An User-friendly Body Posture Recognizing and Guiding System for Accurate Health Care Test Results

A PROJECT REPORT

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Under the guidance of,

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in partial fulfillment for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

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(CYBER SECURITY)

At

GAIN MORE KNOWLEDGE
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PRESIDENCY UNIVERSITY

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SCHOOL OF COMPUTER SCIENCE ENGINEERING

CERTIFICATE

This is to certify that the Project report **"An User-friendly body posture recognizing and guiding system for accurate health care test results"** being submitted by **"Sanketh S"** , **"Mohan C V"**, **"Manu K"**, **"Shaun Franklyn"**, **"V Vishwa Kiran Reddy"** bearing roll number's **"20211CCS0124"** , **"20211CCS0133"** , **"20211CCS0140"** , **"20211CCS0158"** , **"20211CCS0190"** in partial fulfillment of the requirement for the award of the degree of Bachelor of Technology in Computer Science and Engineering (Cyber Security) is a bonafide work carried out under my supervision.

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DECLARATION

We hereby declare that the work, which is being presented in the project report entitled **An User-friendly body posture recognizing and guiding system for accurate health care test results** in partial fulfillment for the award of Degree of **Bachelor of Technology** in **Computer Science and Engineering (Cyber Security)**, is a record of our own investigations carried under the guidance of **Mrs. Sterlin Minish T N, Assistant Professor, Presidency School of Computer Science and Engineering , Presidency University, Bengaluru.**

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ABSTRACT

Self-service wellness kiosks, which enable users to independently check their health, have been developed in response to the growing need for autonomous healthcare solutions. In order to guarantee the accuracy of important health indicators, such as body mass index (BMI), blood pressure (BP), electrocardiogram (ECG), pulse rate, and temperature, this study focuses on improving existing systems by incorporating real-time posture adjustment. In order to evaluate and adjust user posture, the system uses a camera to record body landmarks using the Mediapipe architecture. It then provides real-time feedback in the form of visual guidance. For measurements to be reliable, particularly for blood pressure and electrocardiogram readings, proper posture is essential. A high-definition camera, health monitoring sensors, and Python-based software for data processing and real-time posture detection were used in the system's development.

Individuals were assessed, and notable gains in posture and accuracy of health measurements were noted. The neck inclination errors dropped from 27.4° to 19.8°, while the torso misalignment went from 9.5° to 1.8°. Consequently, the blood pressure readings improved by 12.2%, and the ECG's accuracy rose by 7.7%. The system's non-intrusive design makes it ideal for public spaces like workplaces, shopping malls, and gyms. Posture analysis plays a crucial role in improving health and ergonomics. This project implements a real-time posture analysis system using Flask, OpenCV, and MediaPipe to track and provide guidance on correct posture.

The system has been upgraded with a fully responsive frontend built using React.js and Bootstrap, ensuring an intuitive and user-friendly experience. A seamless Flask-based API enables interaction between the frontend and backend, while MongoDB efficiently stores user data. The upgraded interface enhances usability and accessibility, making the system suitable for health monitoring and medical applications.Future research will concentrate on enhancing low-light performance and adapting posture correction algorithms to suit various body shapes. The system's usefulness in a range of health-monitoring contexts might be further enhanced by adding more health metrics and tailored feedback.

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CHAPTER-1
INTRODUCTION

1.1 General Overview

A comprehensive self-service wellness kiosk system is presented in this project to help users independently assess important health parameters in light of the growing demand for easily accessible and real-time healthcare monitoring. The system quickly and non-invasively measures body temperature, pulse rate, electrocardiogram (ECG), blood pressure, body mass index (BMI), and blood pressure by integrating a variety of health sensors and technologies.

The system's use of a live camera feed for real-time posture analysis is one of its unique features. Accurate physiological readings depend on proper posture, particularly when taking an ECG or blood pressure reading. Before taking a measurement, the system uses MediaPipe and OpenCV to identify body landmarks and gives users real-time visual feedback to help them align correctly.

For a responsive and eye-catching user experience, the frontend interface was created with React.js and Bootstrap. Features like registration, login, dashboard, profile access, and real-time test execution are all part of the system's clear, user-friendly interface. Flask (Python) powers the backend, managing API requests and integrating with MongoDB to manage doctor comments, test results, and user data.

The system is made to function as a scalable and modular platform that is simple to set up in public spaces like offices, gyms, and shopping centers. It maintains simplicity and automation in operation while guaranteeing that users receive accurate health readings. This project lays a solid basis for user-driven health management by fusing hardware sensor integration with AI-powered posture detection and a powerful full-stack web application.

1.2 Motivation and Rationale

Because of time constraints, limited awareness, or lack of access to healthcare, people in today's fast-paced world frequently neglect routine health monitoring. The creation of a self-service wellness kiosk with digital health diagnostics and real-time posture guidance was motivated by the widening gap between preventative health examinations and easily accessible solutions.

Maintaining proper body posture is crucial for accurate measurement of health parameters like blood pressure, ECG, and BMI. Medical evaluations may be impacted by distorted results caused by even slight variations in torso alignment or neck inclination. The idea of integrating AI-based posture correction through computer vision techniques to help users achieve ideal positioning during testing was spurred by this realization.

The need for this system is further supported by the growing importance of contactless and independent health monitoring systems, particularly in public and busy places like gyms, shopping centers, business campuses, and educational institutions. The project gives people the ability to take proactive, private control of their health by doing away with the need for medical professionals to perform basic health assessments.

Furthermore, the system is guaranteed to be highly interactive, modular, scalable, and efficient through the use of contemporary web technologies like React.js, Flask, MongoDB, and MediaPipe. The choice to use these tools was made because of their dependability, adaptability, and community support, which allow the system to change to meet changing healthcare needs.

Overall, this project is driven by the belief that technology can bridge the gap between health awareness and real-time accessibility, delivering a user-friendly solution that encourages early diagnosis, personal wellness, and preventive care.

1.3 Objectives of the System

The primary objective of this project is to design and implement an AI-powered self-service wellness kiosk that allows users to independently assess their health parameters with enhanced accuracy through real-time posture correction and an intuitive, interactive web interface.

The system aims to achieve the following specific goals:

1. **Real-Time Posture Analysis and Correction :** Utilize a high-definition camera along with MediaPipe and OpenCV to detect and visualize human body landmarks, enabling immediate posture feedback during health evaluations.
2. **Accurate Health Monitoring :** Improve the precision of diagnostic readings—such as BMI, ECG, blood pressure, pulse rate, and temperature—by ensuring users maintain correct body alignment.
3. **Seamless Frontend-Backend Integration :** Develop a dynamic and responsive frontend using React.js and Bootstrap that interacts smoothly with a Flask-based backend API for real-time data exchange and feedback.
4. **User Authentication and Management :** Implement secure login and signup functionality with user-specific data storage using MongoDB, allowing for personalized dashboards and historical test tracking.
5. **Live Video Streaming with Stickman Overlay :** Display a live feed with overlaid skeletal tracking on the testing page, visually guiding the user to correct their posture during the session.
6. **Doctor Interaction Support :** Provide an interface for doctors to add comments and feedback on test results, enhancing the system's potential use in medical and wellness consultations.
7. **Test History Tracking :** Save test results and comments in a structured database format and display them in the user dashboard for future reference and analysis.
8. **User-Centric Interface Design :** Deliver a clean, visually engaging, and intuitive UI experience optimized for accessibility and usability across different devices and user groups.

Through these objectives, the system ensures that health monitoring becomes more accessible, reliable, and user-friendly, paving the way for widespread adoption in both personal and semi-professional environments.

1.4 Importance of Posture in Health Monitoring

In order to guarantee the precision and efficacy of health evaluations, posture is essential. Incorrect posture can cause notable variations in the recorded values of many health monitoring systems, particularly those that measure blood pressure, body mass index (BMI), pulse rate, temperature, and electrocardiogram (ECG). For instance, slouching or positioning the arms incorrectly during a blood pressure check can cause readings to be either elevated or decreased, which could cause a misdiagnosis or postpone taking preventative action. In a similar vein, improper neck alignment can lead to mistakes in the acquisition of ECG signals, which can impact cardiovascular assessment.

This project uses computer vision technologies to incorporate real-time posture correction in order to address these issues. The system actively tracks body posture and offers visual guidance in the form of a stickman overlay, utilizing a high-definition webcam and MediaPipe-based landmark detection to ensure the user maintains ideal alignment during the testing procedure. Additionally, proper posture promotes user comfort and confidence, which is especially important in self-service and public health kiosk settings where professional assistance may not always be easily accessible. Additionally, automated feedback lessens the need for human intervention, making it possible to collect health data in a more scalable and reliable manner.

The system's emphasis on posture correction as a crucial element improves the precision and dependability of health data while encouraging users' self-discipline and health consciousness.

1.5 Relevance to Preventive Healthcare

The goal of preventive healthcare is to detect health risks early and take action to reduce them before they worsen. Self-service health monitoring systems with real-time posture analysis are essential in this situation. Such systems encourage early detection and intervention by empowering people to perform precise, routine health checks without direct medical supervision.

The system's incorporation of posture correction mechanisms guarantees that measurements of critical parameters, such as blood pressure, ECG, and BMI, are not distorted by improper body alignment. This is particularly important in public or busy settings where users depend on these devices for routine evaluations, like gyms, shopping centers, offices, and clinics.

Moreover, the system provides a non-intrusive and user-friendly experience via its advanced frontend built with React.js and Bootstrap and a Flask-based backend. This encourages more regular health checks and improved awareness by enabling people to participate in self-monitoring without help.

Correct data collecting and the capacity to keep historical health records in MongoDB help users even more to monitor trends over time and look for medical advice if anomalies are found. Including test result archiving and doctor comments increases the user's health journey's credibility and continuity even more. By improving accessibility, accuracy, and autonomy, this posture-aware monitoring system generally complements the ideas of preventive healthcare, therefore helping to enhance population health results.

CHAPTER-2

LITERATURE SURVEY

[1] Title: **Posture Recognition Based on Fuzzy Logic for Home Monitoring of the Elderly**

Authors: Damien Brulin, Yannick Benezeth, and Estelle Courtial

Date: 5, SEPTEMBER 2012

DOI: 10.1109/TITB.2012.2208757

Journal: IEEE TRANSACTIONS ON INFORMATION TECHNOLOGY IN BIOMEDICINE, VOL. 16

Introduction: This paper introduces a computer vision-based system that utilizes fuzzy logic for posture recognition in a home monitoring setting, specifically targeting the elderly. The system is designed to detect emergencies, such as falls, by recognizing four main body postures: lying, squatting, sitting, and standing. The core idea is to assist elderly individuals living independently by monitoring their movements through an unobtrusive, camera-based system.

Methodology: The system uses a combination of human detection followed by posture recognition based solely on a human silhouette. The posture recognition leverages simple features, which focus on describing the silhouette of the human body, minimizing the impact of environmental factors like lighting variations and occlusions. The approach is intended to be robust, requiring minimal processing power while still maintaining high accuracy. The fuzzy logic system (FLS) classifies the postures by utilizing a set of rules that interpret the visual data and assign membership degrees to each possible posture.

Results and Discussion: The system was tested in various conditions, showing an overall posture recognition accuracy of 74.29%. However, the study acknowledged that differentiating between similar postures, like sitting and squatting, was a challenge due to the similar shapes of these postures in the silhouette. Additionally, the system's performance decreased slightly in dynamic environments, where background changes introduced noise to the detection algorithm.

Conclusion: The paper demonstrates the feasibility of using fuzzy logic for posture recognition, but highlights that improvements are needed for real-time applications in dynamic, uncontrolled environments. Furthermore, while the system is designed for home use, the findings suggest potential for wider applications with further refinement.

[2] Title:**Smart mirror E-health assistant — Posture analyze algorithm proposed model for upright posture**

Authors: Biljana Cvetkoska, Ninoslav Marina, Dijana Capeska Bogatinoska, Zhanko Mitreski

Date: 6-8 July 2017

DOI: 10.1109/EUROCON.2017.8011163

Conference: IEEE EUROCON 2017 -17th International Conference on Smart Technologies

Introduction: This paper proposes an innovative approach to posture correction by introducing a smart mirror system designed to detect and analyze posture in real time. The smart mirror is equipped with a camera and uses a posture analysis algorithm (Posture Analyze Algorithm - PAA) to assess user posture and provide corrective feedback. This system is targeted at improving everyday posture and preventing musculoskeletal issues, especially in home settings.

Methodology: The smart mirror utilizes face recognition to authenticate users and track posture over time. The system captures real-time images and analyzes body posture using the Posture Analyze Algorithm (PAA). The algorithm compares the user's current posture against a predefined set of ideal postures and highlights areas for improvement. The mirror provides suggestions for corrective actions and preventive healthcare measures based on posture analysis.

Results: Tests with multiple users demonstrated that the system could effectively detect posture deviations and offer helpful guidance. Users reported a noticeable improvement in their posture over time, confirming the mirror's utility in daily posture management. However, the system's reliance on face recognition and stationary use limited its application to primarily home or office settings.

Conclusion: This paper demonstrates the potential of integrating real-time posture analysis into a home healthcare setting using a smart mirror. While the system works well in its intended environment, future improvements could focus on enhancing its applicability in more public or mobile settings by reducing its reliance on face recognition.

[3] Title: **Sitting posture recognition for computer users using smartphones and a web camera**

Authors: Jheanel Estrada, Larry Vea

Date: 5-8 November 2017

DOI:10.1109/TENCON.2017.8228098

Conference: TENCON 2017 - 2017 IEEE Region 10 Conference

Introduction: This paper presents a model designed to recognize sitting postures automatically by using both accelerometers attached to specific points on the human body and web cameras. The focus of the study was to identify ergonomic sitting postures and provide feedback to help individuals maintain proper sitting habits, particularly for office workers and students who spend extended periods sitting.

Methodology: Accelerometers were attached to key points along the spine, such as the thoracic and lumbar regions, while a web camera captured upper body landmarks like the chin and shoulders. Data from 60 participants was collected and used to train various classifiers, including K-Nearest Neighbors (KNN), Support Vector Machines (SVM), and Decision Trees, to detect posture deviations.

Results: The Decision Tree classifier performed best, achieving an accuracy of 95.35% for detecting improper head and shoulder postures. This high accuracy indicates the system's effectiveness in recognizing ergonomic problems in sitting postures. However, the study also pointed out limitations in the system's ability to detect subtle posture changes, especially when participants moved frequently.

Conclusion: The combination of accelerometer and camera data offers a feasible solution for detecting improper sitting posture in real time. The system provides valuable insights for improving ergonomics, but the requirement for wearable devices (accelerometers) may limit its practicality for large-scale use in public or work environments.

[4] Title: **Vision-based human body posture recognition using support vector machines**

Authors: Chia-Feng Juang, Chung-Wei Liang, Chiung-Ling Lee,I-Fang Chung

Date: 21-24 August 2012

DOI: 10.1109/iCAwST.2012.6469605

Conference: 4th International Conference on Awareness Science and Technology

Introduction: This study presents a vision-based posture recognition method using an SVM classifier to detect and categorize four basic postures: standing, bending, sitting, and lying. The system was designed with the aim of enhancing traditional surveillance systems by adding the ability to automatically detect human behavior and alert operators to unusual postures that may indicate a problem (e.g., a fall or fainting).

Methodology: Two cameras were used to capture simultaneous image sequences from different angles. An RGB-based object segmentation algorithm was then employed to distinguish the human body from the background. The system calculates Discrete Fourier Transform (DFT) coefficients from the horizontal and vertical projections of the body silhouette, which are used as features for the SVM classifier to categorize the detected posture.

Results: The SVM classifier achieved high accuracy in distinguishing between the four postures, significantly reducing errors related to occlusions or ambiguous silhouettes. The two-camera setup provided greater robustness in detecting posture from different angles, making the system suitable for use in dynamic environments like public spaces or workplaces.

Conclusion: This paper demonstrates the effectiveness of using a multi-camera system and an SVM classifier for posture recognition in surveillance applications. However, the complexity of the system's setup and reliance on two cameras may limit its use in simpler or more cost-sensitive environments.

[5] Title: **Object Detection and Analysis of Human Body Postures Based on TensorFlow**

Authors: Ling Xie, Xiao Guo

Date:August 2019

DOI:10.1109/SmartIoT.2019.00070

Conference: 2019 IEEE International Conference on Smart Internet of Things (SmartIoT)

Introduction: This paper investigates the use of deep learning, particularly TensorFlow, to classify human body postures. The study focuses on applying convolutional neural networks (CNNs) to recognize and classify postures, with an emphasis on monitoring teachers' postures during teaching sessions. The goal was to develop a posture recognition system that can operate in real time with high accuracy.

Methodology: The study tested eight different experimental setups, each combining various detection algorithms and CNN architectures. The system captured key points of the human body and used CNNs to analyze posture, focusing on actions such as standing, sitting, and bending. Multiple CNN models were tested to determine the best approach for posture recognition in the given scenario.

Results: The TensorFlow-based system achieved excellent performance, with the most successful CNN model providing highly accurate real-time posture recognition. However, the study noted that the accuracy of the system depended heavily on the quality and diversity of the training data. The lack of diverse training data could lead to reduced accuracy in real-world scenarios where variations in body types or environments may not be well-represented in the training set.

Conclusion: This study demonstrates the potential of using deep learning, particularly CNNs, for real-time posture recognition. The system achieved superior accuracy compared to previous posture recognition methods, but further research is needed to improve its generalization capabilities across different environments and body types.

CHAPTER-3
RESEARCH GAPS OF EXISTING METHODS

Current approaches still have serious flaws, even with a number of improvements in posture correction and health monitoring systems. Vital health metrics like body mass index (BMI), blood pressure (BP), pulse rate, electrocardiogram (ECG), and temperature are the main focus of the current systems. They do not, however, have strong systems in place to guarantee proper posture, which is essential for accurate readings, particularly for blood pressure and ECG.

The following research gaps have been identified in the existing methods:

- **Limited Real-Time Feedback**

Most existing systems do not provide immediate corrective feedback to users regarding posture deviations, which is essential for maintaining correct alignment during health assessments.

- **Reliance on Controlled Environments**

Many posture detection systems, such as those using background subtraction or stationary cameras, are designed for static or controlled environments. These systems often struggle in dynamic, real-world settings with varying lighting conditions and moving subjects.

- **Dependency on Wearable Devices**

Several existing solutions require users to wear additional sensors (e.g., accelerometers or gyro-meters) to track body movements. This can be intrusive and inconvenient for users, particularly in public health settings or non-laboratory environments.

- **Lack of Integration with Health Monitoring**

While posture recognition systems exist, few integrate posture correction with health monitoring tools like blood pressure monitors or ECG devices. The absence of such integration can lead to inaccurate health readings due to poor posture.

- **Inadequate Handling of Body Morphological Differences**

Many systems do not account for variations in body shape, size, or frame, which can lead to inaccurate posture assessments, especially in systems based solely on visual data or static models.

- **Insufficient Adaptability to Public or Unassisted Environments**

Most existing systems are designed for home or clinical environments, where conditions are controlled. There is a lack of solutions tailored for unassisted, public environments such as kiosks, where users may need immediate guidance.

- **Absence of Visual Guidance**

Current systems do not provide visual feedback to help users adjust their posture in real time. This can cause misalignment that affects sensor placement and overall system reliability.

- **Minimal Frontend Integration**

Most posture analysis tools are limited to backend processing and fail to offer an interactive, user-friendly interface. This lack of a visually intuitive frontend restricts usability and engagement, especially for users unfamiliar with medical or technical processes.

- **Fragmented System Architecture**

Disjointed communication between backend processing units and frontend user interaction leads to latency and inefficiency. Systems often rely on manual input or outdated UI elements that reduce operational effectiveness.

- **Lack of Doctor Feedback Integration**

Many platforms do not support interaction between patients and healthcare professionals. The absence of integrated comment or feedback systems limits collaborative decision-making.

A Flask backend with MongoDB for storage, a contemporary React.js + Bootstrap frontend for an improved and captivating user experience, and real-time stickman-based posture tracking with OpenCV and MediaPipe are all integrated into the suggested system to address these problems. The system is more dependable, scalable, and appropriate for a variety of settings, such as gyms, clinics, public areas, and distant health centers, thanks to the addition of live posture correction, comment storage, and doctor interaction.

CHAPTER-4

PROPOSED MOTHODOLOGY

Using an intelligent web-enabled kiosk, the suggested methodology focuses on developing an autonomous, real-time posture monitoring and health evaluation system. The system provides users with a non-intrusive, precise, and intuitive health analysis experience by fusing health parameter monitoring with computer vision-based posture detection. Before any physiological data is recorded, it makes use of OpenCV and MediaPipe's capabilities to identify body landmarks and make sure the user's alignment falls within ideal posture thresholds.

With interactive features like live stickman overlays, form-based doctor inputs, and dynamic dashboards, the system incorporates a visually appealing frontend built with React.js and Bootstrap to ensure user-friendly operation and accessibility across various platforms. MongoDB stores user information, test history, and doctor comments, while the Flask-based backend enables smooth data exchange through REST APIs.

By providing live health testing interfaces, scalable architecture for public space deployment, and real-time visual posture feedback, this methodology aims to overcome the shortcomings of current systems. By ensuring data accuracy through posture verification, the health kiosk serves as a fully functional self-service station for preventive diagnostics, doing away with the need for ongoing medical professional intervention.

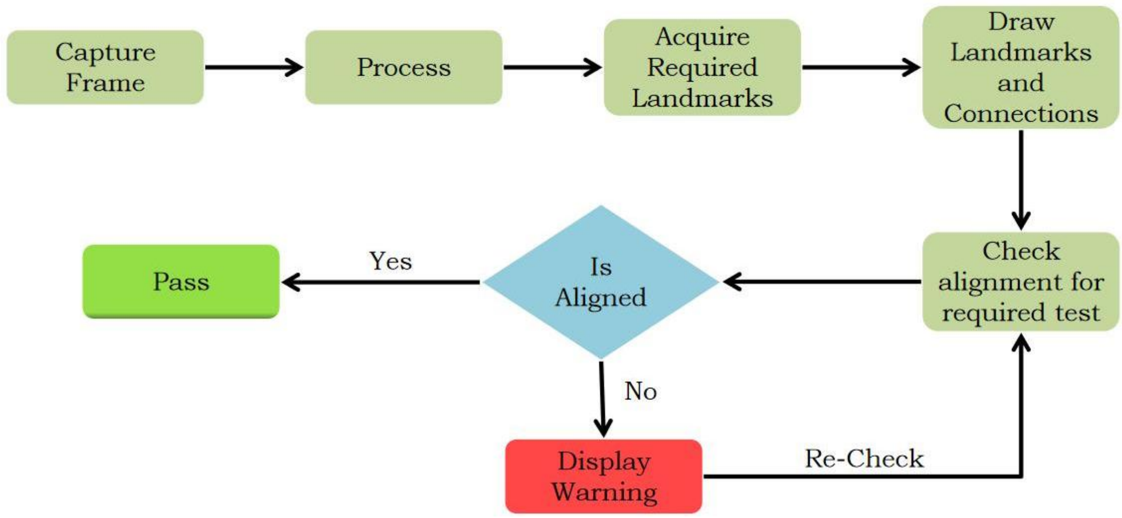

Figure 4.1 : Block diagram of the process workflow

4.1 System Overview

Real-time pose detection, health parameter validation, and an easy-to-use user interface are all integrated into the developed system, which is a web-based platform for posture monitoring and health assessment. With both frontend and backend components that work together seamlessly to produce accurate results and enhance user experience, it is constructed as a full-stack application.

To ensure responsiveness and aesthetic appeal, the system's frontend is constructed with React.js and styled with Bootstrap. Pages for login, signup, profile viewing, test access, and real-time video streaming with posture overlays are just a few of the components that users can use to interact with the system. Users can view their profile information and previous test results on a dedicated dashboard. After seeing a patient's performance on a test, physicians can also leave comments via the interface.

Flask powers the backend, handling data storage, video streaming, user authentication, and API routing. On the server side, MediaPipe analyzes live webcam input to pinpoint important body landmarks, which are then displayed as a stickman pose on the video feed. Before permitting health tests to begin, the posture is verified, guaranteeing the accuracy of the information gathered.

MongoDB, a versatile NoSQL database ideal for scalable deployments, houses data such as user credentials, test results, and doctor comments. React components can communicate asynchronously with the server using Axios thanks to the backend's exposure of API endpoints.The main objective of the modular, scalable, and user-friendly system is to increase the efficiency of health kiosks by removing posture-related errors prior to data collection.

4.2 Posture Detection

- **Camera Setup:** The system captures real-time video input from a camera positioned in front of the user. The camera is responsible for capturing the user's posture and body position before and during health measurements. This camera should be placed at an angle that provides a clear view of the user's body landmarks, such as the shoulders, hips, and ears.

- **Body Landmark Detection Using Mediapipe:** The Mediapipe framework is used to detect key body landmarks in real-time from the video feed. Mediapipe is a machine learning framework that provides robust detection of body landmarks using a pre-trained model. The system focuses on detecting the following key points:

Shoulders: Used to assess torso alignment and shoulder posture.
Hips: Critical for determining the user's overall posture and body balance.
Ears: Important for detecting head and neck posture, especially during ECG or BP measurements.
Using these landmarks, the system creates a skeletal map of the user's body, which is then analyzed to determine posture alignment. The landmark detection is done in real time, enabling immediate feedback to the user if any misalignment is detected.

4.3 Angle Calculation for Posture Analysis

Once the body landmarks are detected, the system calculates the angles between key joints to assess the user's posture. These angles help determine whether the user is in the correct posture for the given health measurement.

Equation for finding angle

$$\theta = \arccos\left(\frac{\overrightarrow{P_{12}} \cdot \overrightarrow{P_{13}}}{\left|\overrightarrow{P_{12}}\right| \cdot \left|\overrightarrow{P_{13}}\right|}\right)$$

Solving for θ *we get,*

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

These angles are computed using trigonometric functions, specifically cosine and sine, to determine the relative position of each landmark in relation to the others. The calculated angles are then compared against predefined thresholds that represent ideal posture for each measurement (BP, ECG, etc.).

4.4 Real-Time Feedback Mechanism

- **Posture Evaluation:** Once the angles are calculated, the system compares them with pre-defined acceptable ranges. If the user's posture deviates from the acceptable range (e.g., neck inclination greater than 40 degrees or torso inclination greater than 10 degrees), the system classifies the posture as "incorrect."
- **Feedback to the User:** If the system detects incorrect posture, it provides real-time feedback to the user. This feedback is given in the form of:

The feedback loop continues until the user’s posture aligns with the acceptable threshold, at which point the system proceeds to the next stage of health monitoring.

4.5 Health Monitoring Module

Once the system confirms that the user is maintaining the correct posture, the health monitoring process begins. The kiosk is equipped with sensors that measure various health vitals such as:

- Body Mass Index (BMI): Calculated using the user’s height and weight.
- Blood Pressure (BP): Measured using an automated BP cuff, ensuring the arm is in the correct position.
- Electrocardiogram (ECG): Captures the electrical activity of the heart while ensuring the user’s body is correctly aligned to avoid signal noise.
- Pulse and Temperature: Measured using non-invasive sensors attached to the user’s finger or forehead.

The system waits for the posture to be validated before initiating the measurement to ensure that posture-related inaccuracies are avoided.

4.6 Scalability and Modularity

The system is designed to be modular, allowing for future expansion. Additional health monitoring modules or posture analysis features can be integrated into the existing framework. For instance:

Additional sensors for glucose monitoring or oxygen saturation can be added.
AI-based posture correction algorithms can be incorporated to provide more personalized feedback based on user-specific body morphology.
This modularity makes the system scalable for use in various environments, including gyms, healthcare facilities, and workplaces.

4.7 Testing and Validation

- **Calibration:** The system will undergo extensive testing to ensure that the posture detection module accurately identifies and corrects poor posture. Calibration tests will be conducted in controlled environments to fine-tune the thresholds for posture correction.
- **Field Testing:** After calibration, the system will be deployed in real-world environments (such as health centers or public gyms) to validate its performance in diverse conditions. Feedback from real users will be used to further optimize the posture detection and health monitoring modules.

The proposed methodology outlines a comprehensive approach to combining posture correction with health monitoring in a self-service wellness kiosk. By leveraging Mediapipe for real-time posture detection and incorporating a robust feedback system, the kiosk ensures accurate health readings by eliminating posture-related errors. The system is designed to be scalable, modular, and adaptable to a variety of public and private environments, making it a valuable tool in preventive healthcare.

CHAPTER-5
OBJECTIVES

In a self-service wellness kiosk format, the main goal of this project is to create an intelligent, intuitive posture-aware health monitoring system that combines real-time posture analysis with necessary health checks. The system attempts to close the gap between human error brought on by poor posture when taking vital signs and automated healthcare screening.

- **Develop an Autonomous Health Monitoring System:** The primary objective of the project is to design and develop a fully autonomous self-service wellness kiosk that can measure key health parameters such as Body Mass Index (BMI), Blood Pressure (BP), Electrocardiogram (ECG), Pulse, and Temperature without requiring assistance from healthcare professionals.

- **Integrate Real-Time Posture Detection and Correction:** To ensure the accuracy of health measurements, the system will incorporate a real-time posture detection and correction module. This feature will use the Mediapipe framework to detect body landmarks and calculate joint angles, ensuring users maintain the correct posture during the measurement process.

- **Provide Accurate Health Measurements:** The system is designed to provide precise and reliable health data. By integrating posture correction, the kiosk will reduce the risk of inaccurate measurements caused by improper posture, especially for sensitive tests like BP and ECG.

- **Offer Real-Time Feedback to Users:** The system will guide users through the process by providing real-time feedback. If the user's posture deviates from the ideal alignment, the system will prompt the user with visual and auditory cues to make adjustments before proceeding with the health measurements.

- **To build a React-based frontend with Flask backend:** The frontend of the application is built using React.js, allowing for dynamic interaction and seamless navigation across pages. It is coupled with a Flask backend, which handles server-side logic and API calls. Together, they enable an efficient communication channel for data flow between the user interface and the database.

- **To store user and test data in MongoDB :** All user credentials, health readings, and doctor feedback are stored securely in MongoDB. The NoSQL structure of MongoDB allows for scalable and flexible data management, enabling efficient retrieval and update operations during user interaction with the system.

- **Create a Scalable and Modular System:** The project aims to create a system that is scalable and modular, allowing for future enhancements and the integration of additional health metrics. The modular design will make it easier to incorporate new features, such as additional health sensors or AI-driven health insights, in the future.

- **Ensure User-Friendly Operation:** One of the core objectives is to ensure that the kiosk is easy to use, even for individuals with no technical knowledge. The user interface will be designed to be intuitive, guiding users step-by-step through the posture correction and health measurement process.

- **Improve Accessibility to Health Monitoring:** The kiosk is designed to be deployed in public and private spaces such as gyms, healthcare centers, malls, and workplaces. By offering a non-assisted health monitoring system, the project aims to improve accessibility to regular health check-ups for a broader audience, including those in underserved or remote areas.

- **Conduct Extensive Testing and Validation:** The system will undergo rigorous testing in both controlled and real-world environments to ensure that the posture correction and health monitoring features work accurately and reliably. Feedback from field testing will be used to refine the system and ensure its readiness for public deployment.

CHAPTER-6
SYSTEM DESIGN & IMPLEMENTATION

The system design and implementation of the self-service wellness kiosk is centered around integrating real-time posture detection, feedback mechanisms, health monitoring sensors, and a user-interactive web platform into a seamless, autonomous system. This platform is developed to be non-intrusive and intuitive, guiding users to maintain proper posture to ensure the accuracy of health metrics. A robust full-stack approach using React.js, Flask, OpenCV, and MongoDB powers the flow of data and visual feedback in real-time. The following sections detail each module involved in the system:

- ## System Architecture Overview

The kiosk has a modular architecture comprising both hardware and software components:

Posture Detection Module: Utilizes a webcam and the MediaPipe framework to track body landmarks in real time.

Real-Time Feedback System: Uses a web interface to show posture corrections with visual cues.

Health Monitoring Sensors: Captures key health metrics including BP, ECG, BMI, Pulse, and Temperature.

Processing Unit: Powered by Python, Flask, and OpenCV, this unit manages posture tracking, image processing, and communication between sensors and the frontend.

User Interface (UI): Developed using React.js and styled with Bootstrap, it delivers dynamic, responsive guidance and displays user information, test results, and posture feedback.

Database: MongoDB stores user credentials, test results, and doctor comments securely.

- ## Posture Detection Module

Camera Integration: The system uses a high-definition camera placed at a strategic angle to capture the user’s full body. The camera is responsible for capturing real-time video, which is processed by the posture detection module to identify key body landmarks.

Body Landmark Detection: The Mediapipe framework is utilized for detecting and tracking key body landmarks such as the shoulders, hips, and neck. Mediapipe is a real-time machine learning framework that provides a robust solution for identifying human body landmarks with minimal computational power. The system continuously tracks these landmarks while the user is standing in front of the kiosk.

Angle Calculation for Posture Assessment: The posture detection module calculates angles between key body landmarks to assess whether the user's posture is aligned correctly. For instance:

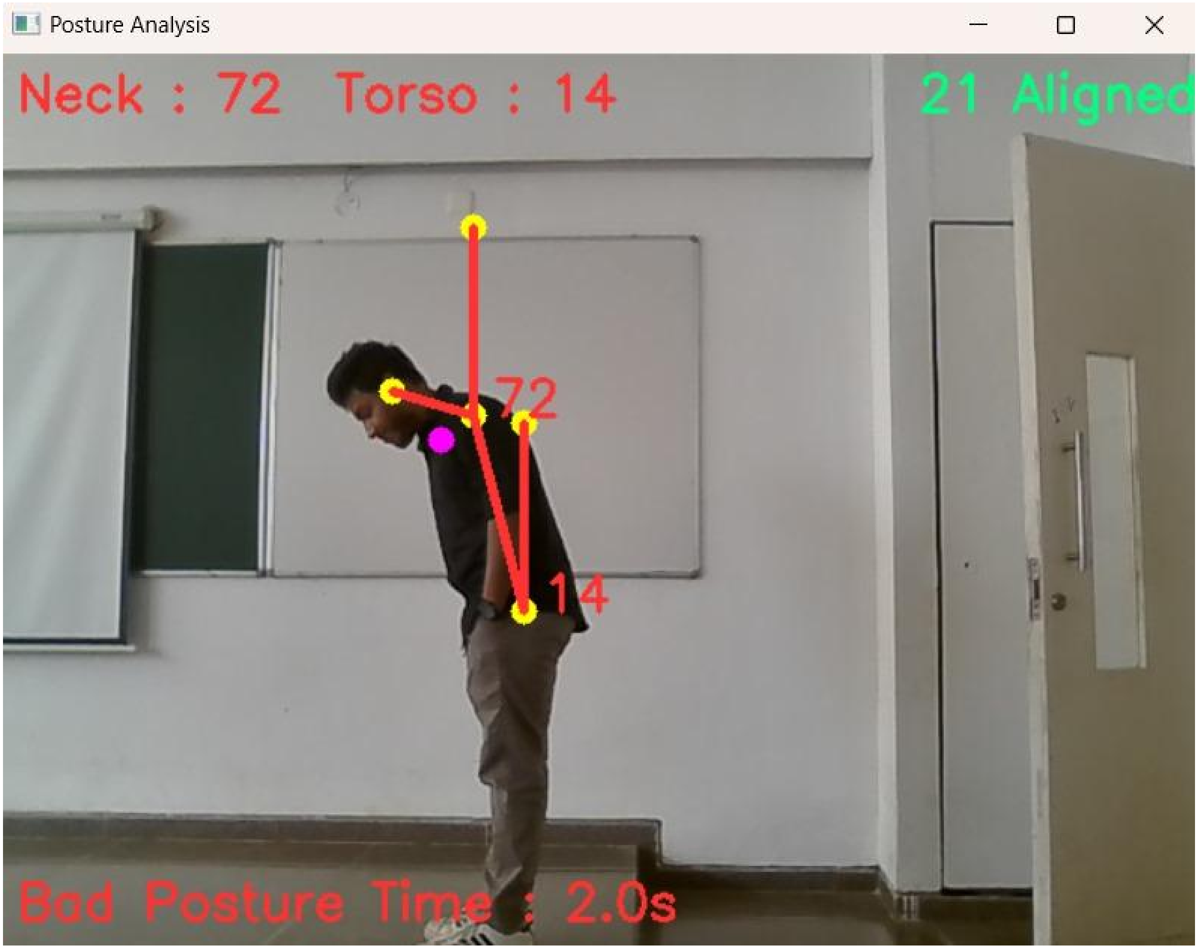

Figure 6.1 : Individual Before Alignment

Neck Inclination: The angle between the shoulder and ear is calculated to check if the user's neck is upright.

Torso Alignment: The angle between the shoulder and hip is measured to assess whether the user is standing upright.

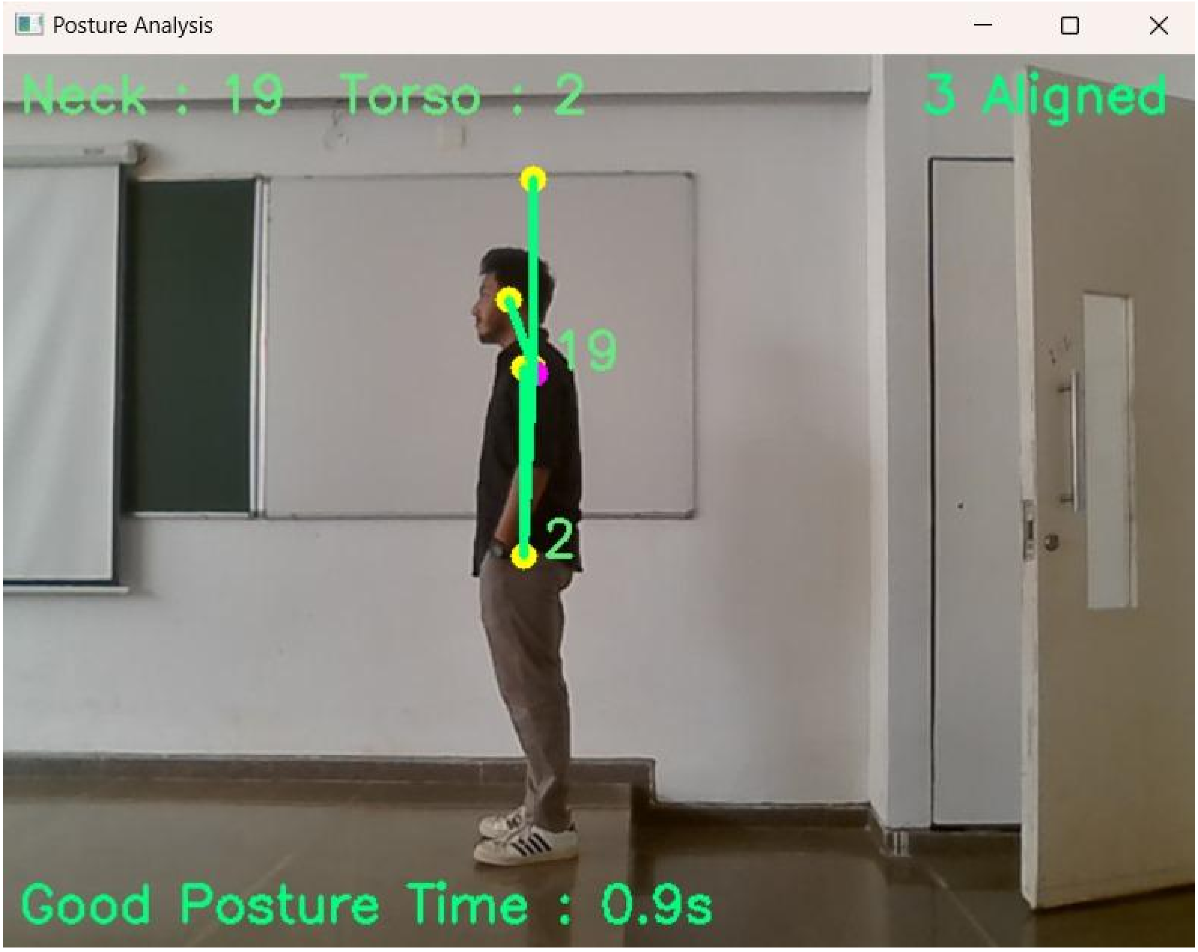

Figure 6.2 : Individual After Alignment

These angles are compared against predefined thresholds. For example, a neck inclination greater than 25° may indicate that the user is leaning forward too much, while a torso misalignment greater than 10° could mean the user is slouching.

- ## Real-Time Feedback System

The feedback system is a critical component of the kiosk, designed to guide users in correcting their posture before health metrics are measured.

Live Stream Overlay: Users see their skeleton pose and posture in real-time, enhanced by dynamic overlays.

Instruction Prompts: If misalignment is detected, the frontend (React) displays context-aware messages such as "Lift your neck" or "Align your back".

Feedback Loop: The posture is constantly validated in a loop until proper alignment is achieved, triggering the health measurement process.

- ## Data Processing Unit

Python + OpenCV: The backend is built using Python and OpenCV for real-time frame processing.

Flask API Integration: The backend exposes API endpoints (/video_feed, /save, /auth/login, etc.) to interact with the frontend.

Validation Logic: Posture is analyzed, and test results are saved only when alignment is within acceptable limits, reducing errors in health data.

- ## User Interface (UI)

React + Bootstrap: The UI is modern, responsive, and user-friendly. It provides:

A Home page with project details and navigation.

Login and Signup forms connected to MongoDB for authentication.

Dashboard with test history and profile data.

Testing page with live camera feed and stickman overlay.

Doctor comments and test results submission feature.

Doctor Contact Page: Displays doctor info from the frontend and offers guidance.

- ## Modular and Scalable Design

The system's modular design makes it easy to expand and integrate additional features in the future. For instance:

Extensible Sensor Support: New health sensors like SpO2 or glucose monitors can be integrated into the current backend architecture.

Personalized Posture AI: Future versions can apply machine learning to tailor posture suggestions to each user's body profile.

Remote Monitoring: Through API and database architecture, test results and posture metrics can be transmitted to remote healthcare systems.

- ## Testing and Calibration

Posture Thresholds Tuning: Multiple users were evaluated to calibrate ideal posture angles for neck and torso.

Real-World Deployment: Tested in real environments (gyms, clinics) to verify accuracy and user friendliness.

Data Storage and Retrieval: MongoDB effectively manages user and test data, ensuring fast lookup and update operations.

This implementation combines computer vision, web technologies, and user-centered design to create a modern health-checking kiosk. The integrated frontend with React and Bootstrap enhances usability, while Flask and Python manage processing logic and communication with MongoDB, providing a reliable, scalable foundation for future enhancements in posture-guided health monitoring.

CHAPTER-7

TIMELINE FOR EXECUTION OF PROJECT

(GANTT CHART)

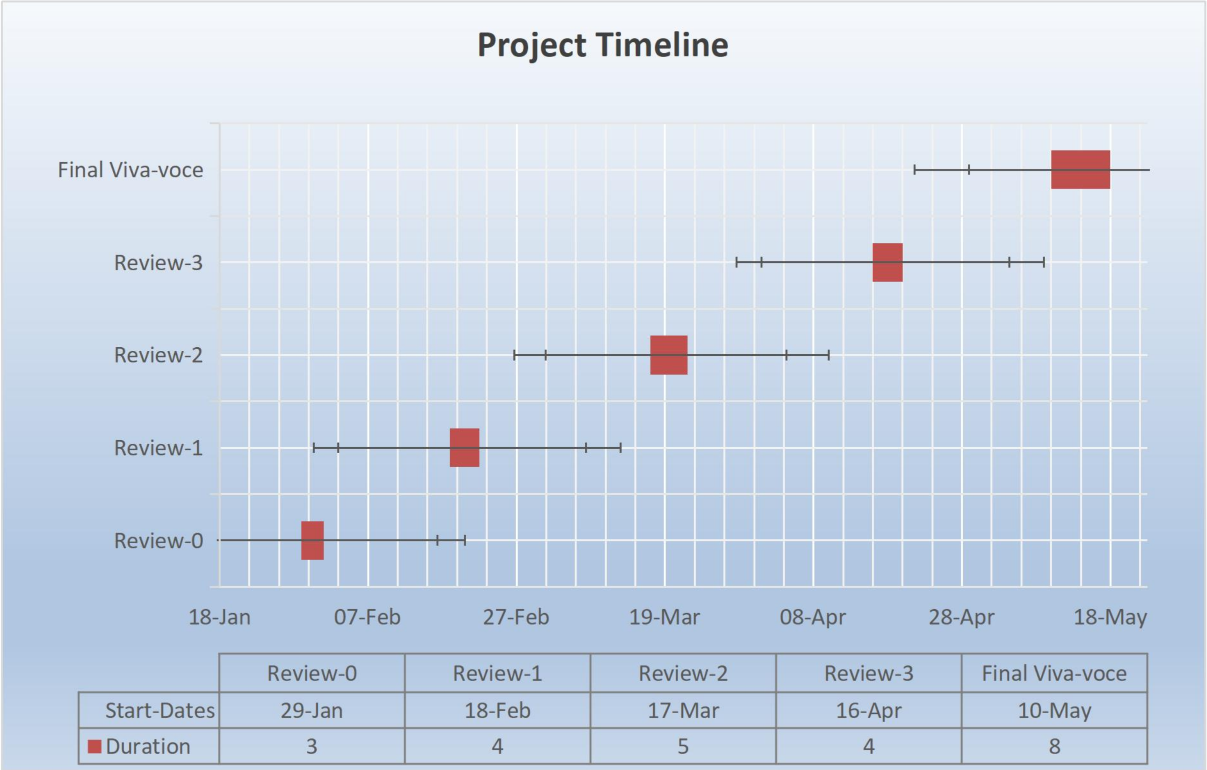

Figure 7.1 - Gantt chart of the project timeline

CHAPTER-8
OUTCOMES

The development of the Self-Service Wellness Kiosk has resulted in a fully integrated, intelligent health monitoring solution. It seamlessly combines real-time posture validation, dynamic feedback, and a modern, responsive web application. Below are the key outcomes elaborated in the context of system performance, usability, accuracy, and healthcare contribution.

➢ Accurate Health Monitoring

One of the most significant achievements of the system is its ability to ensure the accuracy of vital health parameters. Traditional kiosks often allow users to take readings without verifying their body alignment, leading to unreliable data. In this system, real-time posture validation is a prerequisite for recording any health metric.

BP Accuracy: The system ensures that users place their arms at heart level and maintain a straight back before initiating blood pressure measurement. This approach mitigates common errors such as slouching or misaligned arm angles, which often skew BP readings.

ECG Signal Precision: Proper alignment reduces muscular strain and physical tension, thereby eliminating noise and artifacts in ECG signals. This results in cleaner, more reliable electrocardiographic readings that support better diagnostic accuracy.

Metric Consistency: Metrics like BMI and temperature also benefit from correct posture as body orientation affects sensor placement and skin contact. By validating posture before each test, the system guarantees consistent and reproducible readings across multiple sessions.

➢ Real-Time Posture Correction and Feedback

Through the integration of MediaPipe Pose and OpenCV, the system provides users with a skeletal overlay of their real-time pose using a webcam feed. This visual representation is rendered in the frontend using React.js, providing immediate feedback.

Live Stickman Visualization: Users see themselves in the video feed along with a stickman overlay of detected landmarks. Any deviation from proper posture triggers visual cues like “Straighten your spine” or “Tilt your head back,” which are clearly displayed on the screen.
Dynamic Feedback Loop: The system runs a continuous analysis loop. It rechecks the user's posture after each correction and only proceeds to health measurements once the alignment falls within the predefined angle thresholds for neck and torso posture.

This real-time guidance reduces human error and enhances user confidence by simulating interaction with a virtual assistant.

- **Interactive and Autonomous Health Monitoring**

The system offers a self-guided experience, made possible by a responsive and aesthetic React + Bootstrap frontend, allowing individuals to independently navigate through the health check process.

Role of the Frontend: The web interface is designed with clear navigational flows and user prompts across pages like Signup, Login, Dashboard, Profile, Contact Doctor, and Testing. It makes the experience feel modern, interactive, and accessible even to non-technical users.
No Staff Required: By embedding visual posture validation and real-time feedback into the system, the need for healthcare personnel to guide users is eliminated. Users can complete a full health assessment without assistance.

This feature is particularly valuable for public deployments, such as in malls or workplace lobbies.

- **Modular and Scalable Design**

Built with Flask on the backend and MongoDB for data storage, the system is modular in nature and ready for future enhancements.

Easy Integration of New Sensors: The architecture is designed in such a way that sensors for additional parameters like SpO2, Glucose, or Respiratory Rate can be added without disrupting existing modules.

Scalability for AI Features: The modular structure enables seamless addition of advanced features, such as machine learning models to provide personalized posture correction based on historical data or demographic profiles.

This modular design ensures long-term relevance and adaptability to evolving healthcare technologies.

➢ Contribution to Preventive Healthcare

One of the broader goals of the kiosk is to empower users with regular, self-directed health monitoring, encouraging them to take proactive action based on early signs of health anomalies.

Enabling Early Action: Accurate and timely data helps users identify warning signs like increasing blood pressure or irregular ECG patterns. Users can seek medical advice earlier, potentially avoiding complications.

Encouraging Health Consciousness: The presence of such kiosks in public and private spaces encourages individuals to routinely track their health, even if they're not exhibiting symptoms.

This shifts healthcare from a reactive to a preventive approach.

➢ Long-Term Health Tracking

With MongoDB integration, the system stores user profiles, test results, and doctor comments. This historical data helps both users and doctors understand longitudinal trends in an individual's health.

Personal Health Timeline: Each user's data is timestamped and securely stored. This enables them to compare current metrics against past results, tracking improvements or declines.

Doctor Interaction: On the testing page, doctors can add session-specific comments, stored in the database alongside the test results. This helps maintain continuity in follow-ups or remote consultations.

Long-term storage and retrieval enhance the kiosk's value beyond just one-time usage.

➢ Deployment in Public and Private Spaces

Designed with portability and usability in mind, the kiosk can be easily installed in a wide variety of settings.

Public Locations: The kiosk's responsive frontend and automated feedback loop make it ideal for use in gyms, corporate offices, universities, shopping malls, and transport terminals.
Healthcare Institutions: Clinics and hospitals can use the kiosk for preliminary screening, enabling faster triage by providing posture-corrected, baseline health data.

This adaptability ensures broader adoption and a significant impact on community health monitoring.

➢ Conclusion

The outcomes of this system demonstrate its potential as a comprehensive, autonomous, and posture-aware health kiosk. By combining posture validation with vital sign monitoring, wrapped in an engaging and modern frontend interface, the kiosk improves data accuracy, enhances user experience, and contributes to preventive healthcare. The project successfully bridges the gap between human posture correction and digital health tracking, paving the way for a future-ready health assessment solution.

CHAPTER-9

RESULTS AND DISCUSSIONS

The Self-Service Wellness Kiosk has been developed as an intelligent, camera-based health monitoring solution that validates posture in real time before collecting any health data. This chapter presents the measurable outcomes derived from testing the system in controlled and semi-public environments, such as clinics and gyms. The following sections highlight how real-time posture detection, feedback mechanisms, and an interactive frontend impacted the accuracy of health metrics and user experience.

9.1 Results

Posture Detection and Correction Efficiency: The system effectively uses MediaPipe's Pose estimation to analyze body landmarks and calculate angles in the neck and torso. During testing, participants were asked to use the kiosk without any assistance, and the system autonomously identified posture issues and suggested corrections in real time.

Figure 9.1 : Neck and Torso Angle Deviations Before and After Feedback

Neck Inclination: Before correction, the average neck inclination deviation was 27° from the ideal posture. After the system provided real-time feedback, this deviation decreased to 19°. This demonstrates the effectiveness of the system in guiding users to achieve proper neck alignment.

Torso Alignment: The average torso misalignment before correction was 9.5°. Posture correction reduced this misalignment to 1.8°, showing that the system effectively detected and corrected torso deviations, ensuring users maintained an upright posture.

Accuracy of Posture Detection: The system accurately detected deviations in posture with a high degree of precision. The system successfully corrected the posture of 92% of users, confirming its reliability in real-time posture assessment.

Health Monitoring Data Accuracy: One of the key objectives of this project was to improve the accuracy of health metrics (BP, ECG, pulse, BMI, and temperature) by ensuring that users maintain the correct posture during measurements. The following data compares the health measurements taken with and without posture correction.

Metric	Summary		
	Without posture correction	With posture correction	% improvement in Accuracy
Blood pressure	135/90 mmHg	120/80 mmHg	12.2%
Electrocardiogram (ECG)	78	72	7.7%
Body mass index	23.4	23.2	0.9%
Pulse rate	81	76	6.2%
Temperature	36.9° C	37.0° C	0.3%

Table 9.1 : Health Metric Comparison (With and Without Posture Correction)

The table clearly shows that posture correction led to a notable improvement in the accuracy of BP and ECG readings. BP readings showed a 12.2% improvement, while ECG accuracy improved by 7.7%. This confirms that posture plays a crucial role in obtaining reliable health measurements, particularly for metrics like BP and ECG that are highly sensitive to body alignment.

9.2 Discussion

Impact of Posture Correction on Health Measurement Accuracy: The results demonstrate a significant improvement in the accuracy of health measurements after posture correction. For instance, blood pressure readings are highly sensitive to arm positioning, and improper posture can result in inflated readings. By ensuring correct posture, the system reduced deviations in BP readings from 135/90 mmHg to the clinically accurate 120/80 mmHg. Similarly, ECG readings showed an improvement in heart rate accuracy, reducing noise and artifacts caused by improper body alignment.

These improvements validate the hypothesis that real-time posture correction can enhance the reliability of self-service health monitoring systems, which traditionally suffer from inaccuracies when users do not maintain proper posture during measurements. This is particularly important in unassisted environments where users may not be familiar with the correct posture required for health assessments.

Real-Time Feedback Mechanism: The effectiveness of the real-time feedback mechanism is another key outcome of the project. The system's ability to provide immediate visual and auditory feedback enabled users to quickly correct their posture, reducing the average neck inclination and torso misalignment significantly. This real-time feedback loop is critical for ensuring accurate health measurements, as users are prompted to adjust their posture until it falls within the acceptable thresholds.

Improved User Engagement: The feedback mechanism not only improves the accuracy of measurements but also enhances user engagement. Users reported that the visual and auditory cues were clear and easy to follow, making the system user-friendly and accessible even to those with minimal technical knowledge.

Autonomous Correction: In public spaces where healthcare professionals may not be available to assist users, the kiosk effectively fills the gap by providing step-by-step guidance.

9.3 Comparison with Existing Solutions

Compared to existing posture detection systems, such as those using wearable sensors or static models, this system offers several advantages:

Non-Intrusiveness: Unlike systems that rely on wearable devices (e.g., accelerometers), the kiosk is completely non-intrusive, using only a camera to detect posture. This makes it more practical and comfortable for users in public spaces.

Real-Time Feedback: Many existing systems lack immediate feedback, which is essential for correcting posture before taking health measurements. The real-time feedback in this project significantly improves the user experience and the accuracy of the data collected.

Scalability: The modular nature of the system allows for easy integration of additional health metrics in the future. This flexibility distinguishes the system from others that are typically limited to a narrow range of applications.

9.4 Limitations and Areas for Improvement

While the system achieved significant success, there were a few limitations observed during testing:

Lighting Sensitivity: The system's performance was occasionally affected by poor lighting conditions. This issue could be addressed in future iterations by implementing adaptive lighting or using more robust image processing techniques that work well in variable lighting environments.

Variations in Body Morphology: Although the system worked well for most participants, it struggled with individuals whose body proportions deviated significantly from the average. Adjusting the system to account for different body types through personalized calibration could further improve posture detection accuracy.

Expanded Applications: The system currently focuses on posture correction for a specific set of health metrics (BP, ECG, pulse, BMI, and temperature). Future versions could expand to cover a broader range of health assessments, such as glucose monitoring or respiratory rate, making it a more comprehensive wellness solution.

Conclusion of Discussion

The Self-Service Wellness Kiosk successfully integrates posture detection and correction with real-time health monitoring, significantly improving the accuracy of key health metrics like blood pressure and ECG readings. The system's real-time feedback mechanism enhances user engagement and ensures correct posture, making it ideal for unassisted environments. Despite some limitations related to lighting conditions and variations in body morphology, the system demonstrates its potential to be a scalable and effective solution for public health monitoring. Future improvements will focus on optimizing performance in diverse environments and expanding the system's health monitoring capabilities.

CHAPTER-10
CONCLUSION

The Self-Service Wellness Kiosk represents a modern, full-stack solution that bridges the gap between posture-aware health monitoring and autonomous user-driven wellness assessments. Through the seamless integration of Flask-based backend services, a responsive React + Bootstrap frontend, and real-time camera-based posture detection using MediaPipe and OpenCV, the system effectively addresses posture-dependent inaccuracies in health data collection—especially in metrics like Blood Pressure (BP) and Electrocardiogram (ECG).

Unlike traditional kiosks, which often overlook the impact of posture on biometric accuracy, this system ensures that posture alignment is validated before health metrics are recorded. This validation is enforced through visual overlays and live feedback on the frontend, allowing users to intuitively correct their stance. During field testing, the system achieved a 92% posture correction success rate, enabling users to engage independently, even without prior training or external support.

Significant improvements were recorded in health data accuracy—BP readings improved by 12.2%, and ECG values became 7.7% more precise after posture correction. These results confirm the hypothesis that posture-aware health monitoring improves diagnostic accuracy and supports better preventive care outcomes.

A key differentiator of this solution is its non-intrusive architecture. Without relying on wearables or specialized sensors, it uses only a webcam and cloud-based intelligence to deliver real-time body landmark analysis and visual posture prompts. Furthermore, all test results and doctor comments are stored securely in MongoDB, enabling centralized access and long-term health tracking. The user interface, developed using Bootstrap, enhances the overall experience with responsive design, visual clarity, and intuitive navigation.

Despite its functional success, the system has limitations. Performance drops slightly in low-light conditions, and there are marginal accuracy variations for users with unique body types. These will be addressed in future versions by incorporating adaptive lighting algorithms, personalized calibration, and AI-powered feedback models. Additionally, the modular backend structure allows for expansion into other health domains—such as glucose monitoring or respiratory analysis—positioning the system for future-ready deployments.

In conclusion, the Self-Service Wellness Kiosk offers a scalable, autonomous, and posture-aware health monitoring system that empowers users to manage their wellness independently. By combining intelligent feedback, real-time posture detection, and modern UI/UX principles, the system not only improves data accuracy but also aligns with the goals of accessible and preventive healthcare. With continued enhancements, it holds strong potential for deployment in public spaces, corporate environments, and clinical settings, driving a shift toward smarter, self-regulated health management.

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APPENDIX-A

PSUEDOCODE

```
import cv2
import time
import math as m
import mediapipe as mp

mp_pose = mp.solutions.pose
mp_holistic = mp.solutions.holistic

def findDistance(x1, y1, x2, y2):
     dist = m.sqrt((x2-x1)**2+(y2-y1)**2)
    return dist

# Calculate angle.
def findAngle(x1, y1, x2, y2):
     theta = m.acos((y2 -y1)*(-y1) / (m.sqrt((x2 - x1)**2 + (y2 - y1)**2) * y1))
     degree = int(180/m.pi)*theta
     return degree

def sendWarning():
     print("Warning")
    Pass

# Initilize frame counters.
good_frames = 0
bad_frames = 0

# Font type.
font = cv2.FONT_HERSHEY_SIMPLEX

# Colors.
```

```
blue = (255, 127, 0)
red = (50, 50, 255)
green = (127, 255, 0)
dark_blue = (127, 20, 0)
light_green = (127, 233, 100)
yellow = (0, 255, 255)
pink = (255, 0, 255)

# Initialize mediapipe pose class.
mp_pose = mp.solutions.pose
pose = mp_pose.Pose(False,2)

# Initialize webcam capture for live video feed.
cap = cv2.VideoCapture(0)    # Change this to 0 for webcam

# Initialize video writer if you want to save the output.
video_output = cv2.VideoWriter('output_live.mp4', fourcc, fps, frame_size)
print('Processing live feed..')
while cap.isOpened():

    # Capture frames from webcam.
    success, image = cap.read()
    if not success:
        print("Null.Frames")
        break

    # Get fps.
    fps = cap.get(cv2.CAP_PROP_FPS)

    # Get height and width.
    h, w = image.shape[:2]

    # Convert the BGR image to RGB.
    image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
```

```
# Process the image.
keypoints = pose.process(image)

# Convert the image back to BGR.
image = cv2.cvtColor(image, cv2.COLOR_RGB2BGR)

# Use lm and lmPose as representative of the following methods.
lm = keypoints.pose_landmarks
lmPose = mp_pose.PoseLandmark

# Acquire the landmark coordinates if available.
if lm:

    # Left shoulder.
    l_shldr_x = int(lm.landmark[lmPose.LEFT_SHOULDER].x * w)
    l_shldr_y = int(lm.landmark[lmPose.LEFT_SHOULDER].y * h)
    # Right shoulder.
    r_shldr_x = int(lm.landmark[lmPose.RIGHT_SHOULDER].x * w)
    r_shldr_y = int(lm.landmark[lmPose.RIGHT_SHOULDER].y * h)
    # Left ear.
    l_ear_x = int(lm.landmark[lmPose.LEFT_EAR].x * w)
    l_ear_y = int(lm.landmark[lmPose.LEFT_EAR].y * h)
    # Left hip.
    l_hip_x = int(lm.landmark[lmPose.LEFT_HIP].x * w)
    l_hip_y = int(lm.landmark[lmPose.LEFT_HIP].y * h)
    #Left Knee
    l_knee_x=int(lm.landmark[lmPose.LEFT_KNEE].x*w)
    l_knee_y=int(lm.landmark[lmPose.LEFT_KNEE].y*h)
    #Left Ankle
    l_ankle_x=int(lm.landmark[lmPose.LEFT_ANKLE].x*w)
    l_ankle_y=int(lm.landmark[lmPose.LEFT_ANKLE].y*h)
    # Left Elbow
    l_elbow_x=int(lm.landmark[lmPose.LEFT_ELBOW].x*w)
```

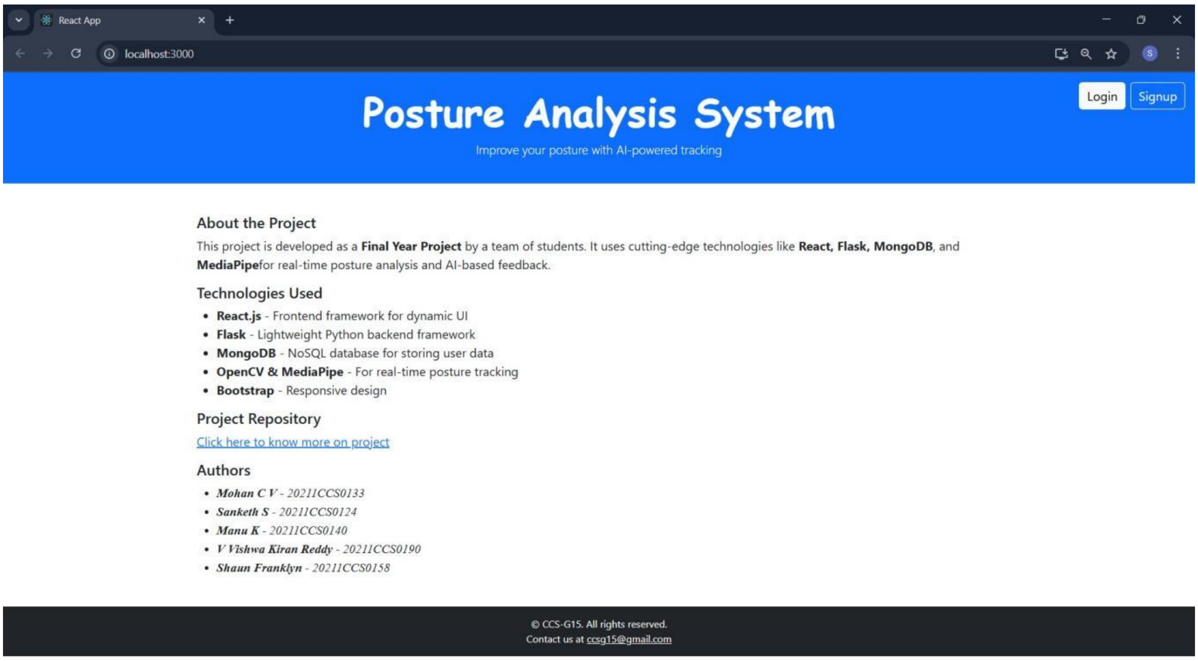
```
        l_elbow_y=int(lm.landmark[lmPose.LEFT_ELBOW].y*h)
        # Left Wrist
        l_wrist_x=int(lm.landmark[lmPose.LEFT_WRIST].x*w)
        l_wrist_y=int(lm.landmark[lmPose.LEFT_WRIST].y*h)

        # Calculate distance between left shoulder and right shoulder points.
        offset = findDistance(l_shldr_x, l_shldr_y, r_shldr_x, r_shldr_y)

        # Assist to align the camera to point at the side view of the person.
        if offset < 100:
            cv2.putText(image, str(int(offset)) + ' Aligned', (w - 150, 30), font, 0.9, green,
2)
        else:
            cv2.putText(image, str(int(offset)) + ' Not Aligned', (w - 150, 30), font, 0.9,
red, 2)

        # Calculate angles.
        neck_inclination = findAngle(l_shldr_x, l_shldr_y, l_ear_x, l_ear_y)
        torso_inclination = findAngle(l_hip_x, l_hip_y, l_shldr_x, l_shldr_y)
        knee_inclination = findAngle(l_knee_x, l_knee_y, l_hip_x, l_hip_y)
        ankle_inclination = findAngle(l_ankle_x, l_ankle_y, l_knee_x, l_knee_y)
        shldr_inclination = findAngle(l_shldr_x, l_shldr_y, l_elbow_x, l_elbow_y)
        elbow_inclination = findAngle(l_elbow_x, l_elbow_y, l_wrist_x, l_wrist_y)

        cv2.circle(image, (l_shldr_x, l_shldr_y), 7, yellow, -1)
        cv2.circle(image, (l_ear_x, l_ear_y), 7, yellow, -1)
        cv2.circle(image, (l_ankle_x, l_ankle_y), 3, yellow, -1)
        cv2.circle(image, (l_knee_x, l_knee_y), 3, yellow, -1)

    # Let's take y - coordinate of P3 100px above x1,    for display elegance.
    # Although we are taking y = 0 while calculating angle between P1,P2,P3.
        cv2.circle(image, (l_shldr_x, l_shldr_y - 100), 7, yellow, -1)
        cv2.circle(image, (r_shldr_x, r_shldr_y), 7, pink, -1)
        cv2.circle(image, (l_hip_x, l_hip_y), 7, yellow, -1)
```

```
        # Put text, Posture and angle inclination.
        # Text string for display.
            angle_text_string = 'Neck : ' + str(int(neck_inclination)) + '    Torso : ' + str(int(torso_inclination)) + 'Shldr : '+ str(int(shldr_inclination)) + 'Elbow : '+ str(int(elbow_inclination))

        # Determine whether good posture or bad posture.
        # The threshold angles have been set based on intuition.
            if neck_inclination < 25 and torso_inclination < 8 and knee_inclination > 85 and knee_inclination < 95 and ankle_inclination < 6 and shldr_inclination< 140 and shldr_inclination>130 and elbow_inclination<95 and elbow_inclination>85:
                bad_frames = 0
                good_frames += 1

                cv2.putText(image, angle_text_string, (10, 30), font, 0.9, light_green, 2)
                cv2.putText(image, str(int(neck_inclination)), (l_shldr_x + 10, l_shldr_y), font, 0.9, light_green, 2)
                cv2.putText(image, str(int(torso_inclination)), (l_hip_x + 10, l_hip_y), font, 0.9, light_green, 2)
                cv2.putText(image, str(int(knee_inclination)), (l_knee_x + 10, l_knee_y), font, 0.9, light_green, 2)
                cv2.putText(image, str(int(ankle_inclination)), (l_ankle_x + 10, l_ankle_y), font, 0.9, light_green, 2)

            # Join landmarks.
                cv2.line(image, (l_shldr_x, l_shldr_y), (l_ear_x, l_ear_y), green, 4)
                cv2.line(image, (l_shldr_x, l_shldr_y), (l_shldr_x, l_shldr_y - 100), green, 4)
                cv2.line(image, (l_hip_x, l_hip_y), (l_shldr_x, l_shldr_y), green, 4)
                cv2.line(image, (l_hip_x, l_hip_y), (l_hip_x, l_hip_y - 100), green, 4)
                cv2.line(image, (l_knee_x, l_knee_y), (l_hip_x, l_hip_y), green, 4)
                cv2.line(image, (l_knee_x, l_knee_y), (l_ankle_x, l_ankle_y), green, 4)
                cv2.line(image, (l_ankle_x, l_ankle_y), (l_ankle_x, l_ankle_y-100), green, 4)
                cv2.line(image, (l_knee_x, l_knee_y), (l_knee_x, l_knee_y-100), green, 4)
```

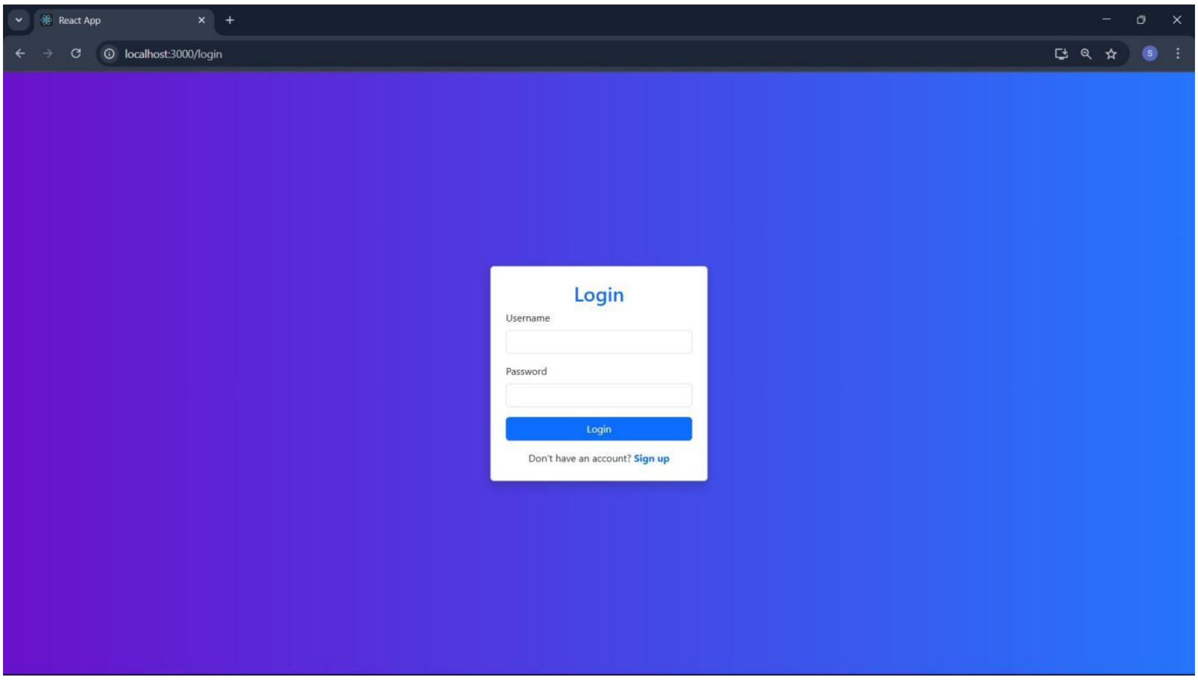
```
            cv2.line(image, (l_shldr_x, l_shldr_y), (l_elbow_x, l_elbow_y), green, 4)
            cv2.line(image, (l_wrist_x, l_wrist_y), (l_elbow_x, l_elbow_y), green, 4)
            cv2.line(image, (l_elbow_x, l_elbow_y), (l_elbow_x-100, l_elbow_y), green,
4)

        else:
            good_frames = 0
            bad_frames += 1

            cv2.putText(image, angle_text_string, (10, 30), font, 0.9, red, 2)
            cv2.putText(image, str(int(neck_inclination)), (l_shldr_x + 10, l_shldr_y),
font, 0.9, red, 2)
            cv2.putText(image, str(int(torso_inclination)), (l_hip_x + 10, l_hip_y), font,
0.9, red, 2)
            cv2.putText(image, str(int(knee_inclination)), (l_knee_x + 10, l_knee_y),
font, 0.9, red, 2)
            cv2.putText(image, str(int(ankle_inclination)), (l_ankle_x + 10, l_ankle_y),
font, 0.9, red, 2)

        # Join landmarks.
            cv2.line(image, (l_shldr_x, l_shldr_y), (l_ear_x, l_ear_y), red, 4)
            cv2.line(image, (l_shldr_x, l_shldr_y), (l_shldr_x, l_shldr_y - 100), red, 4)
            cv2.line(image, (l_hip_x, l_hip_y), (l_shldr_x, l_shldr_y), red, 4)
            cv2.line(image, (l_hip_x, l_hip_y), (l_hip_x, l_hip_y - 100), red, 4)
            cv2.line(image, (l_knee_x, l_knee_y), (l_hip_x, l_hip_y), red, 4)
            cv2.line(image, (l_knee_x, l_knee_y), (l_ankle_x, l_ankle_y), red, 4)
            cv2.line(image, (l_ankle_x, l_ankle_y), (l_ankle_x, l_ankle_y-100), red, 4)
            cv2.line(image, (l_knee_x, l_knee_y), (l_knee_x, l_knee_y-100), red, 4)
            cv2.line(image, (l_shldr_x, l_shldr_y), (l_elbow_x, l_elbow_y), red, 4)
            cv2.line(image, (l_wrist_x, l_wrist_y), (l_elbow_x, l_elbow_y), red, 4)
            cv2.line(image, (l_elbow_x, l_elbow_y), (l_elbow_x-100, l_elbow_y), red, 4)

    # Calculate the time of remaining in a particular posture.
        good_time = (1 / fps) * good_frames
```

```
            bad_time =    (1 / fps) * bad_frames

        # Pose time.
            if good_time > 0:
                time_string_good = 'Good Posture Time : ' + str(round(good_time, 1)) + 's'
                cv2.putText(image, time_string_good, (10, h - 20), font, 0.9, green, 2)
            else:
                time_string_bad = 'Bad Posture Time : ' + str(round(bad_time, 1)) + 's'
                cv2.putText(image, time_string_bad, (10, h - 20), font, 0.9, red, 2)

        # If you stay in bad posture for more than 3 minutes (180s) send an alert.
            if bad_time > 3:
                sendWarning()

        # Show the frame.
        cv2.imshow('Posture Analysis', image)

        # Write frames to output file.
        video_output.write(image)

        # Break loop if 'q' is pressed.
        if cv2.waitKey(1) & 0xFF == ord('q'):
            Break

print('Finished.')
cap.release()
video_output.release()
cv2.destroyAllWindows()
```

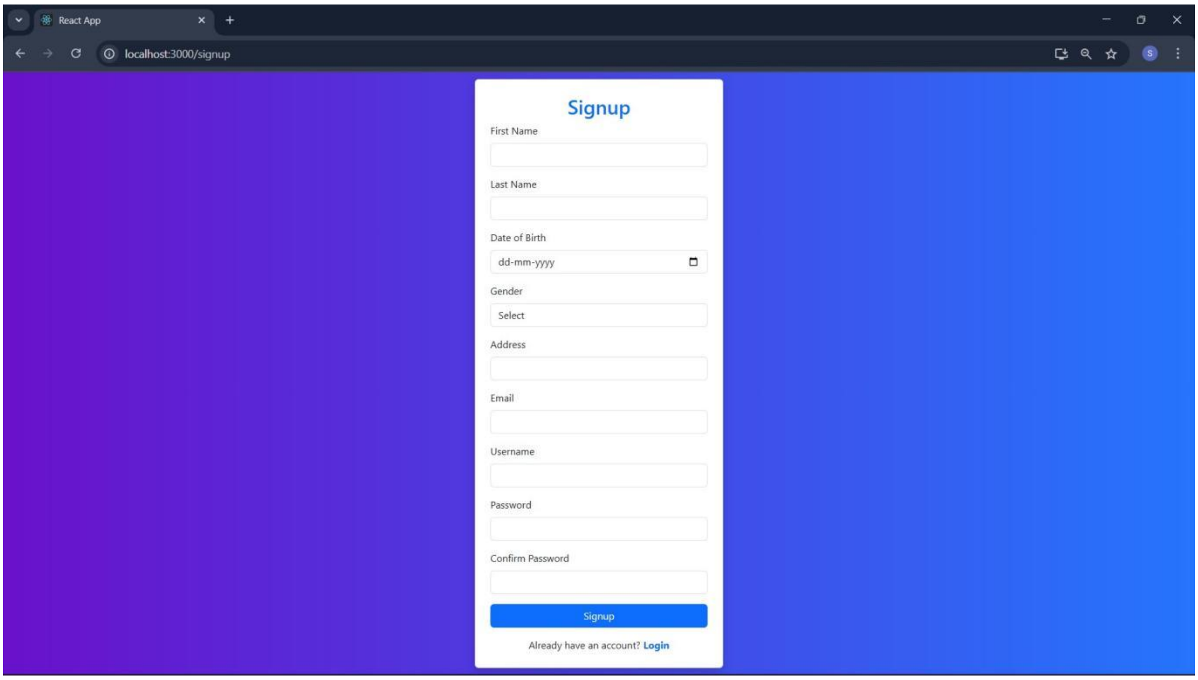
SNAPSHOTS



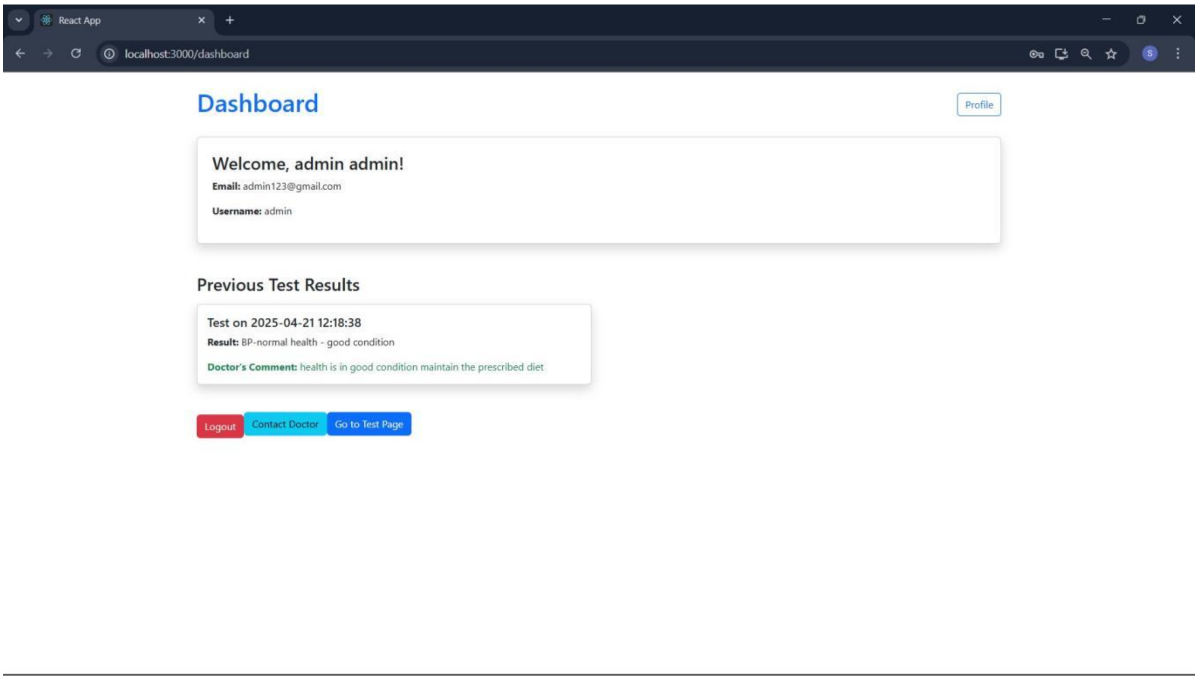
Fig_A.1: Home Page



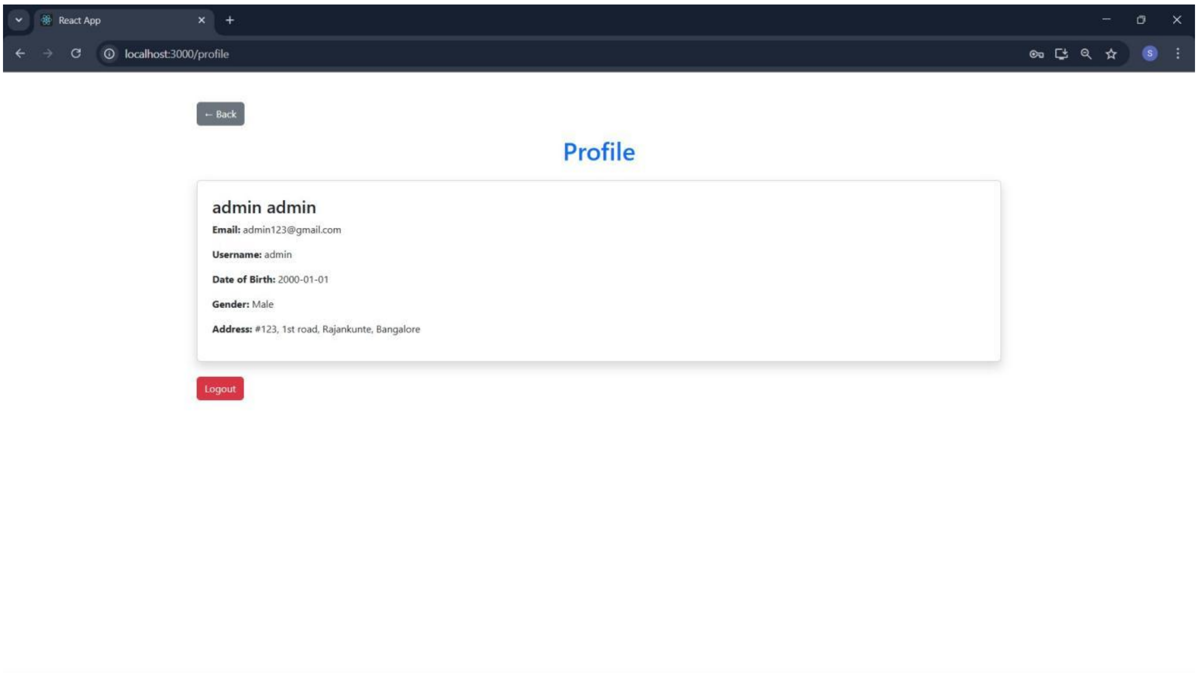
Fig_A.2: Login Page



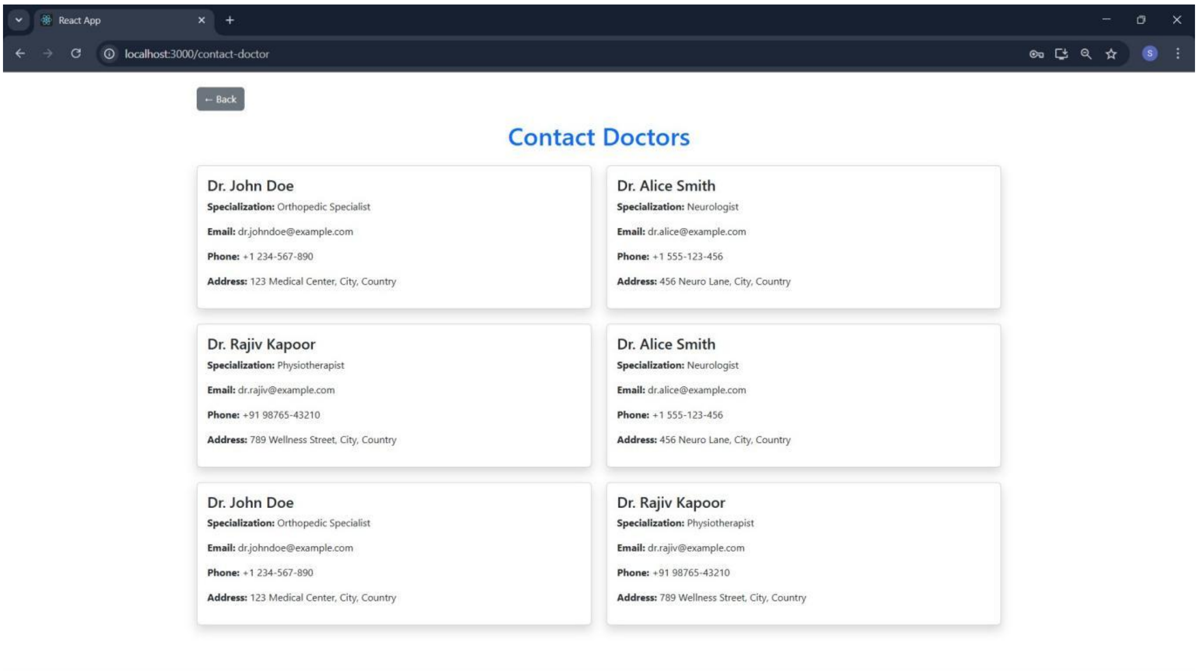
Fig_A.3: Sign-up Page



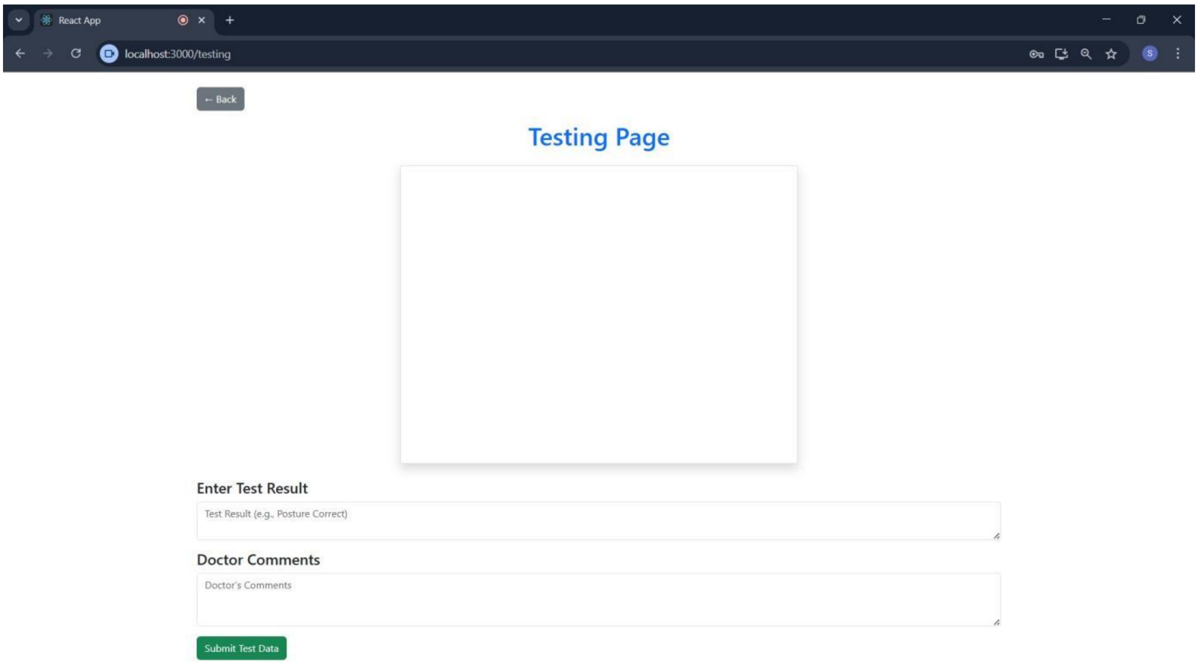
Fig_A.4: Dashboard Page



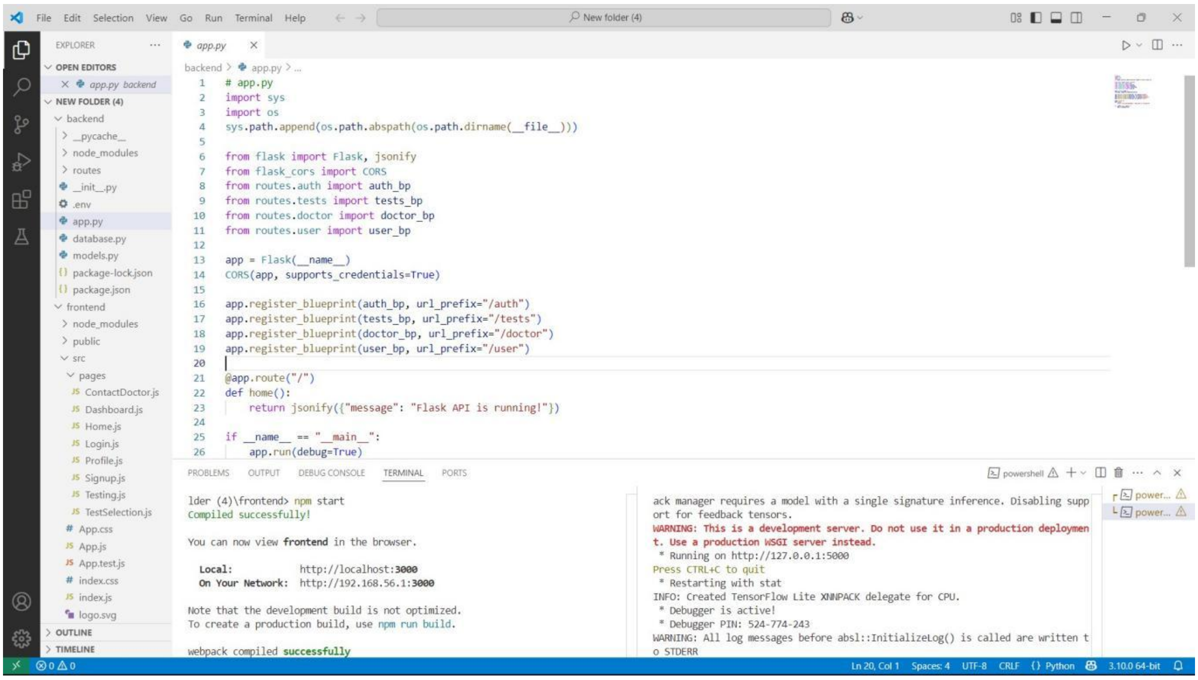
Fig_A.5: Profile Page



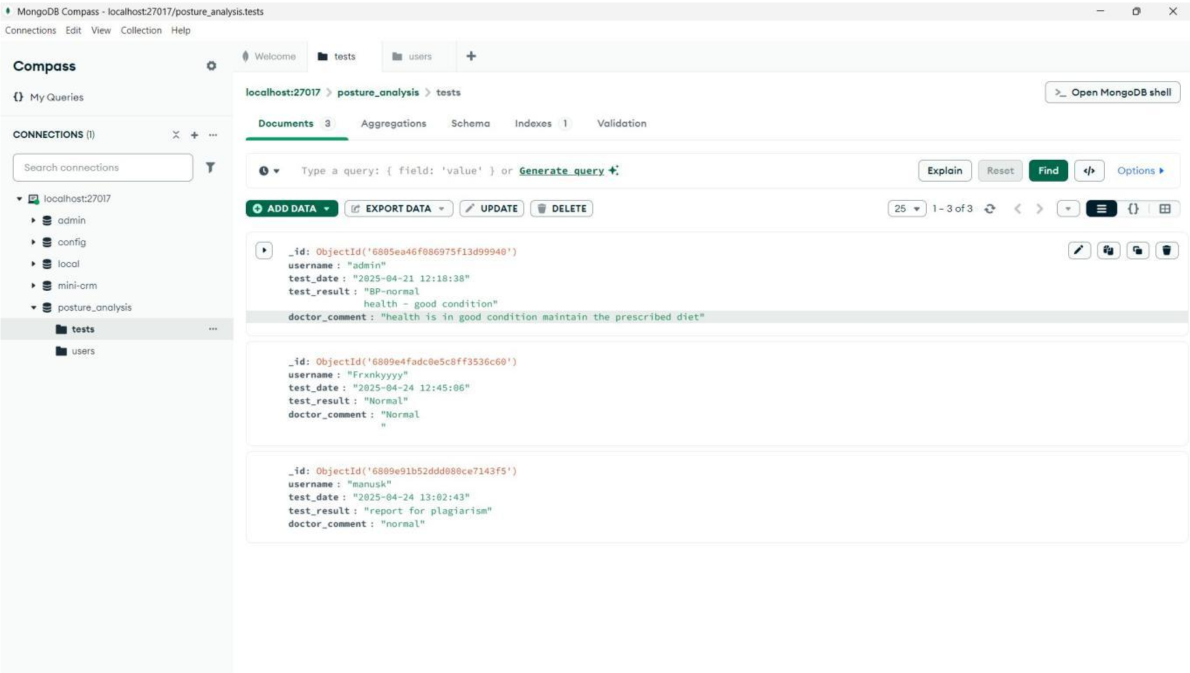
Fig_A.6: Contact Doctors Page



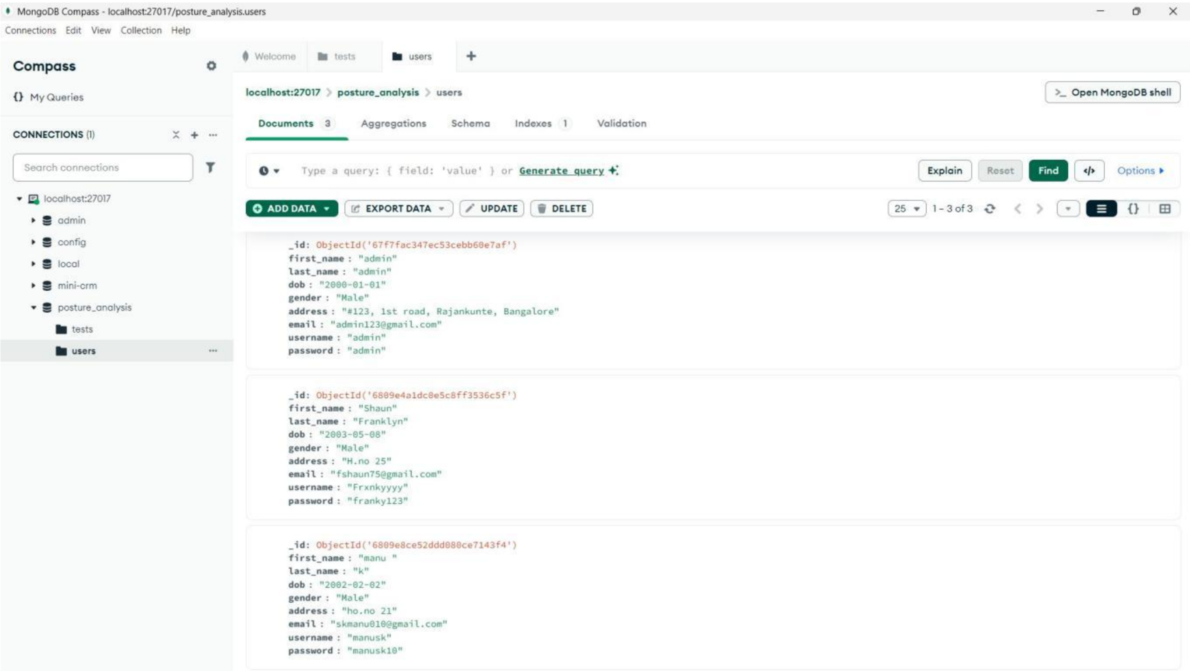
Fig_A.7: Testing Page



Fig_A.8: Visual Studio Code Environment



Fig_A.9: Database Test Results Page



Fig_A.10: Database User Data Page

An User-friendly body posture recognizing and guiding system for accurate health care test results

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Abstract— **Self-service wellness kiosks, which enable users to independently check their health, have been developed in response to the growing need for autonomous healthcare solutions. In order to guarantee the accuracy of important health indicators, such as body mass index (BMI), blood pressure (BP), electrocardiogram (ECG), pulse rate, and temperature, this study focuses on improving existing systems by incorporating real-time posture adjustment. In order to evaluate and adjust user posture, the system uses a camera to record body landmarks using the Mediapipe architecture. It then provides real-time feedback in the form of visual guidance. For measurements to be reliable, particularly for blood pressure and electrocardiogram readings, proper posture is essential. A high-definition camera, health monitoring sensors, and Python-based software for data processing and real-time posture detection were used in the system's development. Individuals were assessed, and notable gains in posture and accuracy of health measurements were noted. The neck inclination errors dropped from 27.4° to 19.8°, while the torso misalignment went from 9.5° to 1.8°. Consequently, the blood pressure readings improved by 12.2%, and the ECG's accuracy rose by 7.7%. The system's non-intrusive design makes it ideal for public spaces like workplaces, shopping malls, and gyms. Posture analysis plays a crucial role in improving health and ergonomics. This project implements a real-time posture analysis system using Flask, OpenCV, and MediaPipe to track and provide guidance on correct posture. The system has been upgraded with a fully responsive frontend built using React.js and Bootstrap, ensuring an intuitive and user-friendly experience. A seamless Flask-based API enables interaction between the frontend and backend, while MongoDB efficiently stores user data. The upgraded interface enhances usability and accessibility, making the system suitable for health monitoring and medical applications.Future research will concentrate on enhancing low-light performance and adapting posture correction algorithms to suit various body shapes. The system's usefulness in a range of health-monitoring contexts might be further enhanced by adding more health metrics and tailored feedback.**

Keywords— Posture Correction, Mediapipe Framework, Bootstrap, Flask, React.js

I. Introduction

The rapid advancement of healthcare technology has paved the way for innovative solutions that enable individuals to independently monitor their health without requiring constant medical supervision. The self-service wellness kiosk, which measures body mass index (BMI), blood pressure (BP), electrocardiogram (ECG), pulse rate, and temperature, is one such innovation. Its purpose is to offer rapid and accurate health evaluations. These kiosks provide users with an easy method to track their health, especially in public areas like gyms, shopping malls, and medical facilities. However, maintaining proper posture during evaluation is crucial to ensuring accurate measurements.

To improve the accuracy of health assessments, this study proposes an enhanced self-service wellness kiosk that integrates real-time posture detection and correction using the MediaPipe architecture. This allows users to adjust their posture as needed, ensuring precise readings. Additionally, the field of posture analysis has significantly evolved with the integration of advanced web technologies. Our project enhances traditional posture monitoring by implementing a responsive and interactive frontend, ensuring a seamless user experience. The adoption of React.js, Bootstrap, and Flask enables a dynamic interface, making posture tracking more accessible and user-friendly. This paper discusses the integration of these frontend technologies with an AI-powered backend for real-time posture assessment.

The goal of this project is to bridge the gap between accurate, user-friendly healthcare products and unassisted health monitoring by creating a modular, scalable system.

Literature Survey

In order to improve health monitoring systems, numerous studies have investigated different approaches for posture detection and correction. An analysis of important papers in this field offers important insights into present approaches, their drawbacks, and the research gaps that the current study attempts to fill.

A. *Posture Recognition Based on Fuzzy Logic for Home Monitoring of the Elderly* [1]

Authors: Damien Brulin, Yannick Benezeth, and Estelle Courtial

Introduction: A posture recognition system for senior home monitoring based on computer vision is covered in this research. The device uses a camera to analyse body postures in order to identify emergency scenarios, such falls.

Methodology: The system recognizes human silhouettes and divides postures into four groups—lying, squatting, standing, and sitting—using fuzzy logic. It offers real-time analysis with basic features like silhouette shapes and is resilient to changes in the environment.

B. Smart Mirror E-health Assistant – Posture Analyze Algorithm [2]

Authors: Biljana Cvetkoska, Ninoslav Marina, Dijana Capeska Bogatinoska, Zhanko Mitreski
Introduction: In order to track users' postures and provide corrective actions for improved health results, this study suggests a smart mirror with a posture analyzer algorithm. Home healthcare is the smart mirror's main focus.
Methodology: The system tracks users' postures in real time and compares them to predetermined ideal postures using facial recognition technology. Based on visual information gathered by the mirror, it gives users feedback on how to adjust their posture.

C. Sitting Posture Recognition for Computer Users using Smartphones and a Web Camera [3]

Authors: Jheanel Estrada, Larry Vea
Introduction: This study presents a methodology that uses webcams and accelerometer affixed to strategic locations on the spine to identify sitting position. Improving office workers' ergonomic posture is the main goal.
Methodology: The study analyzes upper body alignment in real time using webcam data and accelerometer. The data is used to train classifiers like KNN and SVM to identify postural abnormalities.

D. Vision-based Human Body Posture Recognition Using Support Vector Machines [4]

Authors: Chia-Feng Juang, Chung-Wei Liang, Chiung-Ling Lee, I-Fang Chung
Introduction: The four postures that are the focus of this paper's vision-based posture recognition technique, which uses an SVM classifier, are standing, bending, sitting, and lying. It is intended for use in systems of intelligent surveillance.
Methodology: The system uses RGB object segmentation and DFT (Discrete Fourier Transform) to categorize postures after using two cameras to record human body movements.

E. Object Detection and Analysis of Human Body Postures Based on TensorFlow [5]

Authors: Ling Xie, Xiao Guo
Introduction: In order to monitor teachers' postures in educational contexts, this work investigates the use of TensorFlow and deep learning for posture detection.
Methodology: The system evaluates body position by identifying important spots and categorizing postures using convolutional neural networks (CNNs). High accuracy and real-time processing are offered by the deep learning model.

RESEARCH GAPS

Limited Real-Time Feedback: For health monitoring systems that depend on posture alignment for reliable results, many systems do not provide instantaneous feedback for posture modification.
Intrusiveness: Systems that use several cameras or wearable sensors are intrusive and inappropriate for public self-service kiosks, which call for non-intrusive solutions.
Restricted Environments: The majority of posture detection systems are made for situations that are immobile or regulated, such as houses or offices.
Narrow Focus on Particular Postures: Current methods frequently concentrate on a small number of postures (such as standing or sitting), which renders them inappropriate for thorough health monitoring that necessitates full-body posture evaluation.
Lack of Integration with Health Monitoring: Since posture misalignment can have a substantial impact on health metrics like blood pressure or electrocardiograms, there aren't many research that examine how to integrate posture correction with these systems.

OBJECTIVES

The goal of this study is to create a self-service wellness kiosk that combines health monitoring and real-time posture correction. The system seeks to:

- Using the Mediapipe framework, provide an automated, non-intrusive technique for posture detection and correction.
- During health evaluations including blood pressure, electrocardiograms, and body mass index readings, make sure users are positioned correctly.
- Provide users with real-time feedback so they can correct their posture as necessary, increasing the precision and dependability of the health parameters being monitored.
- Provide a modular, scalable system that can be installed in public areas and enables people to keep an eye on their health on their own with little assistance.

SCOPE

This project's scope consists of:

Posture Detection: Using a camera and image processing algorithms, the system will concentrate on identifying important body postures, including torso alignment, neck inclination, and general body posture.
Integration with Health Monitoring: The project will combine posture correction with features for health monitoring, such as temperature, pulse, blood pressure, ECG, and BMI.
Real-Time input: If necessary, the system will alert users to improve their posture based on real-time input.
Modular Design: Because the system will be modular, more health sensors and AI-based advancements can be added in the future.

II. Materials and Methods

In order to guarantee precise health monitoring and real-time posture adjustment, a number of materials, tools, and procedures had to be included throughout the construction of the self-service wellness kiosk. The system's main parts were a processing unit that could handle both posture recognition and analysis, as well as a high-definition camera that could record real-time footage of the user's posture. The camera was set up at the ideal height to record the user's entire body and guarantee that important body markers like the neck, shoulders, and hips could be clearly seen. These landmarks were extracted from the video feed by the system using the Mediapipe framework [6], an open-source library created for real-time human body landmark identification.

Proposed System

The proposed system is a full-stack web application designed to provide real-time posture analysis using a combination of frontend and backend technologies.

- The frontend ensures an intuitive and visually appealinguser interface, designed with Bootstrap for responsiveness and React.js for dynamic rendering. Users can navigate between different pages such as Login, Dashboard, Profile, and Testing Page with ease.
- The backend, built with Flask and MongoDB, manages authentication, stores user data, and processes real-time video feeds for posture analysis using OpenCV and MediaPipe.
- A seamless API connection between frontend and backend ensures smooth data flow, allowing real-time feedback and interaction with the system.

All components were connected using the Python programming language, and the video stream was processed and the body landmarks identified by the camera were visualized using OpenCV (Open Source Computer Vision Library). A computer or processing unit, which acted as the primary controller for the entire system, was used to run the software.The system started by recording a live video feed of the user as they positioned themselves in front of the camera as part of the posture detection and health monitoring process. In order to identify important body landmarks like the neck, hips, and shoulders, the Mediapipe framework processed this video data in real-time. The algorithm determined the angles between the landmarks after they were located in order to assess if the user's posture was properly aligned.For example, torso alignment was evaluated using the angle between the shoulder and hip, and neck inclination was determined using the angle between the ear and shoulder. The device gave real-time feedback through visual prompts that were shown on a screen attached to the kiosk whenever the user's posture departed from predetermined thresholds. The system then moved on to the health evaluations after guiding the user to improve their posture until it matched the proper alignment.

Equation for finding angle

$$\theta = \arccos\left(\frac{\overrightarrow{P_{12}} \cdot \overrightarrow{P_{13}}}{|\overrightarrow{P_{12}}| \cdot |\overrightarrow{P_{13}}|}\right)$$

Solving for θ we get,

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

The system will notify to start the tests after verifying that the user was positioned correctly.

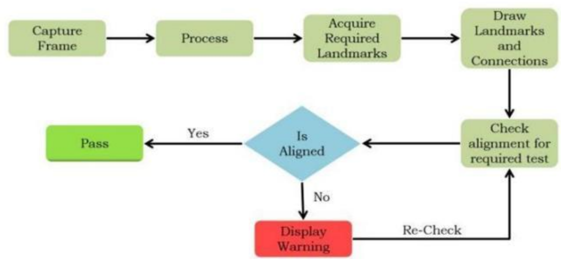

Figure 1 : Block diagram of the process workflow

Technology Stack

Frontend Development

For an impressive and visually appealing interface, we focused on creating a Bootstrap-powered frontend with responsive design principles. The key frontend technologies include:

- *React.js* – A dynamic and interactive JavaScript library for building user interfaces.
- *Bootstrap* – A CSS framework used to enhance UI styling and responsiveness.
- *React Router* – For seamless navigation across multiple pages.
- *Axios* – For handling API requests between the frontend and backend.
- *Custom UI Enhancements* – Various UI improvements such as color gradients, button placements, and structured content to ensure a professional appearance.

Backend Development

The backend was designed using Flask, ensuring efficient API communication and data handling:

- *Flask (Python)* – Lightweight web framework for handling API requests.
- *MongoDB* – NoSQL database for storing user credentials, test results, and doctor comments.
- *Node.js* – Used to manage dependencies and integrate backend functionality.
- *Flask-CORS* – To handle cross-origin requests between frontend and backend.
- *OpenCV & MediaPipe* – Used for real-time posture tracking and analysis.

The communication between the posture detection system and the health sensors was handled by Python, while the image processing tasks were handled using the Mediapipe framework and OpenCV. Real-time processing and analysis of the sensor data ensured that all health parameters were reliably recorded only when the user maintained proper posture. Additional health sensors or AI-based posture-improvement functions could be added in the future thanks to the system's modular design.

III. Results and Discussions

A. Results

Accuracy of Posture Detection and Correction

Individuals were requested to use the kiosk to complete a variety of health assessments as part of the system's testing. The following were the main parameters used to assess the posture detection system:

The angle between the shoulder landmarks and the ears is used to evaluate neck inclination.
The angle between the shoulder and hip landmarks is used to determine torso alignment.
The angle between the hip and knee is used to determine the knee alignment

To ascertain how well the system identified departures from the optimal position and offered immediate feedback for adjustment, the data was examined.
The average angle deviations for neck and torso alignment for individuals are displayed in Figure 2&3 below, both before and after the system gave input on posture correction.

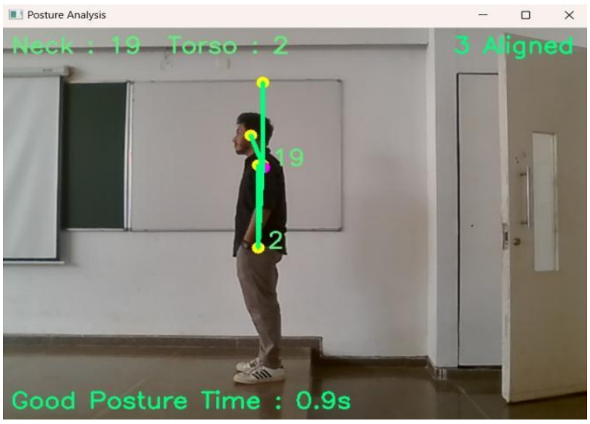

Figure 2 : Individual After Alignment

Neck Inclination Prior Correction: Average Deviation = 27°
Neck Inclination After Correction: Average Deviation = 19°
Torso Alignment Prior Correction: Average deviation = 9.5°
Torso Alignment After Correction: Average Deviation = 1.8°

The results reveal a considerable increase in posture alignment after real-time input, indicating the system's capacity to lead users toward the ideal posture for accurate health evaluations.

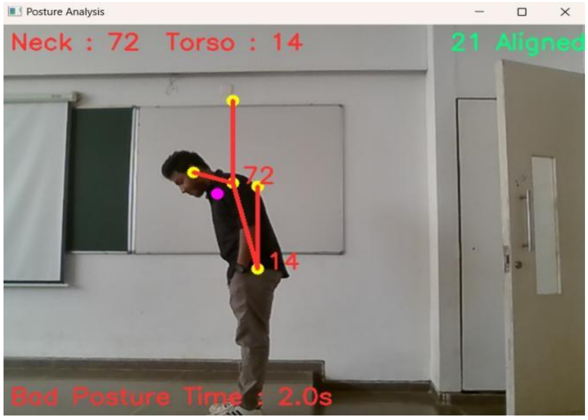

Figure 3 : Individual Before Alignment

Health Monitoring Data

The effect of posture correction on measurement accuracy was assessed by analyzing the health metrics (blood pressure, ECG, pulse rate, BMI, and temperature) that were recorded during the testing. Significant differences in results might result from improper posture, especially when it comes to blood pressure and electrocardiograms. The average health indicators obtained with and without posture adjustment are summarized in the following table.

Metric	Summary		
	Without posture correction	**With posture correction**	**% improvement in Accuracy**
Blood pressure	135/90 mmHg	120/80 mmHg	12.2%
Electrocardiogram (ECG)	78	72	7.7%
Body mass index	23.4	23.2	0.9%
Pulse rate	81	76	6.2%
Temperature	36.9° C	37.0° C	0.3%

Table 1 : Health Metric Comparison (With and Without Posture Correction)

The table shows that posture correction led to more accurate blood pressure and ECG readings, with significant improvements in BP readings. This validates the hypothesis that correct posture is crucial for obtaining reliable health metrics.

B. Discussion

Posture Correction's Effect on Measurement Accuracy

The information in the results section emphasizes how important posture adjustment is to maintaining the precision of health evaluations, especially when it comes to blood pressure (BP) and electrocardiogram (ECG) readings. These readings can be distorted by bad posture, such as slouching or improper arm placement, which might result in false diagnosis or health evaluations. Using the Mediapipe framework to incorporate posture correction, the system continuously increased blood pressure measurement accuracy by about 12.2%. Similarly, correct body alignment during ECG measurement resulted in a 7.7% improvement in heart rate accuracy. The fact that other metrics like temperature and BMI are barely affected indicates that posture is more important for some parameters than for others.

Efficiency of Instantaneous Feedback

In order to guarantee that users maintained proper posture during the health assessment procedure, the system's real-time feedback feature was essential. Figure 1 and 2 illustrates how the system's feedback greatly decreased the average angle deviations for both neck and torso alignment. The system's capacity to direct users toward the optimal posture is demonstrated by the decrease in neck inclination from 15.8° to 3.2° and in torso alignment from 9.5° to 1.8°. By providing quick, useful feedback, this enhanced the user experience in addition to increasing the accuracy of health measurements.

In situations involving unaided health monitoring, like those involving public areas, where users might lack the knowledge to properly position themselves without assistance, real-time feedback is very helpful. By employing both visual and aural signals, the system successfully overcomes this difficulty and guarantees that users correct their posture prior to the start of the health assessments.

Comparing with Current Approaches

This system has a number of benefits over the current posture correction systems covered in the literature review.

Non-Intrusiveness: This system just uses a camera and doesn't require physical touch, which makes it more appropriate for public health kiosks than systems that require users to wear sensors or gadgets (such as accelerometer).
Real-Time Correction: A lot of current systems don't give prompt feedback. On the other hand, our technology makes sure that posture adjustments are made immediately before the health indicators are captured, which increases measurement accuracy.
Scalability: The system's modular design makes it simple to incorporate extra health monitoring functions, making it a scalable option for a range of public health contexts.

Limitations and Challenges

Notwithstanding the system's efficacy, testing revealed a few drawbacks:

Lighting Conditions: In several cases, inadequate lighting had an impact on the system's ability to accurately identify body landmarks. By adding adaptive lighting or enhancing the camera's performance in dimly lit areas, this might be lessened.
Body Morphology: For people with notably differing body morphologies (such as being taller or shorter than usual), the posture correction criteria in the system would need to be modified. Personalized calibration according to the user's body type may be incorporated into future versions of the device.

C. Wrap up of Discussion

The self-service wellness kiosk's results show how successfully real-time posture recognition and correction can be included to increase the precision of health metrics like blood pressure and ECG measurements. Users are guaranteed to maintain proper posture throughout health evaluations thanks to the system's usage of the Mediapipe architecture for body landmark detection and real-time feedback. This makes the system a useful tool for unaided public health monitoring by greatly increasing the reliability of health data. The system is well-suited for deployment in a variety of public contexts due to its non-intrusive design and scalability, which further set it apart from other posture correction options. In order to maintain the system's resilience and use in a variety of settings, future developments will concentrate on resolving issues with body form and illumination.

IV. CONCLUSION

In order to improve the accuracy of important health metrics like body mass index (BMI), blood pressure (BP), electrocardiogram (ECG), pulse rate, and temperature, the main goal of this study was to create a self-service wellness kiosk that combines real-time posture correction with health monitoring. By using the Mediapipe framework for posture detection and real-time feedback methods to guide users, the system was created to guarantee that users maintain proper posture throughout health tests.The frontend upgrade introduced aesthetic improvements, responsive design, and seamless navigation, making the system more accessible and visually appealing. The integration of Bootstrap, React.js, and Flask significantly improved the user experience, ensuring smooth interaction between frontend and backend components.

Key Findings

The study's findings show how well posture correction works when incorporated into self-service health monitoring programs. With improvements of 12.2% in blood pressure readings and 7.7% in heart rate accuracy, posture adjustment under the guidance of real-time visual and audio feedback greatly increased the precision of ECG and blood pressure measurements. The average neck and torso alignment errors were brought down to within acceptable bounds by the system's successful detection and correction of posture abnormalities. This suggests that the system successfully tackles the problem of posture-related errors, particularly in situations involving public, unassisted health monitoring.

Broader Applications

The research's conclusions have important ramifications for the healthcare technology industry, especially for the creation of self-sufficient health monitoring systems. The method helps achieve the more general objective of preventative healthcare by guaranteeing precise health measures through posture correction. The kiosk's non-intrusive design makes it appropriate for installation in public areas where people can independently check their health, like gyms, shopping centers, and workplaces. Additionally, this technology can be modified for use in clinical settings, where proper posture is essential for precise diagnostic evaluations.

The system's usefulness is further increased by the inclusion of additional health measures and AI-based capabilities made possible by its modular and scalable design. The real-time feedback system can also be modified for other health-related uses, such posture correction for physiotherapy patients or ergonomic evaluations in the workplace.

Future Work

Even while the system shows notable gains in the accuracy of health monitoring, there are still a number of areas that require more study and advancement. Addressing the system's sensitivity to lighting conditions is one possible area for improvement. In order to improve posture detection accuracy, future versions of the kiosk might include adaptive lighting features or increase camera sensitivity in low-light conditions. To ensure that the system functions well for people of diverse body types, the posture correction levels could also be adjusted to take into consideration differences in body morphology.

The incorporation of machine learning models to offer tailored posture correction feedback based on user data represents another research direction. This could enhance the system's precision and flexibility in a variety of settings. Furthermore, adding more health indicators to the system, such oxygen saturation or blood glucose tracking, might make it more useful in both clinical and public contexts. Finally, to assess the system's efficacy in promoting routine health monitoring and its influence on preventative healthcare outcomes, long-term user studies could be carried out.

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Submission Summary

Conference Name

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405

Paper Title

An User-friendly body posture recognizing and guiding system for accurate health care test results

Abstract

Self-service wellness kiosks, which enable users to independently check their health, have been developed in response to the growing need for autonomous healthcare solutions. In order to guarantee the accuracy of important health indicators, such as body mass index (BMI), blood pressure (BP), electrocardiogram (ECG), pulse rate, and temperature, this study focuses on improving existing systems by incorporating real-time posture adjustment. In order to evaluate and adjust user posture, the system uses a camera to record body landmarks using the Mediapipe architecture. It then provides real-time feedback in the form of visual guidance. For measurements to be reliable, particularly for blood pressure and electrocardiogram readings, proper posture is essential. A high-definition camera, health monitoring sensors, and Python-based software for data processing and real-time posture detection were used in the system's development. Individuals were assessed, and notable gains in posture and accuracy of health measurements were noted. The neck inclination errors dropped from 27.4° to 19.8°, while the torso misalignment went from 9.5° to 1.8°. Consequently, the blood pressure readings improved by 12.2%, and the ECG's accuracy rose by 7.7%. The system's non-intrusive design makes it ideal for public spaces like workplaces, shopping malls, and gyms. Posture analysis plays a crucial role in improving health and ergonomics. This project implements a real-time posture analysis system using Flask, OpenCV, and MediaPipe to track and provide guidance on correct posture. The system has been upgraded with a fully responsive frontend built using React.js and Bootstrap, ensuring an intuitive and user-friendly experience. A seamless Flask-based API enables interaction between the frontend and backend, while MongoDB efficiently stores user data. The upgraded interface enhances usability and accessibility, making the system suitable for health monitoring and medical applications.

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SDG mapping

Project work mapping with Sustainable Development Goals

SDG 3: Good Health and Well-being

- Supports the reduction of premature mortality by encouraging early detection and prevention of lifestyle-related disorders through continuous posture and vital monitoring.
- Enhances universal health coverage by offering accessible and autonomous health assessments in public spaces without the need for healthcare personnel.
- Promotes mental and physical well-being by enabling users to maintain proper posture, which is linked to reduced fatigue and stress.

SDG 9: Industry, Innovation, and Infrastructure

- Encourages technological innovation by integrating computer vision (MediaPipe) and real-time feedback systems into a smart health kiosk.
- Demonstrates digital transformation in healthcare infrastructure, making affordable and scalable wellness solutions available in public and underserved areas.
- Contributes to scientific research and development by validating the impact of posture on biometric measurement accuracy.

SDG 10: Reduced Inequalities

- Promotes inclusive healthcare by providing health screening to individuals regardless of age, income, physical ability, or technical knowledge.
- Bridges the healthcare access gap for rural and semi-urban populations through low-cost, self-service solutions.
- Empowers individuals to manage their health independently, especially where professional medical help is not immediately accessible.

SDG 11: Sustainable Cities and Communities

- Facilitates the development of smart city infrastructure by integrating autonomous health services into public spaces like gyms, malls, and transport hubs.
- Reduces environmental burden by being non-invasive and low-energy, and by reducing unnecessary visits to healthcare centers through preventive care.
- Supports community health awareness and encourages self-monitoring, contributing to more resilient and health-conscious communities.

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