WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

The Use of IoT in Manufacturing

Dr. A.K Madan [*1], Samardeep Singh Mahur[*2]

[*1,*2] Mechanical Engg., Delhi Technological University, Delhi, India

ABSTRACT

The Internet of Things (IoT) has become a prominent technology that enables different devices to communicate and understand each other via the internet. IoT leverages Artificial Intelligence (AI) algorithms to process data collected by various sensors and take appropriate actions. IoT is being utilized in various industries such as manufacturing, agriculture, education, and commerce, among others.

Keywords—IoT; modern technology; manufacturing; industry 4.0;

1. INTRODUCTION

The internet has had a significant impact on our lives, and the Internet of Things (IoT) is poised to do the same again. From its origins as Arpanet in 1969, the internet has become a critical driver of the high-tech industry, with its distinctive social network. The IoT represents the next phase in the internet's evolution, and by 2022, it is forecasted to have 29 billion devices and generate over $10 trillion, leading to a significant and influential impact on the high-tech industry in general, and especially the semiconductor industry. IoT devices have a broad range of applications, including home automation, smart power, fleet management, and environmental management. The simplicity of semiconductor devices, reduced development costs, and a wide range of applications drive innovation, creativity, and new technology[1]. The IoT is opening up an unprecedented era of IC design opportunity for small to medium-sized companies worldwide.

2. ENHANCED UNDERSTANDING OF THE INTERNET OF THINGS (IOT)

The Internet of Things (IoT) is paving the way for a smarter, more connected world with unlimited potential for new services, applications, and systems. By combining the internet, wireless sensor networks, and data fusion, computational intelligence can be integrated into the physical environment. IC design in the IoT era will transform and shape semiconductor innovation and manufacturing. Data is collected through sensors, and IoT devices facilitate data exchange through a web server. Various sensors are integrated into in-house, customizable, and cost-effective IoT systems that connect to mobile apps. The IoT is a powerful and pervasive technology that can be used in numerous applications, including managing liquids, monitoring stocks, building alarm systems, and controlling smart homes, among others[2].

3. THE FOURTH INDUSTRIAL REVOLUTION AND ITS IMPACT ON INDUSTRY

The first industrial revolution took place between the late 1700s and the early 1800s, during which manufacturing shifted from manual labor with the help of work animals to using water and steam-powered engines and other machine tools for more efficient production. The second industrial revolution began in the early 1900s with the introduction of steel and electricity, which led to greater mobility of factory machines and the adoption of mass manufacturing methods such as the assembly line to boost productivity. The third industrial revolution emerged in the late 1950s as manufacturers started to incorporate more electronic and computer technology into their operations, shifting from analogue and mechanical to digital technology and automation software.

In recent decades, a fourth industrial revolution, also known as Industry 4.0, has emerged, powered by the interconnection of devices via the Internet of Things (IoT), real-time data access, and the introduction of cyber-physical systems. Industry 4.0 takes a more comprehensive, interconnected, and holistic approach to manufacturing, bridging the gap between the physical and digital worlds to improve cooperation and access across departments, partners, vendors, products, and people[4]. It provides business leaders with deeper insights and control over all aspects of their operations, using real-time data to improve productivity, streamline processes, and accelerate growth.

4. THE SHIFT FROM INDUSTRY 3.0 TO INDUSTRY 4.0

Industry 3.0 saw the introduction of computers, which was a disruptive technology at the time. However, Industry 4.0 takes this to a whole new level, as computers now communicate and make decisions with each other through cyber-physical systems, the Internet of Things, and the Internet of Systems.

This level of interconnectivity and automation means that smart machines can operate without the need for human intervention and become more intelligent with access to more data. Industry 4.0 enables factories to become more efficient and productive through digitally connected machines that can create and share information.[3]

5. SHIFTING PATTERNS OR TRENDS

The rapid development of the Internet of Things (IoT) is leading to a world where billions of devices can connect, communicate, and share data over networks. This interconnectedness provides a vast amount of data that can be collected, evaluated, and used to inform decision-making and management processes. [5] The impact of IoT on our daily lives is already apparent, influencing how we shop, work, play, and maintain our health.

6. DIVERSE RANGE OF APPLICATIONS

The Internet of Things (IoT) is a fast-evolving technology that has numerous applications, functions, and services in various industries and sectors. Although there have been recent advancements in ubiquitous computing and the potential for many more applications, only a few are currently available. [6] The main objective of IoT applications is to enhance the quality of life for end-users and support infrastructure and general-purpose operations. The complexity and scale of the problems that can be solved using IoT solutions, as well as the unique needs and requirements of different domains and contexts, make it possible to apply them in many different areas.

- Transportation and logistics domain: This domain involves the use of IoT to improve logistics operations, such as tracking and monitoring shipments, assisting with driving tasks, and enabling mobile ticketing. It also includes the use of IoT for environmental monitoring and creating augmented maps for navigation.
- Healthcare domain: The healthcare domain utilizes IoT for a range of applications, including tracking patient health and activity, identifying and authenticating individuals, collecting and analyzing health data, and sensing environmental factors that can impact health outcomes.
- Smart environment domain: This domain focuses on creating more comfortable and efficient homes, offices, industrial plants, and other environments using IoT. Examples of applications in this domain include smart thermostats, lighting, and security systems, as well as smart museums and gyms.
- Personal and social domain: The personal and social domain of IoT includes applications related to social networking, historical queries, and theft prevention. For example, IoT can be used to track lost or stolen items and to provide users with historical information about places they visit.
- Futuristic domain: This domain includes a range of cutting-edge applications for IoT, such as robot taxis that utilize autonomous driving technology, city information models that enable more efficient urban planning, and enhanced game rooms that offer immersive gaming experiences using IoT sensors and devices.

7. VALUABLE APPLICATIONS IN INDUSTRIAL SETTINGS

Smart manufacturing is a concept that has been around since the late 1980s and gained attention as a research topic in the late 1990s. It was widely adopted in 2013 with the German "Industry 4.0" project. The use of ICT is central to smart manufacturing, as it maximizes the use of resources to create customized and high-quality products while responding to market needs and changes in supply chains. In the past, the standards-setting environment for smart manufacturing was similar to that of the ITS sector, with a small number of firms and limited connections between them. However, the situation has since changed, with a nearly tripled number of key actors and new forms of connections. Communication is crucial in smart manufacturing, as it requires an underlying communication infrastructure that meets specific characteristics such as latency, resilience, dependability, and predictability. Standards for this infrastructure are expected to be more broadly adopted than those for the apps that use it and, as such, are a more lucrative field, at least in the early stages of development.

8. INTELLIGENT MANUFACTURING

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9. SMART CITIES

The most comprehensive application area of smart technology is likely in the realm of "smart cities." A smart city encompasses various smart systems such as smart buildings, smart grid, smart transportation, e-health services, and smart production sites. Building a smart city is a complex task, and according to a study by TU Vienna, there are 90 smart cities with populations of 300,000 to 1,000,000 people and 77 cities with populations of 100,000 to 300,000 people. While there are several pilot projects and small-scale advancements, there is currently no example of a large-scale smart city, as reported by Navigant in 2013.

10. SAFETY

The use of IoT in manufacturing can improve safety and security for both the site and employees. By processing large amounts of data about the equipment, IoT can quickly identify and address any malfunctioning machines before they cause health and safety issues or workplace accidents. Additionally, IoT can monitor environmental conditions and prevent harmful substances from being released into the atmosphere. Overall, IoT plays a critical role in ensuring safety and security in the manufacturing industry.

11. ENSURING QUALITY CONTROL

The Internet of Things (IoT) is a crucial tool for product development and quality assurance in manufacturing. It allows for the monitoring of materials, manufacturing environment, temperature, waste generated per product, and other factors at every stage of the manufacturing process[9] . Plant managers can receive comprehensive reports on each step of production, transportation, and distribution of finished goods. This data can be used to identify issues in product quality, equipment, process, environment, and transportation vehicles.

12. CLOUD COMPUTING TECHNOLOGY

Cloud computing plays a crucial role in enabling Industry 4.0 and digital transformation. It provides numerous benefits, including speed, scalability, storage, and cost savings. Furthermore, it paves the way for advanced technologies such as artificial intelligence, machine learning, and the Internet of Things. Cloud computing enables businesses to innovate and store the data needed for Industry 4.0 technologies. The cyber-physical systems at the core of Industry 4.0 interact and coordinate through the cloud.

13. OBSERVED AND PROVEN BENEFITS

Many companies are adopting Industry 4.0 solutions to modernize their supply chain processes. These solutions involve revamping production processes, prioritizing customer needs, and connecting all parts of the organization. By using data to drive decision-making, companies are improving their forecast accuracy, meeting delivery deadlines, and developing optimized strategies for maximizing profits. Industry 4.0 solutions are also helping companies to plan for economic fluctuations and trends. By adopting sustainable and environmentally-friendly practices, companies are reducing costs and improving market efficiency, while still achieving profitability and scalability. Additionally, digitalization is allowing companies to experiment with new products and markets.

CONCULSION

The world is constantly changing, and technological advancements like the Internet of Things (IoT) are playing a major role in our daily lives. The adoption of IoT and related devices has been rapidly increasing and is expected to continue to do so in the future. With large investments being made in this area, the use of IoT technology is becoming more accessible and affordable to people from all walks of life. As a result, IoT is becoming more widely used and integrated into our daily routines, making our lives more convenient and efficient. The widespread adoption of IoT is also creating new opportunities for businesses to improve their operations and enhance their customer experience. Overall, the future of IoT looks promising and it will continue to shape the way we live and work in the years to come.

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