Journal of Online Engineering Education
ISSN: 2158-9658 Volume: 17 Issue: 2
Article Received: 15 March 2026 **Revised**: 18 May 2026 **Accepted**: 10 June 2026

An Edge-Enabled IoT Framework for Real-Time Stroke Risk Prediction Using Explainable Machine Learning

R. Sujitha[1], S. Sivakumar[2]

[1] Cardamom Planters' Association College, Affiliated to Madurai Kamaraj University, Bodinayakanur, Theni, Tamil Nadu, India

[2] Cardamom Planters' Association College, Affiliated to Madurai Kamaraj University, Bodinayakanur, Theni, Tamil Nadu, India

[1] sujiani92@gmail.com

[2]sivaku2002@yahoo.com

Abstract: One of the most common causes of death and long-term disability, stroke requires immediate detection. The current stroke prediction methods based on traditional machine learning methods are mostly based on offline datasets and the IoT-based healthcare systems mainly detect and monitor healthcare data without performing intelligent prediction. This study proposes a conceptual framework based on the Internet of Things (IoT) concept. Digital twins (IoT) and real-time health monitoring, edge-computing and explainable machine learning to dynamically forecast strokes. The suggested framework consists of a number of wearable sensors that continually monitor several physiological indicators such as heart rate, blood pressure, glucose level, and body mass index. The preliminary data preprocessing and anomaly filtering are done in an edge computing layer and the real-time stroke risk prediction is done by a cloud-based machine learning module. Especially, the framework includes explainable AI methods to enhance the understanding and trust in clinical decisions. The proposed system can offer "interpretable predictions" and low latency processing, and have continuous monitoring capabilities that make them suitable for next-generation smart healthcare applications when compared with conventional systems.

Keywords: Stroke Prediction, Internet of Things, Edge Computing, Explainable AI, Machine Learning

1. INTRODUCTION

Early detection of strokes is crucial as they are one of the main causes of death and disability globally. Prompt and appropriate treatment is imperative. Numerous research has suggested using machine learning techniques to forecast stroke [1, 2]. Traditional algorithms like Random Forest (RF) [14] and Support Vector Machine (SVM) [15] are frequently employed in healthcare prediction systems. However, the majority of existing techniques rely on static data and are challenging to use for real-time monitoring.

Wearable devices are able to continuously gather patient health data like heart rate, body mass index [5], blood pressure, glucose level and many more as a result of the swift advancement in the innovation of the Internet of Things (IoT) [6]. The technologies are being created to improve healthcare monitoring by collecting data continuously and remotely monitoring the patient. In the meantime, edge computing reduces data processing time by processing data at the edge where the data is created, and improves the efficiency of the system and the speed of responding to data. [8, 10]. Meanwhile, edge computing reduces the processing time by processing the data in the vicinity of the data source, and improves the efficiency of the system and the speed of reacting to data. [8, 10].

An important factor in healthcare systems is the interpretability of machine learning predictions. Explainable AI methods such as SHAP or LIME improve openness and help doctors understand the forecasts' outcomes [11] and [12].

Journal of Online Engineering Education
ISSN: 2158-9658 Volume: 17 Issue: 2
Article Received: 15 March 2026 **Revised**: 18 May 2026 **Accepted**: 10 June 2026

Thus, this paper suggests a conceptual framework of integrating IoT, edge computing and explainable machine learning for real-time stroke prediction. The proposed system enables continuous monitoring, low latency response and intelligent health care decision making for early stroke risk assessment.

2. LITERATURE REVIEW

The machine learning techniques are used in a broad application for stroke prediction as they can analyze the vast amount of healthcare data and reveal the patterns of stroke risk. Algorithms including Logistic Regression (LR), RF, Decision Tree (DT), and SVM have been employed in a number of studies to predict the risk of stroke [1], [14], and [15]. Mohan et al. [2] used hybrid machine learning approaches to give more accurate predictions; Khosla et al. [1] proposed an integrated machine learning approach for stroke prediction. Although these approaches achieved promising results, most of them mainly rely on static datasets and do not support real-time healthcare monitoring.

By enabling real-time monitoring of patient health metrics, Internet of Things (IoT) technology has created enormous opportunity to improve health systems. IoT-enabled wearable equipment may collect physiological data in real time, such as heart rate, blood pressure, blood glucose, and body mass index [5] [6]. These solutions improve access to healthcare and allow for remote patient monitoring. However, many IoT-based healthcare systems lack intelligent prediction capabilities and are mostly focused on monitoring.

With the real-time healthcare applications, it has been identified that edge computing is an efficient solution to tackle the latency and enhance processing efficiency [8,10]. Furthermore, Explainable AI methods like SHAP and LIME make Machine Learning predictions easier to understand and explain [11] [12].

While a few works integrate IoT and machine learning for healthcare, there is a need for an integrated framework that enables real-time monitoring, low latency processing, and explainable prediction of stroke [17, 18].

3. PROPOSED SYSTEM ARCHITECTURE

3.1 Overview

The suggested approach uses explainable machine learning, edge computing, and the Internet of Things (IoT) to give a comprehensive solution for real-time stroke risk prediction. Its scalable architecture allows for real-time processing of data, data-driven decision making, and continuous health monitoring. The system collects physiological data from wearable sensors, interprets it at the edge layer, and then uses machine learning models on the cloud to make predictions.

3.2 System Architecture Diagram

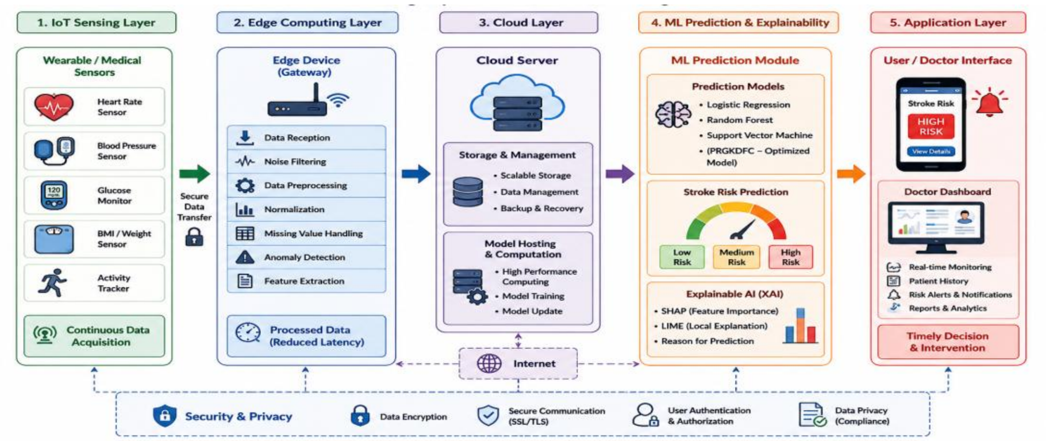

Figure 1. Proposed Edge-Enabled IoT Framework for Real-Time Stroke Prediction Using Explainable Machine Learning

It gathers real-health data from wearables, processes data on the edge to decrease latency, stores data in the cloud for scalable storage and ML computations, predicts stroke risk, explains the prediction and informs the user for timely action.

3.3 System Components

3.3.1 IoT Sensing Layer

This layer comprises of wearable and medical sensors that gather patient health data on an ongoing basis. Heart rate, blood pressure, blood glucose concentration and body mass index (BMI) are the key parameters. These sensors can be used to monitor and have the ability to acquire data without manual operation in real time.

3.3.2 Edge Computing Layer

The entity that is doing some initial data processing near the data source is called the edge layer. increases system efficiency and reduces latency. The crucial roles are:

- Noise filtering
- Data normalization
- Removal of missing or inconsistent values
- Initial anomaly detection

The edge layer reduces network traffic and speeds up the response time by processing data onsite.

3.3.3 Cloud Layer

The primary memory and computing layer is the cloud layer. It is competent in storing vast amounts of data related to patients and in providing scalable computation. Machine learning models for stroke prediction are deployed in the cloud and healthcare professionals can access the machine learning models remotely.

3.3.4 Machine Learning Prediction Module

This module is responsible for forecasting the risk of stroke and evaluating the processed data. makes use of ML technologies such as RF, SVM, and LR. The system's performance could also be enhanced by using optimised models such as PRGKDFC. On the basis of risk, the output is classified into three groups: Low, Moderate and High.

3.3.5 Application Layer

The application layer offers patient, user and healthcare provider interface. Shows predictions and alerts for high stroke risk. These notifications will be made through mobile apps or web platforms, allowing prompt medical attention.

3.4 Data Flow Process

In general, the course of action of the system is as follows:

1. IoT sensors are always gathering health data from patients.
2. The collected data is transmitted to the edge device.
3. The edge layer preprocess data and reduces noise.
4. The cloud server receives the processed data.
5. Machine learning models examine the data and forecast the risk of stroke.
6. The prediction results are sent to the application layer.
7. Alerts sent to patients and healthcare providers as required.

Journal of Online Engineering Education
ISSN: 2158-9658 Volume: 17 Issue: 2
Article Received: 15 March 2026 **Revised**: 18 May 2026 **Accepted**: 10 June 2026

4. METHODOLOGY

4.1 Data Acquisition

Data from the IoT capable wearables is constantly being gathered. These data contain physical and lifestyle parameters which are relevant to stroke prediction.

4.2 Data Preprocessing

Collected data goes through the following pre-processing steps:

- Handling missing values
- Normalization
- Encoding categorical data

These steps are necessary to obtain data that is appropriate for machine learning analysis.

4.3 Prediction Mechanism

The processed data is then passed to a machine learning model that is running in the cloud. The models are pattern recognition models, which classify the stroke risk level. The prediction outcomes are continually refreshed utilizing real-time data as it becomes available.

4.4 Explainability

Explainable AI techniques are used in the system to interpret the results of prediction. This enables healthcare providers to be aware of the major risk factors for stroke.

5. NOVELTY OF THE PROPOSED WORK

The new concepts that the proposed work will bring:

1. Integration of IoT with machine learning for real-time stroke prediction
2. Use of edge computing to reduce latency and improve efficiency
3. Inclusion of explainable AI for interpretable predictions
4. Creation of a comprehensive end-to-end healthcare monitoring system

6. COMPARATIVE ANALYSIS

The proposed framework is contrasted with the existing machine learning systems with regard to their real-time prediction capability, continuous monitoring, low latency, and explainability. Static systems are typically based on a fixed set of data and provide limited support for health care in real time. The proposed framework, on the other hand, uses explainable machine learning, edge computing, and IoT, ensuring continuous monitoring and intelligent prediction for early detection of stroke, as shown in Table 1.

Table 1. Comparative analysis between the traditional systems and proposed framework.

Feature	*Traditional ML*	*IoT Systems*	*Proposed System*
Real-time prediction	No	Partial	Yes
Continuous monitoring	No	Yes	Yes
Low latency	No	No	Yes
Explainability	Limited	No	Yes

7. CHALLENGES AND SOLUTIONS

Several challenges are faced with proposed healthcare framework, which are related to security, processing delay and prediction reliability. System efficiency and trustworthiness are enhanced by appropriate solutions that are embedded in the framework, as shown in Table 2.

Table 2. Challenges and solutions in the proposed framework.

Challenge	*Solution*
Data privacy	Secure encryption
Network delay	Edge processing
Model trust	Explainable AI

The sensitive patient data is safeguarded with secure encryption methods to prevent unauthorized access. Edge computing reduces the latency of data processing by processing the data near its origin. Explainable AI techniques make the outcomes of predictions more transparent and build trust among health care professionals.

8. CONCLUSION

The current study combined the ideas of explainable machine learning, edge computing, and the IoT to create a conceptual architecture for real-time stroke prediction. The system enables intelligent prediction for early stroke detection, low latency processing, and continuous health state monitoring. Transparency is enhanced with explainable AI and this aids in healthcare decision-making.

The framework can be further expanded in the future by implementing it in real-time hardware, using mobile healthcare apps, integrating with hospitals, and employing advanced deep learning algorithms. In this way, the suggested system will lay a solid basis for the future intelligent health monitoring systems.

REFERENCES

[1] A. Khosla et al., “An integrated machine learning approach to stroke prediction,” *IEEE Access*, 2020.
[2] S. K. Mohan et al., “Effective heart disease prediction using hybrid machine learning techniques,” *IEEE Access*, 2019.
[3] A. A. Torkey, “Machine learning approaches for predicting stroke risk,” *Journal of Healthcare Engineering*, 2021.
[4] M. S. Hossain and G. Muhammad, “Cloud-assisted industrial internet of things enabled framework for health monitoring,” *IEEE Internet of Things Journal*, 2018.
[5] D. Bandyopadhyay and J. Sen, “Internet of Things: Applications and challenges in healthcare,” *Wireless Personal Communications*, 2011.
[6] S. M. R. Islam et al., “The Internet of Things for health care: A comprehensive survey,” *IEEE Access*, 2015.
[7] A. Alaa et al., “Machine learning in healthcare: IoT applications,” *IEEE Reviews in Biomedical Engineering*, 2019.
[8] W. Shi et al., “Edge computing: Vision and challenges,” *IEEE Internet of Things Journal*, 2016.
[9] X. Sun and N. Ansari, “EdgeIoT: Mobile edge computing for the Internet of Things,” *IEEE Communications Magazine*, 2016.
[10] M. Satyanarayanan, “The emergence of edge computing,” *Computer*, 2017.
[11] S. M. Lundberg and S.-I. Lee, “A unified approach to interpreting model predictions,” *NIPS*, 2017.
[12] M. T. Ribeiro et al., “Why should I trust you? Explaining the predictions of any classifier,” *KDD*, 2016.
[13] T. Chen and C. Guestrin, “XGBoost: A scalable tree boosting system,” *KDD*, 2016.
[14] L. Breiman, “Random forests,” *Machine Learning*, 2001.
[15] C. Cortes and V. Vapnik, “Support-vector networks,” *Machine Learning*, 1995.
[16] H. Alemdar and C. Ersoy, “Wireless sensor networks for healthcare: A survey,” *Computer Networks*, 2010.
[17] J. Wan et al., “Wearable IoT enabled real-time health monitoring system,” *IEEE Access*, 2018.

Journal of Online Engineering Education
ISSN: 2158-9658 Volume: 17 Issue: 2
Article Received: 15 March 2026 **Revised**: 18 May 2026 **Accepted**: 10 June 2026

[18] R. Kumar et al., “Smart healthcare monitoring using IoT,” *Procedia Computer Science*, 2019.