

AI-Driven IOT System for Diabetes Monitoring: A Systemic Review of Intelligent Multi-Parameter Health Monitoring Approaches

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Received Date: April 01, 2026 **Accepted Date:** April 16, 2026 **Published Date:** April 20, 2026

Citation: Syed Asif Ali, Bisma Ali, Bhawana Dhera (2026) AI-Driven IOT System for Diabetes Monitoring: A Systemic Review of Intelligent Multi-Parameter Health Monitoring Approaches, J Artif Intel Sost Comp Tech 3: 1-8

Abstract

Diabetes Mellitus (DM) has become a global health epidemic, with over 700 million people living with DM projected by 2045. Currently available DM monitoring practices are limited to one DM biomarker at a time and offer no solutions for elder and marginalized users in developing countries, where infrastructure is lacking. This review examined 26 peer-reviewed articles between 2022 and 2026, retrieved from IEEE, Springer, Scopus, and PubMed, to analyze current AI-based and IoT-enabled DM monitoring tools, for home or community level implementation. Articles were selected based on abstract review, year of publication, technical merits and suitability for home/community use. Found systems demonstrated robust algorithmic accuracy of 82% to 99.8%. However, all systems utilized expensive wearable hardware, utilized always-on cloud infrastructure or digital literacy, or available digital voice support. It was concluded that no system, to date, combines multi-sensor monitoring, offline capabilities, and localized voice support. These evidence supported the design of a low-cost, kiosk-based, intelligent multi-level home health monitor (HHM) platform with a hybrid AI pipeline and Urdu voice interface.

Keywords: Artificial Intelligence; Diabetes Monitoring; Machine Learning; Internet of Things; Remote Healthcare

Introduction

Diabetes Mellitus is a rapidly increasing chronic disease on a worldwide scale. The numbers projected by the International Diabetes Federation suggests there may well be as many as 700 million worldwide by the year 2045, which places a significant demand on healthcare delivery particularly in low and middle income countries. Diabetic management often involves the correlating measurement of many parameters such as blood glucose, blood pressure and weight. Standard monitoring systems only tend to measure one of these factors at a time.

The post-IoT and machine learning era has seen the emergence of novel health monitoring solutions that can provide multi-parameter data in real time coupled with intelligent aggregation and analysis. Nevertheless, most of these systems of solutions still operate only in well-resourced clinical or urban settings and remain inherently less accessible to the neglected and often neglected elderly, semi-literate or poor segments of the world's population that tend to carry a disproportionate share of the world's diabetes burden, especially, in South Asia.

AIMS of this survey are [1] to explore the literature on AI and IoT-based diabetes monitoring systems published between 2022-2026, [2] to assess the methodological approaches including machine learning, deep learning, hybrid model, etc., [3] to find out some remaining shortfalls in terms of accessibility, cost-effectiveness and usability, and [4] to recommend a suitable design for the proposed Intelligent Multi-Level HHM system, [5]. The paper is like structure: Section 2 elicits the methodology, Section 3 examine the thematic survey, Section 4 exhibit the comparison, Section 5 addresses the challenges, Section 6 states the future scope, and Section 7 concludes.

Literature Review Methodology

This research adopts a systematic narrative review process, with the aggregation of findings from 26 journal articles from 2022 – 2026. The process was defined by the parameters of:

Type of Review: A systematic narrative review, with systematic selection criteria and narrative synthesis

methods (enabling thematic grouping of studies and qualitative comparison) for heterogeneous study designs.

Data Sources Searching was conducted on academic databases such as: IEEE Xplore, and Springer Link, alongside a specialist search engine (Scopus, PubMed and Google Scholar). Journal papers and conference proceedings were the primary source of information from the selected date range.

Search Strategy: The key search words were as follows: “diabetes monitoring IoT”, “machine learning diabetes prediction”, “wearable glucose monitoring”, “remote health monitoring system”, “multi-sensor diabetes detection”, “AI chronic disease management”, “home health monitoring diabetes”.

Inclusion Criteria: Publication had to be on (i) the usage of AI or IoT-based approaches for monitoring prediction of diabetes; (ii) found within the time period of 2022-2026; (iii) come with quantitative measures of performance and/or systematic evaluation; (iv) written English.

Exclusion Criteria Three articles were excluded for one of the following reasons (i) indicated only pharmaceutical or surgical treatment; (ii) were not detailed enough for analysis; or (iii) were theoretical models.

Thematic Discussion / Review of Literature

Traditional Approaches: Single-Sensor and Dataset-Based Methods

For the earliest work in this domain before the effect of climate change, autonomous detection relied on benchmark datasets, and single-modality methods. Specifically, [6] compared machine learning algorithms and validated with Real World statistical accuracy (82.26%) on clinical data – a stepping stone baseline without hardware in real-world deployment. Similarly, [7] tested various algorithms (Logistic Regression, Naïve Bayes and K-Nearest Neighbor) on the Pima Indian Diabetes Dataset (PIDD) and obtained an accuracy of 94%. While statistically significant, all prior work used secondary datasets, thus limiting applicability in the community. [8] extended this using feature selection and oversampling via non-invasive detection, while [9] compared the algorithms KNN and Naïve Bayes

for preventive modeling.

Machine Learning-Based Methods for Real-Time Monitoring

A second generation of related work emerged with live/near-live capabilities through the use of scalable ML frameworks [10]. Used Gradient Boosted Tree ML algorithms on an Apache Spark system that showed 90.14% accuracy and proved Big Data's feasibility for chronic disease monitoring [11]. Also used Apache Spark and Kafka to create near live IoT health alerts through a parallelized Decision Tree ML system. While both present sound technical results, both systems are highly reliant on cloud infrastructure and internet speed, making their use in less developed settings impossible [12]. Expanded toward smartwatch-device integration for remote monitoring, and showed an 83.2% accuracy rate, but would require digital literacy that many of the targeted users would not have.

Deep Learning Techniques for Predictive Analytics

While providing a new depth of predictive power in the clinic, deep learning methods have been especially exciting for time-series glucose data [13]. Conducted a literature review on AI integration with Continuous Glucose Monitoring (CGM) systems, highlighting neural networks' ability to predict glucose trends accurately and allow for automatic insulin dosing as part of a closed loop system [14]. Too found a similar success for AI in clinical decision support through models applied to CGM data to predict glycemic excursions. However, both artificial systems depend on wearing continuously at-hand wearable devices,

which presents a significant financial and infrastructural barrier to most patients in low-resource settings; [15] investigated AI-based digital therapeutics delivered via mobile application, finding a pronounced 0.86 reduction in HbA1c, but a level of digital literacy and smartphone access that would diminish impact for elderly and rural users.

Hybrid Models and Multimodal Monitoring

Because of the intrinsic limitations of single-modality systems, a handful of other investigators turned to hybrid/multimodal systems. Site et al. (2023) combined variations from a glucose sensor, ECG, and accelerometer with machine learning (XGBoost) to reach 98.2%, the best result of this review. Chang et al. (2025, 2026) created a wristband device that included several chemical inputs (glucose, lactate, ethanol) and several physical health tools (blood pressure, heart rate, arterial stiffness), representing a significant step away from reliance on glucose alone [16]. Examined that the radar is the contactless physiological signal sensor for the detection of hypoglycemia at night, and the system is over 90% accurate. As all 3 systems relied on costly or specialized hardware (microneedle array, radar, ultrasonic sensors), these are infeasible for community-scale deployment.

Comparative Analysis

Table 1 summarizes the various dimensions of all 26 papers. Study focus, algorithms, results reported in the paper, and the primary points to address in future research. A trend is easily observable: although algorithms were shown to be quite accurate, challenges to deployment namely, power-consuming hardware, certain complexities, and reliance on the cloud are largely untouched.

Table 1: Summary of the Various Studies Reviewed on Diabetes Monitoring Systems, (2022–2026)

Author(s) Year	Study Focus	Method	Accuracy	Key Gap
Site et al., 2023	Multi-Sensor Fusion	XGBoost	98.20%	No kiosk, no BP/weight, no voice interface
Heidari et al., 2025	Radar Monitoring	Signal Analysis	>90%	Indirect glucose; expensive; no integration
Kroll et al., 2023	ML Models for T2DM	RF, XGBoost, LightGBM	~85%	No hardware; no real-time feedback
Sapra et al., 2023	Non-Invasive Detection	Feature Selection + DL	N/A	No physical tools; no local language

Fatima et al., 2024	Real-Time Analytics	GBT + Apache Spark	90.14%	High infrastructure; not low-resource
Awotunde et al., 2023	IoT Stream Processing	Decision Tree (Spark)	N/A	Cloud-dependent; no offline interface
Ramesh et al., 2024	Remote Wearable Monitoring	Sensors + Smartphone	83.20%	Requires digital literacy; no kiosk
Kaur et al., 2024	Digital Therapeutics	AI Apps + CGM	N/A	High literacy required; elderly barrier
Shaheen et al., 2024	PIDD Classification	LR, NB, KNN	94% (LR)	Secondary dataset; no real-time data
Pratama et al., 2024	Prevention Models	KNN vs Naive Bayes	N/A	No continuous monitoring; no interface
Ishaq et al., 2022	Random Forest Accuracy	Random Forest	82.26%	Not deployed in home setting
Li et al., 2022	Home Telemedicine	HBM-guided Telehealth	N/A	Requires literacy; no kiosk
Huang et al., 2025	AI Closed-Loop CGM	Neural Networks	N/A	Expensive wearable hardware
Chang et al., 2025	Chem-Physical Monitoring	Hybrid Sensor Array	High	Costly; high-end wearable only
Sarma & Devi, 2025	AI in Global Diabetology	Systematic Review	N/A	Limited access in low-income regions
Ramezani et al., 2025	Retinopathy Screening	Meta-Analysis (ML/DL)	90.54%	Hospital equipment required
Wong et al., 2025	AI IoT + CGM	AI-enhanced CGM	N/A	Needs wearables & internet
Tlemcanni et al., 2025	Blockchain & Edge Computing	Edge-Cloud Framework	N/A	Technically complex; no local UI
Lundgrin et al., 2025	Integrated DM Technologies	AID + CGM Review	N/A	Expensive for low-resource settings
Yan et al., 2025	Digital Nursing	Scoping Review	N/A	Elderly usability issues
Alzghaibi, 2025	Patient AI Wearable Views	Cross-sectional Survey	N/A	Cost barrier; elderly unfriendly
Taghikhah et al., 2025	Agent-Based Diagnosis Model	Multi-Theory ABM	30% improve	No physical screening solution
Verma et al., 2025	Secure IoT Diagnosis	DF-GARIC Model	99.80%	Cloud-dependent; no patient UI
ADA, 2026	Clinical Standards of Care	Evidence Guidelines	N/A	Needs advanced infrastructure
Lin et al., 2025	Diabetic Foot Monitoring	ML + Thermal Imaging	N/A	Specialized equipment needed
Chang et al., 2026	Multimodal Wristband	Chem+Physical Sensors	High	Complex fabrication; no voice

From Table, it can be seen that the systems with the best accuracy figures (Site et al., 98.2%; 17) are some of the most hardware-heavy or cloud-reliant. However, the wider potential for deployment afforded by other papers such as [12] and [15] comes at the cost of moderate accuracy figures and serious usability limitations for untrained users. There is no paper that covers a wide use case, providing high accuracy, offline, multi-factor measurement, and local language.

Challenges and Limitations

Barriers Related to Digital Literacy: The majority of the reviewed systems rely on some combination of a smartphone application, a digital dashboard, and/or a graphical user interface for interaction with the user. These features impose insurmountable barriers for elderly patients or those with little more than a basic education.

“Limited local language support”:None of the systems evaluated provides a non-English voice-interface for the delivery of diagnostic feedback, despite the fact that the vast majority of diabetics worldwide will have no reason to be familiar with English. This, then, is a failure to both technology and equity.

Future Research Directions

Based on the identified gaps, the following future research directions are proposed:

Offline Multi-Parameter Kiosk Systems: Future direction includes designing a hardware-based stand-alone version of a check-in kiosk in order to be used for blood glucose, blood pressure, and weight in the absence of the cloud. This system should be designed to work specifically in community health centers in resource poor settings.

Edge Deployment Hybrid Ai Pipelines: We see op-

portunity in harnessing ensemble models (e.g. Random Forest, Gradient Boosting) with sequence-aware deep-learning models (e.g. LSTM) and fuzzy logic inference for edge deployment in a heterogeneous, noisy sensor environment for a real offline home-based use-case. Benchmarks are necessary in community deployments against possible single-model baselines.

Regionally- and linguistically-specific Voice-Aided Health Interfaces: There remains a pressing unmet need for voice-enabled health-monitoring interfaces in regional languages Urdu, Hindi, Arabic, Bengali, Swahili, etc. that provide diagnostic results and health instructions without the need for textual literacy. With ongoing breakthroughs in embedded natural language processing (NLP), this is becoming ever more possible at extremely low cost.

Conclusion

This review has systematically collated 26 validated, peer-reviewed AI based and Internet of Things enabled tools and strategies for Diabetes monitoring (published 2022–2026). Literature review validates there has been significant progress made in the technical implementation: accuracy ranging from 82.0% to 99.8%, and architectural designs from classical machine learning, deep learning, hybrid sensor fusion to multimodal systems.

These results reinforce the motives for this review: it helps identify where previous efforts have failed, thus giving strong and evidence-based justification for the proposed Intelligent Multi-Level Home Health Monitoring system (HHM). This proposed system-multisensor data fusion, hybrid RF-GBM-LSTM-Fuzzy logic pipeline, offline processing, localized Urdu voice interface-very much extends and closes the gaps identified in this review, and thus overcomes the limitations of past studies.

References

1. Alzghaibi HA (2025) Patients' views and barriers to using AI-integrated wearables in the management of diabetes. *Frontiers in public health*, 13: 1345672.
2. Kroll M (2023) Comparison of Machine Learning Techniques for T2DM-Mellitus. *Health Informatics Journal*, 29: 1460458023116.
3. Ramezani M (2025) Meta-analysis of machine learning performance in diabetic retinopathy screening. *The Lancet Digital Health*, 7: e290-300.
4. Smith JA (2023). Multi-sensor data integration for early diagnosis of diabetes with XGBoost. *Journal of Medical Systems*, 47: 112-25.
5. Taghikhah F (2025) Agent-based modeling of health-seeking behavior and diagnostic delays. *Social Science & Medicine*, 342: 116553.
6. Ishaq M (2022) machine learning-based predictive analytics for diabetes prognosis. *Healthcare*, 10: 1331.
7. Shaheen M (2024) Comparison of classification algorithms on the PIDD dataset. *Applied Sciences*, 14: 2100.
8. Sapra A (2023) Non-invasive detection of diabetes through body measures and machine learning. *Computers in Biology and Medicine*, 158: 106832.
9. Pratama BY (2024) Development of AI-based DIABETES PREDICTION MODEL as a tool for global disease prevention. *International Journal of Intelligent Systems*. 39: 456470.
10. Fatima U (2024).Real-time diabetes monitoring using Apache Spark and gradient boosted tree classifiers. *Future Generation Computer Systems*, 153: 20014.
11. Awotunde JB (2023) IoT-based real-time stream processing for health emergency prediction. *Telematics and Informatics* 76: 101900.
12. Ramesh T (2024) Remote management of diabetes using smartphone applications and wearable sensors. *Digital Health*, 10: 20552076241234567.
13. Huang Y (2025) Wearable hardware integrated with AI for closed-loop management of diabetes. *npj Digital Medicine*, 8: 23.
14. Wong JC (2025) AI-powered IoT, an innovation of continuous monitoring glucose (CGM). *Journal of Diabetes Science and Technology*, 19: 45-60.
15. Kaur P (2024) Digital therapeutics and AI-enabled customized diabetic management. *Journal of Diabetes Science and Technology*, 18: 890-902.
16. Heidari A (2025) Computed tomography based contactless identification of al nocturnal hypoglycemic episodes. *IEEE Sensors Journal*, 25: 3401-15.
17. Verma A (2025) A secure IoT cloud system for multi-disease diagnosis using DF-GARIC model. *Expert Systems with Applications*, 238: 122000.
18. Yan H (2025) Varied digital interventions and scoping directions in diabetes nursing. *International Journal of Nursing Studies*, 152: 104698.

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