



INTERNET OF THINGS (IOT) FOR SUSTAINABLE DEVELOPMENTS

Dr. Rekha G Nair, Dr. Geetha G, Dr. AnilKumar K. R, NSS College Of Engineering, Kerala

Abstract

The Internet of Things (IoT) is constantly developing due to the extensive use of networked, intelligent sensor technology. In the future, hundreds of billions of intelligent sensors and gadgets will communicate with one another and machine-to-machine (M2M) without the need for human interaction. Even in remote physical contexts, they will produce vast amounts of data and will give people information and control over things and occurrences. This paper studies the major areas in which IoT finds applications.

Key words : Internet of Things, Sustainability, agriculture, industry, waste management

I. Introduction

The Internet of Things (IoT) is a network of sensors collecting data for further processes. The rapid development and applications of Internet of Things (IoT) technology has enabled breakthroughs in all spheres of life. IoT technology aims to streamline procedures and improve efficiency across various fields and eventually to enhance life quality and provides a better living environment.

While these technologies offer numerous benefits, they must be carefully monitored and evaluated from an environmental perspective to avoid negative impacts and maximise the use of limited global resources. So the rapid development of IoT technologies has raised concerns about sustainability. This shows that further research is necessary to properly understand the benefits and drawbacks of IoT [1-5].

The Internet of Things (IoT) has a wide range of application areas, and the most prominent sectors are illustrated in Fig. 1. The primary and rapidly advancing domains of IoT are linked to industrial applications, agricultural applications and the smart city initiatives. Other notable sectors include transportation, smart energy management in buildings, power network management, and waste management, all of which exhibit considerable potential. The growth of specific IoT application areas is significantly influenced by several critical factors, including: - advancements in electronic components, developments in sensor technologies and data acquisition methods, the quality of network infrastructure and connectivity, adequate energy supply for the production and operation of IoT devices.

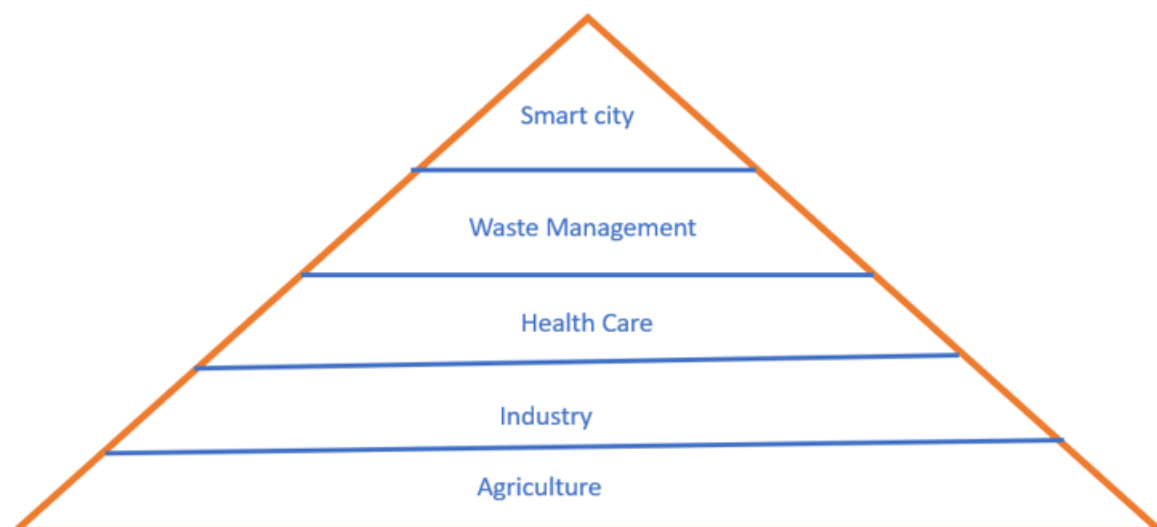


Figure-1 Major areas which find applications of IoT.

The integration of IoT technologies in industrial settings can enhance production efficiency and facilitate improved communication and networking between operators and machines. This integration

is expected to foster greater competitiveness among companies by enabling more effective quality control and reduced losses. A crucial aspect of this development is the design, integration, and deployment of various essential sensors within industrial applications which are necessary for creating cohesive and efficient management systems. There is a huge need for intensified research efforts to optimize the application of IoT technologies in the industrial sector and to gain a deeper understanding of how these technologies can be effectively implemented across different areas leading to sustainability like agriculture, industries, waste management etc.

This study focusses on some key areas of IoT applications, the main developments and challenges in these areas are also discussed and the paper is organised with an introduction of IoT in section I. The major applications and the major developments in the field of industry and agriculture and waste management are discussed in section II and the paper concludes in section III.

II. Major areas of applications and developments

The major areas of applications of IoT includes agriculture, industry, wearable devices, smart city, waste management, energy management etc. Among the different areas, this paper focus on applications related to agriculture, industry and waste management.

(a). Agriculture.

One of the earliest human pursuits, agriculture is still a fundamental aspect of our culture. It has undergone significant transformation throughout time to meet the demands of a growing world population, adapt to changing climatic conditions, and address sustainability-related concerns. The agricultural landscape has been significantly impacted by the interaction between agriculture and key factors such as population dynamics, climate change, sustainability, and the size of the global market. In order to feed the world's growing population, the agricultural industry must produce adequate food. To boost productivity, innovative agricultural technologies are required, such as crop management systems and soil sensing systems. Sustainable agriculture, can be considered as a farming method that aims to meet the needs of the current generation without endangering the capacity of future generations to meet their own needs [6,7]. Its main goal is to lessen agriculture's detrimental effects on the environment while still enabling farmers to support themselves and produce wholesome food. It might assist regional food systems, encourage rural development, create jobs in rural areas, and strengthen the economies of neighbouring towns and farms. So, sustainable agriculture is an essential farming practice that might help to guarantee that future generations have access to food and a healthy environment [8,9]. IoT based applications like sensing the humidity in soil, sensing the change in colour of leaves, fruits etc. will help to improve the yield and will increase agriculture sustainability. Precise seeding and use of fertilizers and other nutrients with the help of IoT will ensure sustainability in the field of agriculture. Some IoT based applications in agriculture is shown in Figure .2.

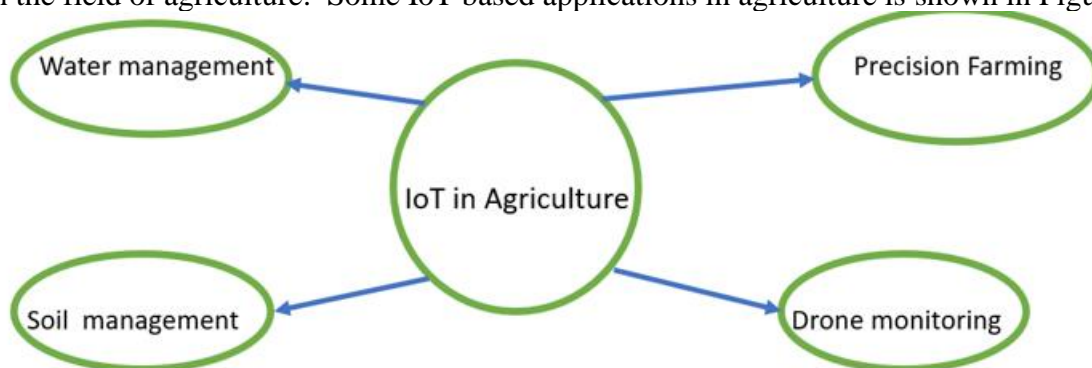


Figure .2 IoT based applications in agriculture.

(b) Industry

In addition to ensuring more effective networking and communication between operators and machines, the use of IoT technology in industrial applications would enable an increase in production

process efficiency. It would enable more competitive businesses with improved quality control and lower losses to enter the market. In order to create comprehensive and efficient management systems, it would be essential to develop, design, and integrate a variety of practical sensors for industrial applications. IoT technologies could be applied in particular industries where advantages could be realized to ensure that IoT technologies are applied in an efficient manner in the industry [10]. Figure. 2 depicts some IoT based applications in industry.

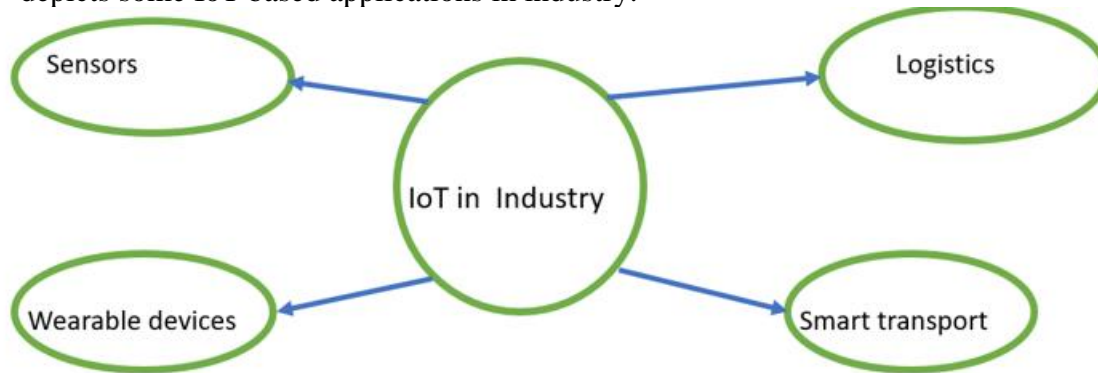


Figure .2 IoT based applications in industry.

(c) Waste management

An important contemporary population issue is waste management in the direction of a circular economy idea where IoT technologies undoubtedly have a role to play in offering more effective recycling [11,12]. The smart waste management idea is currently being supported by a number of technical solutions. A few of them are already on the market and may be widely used. The developed solutions are primarily focused on smart waste bin monitoring, including bin filling level detection, waste temperature and fire detection, bin tilt and vibration occurrence, waste operator presence, waste humidity, bin GPS position, etc. Waste management is critically important in achieving sustainability, so intelligent waste management systems using the Internet of Things needs further developments. Figure. 3 shows some IoT based applications in waste management.



Figure. 3 IoT based applications in waste management.

III. Conclusion

Governments, businesses, and other stakeholders should collaborate to develop policies and strategies that will promote the use of IoT and sensor technology in agriculture and address the challenges the sector faces. The future of smart agriculture depends on the creation of efficient and sustainable farming methods that can meet the needs of an expanding population while preserving the environment for coming generations. It also depends on the proper integration of IoT and sensor technology. Developments in the field of IoT is hence critical in ensuring sustainable future.

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