REAL TIME POSTURE DETECTOR

PROJECT SYNOPSIS

OF MINOR PROJECT

BACHELOR OF TECHNOLOGY

COMPUTER SCIENCE AND ENGINEERING

SUBMITTED BY

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TABLE OF CONTENT

INTRODUCTION

Real time posture detector is a machine learning based model that aims to help people to maintaining physical activity and make it as a part of their daily routine. In today's world, maintaining a healthy lifestyle has become increasingly crucial. However, achieving and maintaining optimal posture, especially during exercise, can be challenging. To address this concern, our project focuses on the development of a Real-Time Posture Detector, leveraging the capabilities of the open pose library.

This system leverages the power of OpenPose with torsion angle, a state-of-the-art pose estimation library, to accurately analyze body movements in real-time. Using this data, the system can:

- Recognize incorrect postures: The system identifies deviations from proper body alignment, alerting users to potential risks of injury.

- Provide real-time feedback: Utilizing an intuitive interface, the system presents precise instructions and visual prompts to assist users in promptly adjusting their posture.

- Exercise guidance: The system can recognize and analyze specific exercises, providing real-time feedback on whether the user is performing them correctly. This can help prevent injuries caused by improper form, improve exercise effectiveness, and guide users towards achieving their fitness goals.

- Flexibility and Autonomy: One of the key attributes of this project is its ability to empower users to engage in exercise anywhere, at any time, and without the need for a coach. By providing real-time feedback and guidance, the Real-Time Posture Detector reduces the dependence on a physical instructor.

- Personalized feedback: The system can be tailored to individual needs and fitness levels. By understanding the user's goals and limitations, it can provide targeted feedback and personalized recommendations for improving posture and optimizing exercise routines.

Technology Framework

- Pose Estimation Technology: At the core of the project, the OpenPose library is leveraged for state-of-the-art pose estimation, enabling accurate analysis of body movements in real-time.
- Custom Machine Learning Algorithm: A custom machine learning algorithm is implemented to recognize and classify different postures, providing real-time feedback and exercise guidance.

STUDY OF EXISTING SYSTEM

The development of the Real-Time Posture Detector project necessitates a comprehensive understanding of existing systems in this domain. This report provides a concise overview of relevant research, technologies, limitations, and potential gaps that the project can address.

1. OpenPose library: This popular library leverages computer vision and pose estimation techniques for accurate multi-person tracking in real-time, published in ITM Web of Conferences. Its strengths lie in its open-source nature and accessibility, although limitations include potential inaccuracies in complex movements and occlusions.

2.Kinect-based systems: Microsoft's Kinect utilizes depth information alongside RGB data for improved accuracy, particularly in cluttered environments. While effective, its dependence on specific hardware restricts broad user adoption.

3.Wearable sensors: Accelerometers, gyroscopes, and EMG sensors worn on the body can capture muscle activity and joint angles. However, data interpretation can be complex, and device placement sensitivity impacts accuracy.

4.Pressure sensors: Integrating pressure sensors into chairs or mats allows analysis of posture based on weight distribution. They primarily focus on sitting postures.

Common limitations of existing systems:

- Accuracy and robustness: Many systems struggle with complex movements, occlusions, and variations in body types and clothing.
- Exercise recognition: Most systems lack the ability to identify and assess specific exercises for optimal form and injury prevention.
- Real-time feedback and guidance: Limited visual cues and feedback mechanisms hinder user engagement and adherence to proper form.
- Accessibility and cost: Hardware dependence, complex setups, and limited platform compatibility can restrict user adoption and broad applicability.

By building upon OpenPose's accurate real-time posture detection, the project aims to address these limitations through:

- Custom machine learning algorithm for exercise recognition: This algorithm analyzes detected postures to assess exercise execution
- User-friendly interface: Designed for intuitive interaction and seamless guidance, the interface provides clear visual cues and actionable feedback during exercises.
- Adaptive learning: The system adapts to individual needs and progress over time, tailoring feedback and recommendations for personalized improvement.

Through a thorough analysis of existing systems and their limitations, the Real Time posture detector project is well-positioned to leverage cutting-edge technology and user-centric design, the project holds great potential to revolutionize how people maintain proper posture and exercise safely and effectively.

RATIONALE

In the realm of Real-Time Posture Detection, the rationale for the development of this project is grounded in recognizing prevalent challenges and the necessity for innovative solutions:

1.Precision in Body Movement Tracking: The existing landscape lacks a comprehensive real-time posture detection system. By leveraging the open pose library, our project seeks to address this gap by implementing a sophisticated solution that ensures precision in tracking human body movements. The rationale is to offer users a tool that goes beyond conventional methods, enabling accurate and immediate feedback on their exercise postures.

2.Injury Prevention through Posture Recognition: The acknowledgment of potential injuries resulting from improper exercise postures highlights the need for a preventive approach. Our project aims to recognize correct and incorrect exercise postures in real-time. This feature serves as a vigilant safeguard, alerting users when their movements deviate from proper form. The rationale here is to minimize the risks associated with workouts and enhance overall user safety during physical activities.

3.User-Friendly Interface for Real-Time Guidance: Existing solutions often lack a user-friendly interface that provides instantaneous feedback during exercises. Our project seeks to bridge this gap by designing an intuitive interface. This interface not only fosters seamless interaction but also delivers real-time feedback on detected postures. The rationale is to empower users with a virtual guide, assisting them in maintaining proper body alignment and optimizing the effectiveness of their workouts**.**

In summary, the rationale for the Real-Time Posture Detector project is founded on a deep understanding of existing challenges in exercise routines. By integrating cutting-edge technology and user-centric design principles, our objective is to pioneer advancements in the realm of fitness. This project aims to redefine standards by addressing identified gaps and introducing features that enhance precision, user experience, and safety in maintaining correct body postures during exercises.

Feasibility Study

1. Technical Feasibility:

- The Real-Time Posture Detector can utilize the OpenPose library, a widely recognized and extensively employed tool for real-time pose detection.
- The project can utilize standard computing hardware and cameras, ensuring technical compatibility and feasibility.

2. Economic Feasibility:

- The project can be economically viable through potential revenue streams, such as offering premium features or collaborating with fitness-related businesses.
- Cost-effective development practices and the use of cloud-based solutions can help manage
  development and maintenance expenses efficiently.

3. Operational Feasibility:

- The design of a user-friendly interface addresses operational feasibility, providing an accessible platform for users to receive real-time feedback on their postures.
- Scalability considerations, including the use of cloud-based solutions, ensure that the app can accommodate a growing user base and handle increased demand seamlessly.

4. Legal and Ethical Feasibility:

- Privacy compliance and ethical considerations are integral to the project, ensuring that user data is handled responsibly and in adherence to relevant regulations.
- Transparency in communication and user consent mechanisms contribute to the ethical feasibility of the Real-Time Posture Detector.

5. Schedule Feasibility:

- The development timeline for the Real-Time Posture Detector project can be established realistically, taking into account the integration of the OpenPose library, algorithm development, and user interface design.

In summary, the Real-Time Posture Detector project exhibits strong technical, economic, operational, legal, ethical, and schedule feasibility. The chosen technologies and development approaches align with industry standards, and the outlined considerations ensure a comprehensive and realistic approach to project implementation.

OBJECTIVES

1 . To detect real time posture using open pose library

2 . To recognize if someone is performing exercises correctly to prevent potential injuries from improper posture.

3 . Design a user-friendly interface that provides real-time feedback on detected postures, aiding users in maintaining proper body alignment.

METHODOLOGY

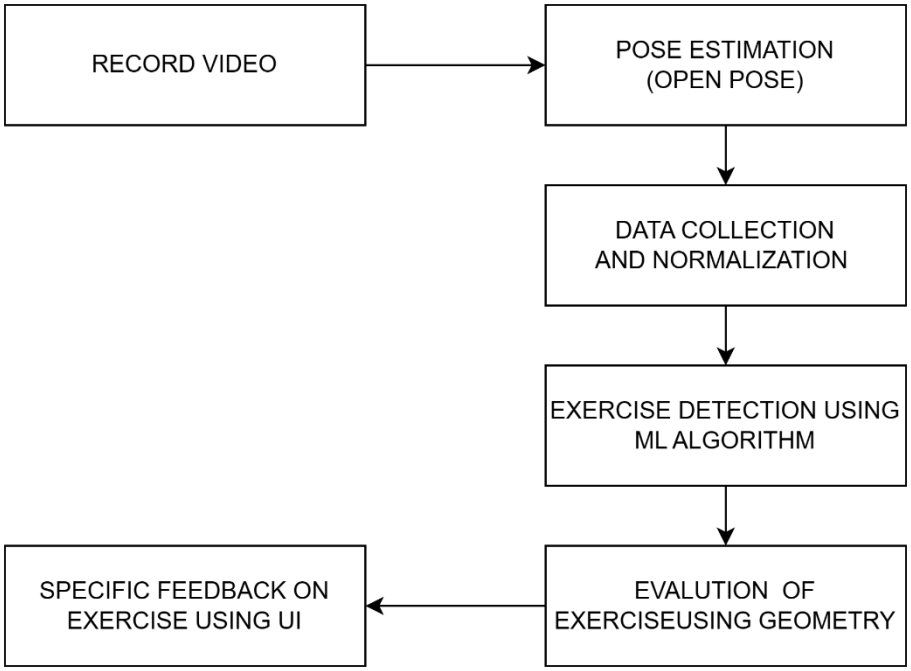
The Real-Time Posture Detector project employs a systematic approach to achieve its objectives, integrating advanced technologies and user-centric design principles. The following methodology outlines the key steps undertaken:

1. Literature Review:

Conducted an extensive review of existing literature on posture detection and related technologies to gain insights into state-of-the-art methodologies, challenges, and potential solutions.

2. OpenPose Library Integration:

Implemented the OpenPose library alongwith PoseNet library, a robust and widely-used pose detection tool, for real-time posture detection. Customized and fine-tuned the library parameters to suit the specific requirements of the project.



3. Data Collection:

Collected a diverse dataset comprising real-time posture examples and variations, ensuring the model's robustness and accuracy across different body types and movements. The dataset includes annotated instances of correct and incorrect postures during exercises.

4. Machine Learning Model Training:

Utilized a machine learning approach, employing a neural network architecture, to train the model for posture detection. The model was trained on the annotated dataset, emphasizing accurate recognition of real-time postures and exercise form.

5. Exercise Recognition Algorithm:

Developed an exercise recognition algorithm that analyzes the detected postures to assess whether individuals are performing exercises correctly. This involved correlating the real-time data with predefined correct posture benchmarks for various exercises.

6. User-Friendly Interface Design:

Collaborated with UX/UI designers to create an intuitive and user-friendly interface. The design prioritizes simplicity and accessibility, offering real-time feedback on detected postures and providing guidance for maintaining proper body alignment during exercises.

7. Integration Testing:

Conducted rigorous integration testing to ensure seamless communication between the OpenPose library, machine learning model, and the user interface. Addressed any discrepancies in real-time feedback and refined the system for optimal performance.

8. User Feedback Iterations:

Incorporated user feedback through iterative testing phases to enhance the interface's usability and responsiveness. Adjustments were made based on user experiences to improve the overall effectiveness of the Real-Time Posture Detector.

9. Deployment and Evaluation:

Deployed the Real-Time Posture Detector for practical use, collecting real-world user data for further evaluation. Conducted ongoing assessments to validate the system's effectiveness in detecting and correcting postures during exercises.

10. Documentation and Reporting:

Compiled comprehensive documentation detailing the methodology, algorithms, and design choices. Produced a synopsis report summarizing the project's key findings, successes, and areas for potential future enhancements.

FACILITIES REQUIRED

The facilities required for the proposed Real-Time Posture Detector project are outlined as follows:

1. Hardware:

- Computers equipped with ample processing power and memory for algorithm development and system integration.
- Cameras capable of capturing high-quality video footage for posture detection and exercise recognition.
- Mobile devices for testing the real-time posture detector in various scenarios.
- Integration of a powerful GPU is recommended to accelerate complex computations involved in real-time posture detection and exercise analysis. This enhances the system's efficiency, especially when processing large amounts of visual data.

2. Software:

- Code editing tools such as Visual Studio Code for algorithm development.
- Machine learning frameworks like TensorFlow or PyTorch for model training.
- OpenPose and PoseNet library for real-time posture detection.
- Programming languages (e.g., Python) for algorithm implementation.
- Design software for creating and refining the user-friendly interface.

3. Human Resources:

- Developers with expertise in front-end, back-end, and machine learning components of the system.
- Technical writers for comprehensive documentation of the project.

4. Infrastructure:

- Stable internet connection for downloading necessary software, libraries, and updates.
- Cloud hosting services, such as Amazon Web Services or Microsoft Azure, for hosting the real-time posture detection system.

5. Legal and Financial Requirements:

- Acquiring licenses for any third-party software or libraries used in the development.
- Ensuring compliance with data privacy laws and regulations in the design and implementation of the system.

Overall, the facilities outlined above are fundamental for the successful execution of the Real-Time Posture Detector project. The availability and utilization of these facilities will significantly impact the project's cost and timeline, ensuring a comprehensive and effective development.

REFERENCES

1. OpenPose and Pose Estimation:

- In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition https://github.com/CMU-Perceptual-Computing-Lab/openpose:
- Real-time human pose recognition in parts from single depth images. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (pp. 1297-1304). https://ieeexplore.ieee.org/document/5995316
- https://www.researchgate.net/publication/356915407_Real-Time_Human_Posture_Recognition

2. Machine Learning for Posture and Exercise Recognition:

- A survey on wearable sensor based human activity recognition (HAR) using machine learning methods and its applications in various domains. Sensors, 20(20), 5952. https://link.springer.com/chapter/10.1007/978-3-031-24352-3_5:
- Yang, B., & Park, J. M. (2018). Smart yoga mat system with a novel weight distribution https://ieeexplore.ieee.org/document/9444325
- Human action recognition by Dynamic Time Warping (June 2011)-Samsu Sempena,Nur Ulfa Maulidevi, Peb Ruswono
- https://blog.tensorflow.org/2018/05/real-time-human-pose-estimation-in.html
- https://google.github.io/mediapipe/solutions/pose_classification.html
- https://towardsdatascience.com/just-used-machine-learning-in-my-workout-ff079b8e1939
- https://towardsdatascience.com/used-again-machine-learning-in-my-workout-this-time-building-a-personaltrainer-3dfae9730c2b
- https://towardsdatascience.com/exercise-classification-with-machine-learning-part-i-7cc336ef2e01
- https://www.researchgate.net/publication/228785661_Dynamic_Time_Warping_Algorithm_Review