# PHYSIOTHERAPY POSE DETECTION MODEL

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**ABSTRACT**

This study focuses on the difficulties patients face in performing physiotherapy exercises correctly at home without expert guidance. Improper posture can lead to reduced recovery efficiency or even further injury. To address this issue, an intelligent system has been proposed that uses computer vision to detect poses in real time through a webcam. This system, integrated with a user-friendly graphical interface, employs MediaPipe holistic pose estimation and machine learning classifiers to identify physiotherapy poses (āsanas) and their execution accuracy. Upon performing the pose, the system immediately displays the pose name and confidence score. The goal is to help users improve rehabilitation outcomes without requiring constant therapist supervision. The platform offers a supportive visual guide and feedback, making it easier for patients to follow correct techniques during home-based physiotherapy sessions.

***KEY WORDS:***

Assistive, posture-based, real-time monitoring.

1. **INTRODUCTION**

Physiotherapy is essential in the treatment of physical injuries, surgeries, and chronic conditions. However, the effectiveness of exercises largely depends on performing them correctly. Patients performing physiotherapy exercises at home often face difficulties in maintaining proper form, leading to poor recovery or new injuries. Our project addresses this gap through an AI-based physiotherapy pose detection system. Using a live webcam feed and MediaPipe holistic tracking, the system identifies body landmarks and predicts the physiotherapy pose class in real time. Along with detection, the model displays a confidence score to indicate how accurately the pose matches the trained data. A GUI interface has been developed using Tkinter that helps patients easily access pose monitoring, view sample poses, and receive immediate feedback. The solution ensures that physiotherapy sessions at home become more structured, effective, and safe, without constant human supervision.

1. **FUTURE SCOPE**

As the healthcare industry embraces digital transformation, home-based physiotherapy solutions will become essential. The integration of mobile apps allows users to conduct sessions on their phones with ease. These apps can include speech-based feedback to enhance user interaction. Moreover, the system can evolve with wearable device integration to improve detection precision and monitor user progress. A future version may also feature virtual coaching assistants, personalized exercise plans, and daily activity tracking. With deeper pose understanding, such tools can assist doctors and therapists in remotely analyzing progress and adjusting rehabilitation protocols as needed.

1. **LITERATURE REVIEW**

Z. Cao introduced OpenPose, a popular method for pose keypoint detection using part affinity fields. Google’s MediaPipe Holistic model enables real-time face, hand, and full-body landmark detection optimized for CPU devices. Harsh Vardhan et al. used CNN-based classification techniques for yoga pose detection. S. Wang et al. explored using joint-angle and landmark data for evaluating pose quality. Logistic Regression and Ridge Classifiers have also proven effective in multi-class classification tasks involving high-dimensional feature sets. Our study builds upon these models using holistic body landmarks and focuses on real-time inference using lightweight models.

1. **DESIGN AND IMPLEMENTATION**

**Identifying the Need:**  
Patients often perform physiotherapy at home without guidance, which can reduce effectiveness or result in injuries. There is a need for a system that guides and monitors exercise posture.

**Solution Architecture:**

* **Pose Detection:** MediaPipe holistic detects 501 facial and body landmarks using a webcam.
* **Data Collection:** Coordinates and class labels are exported into a CSV dataset using custom Python scripts.
* **Model Training:** Logistic Regression, Ridge Classifier, and others are trained using scikit-learn pipelines.
* **Accuracy Metrics:** Accuracy scores are generated and the best model is saved as a .pkl file.
* **GUI Integration:** Tkinter-based GUI allows login, registration, and pose recognition options.
* **Prediction Feedback:** Real-time pose classification with accuracy scores and visual guidance.

**Value Proposition:**

* **Accessibility:** Home users can do exercises confidently.
* **Real-Time Feedback:** Immediate correction based on pose prediction.
* **Visualization:** Image-based assistance for āsanas.

1. **FIGURES AND TABLE**

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## Dataset

**Dataset:**  
Our dataset consists of landmark data extracted for physiotherapy poses such as Bhadrasana, Cat-Cow, Arm Rotation, Spinal Twist, etc. Each row contains thousands of values representing (x, y, z, visibility) for each keypoint. The final dataset includes over 3000 examples across different classes. The training set achieved around 89% accuracy with Logistic Regression. Figure 5 illustrates dataset generation through live webcam. Figure 6 shows predicted vs actual pose labels and confidence probability bars.

**Model Performance Table:**

| **Task** | **Result** |
| --- | --- |
| Keypoint Detection | Holistic model, 501 keypoints |
| Pose Classification | Logistic Regression - 89% |
| Live Feedback | Pose name + probability |
| GUI | Integrated using Tkinter |
| Accuracy Gap | ~10% between train and test |
|  |  |
|  |  |

1. **RESULTS**
2. Model Performance:  
   The model achieved a training accuracy of 89%, and testing accuracy of 79%, indicating a small generalization gap. The live predictions of poses such as *Bhadrasana* or *Arm Rotation* were found to be reliable when the user performed them under good lighting and stable positioning. The GUI showed the name of the pose and the associated probability with clear, readable visuals. A text-to-speech option was also included to vocalize the pose name, providing auditory feedback.
3. Limitations:  
   When multiple people appear in frame or when occlusions occur (hands behind the back), the model sometimes misclassifies poses. Also, variations in camera angle or user distance can slightly reduce confidence scores.
4. **FUTURE WORK**

To reduce overfitting and improve generalization, the following future enhancements are suggested:

1. **Data Augmentation:** Apply flipping, rotation, and zooming to training data to improve pose variation tolerance.
2. **Angle Analysis:** Use joint angles (e.g., elbow flexion) for more context-aware evaluation.
3. **Repetition Counting:** Add logic to detect and count repetitions of exercises.
4. **Personalization:** Use login data to track and visualize user performance over time.
5. **Voice Interface:** Activate poses using voice commands and receive feedback verbally.

**CONCLUSION**

# Our design effectively blends computer vision with physiotherapy guidance. Through a combination of landmark detection and machine learning classification, we enable home users to practice physiotherapy poses with confidence. The GUI is simple and functional, allowing users to login, register, and access pose monitoring. The system detects the performed pose, displays the āsana name, and indicates how accurately the posture matches the trained class. With further enhancements, this platform can become a powerful tool in telemedicine and remote physiotherapy, offering accessible and accurate rehabilitation support.

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