IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 1, September 2023

Nano-Electronics – A Review Paper

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Abstract: *The IoT devices platform and its components are highlighted in this review. Furthermore, this review provides security challenges regarding IoT and smart buildings. The main factors pertaining to smart buildings are described and the different methods of machine learning in combination with IoT technologies are also described to improve the effectiveness of smart buildings to make them energy efficient. Machine learning can be used to automate a wide range of tasks. Smart buildings, which use the Internet of Things (IoT) to connect building operations, enable activities, such as monitoring temperature, safety, and maintenance, for easier controlling via mobile devices and computers. Smart buildings are becoming core aspects in larger system integrations as the IoT is becoming increasingly widespread. The IoT plays an important role in smart buildings and provides facilities that improve human security by using effective technology-based life-saving strategies. This review highlights the role of IoT devices in smart buildings.*

Keywords: Machine learning; Internet of Things; smart buildings; challenges in smart buildings; IoT applications.

I. INTRODUCTION

The Internet of Things has grown drastically to become one of the most significant inventions of the 21st century. The IoT consists of a collection of connected physical objects that are linked together by sensors, applications, and other technologies for data integration and exchange across devices and systems. These devices connect using the Internet protocol (IP), which is the same technology that is used to recognize computers on the Internet and allows users to interact with one another via the Internet. The goal of the Internet of Things is to have devices that can self-report data and information regularly, enhancing efficiency and delivering essential information speedier than a system that is based on human input. Smart buildings use connected technologies, devices, data analytics, and automation to control infrastructures, such as security, lighting, ventilation, heating, and air conditioning. Smart heating, ventilation, and air conditioning (HVAC).Smart buildings offer great comfort and increase safety for building occupants, improve energy efficiency, and lower facility running costs via automation, sensors, and remote features. Smart buildings deploy IoT sensors to detect and analyze several factorsin building parameters that can be used to improve buildings' environments and activities. Smart buildings, which use the Internet of Things (IoT) to connect building operations, and monitor building temperature, security, and maintenance, are easier to control via smart phones and tablets. Buildings are becoming smarter due to the IoT, which is capable of integrating thousands of sensors and enabling real-time data collecting and analysis, making them more efficient and user-friendly. One of the most key technologies to consider when designing smart buildings is a fire alarm system. An IoT-based fire alarm system is essential to ensure the protection of people's lives and to reduce the amount of damage as much as possible. For home comfort, security, and energy-saving, HEMS-IoT, a smart energy management system that is based on the bigdata for the home and machine learning, was proposed. Machine learning and big data are crucial because they allow the system to track and classify energy usage efficiency, recognize user behavior patterns, and keep the buildings occupants comfortable. In the authors start by exploring the numerous security issues that IoT applications face, second, to address current security concerns, the authors conducted a survey. Away for developing smart building applications that link the IoT with smart building web services is described An Android smartphone application is also included with the smart system, and users can interact with it. A discussion is performed on some of the essential strategic technologies and application fields that are supposed to drive Internet of Things research in future years.

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II. THE ROLE OF IOT DEVICES IN SMART

The IoT devices used – electronic sensors, building management systems, and more – are connected to the internet and to each other. They are usually also connected via an app which allows both management and occupants to easily interact with the devices.

IoT in smart buildings simplifies tasks such as:

- Building temperature control,
- Smart water usage,
- Pest control,
- Fire detection,
- Security and access control, and
- Structural health monitoring.

IoT sensors are essential to making these applications possible. They enable the collection and analysis of real-time data with the purpose of:

- Improving the energy efficiency and sustainability of buildings,
- Reducing maintenance costs, and
- Enhancing occupant comfort, security, and safety.

IoT is utilized in smart buildings

The Internet of Things is being utilized in intelligent buildings in a wide variety of ways all over the world. Let's investigate some of the most important and valuable use cases for smart buildings by looking at specific examples of problems that IoT is helping to solve.

A. Building Temperature Control

IoT for smart buildings is transforming the way that contractors manage heating, ventilation, and air conditioning (HVAC) systems in commercial buildings.

IoT-enabled building temperature control allows companies to intelligently monitor and control the performance and condition of HVAC systems.

This enables companies to:

- Detect inefficiencies, excess power consumption, or excess vibration for preventative maintenance,
- Improve energy efficiency by monitoring usage trends and even weather predictions, and
- Easily and quickly diagnose problems through remote system monitoring.

B. Smart Water Usage

Water efficiency is critical because rapidly increasing populations, pollution, and climate change place significant strain on freshwater availability and quality. To ensure the future security of freshwater resources, new approaches to water management are required.

C. Pest Control

Vermin such as rats, mice, moths, and cockroaches inflict operational and financial pain on companies by contaminating buildings, spreading disease, damaging stock, gnawing wires, and more.

Standard pest control involves setting out a large number of poison traps in various locations around a building. This approach is inefficient because it requires the use of more traps and poisons than are actually necessary. Additionally, the traps should be checked on a regular basis to ensure that no unwanted pests have made their way inside.

Traps deployed in this manner are frequently unused, are inefficient at catching outbreaks of vermin early, and inspecting them by hand is an expensive and time-consuming task.

IoT solutions for smart buildings can facilitate pest control by:

- Enabling the deployment of smart traps,
- Allowing technicians to check on deployed traps with just a few clicks via pest control portals, and

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- Keeping costs affordable for pest control companies via scalable pricing and low data usage needs.

D. Fire detection

House fires are one of the main concerns for occupants, designers, and builders. For a long time, singular sensors have been used for fire detection. However, these sensors cannot measure the severity of the fire to alert emergency response units.

Through the implementation of integrated detectors, IoT solutions for smart buildings can address this problem.

The integrated detectors can register different elements such as heat, smoke, and flames. The system algorithm within the solution then calculates the fire's potential and broadcasts the predicted results to relevant parties.

This makes it possible to:

- Quickly alert occupants, property owners, emergency services, and local police stations of danger,
- Increase system reliability and reducing costs by minimizing false alarms, and
- Provide fire departments with real-time data for test purposes without endangering the lives of building occupants.

E. Security and access control

When it comes to building security, access control is one of the most important aspects.

IoT enables the use of security systems including intelligent locks, card readers, keypads, alarms, and other related devices.

The employment of IoT-driven security and access control solutions in smart buildings makes it possible to:

- Configure applications to both automatic and manual operation of locks and controllers,
- Access systems via mobile apps and devices from anywhere in the world, and
- Receive detailed notifications and alerts from your access systems in real time.

F. Structural health monitoring

Modern buildings are more structurally sound than ever – but accidents still happen. As buildings and critical structures such as bridges and dams are constructed and age, the need to ensure their safety and longevity rises.

IoT solutions for smart buildings can help prevent building and structural collapse from occurring, as well as extend structural lifetimes through predictive maintenance.

IoT sensors deployed in smart buildings make it possible to:

- Gather and analyze data to monitor structural deterioration,
- Detect and identify structural defects before they escalate, and
- Alert occupants and relevant parties to defects and imminent safety risks.

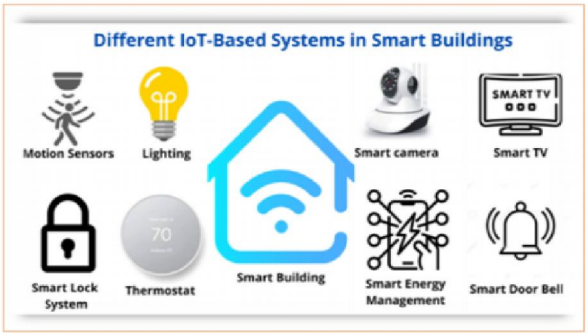

Figure 1. IoT-based systems in smart buildings

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III. THE PLATFORM AND COMPONENTS OF IOT-BASED DEVICES

The Internet of Things (IoT) is a network of interconnected devices that share, communicate, and use real-world data to deliver services to individuals, organizations, and society. The IoT is a technology that links physical devices to the Internet. The IoT platform connects devices and objects with built-in sensors, integrating data from huge devices and utilizing analytics to provide the most useful information. IoT technologies have a variety of applications, such as detection systems, communications technologies, cloud technologies, and location technologies.

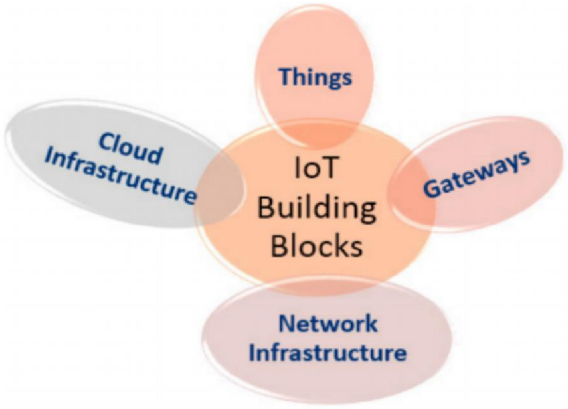

Figure 2. Basic components of an effective IoT system

- IoT sensors: The sensors save all of the information on the server and display it as required, for example, to draw energy consumption patterns of building workloads and minimize power usage. This benefits customers and also improves the outside environment of the building. The main components of an effective IoT system are depicted in Figure 2.
- IoT gateways: A gateway's principal function in telecommunications is to act as a link between different communications systems. With respect of communication options, interfaces, and protocols, these technologies can vary.
- Cloud infrastructure: The importance of cloud infrastructure in IoT clouds for IoT services, such as vehicle-to-vehicle (V2V) connectivity, real-time health tracking, and commercial IoT, is higher than simple computing services . The most popular endeavor is smart device scheduling. Smart device scheduling effectively controls device functionality for end-users and also saves money and energy. At the same time, it is guaranteed that the users' comfort is not endangered. In this case, the energy management system schedules the devices efficiently in response to the external data and user input.
- Network infrastructure: In the coming years it is expected that cellular-based technologies that install lowpower wide area networks (LPWAN) would be important growth drivers in the Internet of Things connectivity of smart buildings. There are several different connectivity options available, such as LTE and LoRAWAN, which are cellular-based, as well as Wi-Fi-based options, that can be used to link Internet of Things devices to each other and the cloud.
- •Building management systems: Building management systems, often referred to as building automation systems, have an important part in energy management in commercial and industrial buildings. Smart buildings provide better convenience for facility managers, increase safety and comfort for building occupants, and reduce facility running costs through automation, sensors, and remote features.

IV. Role of machine learning in smart building

V. What is smart building

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