

A ROLE OF AI AND IOT IN BUILDING SMART OFFICE

Abstract

AI (Artificial Intelligence) and IoT (Internet of Things) play crucial roles in building a Smart Office by enhancing efficiency, productivity, and the overall work environment. Smoke detectors, fire alarms, and other safety devices can be connected to AI systems for rapid response and early detection. These sensors can detect the presence of individuals and adjust the temperature and lighting appropriately, conserving power. In another example, a smart building may use face recognition technology to control access to the building. At work, AI-powered cameras can provide real-time video analytics for security purposes. They can detect intruders, recognize employees, and notify security personnel of any unusual activities. IoT-based access control systems can use biometrics or smart cards for secure entry, and AI can monitor access patterns to identify potential security threats. AI and IoT technologies are pivotal in creating smart offices that prioritize efficiency, sustainability, security, and employee well-being. By integrating these technologies, organizations can enhance their workplace environments, ultimately improving productivity and employee satisfaction while reducing operational costs.

Keywords: Artificial Intelligence, Artificial Intelligence Internet of Things (AIoT), Internet of Things, Smart office, Sensors

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I. INTRODUCTION

An Intelligent Management System (IMS) that utilizes both Artificial Intelligence (AI) and the Internet of Things (IoT) can revolutionize various industries and processes by enabling automation, data-driven decision-making, and enhanced efficiency. [1]. The increased security risks caused by interactions between activities related to cyber and physical entities have moved the focus of this study. Intelligent management systems usually permit the creation of relevant features, topological visualization for building security, and the verification of access control policies to guarantee that security tasks are satisfied. Recent research advocated uniform metadata for building modeling. These techniques make use of sensor ontologies, subsystems, and linkages. The initial stage of analysis is to establish a proper environment, which involves data storage, cleansing, and preparation, as well as selecting the optimal analytical approach for each type of facilitation required. Nonetheless, intelligent buildings face a tough challenge in real-time data storage and search [1]. The technological components that comprise the smart building ecosystem. The primary purpose of this study is to evaluate the existing work on smart buildings, with a particular emphasis on the Internet of Things (IoT) and Artificial Intelligence (AI), which are the two fundamental technological components in our environment.

Further, the chapter is organized as follows. Section II provides a summary of the related work. Section III explains the benefits of a smart office. Section IV presents the need for AI in smart offices. Finally, Section V concludes on the necessity of a smart office and its future scope.

II. RELATED WORK

Everyone has become smart applications in the current environment by putting intelligence into applications, decreasing the load of repeated interruption or access control by people. A smart environment is described as the capacity to employ M2M (machine-to-machine) interaction to link more real-time parameters and make sound judgments in potentially hazardous situations. There are a plethora of low-cost devices on the market that can collect real-time data and transfer it to Internet of Things (IoT) devices. As a result, it is feasible to use a remote control. This [2] will look at a few simple applications in smart buildings and compare them to technical improvements that can automatically deliver improved solutions. The Information collected by numerous sensors would be useful for analytics as well as the creation of smart design models for better construction. Smart building services, security monitoring, power control, HVAC overall control on system and monitoring, water control, electric lighting systems, elder health monitoring systems, and fall detection will all be investigated. The primary purpose of this [2] is to outline the issues that existing techniques have with certain applications and to provide a pathway for future related research. Building smart and usage can be influenced by apps, and the smart system can intelligently adapt to future occurrences based on a study of applicable techniques and needs. In the future, all conventional structures will be automotive systems based on HVAC [2] construction.

A new era of urban energy efficiency may soon arrive thanks to the notion of "smart buildings," which integrate sensors, big data analytics, and artificial intelligence. By utilizing AI technology for improved control, dependability, and automation, energy consumption in

smart buildings may be decreased. In higher depth, an analysis of the most recent review on the use of artificial intelligence (AI) technology in smart buildings is provided using Building Management Systems (BMS) and a lot of demand on response AI programs [3]. An evaluation framework is offered and utilized to evaluate current research in this subject as well as across the primary AI domains of building energy usage prediction, also to elaborate on the concepts and applications of AI-based modelling methodologies frequently explored. Finally, [3] discusses outstanding challenges and prospective research directions in AI's use [6] in smart buildings.

The Internet of Things (IoT) makes it possible for machines and gadgets to communicate with one another and generate massive amounts of data, which has the potential to reveal significant information in several service sectors. It is possible to create integrated semantic systems that enable semantic interoperability by fusing the IoT context with semantic technologies. To enable modelling across several IoT-based services in a smart city, an integrated semantic service platform (ISSP) was suggested by [4]. The three main barriers to providing integrated semantic services with IoT systems are semantic discovery, dynamic semantic representation, and semantic data repositories for IoT resources [4]. To demonstrate the possibilities of the ISSP, we created a smart office prototype service that provides a pre-configured, personalized workplace surroundings by scanning user text input via a smartphone. Additionally, a scenario was given to illustrate how the ISSP-based approach may aid in the development of a smart city by enabling services from various service domains to find and utilize IoT devices that are necessary across domains.

The move from the traditional office to today's smart office can be broken down into three stages:

1. 1996-2006: This is where it all began. To boost productivity, laptops, cell phones, and the Internet were introduced.
2. 2006-2016: Technological advancements grew in sophistication. Apps, software, and cloud computing were all born as a result of the introduction of smartphones and other fast devices to the market.
3. 2017 to date: Smart offices are becoming more and more common. Now that business owners are more aware of the notion, they are adopting automated technology to increase productivity in offices, reduce operational costs, and provide personnel with a relaxing and collaborative work atmosphere.

A smart office is a location where employees can use technology to perform better, quicker, and, of course, smarter. Employees may employ beacons, sensors, and mobile apps to complete tiresome tasks more effectively, freeing their time to focus on building their business and creating.

Furthermore, technology assists in improved communication in a smart office. Sensors can identify whether or not someone is in the building, where they are at any given time, and even whether or not and for how long a particular conference room is reserved.

III. SMART OFFICES BENEFITS

The use of a smart intelligent workplace might be a barrier to a company's long-term success. Here are a few advantages of having a smart office:

- 1. Increase Your Output:** Businesses that adopt a smart office strategy have a higher chance of success than those that do not. This concept promotes innovation and creativity. As a result, the way business operations are carried out is impacted. There is a large quantity of data that may be tapped into in a labor-intensive work setting. There are various options for processing, monitoring, and managing information in a smart workplace. This data may be advantageous to developing trends and strategic plans to increase workplace relationships and connectivity. It provides employees with a uniform platform and tools.
- 2. Easier Administration of Employees and Job Schedules:** The smart office solution makes tracking and managing employee and office schedules quick and easy. Reports, smart gadgets, and automated systems that support business operations make it easier to account for the schedules of personnel. Increased connectivity is advantageous for collaboration and document sharing.
- 3. Better Cost Management:** Business managers must evaluate the performance of the organization in terms of expenses and corporate goals. In a smart workplace, sensors and automated systems collect real-time data. This information can be used to analyze, evaluate, and optimize employee behavior and facility performance on a budget.

To avoid system downtime, this can be accomplished by space minimization and early defect identification. As an alternative, a business can operate all systems via graphical user interface software. For instance, information from a prior working year can be utilized to determine whether heating units can be controlled to lower overall costs.

- 4. Consumption of Data Analytics:** A company may easily maintain track of bookings, space usage, and facility usage. System alarms and reports are used to gather information about space consumption. Relevant stakeholders can receive notifications and timetables for consumption analytics via email or cell phones to aid in decision-making.
- 5. Using Cloud Computing:** Thanks to the Internet of Things, businesses may now perform the majority of their activities through the Internet. As a result, organizations may process, store, manage, and retrieve data on numerous platforms over the internet from anywhere. Information storage on a PC in your office is a thing of the past. Cloud storage offers guaranteed access to information from anywhere, even if you misplace your laptop or have a malfunctioning hard drive.
- 6. Smart Brand [9]:** Having a nice brand is no longer enough. You'll need an ingenious brand. If smart technologies are integrated into your usual office activities, they will boost communication between your brand and its target audience.

The creation of a smart brand is possible in a number of ways using a smart workplace system. For instance, your clients are not required to check in at the front desk

each time you call to schedule a meeting. They can enter the boardroom right away if you issue them an email meeting invitation.

- 7. Efficient and Unified Communication:** In the previous workplace, employees lacked a robust and consistent communication system. In the current world, messaging applications have made it easier to engage with individuals or groups.

A smart workplace is made up of several networked platforms that allow employees to communicate with one another regardless of where they are. Because input is instantaneous, this may greatly improve decision-making and allow things to move more swiftly.

- 8. Making a Pleasant Working Environment [10]:** Employee satisfaction is crucial to the success of any organization. Employees who love going to work and carrying out their duties are more likely to do so if they work in a nice environment. Employee absenteeism is generally acknowledged to have a detrimental influence on the performance of a firm.

Fortunately, absenteeism may be drastically reduced when the workplace fulfills the demands of the employees.

Smart companies are quickly adopting technology that controls the entire office setting to prevent or lessen such problems. By making adjustments to the facility's heating, lighting, ventilation, water, and air systems, workers will be able to perform their tasks more comfortably.

- 9. Time-Saving:** In a smart office system, even the most complex chores are easy by utilizing cutting-edge technology. These tasks may be accomplished quickly, allowing workers to focus on other vital obligations.

- 10. Recruiting and Retaining Employees:** A healthy work environment can help a firm recruit and retain qualified employees in the long run. They encourage a positive work atmosphere for everyone and increase staff collaboration. By giving your staff a comfortable and productive work environment, you can prevent the expense of losing a great employee.

- 11. Managing Identities:** By keeping track of who is on the premises, businesses may strengthen their security. With a smart office system, separating visitors from employees is straightforward. The use of ID trackers and face recognition software in the workplace is an essential part of office security. Furthermore, whether your employees work in an office or remotely, technology may assist you in tracking the time they spend on actual work.

IV. ARTIFICIAL INTELLIGENCE IN SMART OFFICES

The simple stimulation of human intelligence by technology, particularly computer systems, is known as artificial intelligence (AI). Examples of AI applications include expert systems, NLP, speech recognition, and machine vision [6]. The learning phase, during which the AI software focuses on gathering data and developing rules to analyze existing data, is

separated into three sections. The reasoning phase is in charge of determining the optimum algorithm to achieve the desired outcome. The self-performing phase is concerned with algorithm consistency and the correctness of AI-generated outputs.

A smart office is a technologically enhanced workplace where technology rules supreme. Sensors, mobile applications, software, computers, and other forms of technology handle all company processes in smart workplaces. Employees may work more efficiently and successfully with the assistance of technology and precise data. Employees will do monotonous jobs more efficiently and quickly if they use employee-efficiency mobile applications or desktop solutions rather than the manual method.

From a business standpoint, smart office technologies [10] are those that provide an automated corporate environment while reducing the strain of repetitive chores. Artificial intelligence in the workplace can accomplish the same thing because it collects data from people and then processes it using various algorithms to create an automated procedure. In this way, artificial intelligence will be useful in office automation.

- 1. Artificial Intelligence Scheduling [6]:** In today's workplaces, multitaskers who can handle multiple processes in the corporate organization are hired. Companies hire people who can be quickly assigned to different business processes based on their availability. For example, if a sales representative is on the road, he can be tasked with meeting with clients to solicit feedback. An artificial intelligence scheduling tool can help you determine when your employees have free time and provide them with weekly or monthly schedules. The artificial intelligence-driven employee efficiency software provides managers with a shared window where they can view all of their employees' schedules and even make changes as needed. Furthermore, if employees are falling behind schedule,
- 2. Real-Time Assistance:** AI is also useful for businesses that must communicate with a large number of clients daily. Manufacturing and sales companies, for example, must communicate with millions of customers daily. Artificial intelligence facilitates real-time client interaction as well as the creation of personalized gift vouchers and discounts. Companies can use real-time location tracking tools to provide clients with an accurate delivery time and track the whereabouts of delivery vehicles, ensuring that manufactured items arrive at their assigned destination on time. This will also help to build a positive brand reputation because clients will be aware that the organization's information is always up to date.
- 3. Attendance Tracking [9]:** To evaluate their employees' working hours, corporate organizations must keep accurate records of their employees in and out times. Especially in businesses where the amount is based on the number of hours worked. It is now impossible to keep track of the attendance of thousands of different departmental employees on time without an automatic attendance system. As a result, if artificial intelligence-assisted software allows employees to enter their work start and stop times with a single tap, the process of compiling an attendance report will be accelerated. Employees' app attendance time will be served as data, which will be automatically evaluated by artificial intelligence algorithms, generating various performance reports for managers to review.

- 4. Monitoring Employees Working Hours:** It is difficult for management to obtain time spent by a specific employee on completing a job in a corporate organization with a huge crew. This is because everyone takes a varied amount of time to finish the same task. However, in a corporate setting, it is necessary to commit a specific time limit to complete a job to establish a standard bar for performance evaluation — the employee who completes his work within the specified period is ranked as a top worker, and vice versa. In a smart workplace setting, artificial intelligence supports managers in tracking down every second detail of employees so that managers may examine which employees are on time or behind schedule. AI will evaluate real-time data from numerous tracks to provide a variety of tracking reports for managers to review, such as stoppage reports, total time spent on a task, distance traveled, and so on.
- 5. Leave Management:** When one of your employees is forced to take unpaid vacation for an unannounced period due to a family emergency, your manager must be prepared to handle the situation. That's because you have to provide services to your clients on time, no matter what, and it's not the client's fault that your employee is on vacation. Additionally, businesses must give their employees clear leave rules. In the office, artificial intelligence will be particularly useful in managing leaves and generating personalized leave policies for the organization. Employees will be notified if they take more than the allotted number of days off, and a leave management report will be generated automatically for both the employee and the company. Employees now have access to a one-tap automatic leave balance summary, which provides precise information about the amount of paid and unpaid leaves in their account.
- 6. Deployment of IoT in Smart Office:** [8] We recently covered an article about IoT productivity, so if you want to incorporate IoT technology benefits into your smart office, you must focus on AI first. Artificial Intelligence is the bedrock of the Internet of Things ecosystem, thus if you want to establish a solid IoT infrastructure, you must first focus on AI. IoT devices based on AI platforms are becoming increasingly popular, which could lead to game-changing developments shortly. This tendency will benefit both businesses and consumers.
- 7. Cost-cutting and Profit-Boosting:** Increasing your income and decreasing your expenses are the two main business ideas. A corporation that adheres to these principles when developing diverse business policies is almost always successful. Management requires many reports to monitor the organization's spending and profits, and they must make accurate predictions based on the reports available. If reports are generated manually, there is a considerable risk of errors due to the participation of a personal base. So, if the data isn't correct, how will the correct analysis be based on it? When data is recorded, processed, and analyzed by a machine utilizing various algorithms, however, the possibility of error and favoritism is virtually eliminated. As a result, artificial intelligence indirectly contributes to increased business profit by minimizing wasteful expenses [8].

Lower maintenance, power consumption costs, higher productivity, habitable buildings, and scope of reselling value are some of the benefits of smart buildings. However, there are drawbacks, such as cyber security issues, initial installation expenses, continuous internet connection, and usability.

V. ADVANTAGES

- 1. Cost-cutting:** Costs associated with operation and maintenance can be significantly reduced in smart buildings. By integrating HVAC systems [11], intelligent lighting, occupancy monitoring sensors, and other IoT solutions [7], these buildings may reduce their operating costs by more than 30%.
- 2. Predictive Maintenance:** By utilizing real-time data and artificial intelligence, maintenance efforts may be cut down and problems can be resolved more quickly [7]. Before the damage is too expensive, algorithms can shut down or alert individuals to events that could harm equipment inside a facility.
- 3. Reduced Energy Consumption:** One benefit of smart buildings that has a substantial environmental impact is the reduction of energy consumption. By utilizing sensors and their data, it will be possible to increase the efficiency of the usage of power, water, and gas [7].

Occupancy management can determine which rooms have a large number of people and alter the climate, lighting, and heating accordingly. Furthermore, renewable energy sources such as photovoltaic panels and heat pumps can be used to generate low-cost, environmentally friendly energy.

- 4. Productivity Improvements:** As a result of the COVID-19 issue, an increasing number of people are working from home. For many, this has numerous advantages, but it is also extremely difficult. By providing improved lighting and climate control, smart buildings can help make working at home or in the office more comfortable and productive [7].

The use of interior navigation and room booking systems is another benefit of smart buildings. People may book a meeting room and get directions to it with ease. This will be especially useful in large companies and for tourists.

- 5. Health and Happiness:** Smart HVAC systems are an important aspect of any smart building since they improve air quality and temperature control [12]. Sensors that detect if a person falls in their residence are also available for the elderly and others with health difficulties. The alarm can then be sent to a caregiver, who can then enter the room via smart access control [7].
- 6. An Increase in the Property's Value:** People are willing to pay more rent for these benefits in their apartments and buildings as a result of the installation of smart building technologies. Furthermore, because operational costs can be decreased, real estate profit margins can be increased, increasing resale value.

VI. DISADVANTAGES

- 1. Cyber Security:** It goes without saying that connecting almost all of a facility's equipment to the internet creates a danger. Cheap IoT devices, in particular, lack the best security software and are vulnerable to hacking by nefarious parties [7].

2. **Initial Installation Costs:** Tens of thousands or even hundreds of thousands of euros may be required to install smart technology. Particularly for novice investors or smaller companies, this is a big investment. Obviously, the size of the structure and the quantity of solutions used are important.
3. **Internet connection:** The need for constant internet access is another disadvantage of smart buildings. [7] A reliable network must be created to realize the full potential of intelligent technology.
4. **Usability of Smart Technology for Tenants:** Even though many youngsters these days are growing up with technology, there are still many others who are unfamiliar with it. This is one of the goals of smart trending technology and the Internet of Things must be that anyone may use it without any prior expertise.

VII. APPLICATIONS

To save energy, smart buildings are equipped with a wide range of sensors, subsystems, and actuators as well as modern and intelligent automation monitoring and control tools [7]. Along with these energy usage cuts, greenhouse gas emissions are also falling. It has been established that smart buildings may protect the environment, lower building operating expenses, and conserve energy in urban areas. The idea of "smart building" describes the infrastructure of the present. It uses data and automated control systems to enhance the performance of the building and the level of comfort that its occupants experience.

1. IoT Application in Buildings and Houses: This concept can be utilized in buildings or households to monitor and regulate various physical factors such as lighting and curtains, smart equipment such as media, air control, music system, central heating or air conditioning, and so on [7].
2. A building automation system, that can access, monitor, and operate multiple subsystems based on the user's requirements, is another application that incorporates this notion. HVAC [7][11] maintenance, lighting control, environmental control, fire detection and alarm, smoke detection, Indoor Air quality services, and other outdoor subsystems such as digital video surveillance, intrusion detection, security and access control, onsite technical services, and so on may be included in this system. The system can also be combined for total control of energy information, water, and mechanical maintenance, allowing consumers to manage their connected homes or businesses remotely from anywhere at any time using a smartphone or computer.
3. IoT technology can help smart homes automate their lighting, water supply, network, television, and temperature systems [12]. [10] Security, fire alarms, and a variety of additional subsystems can all be included.

AI is a key enabler of the modern smart office, providing numerous benefits that contribute to increased productivity, employee satisfaction, and cost-efficiency. Its ability to process and analyze data, automate tasks, and provide personalized experiences makes it an indispensable tool for creating a more efficient and enjoyable workplace.

VIII. CONCLUSION AND FUTURE SCOPE

To achieve zero-emission buildings, several challenges must be addressed. Several energy sources need to be changed in order to provide outstanding security and a healthy atmosphere for building users while using little energy. It is important to strike the correct balance between quality of life and energy savings in buildings because increasing occupant comfort levels requires a lot of energy. It is computationally difficult to optimize the performance of the entire building, and accurate information on the condition of all systems and equipment is a requirement. Energy systems for buildings are developing into sophisticated networked cyber-physical energy systems, where embedded components and sensors are being gradually incorporated. By swiftly and effectively managing the computing load, artificial intelligence can assist in the optimization of the operation of these complicated systems. Common communication protocols are part of artificial intelligence (AI), which enables information to be communicated to achieve important objectives in living spaces, such as comfort, energy efficiency, and productivity. Building intelligence and automation will become increasingly important in future smart cities. Smart buildings, which are integrated with technology and energy systems, are a crucial contributor to a future low-carbon economy, and their potential is unlimited.

Soon, all buildings will be built with sensors and communication mechanisms to provide the residents with the comfort they seek. As a result, it will influence the design of buildings in the future, potentially transforming even non-residential structures such as hotels and airports into smart structures. There will be a plethora of innovative smart building life cycle models available. Every component in the smart building must be adaptable to technological advancements to provide a better experience for the consumers.

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