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Appliances Energy Consumption Monitoring Using Home Assistant

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Abstract

World energy consumption has increased dramatically in the last three decades of the last century. The increase in the cost of electricity goes up in parallel with the increase in the cost of world fuel. Educational institutions such as polytechnics are no exception to the effects of this increase. This paper discusses the development of an energy monitoring system from equipment and to identify the equipment that contributes to energy wastage in the institution. Energy is recorded using a modified Wi-Fi power socket that is integrated with the Home Assistant platform. Some equipment in the academic building was selected in this experiment. The developed system is able to control ON and OFF of the equipment and can also record the power, voltage and current values for all the equipment used. Based on observations, it was found that the amount of energy wasted for each equipment was 3.88 Kw (water filter), 0.4 Kw (Voltage regulator) and 0.1 Kw (photostat machine). The use of a comprehensive system has been able to help monitor the energy consumption of each equipment and indirectly reduce the cost of the institution's electricity bill.

Keywords: - Wi-Fi power socket, energy monitoring, home assistant, energy saver

1. Introduction

Electricity supply is the most important element for the operation of a building in an educational institution. Basically, most of the academic department buildings have laboratories that involve equipment such as computers, machine, and other equipment. Besides that, each building is also equipped with lighting system, air conditioning system, internet and communication system, motor control system and so on. Failure of electricity supply in the institution can affect the entire work activities and learning process. Each institution should regularly monitor the use of electricity so that electricity can be managed well and used efficiently without waste. In addition, all staff also need to be given knowledge and awareness in using energy efficiently. In other words, consumers should realize how important it is to use energy wisely because it can preserve the environment and save costs. Nowadays there are many devices and sensors that can monitor the energy used. The overall energy monitoring can be done using a smart meter, but the monitoring of each load requires a special tool to be used. In this paper, appliance energy consumption using home assistant is proposed to identify energy waste in polytechnic buildings. The energy consumption of some appliances is monitored using a modified Wi-Fi socket.

World energy consumption has doubled in the last three decades of the last century. The largest generation ever recorded was from fossil fuels which accounted for 77.8% and the estimated total energy consumption for the period from 2025 to 2035 for the entire world is projected to be 18608 Mtoe (Beretta,2007). In Malaysia, many efforts have been implemented to increase awareness of energy saving. Several policies have been made and circular

guidelines have been issued to guide energy saving in government buildings. Nowadays monitoring can be done using manual methods and using equipment equipped with wireless applications. IOT systems become a priority because they are easier to reach anywhere. The development of a monitoring system that uses a wireless system can come from several methods, namely using GSM (Fakharuddin et al., 2012; Sultan et al., 2019; Sanni et al., 2019), Wi-Fi (Luechaphonthara & Vijayalakshmi, 2019; Suhaimi & Hashim, 2021; Mudaliar & Sivakumar, 2020) and Zigbee (Tung & Lam, 2008; Peng & Huang, 2016; Govindarajan et al., 2018). Now more and more Wi-Fi-based systems are being used, for example systems developed using the ESP8266 microcontroller and ACS712 current sensor are capable of monitoring equipment such as refrigerators and water dispensers (Luechaphonthara & Vijayalakshmi, 2019). Wi-Fi-based systems can be accessed online, and data can be stored in the database. In addition, there are also systems that use light weight protocol access such as MQTT (Mudaliar & Sivakumar, 2020). Based on observations, there are many types of cloud and mobile applications that are often used in developing dashboard systems, whether in the form of controls, gauges or graph displays such as Blynk Application (Ahmad et al., 2021; Othman & Zakaria, 2020), InfluxDB (Mudaliar & Sivakumar, 2020), Node-Red (Zamani et al., 2023; Baig et al., 2021) and many other platforms.

In this paper, the development of an energy monitoring system uses a home assistant. The Home Assistant software platform is a client-server service through which all smart appliances in a home network can be managed, controlled and monitored, even if these appliances come from different manufacturers. The use of the home assistant platform in this project is using a VM ware workstation

2. Methodology

The development of the monitoring interface is using the Home Assistant platform. This study focuses on monitoring equipment in the Electrical Engineering Department, Politeknik Sultan Idris Shah as shown in Table 1. The energy data of some equipment is monitored during office hours and after office hours. The selection of equipment is focused on equipment that needs to be turned OFF after use and equipment that can be limited in operation. The block diagram of the monitoring system is shown in Fig. 1

Table 1. Appliance energy monitoring

Appliances	Location
Computer Desktop	Computer Programming Lab 1
Voltage Regulator	Computer Programming Lab 1
Water Filter	Electrical Engineering Department, Islamic Centre, Cafeteria
Photostat Machine	Electrical Engineering Department

The power value of the equipment is measured using a Wi-Fi power socket. The current, voltage and power values are monitored via the home assistant platform and the Smart Life app on the mobile phone as shown in Fig. 2. Apart from monitoring energy values, the system can also ON and OFF appliance through mobile App and Home Assistant dashboard.

3. Result and Discussion

The data collected is a graph displayed on the home assistant platform. In addition, through the platform, data for each parameter (Current, voltage and power) is collected in the form of an excel file. Based on the analysis carried out on some equipment, there is a significant difference between the values for each equipment either during office hours or after office hours. Fig. 3 shows a graph comparison for each equipment.

All equipment used in this study has a power saving mode function except for the voltage regulator device. Based on observation, although some of the appliances have power saving mode function, it is only for a certain period of time and still use small energy to maintain operation. Therefore, the analysis focused on energy waste from each appliance. Fig. 4 shows the energy used by each appliance, the energy wasted after office hours and the energy wasted during weekends.

Based on the observations carried out, it was found that the highest energy consumption is from the water filter, which is as much as 3.88 Kw. The amount of energy measured after working hours is 0.41 Kw for the water filter and 0.13 Kw for the voltage regulator. For the energy measurement measured on the weekend, it was found that the amount of energy wasted for each equipment was 3.88 Kw (water filter), 0.4 Kw (Voltage regulator) and 0.1 Kw (photostat machine). The results also show that devices such as desktop computers, LCD projectors and printers do not show energy consumption if the switch is not closed.

4. Conclusion

The development of an energy monitoring system for electrical equipment has been successfully developed through the integration of power Wi-Fi socket and home assistant platform. The results of the analysis show that if each equipment is not closed after use, it will cause energy waste to occur. However, not all equipment records energy consumption either after office hours or weekend days. There are two equipment identified in this study that contribute to the consumption of a lot of energy, namely the water filter and the voltage regulator. Therefore, to avoid further wastage of electricity, it is recommended that all equipment be turned off after office hours. As for water filter operation, it is recommended that operating hours be limited to office hours only and the power switch will be closed on weekends and after office hours.

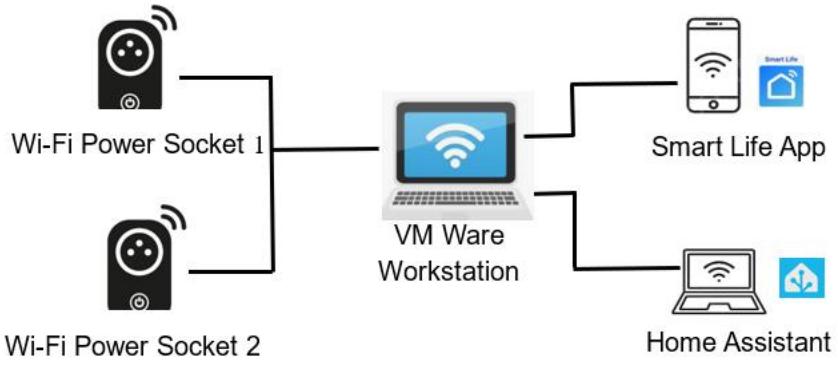
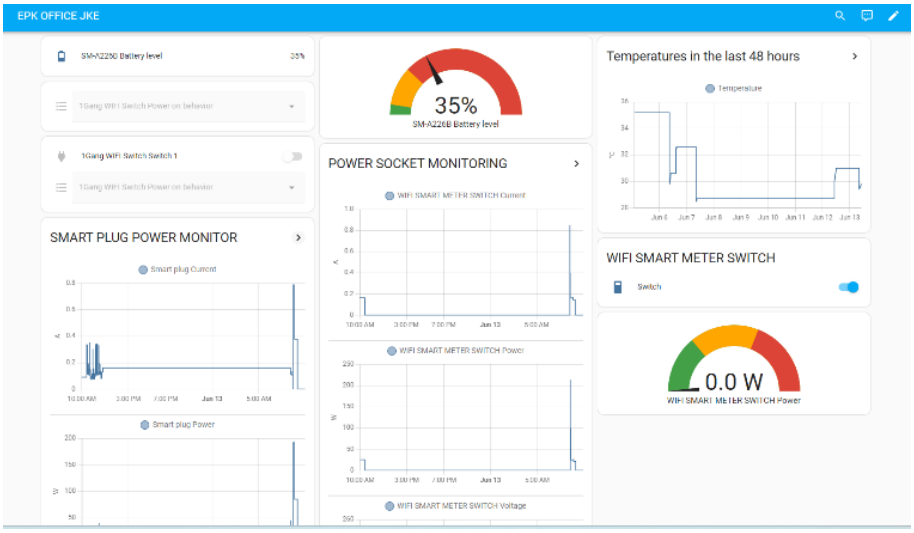


Fig. 1. Block diagram of the system



Fig, 2. Home assistant platform

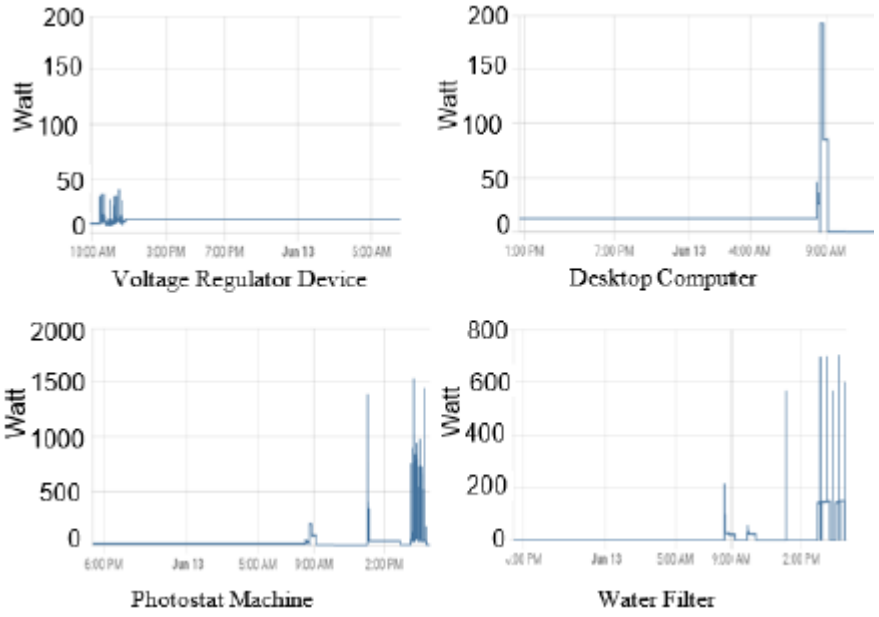


Fig. 3. Power Comparison between different appliances

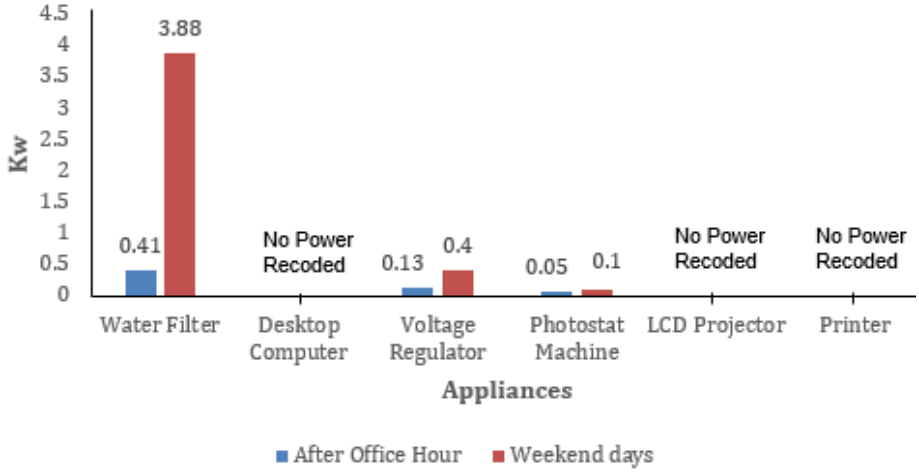


Fig. 4. Energy wasted from appliances after hour and weekends

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