IoT-based real-time monitoring in healthcare and analytics

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Research Background

- Healthcare faces challenges in timely and comprehensive patient monitoring due to reliance on manual methods and limited access to continuous data streams.
- The integration of IoT devices in healthcare enables real-time monitoring, fostering proactive interventions and personalized care while big data analytics provides actionable insights for optimizing healthcare delivery.
- Therefore, there is a continuous need to explore the integration, challenges, opportunities, and implications of IoT-based real-time monitoring systems and big data analytics in healthcare settings.

Fig. 1: Wearable sensors

Methodology

Search Strategy:

- Keywords: "IoT healthcare monitoring," "real-time healthcare analytics," "IoT-based patient monitoring," "big data healthcare," "end-to-end."
- Databases: Google Scholar, IEEE Xplore, Elsevier, Springer.
- Time Frame: Limited to papers published between 2019 and 2024 to ensure state-of-the-art relevance.

Paper Selection Criteria:

- Relevance: Papers focuses on IoT-based real-time monitoring and big data analytics in healthcare.
- Recency: Limited to papers published between 2019 and 2024.
- Quality: Preference given to peer-reviewed journals and conference proceedings.

Filtering Techniques:

- Inclusion Criteria: Papers addressing IoT-based real-time monitoring, big data analytics, and their applications in healthcare.
- Exclusion Criteria: Papers not directly related to the topic or published before 2019.

Review Process:

- Initial Search: Identified relevant papers using search keywords in selected databases.
- Screening: Evaluated titles and abstracts for relevance and recency.
- Full-text Assessment: Read full texts of selected papers to ensure alignment with research focus and quality standards.

Final Paper Selection:

- Five state-of-the-art research papers meeting all selection criteria were chosen for detailed analysis and inclusion in the literature review.

References

1. Singh et al. 2022
2. Kadir et al. 2022
3. Faruk et al. 2022
4. Chakraborty et al. 2023
5. Syed et al. 2019

Literature Review

- The first paper titled “IoT enabled hybrid model with learning ability for E-Health care systems” [1] outlines a study on IoT-driven E-Health technology to minimize hospital visits through remote patient monitoring during epidemics by utilizing IoT protocols and AI to optimize diagnosis through neural networks enabling autonomous illness recognition for patients and remote disease detection for clinicians.
- In the second paper, an IoT health monitoring system was designed for the elderly population [2]. It enables real-time data visualization and immediate fall detection alerts by featuring vital sign sensors and fall detection capabilities.
- In [3], the paper introduces a novel framework for monitoring human hygiene using vibration sensors and ML techniques which could aid healthcare professionals in proactive outbreak control.
- Another paper published to Elsevier in the journal of “Internet of Things” [4], outlines the development of an IoT-based remote health monitoring system for asthma patients, integrating various sensors and platforms for real-time feedback and data analysis.
- In [5], the paper on “Smart healthcare framework for ambient assisted living using IoMT and big data analytic techniques” presents a novel smart healthcare framework for ambient assisted living, utilizing IoMT and ML algorithms to monitor elderly individuals’ physical activities, achieving a high prediction accuracy of 97% and offering a promising solution for remote health monitoring.

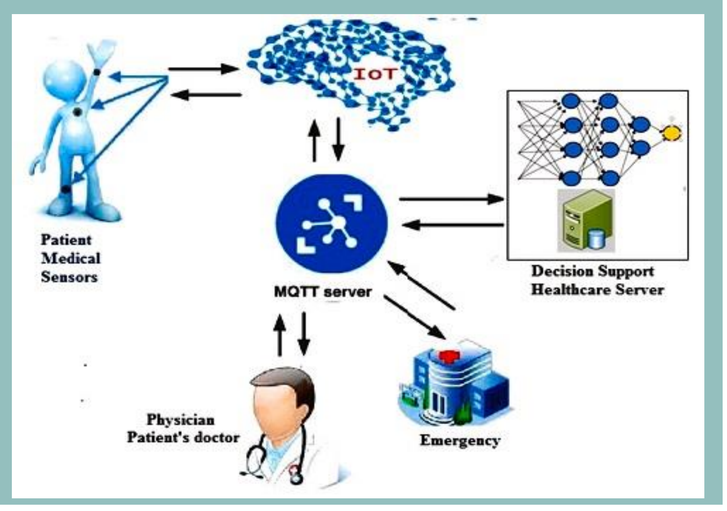

Fig. 2: IoT-based decision assistance for healthcare

Results

The papers reviewed showcase advancements in remote health monitoring including asthma patients, elderly care, ambient assisted living (AAL) and so on. While each study demonstrates promising outcomes in sensor integration, data analytics, and visualization, critical analysis uncovers shared limitations, including the need for validation studies, data security concerns, and challenges in real-world deployment. These insights underscore the importance of addressing interoperability issues, enhancing system robustness, and ensuring user acceptance for the practical implementation of IoT-driven healthcare solutions. Further research is warranted to bridge these gaps and maximize the effectiveness of these technologies in improving outcomes and healthcare delivery.

Table 1: Precision and recall for different physical activity

Physical activity	Precision %	Recall %
Climbing Stairs	97.3	98.4
Cycling	95.6	95.9
Frontal Elevation of Arms	98.9	98.6
Jogging	93.3	95.5
Jump Front & Back	84.9	94.8
Lying down	96.5	100
Running	94.2	92.9
Sitting & Relaxing	99.9	97.2
Standing	100	97.6
Waist bends Forward	99.3	97.9
Walking	98.5	98
Knees bending	98.2	97.2

Conclusion

The literature review highlights the transformative potential of the Medical Internet of Things (IoMT) and big data analytics in revolutionizing healthcare delivery through real-time monitoring. The integration of wearable sensors with IoMT offers unprecedented opportunities for smarter healthcare services, facilitating proactive intervention and personalized patient care.

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