Smart Health Monitoring Chair: An IoT-Based Multi-Sensor System for Passive Vital Sign Monitoring

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Purpose Older adults often face barriers to continuous health monitoring, particularly when conventional systems rely on wearables, frequent user interaction, or clinical supervision [1]. This project aims to design a passive, chair-embedded monitoring system capable of tracking multiple vital signs, including heart rate, SpO_2, and the chair's surface temperature, without requiring the user to wear sensors or modify their daily routines. The purpose of this work is to develop an inexpensive, unobtrusive IoT solution that supports aging in place, facilitates early detection of health anomalies, and enhances remote caregiver awareness. **Method** A prototype health-monitoring chair was constructed by integrating two low-cost biosensors into the armrest and backrest of a chair, using a MAX30100 sensor for heart rate and SpO_2 measurement, and a DS18B20 temperature sensor to measure the chair's surface temperature at points of physical contact, providing an approximation rather than true skin temperature. Sensor data was processed through two Arduino microcontrollers, which performed filtering and preliminary validation before transmitting readings via Wi-Fi to an interactive dashboard. The system displayed real-time values locally on a mounted LCD and remotely through time-series charts, gauges, and alert notifications. To examine feasibility and usability, a pilot evaluation was conducted in which adult and older-adult volunteers were seated naturally while measurements were collected across multiple seating postures. Heart rate and SpO_2 readings obtained from the chair were compared with values from a consumer-grade wearable device (Apple Watch) to assess signal stability and approximate agreement. **Results and Discussion** The Smart Health Monitoring Chair successfully collected continuous multi-sensor data and transmitted it with minimal latency to both a cloud dashboard and a local LCD (Figure 1). Heart rate and SpO_2 readings demonstrated acceptable agreement with reference devices, typically within a ±5% margin, consistent with expectations for low-cost optical sensors. Temperature readings remained stable when consistent contact with the chair's surface was maintained. Participants reported that the chair required no additional effort or technical familiarity during use. The findings indicate that the proposed chair-based monitoring system is suitable for older adults who may face cognitive, physical, or technological barriers to wearable-based health monitoring. The system's passive nature suggests strong potential for use in homes, community centers, and assisted living facilities. While the prototype is not intended for clinical diagnosis, its multi-sensor fusion and remote monitoring features provide valuable early-warning insights and opportunities for preventive care, aligning with global digital health priorities [2]. Future iterations will incorporate adaptive filtering, posture awareness, and expanded testing with older adult populations to support long-term health monitoring.

References

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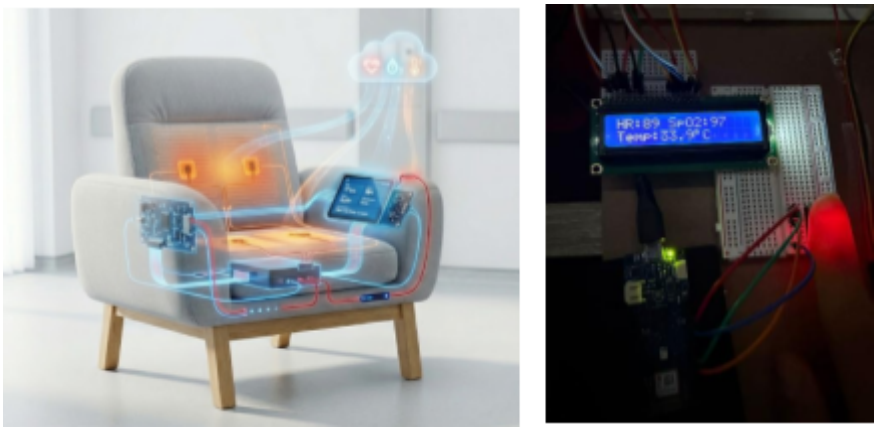

Figure 1. Smart Health Monitoring Chair prototype: (Left) conceptual rendering of the chair-embedded sensing design; (Right) hardware prototype showing embedded sensors and real-time vital sign display on an LCD.