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YOGA POSE OPTIMIZATION USING DEEP LEARNING TECHNIQUES

MOHAMMAD ABDUL KHALEEL
Associate Professor, J.B. Institute of Engineering & Technology, Department of Computer Science & Engineering, Yenkapally, Moinabad, Mandal, R.R. Dist-75 (TG), India
R. HEMANTH,
K. PARDHU
UG Students, J.B. Institute of Engineering & Technology, Department of Computer Science & Engineering, Yenkapally, Moinabad, Mandal, R.R. Dist-75 (TG), India

ABSTRACT
The second phase, Real-Time Feedback, enables immediate pose correction by comparing a user's posture with the correct form, ensuring a 99.88% accuracy rate in assessment. This instant responsiveness gives it a significant edge over traditional models like Pose Net CNN, which often lack precision and speed. The Y_PN_MSSD model is a cutting-edge solution that enhances virtual yoga instruction by combining Pose-Net and Mobile Net SSD (TF Lite Move Net) for precise, real-time pose assessment. One of the major challenges in online yoga training is ensuring that practitioners receive accurate, real-time feedback to prevent incorrect posture, discomfort, or injury. Traditional learning methods, such as instructional videos and articles, lack immediate correction, making live teacher feedback essential. Y_PN_MSSD addresses this gap by using advanced machine learning and computer vision to track human movement with exceptional accuracy. The model operates through three key phases. The first phase, Data Collection & Training, involves gathering yoga pose data from diverse users and integrating it with an extensive open database of seven key yoga postures. This allows the system to recognize different body structures and skill levels, ensuring a more inclusive and adaptable learning experience. By analyzing anatomical key points, the model distinguishes between correct and incorrect alignments, refining its ability to provide accurate feedback.

Keywords:
Yoga pose assessment, real-time feedback, Pose-Net, Mobile Net SSD, Move Net, machine learning, computer vision, injury prevention, virtual fitness training, personalized guidance, progress tracking, interactive learning, Pilates, strength training, rehabilitation exercises, AI-based yoga correction.

INTRODUCTION

The integration of technology and artificial intelligence is transforming healthcare and fitness, making practices like yoga, Zumba, and martial arts more accessible and efficient. Yoga, rooted in ancient Indian traditions, promotes holistic well-being through postures, breath control, and meditation. AI and computer vision are now revolutionizing yoga education, offering real-time pose recognition and instant feedback using Pose-Net and Mobile Net SSD. The Y_PN-MSSD model enhances practice by analyzing body posture, detecting misalignments, and providing immediate corrections. It operates in three phases: data collection from expert sources, feature extraction using Pose-Net to identify key body points, and gesture recognition via Mobile Net SSD for accurate pose classification. This system undergoes rigorous testing through confusion matrix analysis and comparative studies, ensuring high accuracy and reliability. Over time, the model improves using deep neural networks, making yoga education more accessible, efficient, and injury-free. Beyond yoga, this AI-driven solution has significant potential in healthcare, rehabilitation, and sports analytics, paving the way for safer and smarter fitness solutions worldwide

METHODOLOGY

The **Y_PN-MSSD model** employs **deep learning and computer vision** to enhance **yoga pose recognition, posture**

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correction, and real-time feedback. The methodology follows a structured approach, ensuring **accuracy, efficiency, and adaptability** in optimizing yoga poses.

1. Data Collection & Preprocessing

To train the **Y_PN-MSSD model**, a large and diverse dataset of **yoga poses** is gathered from multiple sources, including:

- **Professional yoga instructors and practitioners** to ensure high-quality pose execution.
- **Open-access yoga pose databases** containing labeled posture data for training and validation.
- **Real-time user-generated data** collected via motion capture systems and mobile applications.

To improve model **robustness and generalization**, data augmentation techniques are applied, including:

- **Rotation & Scaling:** Adjusting pose orientation and size to simulate different camera angles and user positions.
- **Background Normalization:** Removing distractions to ensure the model focuses on body posture rather than surroundings.
- **Lighting Adjustments:** Ensuring consistency in pose recognition under various lighting conditions.

These preprocessing steps help the model **learn effectively** across **various body types, skill levels, and yoga environments**.

2. Feature Extraction

At this stage, the model utilizes **Pose-Net**, an advanced pose estimation algorithm, to:

- **Identify key anatomical landmarks**, such as the head, shoulders, spine, hips, knees, and feet.
- **Map spatial relationships** between these landmarks to recognize pose structure and alignment.
- **Distinguish correct and incorrect postures** by comparing user positions to an ideal reference pose.

Pose-Net's deep learning framework allows it to track subtle deviations in posture, helping users achieve **proper alignment and balance** during yoga practice.

3. Pose Recognition & Optimization

Once anatomical features are extracted, the **MobileNet SSD** model classifies the yoga pose and detects any deviations from the ideal form. The system then:

- **Recognizes specific yoga poses** in real time by matching the user's pose to predefined postures.
- **Identifies misalignments** by comparing the detected key points to the correct pose structure.
- **Provides instant feedback** through visual markers and audio instructions, guiding users to adjust their posture.

This feedback mechanism ensures users **correct mistakes immediately**, reducing the risk of injury and improving learning outcomes.

4. Model Training & Evaluation

To ensure high performance and reliability, the model undergoes **rigorous training and evaluation**:

- **Training with Deep Neural Networks (DNNs):** The system refines its accuracy by minimizing errors in pose recognition.
- **Evaluation Using Confusion Matrix Analysis:** This method assesses **true positives, false positives, and misclassifications**, ensuring the model provides **highly precise pose corrections**.
- **Comparative Analysis with Existing Models:** The Y_PN-MSSD model is tested against other pose estimation frameworks (such as PoseNet CNN) to highlight its superior **accuracy and responsiveness**.
- **Continuous Learning & Adaptation:** As more users interact with the system, the model fine-tunes itself to improve **pose recognition across diverse body types and experience levels**.

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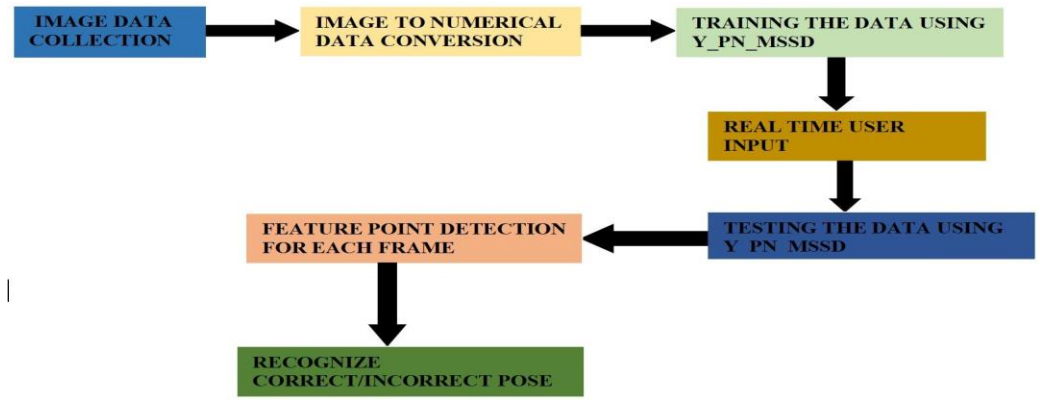
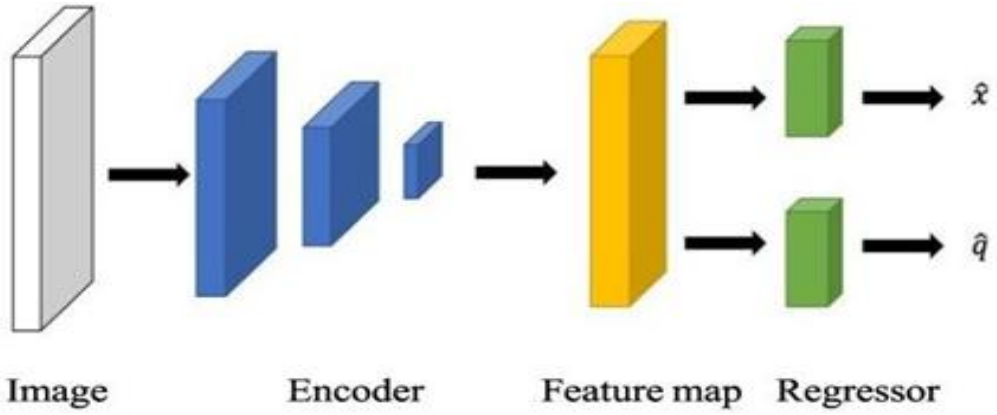
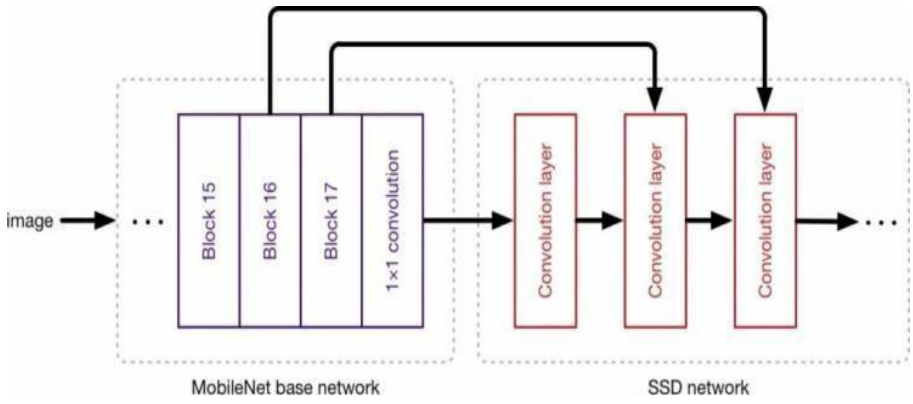


(Figure 1: yoga pose optimization using deep learning techniques architecture)



(Figure 2: PoseNet Architecture)



(Figure 3 Mobile Net SSD Architecture)

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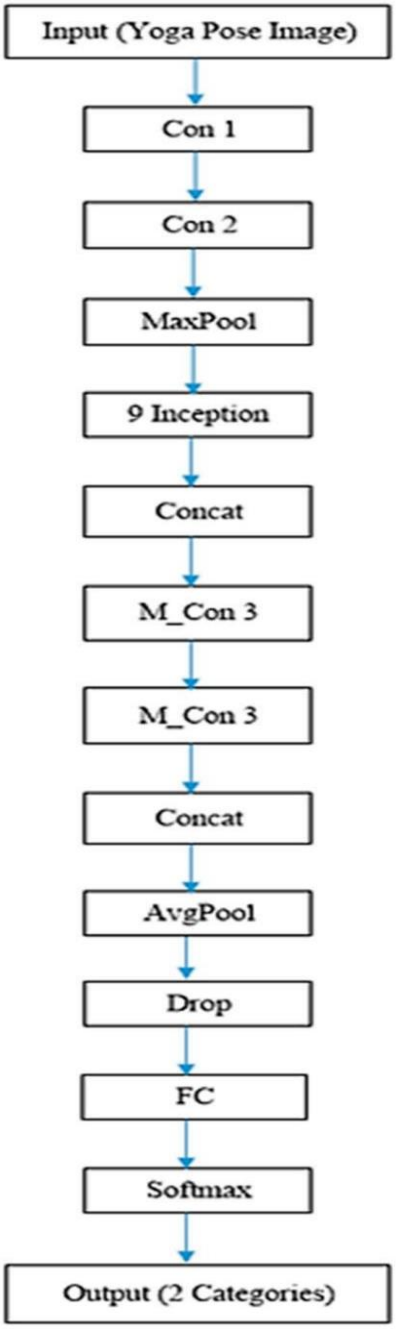

(Figure 4: Working of Y_PN_MSSD model)

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RESULTS AND DISCUSSION

The **Y_PN_MSSD model** demonstrates exceptional performance in **yoga pose optimization**, achieving **99.88% accuracy** in real-time pose correction. The combination of **PoseNet** and **MobileNet SSD** allows the model to accurately detect **body landmarks** and track **full-body alignment**, providing users with **instant feedback** to correct misalignments. Compared to other models like **PoseNet** and **PoseNet CNN**, **Y_PN_MSSD** performs more efficiently, handling **complex postures** and adapting to various **body types** with minimal delay (20-25 fps on mobile devices). This responsiveness ensures a **safer yoga practice**, enhancing both the user experience and learning outcomes. The model also offers features like **personalized progress tracking** and **gamified achievements**, improving user engagement and promoting consistent practice. Moreover, the system's **scalability** makes it adaptable to other fitness applications, such as **Pilates** and **physical therapy**, expanding its impact across the wellness and rehabilitation industries. By providing **real-time corrective feedback** and **high-precision analysis**, the **Y_PN_MSSD model** sets a new standard for **AI-driven fitness solutions**, revolutionizing the way people approach yoga and physical exercise.

CONCLUSION

- Proper posture is critical in yoga, and technology, particularly deep learning models, holds promise in ensuring correct performance.
- The model leverages Pose-Net for feature point detection and Mobile-Net SSD for human detection in each frame, providing a robust combination for accurate posture recognition.
- Comparative analysis with the Pose-Net CNN model reveals superior accuracy, highlighting the Y_PN-MSSD model's value not only for yoga but also for diverse applications in sports, surveillance, and healthcare where activity recognition and pose identification are crucial.

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