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Internet of Everything - A Future Solution?

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Abstract

The Internet of Everything (IoE) represents a smart interaction between people, data, processes, and objects developed by modern internet technologies. The Internet of Things explains the important connections between these elements, transforming raw data into implemented data. The present survey discusses the Internet of Everything and its enabling technologies for the future of IoE. The key features, including artificial intelligence and machine learning, 6G, and advanced networking, and their use in future technologies are mainly explained in this review article. This research work also describes IoE applications and their future uses, such as smart cities, agricultural changes, advancements in transportation, and innovations in social networks. The challenges of IoE include those in agriculture, industry, education, smart cities, and health care. The review article explains how the Internet of Everything provides solutions for the different challenges and provides researchers with a simple understanding of the current situation, limitations, and future scope of IoE-based systems.

Keywords: Internet of Everything (IoE), Internet of Things (IoT), Artificial Intelligence (AI), Enabling Technologies, 6G Communication, Advanced Networking, Intelligent Transportation Systems, IoE Applications, Social Network Innovations.

1. Introduction

The Internet of Everything (IoE) is an advanced network that connects people, data, processes, and devices, ensuring they can communicate with one another. The term IoE describes the connectivity to improve industries. The Internet of Things (IoT) mainly focuses on specific applications such as smart buildings, smart grids, and smart farming. IoE has a more comprehensive method, including machine-to-machine and person-to-person interactions. It is designed for enhancing industrial workflows and large-scale operations to help IoT connections

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instead of individual use cases. IoE connects many devices using internet sensors to collect and analyze data [1]. Recent studies explain the adoption of AI-powered IoE solutions in different areas like smart homes, healthcare, and pandemic management has shown major increases in efficiency, customization, and predictive capacities [2]. However, large-scale implementation of IoE requires an efficient network system, edge computing for low-latency data processing, and an effective transmission method to ensure continuous communication among multiple devices [3]. IoE involves networks, objects, people, and data, where the IoT only considers networks and things. When compared to IoT, IoE supports improved communication, customized services, and smarter system interactions [4]. It provides an analysis of IoT and IoE solutions that contain various interconnected sensors communicating with physical devices, persons, and applications. In [5], the research identified important challenges such as huge connectivity devices, security and privacy, and increased user dependence and unauthorized access. IoE mainly interconnects physical devices and transfers data. It deals with numerous major issues that should be resolved for the purpose of ensuring its reliable and long-term implementation [6]. In the future, the Internet of Everything is designed to address complicated worldwide problems using advanced technologies such as cloud computing, big data analytics, and artificial intelligence to provide more responsive, sustainable, and connected systems. Figure 1 illustrates the applications of IoE, including smart cities, agriculture, transportation, and social networks. IoE develops a network of interconnected devices, appliances, and things that continually broadcast data across the network via sensors. Recent developments in IoE will support technologies like artificial intelligence and high-speed communication networks.

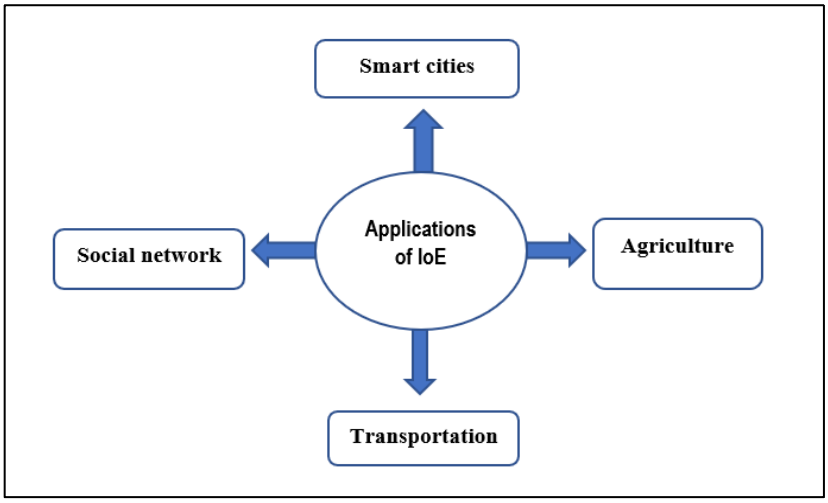

Figure 1. Applications of IoE

1.1 Internet of Everything

The Internet of Everything (IoE) plays a transformative role in industries by connecting processes, people, devices, and data to create smart and efficient systems. In the production field, IoE enables smart factories using real-time monitoring, predictive maintenance, and automated decision-making, which improves productivity and reduces downtime. In the healthcare field, it supports remote patient monitoring, smart medical devices, and data-driven diagnoses, leading to better patient monitoring and improved quality of life. Industries such as transportation and logistics benefit from IoE through smart traffic management, fleet tracking, and optimized supply chains. Additionally, sectors like energy, agriculture, and retail also use IoE to improve resource management, sustainability, and deliver personalized services. Overall, IoE helps industries achieve higher efficiency, reduced operational costs, and improved innovation by enabling simple connections and smart data utilization. The main difference between IoE and IoT is that IoT focuses on physical objects only, but IoE connects people, processes, data, and things across multiple devices. IoE uses micro-controllers in smart systems to improve their performance. IoT architecture consists of sensing/perception, network, data processing, and application layers in a device-centric layered architecture. This connects physical things, including sensors and actuators, for data collection and control. IoE uses an improved and unified architecture that includes people, data, and processes along with devices. When comparing technologies like edge and cloud computing, artificial intelligence, and complex analytics, the IoE architecture encourages interoperability, smart data flow, and large-scale integration to create flexible and scalable systems. From a functional perspective, IoE focuses on higher-level intelligence and value generation by enabling context-aware services, real-time decision-making, and continuous interaction across people, machines, and apps. This architectural and functional comparison illustrates how the IoE developed from basic device connection to an automated, complete system for supporting complex, multi-domain applications. Figures 2 & 3 illustrate the differences between IoE & IoT.

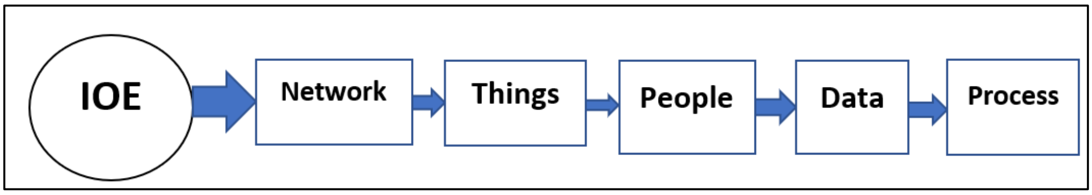

Figure 2. Internet of Everything Follows [3]

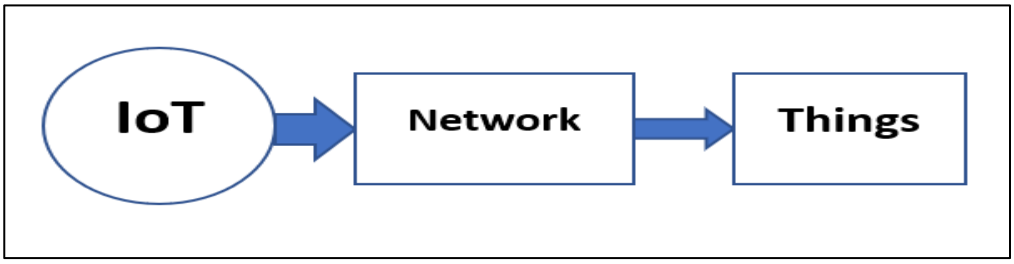

Figure 3. Internet of Things Follows [3]

2. Literature Review

The literature review discusses references and explanations that highlight the importance of IoE. Bajahzar [7] explores the significance of AI-enabled Internet of Everything (IoE) services, highlighting how artificial intelligence enhances decision-making, smart home management, and system adaptability. This study points out the role of intelligent data processing in enabling real-time monitoring and efficient resource utilization within interconnected home environments for predictive control. By integrating AI techniques with IoE infrastructures, the work illustrates improvements in user energy management, experience, and security through context-aware and self-learning mechanisms. This study contributes to the existing literature by emphasizing the importance of AI-driven intelligence as a key enabler for expandable and efficient smart home IoE ecosystems.

Li et al. [8] investigated personal data sensitivity within the Internet of Everything (IoE) context, providing empirical insights based on user perceptions and behavioral data from China. This study systematically analyzes how different categories of personal data are perceived in terms of sensitivity when collected and processed within interconnected IoE environments. This work underscores the need to incorporate privacy-aware design principles and regulatory compliance into IoE architecture.

Mahmud et al. [9] focused on the technical dimension of contextual data acquisition in IoE systems by proposing a smartphone-based framework for collecting contextual information. This research shows how smartphones may be effective sensing platforms for gathering energy usage data in real time. In order to improve system efficiency and user experience, the study highlights the significance of energy-aware data collecting and context modeling. Data management must be carefully balanced with efficient data collecting and intelligent context awareness.

Padhi and Charka-Santos [10] present a theoretical framework for the 6G-enabled Industrial Internet of Everything (IIoE), highlighting the role of communication technologies and the changes of next-generation industrial ecosystems. The study discusses how 6G capabilities, high reliability, ultra-low latency, and data connectivity can support advanced industrial automation and cyber-physical systems. By outlining the architectural components and enabling technologies, the work produces a conceptual foundation for integrating intelligent devices, services, and processes within industrial IoE environments. This contribution advances the identification of research challenges and opportunities of 6G in future industrial IoE developments.

Raj and Prakash [11] conveyed a comprehensive survey of the Internet of Everything (IoE), focusing on key components, associated challenges, and architectural framework. This study fundamentally examines IoE architecture by defining the interaction between networks, devices, data, and services, and also addresses critical issues such as scalability, security, and interoperability. Additionally, the authors discuss the operational and technical challenges that hinder large-scale IoE adoption, including device integration and data management complexity. This work contributes to the IoE literature by providing a structured overview of existing IoE.

The idea of universal transceivers as a fundamental technological enabler for the Internet of Everything (IoE) was put forth by Chivas et al. [12], highlighting its potential to facilitate smooth communication across heterogeneous devices, networks, and frequency bands. This paper explores how intelligent and reconfigurable transceiver architecture might solve important issues within IoE contexts, and outlines future research topics, such as adaptive waveform design, energy-efficient communication, and interaction with evolving networking paradigms, to improve IoE deployment.

Mohd Ali et al. [13] presented a systematic mapping analysis that offers a thorough overview of IoE technologies and current advances. This analysis provides a structured overview of the current status of IoE research and highlights research gaps in security, interoperability, and system integration, while identifying important technological drivers like IoT, data analytics, and advanced networking. This study offers insightful information about the IoE's communication-layer underpinnings as well as its larger technological ecology, which helps guide future research and development.

3. Enabling Technologies for Future IoE

3.1 Artificial Intelligence and Machine Learning

Artificial intelligence (AI) and machine learning (ML) are important technologies that allow next-generation smart systems to provide computational mechanisms for sensing, reasoning, learning, and decision-making. Machine learning is an advanced form of AI focused on data-driven model construction, enabling systems to recognize patterns, determine connections, and improve performance using user experience instead of plain rule-based programming. AI includes a wide range of techniques designed to replicate brain functions [15]. AI and ML use large datasets, complicated statistical learning models, and high-performance computing infrastructures to enable adaptive system behavior, real-time optimization, and predictive analytics across a wide range of application fields. These technologies play an important role in applications such as healthcare diagnostics, smart environments, and data-driven decision support systems, and intelligent automation improves transparency, ethics, and data privacy. IoE-based machine learning issues related to distributed learning and edge intelligence are not addressed in the analysis of IoE enabling technologies. Additionally, edge intelligence is essential to the Internet of Everything (IoE) because it reduces latency and dependency on cloud infrastructure, providing real-time deduction and decision-making near data sources. In IoE support technology, addressing the issues is important to achieve scalable, secure, and intelligent IoE systems.

3.2 6G and Advanced Networking

6G and advanced networking technologies represent the next evolution, aiming to provide ultra-high data rates, very low latency, massive connectivity, enhanced reliability, and wireless communication systems to support future digital ecosystems. The basis of 6G is expected to include artificial intelligence-driven optimization, continuous integration of terrestrial, aerial, and satellite networks, and smart network management. These advancements enable applications such as autonomous systems, smart cities, immersive extended reality, and the Industrial Internet of Everything. [16] Additionally, advanced networking architectures include software-defined networking, network slicing, edge and fog computing, and resource efficiency plays an important role in improving scalability and real-time responsiveness. 6G and advanced networking introduce challenges related to security, standardization, interoperability, and energy efficiency, which remain active areas of research.

3.3 Key Features of 6G Networks

6G is expected to deliver very high data rates, possibly achieving terabits per second. It increases the available bandwidth to support real-time, data-intensive services. 6G latency within the microsecond range systems supports immediate communications for real-time control systems, the sensory internet, and safety-based applications like automated vehicles and remote surgery. 6G network layers include artificial intelligence (AI) and machine learning (ML), allowing self-healing, autonomous resource allocation, and real-time network optimization. This helps in complicated management and continuously changing environments in IoE. Networks will use advanced security designs, including post-quantum cryptography, zero-trust models, and AI-driven threat detection, to protect large and different IoE installations. Figure 4 represents the components of 6G and advanced networks.

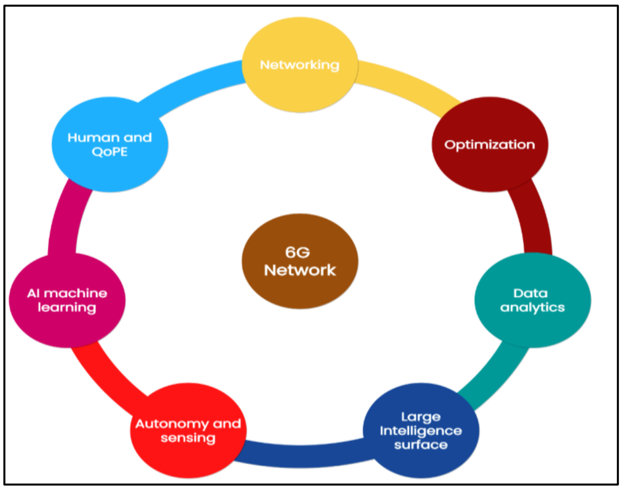

Figure 4. 6G and Advance Networking Components [16]

4. Internet of Everything in Industries

In industrial environments, IoE plays a main role in smart manufacturing and industry by process automation, real-time monitoring of devices, and enabling predictive maintenance. IoE supports industrial safety, energy management, and supply chain optimization. It connects workers, machines, and management systems. The Internet of Everything (IoE) in industries refers to the comprehensive integration of intelligent machines, data, people, and connected devices within industrial environments to enable smart and independent operations. IoE increases operational efficiency, smart analytics, productivity, and decision-making by improving current industrial systems with advanced sensing and real-time connectivity. Technologies such as edge computing and advanced networking support predictive maintenance, quality control, and resource management across manufacturing, artificial intelligence, and industrial sectors.

4.1 Applications of IoE in the Future

4.1.1 Smart Cities

The Internet of Everything (IoE) plays a significant role in the development of smart cities by enabling the seamless integration of data, people, devices, and urban processes into a unified digital ecosystem. IoE supports efficient management of city services such as transportation, waste management, public safety, healthcare, and energy. The use of technologies including cloud and edge computing and artificial intelligence optimizes resource utilization, improving the quality of life for citizens. Smart cities are complex systems interconnected with technological systems, smartphones, applications, services, and data exchanged between them [17]. IoE is being adopted for the development of smart city applications. This application checks the conditions of air quality in cities and collects traffic data for environmental observations. In IoE, the smart city application will generate data from different sources in various patterns used to prevent interoperability systems.

4.1.2 Agriculture

Agriculture is most important for humans and a backbone of national economies, job creation, and generating foreign exchange through exports. It is also very important in historical establishments. [18] Combining agriculture with the IoE results in monitoring and controlling agricultural systems using mobile phones.The Neolithic Revolution gave rise to agriculture 1.0, defined by the change from hunting and gathering to permanent farming with basic implements like hoes and ploughs. Although, it was highly dependent on manual labour and environmental factors. The British agricultural revolution corresponds to Agriculture 2.0, where mechanization, crop rotation, and selective breeding highly increased productivity and efficiency. The Green Revolution, which defined Agriculture 3.0, explains high-yield crop varieties along with chemical pesticides and fertilizers. This led to a significant rise in the world's food production, but it also created issues of sustainability and the environment. Agriculture 4.0 combines technology for communication and information (ICT) to enable accurate farming, real-time monitoring, and data-driven decision-making. Agriculture 5.0

includes technologies such as virtual and augmented reality, quantum computing, nanotechnology, smart materials, advanced genetics, and highly accurate plant-level and sustainable systems based on the Internet of Everything. In agriculture, smart harvesting allows farmers to automate their harvesting process, which reduces labour costs and maintains time efficiency. The use of agricultural robots for fruit harvesting supports the development of smart agriculture. Several categories of agricultural applications include smart water management, smart monitoring, smart harvesting, and disease control. These are the categories of applications in agriculture.

4.1.3 Transportation

Future transportation applications enabled by the Internet of Everything (IoE) are expected to transform mobility systems by using infrastructure, users, and data in a smart and interconnected system. The application of the Internet of Everything provides interconnectivity with mobility, safety, and efficiency. IoE also optimizes logistics and supply chain management by providing real-time tracking, predictive maintenance, and route planning. IoE refers to the integration of vehicles, traffic systems, and mobility systems. IoE also increases the efficiency of public transportation systems by improving management, scheduling, and passenger data services.

4.1.4 Social Networks

Social networks in the Internet of Everything play a significant role by connecting people with smart devices, data, and processes to enable socially driven services. Data generated from social interactions are combined with sensor and environmental data, healthcare, and emergency response systems. Social networks provide communication, online connections, and adaptive communities that create complex structures similar to traditional social networks. Overall, social networks in IoE support more interconnected, intelligent, and responsive socio-technical systems.

4.1.5 Smart Harvesting

Smart harvesting in IoE represents a transformative approach for modern agriculture by integrating connected systems across the entire farming ecosystem. IoE-enabled harvesting devices automatically adjust the height, speed, and quality of resource efficiency. Smart harvesting systems utilize data from soil, crop, and environmental sensors to determine optimal harvesting to improve the quality and reduce the loss of data. Smart harvesting contributes to sustainable agriculture by improving productivity and supporting environmentally responsible farming practices. Table 1 represents the future applications of IoE, and Table 2 illustrates the differences between IoE and IoT.

Table 1. Future Application of Internet of Everything

Application Domain	Future IoE Applications	Key Benefits and Outcomes
Smart Cities	Traffic management, waste management, smart surveillance, smart energy grids, and E-governance systems.	Improved efficiency, enhanced public safety, reduced congestion, energy optimization, and sustainable city development.
Agriculture	Precision farming, soil and crop monitoring, smart irrigation, livestock tracking, water level sensors, temperature sensor, and climate-adaptive farming systems	Increased crop productivity, providing essential food, supporting rural development and poverty reduction, efficient resource utilization, reduced environmental impact, and improved food security
Transportation	Connected and autonomous vehicles, smart parking, predictive maintenance, fleet management, and real-time traffic monitoring.	Enhanced road safety, enabling economic growth, social connection, environmental improvements, efficient mobility, reduced travel time, lower emissions, and improved transportation reliability.
Social Networks	Context-aware social platforms, community-based services, emergency communication, human–device interaction, and social data analytics.	Global connectivity, community building, real-time information sharing, improved social connectivity, Personalized services, and enhanced decision-making.
Smart Harvesting	Automated harvesting systems, adjust the height, crop maturity detection, speed and quality, intelligent sorting, yield prediction, and post-harvest monitoring.	Boosts yields and quality, reduced labor dependency, reduced costs, minimized post-harvest losses, sustainability, improved yield quality, and increased agricultural sustainability.

Table 2. Differentiation between IoT and IoE

	Internet of Things (IoT)	Internet of Everything (IoE)
Definition	IoT connects sensors and physical devices to the internet.	IoE connects people, data, processes, and things into an intelligent ecosystem.

Scope	Restricted to communication between devices.	Wide-ranging, comprehensive integration of processes, people, and technology.
Architecture Focus	Device – centric and connectivity oriented.	Process – driven and intelligence focused.
Data Processing	Cloud – based processing that is primarily centralized.	Cloud, fog, and edge computing for distributed intelligence.
Application Nature	isolated and domain – specific.	Adaptive, Integrative and cross – domain.
Typical Use of Cases	smart homes, smart meters, and industrial monitoring.	IoE digital twins, intelligent industries, smart cities, and healthcare ecosystems.

4.2 Future Challenges in IoE

Future problems in the IoE include social, technological, and organizational factors. One of the most significant issues in IoE is that as devices, people, data, and processes increase, the possible chances of data loss and cyber-attacks also increase. Several issues have included internet-connected devices. Some issues can be classified as below,

- **Agriculture:** The future challenges in agriculture are increased due to the impacts of the environment, socio-economic constraints, climate change, and weather changes; water scarcity directly affects crop productivity and food security. [19] The Internet of Everything provides a solution through agriculture and automation.

- **Industry:** In industry, increased technological advancements and environmental and socio-economic demands are the future challenges. Industries face high pressure to improve energy efficiency and reduce productivity and profitability. The major challenges in industry include workforce upskilling, labor shortages, and skill gaps. The Internet of Everything provides a solution for industry by smartly connecting people, processes, data, and things into a system. This interconnected ecosystem helps industries reduce costs and create new ideas about the business or operations to create new and better opportunities. This field requires comprehensive architectural validation to ensure interoperability, scalability, and dependability. Industrial IoE systems must be verified using practical limitations such as heterogeneous device integration, high data throughput, latency requirements, and fault tolerance. Additionally, architecture validation is required to analyze performance under various workloads and failure situations and to confirm security and safety regulations of industrial standards.

- **Education:** Future challenges in education require increasing demand for diverse and high-quality learning experiences. Digital educational platforms provide challenges in teacher preparation, curriculum redesign, and maintaining student engagement and learning results in online learning. Now, the educational system is becoming more digitized. Technological and curricular challenges in education transfer from rote memorization to creativity, critical thinking, and problem-solving. The Internet of Everything provides a solution for education by creating smart classrooms that enable adaptive learning and improve campus management through connected devices. It leads to better engagement, real-time skills, and future-ready skills for students.

- **Smart Cities:** Future challenges in smart cities are increasingly complex due to rapid technological integration, rapid urbanization, and sustainability requirements. Data security and privacy issues are increasing in smart cities due to data collection from connected systems. Future challenges for smart cities involve huge data management, finance, infrastructure integration, and maintaining people's trust and participation. Key challenges include large investment, navigating complexity, creating seamless ecosystems, and maintaining privacy. The Internet of Everything provides a solution for smart cities by connecting devices and enabling intelligent analysis. Services like traffic and energy, and collecting real-time data via sensors, lead to a higher and better quality of life for citizens by informing decisions for resource management.

- **Healthcare:** Future challenges in healthcare are based on the quality and accessibility of patient care. One of the main challenges in healthcare is the high population of elderly patients, chronic diseases, high costs, and workforce capacity. Financial pressure is also one of the main problems in this application. The Internet of Everything provides an effective solution by connecting medical devices, patients, data-driven diagnoses, and healthcare professionals into a unified digital ecosystem. IoE contributes to the preventive and effective addressing of these challenges faced by modern healthcare systems.

5. Conclusion

Finally, the Internet of Everything (IoE) supports real-time data sharing combined with advanced analytics. IoE transforms raw data into functional data for decision-making. Real-time monitoring is used to handle major challenges and improve service delivery, illustrating the necessity of proactive solutions for smart cities, industrial processes, and network transportation. The application of IoE-based systems faces challenges in the areas of security, privacy, scalability, and data management. Recent research related to IoE shows the potential for developing a future-oriented model for data transformation and development. This study discusses previous research efforts, highlights existing limitations, and proposes research methods to encourage the development of safe and efficient IoE-based systems. Overall, IoE has been identified as an important support for smart, interconnected networks to improve quality of life and encourage innovation in modern society.

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