Energy Saving Application with Operational Automation for Tourism Accommodation Utilities

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Abstract. Energy in buildings in tropical regions such as Indonesia is dominated by air conditioning systems. With the high use of electrical energy from tourism accommodation, it will be difficult to develop because operational costs are high. Thus, the purpose of this research is to obtain energy savings from operational utilities used such as air conditioning, refrigerators, water heaters, pumps and lights. The saving system is carried out with an internet-based automation system so that it can be controlled properly and can influence the occupants' energy-saving culture. The method used is the application of an energy saving model with internet-based automation. Experimental rig is made to automatically simulate energy saving. The expected result is significant energy savings in the simulated room compared to the conventional one. With a good automatic operational system, it will be able to change the energy-saving behavior of occupants.

Keywords: Saving energy, Automatization operational, tourism accommodation.

1. Introduction

Bali, as one of the renowned tourist destinations both nationally and internationally, offers various types of tourism accommodations such as hotels, villas, bungalows, and more. In carrying out their operations, these tourism accommodations heavily rely on the internet as a crucial component to ensure smooth functioning and performance [1, 2].

The rapid development of technology in the era of Industry 4.0 has changed the lifestyle and behavior of various societies. The development of the world of information and the Internet, other applications of the Internet that are quickly connected with the

M. U. H. Al Rasyid and M. R. Mufid (eds.), *Proceedings of the International Conference on Applied Science and Technology on Engineering Science 2023 (iCAST-ES 2023)*, Advances in Engineering Research 230,
https://doi.org/10.2991/978-94-6463-364-1_4

use of electronic equipment that occurs in society, known as the Internet of Things (IoT) [3, 4, 9].

At the moment, the use of energy for accommodation needs is still a significant issue. Such high energy consumption not only leads to a high cost burden for accommodation owners, but also hampers the tourism industry's ability to compete with other large hotels. However, there is a solution that can help solve this problem, namely the application of the Internet of Things system. (IoT) [5, 6, 10].

One of the causes of energy waste is the operation of equipment (utilities) that does not comply with energy-saving procedures. Therefore, it is very important to create an energy-saving application system based on the Internet of Things (IoT) so that automatically operate energy-efficient equipment [13, 14].

In Indonesia there are already some sectors that implement the Internet of Things (IoT) based system but still many communities in Indonesia have not implemented it and still many do not know what is IoT [15].

The aim of this study is to find out how the process of applying the Internet of Things (IoT) in a room through monitoring, controlling or regulating the system in a building via a smartphone and can determine its performance.

2. Methodology

2.1 Location

The method used in this study was by applying the Internet of Things (IoT) system model to a space conditioned as a working space that lasts for 7 days and 8 hours each day.

Figures 1 and 2 show the location where the IoT system is implemented.

Fig. 1. Location of the IoT system implementation

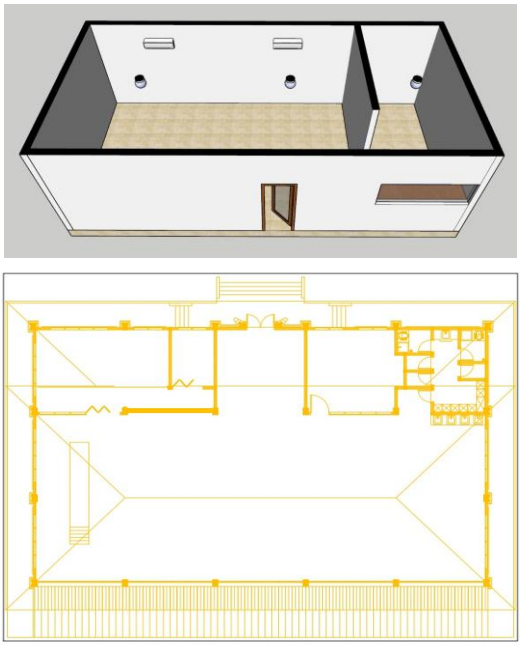


Fig. 2. Room layout where the IoT system installed.

The IoT system installed in this room can be controlled through the smartphone application so that action can be taken immediately to turn off the equipment not used in the room. For example, when hours of rest, there are devices that should be turned off, such as TV and air conditioning, but often forget to turn off. With the IoT system that can be doped through HP, this can be avoided.

2.2 Procedure

Research on the application of IoT systems is carried out in one of the workspaces. The application is applied to three lights, one TV, one refrigerator, and one air conditioner. There are several components that are applied by adding electronic equipment installed on the plantation in a building.The use of an electricity consumption monitoring and control system using IoT to monitor energy usage in buildings in real-time.

Smart lights installed in the room are three pieces. This smart lamp can be controlled automatically through an application without any specified distance limit The control includes controlling on and off and controlling the brightness of the lights as we want. The installation of a light control system connected to IoT functions for on/off settings, adjusting the color of the lights, adjusting the brightness level of the lights automatically as needed and can adjust the usage schedule.

The smart plug attached to the television has the purpose of being able to know the use of energy consumption and its on/off control automatically through the application.

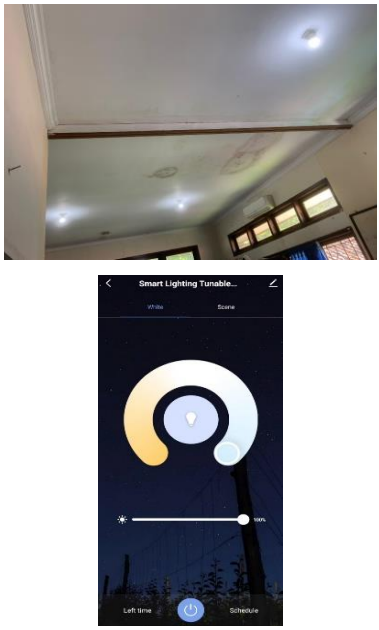


Fig. 3. Smart ligh bulb installation.

Fig. 4. Smart plug installation on TV and refrigerator.

The refrigerator is also fitted with a smart plug so that it can know the energy consumption used and can be controlled automatically through the application as well.

In a conditioned room, there is only one air conditioner that is functioned so that only one smart plug is used, with the aim not only able to control the Air Conditioning on / off system but also adjust the temperature as desired through an application. The electrical energy used that has been installed on a smartphone can be controlled respectively.

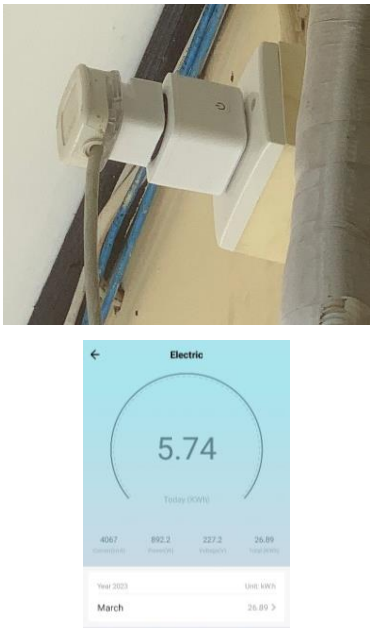


Fig. 5. Smart plug installation on air conditioning.

2.3 Implementation of IoT device

The purpose of implementing this application system is to find out how the use of this system works, and what processes will be carried out so that the system can connect and work as expected. The steps that must be taken include the following:

1. Download the Bardi Smart Home app from Playstore / Appstore on your smartphone.
2. Regi ster to create an account using your e-mail address or phone number.
3. You will enter the Home section for the first time. Tap the "+" sign on the top right of the screen to add devices.
4. You will arrive at the Add Manually menu. Select the device you want to connect.
5. Make sure your device is on,
    a. If the light is already blinking rapidly, press the Confirm Indicator Rapidly Blink button.

   b. If the lamp is not blinking, turn the lamp off and on 3 times (off-on-off-on-on-on-off-on). After the lamp blinks rapidly, press the Confirm Indicator Rapidly Blink button.
6. Enter your Wi-Fi and Wi-Fi password then press the Confirm button.
7. Wait for the process of connecting your Wi-Fi, smartphone, and device.
8. After the Device Added Successfully notification appears, you can change the device name (if you want), then press the Completed button.
9. Control the device with the features available in the app.

2.4 Tool component testing

Tool testing is very important to get good performance, safety, and user comfort. Here are some steps that can be taken in testing the tool:

1. Functionality: Verify all the functions promised by the smart home appliance. Ensure that the device can perform the expected tasks, such as controlling devices, detecting motion, measuring temperature, etc. This test is conducted to ensure that the device can run correctly under various conditions.
2. Connection: Check the network connection of the smart home appliance. Ensure that the appliance is connected to a Wi-Fi network or the communication protocol being used, such as Bluetooth or Zigbee. Test the stability of the connection and the appliance's response to user queries.
3. Security: Secure the smart home appliance from security threats. Check if the appliance has adequate security mechanisms, such as data encryption and user authentication. Test for potential security vulnerabilities and ensure that the appliance can protect users' personal information and prevent unauthorized access.
4. Integration: if the smart home appliance can be integrated with other platforms or systems, conduct tests to ensure good compatibility and interoperability. Test integration with mobile apps, larger smart home platforms, or existing home automation systems.
5. Energy Performance: evaluate the energy usage of the smart home appliance. Check that the appliance uses energy efficiently and does not consume excessive power. Test different operation modes to measure power consumption under different conditions.
6. User Interface: test the user interface of the smart home appliance. Ensure that the user interface allows users to set preferences according to their needs.
7. Durability and safety: test the smart home appliance's resistance to extreme environmental conditions or sudden changes, such as extreme temperatures, high humidity, or electrical interference. Ensure that the appliance can function properly and can recover after an interruption.
8. Scalability: with multiple smart home devices connected, test the system's ability to manage a larger number of devices. Ensure that the smart home appliance can operate well on a larger scale without degrading performance.

3. Results And Discussions

Based on the use of the IoT application controlled on a smart phone, data on monitoring energy consumption on air conditioning, refrigerator, and television is obtained, as shown in the table.

3.1 Monitoring Data Table

Table 1 shows the results of monitoring the energy consumption of the IoT-based system every month from March to June. In this table, the energy consumption of air conditioning devices, refrigerators, and televisions is recorded. From the data, it can be seen that the total energy consumption for four months monitored through the IoT-based application is 661.41 kWh. This confirms that the application of the IoT system will facilitate data collection, so that the results can be known more quickly and efficiently.

Table 1. Energy consumption based on monitoring

No.	Month	Energy (kW.h)		
		AC	Refrigerator	TV
1	March	60.95	26.93	0.26
2	April	96.92	82.47	2.37
3	May	48.43	206.47	3.1
4	June	35.21	96.72	1.58

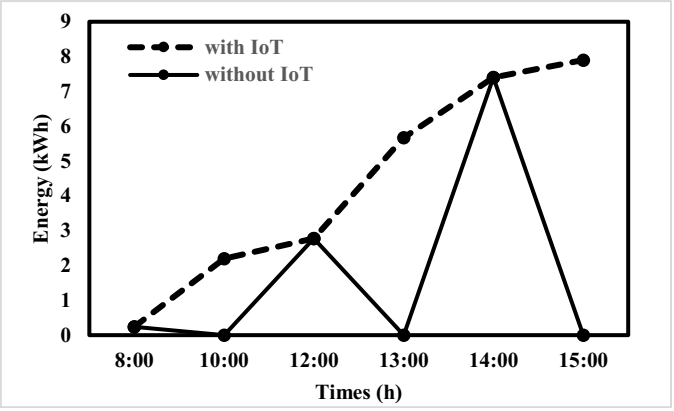
Tabel 2. Perpaduan Data Konsumsi energy dari AC

Time	Energy (kWh)	
8:00	0.24	0.24
10:00	2.2	0
12:00	2.78	2.78
13:00	5.67	0
14:00	7.4	7.4
16:00	7.9	0

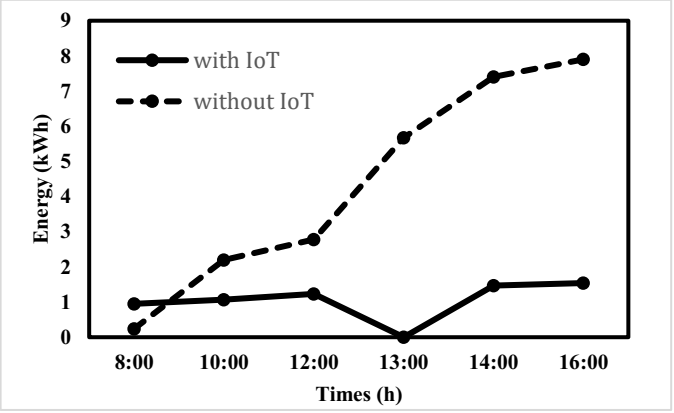
In Table 2, we can see a combination of energy consumption data from the air conditioner implemented by using the IoT system through its application. In this context, we have the ability to control energy usage through the application of the system that has implemented IoT. When an empty value is seen, it indicates that at that time we can turn off the air conditioner so that it no longer requires power for its operation.

3.2 Energy cunsumption

Figure 6 shows an illustration of the energy use of air conditioning in the room used as a research site. Monitoring was conducted from 8 am to 3 pm. This schedule is an illustration of the daily work schedule. Figure 6 (a) shows that with an application that can be accessed via a smart phone, it appears that the value of zero indicates that the electronic equipment is turned off. So in this case, we can set the time when the electronic equipment in the room is turned off if it is no longer useful. The total amount of energy required if no operational control is carried out is 26.19 kWh. While the value is different after the control is carried out so that it can save the value of energy consumption to 10.42 kWh. This also illustrates that with this system we can save energy consumption.

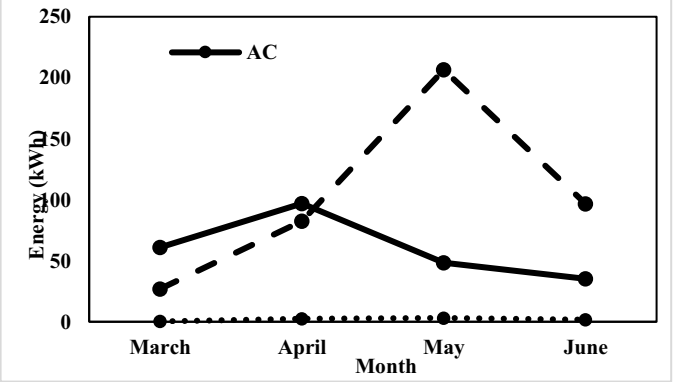


(a)



(b)

Fig. 6. Combination of energy consumption by applying IoT system applications.



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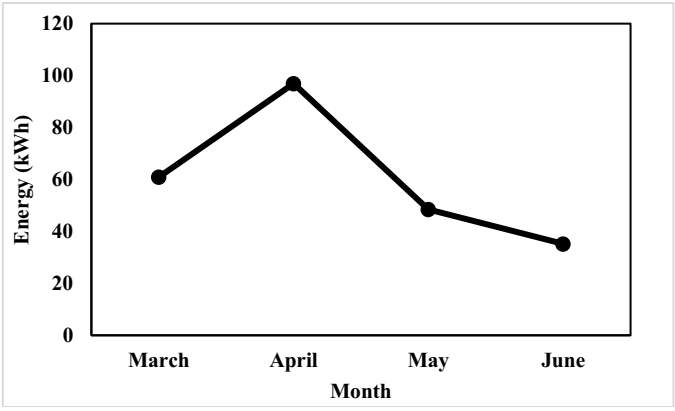

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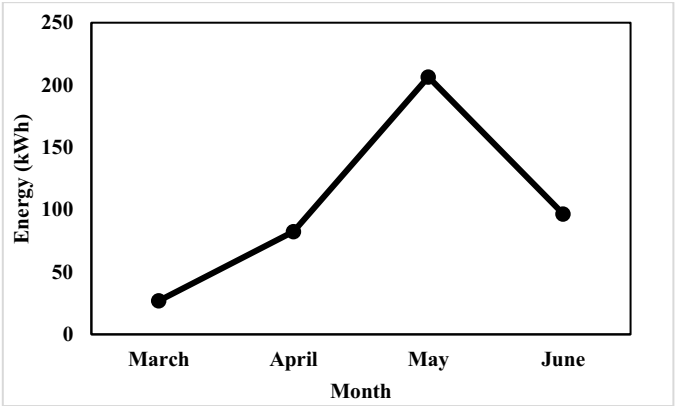
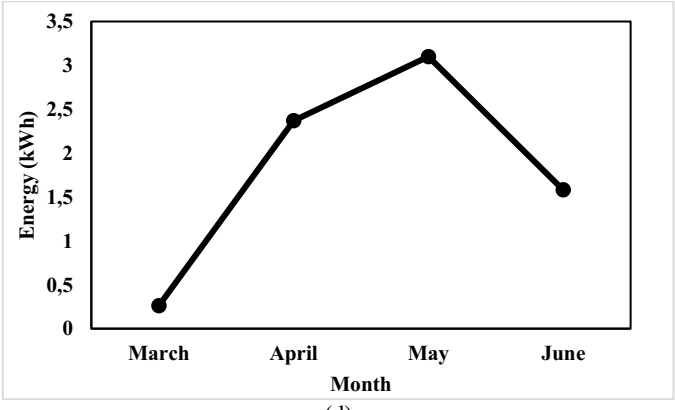


(c)



(d)

Fig. 7. Energy consumption for four months based on monitoring through an IoT-based application.

Figure 7 tells us that for four months, the room that was conditioned as a research site, had electronic equipment that required considerable energy in its operation. The total energy consumption required during the four months from the use of air conditioning, TV and refrigerator was 661.41 kWh.

By referring to the explanation from Figure 6, we can control this considerable energy usage, where the savings are up to 30%, assuming the condition of deactivating electronic equipment that is not useful. The good thing is that we can control it through the application on the cellphone.

4. Conclusion

This research is a study of how the IoT system can be implemented for a room with the aim of being able to control electronic equipment so that energy consumption savings can be made. In this research, savings can be made up to 30% of the total energy consumption required.

Acknowledgement

The author would like to extend their appreciation to the Directorate Academic and Vocational Higher Education (DAPTV), Directorate General of Vocational Education, Ministry of Education, Culture, Research, and Technology of the Indonesian Government for providing research funding in 2023 under Grant No. 162/SPK/D.D4/PPK.01.APTV/VI/2023. Gratitude is also expressed towards all the members and research assistants in the Mechanical Engineering Department of Bali State Polytechnic, as well as to the Research Centre (P3M) at Bali State Polytechnic for their outstanding administrative support.

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