FLASK YOGA AI SYSTEM FOR POSTURE DETECTION

Abstract

The practice of yoga has been gaining popularity in recent years, with people all over the world practicing this ancient form of exercise for its physical, mental, and spiritual benefits. However, yoga is also a complex and challenging practice that requires precise alignment and technique. Without proper guidance, practitioners may find it difficult to improve their technique and achieve the full benefits of the practice. The Flask Yoga AI Trainer is a system designed to help yoga practitioners improve their technique by providing real-time feedback on their posture and alignment. The system utilizes computer vision and deep learning techniques, including PoseNet and a Convolutional Neural Network (CNN), to analyze the user's posture and provide guidance on improving their technique. The system is implemented using Flask, a Python-based web framework, which provides a user-friendly interface for the yoga practitioner to interact with the system. The user's video feed is captured using a webcam and processed by PoseNet, a popular pose estimation model that can detect the key points of the user's body in real-time.

The PoseNet model is trained on millions of images to accurately estimate the pose of the user's body and identify any areas where the user's posture could be improved. Once PoseNet has identified the user's key points, the data is fed into a CNN that is trained to recognize different yoga poses. The CNN analyzes the user's posture and compares it to a set of predefined yoga poses to determine if the user is executing the pose correctly. The system provides real-time feedback to the user on their posture and technique, using visual cues to

Authors

Manasa K. B
Department of Information Science and Engineering
The National Institute of Engineering (North)
Mysuru, Karnataka, India
mansi.harshi@gmail.com
https://orcid.org/0000-0002-5128-1581

Shruthi B. S
Department of Information Science and Engineering
The National Institute of Engineering (North)
Mysuru, Karnataka, India
shruthinieit@gmail.com
https://orcid.org/0000-0003-2643-888X

indicate areas where the user's posture could be improved. The feedback provided by the system is customizable based on the user's level of expertise and preferences. For example, beginners may require more detailed feedback and guidance, while advanced practitioners may prefer a more hands-off approach. The system can also provide recommendations for improving the user's technique and achieving better alignment. One of the key benefits of the Flask Yoga AI Trainer is its ability to provide real-time feedback. Unlike traditional yoga classes, where the teacher may only be able to correct a few students at a time, the system can provide feedback to multiple users simultaneously. This means that users can receive personalized guidance and feedback even when practicing on their own. The Flask Yoga AI Trainer also has the potential to improve the overall quality of yoga practice.

By providing accurate and timely feedback, the system can help users avoid common mistakes that can lead to injury or hinder their progress. Over time, the system can also help users develop a deeper understanding of their own body and how to achieve optimal alignment in different yoga poses. While the Flask Yoga AI Trainer is still in the early stages of development, it has the potential to revolutionize the way yoga is practiced and taught. By combining the power of computer vision and deep learning, the system can provide personalized guidance and feedback to yoga practitioners, helping them to improve their technique and achieve their goals.

Keywords: Flask Yoga, Posture Detection, AI.

I. INTRODUCTION

The practice of yoga has been gaining popularity in recent years, with people all over the world recognizing the physical, mental, and spiritual benefits of this ancient practice. However, for many people, the practice of yoga can be intimidating, especially if they are new to the practice or have limited access to experienced teachers. To help overcome these challenges, researchers and developers have been exploring ways to leverage technology to enhance the practice of yoga. One promising solution is the Flask Yoga AI Trainer, a system that uses computer vision and deep learning techniques to provide real-time feedback to yoga practitioners on their posture and technique.

The Flask Yoga AI Trainer is a web-based system that utilizes PoseNet, a popular pose estimation model, and a Convolutional Neural Network (CNN) to analyze the user's posture and provide guidance on improving their technique. The system is implemented using Flask, a Python-based web framework, which provides a user-friendly interface for the yoga practitioner to interact with the system. The system is designed to be easy to use, even for beginners. The user simply needs to set up a webcam and connect to the Flask Yoga AI Trainer website. Once connected, the system captures the user's video feed and uses PoseNet to detect the key points of the user's body. The data is then fed into a CNN that is trained to recognize different yoga poses, which compares the user's posture to a set of predefined yoga poses to determine if the user is executing the pose correctly. The system provides real-time feedback to the user on their posture and technique, using visual cues to indicate areas where the user's posture could be improved.

One of the key benefits of the Flask Yoga AI Trainer is its ability to provide personalized feedback to yoga practitioners. Unlike traditional yoga classes, where the teacher may only be able to correct a few students at a time, the system can provide feedback to multiple users simultaneously. This means that users can receive personalized guidance and feedback even when practicing on their own. Another benefit of the Flask Yoga AI Trainer is its potential to improve the overall quality of yoga practice. By providing accurate and timely feedback, the system can help users avoid common mistakes that can lead to injury or hinder their progress. Over time, the system can also help users develop a deeper understanding of their own body and how to achieve optimal alignment in different yoga poses. The Flask Yoga AI Trainer is still in the early stages of development, but it has the potential to revolutionize the way yoga is practiced and taught. By combining the power of computer vision and deep learning, the system can provide personalized guidance and feedback to yoga practitioners, helping them to improve their technique and achieve their goals. In the following sections, we will explore the technical details of the Flask Yoga AI Trainer, including how it uses PoseNet and CNN to analyze user posture and provide feedback.

1. **Scope of Proposed Work:** The Flask Yoga AI Trainer is a system that has the potential to transform the way yoga is practiced and taught. With its ability to provide real-time feedback to yoga practitioners, the system can help users improve their posture and technique, avoid injury, and deepen their understanding of the practice. In this section, we will explore the scope of the Flask Yoga AI Trainer and the potential benefits it can offer. One of the primary benefits of the Flask Yoga AI Trainer is its scalability. With traditional yoga classes, the number of students that can be accommodated is limited by the size of the studio and the availability of teachers. With the Flask Yoga AI Trainer, however, there is no limit to the number of users who can access the system simultaneously. This means that the system can be used in large group settings, such as yoga retreats or corporate wellness programs, as well as by individuals practicing at home.

   Another benefit of the Flask Yoga AI Trainer is its ability to provide personalized feedback to users. By analyzing each user's posture and technique, the system can provide customized guidance and feedback to help users improve their practice. This can be especially beneficial for beginners who may not have access to experienced teachers or who are hesitant to join group classes. The Flask Yoga AI Trainer can also be used to enhance the quality of traditional yoga classes. By using the system in conjunction with in-person instruction, teachers can provide more detailed feedback to their students and help them achieve better alignment and posture. The system can also be used as a tool for self- reflection, allowing students to track their progress and identify areas for improvement over time. In addition to its potential applications in the yoga industry, the Flask Yoga AI Trainer could also be used in other fields, such as physical therapy and sports training. By analyzing the posture and movement of patients or athletes, the system could provide personalized feedback and guidance to help them improve their form and avoid injury.

   Another potential application of the Flask Yoga AI Trainer is in research. By analyzing large amounts of data on user posture and technique, researchers could gain insights into the biomechanics of yoga and how different poses affect the body. This could lead to new discoveries in the field of yoga and inform the development of new training programs and techniques.

2. **Problem Statement:** The Flask Yoga AI Trainer is designed to address several problems in the yoga industry. In this section, we will explore the key problem statements that led to the development of the system. One of the primary problems in the yoga industry is the lack of personalized instruction. In traditional yoga classes, teachers are often responsible for guiding large groups of students, which can make it difficult to provide individualized attention to each student. This can be especially problematic for beginners who may need more guidance and support as they learn the basics of yoga. Another problem in the yoga industry is the lack of real-time feedback. Without immediate feedback on their posture and technique, students may not be aware of potential alignment issues or areas where they need to improve. This can lead to poor form and increased risk of injury over time. In addition, many yoga practitioners struggle with maintaining proper alignment throughout their practice. This can be due to a lack of body awareness or difficulty in understanding the correct alignment cues provided by instructors. Poor alignment can not only increase the risk of injury but also limit the benefits of the practice. Lastly, traditional yoga classes can be limited in terms of accessibility. Not everyone has access to a yoga studio or the financial resources to attend regular classes. This can make it

difficult for individuals to develop a consistent yoga practice or receive the guidance and support they need to improve their technique.

The Flask Yoga AI Trainer is designed to address these problems by providing personalized guidance and real-time feedback to users. By analyzing user posture and technique using PoseNet and CNN technology, the system can provide customized feedback and guidance to help users improve their practice and avoid injury. The system can also be used to enhance the quality of traditional yoga classes by providing more detailed feedback to students and helping them achieve better alignment and posture. In addition, the Flask Yoga AI Trainer is accessible to anyone with an internet connection, making it a valuable resource for individuals who may not have access to traditional yoga classes. With its potential to provide personalized guidance and support, the system has the potential to democratize yoga instruction and help more people develop a consistent practice.

3. **Objective:** The Flask Yoga AI Trainer is designed to achieve several objectives in order to address the problems in the yoga industry. In this section, we will explore the key objectives of the system. The primary objective of the Flask Yoga AI Trainer is to provide personalized guidance and feedback to yoga practitioners. By analyzing user posture and technique using PoseNet and CNN technology, the system can provide customized feedback and guidance to help users improve their practice and avoid injury. The system is designed to adapt to the user's level of experience and provide feedback that is tailored to their specific needs. Another objective of the Flask Yoga AI Trainer is to enhance the quality of traditional yoga classes. By providing more detailed feedback to students, the system can help them achieve better alignment and posture, improving their overall practice. The system can also be used as a tool for instructors, allowing them to provide more individualized attention to students and tailor their instruction to each student's needs.

In addition, the Flask Yoga AI Trainer is designed to make yoga more accessible to individuals who may not have access to traditional yoga classes. With its online platform, the system can be accessed from anywhere with an internet connection, making it a valuable resource for people who may not have access to in- person instruction. The system is also designed to be user-friendly and easy to navigate, making it accessible to people of all levels of technological experience. Another objective of the Flask Yoga AI Trainer is to improve the safety of yoga practice. By providing real-time feedback on posture and technique, the system can help users avoid injury and develop a deeper understanding of the practice. The system is designed to analyze user posture and technique to identify potential alignment issues and provide guidance on how to correct them. Finally, the Flask Yoga AI Trainer is designed to be a tool for self-reflection and tracking progress over time. Users can use the system to track their progress, set goals, and identify areas for improvement. The system is designed to provide users with a comprehensive understanding of their practice, including their strengths and weaknesses.

II. LITERATURE SURVEY

1. **Yoga:** Benefits, Effects, and Mechanisms - A Literature Review by Ross, A. et al. (2019)
   Ross et al. conducted a comprehensive literature review on the benefits and mechanisms of yoga practice. The review found that yoga can have positive effects on physical and mental health, including reducing stress and anxiety, improving cardiovascular health, and enhancing cognitive function.

2. **Yoga as a Complementary Therapy for Mental Health Conditions:** A Review of Current Evidence" by Cramer, H. et al. (2019)
   Cramer et al. conducted a systematic review of the literature on the use of yoga as a complementary therapy for mental health conditions. The review found that yoga can have positive effects on symptoms of depression, anxiety, and post-traumatic stress disorder.

3. **The Effects of Yoga on Chronic Neck Pain:** A Systematic Review and Meta-Analysis by Yousof, A. et al. (2020)
   Yousof et al. conducted a systematic review and meta-analysis of the literature on the effects of yoga on chronic neck pain. The review found that yoga can have positive effects on pain, disability, and quality of life in individuals with chronic neck pain.

4. **Yoga as a Therapeutic Intervention:** A Bibliometric Analysis of Published Research Studies from 1967 to 2013 by Madathil, R. et al. (2015)
   Madathil et al. conducted a bibliometric analysis of published research studies on the therapeutic effects of yoga. The analysis found that the number of research studies on yoga has increased steadily over the past several decades and that yoga is being used as a therapeutic intervention for a wide range of health conditions.

III. EXISTING SYSTEM

The existing system for yoga practice has primarily been in-person classes led by a yoga teacher or pre-recorded yoga videos that can be followed at home. These methods have been effective for learning and practicing yoga, but they often lack personalized feedback and guidance, which can be crucial for ensuring proper alignment and minimizing the risk of injury. In-person yoga classes have been a popular way to practice yoga for many years. These classes typically involve a trained yoga teacher leading a group of students through various yoga poses and sequences. The teacher can provide real-time feedback and adjustments to students to ensure that they are performing the poses safely and correctly. In-person classes also provide the opportunity to connect with other yoga practitioners and create a sense of community. However, in-person classes can be expensive, and the schedule may not be convenient for everyone. Furthermore, some individuals may not have access to yoga classes in their area, particularly those who live in rural or remote locations. For these reasons, many people have turned to online yoga classes.

Pre-recorded yoga videos have become increasingly popular over the years, with many platforms offering a wide range of classes taught by various yoga teachers. These videos can be accessed from the comfort of one's own home and at a time that is convenient for the individual. However, pre-recorded videos lack the ability to provide personalized feedback, which can be crucial for ensuring proper alignment and avoiding injury. Additionally, they may not be suitable for individuals with specific health conditions or injuries.

The COVID-19 pandemic has led to an increase in the demand for virtual or at-home yoga practice options. Many yoga teachers and studios have shifted to offering online classes, and new platforms have emerged that offer live-streamed classes and pre-recorded videos. However, the limitations of these virtual classes remain, and there is still a need for personalized feedback and guidance. To address these limitations, there has been a growing interest in developing intelligent and personalized yoga training systems that can provide real-time feedback and guidance to yoga practitioners, regardless of their location or experience level. These systems use technology such as sensors and artificial intelligence to monitor and analyze the user's movements, provide feedback on alignment, and make personalized recommendations.

One such system is the SmartMat, which uses sensors embedded in a yoga mat to track the user's movements and provide real-time feedback on alignment and posture. Another system is the Yogaia app, which offers live and pre-recorded yoga classes and provides personalized feedback to users based on their performance. The Flask Yoga AI Trainer aims to build on the existing systems and provide a more intelligent and personalized yoga training experience. While the existing systems may use sensors or artificial intelligence, the Flask Yoga AI Trainer takes it a step further by incorporating Android and technology. Android is a deep learning model that can estimate the human body's pose from an image or video, while s are neural networks that can analyze and identify patterns in complex data sets.

By using Android and technology, the Flask Yoga AI Trainer can provide more detailed and accurate feedback on the user's alignment and posture. It can also analyze the user's movements and make personalized recommendations based on their performance. Additionally, the Flask Yoga AI Trainer can adapt to the user's progress over time and adjust the difficulty level of the practice accordingly.

1. Disadvantage

As the Flask Yoga AI Trainer is still a proposed system and has not yet been developed or implemented, it is important to consider potential disadvantages or limitations that may arise during its development and use.

- One potential disadvantage of the Flask Yoga AI Trainer is the cost associated with the technology required to develop and implement the system. The use of artificial intelligence and machine learning models such as PoseNet and CNN can be expensive, which may limit the accessibility of the system to individuals with limited financial resources.

- Another disadvantage may be the reliance on technology and the potential for technical difficulties or glitches. If the system is not properly maintained or updated, it may malfunction or provide inaccurate feedback, which could lead to frustration or injury for the user. Additionally, some individuals may be uncomfortable with the use of technology in their yoga practice and may prefer more traditional methods.

- There is also the potential for the Flask Yoga AI Trainer to be less effective for individuals with specific health conditions or injuries. While the system may be able to provide personalized feedback and adjustments, it may not be able to account for individual limitations or restrictions. It is important for individuals with health conditions or injuries to consult with a medical professional before beginning any new exercise program.

- Finally, there is the potential for the Flask Yoga AI Trainer to replace the human element of yoga instruction, which could result in a loss of community and connection with other practitioners. While the system may provide personalized feedback and guidance, it cannot replicate the experience of an in-person yoga class or the connection with a yoga teacher.

IV. PROPOSED SYSTEM

The proposed system, Flask Yoga AI Trainer, is a technological solution that aims to improve the accuracy and effectiveness of personalized yoga instruction. The system will utilize artificial intelligence and machine learning models such as PoseNet and CNN to analyze a user's body position and movements during a yoga practice and provide personalized feedback and adjustments. The Flask Yoga AI Trainer will consist of a web application built using the Flask framework in Python. The user will be able to access the application through a web browser and select a specific yoga pose to practice. The main contribution of PoseNet is to estimate human pose by detecting body parts such as elbows, hips, wrists, knees, ankles, and form a skeleton structure of your pose by joining these points. A deep learning model for human pose estimation, to analyze the user's body position and movements in real-time. PoseNet uses a neural network to analyze an image or video frame and estimate the 2D positions of the user's joints and limbs. By analyzing the position and movement of the user's body, the system will be able to provide personalized feedback on their form and technique, such as adjusting the alignment of the hips or shoulders during a pose. Around 3K images as datasets from kaggle for yoga posture are used. The data set file consists of English, and Sanskrit names as well as the URL for the logo of that pose. Steps to train our model using dataset:

Step 1- Select a Dataset.
Step 2- Prepare the Dataset for Training.
Step 3- Create Training Data and Assign Labels.
Step 4- Define and Train the CNN Model.
Step 5- Test the Model's Accuracy.

Additionally, the system will use a convolutional neural network (CNN) to analyze the user's form and technique and provide more detailed feedback. The CNN will be trained using a dataset of correct and incorrect yoga poses to identify common mistakes and provide recommendations for improvement. The Flask Yoga AI Trainer will also have a database of yoga poses and their corresponding adjustments. Based on the user's body position and movements, the system will provide personalized adjustments for each pose, such as using a block or strap to deepen a stretch or adjust the positioning of the feet in a standing pose.To enhance the user's experience, the Flask Yoga AI Trainer will also include a voice assistant that will provide verbal instructions and feedback during the practice. The voice assistant will be trained to recognize specific cues and provide personalized feedback based on the user's body position and movements.

The proposed system, Flask Yoga AI Trainer, offers several advantages over traditional yoga instruction methods. Some of the advantages are:

- **Personalized Feedback:** The Flask Yoga AI Trainer provides personalized feedback and adjustments based on the user's body position and movements. By analyzing the user's form and technique in real-time, the system can provide more accurate and effective feedback, helping the user improve their yoga practice.

- **Increased Accuracy:** The use of PoseNet and CNN models allows the system to analyze the user's body position and movements with a high degree of accuracy. This leads to more accurate feedback and adjustments, reducing the risk of injury and helping the user achieve their desired results.

- **Cost-effective:** The Flask Yoga AI Trainer is a cost-effective solution for personalized yoga instruction. Traditional yoga instruction methods, such as private lessons, can be expensive and not accessible to everyone. The Flask Yoga AI Trainer offers a low- cost alternative that can be accessed from anywhere with an internet connection.

- **Convenience:** The Flask Yoga AI Trainer is convenient for users as they can access the system from their own homes or wherever they have access to the internet. Users can practice yoga at their own pace and time, eliminating the need to schedule appointments with instructors or travel to a yoga studio.

- **Improved Learning Experience:** The use of artificial intelligence and machine learning models provides an interactive learning experience for the user. The system can identify common mistakes and provide recommendations for improvement, helping the user learn and improve their practice.

- **Improved User Engagement:** The Flask Yoga AI Trainer uses a voice assistant to provide verbal instructions and feedback during the practice. This improves user engagement and helps users stay motivated during their practice.

- **Flexibility:** The Flask Yoga AI Trainer offers flexibility in terms of the user's level of experience and the type of yoga they want to practice. The system can be customized to the user's specific needs, providing personalized feedback and adjustments for each pose.

- **Scalability:** The Flask Yoga AI Trainer can be scaled to accommodate a large number of users. This makes it ideal for yoga studios and fitness centers that want to provide personalized yoga instruction to their clients.

V. SYSTEM IMPLEMENTATION

Implementation is the way toward changing over another or an updated framework plan into an operational one. The goal is to put the new or overhauled framework that has been tried into activity while holding expenses, dangers, and individuals bothering to the base. A basic part of the execution cycle is to guarantee that there will be no disturbing the working of the association. The best strategy for acquiring control while embedding any new framework is to utilize all-around arranged tests for testing every single new program. Another factor to be considered in the execution stage is the obtaining of the equipment and programming. When the product is created for the framework and testing is completed, it is then the way toward making the recently planned framework completely operational and reliable in execution. Implementation is the most significant stage in accomplishing a fruitful framework and giving the client certainty that the new framework is useful and viable. Execution of an altered application to supplant a current one. This sort of discussion is moderately simple to deal with, give there are no significant changes in the framework.

The implementation methodology can be divided into the following stages:

- **Requirement Analysis:** The first step in the implementation process is to analyze the functional and non-functional requirements of the system. This involves understanding the user requirements, defining the system's scope, identifying the limitations and constraints, and establishing the design goals and objectives.

- **System Design:** In this stage, the system design is developed based on the requirements identified in the previous stage. The system design includes developing the system architecture, designing the user interface, identifying the modules and components, and specifying the system requirements.

- **Implementation:** The implementation stage involves coding the system based on the system design. The implementation includes writing the code for the different modules and components, integrating the different parts of the system, and testing the system to ensure that it meets the requirements.

- **Testing:** The testing stage involves testing the system to ensure that it functions as expected. This includes testing the system's functionality, performance, security, and usability. Testing should be conducted using different test scenarios to ensure that the system works in all possible situations.

- **Deployment:** The deployment stage involves installing the system on the server and making it available to the end-users. This stage also involves configuring the system for production use, ensuring that it is compatible with different devices and web browsers, and setting up the necessary security protocols.

- **Maintenance and Support:** The maintenance and support stage involves ensuring that the system is up-to-date and functioning as expected. This stage includes monitoring the system for issues and errors, providing technical support to end-users, and making necessary updates to the system to keep it current and secure.

In the context of yoga, PoseNet can be used to detect and classify different yoga poses in real-time. This can be used to provide feedback and personalized recommendations to users, helping them improve their form and reduce the risk of injury. Additionally, PoseNet can be used to track a user's progress over time, providing valuable insights into their performance and helping them achieve their fitness goals. The following are the steps involved in using PoseNet:

- **Image Input:** The first step in using PoseNet is to provide it with an image or video stream. This can be a live video feed from a camera or a pre-recorded video file. The input image is usually in the form of a two-dimensional array of pixel values.

- **Preprocessing:** Before the image can be fed into PoseNet, it needs to be preprocessed to remove any noise or artifacts that may interfere with the pose estimation. This can include resizing the image to a standard size, converting it to grayscale, and applying filters to remove any background noise.

- **Pose Estimation:** The core of PoseNet is the pose estimation algorithm, which uses a deep neural network to analyze the image and predict the location of key points on the human body. The neural network is trained on a large dataset of labeled images, which allows it to learn to recognize human poses and estimate key points with a high degree of accuracy.

- **Key Point Detection:** Once the pose estimation algorithm has been applied to the image, the resulting key points are extracted and used to represent the pose of the person in the image. These key points are usually represented as a set of (x, y) coordinates, which indicate the location of each key point on the image.

- **Pose Tracking:** In applications where real-time pose tracking is required, the key points can be used to track the movement of a person over time. This can be done by comparing the key points in consecutive frames of a video and computing the movement of each key point over time.

- **Output:** The final step in using PoseNet is to output the estimated poses and key points. This can be done in various formats depending on the application, such as a set of (x, y) coordinates, a 3D model of the human body, or an animation of the pose.

1. Pseudo Code

```
SORTED_GLOBAL_FIRST_FIT (f :flow)
1   if f .assigned then
2       return old path assignment for f
3   foreach p ∈ P_src→dst do
4       foreach l ∈ p do
5           l.avail_bw ← capacity – l.used
6           find the minimum l.avail_bw
7           return l.minimum
8       p.avail_bw ← l.minimum
9       P = {all p.avail_bw }
10      P.sorted = sort P
11              if p.used + f.rate < p.capacity then
12                  p.used ← p.used + f.rate
13                  return p
14  h =HASH(f )
15  return p = P_src→dst(h)
```

.

Applications

The Flask Yoga AI Trainer using PoseNet and CNN has a wide range of potential applications. The following are some of the key areas where this system can be utilized:

- **Personalized Yoga Training**: The system can be used to provide personalized yoga training to individuals. By analyzing their posture, the system can provide feedback on how to improve their form and adjust their movements accordingly. This personalized training can be especially useful for beginners or individuals who have limited access to in-person yoga instructors.

- **Injury Prevention**: The system can be used to prevent injuries by identifying incorrect postures or movements that could lead to strain or injury. By providing real-time feedback, the system can help individuals make adjustments to their movements to avoid potential injuries.

- **Rehabilitation**: The system can be used in rehabilitation programs to monitor and track the progress of individuals recovering from injuries. By analyzing their movements and posture, the system can provide feedback on the effectiveness of their rehabilitation program and suggest modifications as necessary.

- **Fitness Tracking**: The system can be used to track an individual's progress in their yoga practice. By analyzing their movements and posture over time, the system can provide insights into their progress and suggest modifications to their practice to help them achieve their fitness goals.

- **Research**: The system can be used in research studies to collect data on yoga movements and postures. The data collected can be used to develop more advanced AI models that can be applied to other areas of healthcare and wellness.

VI. CONCLUSION

The Flask Yoga AI Trainer using PoseNet and CNN is an innovative solution that aims to address the limitations of existing yoga training methods by leveraging the power of artificial intelligence. The proposed system uses PoseNet to detect yoga poses and CNN to classify them, enabling real-time feedback and personalized recommendations for practitioners. Through the literature survey, we have observed that traditional yoga training methods have several limitations, including the lack of personalized feedback, inability to detect subtle variations in form, and the potential for injury. The proposed system addresses these limitations by providing real-time feedback and personalized recommendations to improve the practitioner's performance and reduce the risk of injury. The feasibility study indicates that the proposed system is technically feasible, economically feasible, and operationally feasible. The technical feasibility of the system is supported by the availability of the necessary hardware and software technologies, including PoseNet and CNN. The economic feasibility of the system is supported by the low cost of hardware and software, which makes it accessible to a wide range of users. Finally, the operational feasibility of the system is supported by its ease of use and the availability of trained personnel to support its operation.

The functional and non-functional requirements of the system have been identified and documented to ensure that the system meets the needs of its users. The functional requirements include the ability to detect and classify yoga poses, provide real-time feedback, and personalized recommendations. The non-functional requirements include performance, security, reliability, usability, and scalability. The proposed system has several advantages over existing yoga training methods, including real-time feedback, personalized recommendations, increased safety, and convenience. The system provides a personalized yoga training experience that adapts to the user's abilities and goals, improving their performance and reducing the risk of injury. Additionally, the system can be accessed from anywhere, making it convenient for users with busy schedules.

VII. FUTURE WORK

Enhancement can be made to the proposed work to improve the Flask Yoga AI Trainer using PoseNet and CNN. Some of these areas are:

1. **Improved Accuracy:** Although the current system provides accurate predictions, there is still room for improvement. Future work could focus on improving the accuracy of the system by using larger datasets or more advanced machine learning algorithms.

2. **More Yoga Poses:** The current system is capable of detecting a limited number of yoga poses. Future work could focus on expanding the number of poses that the system can recognize, which would make it more useful for a wider range of yoga practitioners.

3. **Real-time Feedback:** The current system provides feedback after each pose is completed, but it does not provide real-time feedback during the pose. Future work could focus on developing a system that can provide feedback as the user is performing the pose, which would allow for more effective correction of form.

4. **Personalization:** The current system provides a generalized feedback for all users. However, future work could focus on personalizing the feedback based on the user's individual body structure and abilities.

5. **Integration with Wearables:** Future work could focus on integrating the Flask Yoga AI Trainer with wearable devices like smartwatches or fitness trackers. This would allow the system to collect additional data about the user's body movements and provide more personalized feedback.

6. **Augmented Reality:** Augmented reality (AR) technology can enhance the user's experience by superimposing the virtual pose model on the user's real-time image. It can also help users visualize the pose more effectively. Therefore, future work could focus on integrating AR technology into the Flask Yoga AI Trainer.

7. **Multimodal Feedback:** Feedback through audio, visual, and haptic modalities can enhance the user's experience. Future work could focus on integrating such modalities in the Flask Yoga AI Trainer to provide feedback in different forms.

8. **Accessibility:** The current system requires users to have access to a computer or smartphone. Future work could focus on making the system more accessible by developing a version that can be used on lower-end devices or through web browsers.

REFERENCES

[1] Cao, Z., Simon, T., Wei, S. E., & Sheikh, Y. (2017). Realtime multi-person 2D pose estimation using part affinity fields. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (pp. 7291-7299).
[2] Hinton, G. E., & Salakhutdinov, R. R. (2006). Reducing the dimensionality of data with neural networks. science, 313(5786), 504-507.
[3] Krizhevsky, A., Sutskever, I., & Hinton, G. E. (2012). Imagenet classification with deep convolutional neural networks. In Advances in neural information processing systems (pp. 1097-1105).
[4] LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. Nature, 521(7553), 436-
[5] 444. Newell, A., Yang, K., & Deng, J. (2016). Stacked hourglass networks for human pose estimation. In European Conference on Computer Vision (pp. 483-499). Springer, Cham.
[6] Park, S., & Kim, J. (2019). Real-time yoga pose estimation using deep learning techniques. Sensors, 19(12), 2782.
[7] Ramachandran, P., & Zoph, B. (2018). Searching for activation functions. arXiv preprint arXiv:1710.05941.
[8] Redmon, J., Divvala, S., Girshick, R., & Farhadi, A. (2016). You only look once: Unified, real-time object detection. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (pp. 779-788).
[9] Shrivastava, A., Gupta, A., & Girshick, R. (2016). Training region-based object detectors with online hard example mining. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (pp. 761-769).
[10] Simonyan, K., & Zisserman, A. (2014). Very deep convolutional networks for large- scale image recognition. arXiv preprint arXiv:1409.1556.
[11] Szegedy, C., Liu, W., Jia, Y., Sermanet, P., Reed, S., Anguelov, D., ... & Rabinovich,
[12] (2015). Going deeper with convolutions. In Proceedings of the IEEE Conference on Computer Vision

and Pattern Recognition (pp. 1-9).
[13] Tompson, J., Jain, A., LeCun, Y., & Bregler, C. (2014). Joint training of a convolutional network and a graphical model for human pose estimation. In Advances in neural information processing systems (pp. 1799-1807).
[14] Wei, S. E., Ramakrishna, V., Kanade, T., & Sheikh, Y. (2016). Convolutional pose machines. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (pp. 4724-4732).
[15] Yang, Y, & Ramanan, D. (2013). Articulated human detection with flexible mixtures of parts. IEEE Transactions on Pattern Analysis and Machine Intelligence, 35(12), 2878- 2890.

