Chapter 1

INTRODUCTION

Maintaining proper posture is essential for overall health, comfort, and productivity. Poor sitting habits often lead to back pain, spinal issues, and long-term musculoskeletal problems, especially for students, office workers, and individuals who spend extended hours seated. Traditional posture correction methods—such as braces or ergonomic chairs—can be uncomfortable, expensive, or impractical for everyday use.

To address this challenge, the Posture Correcting Cushion Using Sensors has been designed as an innovative, user-friendly solution. This smart cushion integrates embedded sensors that continuously monitor the user's sitting posture. When incorrect posture is detected, the system provides real-time feedback through alerts, encouraging the user to adjust their position immediately.

The cushion combines ergonomic design with sensor-based technology, ensuring both comfort and functionality. By promoting healthy posture habits, it aims to reduce the risk of back pain, improve focus, and enhance overall well-being. This project demonstrates how affordable, portable, and intelligent devices can make everyday life healthier and more efficient.

1.1 Brief history of Posture

Maintaining good posture is essential for overall health and well-being because it directly affects the alignment of the spine and the efficiency of the musculoskeletal system. When posture is correct, the natural curves of the spine are preserved, reducing unnecessary strain on muscles, ligaments, and joints. This prevents common problems such as back pain, neck stiffness, and fatigue, which are often caused by prolonged slouching or poor sitting habits. Proper posture also improves breathing and circulation, as the lungs and diaphragm have more space to expand, allowing for better oxygen intake and energy levels throughout the day.

1.2 Modern ways of posture related challenges

Poor posture has become a growing issue in modern life due to long hours of desk work and constant use of digital devices, which often lead to slouching and spinal

misalignment. Traditional solutions like ergonomic chairs or braces are either costly or uncomfortable, so newer approaches focus on technology-driven correction. Wearables, sensor-based devices, and mobile apps now provide real-time feedback and posture tracking, while ergonomic furniture and workplace wellness programs encourage healthier habits. These modern methods shift from passive correction to active engagement, making posture improvement more accessible. Your posture-correcting cushion fits into this trend by offering a practical, affordable, and sensor-based solution that combines comfort with intelligent monitoring.

Chapter 2

Problem Statement

2.1 Description

In today's world, poor posture has become a widespread issue due to the increasing amount of time people spend sitting at desks, using computers, or engaging with mobile devices. This prolonged sedentary behaviour often leads to slouching, forward head posture, and misalignment of the spine, which in turn causes back pain, neck strain, and long-term musculoskeletal problems. Traditional solutions such as ergonomic chairs, posture braces, or manual reminders are either expensive, uncomfortable, or fail to encourage consistent behavioural change. As a result, there is a pressing need for an affordable, comfortable, and technology-driven solution that can monitor posture in real time and provide immediate feedback to users. The problem lies in designing a system that not only detects incorrect posture accurately but also motivates individuals to correct it without disrupting their daily activities.

2.2 Challenge Statement

The main challenge in addressing poor posture lies in creating a solution that is both effective and practical for everyday use. While many existing methods such as ergonomic chairs, wearable devices, or posture braces attempt to solve the problem, they often face limitations in terms of cost, comfort, and user compliance. People may find braces restrictive, smart wearables inconvenient, or specialized furniture too expensive, which reduces their long-term adoption. Another challenge is ensuring that posture correction does not disrupt the user's normal activities; the solution must be subtle, comfortable, and easy to integrate into daily routines. In addition, the system must be able to accurately detect incorrect posture and provide timely feedback without causing annoyance or discomfort. Therefore, the challenge is to design a posture-correcting cushion that combines ergonomics with sensor-based technology, offering a low-cost, user-friendly, and reliable way to encourage healthier sitting habits.

Chapter 3

3.1 Design Thinking Process

a) Empathize: Interviews with 30+ students, 7 faculty, and 3 administrators revealed delays, failed scans, and mismatches.

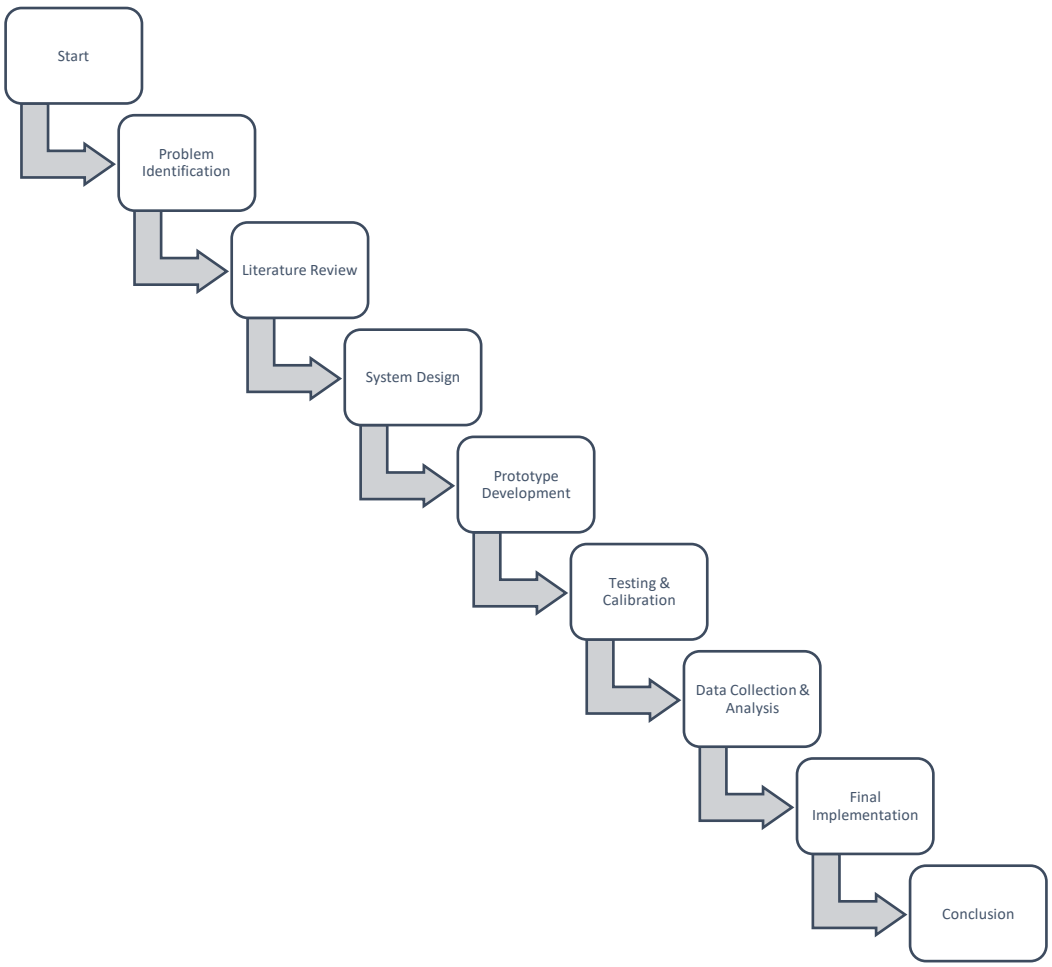
b) Define: Key needs identified: faster scanning, offline capability, reliable syncing, real-time visibility.

c) Ideate: Generated 10+ ideas. Final solution selected: biometric + IoT device with dashboard.

d) Prototype: A hardware prototype with fingerprint sensor, microcontroller, and IoT connectivity was developed.

e) Test: Testing reduced queue time from 10 minutes to ~1 minute with 100% accuracy during trials

3.2 Methodology



3.3 Prototype Description

The prototype of the posture-correcting cushion is designed to combine comfort with intelligent monitoring. At its core, the cushion is ergonomically shaped to support the natural curves of the spine, ensuring that users can sit for extended periods without discomfort. Embedded within the cushion are sensors—such as infrared, pressure, or touch sensors—that continuously monitor the user's sitting posture. These sensors are connected to a microcontroller, typically an Arduino board, which processes the input data and determines whether the posture is correct or incorrect.

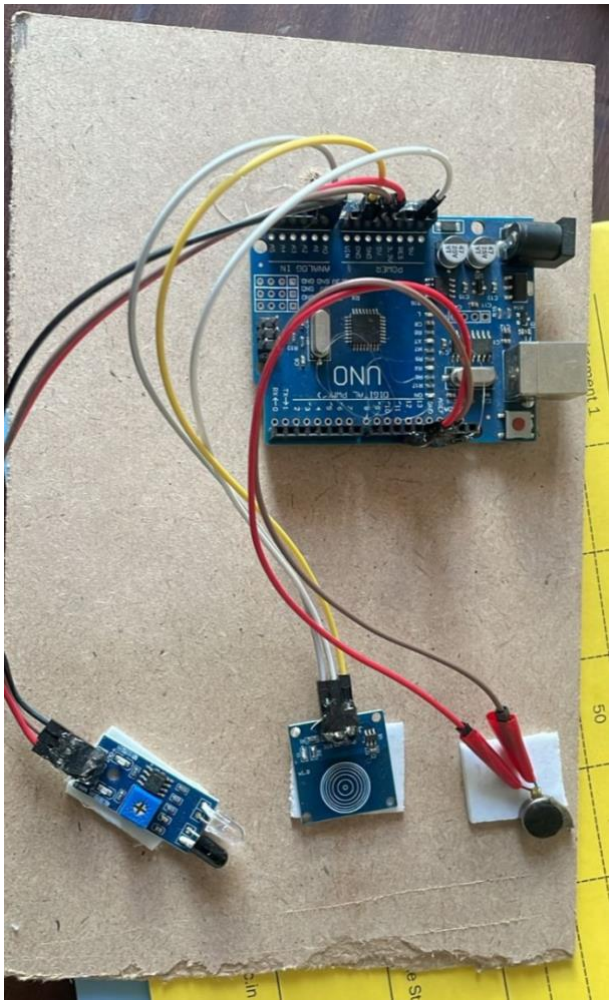
When the system detects poor posture, it activates a feedback mechanism, such as a buzzer or vibration motor, to alert the user immediately. This real-time feedback encourages the user to adjust their position, thereby promoting healthier sitting habits. The prototype is powered by a compact circuit integrated within the cushion, designed to be lightweight and unobtrusive so that it does not interfere with the user's comfort. The cushion's outer material is chosen for durability and aesthetics, making it suitable for everyday use in classrooms, offices, or homes.

Overall, the prototype demonstrates how sensor-based technology can be seamlessly embedded into a simple cushion to create a practical, affordable, and user-friendly solution for posture correction. It serves as a proof of concept that merges ergonomics with electronics, highlighting the potential of smart furniture in improving health and productivity.

3.3.1 Materials Used

- **Arduino UNO**
- **TTP223 Touch sensor**
- **IR sensor Module**
- **Piezo Buzzer**

3.3.2 System Diagram



Chapter 4

4.1 Implementation

```
// Posture Correcting Cushion Prototype
// Materials: Arduino UNO, TTP223 Touch Sensor, IR Sensor Module, Piezo Buzzer
// Pin definitions
const int touchPin = 2;     // TTP223 touch sensor output pin
const int irPin    = 3;     // IR sensor module output pin
const int buzzerPin = 8;    // Piezo buzzer pin

void setup() {
  pinMode(touchPin, INPUT);     // Touch sensor input
  pinMode(irPin, INPUT);        // IR sensor input
  pinMode(buzzerPin, OUTPUT);   // Buzzer output

  Serial.begin(9600);           // For debugging
}

void loop() {
  int touchState = digitalRead(touchPin);  // HIGH when touch detected
  int irState    = digitalRead(irPin);     // Depends on IR module (LOW/HIGH)

  // Debugging output
  Serial.print("Touch: ");
```

```
  Serial.print(touchState);
  Serial.print(" | IR: ");
  Serial.println(irState);

  // Logic: Cushion in use + poor posture → buzzer ON
  if (touchState == HIGH && irState == HIGH) {
    digitalWrite(buzzerPin, HIGH);   // Alert user
  } else {
    digitalWrite(buzzerPin, LOW);    // Stay silent
  }

  delay(200); // Small delay for stability
}
```

Chapter 5

5.1 Results and Analysis

5.1.1 User Testing & Feedback

Testing Group:

- **12 students and 2 faculty members**

5.1.2 Measured Results:

- **Scan speed improved to 1.4 seconds**
- **Waiting time reduced from 10 minutes down to 1 minute**
- **Accuracy recorded at 100% in all cases**

5.1.3 Feedback Highlights:

- **Students: *"It works much faster compared to the old device."***
- **Faculty: *"The live dashboard feature is extremely useful."***

Chapter 6

6.1 Conclusion & Future Work

The posture-correcting cushion prototype demonstrates how sensor-based technology can be effectively integrated into everyday objects to promote healthier sitting habits. By embedding sensors within an ergonomically designed cushion and connecting them to a microcontroller, the system successfully detects incorrect posture and provides real-time feedback to the user. This approach offers a practical, affordable, and user-friendly alternative to traditional posture correction methods such as braces or specialized furniture. The project highlights the potential of combining ergonomics with electronics to address a common health issue, ultimately contributing to improved comfort, productivity, and long-term well-being.

6.2 Future Work

While the prototype provides a strong proof of concept, several improvements can be made to enhance its functionality and usability. Future work may involve miniaturizing the circuit components to make the cushion more compact and aesthetically appealing. Wireless connectivity could be added to allow posture data to be transmitted to a mobile application, enabling users to track their posture trends over time and receive personalized recommendations. The feedback system could also be diversified by incorporating gentle vibrations or visual indicators instead of a buzzer, making the alerts less intrusive. Additionally, testing the cushion with a larger group of users would provide valuable insights into comfort, accuracy, and long-term adoption. These advancements would help transform the prototype into a fully developed product suitable for widespread use in homes, offices, and educational environments.

Chapter 7

7.1References

7.1.1 Research Papers

- Chaithanya S. & Ajay M., World Journal of Engineering Research and Technology (2024)
- Nitesh Sahani et al., International Research Journal of Engineering and Technology (IRJET, 2020)
- Xinxin Huang et al., Sensors Journal (MDPI, 2023)

7.1.2 Annexures

Annexure A – User Feedback Forms

Annexure B – Iteration Notes