

Seminar Report
On
“Artificial Intelligence of Things (AIoT)”

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Certificate

This is to certify that **Hrishikesh V. B. Divekar** has successfully completed a Seminar course titled “**MIS Technical Seminar**”, towards the partial fulfillment of requirements for the Fifth Semester B.Tech. of Computer Science & Engineering.

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1. ABSTRACT

The convergence of Artificial Intelligence (AI), Machine Learning (ML), and the Internet of Things (IoT) has led to a major shift in how modern automated systems operate. IoT has already connected billions of devices, but without intelligence, these devices can only sense and report data. AI and ML add the capability to understand patterns, make predictions, and automate decisions. Together, the integration—commonly known as AIoT—creates systems that are smarter, faster, and more responsive to changes in the physical environment. This report studies how AIoT transforms traditional monitoring systems into intelligent ecosystems capable of real-time decision-making. It reviews earlier work, explains methodologies used in AIoT systems, and highlights the benefits achieved in industries like manufacturing, healthcare, agriculture, logistics, and smart cities. The report also discusses the increasing shift toward edge computing, the reliance on cloud platforms for large-scale model training, and the challenges such as security risks, interoperability issues, and algorithmic bias. Results from the referenced documents clearly show that AIoT enables predictive maintenance, better resource management, improved safety, and more reliable automation. The study concludes that AIoT is becoming an essential part of future technological development, offering substantial advantages for industry and society while also requiring responsible implementation.

2. INTRODUCTION

The rapid growth of intelligent systems in recent years has been shaped by two major technological domains: Artificial Intelligence (AI) and the Internet of Things (IoT). While both fields have matured independently, their integration has opened a new era in which connected devices are not only able to gather and exchange data but also learn, interpret, and act on that data. This combined framework is known as the Artificial Intelligence of Things (AIoT). AIoT aims to bring intelligence closer to devices so that they can respond more accurately and more quickly to real-world situations. As modern applications demand faster decisions, reduced manual involvement, and higher automation, the importance of AIoT continues to grow across sectors such as healthcare, smart homes, manufacturing, transportation, and agriculture.

Need for AIoT

The core motivation for merging AI with IoT arises from the limitations of traditional IoT systems. A basic IoT setup generally collects data from sensors and sends it to servers or cloud platforms for processing. Although this structure works for monitoring-oriented tasks, it struggles when the system must make fast or intelligent decisions, especially in environments where delays can cause inconvenience or risk. AIoT reduces such dependency on distant servers by enabling computation on the device or at the edge layer, which decreases response time. Another need for AIoT comes from the huge amount of data IoT devices generate. Without AI-based analysis, most of this data remains unused. AI algorithms convert raw sensor readings into meaningful insights, improving the overall value of the system.

Role of Artificial Intelligence in IoT Systems

Artificial Intelligence plays a crucial role in enhancing IoT by enabling learning, prediction, and automation. Machine learning models can identify trends from sensor data and anticipate events like equipment failure, system anomalies, or environmental changes. Deep learning models help recognize patterns that may not be visible through manual analysis, thus improving accuracy. AI also helps IoT devices make local decisions without waiting for human intervention. As a result, systems become more adaptive and capable of handling complex scenarios. With time, AI models improve their performance by observing new data, making the IoT system more refined and intelligent in its operation.

Role of IoT in AI-Driven Systems

IoT also supports AI by providing the real-time data that AI models need for training and continual improvement. Without sensor inputs, AI systems may lack context or updated information. IoT devices act as the sensory layer of the AIoT environment, capturing values like humidity, temperature, motion, pressure, or location. This data is transmitted to processing units, where AI algorithms can analyze it. IoT also helps AI systems deploy their decisions effectively. For example, after an AI model predicts an anomaly, IoT devices can take an action such as adjusting an actuator, sending a notification, or changing system parameters. This partnership between sensing and decision-making forms the backbone of AIoT.

AIoT Architecture Overview

The typical architecture of AIoT consists of interconnected layers that work together to deliver intelligent functionality. At the base is the sensing layer, where IoT devices collect data from the environment. The next layer involves communication, where data is shared through wired or wireless networks. After that, the processing layer handles data analysis using AI algorithms. Processing may take place at the edge, fog, or cloud level depending on the application's needs. Some systems require fast decisions, so edge devices with AI capabilities are preferred, while others that include heavy computations may rely on cloud resources. Finally, the application layer uses the outcomes of AI processing to automate operations, provide insights, or support decision-making for users.

Conclusion

AIoT has emerged as a powerful combination that enhances the capability of connected systems by merging sensing and intelligence. It supports faster responses, better decision-making, and greater automation across a variety of applications. Although challenges exist, continuous advancements in edge computing, communication networks, and lightweight AI models are making AIoT systems more practical and more widely adopted. As industries and institutions move towards smarter infrastructures, AIoT will continue to play an essential role in shaping the next generation of intelligent technologies.

3. LITERATURE REVIEW

The literature on AIoT primarily focuses on how AI, ML, and IoT complement each other to create scalable and autonomous systems. IoT is defined as a network of connected sensors that continuously gather data from physical environments, including industrial machines, medical equipment, vehicles, agricultural fields, and household devices.

However, the documents show that IoT cannot reach its full potential without intelligence. AI and ML provide exactly that by enabling systems to learn from the collected data, generate predictions, and take actions without requiring constant human control. One central theme found in the literature is the volume and speed of IoT-generated data. Billions of devices connected globally produce information at a scale that human operators cannot manually analyze. As stated in the documents, organizations relying solely on IoT often fail to benefit from this data because they lack the capability to interpret it meaningfully. This is where AI becomes essential. ML models trained on historical IoT data can detect irregularities, optimize operations, and identify patterns that remain invisible to traditional rule-based systems.

The reviewed documents highlight key AIoT advantages across multiple sectors. In manufacturing, AIoT supports predictive maintenance by detecting early signs of machine failure using vibration, temperature, and energy data. In healthcare, patient-worn IoT devices feed continuous data to AI models that can detect anomalies and signal risk at an early stage. Smart cities benefit from AIoT systems that analyze traffic data in real time and optimize traffic lights or public safety responses. Agriculture uses sensors and drones paired with AI to monitor soil conditions, irrigation levels, and crop health, leading to reduced resource usage and improved yield. The literature also explains the four-layer architecture essential for designing AIoT systems: perception, connectivity, processing, and application layers. This structured approach ensures that data flows smoothly from sensors to decision-making components.

The processing layer—powered by AI and ML—is the heart of the system because it carries out model inference, anomaly detection, classification, and prediction. A major development emphasized in the literature is the move toward edge computing. Traditional cloud-based AI introduces delays due to data transfer and depends heavily on stable networks. Edge computing resolves this by pushing intelligence closer to the device, allowing real-time analysis even when connectivity is weak. Many modern applications such as autonomous robots, self-driving vehicles, and factory automation rely on edge AI for immediate reaction times. The literature also discusses limitations and challenges. Security concerns increase with the number of connected devices, and every device acts as a possible entry point for cyberattacks. Interoperability is another difficulty, as IoT devices often use different communication methods and standards. Bias in AI algorithms is highlighted as a major ethical concern—if the training data is biased or incomplete, the system may produce unfair or inaccurate results. Overall, the literature reveals a strong consensus that AIoT is transforming industries and will continue expanding. However, its growth also depends on responsible use, secure design, and efficient system architecture.

3. METHODOLOGIES

4.1 AIoT Architectural Methodology

4.1.1 Perception Layer

This layer includes all sensors and actuators used to capture real-world data. The methodology involves identifying necessary sensors, understanding their output format, and determining how frequently data should be collected. Since AI predictions rely heavily on accurate data, selecting suitable sensors becomes a foundational step.

4.1.2 Connectivity Layer

This layer focuses on how IoT devices communicate with processing systems. The methodology includes choosing between Wi-Fi, 5G, Bluetooth, or LPWAN depending on distance, power usage, and data volume. Secure communication protocols are considered to prevent unauthorized access.

4.1.3 Processing Layer

This is where AI and ML algorithms operate. The methodology involves cleaning data, running ML models, and deciding whether processing should occur in the cloud or at the edge. Cloud is preferred for training large models, while edge processing is used for real-time inference.

4.1.4 Application Layer

This layer transforms AI output into practical actions such as alerts, dashboard updates, or automated controls. The methodology includes designing user interfaces and ensuring that system actions align with the intended purpose.

4.2 Data Processing and ML Integration

4.2.1 Data Preprocessing

Data collected from sensors may contain noise or missing values. Preprocessing includes filtering, normalization, and structuring the data so ML models can analyze it effectively.

4.2.2 ML Model Training

Large datasets are stored in cloud systems where ML models are trained to recognize patterns or detect anomalies. The methodology includes splitting data into training and testing sets, choosing appropriate algorithms, and tuning model parameters.

4.2.3 Edge Deployment

Lightweight versions of trained models are deployed to edge processors. This enables quick decision-making in environments where even milliseconds matter.

4.3 Sector-Specific Methodologies

4.3.1 Manufacturing (Predictive Maintenance)

Sensors on machines collect vibration, temperature, and usage data. AI models analyze trends to predict failure in advance, allowing planned maintenance.

4.3.2 Healthcare (Remote Monitoring)

Wearable devices track vital signs. AI models identify abnormal patterns and notify healthcare staff.

4.3.3 Smart Cities (Traffic Management)

Cameras and sensors gather traffic flow data. AI adjusts signals and alerts authorities about congestion or accidents.

4.3.4 Agriculture (Precision Farming)

Soil, weather, and crop sensors supply data to AI models that control irrigation and predict crop needs.

4.4 More Methodologies

1. Data-Driven Sensing and Acquisition

This methodology focuses on collecting reliable data from distributed IoT sensors and preparing it for intelligent processing. The process begins with continuous sensing of environmental or system parameters, followed by filtering and basic preprocessing at the device or gateway. The aim is to ensure that the collected data is clean, organized, and meaningful before it is passed to AI models. This foundation makes all further AI-based decisions stable and consistent.

2. Edge-Level Intelligence Integration

In this approach, lightweight AI models are deployed directly on edge devices or nearby gateways instead of relying only on cloud servers. By shifting computation closer to the data source, the system reduces delay and improves real-time decision-making. Edge intelligence is suitable for tasks like anomaly detection, quick predictions, and local control actions. It balances efficiency and accuracy while reducing network load.

3. Cloud-Assisted Model Training and Optimization

Here, the cloud is used mainly for handling large-scale data storage, complex model training, and long-term analytics. Since cloud platforms have greater computing capacity, they can train deeper models, perform model tuning, and manage long-term learning cycles. Once optimized, the refined models are pushed back to the edge devices for field use. This methodology maintains a steady flow between heavy cloud processing and efficient edge execution.

4. Continuous Learning and Model Updating

AIoT systems often operate in dynamic environments where data patterns change over time. This methodology focuses on allowing models to learn continuously using updated sensor data. Through periodic retraining or incremental learning techniques, the system adapts to new behaviors, trends, or unusual events. This reduces performance degradation and ensures that the AI components remain relevant as conditions evolve.

5. Secure and Reliable Decision Automation

This methodology ensures that decisions made by AI-enabled IoT systems are trustworthy, safe, and protected from unauthorized access. It includes adding authentication layers, encrypted communication, and validation checks before an automated action is executed. By combining AI-based predictions with strict security practices, the system prevents faulty decisions, avoids data manipulation, and maintains reliability in sensitive applications.

5. RESULT/ANALYSIS

The analysis of AIoT systems based on the provided documents shows measurable improvements across industries. One of the most notable results is the reduction in downtime through predictive maintenance. AI models analyzing sensor data are able to detect early signs of equipment wear and potential failure. This allows industries to perform maintenance activities at the right time, reducing both repair costs and unexpected production stoppages. AIoT systems also significantly improve accuracy in decision-making.

For example, AI-driven quality control systems can identify defects on production lines more reliably than manual inspection. Similarly, in healthcare, wearable IoT devices combined with AI analytics offer early detection of health abnormalities, leading to timely intervention.

Another key result seen in the documents is improved resource optimization. Smart city systems reduce traffic jams and energy waste by adjusting infrastructure operations dynamically. Smart agriculture systems optimize irrigation and fertilizer usage, reducing costs and improving crop productivity. Across all sectors, AIoT increases visibility, transparency, and responsiveness. Systems become capable of monitoring conditions continuously and reacting to changes faster than a human operator could manage. The analysis further indicates that hybrid cloud-edge architecture is highly effective.

Cloud computing handles heavy model training tasks, while edge devices enable real-time inference. This distributed approach delivers both accuracy and speed. Overall, the results demonstrate that AIoT systems offer high value in operational efficiency, safety, accuracy, and sustainability.

6. APPLICATIONS

1. Smart Healthcare Monitoring

AIoT supports continuous tracking of vital signs using connected sensors and intelligent algorithms. It helps doctors identify abnormal health patterns earlier and improves medical response time, especially for chronic patients.

2. Smart Agriculture and Crop Management

AIoT devices observe soil moisture, temperature, and crop conditions in real time. The AI layer analyses this data to guide irrigation, fertilizer use, and pest control, leading to better yield and reduced wastage.

3. Smart Parking Assistance

Parking sensors detect available spaces and share this information instantly with users. AI processing at the edge or fog layer reduces delays and improves the accuracy of slot detection, making parking faster and more convenient.

4. Industrial Automation and Predictive Maintenance

AIoT systems track machine vibrations, temperature, and usage hours to predict failures before they happen. This reduces downtime, improves safety, and supports more reliable production cycles in industries.

5. Smart Traffic Management

Cameras and road sensors gather real-time traffic flow data, while AI models adjust signal timings and detect congestion. This leads to smoother traffic movement and helps emergency vehicles reach destinations faster.

6. Energy-Efficient Smart Homes

AIoT devices regulate lighting, cooling, and energy consumption based on user habits. They make everyday appliances more responsive and help reduce overall power usage without disturbing comfort.

7. Retail Automation and Customer Tracking

Smart cameras and shelf sensors combined with AI observe product demand, track inventory, and support unmanned billing systems. This reduces waiting time and helps stores manage stock more accurately.

8. Smart Waste Management

IoT sensors fitted in bins monitor waste levels and send updates to the central system. AI then maps optimal collection routes and schedules, reducing fuel use and keeping public areas cleaner.

9. Environmental and Air Quality Monitoring

AIoT nodes track air pollutants, humidity, and weather conditions continuously. AI predicts pollution trends and assists authorities in planning safety measures or public advisories.

10. Smart Security and Surveillance

AI-enabled cameras analyse motion patterns, recognise unusual activities, and raise alerts in real time. This improves the reliability of surveillance systems and reduces manual monitoring efforts.

11. Supply Chain and Logistics Optimization

AIoT helps track goods, vehicle locations, and storage conditions. AI processes this data to plan efficient routes, reduce delays, and maintain product safety during transportation.

12. Smart Water Management Systems

Connected sensors measure water levels, pressure, and quality in pipelines. AI evaluates this behaviour to detect leaks early and ensures better distribution of water in urban and rural regions.

7. RELEVANCE TO INDUSTRY/SOCIETY

The integration of Artificial Intelligence with the Internet of Things, widely referred to as AIoT, is steadily reshaping how industries function and how society interacts with technology. The relevance of AIoT has grown because modern systems require not only connectivity but also intelligence that can interpret data, predict conditions, and respond autonomously. AIoT brings these capabilities together, enabling environments where machines do more than sense; they learn, adapt, and collaborate to achieve better outcomes.

1. Enhancing Real-Time Decision-Making in Industry

Industries are increasingly dependent on timely and accurate decisions. Traditional IoT systems can collect data from sensors, but the decision-making still depends on human monitoring or cloud processing, which may cause delays. AIoT addresses this by combining sensor networks with local or distributed intelligence. As a result, many operations become faster, more reliable, and more adaptive.

Manufacturing plants use AIoT systems to continuously observe machinery conditions, detect irregular patterns, and predict when maintenance is required. This reduces downtime, prevents expensive breakdowns, and ensures smoother production. The ability to make real-time decisions directly at the edge also decreases the dependency on cloud-only architectures, which often suffer from latency.

2. Improving Efficiency and Productivity

AIoT has significant relevance for industries seeking higher efficiency with minimal resource wastage. Automated optimization is one of the strongest advantages of AIoT-enabled infrastructures. For instance, industrial machines equipped with intelligent monitoring can adjust their operating parameters based on demand, load, or performance trends.

In logistics, AIoT improves efficiency by tracking goods, forecasting delivery conditions, and reducing manual supervision. Warehouses can implement robotic systems guided by AIoT to manage inventory, thereby speeding up dispatch times and reducing operational errors. Even in energy sectors, smart grids powered by AIoT help balance loads, forecast consumption, and reduce losses.

3. Strengthening Safety and Risk Management

Safety is a crucial responsibility for any industrial environment. AIoT has become highly relevant because it helps identify hazardous situations before they escalate. Smart sensors combined with intelligent analysis can detect gas leaks, overheating machinery, electrical abnormalities, or unsafe human activities.

In sectors such as mining, oil and gas, and chemical manufacturing, AIoT helps monitor worker locations, environmental conditions, and equipment health. The system can instantly alert supervisors or automated control units if any danger arises. This not only protects human lives but also saves industries from long-term legal and financial risks.

4. Transforming Healthcare and Public Well-Being

AIoT plays a major role in improving societal health systems. Smart healthcare devices continuously monitor patient vitals and use AI models to detect anomalies. This ensures that critical health conditions are identified early and appropriate action is taken without delay. Remote patient monitoring has become common due to AIoT, making healthcare more accessible to people living in rural or remote regions. Hospitals also use AIoT-based asset tracking to locate essential equipment and maintain organized workflows. The societal impact is extensive because it supports faster treatments, reduces hospital load, and enables well-managed healthcare processes.

5. Enabling Smart Cities and Improved Quality of Life

The relevance of AIoT to society is particularly visible in the development of smart city infrastructure. Smart parking, smart traffic lights, air-quality monitoring, and waste-management systems operate effectively when AI and IoT work together. AIoT systems analyze incoming data to predict traffic congestion, adjust signal timings, guide vehicles to empty parking spots, or alert authorities about pollution peaks. Smart lighting in public areas adapts brightness based on pedestrian movement and surrounding conditions, helping reduce energy usage. For citizens, these applications bring smoother commuting, safer environments, and enhanced urban living standards.

6. Advancing Agriculture and Environmental Monitoring

Agriculture has benefited greatly from AIoT because farms are now able to use intelligent sensors to measure soil moisture, temperature, humidity, and nutrient levels. AI systems analyze this data to guide irrigation, fertilization, and pesticide usage. This leads to better crop health, reduced wastage of water and chemicals, and improved harvest yield. AIoT also supports environmental monitoring systems that track water levels, detect forest fire signatures, and observe climate changes. Such systems protect natural resources and help society address environmental challenges with accurate insights.

7. Supporting Automation and Autonomous Systems

Industries increasingly rely on automation, and AIoT is central to enabling autonomous systems. Robots, drones, autonomous vehicles, and smart assistants operate more effectively when they receive real-time sensor information supported by AI intelligence.

In sectors such as construction, AIoT-powered drones survey sites, check structural integrity, and create detailed layouts. In retail environments, autonomous machines track inventory, identify expired products, and restock shelves. These autonomous operations reduce repetitive labor and support a more streamlined workflow.

8. Ensuring Energy Optimization and Sustainability

Energy management is one of the most pressing challenges for modern society. AIoT contributes to sustainability by intelligently controlling energy consumption in homes, industries, and commercial spaces. Smart meters analyze power usage patterns, while AI systems forecast demands and automatically adjust device operations.

AIoT-led building automation systems control lighting, HVAC, and other electrical components based on occupancy and weather data. This reduces electricity bills, avoids unnecessary consumption, and supports eco-friendly living. For industries, this translates to cost-saving and adherence to environmental norms.

9. Supporting Economic Growth and New Business Models

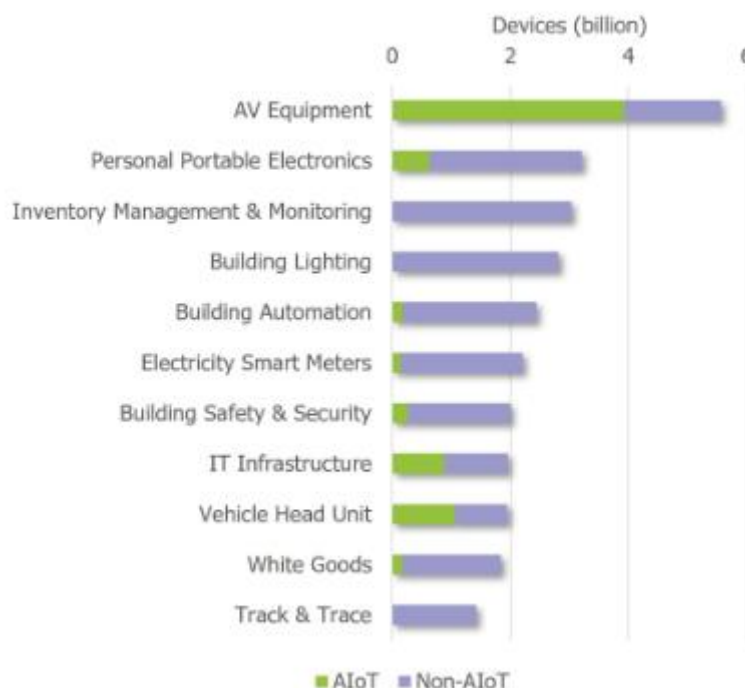
AIoT's relevance goes beyond technology, influencing economic structures and market trends. Industries adopting AIoT benefit from reduced operational costs, improved product quality, and faster time-to-market. Predictive maintenance, intelligent supply chains, and real-time analytics allow businesses to function more competitively. New business opportunities also emerge with AIoT solutions, such as subscription-based monitoring services, AI-driven analytics platforms, and integrated automation systems. This stimulates innovation, creates new job roles, and strengthens the economic development of countries.

10. Increasing Personal Convenience and Daily Life Comfort

In everyday life, AIoT enhances convenience through smart home devices such as intelligent thermostats, automated kitchen appliances, and voice-controlled assistants. These devices adapt to user behavior and create a personalized environment. Wearable devices monitor physical activity, sleep patterns, and wellness indicators. AI models interpret this data to guide users toward healthier lifestyles. Overall, AIoT makes daily routines simpler, more organized, and more efficient.

As per survey of 2023, following is share of AIoT in society application:

Top IoT applications, with AIoT share, 2023



8. CONCLUSION

AIoT represents a major shift from connected systems to intelligent systems. By combining the sensing ability of IoT with the decision-making power of AI and ML, AIoT allows machines and devices to operate more independently and efficiently. The documents clearly show that AIoT improves predictive accuracy, reduces downtime, and increases operational reliability. Whether in manufacturing, healthcare, agriculture, or city management, AIoT enables faster decision-making and better resource use. The conclusion also highlights that AIoT is becoming increasingly important as the world generates more real-time data than humans can process manually. Edge computing plays a major role in ensuring real-time responses, while cloud platforms support large-scale model training.

However, challenges remain, such as ensuring device security, reducing algorithmic bias, and creating standards for interoperability. Addressing these issues is essential for responsible adoption.

In summary, AIoT is set to influence future automation significantly. Its ability to turn raw data into intelligent actions makes it a key element of technological growth and a valuable tool for industries and society.

9. FUTURE SCOPE

The future of AIoT is highly promising, with continuous expansion expected as new technologies mature. Edge computing will become more common, enabling devices to run AI models locally and react instantly to real-world conditions. TinyML will bring AI to low-power microcontrollers, making small sensors capable of intelligent behavior. The rollout of 5G and upcoming 6G networks will support large-scale AIoT deployments, offering extremely low latency and high data capacity. This will enable advanced applications like autonomous transportation, real-time industrial coordination, and immersive smart environments.

Digital twins will play a major role, allowing industries to simulate equipment and processes virtually before implementing changes. Blockchain integration will improve trust, device authentication, and data security in AIoT systems. Overall, the future scope indicates deeper automation, higher accuracy, and wider adoption across all major sectors.

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