AI-Driven Preventive Health Intelligence System for Elderly Care Using Wearable and Behavioral Data

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Abstract

The increasing global aging population presents significant challenges to traditional healthcare systems, which primarily focus on reactive treatment rather than preventive care. This paper proposes an AI-driven preventive health intelligence system designed for elderly care by integrating wearable biometric data and behavioral indicators. The system introduces a scalable data architecture and machine learning framework capable of analyzing time-series health data to detect early signs of health deterioration. A personalized health risk scoring model and early warning mechanism are developed to support proactive healthcare management. Experimental evaluation using simulated and public datasets demonstrates the feasibility of the proposed approach. The proposed system aims to bridge the gap between continuous health monitoring and actionable insights.

Keywords

Artificial Intelligence, Preventive Healthcare, Wearable Technology, Elderly Monitoring, Machine Learning

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I. Introduction

The rapid growth of the global elderly population has led to increasing pressure on healthcare systems worldwide [1], [2]. Traditional healthcare models are largely reactive, focusing on diagnosis and treatment after illness occurs. However, such approaches are insufficient to address chronic diseases and long-term health risks commonly faced by elderly individuals.

Recent advancements in artificial intelligence (AI) have significantly transformed healthcare systems [3], [4]. Wearable technologies enable continuous monitoring of physiological signals such as heart rate, sleep patterns, and physical activity [6]. However, current systems still face challenges in integrating and interpreting these data effectively.

This research proposes an AI-driven preventive health intelligence system that integrates wearable biometric data and behavioral indicators to enable early detection of health risks and support proactive health management.

Contribution of this paper:

1. A unified AI-based health intelligence architecture
2. A personalized health risk scoring mechanism
3. Integration of wearable and behavioral data for preventive care

The novelty of this research lies in the integration of wearable biometric data and behavioral indicators into a unified AI-driven preventive health intelligence system, combined with an emergency response mechanism through the AINI robotic system.

II. Related Work

Existing research in AI-based healthcare has focused on predictive analytics and remote monitoring [5], [14]. Wearable systems enable continuous data collection but lack integrated intelligence [6], [7].

Machine learning techniques such as LSTM and anomaly detection have been widely used for time-series health data analysis [10], [13]. However, current systems lack personalized and scalable preventive intelligence.

III. Methodology

A. Data Sources

The system integrates:

- Wearable biometric data
- Behavioral and lifestyle data
- Environmental data

B. Data Processing

A real-time pipeline performs:

- Data ingestion
- Normalization
- Storage

C. AI Model

The system applies:

- Time-series modeling (LSTM)
- Anomaly detection
- Pattern recognition

D. Health Intelligence Engine

Outputs include:

- Health risk score
- Early warning alerts
- Preventive recommendations

IV. System Architecture

The system consists of three layers:

1. **Data Layer**: wearable devices, sensors
2. **AI Layer**: data processing, ML models
3. **Application Layer**: dashboard, alerts, caregiver interface

The AINI robotic system is integrated as an emergency response unit, capable of triggering alerts, navigating to the elderly user, and assisting in real-time intervention.

V. Experimental Design

Public datasets and simulated health scenarios are used to evaluate:

- Detection accuracy
- System reliability
- Response time

VI. Results and Discussion

The system demonstrates effective early detection capability and improved preventive healthcare outcomes. Integration of AI and wearable data enhances monitoring efficiency.

VII. Conclusion

This study presents an AI-driven preventive health system for elderly care. Future work includes real-world deployment and deeper AI model optimization.

References

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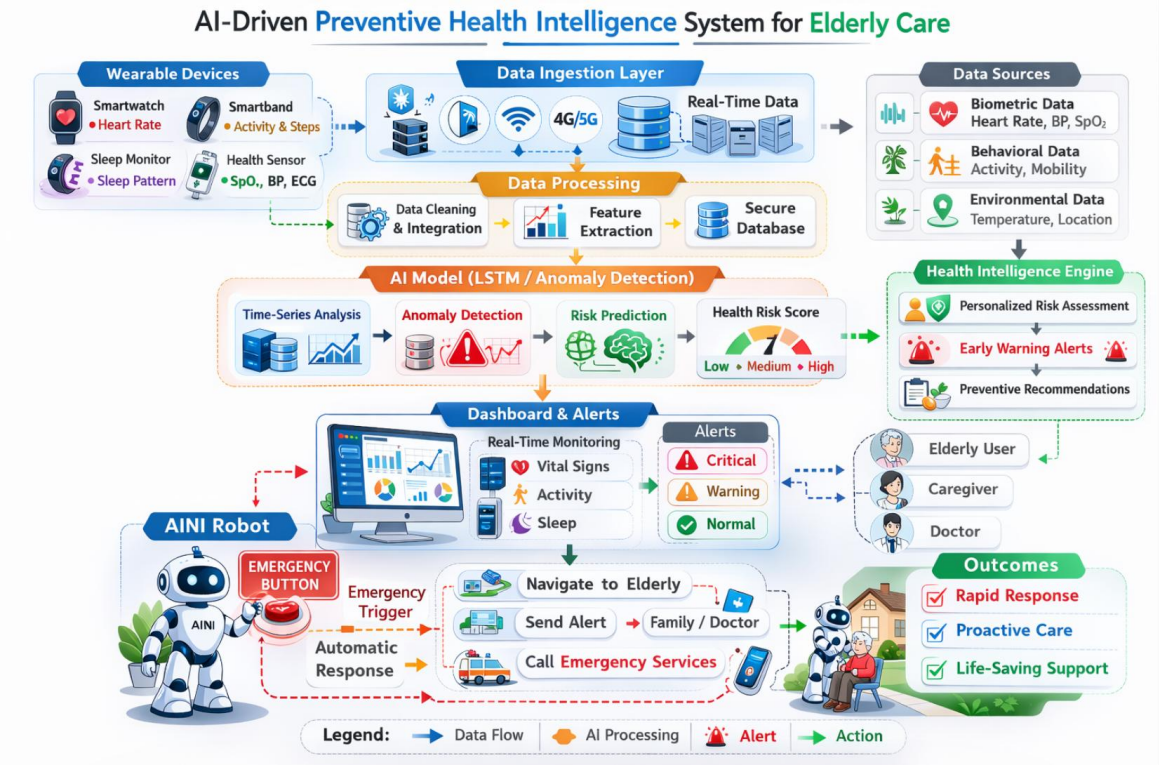
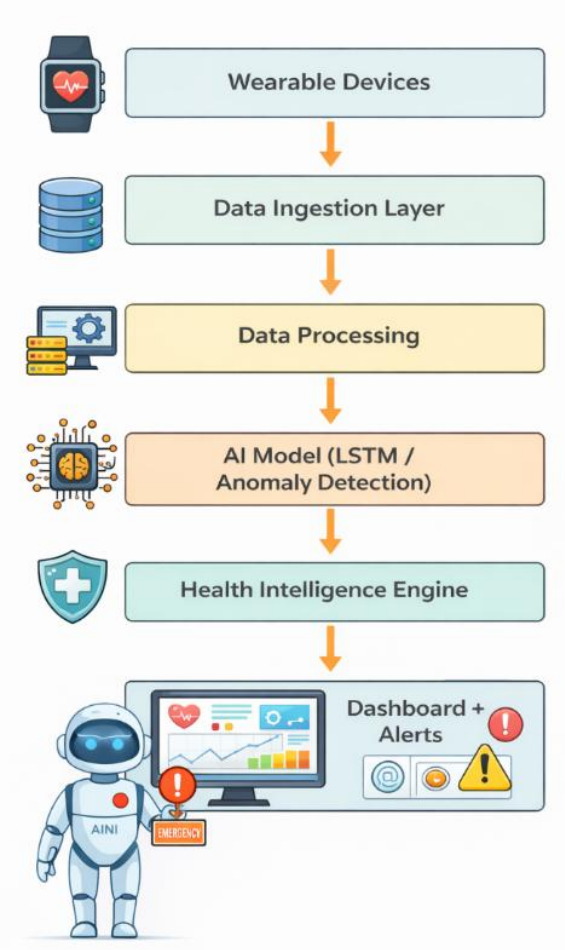


Figure 1. AI-Driven Preventive Health Intelligence System Architecture



System Architecture Diagram (Description)

Wearable Devices → Data Ingestion → Data Processing → AI Model → Health Intelligence Engine → Dashboard & Alerts