A Role of AI and IoT in building Smart Office

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Abstract— Smart office buildings are an area where artificial intelligence and the internet of things intersect. Some companies want to install a network of smart environmental sensors in their office buildings. 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, AIoT is a mix of networked cameras and artificial intelligence that can compare real-time photographs to a database to determine who should be allowed admission into a facility. Employees would also no longer need to clock in or complete attendance for mandatory meetings since the AIoT system will handle it.

Keywords**-** . Internet of Things (IoT) , Artificial Intelligence (AI), Artificial Intelligence Internet of Things (AIoT), Smart office, Sensors

1. Introduction

Because of the growing interest in intelligent buildings and the emergence of new technologies in this field, several studies have been conducted to implement various types of applications such as energy optimization, building management simplification, resident comfort improvement, reactive alarm management, personal protection, asset protection, intrusion event management, and so on [1]. The increased security risks caused by interactions between cyber and physical entities have moved the focus of this study. The intelligent management systems proposed allow for the creation of relevant features, topological visualisation for building security, and the verification of access control policies to guarantee that security tasks are satisfied. A recent research advocated uniform metadata for building modelling. 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 current literature 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.

The rest of the paper is organized as follows. Section II gives 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.

1. related work

Everyone has become smart applications in the current environment by putting intelligence into applications, decreasing the load of frequent interruption or control by people. Smartness 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 transmit it over the Internet of Things (IoT). 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 has collected by numerous sensors would be useful for analytics as well as the creation of smart design models for better constructions. As smart building services, security control, energy management, HVAC system control and monitoring, water management, lighting systems, elder health 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 give a path for future research. Building construction 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 traditional structures will be automotive-based on HVAC [2].construction

The emerging concept of smart buildings, which includes the integration of sensors, big data (BD), and artificial intelligence (AI), has the potential to usher in a new era of urban energy efficiency. Energy usage in smart buildings may be reduced by utilising AI technologies for increased control, dependability, and automation. Building management systems (BMS) and demand response programmes are utilised to give an in-depth evaluation of current research on the application of artificial intelligence (AI) technology in smart buildings (DRPs) [3]. In addition to elaborating on the principles and applications of AI-based modelling approaches commonly used in building energy use prediction, an evaluation framework is presented and used to assess recent research in this field as well as across the major AI domains of energy, comfort, design, and maintenance. Finally, [3] discusses outstanding challenges and prospective research directions in AI's use [6] in smart buildings.

The Internet of Things (IoT) enables machines and devices all around the world to interact and create large volumes of data, which has the potential to give important information across a wide range of service domains. By merging the context of IoT with semantic technology, we may build integrated semantic systems that allow semantic interoperability. [4] proposed an integrated semantic service platform (ISSP) to enable ontological models across several IoT-based service domains in a smart city. The three main challenges in providing integrated semantic services with IoT systems are [4] semantic discovery, dynamic semantic representation, and semantic data store for IoT resources. We designed a smart office prototype service that can give a preconfigured, personalised workplace environment by scanning user text input via a smartphone to illustrate the ISSP's potential. A scenario was also provided to show how the ISSP-based technique may help in the construction of a smart city by allowing services from different service domains to discover and use IoT resources that are required across domains.

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

* Phase 1 (1996-2006): This is where it all began. To boost productivity, laptops, cell phones, and the Internet were introduced.
* Phase 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.
* Phase 3 (2017 to date): Smart offices are becoming increasingly popular. Companies are integrating automated technology to make their offices super-efficient, save operational costs, and provide a suitable and well-connected working environment for employees now that they have a greater knowledge of the concept.

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 them 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 certain conference room is booked.

1. BENEFITS OF SMART OFFICES

Adoption of a smart 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: Companies that use a smart office approach are more likely to prosper than those that do not. This idea encourages creativity and innovation. As a result, the manner in which 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 data in a smart workplace. This information may be used to develop trends and strategic plans to increase workplace relationships and connectivity. It provides employees with an uniform platform and tools.

2. Easier employee and work schedule management: The smart office system makes it simple to track and manage employees and office schedules without wasting time. Reports, smart gadgets, and automated systems that aid in company operations make it easier to account for employees' schedules. Increased connection benefits cooperation and document sharing as well.

3. Better cost control: Business managers must evaluate the success of their organisation in terms of expenditures and corporate goals. In a smart workplace, sensors and automated systems collect real-time data. This data may be utilised to cost-effectively analyse, appraise, and optimise employee behaviour and facility performance.

This may be performed through space minimization and early defect detection to prevent system downtime. Alternatively, a corporation can manage all systems with control software that has a graphical user interface. Data from a previous working year, for example, can be used to determine whether heating units can be regulated to reduce total expenses.

4. Consumption of data analytics: It is simple for a corporation to keep track of space, facility usage, and bookings. Data on space use is derived from system alerts and reports. To facilitate decision-making, relevant parties can get consumption analytics alerts and timetables through email or cellphones.

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, organisations may process, store, manage, and retrieve data on numerous platforms over the internet from anywhere.The days of saving information on one of your office PCs are long gone. Even if you misplace your laptop or have a broken hard disc, cloud storage provides guaranteed access to information from anywhere.

a 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.

A smart workplace system offers a number of options for developing a smart brand. For example, your clients do not need to sign in at the reception counter every time you contact them for a meeting. You may send them an email meeting invitation that allows them to enter the boardroom immediately.

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 organisation. 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 significantly reduced when the workplace meets the needs of the employees.

Smart workplaces are rapidly using technology that manages the whole office environment to minimise or reduce such issues. Employees may do their duties more comfortably by altering elements such as heating, lighting, ventilation, water, and air within the facility.

9. TTime-saving: The smart office system makes even the most complex chores easy by utilising 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. Smart office solutions give such an atmosphere.

They improve employee collaboration and foster a good working environment for everybody. You may avoid the price of losing a fantastic employee by providing a pleasant and smart working environment for your employees.

11. Managing identities: By keeping track of who is on the premises, businesses may strengthen their security. It is simple to separate visitors from workers when using a smart office system. In the workplace, the usage of ID trackers and face recognition software is a vital component 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.

1. ARTIFICIAL INTELLIGENCE IN SMART OFFICES

The simple stimulation of human intelligence by technology, especially computer systems, is known as artificial intelligence (AI). AI applications include expert systems, natural language processing, speech recognition, and machine vision [6]. The learning phase, during which the AI software focuses on gathering data and developing rules to analyse 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 organisation 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 on a daily basis. Manufacturing and sales companies, for example, must communicate with millions of customers on a daily basis. Artificial intelligence facilitates real-time client interaction as well as the creation of personalised 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]: In order to evaluate their employees' working hours, corporate organisations must keep accurate records of their employees' in and out times. Especially in businesses where pay 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 organisation 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 in order to establish a standard bar for performance evaluation — the employee who completes his work within the specified time 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 travelled, and so on.

5. Leave Management: When one of your employees is forced to take unpaid vacation for an unannounced period of time 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 clients' fault that your employee is on vacation. Additionally, it is critical for businesses to give their employees with clear leave rules. In the office, artificial intelligence will be particularly useful in managing leaves and generating personalised leave policies for the organisation. 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 in the near future. This tendency will benefit both businesses and consumers.

7. Cost-cutting and profit-boosting: Increasing your income and decrease 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 analysed by a machine utilising various algorithms, however, the possibility of error and favouritism is virtually eliminated. As a result, artificial intelligence indirectly contributes to increased business profit by minimising wasteful expenses [8].

Lower maintenance and energy consumption costs, reduced emissions, higher productivity, more habitable buildings, and increased resale 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.

ADVANTAGES

1. Cost-cutting: Smart Buildings can greatly reduce both operating and maintenance costs. These buildings may save more than 30% on running expenses by integrating HVAC systems [11], intelligent lighting, occupancy monitoring sensors, and other IoT solutions [7].
2. Predictive Maintenance: It is feasible to reduce the amount of maintenance work and fix issues faster by employing real-time data and artificial intelligence [7]. Algorithms can detect events that could damage gadgets inside a building and shut them off or notify people before the damage becomes too costly.
3. Reduced Energy Consumption: The reduction of energy usage is one advantage of smart buildings that has a significant environmental impact. It will be feasible to make the use of electricity, water, and gas more efficient by utilising sensors and their data [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.

1. 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.

1. 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].
2. 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.

DISADVANTAGES

1. Cyber Security: It is self-evident that linking practically every equipment in a facility to the internet poses a risk. Cheap IoT devices, in particular, are not equipped with the finest security software and may be hacked by malicious individuals [7].
2. Initial Installation Costs: Installing smart technology can cost tens of thousands or even hundreds of thousands of euros. This is a significant investment, especially for smaller investors or businesses. Of course, the size of the building and the number of solutions implemented play a role.
3. Internet connection: Another drawback of smart buildings is the requirement for continuous internet access. [7] to realise the full potential of intelligent technology, a trustworthy network must be developed.
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 why one of the goals of smart technology and the Internet of Things must be that anyone may use it without any prior expertise.

APPLICATIONS

Smart buildings are outfitted with a variety of sensors, subsystems, and actuators, as well as a variety of advanced and smart automation monitoring and control tools that can be used to save energy [7]. These energy consumption reductions are accompanied by decreases in greenhouse gas emissions. It was demonstrated that smart buildings have the ability to safeguard the environment, reduce building operating costs, and conserve energy in metropolitan areas. Smart building is a concept that exemplifies today's infrastructure. It incorporates automated control systems and makes use of data to improve the building's performance and the level of comfort enjoyed by its occupants.

1. IoT Application in Buildings and Houses: This concept can be utilised 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, which 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 alarm, and a variety of additional subsystems can all be included.
4. CONCLUSION AND FUTURE SCOPE

Several hurdles must be overcome on the route to zero-emission buildings. Several energy sources must be modified in modern energy systems to provide high security and a healthy atmosphere for building users while consuming little energy. Improving inhabitants' comfort levels is linked to the usage of a lot of energy, emphasising the importance of striking the right balance between quality of life and energy savings in buildings. The optimization of the entire building's performance is computationally complex and necessitates reliable data on the status of all systems and equipment. Building energy systems are evolving into complex networked cyber physical energy systems like sensors and embedded components are progressively integrated. Artificial intelligence can aid in the optimization of the operation of these complex systems by quickly and efficiently controlling the computational load. AI comprises common communication protocols that allow information to be exchanged in order to fulfil major goals in living spaces, such as energy efficiency, comfort, health, 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.

In the near future, 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. Each component of the smart building must be adaptable to technology advancements in order to provide a better experience for the consumers.

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