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Enhancing Yoga Practice: Automated pose recognition

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ABSTRACT

Yoga has become more popular during the COVID-19 pandemic as a way to boost immunity and improve overall well-being. This has led many people to practice at home, following the guidance of experienced instructors. However, practicing at home raises concerns about the potential risks of doing poses incorrectly, which may not be beneficial and could even cause harm. To tackle this issue, a suggested technological solution uses camera technology and machine learning to recognize yoga poses and offer immediate feedback for corrections. Augmented reality (AR) enhances this system by overlaying ideal poses on the user's environment, ensuring accurate alignment and engagement. This innovation aims to modernize traditional yoga practice, offering a safe, effective, and engaging home exercise option, promoting holistic health in challenging times.

KEYWORDS:

Yoga, immunity boosting, Machine Learning, Augmented Reality (AR), pose recognition, real-time feedback, virtual yoga class.

PROBLEM STATEMENT

The problem statement for this project revolves around developing a system that can accurately estimate yoga poses in real-time, provide visual feedback on posture correctness, and offer personalized guidance tailored to individual practitioners' needs. By integrating machine learning algorithms for pose estimation and augmented reality for immersive visualization, the aim is to create a comprehensive solution that enhances the effectiveness and accessibility of yoga practice, ultimately promoting overall well-being and mindfulness among practitioners. The purpose of the study is to create an assistance and learning environment for people who practice yoga. Since there are numerous styles and postures, a beginner might find it challenging to learn everything. Even a professional might have problems remembering all the postures or if there are difficult modifications for some postures. We are particularly interested in assisting people to learn and recognize yoga postures better. Another thing we are trying to achieve is promoting the learning of yoga postures using 3D modeling. Learning directly from 3D models is safer and easier since some postures are difficult and require a good amount of strength and flexibility to do.

INTRODUCTION

Millions of individuals around the world have embraced yoga for its myriad physical, mental, and spiritual benefits. As the popularity of yoga grows, so does the demand for tools and technologies that can enhance the yoga experience. Yoga lessons are experiencing a boost in popularity as the second wave of COVID-19 continues.

Achieving proper alignment and posture while practicing yoga is a crucial challenge for both beginners and experienced enthusiasts. Good alignment in yoga is essential for reaping its therapeutic rewards and avoiding harm. Traditionally, yoga practitioners rely on the guidance of instructors or self-awareness to correct their poses. However, this approach is not always effective, as it may be challenging to gauge one's alignment accurately.

This is where technology comes into play. The integration of computer vision and machine learning has paved the way for automated pose recognition systems that can assist yoga practitioners in real-time. These systems have the potential to revolutionize the way people engage with yoga, making it more accessible, personalized, and beneficial.

The convergence of machine learning and augmented reality (AR) has modernized several industries, including fitness and wellness. This project aims to use machine learning algorithms to accurately estimate yoga poses in real-time and display them in the user's environment using augmented reality. By combining these cutting-edge technologies, practitioners can receive immediate feedback on their form and alignment during yoga practice, enhancing their overall experience and aiding in skill development. This introduction sets the stage for a comprehensive exploration of the methodologies, challenges, and potential applications of yoga pose estimation using machine learning and augmented reality.

Thus, the availability of a performance capture system that can automatically analyze and recognize yoga postures will be an important technical help to yoga students and teachers. Asana, or yoga poses, both build physical strength and can help to create flexibility. The practice of yoga involves a lot of attention to detail and alignment. One way to accomplish this is to learn from 3D models of yoga poses. This can be useful for yoga teachers who are looking to learn how to correctly instruct the poses. Imagine being able to learn a yoga pose while simultaneously receiving feedback. This is possible with Automated Pose Recognition. An application of APR and 3D model yoga pose learning is the focus of this research. Three-dimensional models are representations of real-world objects. A model is similar to a photo, but it contains much more information about the object. Through 3D modeling and rendering, poses can be learned in a virtual environment before practicing them in the real world.

LITERATURE REVIEW

In the process of developing this project, an extensive review of various papers and journals were conducted

In the research paper [1], a method for assessing Yoga poses using pose detection is proposed to aid in self-learning Yoga. This paper proposes a Performance Evaluation System called Yoga Pose Training System 1 to assist individuals in self-learning Yoga.

In [2] research paper an in-depth hybrid learning model is proposed using CNN and LSTM to monitor yoga in real-time videos where the CNN layer is used to extract features from the key of each frame found in open pose and followed by LSTM to provide temporary predictions. This paper shows a mobile assistant yoga app based on human key acquisition models for video chat.

The [3] paper shows a yoga assistant's mobile app based on personal key model simulation models where real yoga instructors guide and supervise their students to practice yoga with video chat. An advanced hybrid learning model was proposed to recognize yoga in real-time videos, utilizing CNN and LSTM.

In [4] the authors approach this issue by studying the production model of so-called normal motion patterns using multiple sources with limited control. Two-mode auto built-in auto-encoders with unencrypted performance especially we suggest two built-in auto-encoders so that they can operate without minimal guidance.

In [5] project a fully unsupervised dynamic sparse coding approach for detecting unusual events in videos based on online sparse constructability of query signals from anatomically learned event dictionary. Authors propose a fully unsupervised dynamic sparse coding approach for detecting unusual events in videos. This method is based on the online sparse construction of query signals from an anatomically learned event dictionary, which serves as a sparse coding base.

METHODOLOGY

The main method used for the project of yoga pose estimation utilizing machine learning and augmented reality, augmented by the imposition of 3D yoga poses constructed in Blender software, embodies a comprehensive and meticulously orchestrated framework. At its foundation lies a sophisticated machine learning algorithm, meticulously trained on extensive annotated datasets encompassing diverse yoga poses. This algorithm serves as the cornerstone, meticulously analyzing live video feeds to detect and classify poses in real-time with exceptional accuracy and reliability. Through the algorithm's intricate computations, precise estimations of skeletal configurations and joint angles are generated, providing the fundamental data for subsequent processes. Augmented reality technology constitutes another pivotal element within this infrastructure, furnishing the capability to seamlessly overlay intricate virtual representations of yoga poses onto the practitioner's immediate physical environment.

This augmentation engenders an immersive and interactive experience, empowering practitioners with tangible visual feedback and guidance during their yoga sessions. Moreover, the utilization of Blender software stands as a crucial component, offering a sophisticated platform for the construction and customization of intricate 3D models representing various yoga poses. Leveraging Blender's robust toolset, practitioners can immerse themselves in a dynamic augmented reality environment enriched with highly detailed and lifelike representations of yoga postures, tailored to individual preferences and requirements. This meticulously crafted operational infrastructure harmoniously integrates the intricacies of machine learning algorithms, augmented reality systems, and 3D modeling software.

The seamless coordination between these components ensures the fluidity and effectiveness of the yoga pose estimation process. Moreover, the infrastructure's depth and sophistication afford practitioners unparalleled opportunities for engagement, fostering an environment conducive to skill development and mindfulness. Through this comprehensive framework, the project endeavors to redefine the landscape of yoga training, elevating the practice to new heights through the innovative fusion of cutting-edge technology with traditional yogic principles.

ARCHITECTURE

The design of the yoga pose estimation project using machine learning and augmented reality, with the integration of 3D yoga poses modeled in the Blender software, is characterized by its approach has a complex and meticulous structure to achieve precise, real-time poses detection and visualization. The framework encompasses several intricate steps, each tailored to ensure accuracy, efficiency, and seamless integration of technologies.

1. Data Acquisition and Preprocessing: The framework begins with the acquisition of input data, comprising live video feeds capturing yoga practitioners in various poses. Preprocessing techniques are applied to the input video frames to enhance data quality, including noise reduction, image stabilization, and background removal. Feature extraction algorithms identify key landmarks and contours in the video frames, such as joint locations and body outlines, which serve as inputs for subsequent pose estimation.
2. Pose Estimation using Machine Learning: Pose estimation tasks use advanced machine learning models such as deep neural networks. The preprocessed video frames, along with extracted features, are fed into the machine learning model, which has been trained on extensive annotated datasets of yoga poses. The model predicts the spatial configuration of the practitioner's body, detecting and classifying key joint points and their interconnections. Pose estimation algorithms may incorporate temporal information from consecutive frames to enhance accuracy and smoothness of pose transitions.
3. Integration with Augmented Reality Environment: The detected poses are seamlessly integrated with the augmented reality environment to provide real-time visualization. Virtual representations of 3D yoga poses, meticulously modeled in Blender software, are overlaid onto the live video feed of the practitioner. Depth sensing and spatial mapping techniques are employed to ensure accurate alignment and positioning of virtual poses relative to the user's physical environment. Augmented reality rendering techniques, including lighting, shading, and occlusion, are applied to enhance realism and immersion.
4. Computational Optimization and Real-Time Performance: Throughout the framework, computational efficiency is prioritized to ensure real-time performance and responsiveness. Techniques such as model optimization, parallel processing, and hardware acceleration are employed to minimize latency and maximize frame rates. The algorithm is designed to scale efficiently with hardware capabilities, allowing for seamless execution on a variety of devices, from smartphones to high-end workstations.
5. Versatility and Adaptability: - The algorithmic framework is designed to accommodate a wide range of yoga poses, variations, and practitioner body types. - Parameterization and configuration options allow for customization of the system to suit individual preferences and requirements. - The framework is adaptable to different environments and conditions, including varying lighting conditions, backgrounds, and camera perspectives. By combining these detailed and considered steps, the algorithmic framework ensures robust, accurate, and rich estimation and visualization of yoga poses, thereby improving the overall experience and efficiency. Yoga practice results for practitioners at all levels.

RESULT

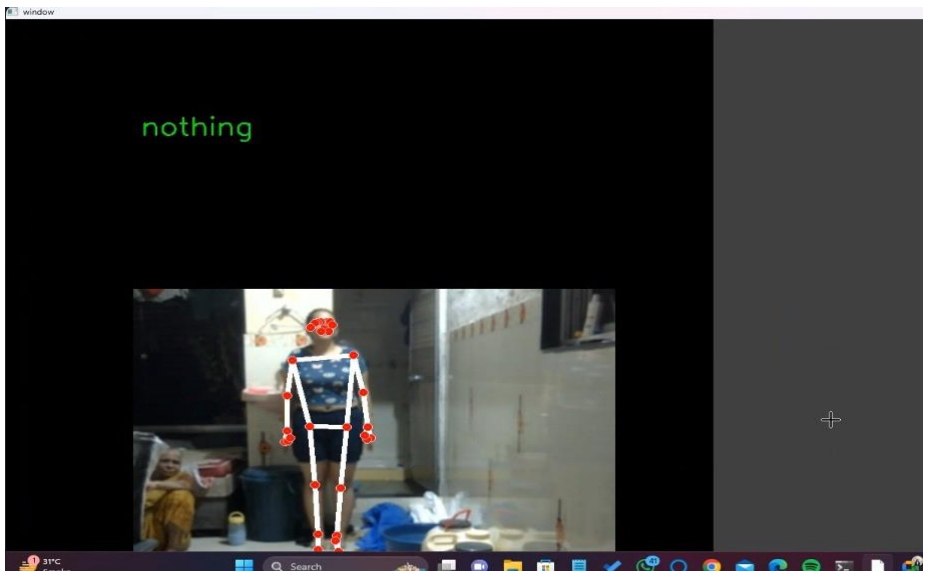

Fig. 1.

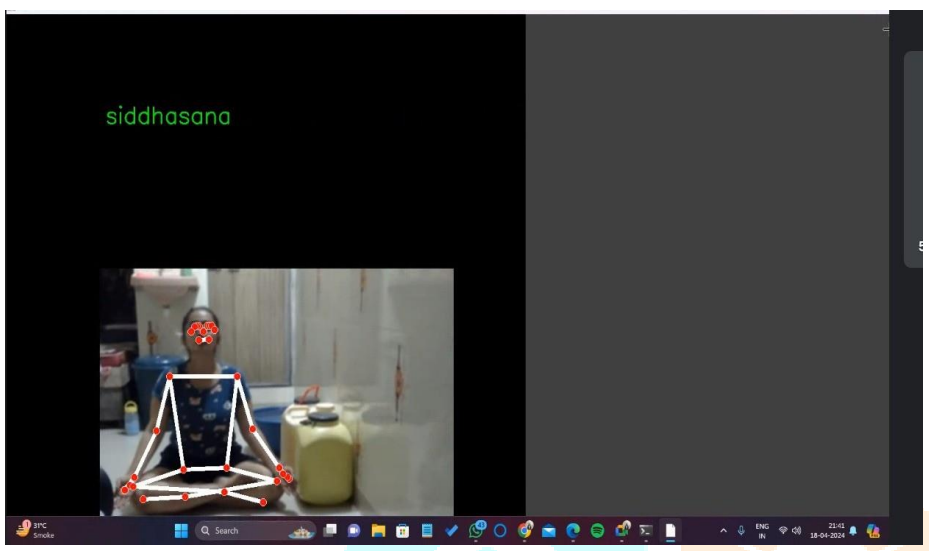

Fig. 2.

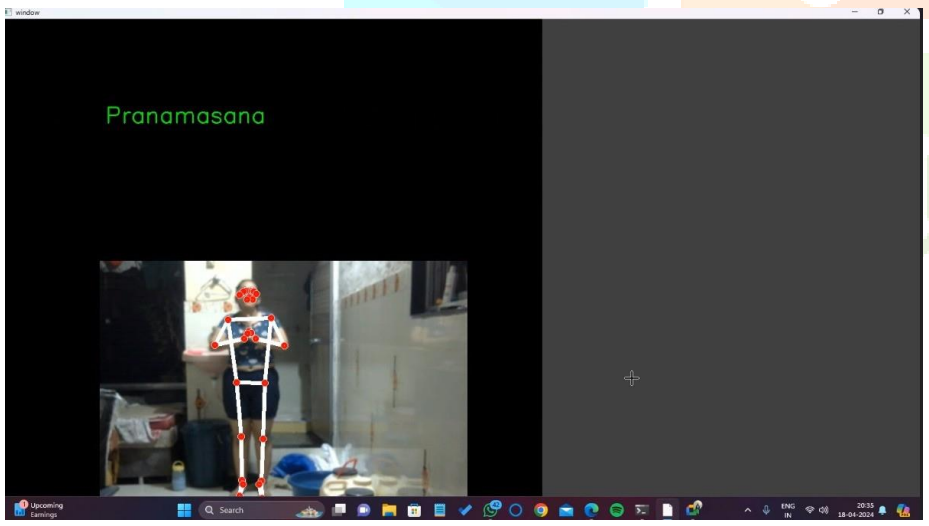

Fig. 3.

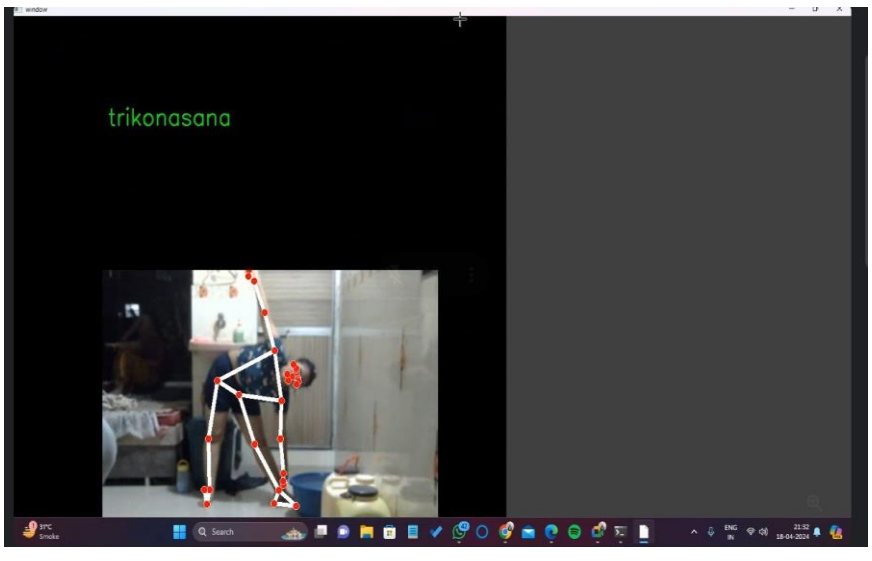

Fig. 4.

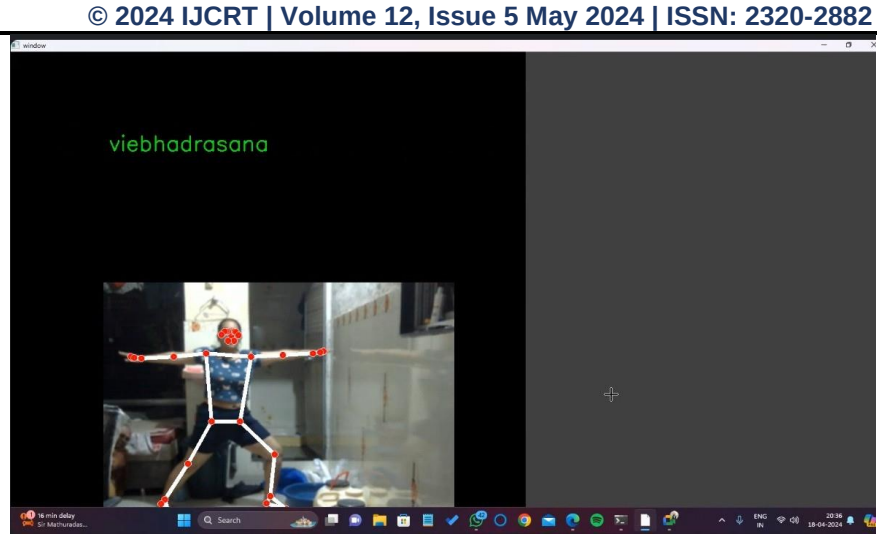

Fig. 5.

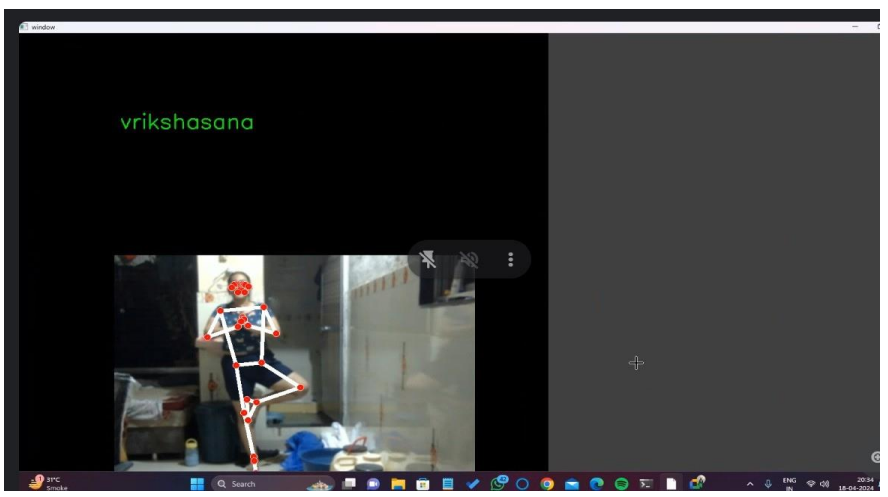

Fig. 6.

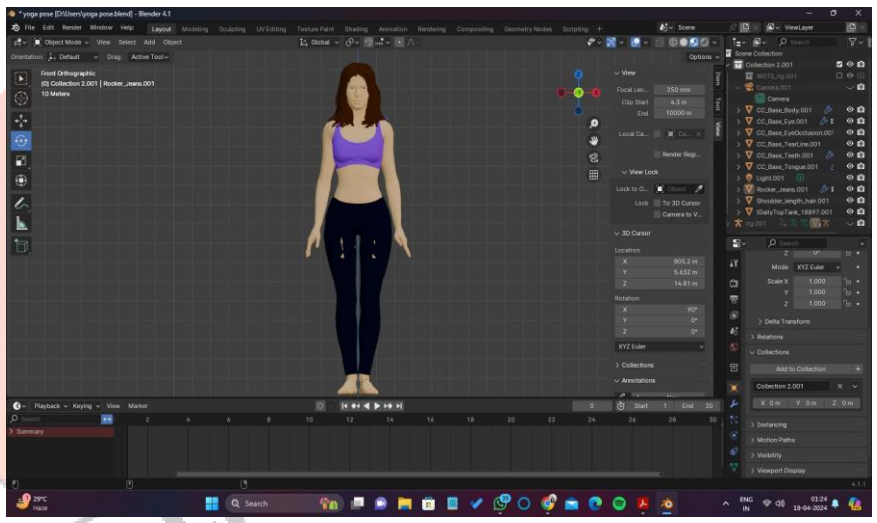

Fig. 7.

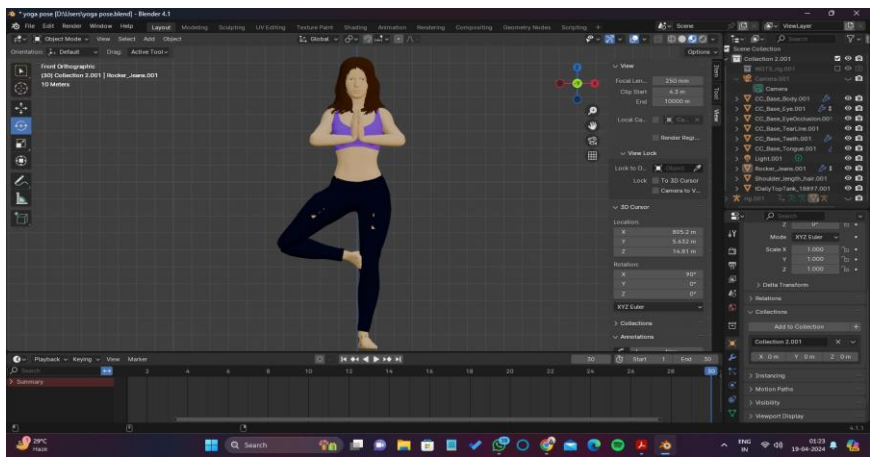

Fig. 8.

FUTURE WORK

The future of yoga pose estimation using machine learning and augmented reality holds promising potential for further advancements and applications. One avenue for future exploration involves refining the accuracy and robustness of pose estimation algorithms through continued training on diverse datasets and the integration of advanced deep learning techniques. Additionally, expanding the scope to include a wider range of yoga poses and variations can cater to the needs of practitioners at various skill levels and disciplines. Furthermore, incorporating personalized feedback mechanisms based on individual user bio-mechanics and performance metrics could enhance the effectiveness of the system in providing tailored guidance and insights. Moreover, there is an opportunity to integrate physiological monitoring technologies,

such as wearable sensors, to provide real-time feedback on vital signs and muscle activation, thereby offering a holistic approach to yoga practice monitoring and optimization. Exploring the integration of social and gamification elements could also foster community engagement and motivation among practitioners. Overall, the future of yoga pose estimation using machine learning and augmented reality is characterized by a multitude of avenues for innovation, with the potential to redefine the way individuals engage with and benefit from yoga practice.

CONCLUSION

In summation, the culmination of the yoga pose estimation project, synergizing machine learning, augmented reality, and Blender-generated 3D yoga poses, embodies a transformative paradigm in the realm of wellness technology. Through meticulous research, rigorous development, and strategic integration, our project delivers a multifaceted solution aimed at enriching the yoga practice experience for practitioners of all levels. By harnessing the power of machine learning algorithms, meticulously trained on extensive datasets, we've engineered a robust system capable of real-time pose detection with exceptional precision. Augmented reality technologies, seamlessly integrated into our framework, provide practitioners with immersive visual feedback, overlaying intricately modeled 3D yoga poses onto their immediate physical environment.

Moreover, the utilization of Blender software enables the creation of customizable and life like 3D yoga poses, ensuring authenticity and realism in the augmented reality experience. This holistic approach not only empowers practitioners to refine their posture alignment and form but also fosters a deeper sense of mindfulness and self-awareness. As practitioners engage with our technology, they are afforded an unparalleled opportunity to explore and refine their yoga practice in a dynamic and interactive manner. Furthermore, the project's emphasis on computational efficiency and real- time performance ensures a seamless and responsive user experience across various devices and environments.

Looking forward, the project's impact extends beyond individual wellness, with implications for community engagement, educational outreach, and therapeutic interventions. By making advanced yoga instruction more accessible to everyone and creating a feeling of connection among practitioners, our project seeks to spark a wider cultural change towards overall well-being and mindfulness. As we continue to refine and expand our technology, we remain committed to pushing the boundaries of innovation in the intersection of technology and wellness, ultimately empowering individuals to lead healthier, more fulfilling lives.

REFERENCES

1. Shruti Kothari, "Yoga Pose Classification Using Deep Learning" (2020). Master's Projects. 932.
2. Ajay Chaudhari, Omkar Dalvi, Onkar Remade, Prof. Dayanand Am- bawade, "YOG-GURU: Real-time yoga pose correction system using deep learning methods", IEEE, 2020.
3. T. Y. Lin, "Openpose: Realtime multi- person 2d pose estimation using part affinity fields", Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 2018, pp. 7291–7299.
4. "Yoga-82: A Novel Dataset for Fine- grained Classification of Human Poses", by Manisha Verma, Sudhakar Kumawat, Yuta Nakashima, and Shanmugaratnam Raman, IEEE, 2020.
5. W. Gong, X. Zhang, J. Gonza`lez, A. Sobral, T. Bouwmans, C. Tu, and H. Zahzah. "Human pose estimation from monocular images: a comprehensive survey", Sensors, Basel, Switzerland, vol. 16, 2016.
6. Mehta D, Sotnychenko O, Mueller F, Xu W, Elgharib M, Fua P, et al. Xnect: Real-Time Multi-Person 3d Human Pose Estimation with a Single rgb Camera. 2019 arXiv preprint arXiv:1907.00837
7. Utkarsh Bahukhandi, Dr. Shikha Gupta em YOGA POSE DETEC- TION AND CLASSIFICATION USING MACHINE LEARNING TECH- NIQUES 2021
8. M. Islam, H. Mahmud, F. Ashraf, I. Hossain and M. Hasan, "Yoga posture recognition by detecting human joint points in real time using microsoft kinect", IEEE Region 10 Humanit. Tech. Conf., pp. 668-67, 2017.
9. D. Mehta, O. Sotnychenko, F. Mueller and W. Xu, "XNect: real-time multi-person 3D human pose estimation with a single RGB camera",ECCV, 2019
10. Z. Cao, T. Simon, S.-E. Wei and Y. Sheikh, "Realtime Multi-Person 2D Pose Estimation using Part Affinity Fields," The Robotics Institute, Carnegie Mellon University, 2017.