PostureChecker

Real-Time Ergonomic Monitoring and Health Feedback

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1. Executive Summary

The PostureChecker project was developed to mitigate the physical health risks associated with modern sedentary work environments. With the rise of remote work and long hours spent in front of computer screens, poor posture has become a primary cause of chronic back pain and musculoskeletal disorders. This project provides a computer vision-based solution that monitors a user's posture through a standard webcam, offering immediate feedback to encourage healthier sitting habits and long-term ergonomic wellness.

2. Project Goal and Purpose

The goal of PostureChecker is to turn a standard workstation into a smart, health-conscious environment. Rather than relying on expensive ergonomic chairs alone, this software focuses on the behavioral aspect of health by correcting the user in real-time.

Core Objectives:

- **Active Monitoring:** Utilize a live camera feed to detect common posture issues such as slouching, leaning, or "tech neck."
- **User Privacy:** Ensure all processing happens locally on the user's machine so that no private video data is ever uploaded to a server.
- **Immediate Intervention:** Provide non-intrusive notifications that prompt the user to adjust their position when a deviation from "good posture" is detected.
- **Ergonomic Education:** Help users develop muscle memory for proper alignment through consistent, data-backed feedback.

3. Libraries and Technologies Used

The project is built on a foundation of high-performance computer vision libraries that allow for fluid, real-time analysis without significant CPU overhead.

Core Technologies:

- **Python:** Chosen for its flexibility and the vast ecosystem of libraries dedicated to artificial intelligence and image processing.
- **OpenCV:** This library handles video capture and image manipulation. It provides the tools necessary to process frames from the webcam at high speeds.
- **MediaPipe:** A key component used for landmark detection. This library allows the software to identify specific "keypoints" on the human body, such as the position of the shoulders, ears, and spine.
- **NumPy:** Used to perform the geometric calculations required to determine the angles between different body parts.

- **Tkinter / PyQT:** Often used for the lightweight desktop interface that allows users to toggle the monitor on and off and adjust sensitivity levels.

4. Methodology and Implementation

The development followed a logic-driven approach to translate visual data into ergonomic measurements.

Pose Estimation

The software uses the MediaPipe Pose model to identify 33 different landmarks on the user's body. By focusing specifically on the nose, shoulders, and hips, the system creates a digital map of the user’s upper body.

Geometrical Analysis

Once the landmarks are identified, the system calculates the angle of the user's spine and the position of their head relative to their shoulders. For instance, if the angle of the ear relative to the shoulder exceeds a certain degree, the system identifies a "forward head" or "slouching" position.

Thresholding and Feedback Loop

The program allows for a "calibration" phase where the user sits in their ideal position. This sets a baseline. During the monitoring phase, if the live coordinates deviate from the baseline for more than a few seconds, the system triggers an alert. This delay is intentional to allow for natural movement while only flagging sustained poor posture.

5. Future Improvements

PostureChecker provides a robust framework for personal health, but several enhancements could further its impact:

- **Desktop Integration:** Building a deeper integration with operating systems to dim the screen or provide subtle UI shifts when posture is poor, rather than using standard pop-up notifications.
- **Session Analytics:** Developing a weekly report feature that shows the user their most common "danger hours" during the day where their posture typically fails.
- **Stretching Prompts:** If poor posture is detected repeatedly, the system could suggest specific desk stretches or "micro-breaks" to relieve muscle tension.
- **Multi-View Support:** Implementing support for dual-camera setups to monitor posture from both the front and side for a more comprehensive 3D analysis of spinal alignment.

6. Conclusion

PostureChecker represents a practical application of computer vision for everyday health. By leveraging accessible hardware like a standard webcam, it empowers users to take control of their physical well-being. The project demonstrates how advanced machine learning models can be simplified into a user-friendly tool that addresses a widespread modern health challenge through consistent and accurate reinforcement.