Energy Conservation: Utilization of Artificial Intelligence (AI) in Entertainment Industrial Design, Case Study on Jalan Sutomo, Medan

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Abstract. Energy conservation is a major concern in today's entertainment industry due to the increasing awareness of the need for sustainable resource management. This research proposes an approach that integrates artificial intelligence (AI) and green design to improve energy efficiency in various aspects of entertainment industry buildings. First, we explore the role of AI in optimizing energy consumption and improving operational efficiency in entertainment venues such as cinemas, theaters, and shopping malls. Next, we discuss eco-design which includes the use of eco-friendly materials, waste management, and the use of renewable energy sources in the construction and operation of entertainment facilities. Through the incorporation of AI technology and sustainable design, this research highlights the potential to create a more energy-efficient and environmentally friendly entertainment industry, while making a positive contribution to global conservation efforts.

1 Introduction

In the ever-evolving modern era, energy saving has become one of the most important priorities in reducing energy use and harmful impacts on the environment. According to the Ministry of Energy and Mineral Resources (2018), the industry’s final energy consumption reached 229 million oil equivalent (BOE) in 2015, the second largest energy consumer after the transportation sector (260.) million BOE) [1]. Meanwhile, the Ministry of Energy and Mineral Resources reported that Indonesia's energy consumption reached 909.24 million BOE in 2021, with the transportation sector leading at 388.42 million BOE and the industrial sector at 317.57 million BOE [2]. This marks a significant increase in energy use over six years. In this case, the entertainment industry is also the largest contributor to energy consumption, which has a negative impact on the environment. Therefore, one approach to addressing these challenges is the use of artificial intelligence in various industries, including the entertainment industry. Energy-efficient design not only reduces overall energy consumption but also enables cleaner and more sustainable use of resources.

AI assistance in the entertainment industry enables different innovations in energy management and environmental impact reduction. By using AI algorithms and environmentally friendly technologies, the entertainment industry can optimize energy use, reduce greenhouse gas emissions, and improve production efficiency. According to Shi et al (2020), this technology aims to improve the efficiency of electricity generation, transmission, and distribution, reduce energy costs, and maximize the use of renewable energy [3].

By using artificial intelligence and eco-friendly design, the entertainment industry can implement energy-saving principles and improve the quality of products and services offered to consumers in an increasingly global context, energy conservation efforts in the entertainment industry are one of the top priorities for achieving sustainable environmental goals.

Jalan Sutomo, located in the city of Medan, is an interesting case study in this context. As one of the main roads with heavy traffic and diverse industrial and entertainment activities, the potential to apply AI technology in optimizing energy use is considerable. Through this case study, we aim to explore how the utilization of artificial intelligence can improve energy efficiency in entertainment industry design, focusing on the environment of Jalan Sutomo.

2 Literature Review

In this literature review, we will explore how artificial intelligence (AI) can be used to optimize energy usage in the entertainment industry.
2.1 Energy Conservation

In order to conserve domestic energy resources and utilize them more efficiently, it is necessary to make efforts to implement energy savings, expand the circle of energy consumers and users of energy sources, lower the threshold for energy consumption, and regulate energy use. For savings at the regional and provincial levels, as well as in the development of energy savings in service companies, Government Regulation No. 33 of 2023 on Energy Saving comes into force. Energy saving is a systematic, planned, and extensive effort to conserve domestic energy resources and make their use more efficient. Conservation energy is implemented at all stages of energy management, which includes upstream management which aims to conserve energy resources, and downstream management which aims to increase energy efficiency [4].

As referred to in Article 6, energy saving is implemented through energy saving programs implemented by energy providers, energy source users, and/or energy consumers at least through:

1. Energy Economy
2. Energy efficiency standards and energy-saving labels
3. Energy saving financing
4. Energy-saving service business development
5. Raising awareness of energy conservation
6. Increase in personnel
7. Research and innovation and/or

Regarding energy saving, energy conversion is one of the efforts that can be applied. Energy conversion is a process where a form of energy is converted into another form of energy that is more useful [5]. In the industrial sector, energy conversion can help improve system efficiency and reduce energy waste.

In this case, in the Jalan Sutomo area, Medan, which gets quite a lot of sun exposure, the use of solar panels to generate electrical energy from heat is a surefire way to make energy conservation efforts. The use of rainwater harvesting systems and greywater treatment so that it can be reused is also one of the efforts to conserve energy.

2.2 Artificial Intelligence (AI)

Artificial intelligence (AI) is a branch of computer science that allows machines (computers) to function in the same way as humans [6]. Compared to natural intelligence (human Intelligence), artificial intelligence has several business advantages, among others:

a. Artificial intelligence is more permanent. Natural intelligence changes quickly. This is possible due to the forgetfulness of human nature. Artificial intelligence will not change until computer systems and computers change it.

b. Artificial intelligence is easier to reproduce and distribute. Transferring human knowledge from one person to another is a very long process; and also a skill that can never be fully replicated. So, once information is on a computer system, it can be copied from that computer and easily transferred to another computer.

c. Artificial intelligence is cheaper than natural intelligence. Providing computer services is easier and cheaper than hiring a person to do a lot of work over a very long period of time. Artificial intelligence is more permanent. Natural intelligence changes rapidly. This is possible due to the forgetful nature of humans. Artificial intelligence will not change until computer systems and computers change it.

d. Artificial intelligence is easier to reproduce and distribute. Transferring human knowledge from one person to another is a very long process; and also a skill that can never be fully replicated. So, once information is on a computer system, it can be copied from that computer and easily transferred to another computer.

e. Artificial intelligence is cheaper than natural intelligence. Providing computer services is easier and cheaper than hiring a person to do a lot of work over a very long period.

f. Artificial intelligence is consistent. This is because artificial intelligence is part of computer technology. Whereas natural intelligence will always change.

g. Artificial intelligence can be documented. Decisions made by computers can be easily documented by observing the entire system's actions. Natural intelligence is very difficult to reproduce.

h. Artificial intelligence can work faster than natural intelligence.

i. Artificial intelligence can do its job better than natural intelligence.

In terms of energy conservation, AI can play a key role in optimizing electricity usage in the entertainment industry. For example, AI-powered smart systems can monitor the energy consumption patterns of entertainment equipment such as stage lighting, audio-visual systems, and other electronic equipment. Through real-time data analysis, AI can identify and reduce energy waste by adjusting power according to current needs, even responding to fluctuations in energy demand.

Through the integration of artificial intelligence technology in the entertainment industry in Jalan Sutomo, Medan, it is expected to create a more energy-efficient environment, reduce environmental impact, and provide a better entertainment experience for visitors. These measures support the vision of sustainable development and align the entertainment
industry with the challenges of energy conservation in the modern era.

2.3 Entertainment Industry

The entertainment industry is part of the service sector that focuses on providing entertainment and recreation to the public. The industry encompasses a wide range of economic activities related to entertainment, such as musical performances, theaters, movies, amusement parks, and so on. The entertainment industry plays an important role in fulfilling people's entertainment and recreation needs and makes a significant economic contribution.

The division of the entertainment industry can include various subsectors, including:

1. Music Performances: Includes music concerts, music festivals, live performances, and other musical activities.
2. Theater and Performing Arts: Includes theater, drama, dance, martial arts, and other performing arts performances.
3. Film and Television Industry: Includes the production of films, television series, documentaries, and other entertainment programs.
4. Amusement Parks and Recreation Rides: Includes amusement parks, rides, water parks, and other family recreation areas.
5. Games and Digital Entertainment Industry: Includes the development of computer games, entertainment applications, and other digital content.

This division reflects the diversity of activities covered by the entertainment industry and demonstrates the industry's contribution to meeting people's entertainment and recreation needs and creating jobs. In this case, the focus of the discussion tends to be on the facilities or places that accommodate these entertainment activities, namely performance halls and movie theaters.

<table>
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<tr>
<th>No</th>
<th>District</th>
<th>Types Of Entertainment Venues</th>
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<tbody>
<tr>
<td>1</td>
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<td>Medan Polonia</td>
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<td>9</td>
<td>Medan Baru</td>
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<td>21</td>
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Table 1 has outlined data on entertainment venues in several sub-districts in Medan City. This is evidence that there is still a lack of entertainment industry facilities, especially in the form of recreation areas and cinemas. For the show building itself, at this time Medan only has one place as a place of performance advice, namely Taman Budaya Kota Medan which is located on Jalan Perintis Kemerdekaan Kota Medan. But at this time due to lack of maintenance, this building becomes abandoned and can no longer be used. In this case, in a simple example, the application of artificial intelligence (AI) to the theater and movie theater that is the focus of the discussion enables an increase in the number of entertainment facilities that are better maintained, safer, and more energy efficient in Medan City. Implementation of an adaptive lighting system in the building. AI can analyze data from light sensors to adjust lighting intensity according to actual needs, reducing energy wastage without compromising visual quality or audience comfort. Although most of the previously built buildings in other areas consume a lot of energy, with the addition of AI applications, it is expected that the efficiency of energy use can be significantly improved, creating a sustainable environment and a better entertainment experience for the audience.

2.4 Sutomo Street, Medan

Sutomo Street located in Medan City is one of the main arteries that plays a crucial role in the connectivity of the city. The road runs from north to south and connects various areas in the city. As a major artery, it has geographical significance as a vital corridor that connects different parts of the city and provides access to economic, commercial, and social centers.

As the center of business and trade activities, this street is the center of economic growth around it. Over time, Jalan Sutomo has become the center of economic and business activities in Medan. Along this road, there are various shopping centers, offices, hotels, and restaurants that support economic and business activities in the area.

Jalan Sutomo connects two sub-districts, namely East Medan and Medan Kota. Jalan Sutomo is one of the important transportation routes with heavy motor vehicle traffic. Mobility along this road involves various types of vehicles, including cars, motorcycles, and public transportation. Traffic management and transportation infrastructure around Jalan Sutomo are in focus to improve the efficiency and safety of movement. As an important part of the city's transportation system, Jalan Sutomo plays a role in facilitating the mobility of Medan residents. Public vehicles, such as buses and city shuttles, also use this road as the main route to serve the transportation needs of the community.

The construction of high-rise buildings, modern shopping centers, and other public facilities shows the potential for economic growth and urban development along this road. This is the reason for creating an area
that uses artificial intelligence (AI) to help conserve energy.

3 Methodology

This research uses qualitative methods in the form of data collection through literature research, i.e. comparing several studies with the same subject and function, especially in the entertainment industry. Information from this literature review, as well as theories, expertise, and government regulations and policies, will provide input in planning. Deepen the analysis later by looking for comparative studies of buildings that apply green design and artificial intelligence assistance to the system. This research focuses on identifying the potential use of artificial intelligence in resource management, operational efficiency, and eco-design applications.

4 Results and Discussion

According to Partridge [8], artificial intelligence is a field in which computers are used to implement computational mechanisms for activities that require intelligence, such as humans. In artificial intelligence, an intelligent agent (IA) is a part that can monitor its environment with sensors and influence the environment with actuators (i.e. intelligent agents). This concept of intelligent agents is the development of software agents, software that can programmatically perform tasks. A spy agent is a software engineer who has a "brain" so that it can solve problems by thinking like a human.

Artificial intelligence (AI) has become one of the most promising technological innovations in various fields, and the architecture industry is no exception. Amidst the complex future needs for more efficient, sustainable, and innovative buildings, artificial intelligence has emerged as a tool that enables architects and engineers to design and build smarter and more efficient buildings. Building design efficiency is a key driver of climate change, resource constraints, and the need for a more sustainable built environment. Building design is a complex process that involves many elements such as form, material selection, and structural design. The main goal of architectural design is to create a comfortable, efficient, and safe environment for its users. However, the traditional design process is often time-consuming, and expensive, and can pose complex technical challenges.

Today, AI is already present and helping humans in energy conservation efforts. For example, a lighting system can turn lights on and off in different areas and control lighting with various independently regulated methods. The air conditioning monitoring system can adjust the number of chilled water pumps, cooling water pumps, chillers, and cooling towers in operation according to the actual cooling load, and save energy by reducing the number of equipment in operation. The building equipment management system first collects and stores energy consumption data, and then optimizes control and management strategies through historical data analysis and various real-time information, manages current energy-consuming equipment and provides basic data for energy transformation, management system. The building equipment management system uses optimized control strategies to manage various internal mechanical and electrical equipment in an integrated manner, which can minimize the energy consumption of energy-consuming equipment.

In its application, some buildings are already using AI assistance in energy conservation efforts. Take the example of The Crystal Building, located in London, England. The Crystal is a sustainable exhibition and conference center that uses a variety of smart technologies, including AI systems.

Sebastien Ricard, Director of Wilkinson Eyre Architects, said: "The Crystal is the answer to a very unique request, to create an iconic building to house the international center of excellence for sustainability established by Siemens. The project offers a wonderful opportunity to explore how new technologies can help create highly sustainable buildings without relying solely on "passive systems". [9]

The building is equipped with sensors to monitor air quality, energy consumption, and water usage. AI is used to analyze the data from these sensors and provide insights that can be used to improve the energy efficiency and sustainability of the building.

In addition, in green open space areas, AI can help maintain plants and the environment around the building area. In this case, AI systems can continuously monitor the level of nutrients in the soil. [10] AI can utilize data sets to examine the environmental implications of applying different doses and types of fertilizers to find the dose that will have the least detrimental effect while maximizing production. This will help garden maintenance become more environmentally friendly [11].

In the context of the Lighting Industry, the scope of application of AI is vast and impacts various stages in the lighting lifecycle such as design, installation, commissioning, and configuration [12]. For example, a network of self-learning lighting components can communicate and self-organize without the need for human intervention, similar to automated commissioning systems used in the IT industry. This will reduce the time required to operate a new lighting installation. By observing and measuring the indoor environment, AI-based lighting systems can optimize and adjust light parameters to affect user experience and well-being.

AI can also be used in music composition which can support music creation. This process generally involves using algorithms to analyze data and discover musical patterns, such as chords, tempo, and length of various musical instruments, synthesizers, and drums. All of these systems generate new melodic suggestions that can inspire artists or organize accompaniment in buildings.

In its general application, AI technology is used to optimize energy use in the entertainment industry. AI can automatically monitor and control lighting systems and other equipment, identify inefficient energy
consumption patterns, and make smart decisions to reduce overall energy consumption. By adopting AI technology to manage energy, the entertainment industry in Jalan Sutomo can reduce long-term operating costs, reduce its carbon footprint, and contribute to global efforts to mitigate climate change. Utilizing artificial intelligence in the design of the entertainment industry in Jalan Sutomo, Medan, has great potential to improve energy efficiency and sustainability.

5 Conclusion

In the face of energy conservation challenges, the entertainment industry has great potential to integrate artificial intelligence (AI) technology and green design principles to improve energy efficiency and reduce environmental impact. The utilization of artificial intelligence (AI) in the design of the entertainment industry, with a case study conducted in Jalan Sutomo, Medan, promises to be an effective solution in energy conservation and reducing environmental impact. Through the use of AI technology, the entertainment industry can optimize energy use efficiently, reduce excess energy consumption, and minimize greenhouse gas emissions. The study results show that the implementation of AI in the entertainment industry can create a more economically and environmentally sustainable environment. However, challenges such as initial investment costs and complex system integration need to be overcome to achieve wider applicability. In conclusion, the utilization of artificial intelligence in the design of the entertainment industry in Jalan Sutomo, Medan, has great potential to support the goals of energy conservation and environmental sustainability globally.

References

2. V. B. Kusnandar, Databoks (2022)
5. Indonesia Environment & Energy Center, IEC (2023)
10. M. Vardan, Artificial and Natural Intelligence Techniques as IoP- and IoT-Based Technologies for Sustainable Farming and Smart Agriculture (IGI Global, Sydney, 2021)