

PROJECT ABSTRACT

Wearable Posture Monitor with Posture Analytics Dashboard

A wearable posture coach: an MPU6050 IMU on an ESP32 tracks neck pitch at 10 Hz against a calibrated upright baseline; sustained slouch triggers a silent vibration nudge, events log to flash, and evening BLE sync feeds a companion dashboard with daily posture score, event timeline, and 7-day trend. Delivered built-to-order with working wearable, firmware, dashboard app, report, PPT and viva kit.

01. Title

Wearable Posture Monitor with Posture Analytics Dashboard.

02. Introduction / Background

Desk workers slouch for hours without noticing; the reminder arrives as neck pain at day's end — far too late to change the habit. Camera-based phone apps cannot watch all day, and commercial posture wearables are expensive black boxes. The first-principles build is an inertial measurement unit worn at the upper back: the MPU6050's accelerometer and gyroscope, fused with a complementary filter, yield a drift-free pitch angle at 10 Hz on an ESP32. Crossing a slouch threshold for a sustained period triggers a private vibration nudge; logged events sync over Bluetooth Low Energy to a companion web dashboard that turns a day of posture into a score, a timeline, and a trend. Hardware corrects in the moment; the dashboard builds the habit.

03. Problem Statement

Posture feedback arrives too late (pain) or not at all (unwatched desk hours). Students need a wearable build demonstrating IMU sensor fusion, threshold-with-persistence event logic, haptic feedback, BLE data sync, and a genuine analytics frontend — with honest framing of a heuristic score versus clinical assessment.

04. Objectives

- Track neck pitch at 10 Hz with MPU6050 data fused by a complementary filter, robust to walking motion.
- Calibrate a per-wearer upright baseline with a one-button 5-second capture.
- Buzz a coin vibration motor on sustained slouch (20°/30 s) and forward-head (35°/60 s) with distinct patterns.
- Log events (time, type, duration, peak angle) to flash in a 14-day ring buffer.
- Sync over BLE to a companion dashboard: daily 0–100 score, event timeline, time upright, 7-day trend.
- Run 10–12 hours on a 500 mAh LiPo using ESP32 light-sleep between samples.

05. Proposed Methodology

Stage one implements the sensing pipeline: MPU6050 interfacing over I2C, complementary filter tuning, and bench validation of pitch against known angles. Stage two adds the event engine — dual thresholds with persistence timers, vibration patterns, per-wearer calibration — and flash

logging. Stage three builds the BLE GATT sync and the single-file dashboard (score cards, event table, canvas trend chart), then validates the full wear → nudge → sync → visualize loop across test days.

06. System Architecture / Working

After a calibration press captures the upright baseline, the filter outputs pitch at 10 Hz. Firmware compares it against the 20° slouch and 35° forward-head thresholds with 30 s / 60 s persistence timers; a confirmed breach buzzes the motor and logs the event. In the evening the dashboard's BLE sync pulls the day's events and the score engine computes 100 minus severity-weighted slouch minutes. The dashboard renders score cards, the event timeline, and the 7-day trend against the 80-point target line.

07. Hardware / Software Requirements

- ESP32 mini development board; MPU6050 IMU (I2C)
- Coin vibration motor with driver; 500 mAh LiPo with charger
- Wearable strap / 3D-printed clip enclosure
- Companion dashboard: single-file HTML/CSS/JS with canvas charts (any modern browser)
- Arduino IDE, C/C++ firmware

08. Expected Outcomes

A working wearable that nudges slouchers in real time and a dashboard that makes a week of posture visible as score, timeline, and trend. The student can explain accelerometer/gyro fusion, threshold-with-persistence design, BLE GATT sync, and low-power firmware — sensing to habit in one system.

09. Applications

- Desk workers and students: real-time posture habit training
- Physiotherapy support: objective posture logs between sessions (non-diagnostic)
- Corporate wellness programs: team-level posture challenges

10. Future Scope

- On-device TinyML classifier distinguishing sitting, standing, and walking contexts
- Phone app replacing the web dashboard with push reminders
- Lumbar-worn second node for full spine posture picture