

Internet of Things with Sustainability

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Abstract

The Internet of Things (IoT) has become a significant facilitator for sustainable development and has begun influencing society. This paper aims to investigate the relationship between IoT and sustainability while critically analyzing recent research. A survey of the literature on IoT technologies and their positive effects in various industries, including farming and sustainable urban development, makes up the research approach. The goal is to provide a thorough, comprehensive review of how IoT might contribute to sustainable development and address contemporary environmental challenges globally. In addition to highlighting the value of IoT technologies in environmental protection, the report stresses how important it is for all stakeholders to use these technologies now and in the future. The present paper's primary contribution to the body of knowledge on environmental protection, sustainable development, and IoT technologies is its enrichment. One of the concepts that is thought to enable sustainable digital transformation and ecological preservation is the Internet of Things (IoT). IoT is becoming a potent enabler in several application areas, including supply chain management, smart cities, smart industry, environmental monitoring, water and energy management, and health. This study adds to the body of knowledge in academia and industry by highlighting a potential connection between sustainability and the Internet of Things. Researchers and marketers are interested in this topic.

Keywords: technology, environment, Internet of Things (IoT), sustainability, and sustainable development.

Overview

Scientists have warned of the impending environmental catastrophe since the turn of the twenty-first century. The actions that have gotten us to this point—the unprecedentedly high emissions of greenhouse gases into the atmosphere, the excessive use of the planet's finite resources, and the ongoing devastation of the environment and natural world—need to change. Furthermore, the need to place sustainable development at the center of both present and future progress and prosperity has been underlined by the COVID-19 pandemic, issues arising from Brexit, and shifts in corporate social responsibility. Climate change, biodiversity loss, and the impending water crisis are a few of the most pressing environmental issues. Governments and nations all around the globe are now attempting to create sustainable strategies and solutions.

Internet of Things (IoT) applications may improve the environment. Recently, there has been research on the positive association between IoT and sustainability. The influence of IoT on resource preservation, smart farming, and sustainable urban development is discussed in the present article. These ideas have changed significantly in recent years, emerging as corporate possibilities and major worldwide concerns in contemporary society. The study aims to investigate and explain the actual consequences of IoT technology in various areas via contemplation and analysis. Owing to the growing interest in contemporary technology around the world, the connection between sustainability and IoT has become a

Study a topic that is both relevant and helpful. This exploratory research aims to experimentally assess the current state of knowledge on the link between IoT and sustainability and the adoption of IoT across different industries. The article begins by reviewing recent research on IoT technology and sustainable development. Second, it examines the connection between smart cities, sustainable urban development, and the Internet of Things. Thirdly, it outlines the primary issues and difficulties of IoT, smart farming, and resource preservation.

Smart cities and sustainable urban development with IoT

Urbanization is a definite global trend. By 2050, two-thirds of the world's population will live in cities. The globe will face more pressure to manage waste and sewage, handle rubbish, and provide transportation, electricity, water, and other resources associated with an urban lifestyle. It is possible to construct and remake modern cities sustainably. A wide range of sectors have begun using IoT technology. For instance, "many Internet of Things, such as GPS, GIS, and remote sensing, are finding popularity in smart mobility for optimal travel routing, impacting travel decisions." Every public space has RFID and IP cameras installed, providing commuters with increased protection. IoT technologies are being used with physical objects related to public utilities, such as electricity, water, and air, to improve efficient usage in various modes of the sources-transmission-destination.

New urban regions with high-quality living might be created with the help of sustainability, cutting-edge technology, and digitalization in urban planning. Green policies, sustainable water management, and environmental care should be the foundation for developing sustainable and environmentally friendly "smart" cities in the present and the future. Through innovative management, digitalization, and advanced technology, human existence may be changed by "ubiquitous and smart services like hybrid vehicles" and renewable energy sources (Mohammadian & Rezaie, 2020). Creating design systems that actively preserve natural and environmental systems is how the Internet of Things (IoTs) is believed to be used in contemporary urban planning.

IoTs may be used for the following purposes as examples of what can make up a smart city's ecosystem:

- intelligent grid load prediction (i.e., energy consumption forecast).
- water demand forecast (using a variety of data sources).
- route planning that takes traffic occurrences into account.

- forecasting the availability of parking spaces (García et al., 2016).
- Resolving traffic and congestion in cities. Enhancing the efficiency of transportation networks.

From the fishing hamlet of the past, Amsterdam has developed into the Sustainable Smart City of today. The city has constructed charging stations, intelligent LED lighting, smart meters, and smart grids and encouraged the usage of electric cars. These should promote more effective urban.

Sustainable development, robust social cohesiveness, innovation and economic growth, and management (Somayya & Ramaswamy, 2016). There are difficulties in using IoT in urban development. Significant investments and well-thought-out preparation are needed to guarantee its success. According to García, Ruiz, and Gómez-Nieto (2016), as a result, both modern and future cities will be heavily dependent on government engagement to build the means required to provide inhabitants with services equitably and sustainably while also guaranteeing quality of life. Given the current obstacles, the role and need for both local and federal governments to be involved in implementing IoTs for sustainable city development is essential. Developing models and proof-of-concept implementations that support sustainability objectives has presented some problems. The potential of IoT to create vast volumes of data is hampered by its inability to be stored, analyzed, modeled, or transformed into input for privacy-focused decision-making. Policies, financial rewards and tax credits, industry generosity, and system analysis and design are a few ways to promote the integration of sustainability objectives into IoT project design and system analysis. Sustainable IoT growth requires an effective business strategy (Salam, 2019).

Resource conservation and IoT: Intelligent farming

The next several decades should see an increase in the global population. UN, 2017). This will unavoidably cause pressure on food supplies and the agricultural output that supports them to rise steadily, especially in conjunction

with rising living standards, incomes, and the globalization of the Western consumerist lifestyle. The world's most developed countries now practice intensive agriculture, and a fast-growing global need for food may serve as a spur for (1) using ever-more-intensive techniques to increase agricultural production (by using extensive amounts of water, fertilizer, pesticides, and land);

(2) Quickening the removal of forests to make way for cultivating lucrative and productive land.

IoT and AI applications in technology may provide an option for making better use of the few available resources and achieving the growth necessary to feed the world's population. Agriculture has always used technology. For a considerable amount of time, various equipment has been used to carry out fundamental tasks, including tracking soil humidity, determining the direction and strength of wind, and identifying specific soil characteristics. The emergence of the Internet of Things (IoT) presents fresh prospects for the widespread integration of these technologies. Additionally, the devices may be connected to data transmission networks, information processing apps and solutions, and modeling algorithms that integrate the information mentioned above to make intelligent agricultural choices.

Several factors may catalyze more intelligent agricultural techniques that lead to better resource management and higher yields. First, "smart" agricultural devices: a range of sensor types capable of measuring air and soil temperature, humidity, compaction, air permeability, wind direction and speed, and atmospheric pressure. Second, "smart" gadgets share data with wireless communication networks. Third, server- or cloud-based software solutions for gathering, storing, and processing the data produced by (1) and sent by (2). Fourth, models and algorithms driven

by artificial intelligence can map and model the condition of a particular crop and assist in making business decisions about when and where to plant, harvest, irrigate, water, fumigate, apply pesticides, fertilize, etc.

The kind of data (rainfall, humidity, temperature, soil moisture, salinity, climate, heat and direct sunlight, pest alerts) that would be produced by implementing and utilizing IoTs in agriculture could support farming decisions to boost productivity and quality, making the best use of resources, and providing much-needed profits for the farmer. For instance, knowledge of soil humidity helps reduce the likelihood of pests and crop illnesses. Farmers can determine the best time and volume for irrigation or watering when combined with precise meteorological information. Pest management choices that maximize the quantity and time of utilizing (or not using) agricultural pesticides may be made by anticipating the movement of pests. “IoT water systems and energy technologies can help reduce water usage and offer new ways for cleaning and recycling” (Salam, 2019, p. 27) concerning water management.

Through AI algorithms and an additional layer of data modeling and analytics, IoT has the potential to improve productivity, lower resource use and environmental impact, lower costs, and raise profitability. In particular, the prudent use of water for irrigation and the implementation of Insecticides and fertilizers used correctly—where, when, and how much—are critical components of sustainable agriculture. IoT can engage farmers and industry organizations while promoting sustainable farming practices that provide lucrative, safe, and healthy agricultural goods (Salam, 2019).

IoT has the potential to significantly change agriculture. However, these opportunities have several obstacles and

limitations, mainly the cost of implementation and farmer profitability. However, IoTs in agriculture will only accelerate due to increased competitiveness and government policies supporting more sustainable growth (Elijah et al., 2018). As IoTs grow increasingly ingrained in our everyday lives, the road ahead is undoubtedly promising and something to look forward to despite some trends and projections (Laine, 2014). (Hristov, 2017).

Conclusion

In summary, IoT technologies have enormous potential to facilitate and assist sustainable development. IoT plays a massive part in sustainability research, with scientists conducting studies across several sectors. Creating smart cities can be essential for community stability and management, farming, water management, and recycling. The consequences for research, practice, and policy, as well as future analysis and research directions, are discussed in the paper's conclusion. Significant and ongoing developments are occurring in IoT technology right now. As this article urges, further empirical study is needed to determine consumers' knowledge of and willingness to accept such technologies in their everyday lives. Future studies on this still-emerging topic should concentrate on the relationship between IoT and other environmental factors, such as waste management, hydric stress, water shortages, or ocean conservation.

Creating a successful business plan is essential for long-term IoT marketing growth. According to Lorek and Spangenberg (2014), the system's adjustments to address environmental challenges, primarily driven by technological advancements, were a disaster. They concluded that while not reasonably sufficient, economic growth based on "technological innovation" is a necessary and significant step towards sustainable development.

This research connects IoT and sustainability, benefiting corporate and academic literature. First, it adds new data to an area that needs further study: the effects of IoT technology on some of the most significant environmental elements. Second, the article covers IoT and sustainability—two dynamic and pertinent current and future ideas. The study, above all, shows that IoT and sustainability can coexist.

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