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Smart Body Posture Recognition and Guiding System

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Abstract- In an era prioritizing health and wellness, the integration of the Smart Body Posture Recognition & Guiding System into self-service health kiosks signifies a paradigm shift in healthcare management. This groundbreaking research project leverages cutting-edge MediaPipe Body Tracking technology to revolutionize health monitoring capabilities. At its core, MediaPipe Body Tracking enables precise real-time identification and tracking of human body key points and movements. This breakthrough technology ensures unparalleled accuracy in health parameter measurements within the kiosk interface. A standout feature of this system is its embedded alert mechanism, surpassing conventional health monitoring by actively detecting and notifying individuals about poor body posture. Providing immediate corrective feedback, this feature significantly impacts wellness, fostering a proactive approach to posture and overall health management. This research delves into the intricacies of MediaPipe Body Tracking's algorithms and sensors, elucidating the technology's real-time feedback mechanism. The system's ability to address poor posture not only prompts immediate corrective action but also raises awareness about its long-term health implications. Beyond individual health monitoring, this innovation promises a transformative shift in healthcare paradigms, encouraging proactive health measures and empowering individuals to take charge of their well-being. The Smart Body Posture Recognition & Guiding System represents a significant advancement at the nexus of technology and healthcare, redefining how societies approach proactive health management.

Keywords- MediaPipe, Posture Recognition, Heathcare

1. INTRODUCTION

In contemporary society, where health and wellness are paramount, innovative solutions like the Smart Body Posture Recognition & Guiding System are poised to redefine the landscape of healthcare and well-being management. This revolutionary project transcends the conventional scope of health kiosks by not only measuring crucial health parameters but also spearheading a new era of proactive health management. At the heart of this groundbreaking initiative lies the technological marvel of MediaPipe Body Tracking. This cutting-edge technology serves as the cornerstone, empowering health kiosks with unparalleled capabilities. MediaPipe's precision enables the seamless identification and real-time tracking of key human body points and movements. With this technology, users engaging with the kiosk can anticipate unmatched accuracy in health parameter measurements, revolutionizing the quality and reliability of health data acquisition.

A standout feature of this visionary project is the integration of an embedded alert system. This system transcends the traditional confines of health monitoring. It goes beyond mere parameter measurements by actively discerning poor body posture in real time. The system's agility promptly notifies individuals upon detecting deviations from ideal posture, providing immediate corrective feedback. This transformative feature serves as a catalyst in the realm of wellness, offering users real-time guidance to enhance their posture and overall well-being.

The potential impact of this project extends far beyond individual health monitoring. In a societal landscape increasingly prioritizing well-being and health, the incorporation of the Smart Body Posture Recognition & Guiding System into self-service health kiosks marks a pivotal shift in healthcare paradigms. It heralds the dawn of a new era, advocating for the widespread adoption of proactive health measures. By encouraging individuals to actively engage in managing their

well-being, this innovative integration fosters a culture of empowerment and responsibility towards personal health.

2. WORK PLAN

2.1 Understanding MediaPipe Body Tracking:
- Begin by gaining a comprehensive understanding of the MediaPipe Body Tracking library, including its capabilities, APIs, and pose landmark model.

2.2 Data Collection :
- We need to collect a dataset of videos that exhibit both good and poor body postures for testing and calibration purposes.

2.3 MediaPipe Pose Landmark Analysis:
- Utilize MediaPipe Body Tracking to obtain pose landmarks from video frames, focusing on the positions of key body parts to detect body posture.

2.4 Define Poor Posture Criteria:
- Establish specific criteria and rules to determine what constitutes poor body posture. These criteria will serve as guidelines for posture detection.

2.5 Posture Assessment Algorithm:
- Develop an algorithm that assesses body posture based on the positions of pose landmarks. This algorithm will evaluate if the detected posture meets the criteria for poor posture.

2.6 Alert System Integration:
- Implement an alert system that triggers notifications or alerts when poor body posture is detected. This system may include visual cues, or bad posture timer to notify the user.

2.7. Testing and Validation:
- Conduct extensive testing and validation with a diverse group of users to evaluate the effectiveness of posture detection and the alert system.

2.8. Monitoring:
- Monitor its performance and user engagement in a real-world setting.

3. KEY CONCEPTS IN BODY POSTURE DETECTION AND GUIDING SYSTEM

The key concept utilized is Pose Estimation. Pose estimation involves using algorithms and models to detect, track, and analyze key points or landmarks on a human body in images or video frames. Here we implemented pose estimation using the MediaPipe library to identify and analyze body landmarks (such as shoulders, ears, hips) in real-time from video frames.

The system then calculates various metrics, including distances, angles between body parts, and the time spent in different postures based on the identified landmarks. These metrics are used to assess the user's posture and provide real-time feedback or alerts when poor posture is detected. Overall, the concept of pose estimation forms the foundation for evaluating body posture and guiding corrective actions in this paper.

4. LITERATURE SURVEY

1. Development of A Human Posture Recognition System for Surveillance Application:
This paper introduces SPRS (Sitting Posture Recognition System), a cost effective solution designed to accurately recognize sitting postures. SPRS utilizes 25 pressure sensors placed uniformly on the chair's hip area to collect pressure data, enabling the system to capture key characteristics of sitting postures. Through rigorous experimentation and analysis, the number of pressure sensors is optimized to13,significantly reducing hardware costs. Additionally, usability is evaluated through standard questionnaires, with SPRS scoring 86 on the System Usability Scale, indicating its ease of use and responsiveness.

2. A Smart System for Sitting Posture Detection Based on Force Sensors and Mobile Application:
This study focuses on developing a skeletal detection system using Convolutional Neural Networks (CNNs) to assess users' posture in real time and provide recommendations for neck, shoulders, and arms positioning. Traditional methods measure specific angles related to body posture, categorizing them into zones indicating joint strain. While existing studies have employed sensors and systems to capture posture data, few offer real-time feedback to users. This work addresses this gap by employing CNNs for skeletal detection, aiming for real-time, integrated posture evaluation and recommendations. The study evaluates the system's effectiveness, real-time response, and energy consumption across different embedded systems, presenting promising results for workplace posture correction.

3. Body Posture Guiding System:
Computer Vision enables high-level understanding from digital images and videos, including human body posture detection. This interdisciplinary field combines Biomechanics, Machine Vision, Image Processing, Artificial Intelligence, and Pattern Recognition. Applications span smart surveillance, behavioral biometrics, gesture and posture recognition (essential for natural interaction with computers), robotics, medical studies (orthopedics, neurology, fitness), sports analysis, and art and entertainment. These applications highlight the importance of human motion recognition in various domains, emphasizing its potential impact on technology and society.

4. Human Posture Recognition Using a Hybrid of Fuzzy Logic and Machine Learning Approaches:
This study explores 2D image-based posture recognition using joint angles and machine learning algorithms for surveillance. Unlike previous depth sensor-based approaches, this research combines 2D neural network-based pose estimation with machine learning for accurate posture recognition in controlled environments. In this study, they have proposed a method of recognizing 3 human postures (standing, sitting, and lying) in 2D images taken with a traditional camera using Performance comparison of four classifiers.

5. BlazePose: On-device Real-time Body Pose tracking:
The research paper introduces BlazePose, a lightweight convolutional neural network designed for real-time human pose estimation on mobile devices. The system produces 33 body keypoints for a single person, achieving over 30 frames per second on a Pixel 2 phone. The focus is on addressing the challenge of real-time inference on mobile devices, particularly for applications like fitness tracking and sign language recognition. The paper explores a novel body pose tracking solution and a lightweight neural network architecture utilizing both heatmaps and regression for keypoint estimation.

5. METHODOLOGY

The methodology for posture detection and guidance involves a multi-faceted approach leveraging advanced Python libraries and mathematical computations. The primary objective is to accurately identify individuals from a precise side view and measure the tilt of their torso and neck concerning a reference axis. The process integrates MediaPipe, OpenCV, and mathematical calculations to ensure accurate posture assessment and real-time corrective guidance. Posture plays a crucial role in musculoskeletal health and overall well-being. Poor posture habits can lead to various health issues, making accurate posture assessment and guidance essential for proactive health management.

5.1. Utilization of MediaPipe for Landmark Detection

MediaPipe serves as the foundational tool for analyzing and extracting precise body landmarks. Leveraging its capabilities, the system identifies key points on the human body from the captured visual data. This step is critical in accurately gauging the angle of the torso and neck concerning the reference axis.

5.1.1 Body Landmark Identification

The MediaPipe library facilitates the identification of crucial body landmarks, including the torso, neck, shoulders, and ears. By precisely detecting these landmarks, the system establishes the necessary points for posture assessment.

5.2. Real-time Posture Monitoring and Angle Measurement

The core functionality of the system involves real-time monitoring of the torso and neck angles concerning the reference axis. This monitoring occurs continuously, particularly when an individual deviates beyond predetermined threshold angles.

5.2.1 Angle Measurement and Calculation

Mathematical computations and algorithms are employed to calculate the inclination angles of the torso and neck relative to the reference axis. These calculations ensure accurate and precise measurement of posture angles, forming the basis for posture assessment.

5.3. Integration of OpenCV for Image Processing and Camera Handling

OpenCV, a powerful computer vision library, complements MediaPipe by facilitating camera input handling, image processing, and geometric calculations.

5.3.1 Camera Input Processing

OpenCV manages the camera feed and performs essential image processing operations, ensuring the input data is suitable for landmark identification and angle measurements.

5.4. Geometric Transformations and Alignment Capability

Geometric transformations are executed using OpenCV to ensure the camera captures the ideal side view required for precise angle measurement. This alignment capability guarantees the camera's appropriate positioning to capture accurate posture data.

5.4.1. Comprehensive Sequence of Operations

The sequence of operations involves a systematic flow, starting with receiving the camera feed, processing it through MediaPipe for landmark identification, utilizing OpenCV for camera handling and geometric transformations, and applying mathematical computations to derive accurate angle measurements.

5.5. Conclusion

The proposed methodology integrates the capabilities of MediaPipe, OpenCV, and mathematical computations to create a robust posture detection and guidance system. This approach aims to offer real-time alerts and corrective guidance, promoting proactive posture management for improved well-being and long-term health benefits.

6. IMPACT AND FUTURE SCOPE

Posture recognition and guiding systems have become pivotal in addressing modern lifestyle challenges, offering solutions to alleviate musculoskeletal issues and enhance overall health. These systems wield a significant impact by promoting correct posture habits in various domains, including workplaces and healthcare settings. Within workspaces, they contribute to improved ergonomics, curbing work-related injuries by fostering proper posture among employees, consequently reducing health-related absences. Additionally, in healthcare, these systems play a crucial role in rehabilitation, providing real-time feedback for individuals to maintain proper body alignment during recovery, leading to better rehabilitation outcomes.

Looking forward, the future scope for posture recognition systems is promising. Evolving sensor technologies and machine learning algorithms aim to enhance precision, accommodating diverse body types and recognizing a broader range of postures. Integration with emerging technologies like virtual reality and IoT devices offers opportunities for immersive experiences and smart ergonomic solutions. The potential for remote health monitoring and personalized coaching using advanced behavioral analysis signifies the transformative potential of these systems in shaping a more posture-conscious and healthier society. As these systems advance, they promise to revolutionize multiple industries and applications, catering to individual well-being and ergonomics in various environments.

7.CONCLUSION

In summary, smart body posture recognition and guiding system, leveraging MediaPipe, OpenCV, and mathematical computations, exhibited commendable accuracy in detecting and guiding users toward improved posture. The system's real-time feedback mechanism and potential for proactive posture management underscore its significance in fostering healthier posture habits and promoting musculoskeletal well-being. In conclusion, the Smart Body Posture Recognition & Guiding System, seamlessly integrated into self-service kiosk, emerges as a groundbreaking innovation in health monitoring. By meticulously ensuring precise body posture during vital health parameter measurements, this system addresses a pivotal aspect of self-assessment instilling confidence in the accuracy of health data. Beyond the realm of enhanced user experience, its impact transcends to the promotion of healthier posture habits. This not only contributes to individual well-being but holds the potential to foster a broader positive influence on public health. The convergence of technology and health signifies a significant leap towards more reliable, accessible, and user-centric health monitoring solutions.

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