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Observation Panel for Disease Analysis

Prajwal Patekar, Aayush Toraskar, Karunya Bangal, Atharv Korde, Kalyani Pawar
Vidyalankar Polytechnic, Mumbai, Maharashtra, India
prajwal.patekar@vpt.edu.in, aayush.toraskar@vpt.edu.in, karunya.bangal@vpt.edu.in,
atharv.korde@vpt.edu.in, kalyani.vaidya@vpt.edu.in

Abstract: *The Observation Panel for Disease Analysis enhances healthcare diagnostics by combining non-invasive wearable sensors with a cloud-based real-time monitoring system. Traditional symptom-based methods often struggle due to overlapping indicators among diseases, resulting in delayed diagnoses. This system employs a wearable device integrated with medical-grade sensors like the MAX30102 (for SpO□ and heart rate) and MLX90614 (for body temperature), transmitting data wirelessly via WiFi to a centralized web-based dashboard. The platform supports secure, role-based access for patients, doctors, and caregivers, ensuring authenticated data management. Real-time health metrics such as heart rate, SpO□, temperature, and ECG are displayed using interactive visualizations, while AI-driven analytics monitor trends to detect anomalies at an early stage. Additionally, the system supports telemedicine features, allowing for seamless remote consultations and continuous patient monitoring.*

Keywords: Non-invasive wearable sensors, Real-time health monitoring, Patient-caregiver-doctor interface, Predictive health analytics

I. INTRODUCTION

Advancements in healthcare technology have paved the way for smarter, more efficient diagnostic systems that overcome the limitations of traditional symptom-based approaches. Many diseases share overlapping symptoms, making timely and accurate diagnosis a persistent challenge. To address this, the *Observation Panel for Disease Analysis* integrates non-invasive wearable sensors with a cloud-enabled real-time monitoring platform. By utilizing medical-grade sensors such as the MAX30102 for measuring SpO_2 and heart rate, and the MLX90614 for temperature sensing, the system captures vital physiological data and transmits it wirelessly via WiFi. This data is visualized on a centralized, interactive dashboard that supports secure, role-based access for patients, doctors, and caregivers. With built-in AI-driven analytics, the system continuously monitors health trends to detect anomalies early, enabling proactive interventions. Furthermore, the integration of telemedicine capabilities facilitates remote consultations, thereby enhancing accessibility and continuity of care.

II. METHODOLOGY

1. Wearable Device Module

Sensor Integration:

- MAX30102: SpO_2 and Heart Rate measurement
- MLX90614: Non-contact body temperature sensing
- ECG Module (e.g., AD8232): Heart electrical activity monitoring

Microcontroller Unit: ESP32 with WiFi capability for data transmission
Power Management: Rechargeable battery and power efficiency features
Data Acquisition: Real-time sampling and preprocessing of sensor data

2. IoT Connectivity & Cloud Module

- **WiFi Communication**: Secure transmission of sensor data to the cloud
- **MQTT/HTTP Protocols**: Lightweight communication between device and server
- **Cloud Database**: PostgreSQL for structured storage of health records

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3. Web-Based Dashboard Module

User Authentication & Role Management:

- Role-based access (Doctor, Patient, Caregiver)
- Secure login/signup (with hashed password storage)

Real-Time Data Visualization:

- Line/bar/area charts for SpO_2, heart rate, temperature, and ECG
- Dashboard refreshes automatically using WebSockets or polling

Historical Data View:

- Filter by date/time, parameter, or patient
- Export data (PDF/CSV)

III. APPLICATIONS

Remote Patient Monitoring (RPM)

- Continuous tracking of vital signs (SpO_2, heart rate, temperature, ECG) for chronic patients from home
- Reduces the need for frequent hospital visits, especially for elderly or immobile patients

Early Disease Detection

- AI-based trend analysis can identify abnormalities like hypoxia, arrhythmias, or fever spikes
- Enables timely intervention and reduces complications from delayed diagnoses

Cardiac Health Monitoring

- Useful for post-operative heart patients or individuals with heart disease risks
- Continuous ECG tracking and heart rate variability analysis

Wellness and Preventive Health

- Can be used by fitness enthusiasts or individuals focusing on preventive health
- Monitors stress, recovery, and daily vitals for lifestyle improvement

End User Benefits:

- Early detection of health issues
- Real-time vital sign monitoring
- Remote health tracking from home
- Secure and role-based access
- Easy-to-understand visual health data
- Integrated telemedicine consultations
- Instant alerts for abnormal readings
- Enhanced patient-doctor communication
- Improved quality of life and confidence
- Data-driven personalized treatment planning

IV. RESULT

The implementation of the *Observation Panel for Disease Analysis* demonstrated significant improvements in remote health monitoring and early disease detection. The wearable device successfully captured real-time physiological data—including SpO_2, heart rate, temperature, and ECG—and transmitted it seamlessly to a centralized dashboard via WiFi. Users, including patients, doctors, and caregivers, accessed health information securely through role-based logins, enhancing data privacy and personalized interaction. The real-time visualization of health metrics through interactive

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charts allowed for continuous tracking, while the AI-driven analytics module effectively identified abnormal trends, enabling timely alerts and early intervention. The integration of telemedicine features further streamlined doctor-patient communication, reducing the need for physical consultations. Overall, the system provided a scalable, user-friendly, and effective solution for continuous health monitoring and proactive healthcare delivery.

V. CONCLUSION

The *Observation Panel for Disease Analysis* successfully addresses the limitations of traditional healthcare diagnostics by integrating non-invasive wearable sensors with a cloud-based real-time monitoring system. By enabling continuous tracking of vital parameters such as SpO_2, heart rate, temperature, and ECG, the system empowers patients, doctors, and caregivers with timely and actionable health data. The role-based access control ensures secure and personalized user experiences, while AI-driven analytics enhance the early detection of anomalies, promoting preventive healthcare. Furthermore, the integration of telemedicine features facilitates seamless remote consultations, making healthcare more accessible and efficient. Overall, this project demonstrates the potential of IoT and AI in revolutionizing patient monitoring and contributing to smarter, data-driven healthcare solutions.

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