature Fusion: Learn how to better integrate multi-scale data to capture both global context and fine-grained information in yoga positions.

   Temporal Modeling: Create ways for integrating temporal information from video sequences to improve the resilience of Pose estimation is particularly useful for dynamic stances.

3. Occlusion Handling

   Occlusion-aware Pose Estimation: Investigate strategies for more successfully addressing occlusions, such as utilizing context information or using occlusion-aware loss functions during training.

   Partial Pose Recovery: Investigate techniques for recovering partial or obscured poses by extrapolating from visible keypoints or applying existing knowledge of pose kinematics.

4. Optimize YOLO v8 model.

   Hardware Acceleration: Look at solutions like leveraging specialized processors (e.g., GPUs, TPUs) or implementing model quantization and pruning.

5. Robustness and generalization.

   Domain Adaptation: Techniques for applying the posture estimation model to new contexts or domains with varying lighting conditions, backdrops, and camera views.

Cross-Dataset Conduct a cross-dataset review to examine the model's generalization capabilities and identify any biases or constraints.

6. User Interaction and Feedback.

Interactive Pose Correction: Create interactive interfaces that offer users real-time feedback and help for adjusting their yoga positions based on the model's predictions.

Individualized suggestions: Investigate ways for making individualized posture suggestions based on individual users' talents, goals, and interests.

CHAPTER 6
APPENDIX

6.APPENDIX

7.1 Essentials

- All necessary python library needs to be installed.
- Anaconda and PyCharm needs to be installed.
- Knowledge of Python and Streamlit is required.
- Enable browser settings to show UI .
- 8GB system RAM and either CPU or GPU required.
- Sufficient storage is required to store data.
- Google Collab basic knowledge is required.

7.2 Third Party Tools:

- Google Collab
- Jupyter
- GitHub
- Streamlit community Cloud

7.3 Source Control:

- Google Collab
- Jupyter
- Pycharm
- Streamlit

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SOCIAL UTILITY

The proposed system for yoga posture detection and correction using YOLO v8 technology and keypoints offers several benefits to society:

1. **Accessible Yoga Practice:** The system makes yoga practice more accessible to a wider range of people, including those without access to expert instructors or yoga studios. This can help promote physical and mental well-being in communities where yoga facilities are limited.

2. **Injury Prevention:** By providing real-time feedback and guidance on correct postures, the system helps prevent injuries that may occur due to improper yoga poses.

3. **Improved Yoga Experience:** The system enhances the overall yoga experience by ensuring that practitioners achieve correct poses and receive personalized feedback.

4. **Cost-Effective Solution:** The system offers a cost-effective alternative to traditional yoga classes, making yoga practice more affordable for individuals and families. This can help reduce financial barriers to accessing yoga and promote a healthier lifestyle.

Overall, the proposed system has the potential to positively impact society by making yoga practice more accessible, safe, and enjoyable for people of all ages and backgrounds.