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Research Article

Internet of Things-Based Smart Electricity Monitoring and Control System Using Usage Data

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In everyday life, electricity is necessary, and proper use is critical. To strengthen home electricity control, the existing systems have been examined over the years. However, the existing PMAS method's error ratio is higher and does not allow for a remote monitoring system. Therefore, this study proposes a smart monitoring and control system (SMACS) for household appliances. The application's significance is to monitor household appliances' electricity usage using hardware and the Internet of Things (IoT) methods. The prototype of the proposed system is designed and developed considering Arduino UNO, a liquid crystal display (LCD), an ACS712 current sensor module, relays, and AC sources. The components are selected from the software library, and the simulation results are found the same as the prototype. WiFi module ESP8266 is not included in the design because it is not provided in the system. The data is recorded in cloud storage using Thing-speak. A mobile application (Virtuino) also accesses the data to visualize it through the graphical and numerical display. This study provides users with an easy system to monitor and control household appliances' power consumption using mobile applications. Results show that the proposed system provides 0.6% current errors for the hairdryer appliance, whereas the existing Power Monitoring and Switching (PMAS) system provides 7.8% current errors.

1. Introduction

In Malaysia, electricity has the highest demand as it is expected to increase gradually in years to come, in line with the expansion of urbanization, rapid industrialization, and the growing population of the country. Statistically, residential sectors consume up to 48% of the energy globally [1]. Around 40% of Malaysia's buildings' energy is divided into commercial buildings and residential buildings [1]. In this modern era, people utilize household appliances with new technologies. In Malaysia, on average, 20 to 30 electrical

household appliances are used in homes [2]. A vast majority of household appliances consume a large amount of power and energy. Consumers mostly tend to leave their lights, fans, freezer, air conditioner, and other appliances turned on when they are not in use, resulting in energy wastage, a tendency of human behaviour [3].

This negligence concerning the consumers' behaviour can lead to excessive power consumption and wastage of the electrical energy needed, and it can shorten the life span of household appliances such as hair dryer, dry iron, induction and rice cooker, water heater, microwave oven, air