POSTURE CARE - A REAL-TIME CHROME EXTENSION FOR ERGONOMIC POSTURE CORRECTION AND WELLNESS MANAGEMENT

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Musculoskeletal disorders, Ergonomics, MediaPipe Pose, Chrome Extension.

Introduction:

1. Prolonged computer use has led to a rise in poor posture habits such as slouching, forward head posture, and shoulder misalignment, which can result in discomfort and long-term musculoskeletal issues. A key challenge is that users often lack real-time awareness to correct their posture during work or study. Existing solutions attempt to address this problem, but many rely on expensive hardware or cloud-based processing, making them less practical and raising concerns about user privacy. Therefore, there is a clear need for an affordable, non-intrusive, and privacy-friendly system that can monitor posture in real time using only a standard webcam.
2. To address this gap, PostureCare is proposed as a real-time Chrome extension that helps users maintain healthy sitting posture. It leverages the MediaPipe Pose framework to detect upper-body landmarks and identify common posture issues such as slouching, forward head posture, and shoulder misalignment. The system operates entirely within the browser, ensuring that all processing is done locally and user data remains private. PostureCare provides instant posture alerts, wellness reminders, and gamified rewards to encourage consistent healthy habits. By offering a lightweight and accessible solution, it aims to improve posture awareness and reduce the risk of musculoskeletal strain among students, professionals, and remote workers.

Objectives:

1. To carry out pre-processing tasks and enable continuous webcam access for real-time frame capture.
2. To implement the MediaPipe Pose model to generate precise 2D and 3D landmark coordinates that are utilized as input for posture analysis and to extract significant upper-body landmarks
3. To classify posture as correct or incorrect by examining body markers to detect lateral torso lean, forward head, and shoulder sag.
4. To provide real-time notifications and break wellness reminders based on the user's posture status.

Methodology

The proposed system, ***PostureCare***, is designed as a real-time posture monitoring solution that operates as a browser-based extension. The methodology focuses on achieving accurate posture detection, low computational overhead, and complete user privacy by performing all operations locally on the user's device. The system integrates computer vision techniques, lightweight pose estimation, and rule-based analysis to continuously monitor and correct user posture during prolonged computer usage.

Overall System Architecture

The system follows a modular architecture where each component performs a specific function in the posture monitoring pipeline. The architecture consists of the following primary modules: webcam capture, frame preprocessing, pose estimation, posture analysis, classification, feedback generation, and privacy handling.

The workflow begins with capturing live video input from the user's webcam. The captured frames are processed in real time and passed through successive modules that extract meaningful posture information. The system ensures minimal latency by using efficient processing techniques and avoids dependency on external servers by executing all computations within the browser environment.

This architecture ensures scalability, portability, and ease of use, as users can access the system directly through a browser without requiring additional installations or hardware.

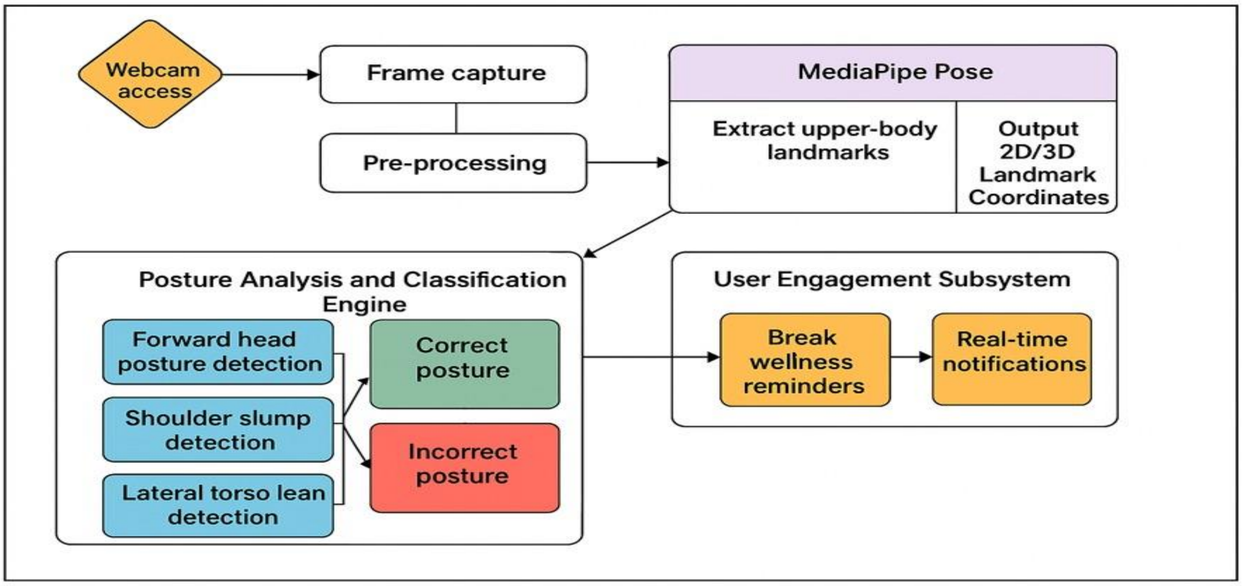


Figure 1: System Architecture

1.Webcam Frame Acquisition

The first step in the methodology involves capturing live video data using the device's webcam. The browser's built-in APIs are utilized to request camera permissions and stream video frames continuously.

To maintain efficiency, frames are captured at a controlled rate rather than processing every frame at maximum camera speed. This reduces computational load while ensuring sufficient temporal resolution for accurate posture detection. The captured frames serve as the primary input for the posture analysis pipeline.

2.Frame Preprocessing

Once the video frames are captured, they undergo preprocessing to ensure compatibility with the pose estimation model. This step is essential for improving detection accuracy and maintaining consistency across different devices and environments.

The preprocessing stage includes:

- Resizing: Frames are resized to a fixed resolution to match the input requirements of the pose estimation model.
- Normalization: Pixel values are normalized to standardize the input data.
- Noise Reduction: Minor adjustments are applied to reduce visual noise and improve landmark detection stability.

These operations help optimize the input data, allowing the model to perform efficiently under varying lighting and background conditions.

3.Pose Estimation

The core component of the system is the pose estimation module, which detects human body landmarks from the pre-processed frames. The model identifies key upper-body points such as the nose, shoulders, and upper torso region.

Each detected landmark is represented as a coordinate in a two-dimensional space, along with an estimated depth value. These coordinates form a skeletal representation of the user's posture, which is used for further analysis.

The system focuses specifically on upper-body landmarks since they are most relevant for sitting posture analysis. By limiting the scope to essential points, the system reduces computational complexity while maintaining sufficient accuracy.

4.Feature Extraction and Landmark Selection

From the detected landmarks, the system extracts specific features that are critical for posture evaluation. Instead of analysing all available points, only selected landmarks are considered to simplify calculations and improve performance.

The key features include:

- Position of the head (nose point)
- Left and right shoulder coordinates
- Midpoint between the shoulders

Using these points, the system derives geometric relationships such as distances, angles, and alignment measures. These features provide a compact yet effective representation of the user's posture.

5.Posture Analysis

The posture analysis module evaluates the spatial relationships between the extracted landmarks to identify deviations from an ideal sitting posture. This is achieved using geometric calculations rather than computationally expensive machine learning models.

The system detects common posture issues such as:

- Forward Head Posture: This condition is identified by measuring the horizontal displacement between the head and shoulder midpoint. A significant forward shift indicates poor neck alignment.
- Shoulder Slumping: The vertical alignment of both shoulders is analysed. Uneven or downward-sloping shoulders indicate slouching.
- Lateral Leaning: The angle formed between the shoulders is calculated to detect sideward leaning of the torso.

Threshold values are defined for each posture condition. If the computed values exceed these thresholds, the posture is considered incorrect. These thresholds are carefully chosen to balance sensitivity and robustness.

6.Posture Classification

Based on the results of the posture analysis, the system classifies the user's posture into one of two categories:

- Correct Posture
- Incorrect Posture

The classification is rule-based and depends on whether the calculated geometric parameters fall within acceptable ranges. This approach eliminates the need for additional training data and ensures fast decision-making. To avoid false alerts caused by temporary movements, the system incorporates a time-based validation mechanism. A posture is classified as incorrect only if the deviation persists for a predefined duration. This improves reliability and reduces unnecessary notifications.

7.Feedback and Notification Mechanism

One of the key features of the system is its ability to provide real-time feedback to users. When incorrect posture is detected consistently, the system generates a notification through the browser interface.

The feedback is designed to be:

- Non-intrusive: Notifications do not interrupt the user's workflow.
- Actionable: Messages provide clear suggestions such as "Sit upright" or "Adjust your neck position."
- Timely: Alerts are triggered only when necessary, avoiding excessive interruptions.

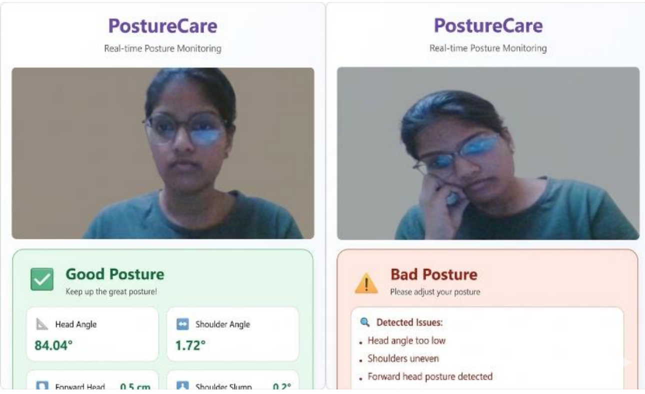
This module plays a crucial role in encouraging behavioural change and improving long-term posture habits.

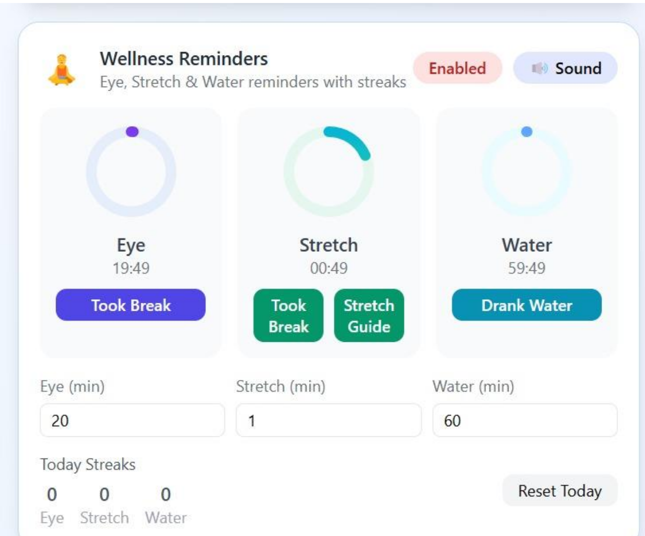
Result and Conclusion:

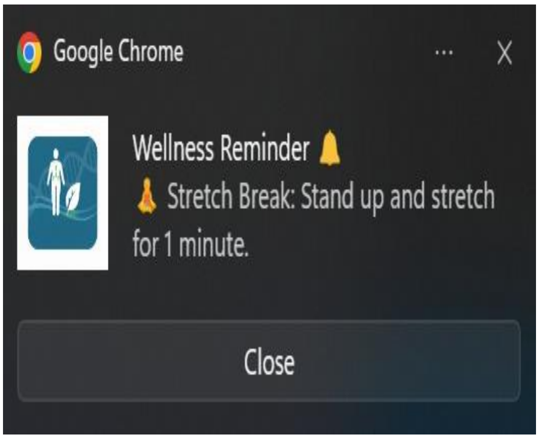
In conclusion, Traditional posture monitoring systems use machine learning, deep learning, or edge computing, each with limitations. Conventional ML struggles with adaptability, while deep learning models like CNNs and LSTMs offer better accuracy but require large datasets and high computational power. Edge-based approaches improve privacy and enable real-time feedback, but balancing speed and accuracy remains challenging.

PostureCare addresses these issues with a real-time posture monitoring system that runs directly in the browser via a Chrome extension. Using MediaPipe Pose, it performs fast, on-device pose detection, ensuring user privacy. By combining lightweight processing with real-time landmark tracking, it delivers low-latency feedback, instant notifications, and wellness reminders for improved posture.

Results:







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Future Scope:

The future scope of this project includes:

1. Mobile app extension (Android/iOS).
2. Introduce gamification features like posture scores, badges, and streaks.
3. AI-based personalized feedback and voice-based alerts and customizable reminder intervals.