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Posture Corrector: Real-Time Detection and Correction with Mediapipe and Machine Learning for Better Ergonomics

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***Abstract*—Posture plays an important role in health and at this point of time where most of students or workers have to sit for long hours it is really essential to follow a proper posture. But it is not always easy to hold a good posture, people tend to begin slouching after some time, which can cause discomfort and health problems like back pain or neck strain. To overcome this limitation, we came up with the Posture Corrector web application which has an advanced solution to posture monitoring and correction in a real-time manner. The app picks up on body positioning through a computer camera and detects when someone is not sitting with ideal posture, by using complex algorithms such as machine learning or some aspects of the computer vision domain. They provide immediate feedback and a user-friendly interface allowing users to correct their posture during long hours of activities such as working on a computer or studying. The Posture Corrector is perfect for anyone to use that wants a better posture and overall health by encouraging proper ergonomics and body alignment to prevent issues caused by poor posture or incorrect positions. Finally, the vision of Posture Corrector is to make a work or study environment for the users where they can sit naturally and maintain proper posture and it becomes available to everyone.**

***Index Terms*— Mediapipe, posture detection, machine learning, computer vision.**

I. INTRODUCTION

In today's contemporary, digital age, poor posture is becoming a more common problem that is made worse by extended sitting, frequent smartphone use, and computer work. Sadly, studies reveal that x-ray results from youngsters as young as 10 years old reveal early indications of spinal degeneration. Numerous health issues, such as migraines, high blood pressure, and diminished lung capacity, are intimately associated with specific postures, especially forward head posture. Sitting incorrectly increases the chance of musculoskeletal problems, which may result in long-term health problems. The risks above make more sense that ever given a real time posture detection tool is needed. The Posture Corrector web application that this project offers will monitor and correct user posture in real time using advanced technologies. The application enables us to analyze the user’s body positioning using computer vision with a side-view camera input.

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The app calculates angles of posture alignment by tracking key landmarks to the body, such as the neck or torso. They determine key points with the help of Mediapipe — a strong framework for ML, which then analyses these points to detect posture anomalies. If the app detects that the user is straying from the ideal posture, visual and auditory reviews are offered to encourage retuning. The Posture Corrector app works like a perfect enemy to the misery brought by bad posture habits of the humans to job related back pain, neck strain and spinal dislocation.

II. Literature Survey

As more and more people suffer from posture related health issues, the development of real time posture correction systems has been focused upon. Musculoskeletal and spinal disorders, degeneration and a reduced lung capacity are associated with poor posture. Studies have pointed the importance of real time feedback systems in reducing these risks especially of people doing long term sedentary work [7], [2]. More accurate body landmarks have been detected by advancements in pose estimation frameworks. Widespread recognition is commonplace for their capabilities in real time body tracking [6], [3]. Blaze Pose is a lightweight and efficient pose tracking framework designed specifically for on device tracking of posture, which introduces a solution for posture correction.

Postural alignment assessment has also been done to detect body misalignments how their deep learning models achieved high precision in detecting body misalignments [4]. Modern posture monitoring systems are based on these technologies.

Completely, they have also been extensively researched of real time posture correction systems for their practicality and user cantered design. Actionable feedback models were developed to integrate posture correction features to be seamlessly integrated into daily workflows [9], [10]. Customizable features, like modifiable alerts and detailed reports, are important to create engagement and experience, and this is shown by the use of Applications such as Posture Monitor and Sit Aware [8], [11]. One of the areas we see needing hybrid process is between ergonomics insight and technological advancements to deliver practical components, and feedback mechanisms; as such, providing ergonomic principles and user cantered design are critical to the success of posture correction systems.

Whereas real time feedback mechanisms have shown adaptability across many domains including sports and fitness [12]. It has been observed that immediate feedback is a strong factor that will invoke users to follow healthier postures [7], [9]. In addition, these systems are versatile in domains ranging from health, education, sports, etc. [2].

Future work in this field involves scaling up the system, making it accessible, and maximizing accuracy. This allows the use of lightweight frameworks such as Blaze Pose on portable devices which are both cost effective and scalable [5]. With the rising need of real time posture correction systems, integrated advanced machine learning frameworks, ergonomic principles and user-friendly interfaces will play a major role for proper posture interventions for health challenges associated with posture.

III. Methodology

This project aims at creating a web application for real-time posture detection and correction using Media Pipe for pose detection. Its methodology is divided into several stages, such as system design, data acquisition, posture analysis and feedback transmission. Now here are the steps and tools in the methodology.

A. System Architecture

The architecture of the Posture Corrector web application is composed of a collection of separate yet interacting components that primarily provide real time posture monitoring as well as feedback. The centre is the UI, which discusses an approach of what is easily interactive with HTML, CSS and JavaScript framework such as React. This UI during webcam access uses browser application program interfaces like WebRTC for capturing live video. These captured frames are then passed through the Image Processing Pipeline where the frames obtained are in BGR format to RGB format compatible.

In conjunction with that, the pose estimation model. Pose Estimation Module utilizes the Media Pipe framework to establish coordinates of important points, namely shoulders, neck, and torso, gathering their coordinates. After this, the Posture Analysis Engine analyses how aligned these landmarks are for evaluation of posture in relation to threshold values and calculation of angles for further breakdown.

If poor posture is detected, the Feedback and Notification System provides immediate visual feedback by blurring the screen along with auditory alerts to notify users. Fig. 1 shows the workflow of the proposed model.

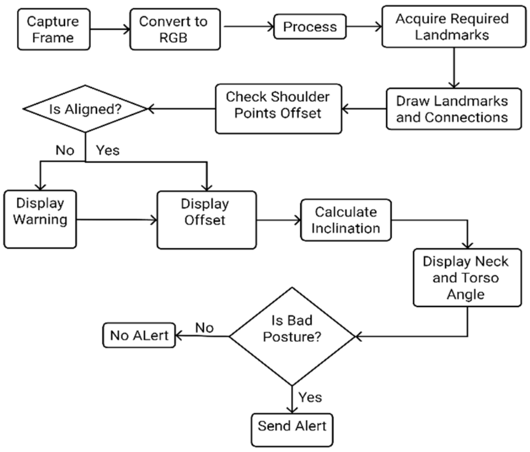

Figure 1-Workflow diagram of Posture Corrector web application

B. Dataset Details

The dataset for the Posture Corrector web application, which leverages the MediaPipe Pose framework, is essential for accurately training and evaluating posture detection models. It consists of a diverse collection of labeled images and videos capturing individuals in various postures, focusing primarily on side-view angles to analyze neck and torso inclination effectively. Each image and video frame is meticulously annotated with key body landmarks, specifically the shoulders, neck, torso, and head, using MediaPipe's 33-point landmark model as mention in figure 2 [9]. These annotations include the pixel coordinates of each landmark and labels categorizing the postures as "Correct" or "Incorrect".

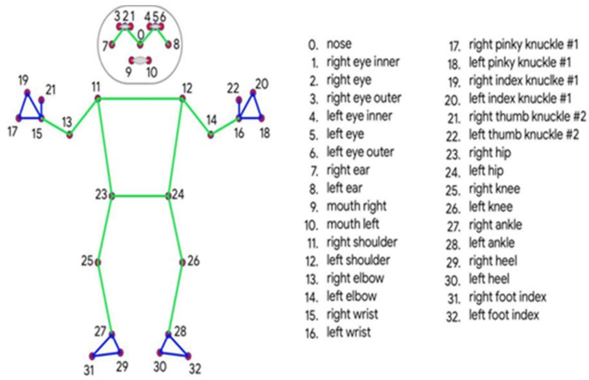

Figure 1. It shows recognition of 33 points on the human body through Mediapipe

C. Implementation

The use of the proposed Posture Corrector web application with the help of Media Pipe Pose consists of several carefully planned stages that imply computer vision, machine learning, and integrated feedback. The first step is to capture video input from the user's webcam on a frame-by-frame basis. Before processing through Media Pipe, each captured frame is also transformed from the BGR to the RGB format. The Media Pipe Pose model is then used to track the user's body posture and locate the landmarks on the shoulders, neck, and torso.

After identification of the landmarks, the application quantifies the angles of inclination for the neck and torso based on geometrical considerations. The angles are derived from the positions of the relevant landmarks, allowing for the assessment of posture alignment. A threshold range is established to differentiate between correct and incorrect posture; if the user's angles exceed these thresholds, the application triggers visual and auditory alerts to prompt corrective actions.

Function to calculate offset distance: In order to work properly, the person has to be in the correct side view. Our findDistance function helps us to find how far two points are apart. The shoulder or eyes it can be either of these, or the hip points, but they have all been chosen as they are almost always, if not always symmetrical about the human body's central axis. With this, we will add camera alignment to the script. We can find the distance formula in (1)[12].

$$Distance = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \qquad (1)$$

Calculate Body Posture Inclination: The angle is the main deterministic factor for the posture. Specifically, we substitute the angle between the neckline and the torso line, being a pair of vectors from the y-axis. The neckline is formed by combining the shoulders and the eyes. We view the shoulder as the vital position. As the torso line starts at the hip and ends at the shoulder, and the hip is a main point. Ref. [12] We can find the Neckline inclination measurement in figure2 given below.

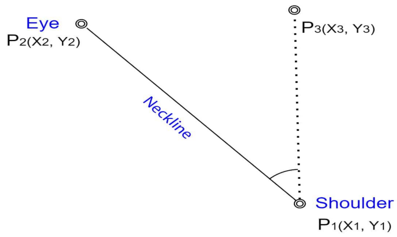

Figure 2. Measurement of neck line

Taking example of neckline, we have the following points.

- P1(x1, y1): shoulder
- P2(x2, y2): eye
- P3(x3, y3): that means any point on the vertical axis passing through P1

Apparently, for P3 x-coordinate matches that of P1. As y3 is matches for all y, let's take y3 = 0 to keep simple for us.

To calculate the inner angle of three points, we will use the vector approach. The angle between two vectors P12 and P13 is calculated by (2),

$$\theta = \arccos\left(\frac{\vec{P}_{12}\,.\vec{P}_{13}}{|\vec{P}_{12}\,| \cdot |\vec{P}_{13}|}\right)$$

Solving for θ we get,

$$\theta = \arccos\left(\frac{y_1^2 - y_1 . y_2}{y_1\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}}\right) \qquad (2)$$

Established Thresholds: Based on ergonomic research and empirical data, we define the following thresholds for good and bad posture

- Neck Inclination:
  - Good Posture: Angle ≤ 40*o*
  - Bad Posture: Angle ≥ 40*o*
- Torso Inclination:
  - Good Posture: Angle ≤ 10*o*
  - Bad Posture: Angle ≥ 10*o*

III. Results

In the implemented posture detection system using Media Pipe, threshold values are established using the angles of neck and torso inclination to distinguish between good and bad posture. Specifically, a neck inclination angle of less than 40 degrees is classified as good posture, while an angle of 40 degrees or more is deemed bad posture. Similarly, the torso inclination angle serves as another critical metric, where an angle below 10 degrees signifies good posture, whereas an angle of 10 degrees or greater indicates bad posture. These thresholds were determined based on empirical observations and ergonomic guidelines, allowing for a clear quantitative assessment of posture in real-time. By monitoring these angles, the system effectively tracks and evaluates an individual's posture, providing immediate feedback and fostering awareness of proper body alignment. Adjustments to these threshold values may be necessary over time to enhance accuracy and applicability across different user scenarios. So when there is bad posture the screen becomes blur and gives alert sound, as shown in the figure 4 and when there is good posture screen become clear and do not give alert sound, as shown in the figure 5.

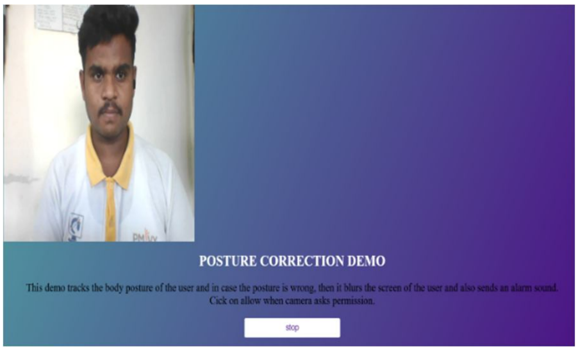

Figure 5. Shows Good Posture and so the clear screen

Figure 4. Shows Bad Posture, so the screen becomes blur and gives alert

IV. CONCLUSION

Building the Posture Corrector web app using Media Pipe Pose effectively combines computer vision, machine learning, and real-time feedback. The app processes video input from the user’s webcam, converting frames to RGB format for pose detection. Key body landmarks, such as the shoulders, neck, and torso, are tracked to assess posture. By comparing real-time data to healthy posture rules, the app identifies improper posture, such as slouching, and provides immediate feedback through alerts or visuals.

This tool promotes better posture in both the short and long term. Future integration of user patterns and advanced machine learning can enable personalized feedback, enhancing its effectiveness. Media Pipe Pose makes posture monitoring accessible and contributes to improved ergonomics, reducing strain and promoting overall health.

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