A report submitted for

MACHINE LEARNING(UML-501)

Yoga Posture Detection System

By

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July-December 2023

Abstract

Through this project we learned:

- To bring out our creativity and imply on the task to achieve the best we can by exploring and safe handling in the supervision of faculty and department members.
- To not only limit ourselves to this project but also extend our approach beyond this course and for the future.
- To apply hands-on experience in coding the functions in Machine learning, Deep learning and their testing.
- To demonstrate designing, and mental skills by integrating ideas into language and preparing projects for different challenges in YOGA.
- To develop team working, including task sub-division and integration of individual contributions from the team.
- We as a team have tried to summarize what we have learnt till now while taking the course in this lab report. It is a glimpse of what we understood, practiced and exemplified in a given time.

Declaration

This is to certify that the project report submitted to Dr. Arun Pundir, CSED, Thapar University, Patiala, in fulfilment of the course objectives, embodies the original work carried out by us Charul Wadhwa and Vishnu Batra , no part of this report has been submitted elsewhere for use for any other purpose. At the very outset of this report, we would like to extend our sincere and heartfelt appreciation toward our teacher and the department.

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Introduction: Yoga Posture Detection System

The Yoga Posture Detection System (YPDS) stands at the forefront of technological innovation, seamlessly blending the ancient practice of yoga with cutting-edge computer vision and machine learning techniques. This groundbreaking project represents a transformative leap in how individuals engage with and benefit from their yoga practice. At its core, YPDS harnesses the power of deep learning algorithms to dynamically analyze real-time video footage of yoga practitioners, introducing a new dimension of intelligence to the ancient art.

The essence of YPDS lies in its ability to provide instantaneous and personalized feedback on posture alignment. Through the intricate analysis of body movements, joint positions, and overall form, the system caters to the unique needs of each practitioner. This level of customization ensures that users receive guidance tailored to their individual capabilities and areas of improvement. In doing so, YPDS becomes a virtual companion on the yoga journey, fostering a deeper, more mindful practice.

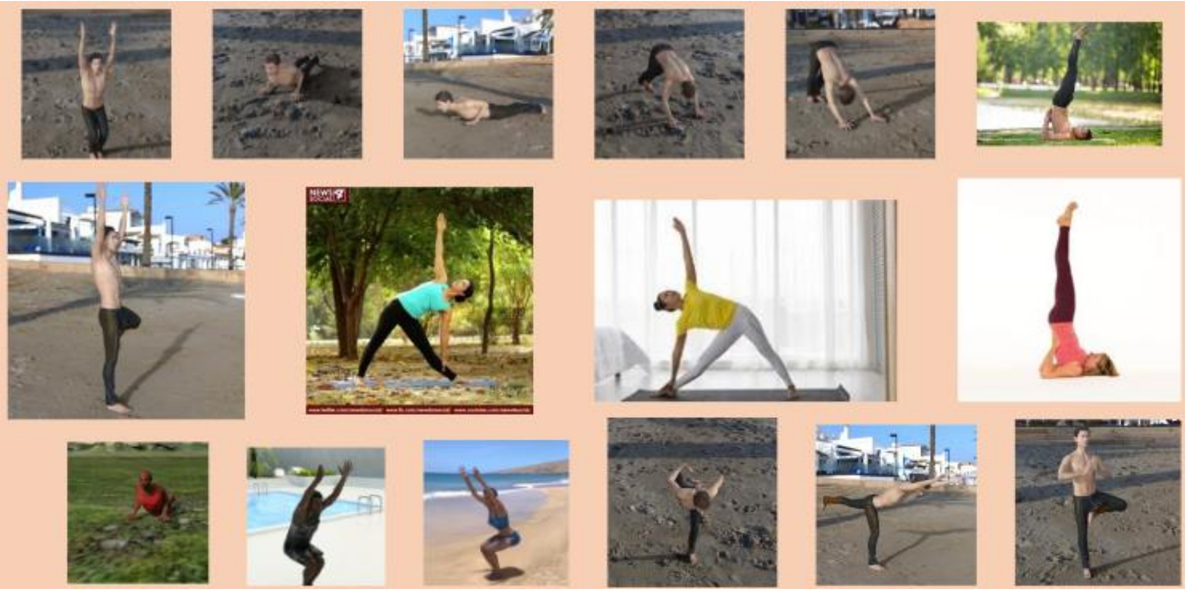
One of the key features that sets YPDS apart is its intuitive and user-friendly interface. Whether one is a seasoned yogi or a beginner, the system is designed to be accessible and accommodating. Practitioners can engage with the technology seamlessly, receiving real-time insights that elevate their practice to new heights. This accessibility extends to yoga instructors as well, offering them a valuable tool to objectively assess and guide their students, thereby enhancing the overall quality of instruction

Objectives

- Develop a robust computer vision system capable of analyzing real-time video footage of yoga practitioners.
- Implement machine learning algorithms to detect and evaluate yoga postures, focusing on aspects such as body alignment, joint angles, and overall form.
- Create a user-friendly interface that delivers personalized feedback to practitioners, offering insights into their posture and suggesting improvements.
- Provide instructors with a tool for objective assessment and guidance, enhancing the quality of yoga instruction.
- Enhance overall safety by identifying and addressing misalignments in real-time, reducing the risk of injuries during yoga practice.

Key Features

- **Real-time Posture Analysis:** YPDS employs deep learning algorithms to analyze video streams, providing instant and accurate feedback on yoga postures.
- **Personalized Guidance:** The system customizes feedback based on individual capabilities and areas of improvement, ensuring a tailored experience for each user.
- **User-Friendly Interface:** An intuitive interface makes YPDS accessible to practitioners of all levels, facilitating seamless interaction with the technology.
- **Instructor Support:** Yoga instructors can utilize YPDS as a valuable tool for assessing student performance objectively and offering targeted guidance.
- **Injury Prevention:** YPDS serves as a preventive measure by identifying and correcting misalignments, reducing the risk of strain or injury during yoga sessions.
- **Dataset Split-**Dataset is split into 2 portions,85% for training and 15% for testing.



Technology Stack

- **Computer Vision:** OpenCV or similar libraries for video processing and analysis.
- **Machine Learning:** TensorFlow or PyTorch for developing and training deep learning models.
- **Frontend Development:** React, Angular, or Vue.js for building a user-friendly interface.
- **Backend:** Python or Node.js for backend logic and integration with machine learning models.

Expected Outcomes

- A functional Yoga Posture Detection System capable of providing real-time feedback to users.
- Improved posture alignment for practitioners, leading to enhanced yoga practice.
- Increased safety and injury prevention during yoga sessions.
- A valuable tool for yoga instructors to objectively assess and guide their students.

Conclusion

The Yoga Posture Detection System aims to bridge the gap between tradition and technology, offering a transformative experience for yoga practitioners and instructors alike. By combining the wisdom of yoga with the power of machine learning, YPDS aspires to contribute to the well-being and evolution of the global yoga community.

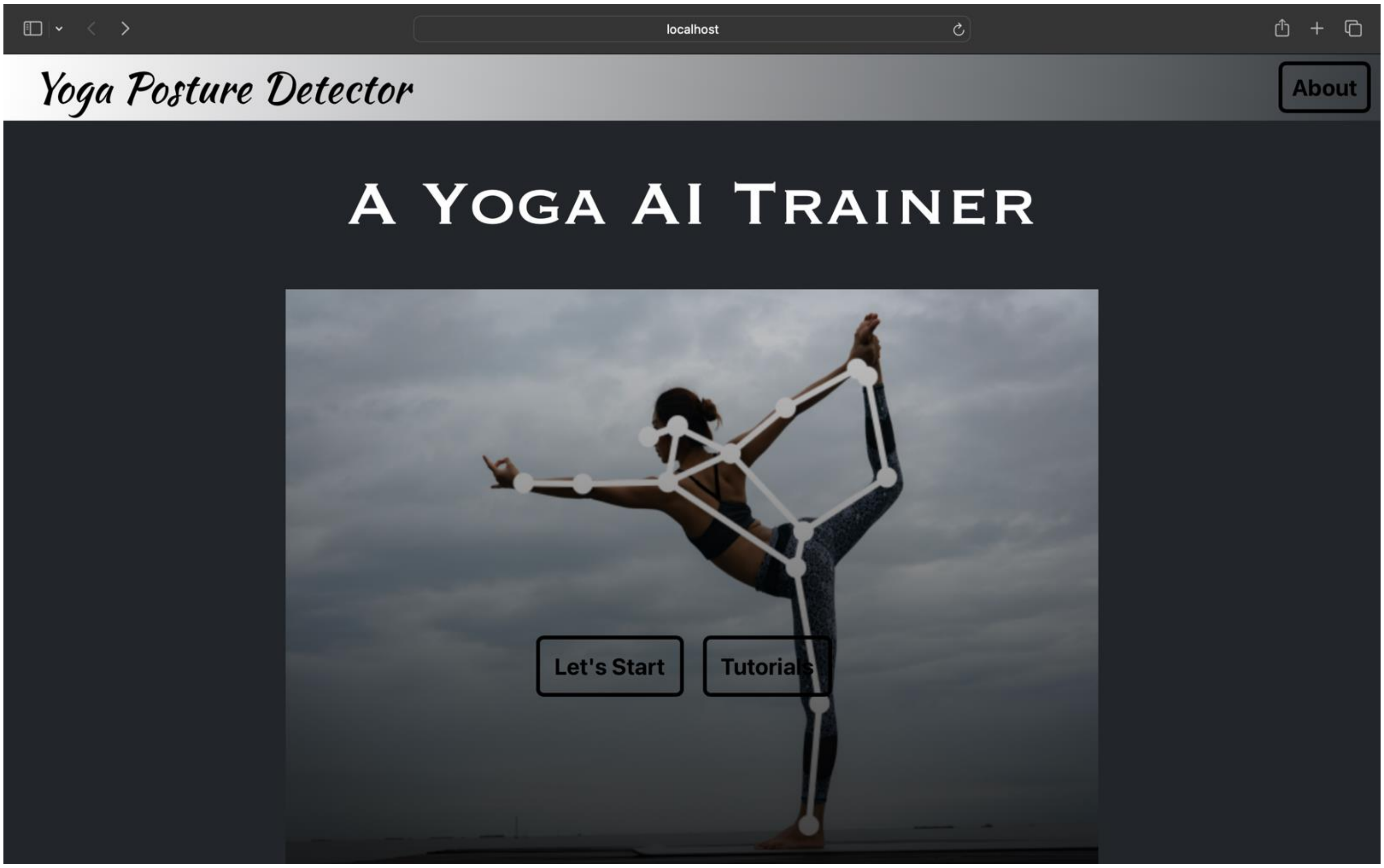
Algorithms Used

- **TensorFlow**:-TensorFlow is an open source machine learning framework developed by Google, widely used for many machine learning and deep learning tasks.. It is known for its flexibility and scalability.. TensorFlow is designed to work efficiently with large datasets and complex neural network architectures
- **PoseNet:-**PoseNet is a computer vision technique used to estimate the pose (position and orientation) of a person or object in an image or video. It is especially popular in applications such as human pose estimation, augmented reality, and robotics.
- **Convolutional Neural Network:-**Convolutional neural networks (CNN) are a class of deep learning models specifically designed to process structured grid data, such as images and videos. They have revolutionized the field of computer vision and are widely used for a variety of tasks including image classification, object detection, image segmentation, and more.
- **React for Frontend:-**React, often referred to as React.js or ReactJS, is an open-source JavaScript library for building user interfaces. It was developed and is maintained by Facebook (now Meta Platforms, Inc.), and it is widely used for creating web and mobile applications.
- **Data Preprocessing:-** An essential phase in the pipeline for data analysis and machine learning is data pretreatment. It entails preparing raw data for analysis or model training by cleaning, converting, and arranging it.

Libraries Used

- **TensorFlow:** A machine learning framework available as open source software that Google created for creating and refining deep learning models.
- **Sklearn:** A well-known Python machine learning toolkit that offers a variety of modeling and data analysis techniques, such as clustering, regression, and classification.
- **pandas:** A Python data analysis and manipulation package that offers functions and data structures for handling structured data, such as tables.
- **Numpy:** Large, multidimensional arrays and matrices, as well as mathematical methods to work on them, are supported by NumPy, a core library for numerical computations in Python.
- **CSV:** A popular file format for storing tabular data as plain text with values separated by commas is called CSV, or Comma-Separated Values.
- **wget:** A command-line tool for internet file downloads, frequently used for content.
- **tqdm:** A Python package that makes it easy to track the completion of time-consuming calculations or processes by adding progress bars to loops and iterables.

Output Screenshots



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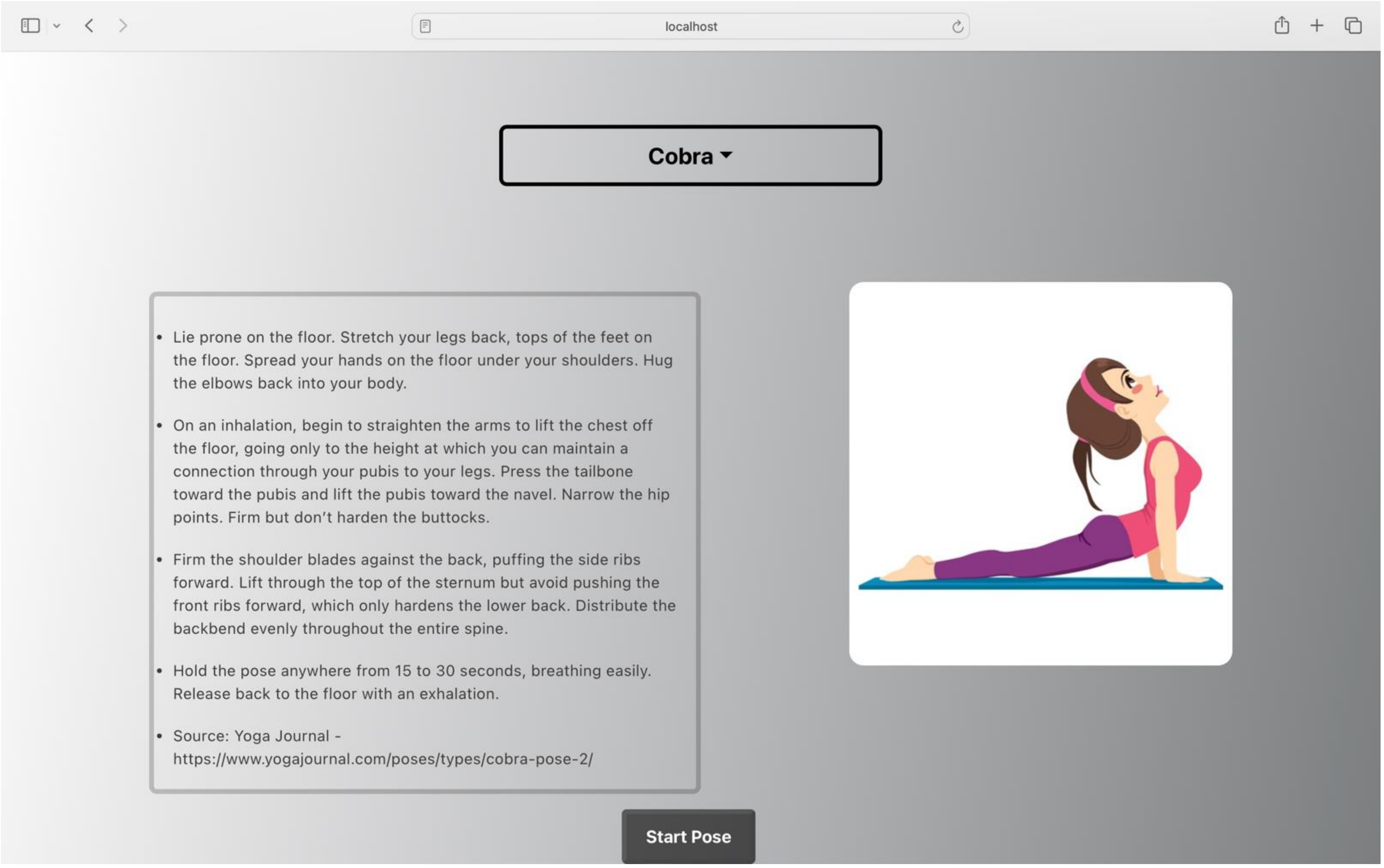
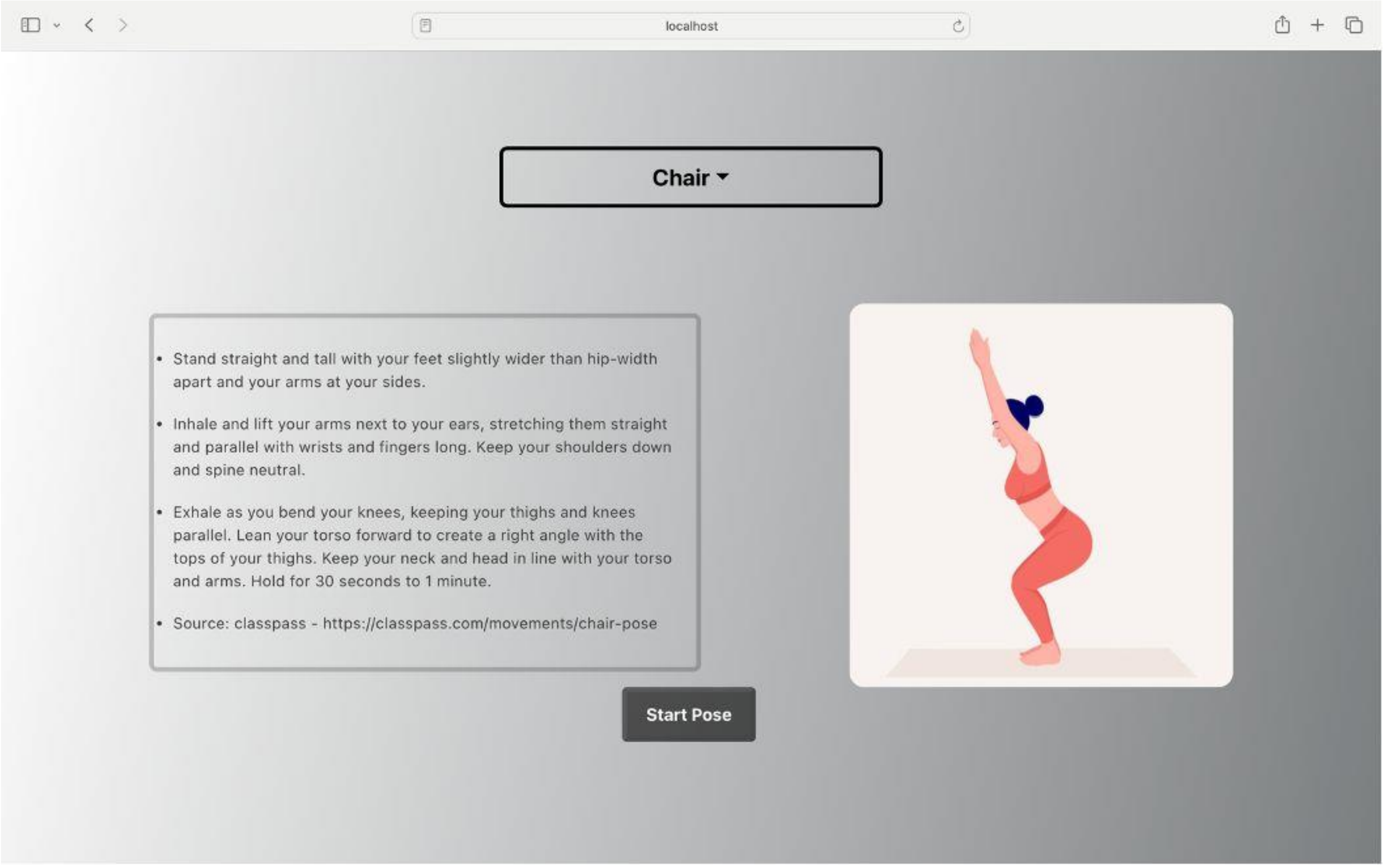
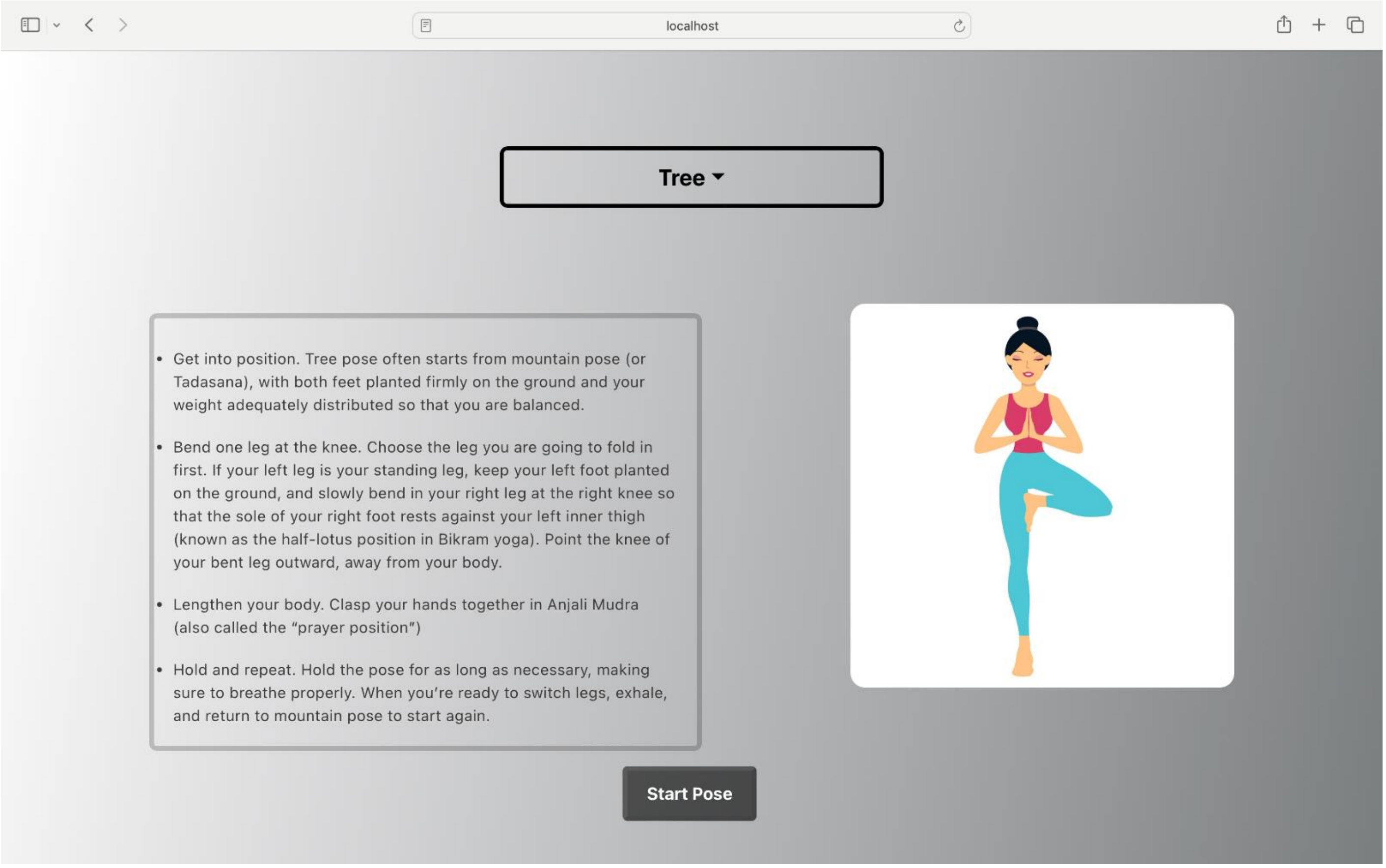


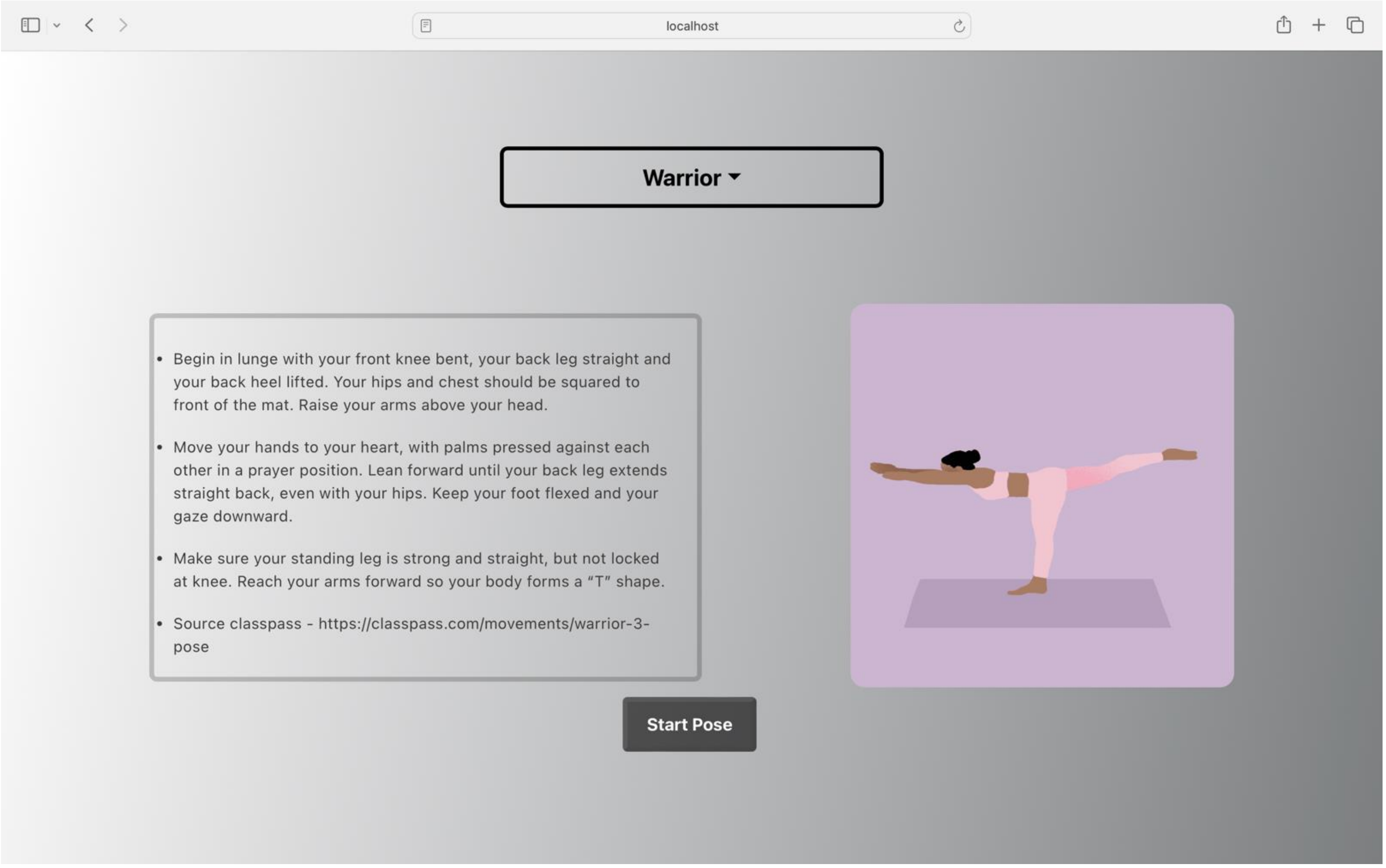
- Lie prone on the floor. Stretch your legs back, tops of the feet on the floor. Spread your hands on the floor under your shoulders. Hug the elbows back into your body.
- On an inhalation, begin to straighten the arms to lift the chest off the floor, going only to the height at which you can maintain a connection through your pubis to your legs. Press the tailbone toward the pubis and lift the pubis toward the navel. Narrow the hip points. Firm but don't harden the buttocks.
- Firm the shoulder blades against the back, puffing the side ribs forward. Lift through the top of the sternum but avoid pushing the front ribs forward, which only hardens the lower back. Distribute the backbend evenly throughout the entire spine.
- Hold the pose anywhere from 15 to 30 seconds, breathing easily. Release back to the floor with an exhalation.
- Source: Yoga Journal - https://www.yogajournal.com/poses/types/cobra-pose-2/



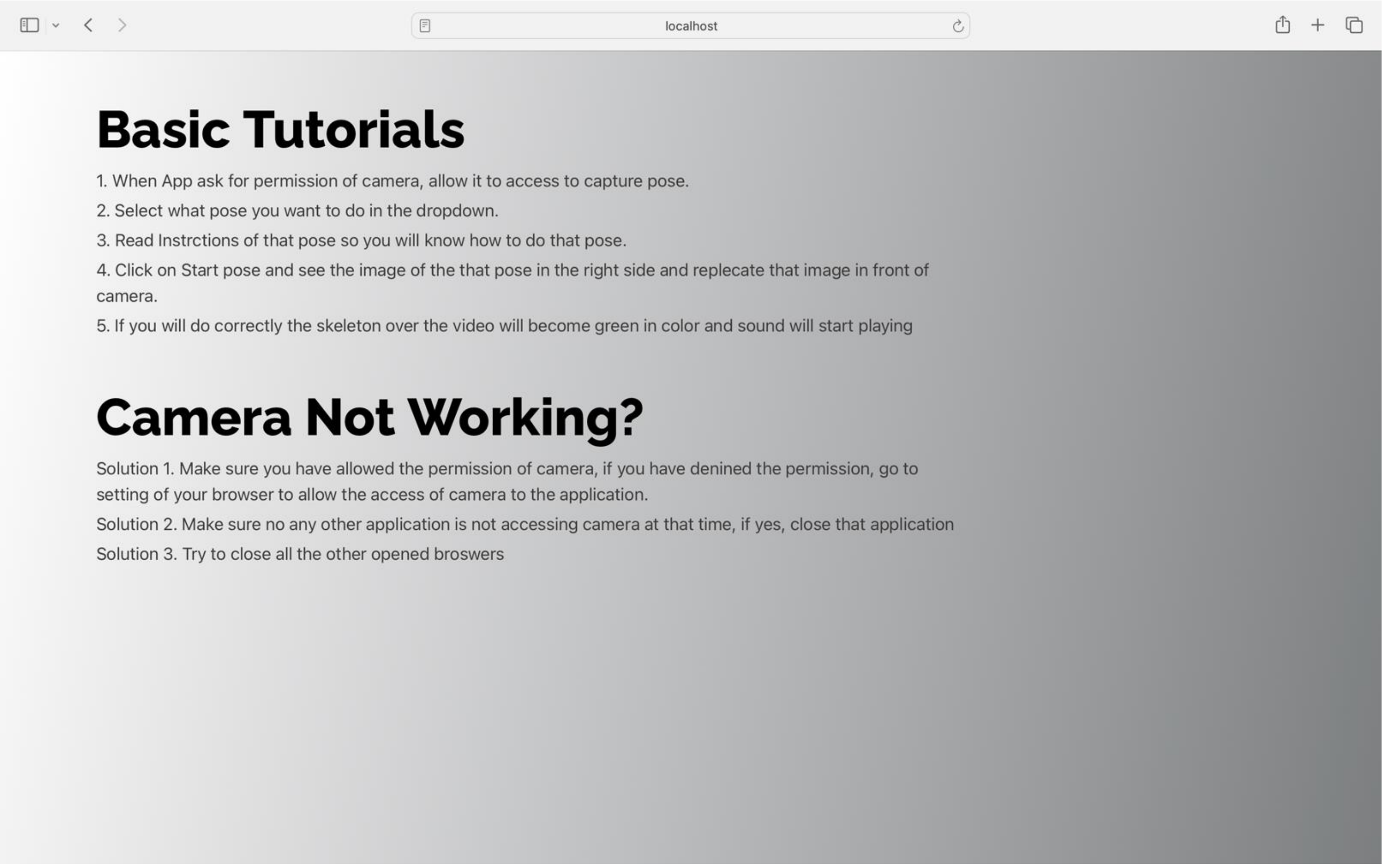
- Stand straight and tall with your feet slightly wider than hip-width apart and your arms at your sides.
- Inhale and lift your arms next to your ears, stretching them straight and parallel with wrists and fingers long. Keep your shoulders down and spine neutral.
- Exhale as you bend your knees, keeping your thighs and knees parallel. Lean your torso forward to create a right angle with the tops of your thighs. Keep your neck and head in line with your torso and arms. Hold for 30 seconds to 1 minute.
- Source: classpass - https://classpass.com/movements/chair-pose



- Get into position. Tree pose often starts from mountain pose (or Tadasana), with both feet planted firmly on the ground and your weight adequately distributed so that you are balanced.
- Bend one leg at the knee. Choose the leg you are going to fold in first. If your left leg is your standing leg, keep your left foot planted on the ground, and slowly bend in your right leg at the right knee so that the sole of your right foot rests against your left inner thigh (known as the half-lotus position in Bikram yoga). Point the knee of your bent leg outward, away from your body.
- Lengthen your body. Clasp your hands together in Anjali Mudra (also called the "prayer position")
- Hold and repeat. Hold the pose for as long as necessary, making sure to breathe properly. When you're ready to switch legs, exhale, and return to mountain pose to start again.



- Begin in lunge with your front knee bent, your back leg straight and your back heel lifted. Your hips and chest should be squared to front of the mat. Raise your arms above your head.
- Move your hands to your heart, with palms pressed against each other in a prayer position. Lean forward until your back leg extends straight back, even with your hips. Keep your foot flexed and your gaze downward.
- Make sure your standing leg is strong and straight, but not locked at knee. Reach your arms forward so your body forms a "T" shape.
- Source classpass - https://classpass.com/movements/warrior-3-pose



Basic Tutorials

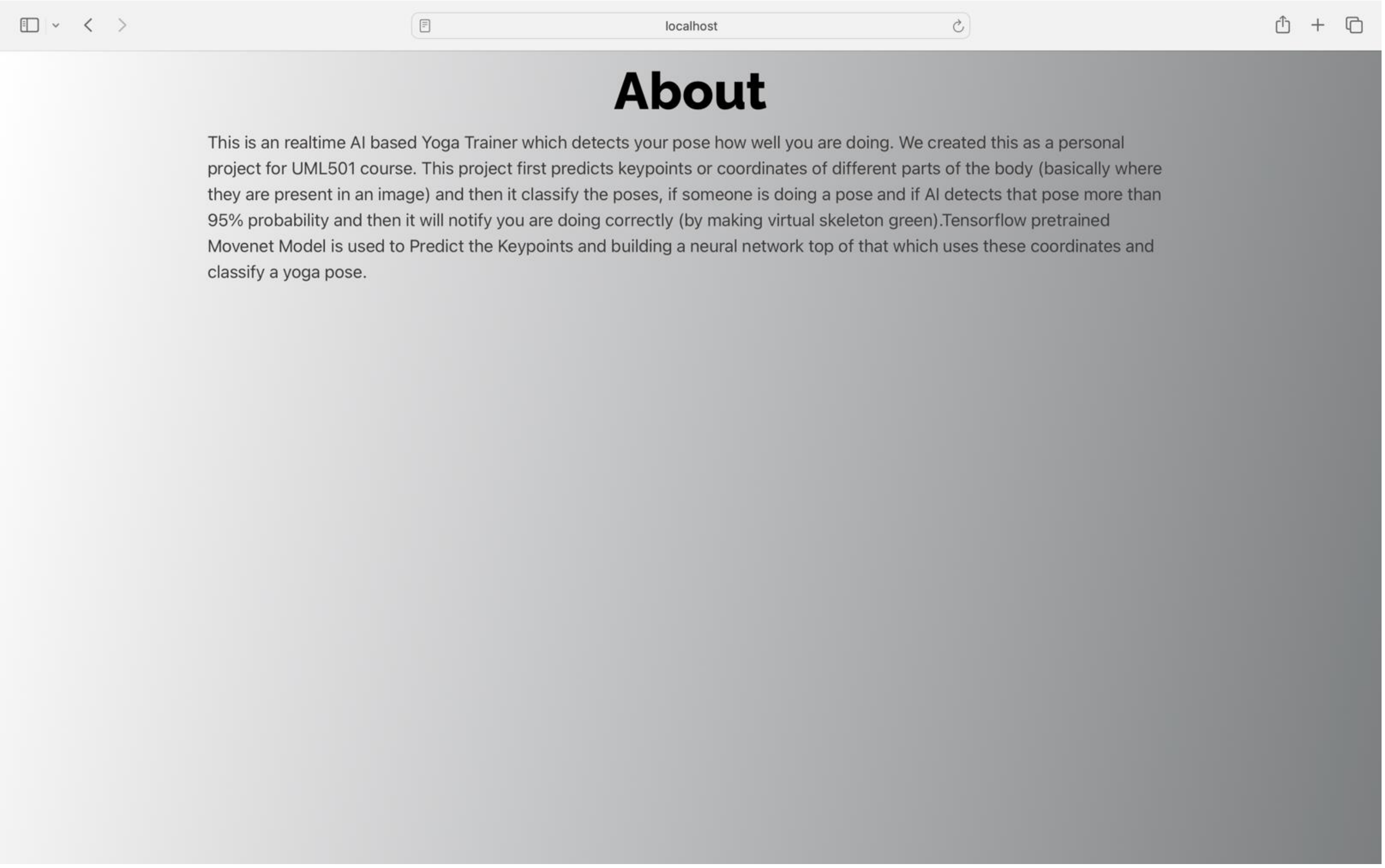
1. When App ask for permission of camera, allow it to access to capture pose.
2. Select what pose you want to do in the dropdown.
3. Read Instrctions of that pose so you will know how to do that pose.
4. Click on Start pose and see the image of the that pose in the right side and replecate that image in front of camera.
5. If you will do correctly the skeleton over the video will become green in color and sound will start playing

Camera Not Working?

Solution 1. Make sure you have allowed the permission of camera, if you have denined the permission, go to setting of your browser to allow the access of camera to the application.

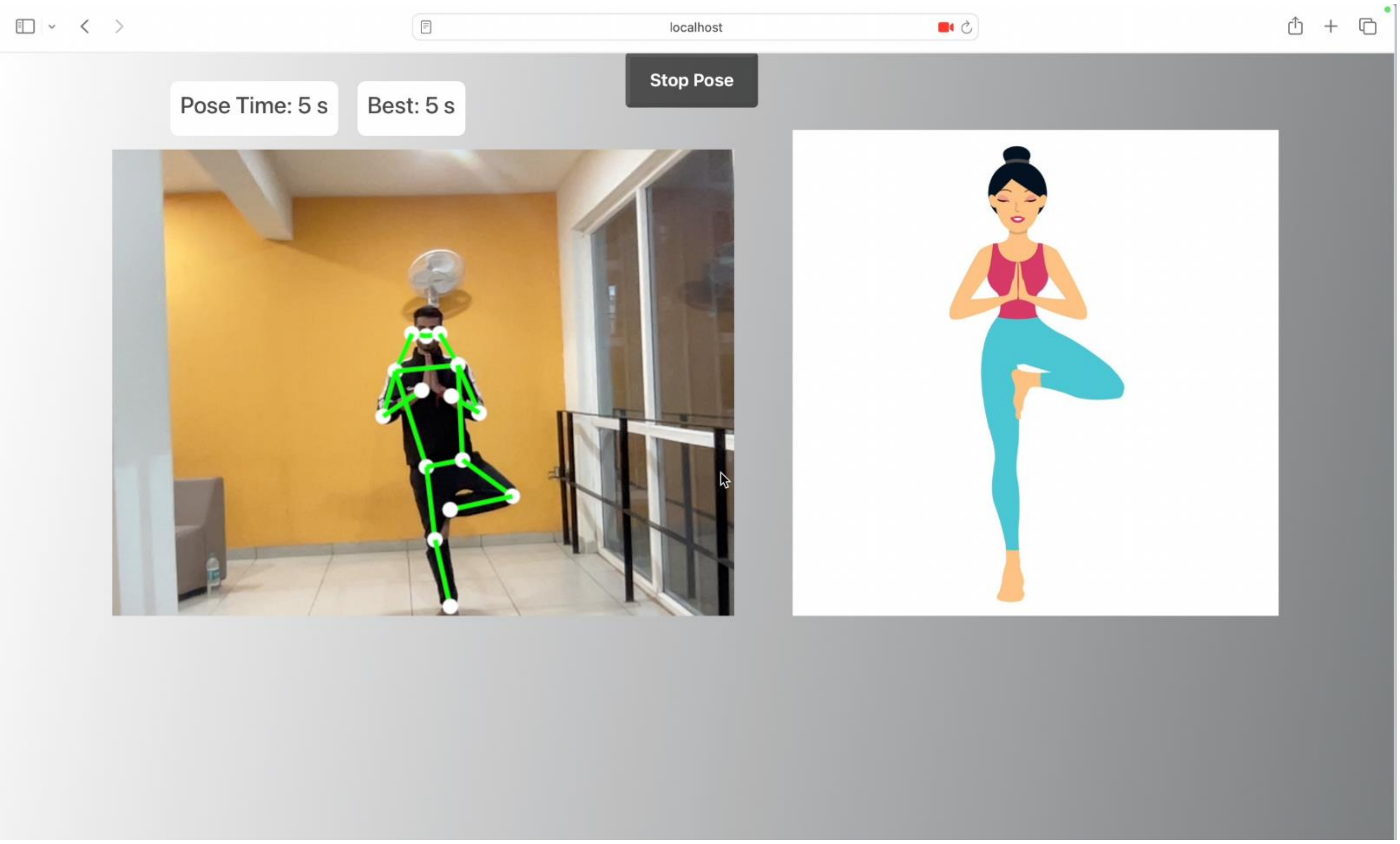
Solution 2. Make sure no any other application is not accessing camera at that time, if yes, close that application

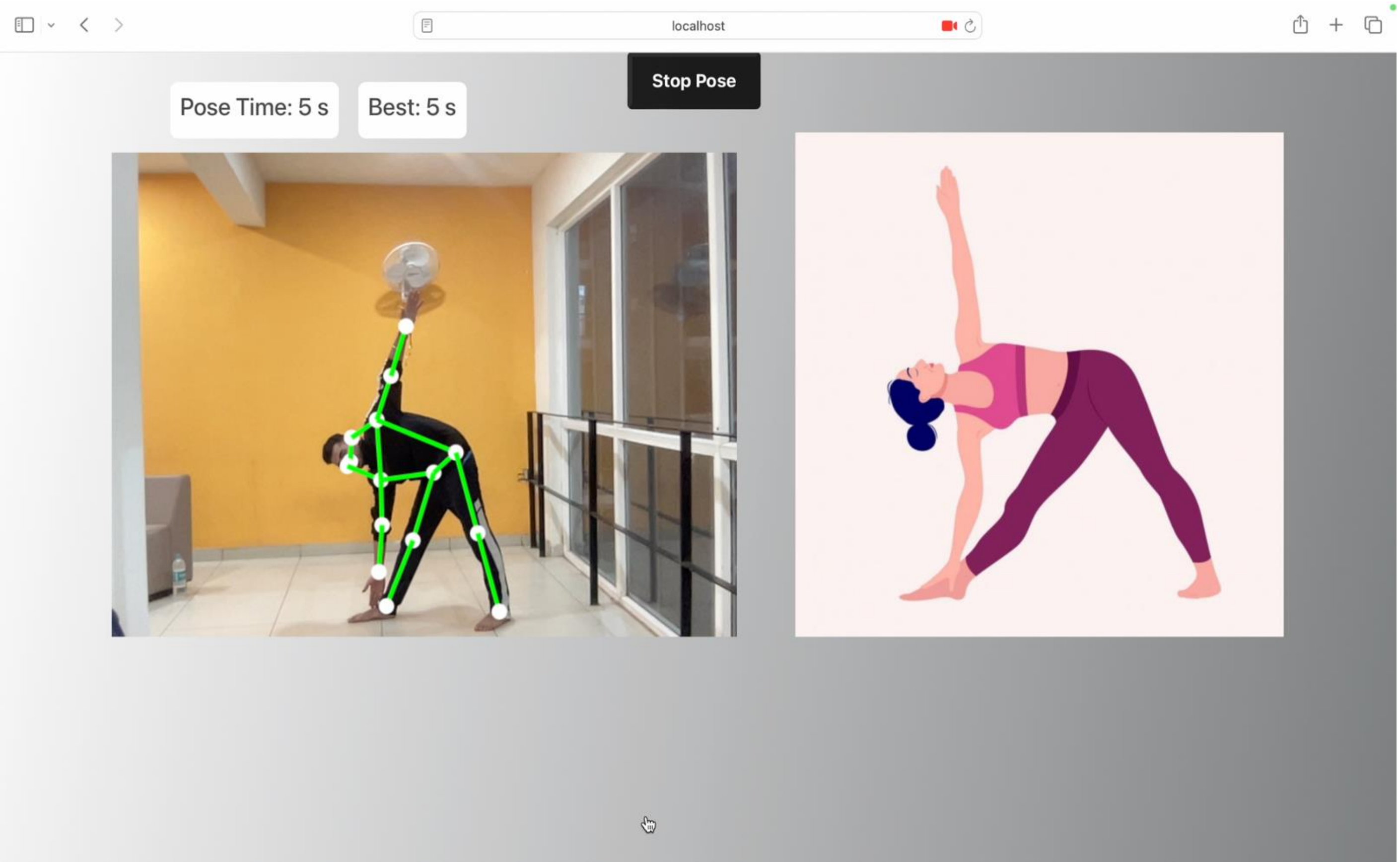
Solution 3. Try to close all the other opened broswers



About

This is an realtime AI based Yoga Trainer which detects your pose how well you are doing. We created this as a personal project for UML501 course. This project first predicts keypoints or coordinates of different parts of the body (basically where they are present in an image) and then it classify the poses, if someone is doing a pose and if AI detects that pose more than 95% probability and then it will notify you are doing correctly (by making virtual skeleton green).Tensorflow pretrained Movenet Model is used to Predict the Keypoints and building a neural network top of that which uses these coordinates and classify a yoga pose.


localhost
Stop Pose
Pose Time: 5 s
Best: 5 s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