International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 01 | Jan - 2025 SJIF Rating: 8.448 ISSN: 2582-3930

PHYSIOTHERAPY POSE DETECTION MODEL

Prof.Saurabh Paradh, Chaitanya Pathak, Atharv Chormale, Jay Patil
Savitribai Phule Pune University, Sinhgad College of Engineering Warje
E-mails: ithod.rmdssoe@sinhgad.edu,chaitanyapathak218@gmail.com,
jaydpatil1102@gmail.com, atharvchormale27@gmail.com

Abstract

Human pose recognition has become an important focus in computer vision, particularly for applications in physiotherapy and self-assessment. In this work, we present an approach for accurate physiotherapy pose assessment using deep learning algorithms. The proposed system utilizes pose detection to facilitate the self-guided learning of physiotherapy exercises. Specifically, our approach employs multi-part pose detection through a standard PC camera to capture and analyze physiotherapy poses in real-time. We introduce an enhanced scoring algorithm capable of assessing various poses, which ensures adaptability across different pose types and environments. Additionally, a hybrid machine learning model is implemented using Linear Regression to extract features from key points identified in each frame, leveraging the Open Pose framework. The robustness of this system is evaluated across multiple physiotherapy poses in diverse settings, demonstrating its potential for effective, real-time physiotherapy

assessment Keywords:
Physiotherapy Pose Assessment
Deep Learning Algorithms
Pose Detection

INTRODUCTION

The physiotherapy pose detection model leverages advancements in computer vision and deep learning to enhance the effectiveness of physiotherapy exercises. Its primary goal is to monitor and assess patients' posture and movements in real-time, providing feedback to ensure accurate exercise execution, which is essential for successful rehabilitation.

The system is built upon human pose estimation techniques, using pose detection algorithms to capture and analyze body movements accurately. It operates via a standard PC camera, allowing users to perform exercises in any setting, making it particularly useful for home-based rehabilitation and self-guided physiotherapy. By detecting and assessing posture through key points on the body, the model ensures that patients maintain proper form, reducing the risk of injury and improving therapeutic outcomes

His model also incorporates machine learning algorithms, such as logistic regression, to analyze the relationship between different posture variables and assess pose accuracy. Additionally, the use of frameworks like OpenPose enhances the precision and adaptability of the model, enabling it to work effectively across various environments and pose types.Ultimately, this physiotherapy pose detection model provides a valuable tool for accessible, reliable, and private physiotherapy support, promoting better recovery outcomes and empowering patients to manage their rehabilitation independently.

LITERATURE REVIEW

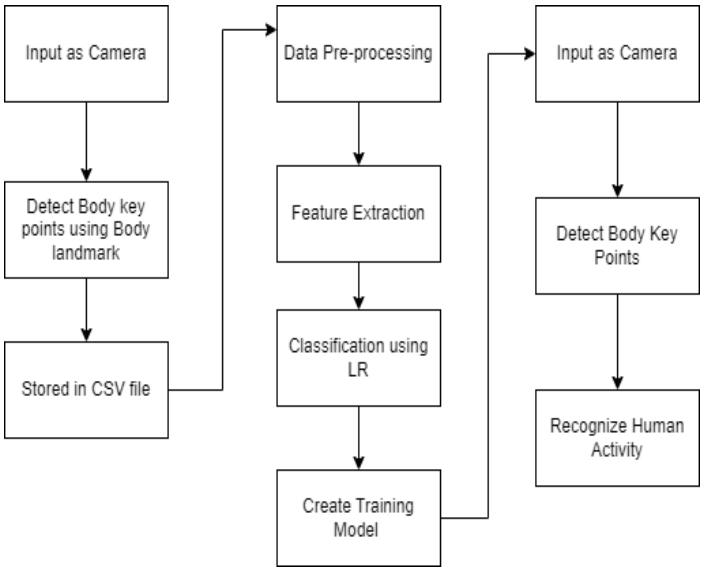
Pose detection for physiotherapy is an emerging field within computer vision, aimed at improving patient rehabilitation by assessing exercise accuracy and providing real-time feedback. This literature review synthesizes key research contributions and identifies ongoing challenges and future directions.Recent studies have focused on developing algorithms that can accurately assess physiotherapy poses in real-time. For instance, Agrawal, Shah, and Sharma's work highlights the importance of dataset diversity and the challenges posed by limited data. They created a specialized dataset of over 5,500 images covering ten distinct physiotherapy poses to train and test their model, which achieved a high accuracy of 99.04% using a Random Forest Classifier. The success of this model is attributed to the use of TensorFlow’s pose estimation framework, which allows precise skeletal structure extraction and joint angle calculation, essential for pose assessment

Despite advancements in pose recognition algorithms, challenges such as real-time feedback, generalizability, and dataset limitations persist. Real-time feedback is critical for physiotherapy applications but remains difficult to implement effectively without significant computational resources. Additionally, the limited diversity of existing datasets hinders model adaptability across varied poses, exercises, and user environments. Addressing these issues is crucial for the effectiveness of physiotherapy pose detection systems in clinical and home settings.

Future research may explore methods to diversify datasets, enhance real-time feedback capabilities, and integrate wearable sensor data to improve accuracy and responsiveness. Studies also suggest that combining machine learning models with Internet of Things (IoT) technologies could provide a more robust framework for pose recognition, extending its utility in physiotherapy and self-guided rehabilitation applications.

DESIGN AND IMPLEMENTATION

The physiotherapy pose detection system leverages a stationary camera to capture continuous video input of individuals performing exercises. Key body points, such as elbows, knees, and shoulders, are identified to assess posture, with the coordinates stored in a structured CSV file for efficient data access. Pre-processing steps, including data cleaning and alignment, enhance the data quality, reducing noise and improving consistency. Essential features, like joint angles and distances between key points, are extracted for precise posture representation. The system then employs Logistic Regression for pose classification by calculating probabilities based on these features. Following training, the model accurately assesses new poses by comparing them to learned patterns, enabling real-time feedback to ensure correct form and support effective physiotherapy and rehabilitation.



Functionalities: Video Input and Capture**:** The system initiates by capturing continuous video input from a stationary camera, recording individuals performing physiotherapy exercises. This video feed serves as the primary source of data, enabling real-time pose detection and analysis for immediate feedback.

Body Key Point Detection**:** Specific body landmarks, including major joints such as elbows, knees, shoulders, and ankles, are detected and tracked. This process allows the system to create a skeletal model of the person, essential for analyzing posture and identifying correct or incorrect alignment.

Data Storage**:** After detecting key points, their coordinates are stored in a CSV file, providing a structured format for data management. This organized storage allows for efficient retrieval and use of the data in later stages of processing and model training.

Data Pre-processing**:** The raw key point data undergoes cleaning and normalization to remove noise and ensure consistency. This pre-processing step includes aligning data points, filtering out irrelevant frames, and standardizing data, which optimizes it for feature extraction and model training.

Feature Extraction**:** The system calculates critical features, such as joint angles, distances between key points, and relative limb positions. These features capture the essentials of body posture, forming a detailed representation that can differentiate between correct and incorrect physiotherapy poses.

Pose Classification: Using the extracted features, the system applies Logistic Regression to classify physiotherapy poses by assigning probabilities to each pose type. This classification step enables the model to label each pose based on the likelihood of its correctness, which is crucial for pose assessment.

Model Training and Evaluation**:** With labeled data and extracted features, a machine learning model is trained to recognize specific poses. Through training, the model learns to accurately classify poses, improving its performance over time to ensure reliable assessment when applied to new data.

Real-time Pose Assessment: Once trained, the system assesses physiotherapy poses in real-time, comparing observed features against trained patterns to determine posture accuracy. This functionality provides instant feedback, helping users maintain correct form and supporting effective rehabilitation outcomes.

CONCLUSION

In our proposed physiotherapy posture recognition and correction system, we aim to assist learners in accurately performing physiotherapy exercises by providing immediate, targeted feedback. The system operates by first detecting the learner's pose and then measuring key body angles in comparison with an instructor's reference pose. Any discrepancies in alignment are identified, pinpointing specific areas where the learner's form diverges from the ideal stance. Based on these differences, the system classifies the learner's posture into four performance levels, offering a structured assessment that guides users toward corrective action and improvement. This approach enhances training effectiveness, supporting precise and reliable physiotherapy practice.

- **REFERENCES** V. Akuhota and S. F. Nedler, "Core Strengthening," American Academy of Phys- ical Medicine and Rehabilitation , 2004.
- R. Szeliski, "Computer Vision: Algorithms and Applications," Springer, 2010.
- G. Bradski and A. Kaehler, "Learning OpenCV," O'Reilly, 2008.
- Z. Cao, T. Simon, S.-E. Wei and Y. Sheikh, "Realtime pose-estimation implified6cfd88542ab3. [Accessed 3 April 2020].

- S.-E. Wei, V. Ramakhrisna, T. Kanade and Y. Sheikh, ”Convolutional Pose Ma- chines,” The Robotics Institute Carnegie Mellon University, 2016.
- P. K. Borkar, M. M. Pulinthitha and A. Pansare, ”Match Pose - A System for Comparing Poses,” International Journal of Engineering Research Technology (IJERT), vol. 8, no. 10, 2019.
- M. C. Thar, K. Z. N. Winn and N. Funabiki, ”A Proposal of physiotherapy Pose Assessment Method Using Pose Detection for Self- Learning,” University of Infor- mation Technology Okayama University.
- S. K. Yadav, A. Singh, A. Gupta and J. L. Raheja, ”Real-time physiotherapy recognition using deep learning,” Springer-Verlag London Ltd., 2019.
- H. Hanaizumi and H. Misono, ”An OpenPose Based Method to Detect Texting while Walking,” 7th IIAE International Conference on Intelligent Systems and Im- age Processing 2019, 2019.
- K. Chen, ”Sitting Posture Recognition Based on OpenPose,” IOP Publishing Ltd, 2019.
- S. Jin, X. Ma, Z. Han, Y. Wu, W. Yang, W. Liu, C. Qian and W. Ouyang, ”To- wards Multi-Person Pose Tracking: Bottom-up and Topdown Methods,” ICCV2017, 2017.