Global Summit on Sensors and Sensing Technologies
04-06 August 2025, Frankfurt, Germany

Wearable Sensors and Sensor Fusion for Healthcare Applications

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Abstract

The increasing prevalence of chronic diseases—such as dementia, diabetes, and hypertension—amid an ageing global population, along with the rising demand for personalised healthcare, has accelerated the development of everyday wearable sensor technologies. These devices, equipped with accelerometers, gyroscopes, and magnetometers, capture real-time data on physiological parameters (including cardiovascular conditions, body temperature, blood pressure, metabolic states, oxygen saturation, posture, and gait) as well as biochemical markers (such as biomarkers found in body fluids). Combined with sensor fusion techniques, wearable sensors provide comprehensive insights into an individual's health status, facilitating early disease diagnosis and prompt detection of health anomalies. This, in turn, enables more effective patient management and personalised healthcare interventions, ultimately improving quality of life. Sensor fusion—the integration of data from multiple sensor modalities—compensates for the limitations of individual sensors, paving the way for better-informed, personalised decisions and enhanced patient outcomes.

This research examines recent advancements in wearable sensor technology, including integrating sensor fusion algorithms enhanced with Artificial Intelligence (AI) and predictive analytics, as well as improvements in communication and energy efficiency, data privacy and security, human-centric design, and user-friendliness. It also assesses their transformative impact on healthcare applications by enabling timely personalised health assessments and early detection of health anomalies.

Index Terms— Artificial Intelligence; sensor fusion; wearable sensors; healthcare, diagnosis, health monitoring

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