

VitalGuard AI — Smart Attendance & Health Monitoring System

An AI-Driven Biometric Attendance and Real-Time Wellness Assessment Platform Using Facial Recognition and Vital Sign Integration

ABSTRACT

VitalGuard AI is an intelligent system for employee attendance and workplace health monitoring. It replaces manual registers and RFID cards with biometric facial recognition via Google Gemini AI, ensuring only the present employee can mark attendance. The platform also monitors health by analysing facial expressions for fatigue, stress, and mood, while collecting real-time sensor data for heart rate, body temperature, and blood oxygen levels. Each measurement is compared against medical thresholds to compute a health risk score. This enables early detection of potential health issues and supports timely intervention. The system provides a unified, browser-accessible interface for seamless attendance and wellness management.

KEYWORDS

Smart Attendance, Health Monitoring, Facial Recognition, Google Gemini AI, Geofencing, Vital Signs, SpO2, Heart Rate, Body Temperature, React, TypeScript, Vite, Anomaly Detection, Wellness Analytics, MediaDevices API, Geolocation API, Biometric Authentication, Health Risk Score.

SYNOPSIS

VitalGuard AI consolidates the full attendance and health monitoring lifecycle into a single browser-accessible platform, serving both employee self-service and administrative oversight workflows through dedicated, role-specific interface components. During each check-in event, the system simultaneously performs facial biometric identification, geofenced location validation, AI-driven wellness inference from facial expression analysis, and real-time acquisition of vital sign sensor readings for heart rate, body temperature, and blood oxygen saturation. These physiological data streams are evaluated against medically established normal ranges to compute a composite health risk score for each employee interaction, with values outside acceptable thresholds triggering automated anomaly alerts to the administrative dashboard. HR managers and safety officers access consolidated attendance records, absenteeism pattern visualisations, aggregated team wellness metrics, and longitudinal health trend charts, empowering data-driven decisions on workload adjustment, medical referral, and occupational safety compliance across the entire organisation.

TECHNOLOGIES

Frontend Framework: React with TypeScript — declarative, component-based single-page application architecture with static type safety, delivering robust and maintainable interfaces for both employee and administrator workflows.

Build Tooling: Vite — high-performance frontend build tool providing near-instantaneous development server startup and optimised, tree-shaken production bundle generation.

AI & Biometrics: Google Gemini AI via the official Generative AI SDK — performs facial recognition for biometric employee identification and simultaneously infers wellness indicators including fatigue, mood, stress, and energy levels from captured images.

Camera Access: MediaDevices API — browser-native permission-gated video capture interface enabling secure, real-time camera stream acquisition for facial recognition and wellness image analysis.

Location Validation: Geolocation API — retrieves real-time GPS coordinates and compares them against administrator-configured authorised workplace boundary polygons to enforce geofenced attendance marking.

Health Sensor Integration: Real-time vital sign acquisition module — ingests readings from connected health sensors measuring heart rate (BPM), body temperature (°C), and blood oxygen saturation (SpO2 %) and evaluates each against medically established normal thresholds.

Analytics Dashboard: React-based interactive visualisation layer — renders attendance records over configurable date ranges, health risk score aggregations, anomaly detection alerts, and longitudinal employee wellness trend charts for administrative review.

PROCEDURE

Step 1: Employee Onboarding and Baseline Setup

New employees are registered with facial biometric images via the MediaDevices API and a baseline health profile

including heart rate, body temperature, and SpO₂. These reference points serve as the standard for future check-ins and wellness monitoring.

Step 2: Check-In Data Capture

During check-in, employees grant camera and geolocation access. Live facial images and GPS coordinates are captured simultaneously, providing inputs for identity verification, health assessment, and location validation.

Step 3: AI Biometric and Health Analysis

Facial images are processed by Google Gemini AI to verify identity and assess wellness indicators such as fatigue, stress, and emotional state. Peripheral sensors measure heart rate, temperature, and SpO₂, with any deviations flagged for risk assessment.

Step 4: Risk Scoring and Geofence Validation

The system calculates a composite health risk score by combining AI wellness insights and sensor deviations, classifying it as low, moderate, or elevated. GPS coordinates are checked against authorised geofences to prevent off-site check-ins, and alerts are triggered for any anomalies.

Step 5: Feedback and Administrative Oversight

Employees receive personalised check-in summaries with attendance status, vital signs, risk tier, and AI-generated recommendations. Administrators use a dashboard to monitor attendance, health trends, geofence compliance, and flagged alerts for informed decision-making.

WHY IT IS BEST

Proxy-Resistant Biometric Verification: Facial recognition powered by Google Gemini AI ensures attendance is recorded exclusively by the physically present, biometrically verified individual, eliminating the proxy marking and card sharing vulnerabilities of all legacy mechanisms.

Proactive Health Surveillance: Real-time vital sign monitoring and AI-driven facial wellness inference detect physiological deterioration at the point of check-in, enabling early intervention before health conditions escalate into serious workplace incidents.

Unified Single-Platform Architecture: Combining attendance tracking, geofence validation, biometric identification, and health monitoring within one browser-accessible application eliminates the operational fragmentation of managing separate systems for each function.

Zero Installation Accessibility: Delivered as a browser-based web application, the platform requires no native application installation or device-specific software, ensuring immediate accessibility across any modern desktop or mobile device with a camera.

Data-Driven HR Decision Support: The administrative analytics dashboard aggregates attendance records, health risk scores, anomaly alerts, and longitudinal wellness trends into actionable visualisations that empower evidence-based HR and occupational safety management.

Extensible and Regulation-Ready Architecture: The modular React and TypeScript codebase provides a clean foundation for integrating wearable device data streams, cloud persistence, predictive AI health modelling, and occupational health compliance reporting modules.

CONCLUSION

VitalGuard AI integrates facial recognition, AI-powered wellness analysis, geolocation validation, and real-time health sensor monitoring into a single browser-based platform, replacing vulnerable manual and RFID-based attendance systems with biometrically verified, geofenced check-ins. It combines facial wellness indicators with heart rate, body temperature, and SpO₂ readings to proactively detect at-risk employees and enable early intervention. Built with React, TypeScript, Vite, and Google Gemini AI, the platform is scalable, maintainable, and validated across core attendance and health workflows. Planned enhancements include wearable device integration for continuous monitoring, cloud-hosted multi-session data persistence, predictive AI health risk models, multi-site geofencing, automated HR alert triggers, and compliance-ready reporting, establishing VitalGuard AI as a comprehensive enterprise workforce wellness and attendance solution.