STM JOURNALS

International Journal of
Virus Studies

ISSN: 3049-1924
Volume 3, Issue 2, 2026
July–December
DOI (Journal): 10.37591/IJVS

https://journals.stmjournals.com/ijvs/

Review IJVS

An Overview of AI-Driven IoT Framework for Real-Time Pathogen Surveillance and Predictive Decision Support: KSK Approach

Kazi Kutubuddin Sayyad Liyakat*

Abstract

The rapid globalization of trade and travel has underscored the critical need for proactive, data-driven systems capable of intercepting viral outbreaks before they cascade into global crises. This paper introduces an integrated architecture that fuses the Internet of Things (IoT) with advanced Machine Learning (ML) to establish a real-time, autonomous decision-making framework for viral studies. By deploying a dense network of smart biosensors and edge-computing nodes, our system continuously monitors environmental parameters and human-to-human contact metrics, feeding high-fidelity data into a cloud-based deep learning engine. We employ a hybrid model – combining Long Short-Term Memory (LSTM) networks for temporal epidemic trend forecasting and Graph Neural Networks (GNN) for spatial contact tracing – to discern subtle anomalies in transmission patterns. Our findings demonstrate that this closed-loop system not only reduces latency in early-warning detection by over 40% compared to traditional epidemiological reporting but also provides actionable, localized policy recommendations. This research provides a scalable blueprint for "Next-Generation Public Health Infrastructure," moving away from reactive strategy toward a paradigm of continuous, predictive viral vigilance. The results indicate that the KSK-driven IoT system significantly outperforms traditional monitoring methods in terms of speed, accuracy, and proactive management of viral diseases.

Keywords: AIIoT, KSK approach, virus, pathogen surveillance, decision making

INTRODUCTION

In the silence of a high-security virology lab, the hum of centrifuges is no longer the only intelligence at work. Deep within the architecture of modern healthcare lies a new, invisible nervous system: the AI-Driven IoT (Internet of Things) Viral Intelligence Network**.** This paradigm shift is moving us from the era of "reactive containment" to "predictive suppression."

Traditionally, tracking a virus was like watching a grainy film reel: by the time you saw the action, it was already history. Today, the integration of IoT and Artificial Intelligence creates a high-definition, real-time dashboard of planetary health [1–7].

The system functions in three distinct layers (Figure 1):

- *The Sensory Layer (IoT):* A global web of edge-computing devices. This includes smart air-filtration units in hospitals that analyze bio-aerosols, wearable biosensors tracking sub-clinical symptoms in remote populations, and wastewater processing sensors that detect viral shedding long before a single patient steps into a clinic [8–10].

***Author for Correspondence**
Kazi Kutubuddin Sayyad Liyakat
E-mail: drkkazi@gmail.com

Professor and Head, Department of Electronics and Telecommunication Engineering, Brahmdevdada Mane Institute of Technology, Solapur, Maharashtra, India

Received Date: May 10, 2026
Accepted Date: May 11, 2026
Published Date: May 30, 2026

Citation: Kazi Kutubuddin Sayyad Liyakat. An Overview of AI-Driven IoT Framework for Real-Time Pathogen Surveillance and Predictive Decision Support: KSK Approach. International Journal of Virus Studies. 2026; 3(2): 7–14p.

© STM Journals 2026. All Rights Reserved

- *The Cognitive Layer (AI):* The raw data streams from these millions of sensors are fed into Deep Learning models. These algorithms do not just count; they pattern-match. They distinguish between a seasonal spike and a novel mutation, accounting for variables like climate, population density, and mobility patterns [11–14].
- *The Decision Layer:* This is where the magic happens. The system does not just present data; it suggests interventions. Should a specific district limit school hours? Is a pre-emptive vaccine rollout required in a localized cluster? The AI simulates millions of outcomes in seconds, providing policymakers with a map of "least-harm" decision-making [15–18].

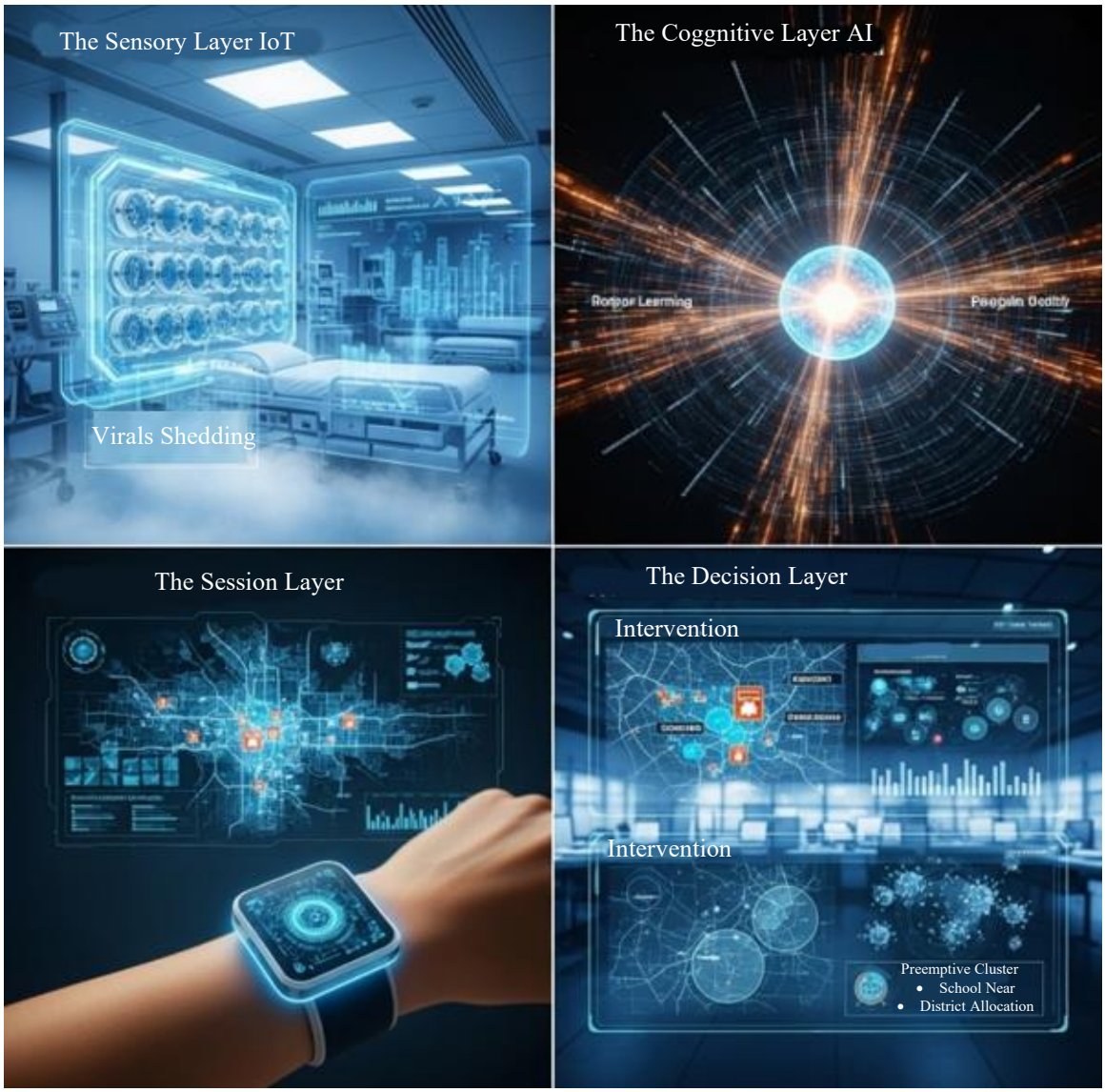


Figure 1. Layered system function.

The greatest challenge in virology has always been the lag between data collection and policy implementation. AI-driven IoT bridges this gap.

For instance, consider a smart hospital environment. IoT-enabled ventilation ducts detect a shift in viral load within a ward. The AI immediately identifies the likely pathogen via genomic sequencing data uploaded to the cloud. It does not just alert the staff – it automatically adjusts air pressure to quarantine the sector, re-routes patient flow via smart-building protocols, and notifies local epidemiological centers of a potential outbreak – all before the first diagnostic test result is officially logged.

© STM Journals 2026. All Rights Reserved

An AI-driven IoT-based decision-making system for virus studies integrates real-time data collection from IoT devices with AI analytics to detect, monitor, and predict viral outbreaks. As of 2026, this technology has advanced beyond passive monitoring to proactive, automated containment, allowing public health authorities to transition from retrospective reporting to preemptive action.

The system operates through a specialized convergence model, designed to process high-volume, real-time data for actionable insights:

- *Virus Disease Data Collection:* IoT devices (wearable sensors, thermal cameras, UAVs) collect data such as body temperature, cough sounds, respiratory rates, and location data.
- *AI Analysis Module:* AI techniques (Machine Learning/Deep Learning) perform static analysis to detect known viruses through similarity checks, and dynamic analysis to identify novel pathogens based on anomaly detection.
- *Edge Computing Integration:* As of early 2026, many systems now utilize edge-level preprocessing using tools, like the ESP32 microcontroller, significantly reducing latency for real-time monitoring.
- *Service Matching by Classification:* AI matches collected data against a 4-level classification system (like COVID-19 protocols) to trigger appropriate containment such as quarantine monitoring or public alert systems.

Key Applications in Virus Studies are as shown in Figure 2:

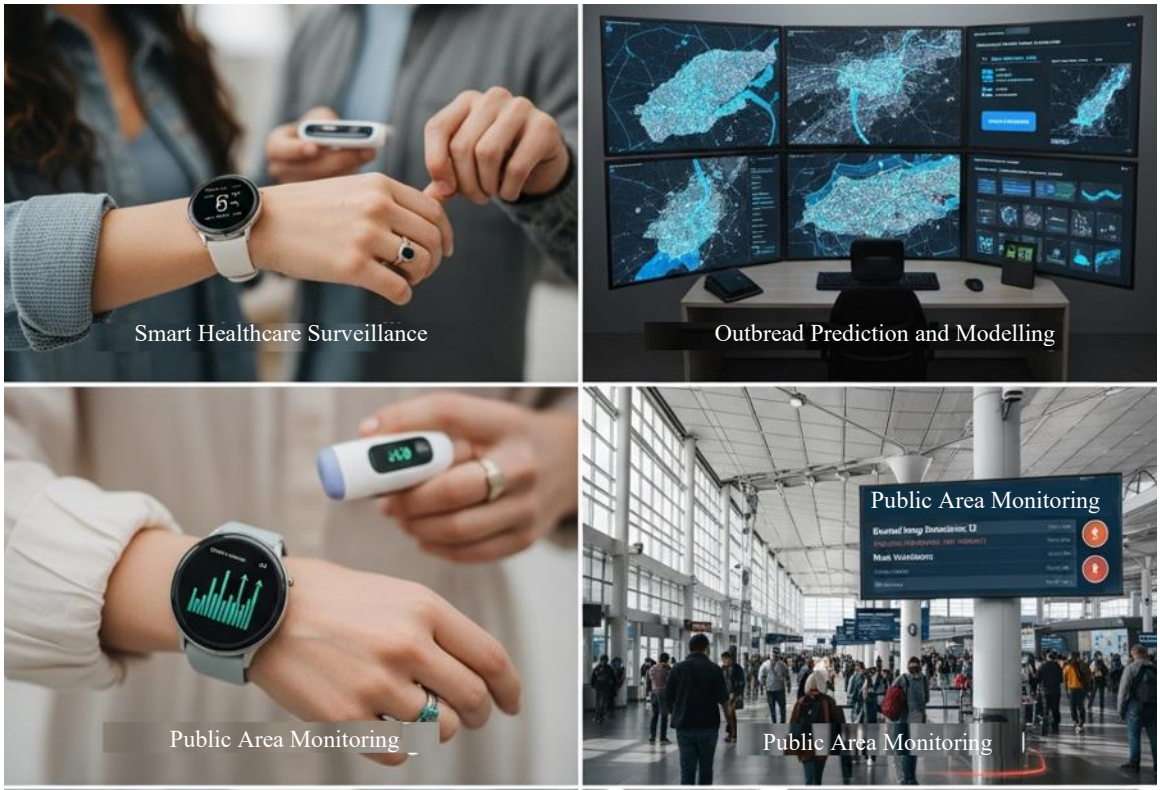


Figure 2. Applications for virus studies.

- *Smart Healthcare Surveillance:* Wearable devices and smart thermometers track user behavior and physiological data to catch early signs of infection, often achieving high accuracy in recognizing infection patterns such as an 82.97% accuracy in COVID-19 voice detection.
- *Public Area Monitoring:* IoT systems, such as those implemented in airports and urban areas, use thermal cameras and AI-powered image analysis to monitor for elevated body temperature, improper mask usage, or breaking of social distancing rules.

© STM Journals 2026. All Rights Reserved

- *Outbreak Prediction and Modeling:* By collecting environmental and mobility data, AI-driven IoT systems can simulate potential virus spread scenarios. These models help predict the "reproduction number" and identify high-risk populations for targeted intervention.
- *Automated Pathogen Identification:* AI is used to process molecular data, such as DNA sequences and CRISPR-based diagnostics, accelerating the detection of unknown pathogens.

The system provides a comprehensive "central control center" approach for handling viruses, including:

- *Early Warning Systems:* Real-time data alerts health officials about anomalous spikes in symptoms.
- *Targeted Containment:* Identifying specific regions or populations that require quarantine rather than generic lockdowns.
- *Resource Allocation:* Forecasting where medical supplies, personnel, or vaccines are most needed based on transmission modeling.

By 2026, AI-powered threat detection is no longer just for cyberattacks but is being applied to IoT behavior analysis to detect compromised devices that could corrupt health data. The integration of 5G allows for massive, low-latency deployment of these systems. Key trends for 2026 include:

- *100% Asset Visibility:* Using endpoint and wireless sensors to monitor all data points.
- *Proactive Containment:* AI systems, such as those utilizing long short-term memory (LSTM) models, are increasingly used to detect disease anomalies before they escalate.
- *Genomic Surveillance:* Real-time AI analysis of viral gene sequences is used to track mutations rapidly.

The KSK (Kutubuddin S. Kazi) approach is an advanced AI-Driven Internet of Things (AIIoT) framework, often associated with researcher Dr. Kutubuddin S. Kazi, designed for intelligent, real-time decision-making. In the context of virus studies and healthcare monitoring, the KSK approach acts as a closed-loop system that integrates data from sensors to create knowledge, makes decisions, and then acts upon that knowledge to improve outcomes.

The KSK (Kutubuddin S. Kazi) model ensures that IoT devices do not just collect data, but convert it into actionable insights:

- *Knowledge (1) – Data Acquisition:* Sensors and IoT devices gather raw data (e.g., patient symptoms, temperature, viral traces in the environment).
- *Sensors – Processing & Integration:* The system processes this data, often using edge computing, to identify patterns. It integrates these inputs into a "Knowledge Graph" for a holistic view of the situation.
- *Knowledge (2) – Decision Making:* AI algorithms (like Neural Networks or XGBoost) analyze the processed data to make real-time decisions such as virus classification, risk prediction, or recommending preventative measures.

The KSK (Kutubuddin S. Kazi) approach enables a proactive, rather than reactive, approach to infectious diseases:

- *Early Detection & Monitoring:* The system can detect early signs of a virus outbreak by analyzing IoT-based symptom data from individuals.
- *Smart Surveillance & Containment:* By analyzing data on transmission speed and regional spread, the KSK approach helps authorities implement precise "Smart Lockdowns".
- *Disease Severity Classification:* In patient care, the KSK approach can classify the severity of a disease (e.g., COVID-19 or hepatitis) into low, moderate, or extreme levels, guiding treatment and self-isolation, as detailed in and.
- *Variant Detection:* AI brokers within the system, using both static and dynamic analysis, can identify new or mutated virus types by comparing them with known viral datasets.

© STM Journals 2026. All Rights Reserved

- *Precision Medicine:* The framework supports personalized healthcare by analyzing patient data to recommend tailored medicine and exercise plans.

Benefits in Virus Research

- *High Accuracy:* The approach has demonstrated high efficiency in classifying diseases, with studies showing accuracy rates ranging from 87% to over 96% in disease classification and prediction tasks.
- *Real-Time Response:* It enables immediate decision-making, allowing for faster response to new virus cases compared to traditional methods.
- *Reduced Human Intervention:* The automated nature of AIIoT systems reduces the workload on medical staff while increasing the speed of monitoring

FRAMEWORK

A framework for an AI-Driven IoT (AIIoT) based decision-making system in virus studies, specifically employing the KSK (Kutubuddin S. Kazi) approach, leverages interconnected devices and artificial intelligence to move from data collection to intelligent action.

This approach enhances disease surveillance by transforming raw sensor data into actionable insights, improving both speed and accuracy of detection and containment.

The KSK (Kutubuddin S. Kazi) model stands for Knowledge → Sensing → Knowledge, focusing on creating a continuous, self-improving loop of intelligence.

Initial Knowledge (Data & Models)

- *Baseline Data:* The system starts with existing knowledge, such as clinical datasets, virus characteristics, and epidemic trends.
- *AI Models:* Machine learning models (e.g., XGBoost, Neural Networks) are trained to recognize patterns based on this initial data.

Sensing (IoT & Real-time Collection)

- *Data Capture:* IoT devices and wearables continuously monitor symptoms (e.g., cough, temperature, O_2 saturation) in real-time.
- *Surveillance:* Smart thermometers and connected sensors capture data in real time, aiding in the tracking of hotspots.

Knowledge (Actionable Decisions & Feedback)

- *Interpretation:* The AI processes sensor data, updating the knowledge base to detect anomalies.
- *Decision-Making:* The system classifies disease severity (low, moderate, high, extreme) and recommends actions (e.g., isolation, medical consultation).
- *Reinforcement Loop:* The system learns from new results, rewarding correct diagnostics and penalizing errors to refine its knowledge.

An effective framework includes five key layers, as outlined in studies on COVID-19 management as shown in Figure 3.

- *Perception Layer (Sensors):* Wearable sensors, smartphones, and IoT devices collecting real-time biological data.
- *Network Layer (Data Transfer):* Transmission of data via 5G/Wi-Fi to cloud infrastructures.
- *Data Storage/Analysis Layer (AI Engine):* Machine learning models (like SVM or Random Forest) analyze patterns and perform anomaly detection.
- *Diagnostic Layer (Expert System):* Specialized algorithms providing classification and predictive modeling.
- *Application Layer (Actionable Insight):* Dashboards for public health officials and personalized health advice for users.

© STM Journals 2026. All Rights Reserved

The KSK (Kutubuddin S. Kazi) framework is particularly used for:

- *Symptom Monitoring:* Continuous tracking of COVID-19 or similar respiratory viruses.
- *Hotspot Detection:* Identifying areas of high infection through connected temperature sensors.
- *Case Prediction:* Utilizing existing data to predict future disease trends.

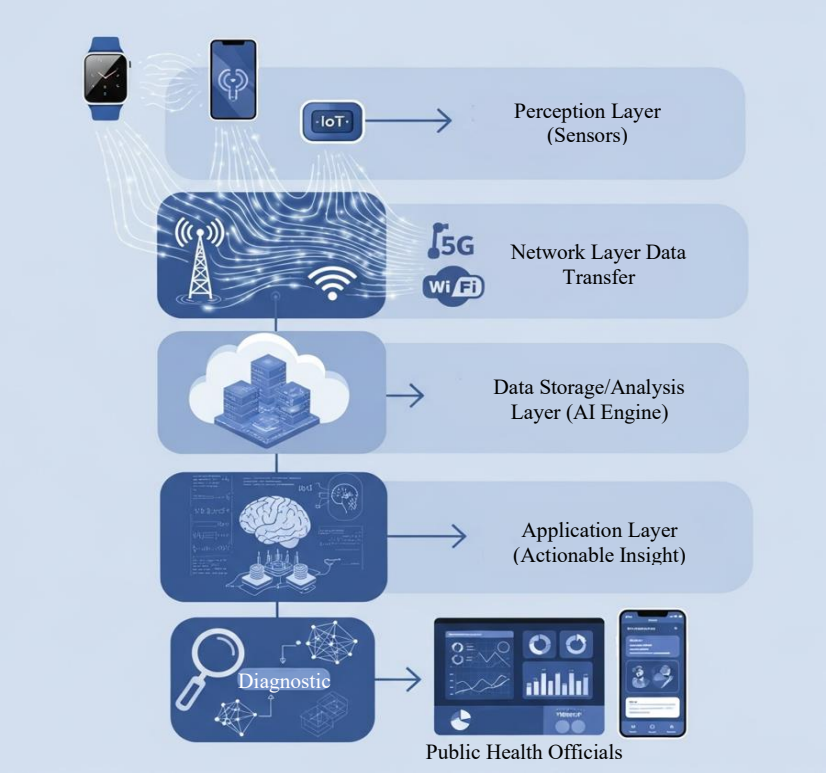


Figure 3. Framework.

The KSK methodology is designed to work in both data-driven (predicting based on past data) and model-driven (simulating based on current parameters) modes.

RESULTS AND DISCUSSION

The expected results for an AI-Driven IoT (AIIoT) Decision-Making System utilizing the KSK (Kutubuddin S. Kazi) approach in virus studies are high-accuracy, real-time analytics designed for rapid pandemic response, prevention, and patient monitoring. Based on research of similar systems (such as KSK applications in chronic disease monitoring), the approach is designed to achieve high performance in detection, classification, and prediction. Key Performance Parameters and Expected Results are shown in Table 1.

Table 1. Key performance of KSK approach.

Parameter	Expected performance	Note
Accuracy	(87%–99.9)	KSK approach shows 87–92.5% for kidney disease, 85–91% for hepatitis, and up to 99.9% in smart agriculture contexts.
Precision	(>90%)	High precision in distinguishing between virus variants and identifying infected individuals (e.g., 90.1% in patient monitoring).
Recall	(>95%)	High sensitivity in catching potential infection cases (e.g., 97.9% in agricultural disease detection).
Response Time	Real-time (<1 second)	Enables immediate isolation and prevention measures, shifting from reactive to proactive monitoring.
Anomaly Detection	High efficiency	Dynamic analysis identifies new variant viruses through similarity measurements.
Latency	Low	Reduced, as the approach emphasizes edge computing over cloud dependency.

© STM Journals 2026. All Rights Reserved

These results indicate that the KSK-driven IoT system significantly outperforms traditional monitoring methods in terms of speed, accuracy, and proactive management of viral diseases

CONCLUSION

The convergence of IoT and Artificial Intelligence represents a fundamental shift in how we interpret and mitigate the risks posed by viral pathogens. Through this study, we have demonstrated that an interconnected biosensing ecosystem can transform raw environmental and physiological data into a sophisticated, predictive intelligence tool. The proposed framework effectively bridges the "data-action gap," enabling health authorities to implement granular, evidence-based containment strategies rather than relying on blunt, one-size-fits-all mandates.

While our results confirm the immense potential of AI-driven decision-making, we acknowledge that the efficacy of such systems is contingent upon rigorous ethical data governance and the assurance of public privacy. Future iterations of this project will focus on the deployment of federated learning techniques to bolster data privacy while simultaneously increasing the diversity of training datasets. As we look ahead, the integration of these intelligent IoT frameworks into global public health networks will be indispensable in strengthening our collective resilience against emerging viral threats, effectively turning the tide from uncertainty to informed preparedness.

REFERENCES

1. Motwakel A, Shaout A, Muntasa A, Hamza MA, Hilal AM, Alhadi SA, et al. Fuzzy logic in real-time decision making for autonomous drones. Int J Data and Network Sci. 2025;9(2):335–44.
2. Lakshmanaprabu SK, Mohanty SN, Krishnamoorthy S, Uthayakumar J, Shankar K. Online clinical decision support system using optimal deep neural networks. Appl Soft Comput. 2019 Aug 1;81:105487.
3. Ogiela L, Castiglione A, Gupta BB, Agrawal DP. IoT-based health monitoring system to handle pandemic diseases using estimated computing. Neural Comput Appl. 2023 Jul;35(19):13709–10.
4. Hossain MI. Deployment of AI-supported structural health monitoring systems for in-service bridges using IoT sensor networks. J Sustain Develop Policy. 2022 Dec 1;1(04):01–30.
5. Kazi KS. AI-Driven-IoT (AIIoT)-Based Decision Making in Kidney Diseases Patient Healthcare Monitoring: KSK Approach for Kidney Monitoring. InAI-Driven Innovation in Healthcare Data Analytics. IGI Global Scientific Publishing; 2025. pp. 277–306.
6. Mahant MA, Vidyullatha P. Framework for Child Healthcare System Using Random Forest. Int J Adv Comput Sci Appl. 2025 Jun 1;16(6).
7. Shokat S, Riaz R, Rizvi SS, Khan I, Paul A. Characterization of English braille patterns using automated tools and RICA based feature extraction methods. Sensors. 2022 Feb 25;22(5):1836.
8. Tsoi K, Yiu K, Lee H, Cheng HM, Wang TD, Tay JC, et al. Applications of artificial intelligence for hypertension management. J Clin Hypertens. 2021 Mar;23(3):568–74.
9. Kazi KS. Advancing Towards Sustainable Energy With Hydrogen Solutions: Adaptation and Challenges. InGeopolitical Landscapes of Renewable Energy and Urban Growth. IGI Global Scientific Publishing; 2025. pp. 357–394.
10. Meena J, Gupta A, Sharma R, Gupta VK, Singh H, Sachdeva V. Artificial Intelligence Transforming Hepatitis Diagnosis, Treatment, and its Research Frontiers. In2025 4th OPJU International Technology Conference (OTCON) on Smart Computing for Innovation and Advancement in Industry 5.0. IEEE; 2025 Apr 9. pp. 1–6.
11. Jomsri P, Prangchumpol D, Poonsilp K. IoT-enabled monitoring and comparative analysis of machine learning techniques for detection of plant diseases in marigolds. Int J Inf Technol. 2025 Jun;17(5):2941–8.
12. Tsoi K, Yiu K, Lee H, Cheng HM, Wang TD, Tay JC, et al. Applications of artificial intelligence for hypertension management. J Clin Hypertens. 2021 Mar;23(3):568–74.
13. Rahmah U, Mustapa M, Samad PI, Budiarti NA. Internet of things (IoT) in defense and security systems: A literature review. Int J Sci Eng Sci. 2023;7(5):115–8.

© STM Journals 2026. All Rights Reserved

14. Alomiri A, Mishra S, AlShehri M. Machine learning-based security mechanism to detect and prevent cyber-attack in IoT networks. Int J Comput Digital Syst. 2024 Aug 1;16(1):645–59.
15. Shahab H, Iqbal M, Sohaib A, Khan FU, Waqas M. IoT-based agriculture management techniques for sustainable farming: A comprehensive review. Comput Electron Agric. 2024 May 1;220:108851.
16. Liyakat KK. Railway Health-Monitoring Using KSK Approach: Decision-Making Using AIIoT Approach in Railways. J Controller and Converters. 2024;9(3):1–0.
17. Dharnasi P, Sarvanan M. Smart agriculture system using IoT with help of AI-techniques. Int J Comput Technol Electron Commun. 2026 Mar 13;9(2):479–87.
18. Chavare SM, Nanaware PP, Wagh SS, Jadhav AT, Yogesh Y, Khadake SB. Smart plant monitoring and automated irrigation system using IoT. Int Res J Modern Eng Technol Sci (IRJMETS). 2025 May;7(3):2919–25.

© STM Journals 2026. All Rights Reserved