ARTIFICIAL INTELLIGENCE (AI) HOME ENERGY AUDITS AS AN EFFORT TO INCREASE ENERGY EFFICIENCY AND FACING POST-PANDEMIC ECONOMIC PROBLEMS

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The Covid-19 pandemic has devastated 213 countries' economies, including Indonesia which made Indonesia's economic growth to slow down significantly to zero percent, far below last year's realization of economic growth which was in the range of five percent (Nainggolan et al., 2020). Enforcement of Large-Scale Social Restrictions (PSBB) that is carried out for several months has an effect on slowing down various aspects of national income.

During the Covid-19 pandemic, one of the problems that can be resolved is related to household energy efficiency, which indirectly affects the household economy. In this Covid-19 pandemic, it is estimated that household energy consumption will not decrease, instead it can significantly increase due to the implementation of the learning and working from home system. With household needs figures that tend to remain, or even increase, with household economic conditions declining due to mass layoffs, concrete steps are needed to make the use of family finances more effective, one of which can be done by streamlining household electrical energy consumption through energy conservation.

Energy conservation itself is an effort to use rational energy efficiently without reducing the energy use needed in all aspects (Utami et al., 2018). Therefore, it is necessary to apply energy conservation in the use of home energy through various energy audit efforts.

One of the ways to improve energy efficiency is by utilizing the available energy appropriately and in a sustainable manner by auditing the conditions of building energy use, so that energy use can be properly managed for benefits. This energy audit will use energy consumption data that has been collected over a certain period of time, it can be assumed that the energy consumption data is in the form of time-based data that represents energy consumption patterns and can be used to predict future energy consumption.

This energy audit idea can also adopt the application of automatic controls that are integrated with artificial intelligence schemes to improve its performance. An artificial intelligence (AI) system in a smart building suite that not only saves massive energy use, but also saves consumption and utility costs.

Smart building performance that is based on a centralized cloud-based system and works in sync with one another via Internet of Things (IoT) technology has the potential to compensate for supply fluctuations and reduce overall energy consumption. This scheme also supports the existence of a comprehensive real-time and historical data acquisition system structured in a network as in the following scheme.

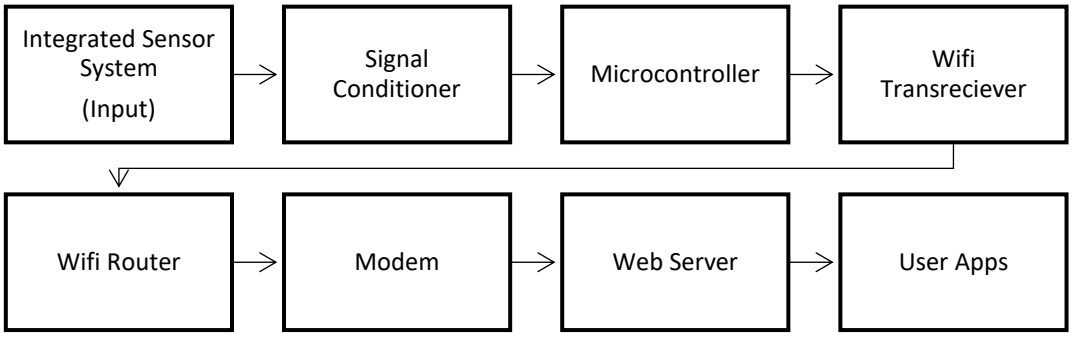

Figure 1. Digital energy audit scheme

The application of artificial intelligence (AI) in smart building schemes enables the provision of sensor network automation which allows automatic discovery of potential problems and provides control response based on algorithmic controls such as PLC (Programmable Logic Controllers). An integrated building automation system can carry out a comprehensive and continuous inspection of energy usage (energy audits) in each electrical network in the building. In addition, energy control in efficiency efforts is also carried out by using occupancy indicators that minimize energy loss for unused space to improve occupant productivity and experience through location-based services.

This system implements control control with feedback to send a return signal from the output to the input input in a close loop scheme as a correction input, assisted by an intelligent controller through the UIC (Integrated Controller Unit) and IDC (Intelligent Digital Controller) schemes. The IDC system is useful as a multipurpose control device for building devices, such as the electric power panel and the Air Handling Unit panel, which in its application can greatly save energy use.

A study conducted by the American Council for an Energy Efficient Economy regarding the energy consumption that has been collected collectively in the building's internal network in an intelligent algorithm system that recommends adjusting energy use based on the ideal pattern of electrical energy consumption states that the use of an automatic control system can save costs by 24 -32% (Vincent Bonneaue and Tiana Ramahandry, 2017) and a significant savings of 20% (Himeur et al., 2020) when using smart HVAC and smart lighting as in the following chart.

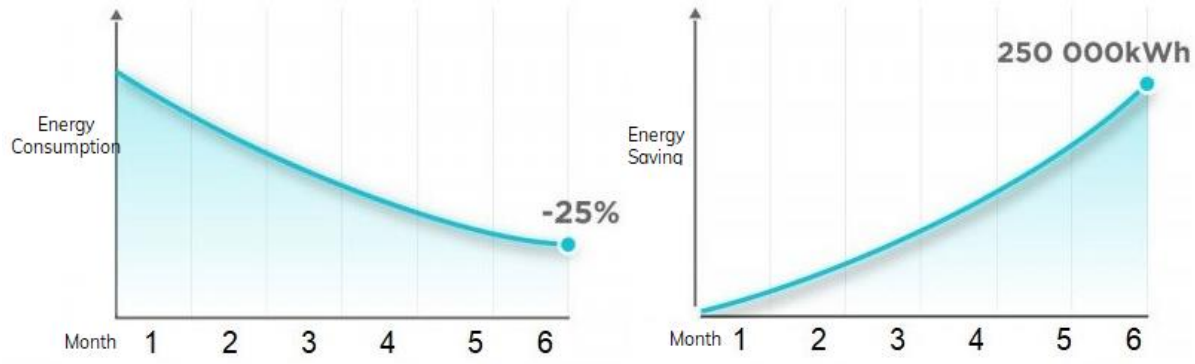

Figure 2. Potential Power Consumption Efficiency

(Vincent Bonneaue and Tiana Ramahandry, 2017)

The Bulding Automation System (BAS) will act as a solution for controlling various energy schemes in the building, such as HVAC control, lighting, electronic equipment and utilities, as well as electronic device schemes in creating residential comfort. This system can save energy consumption in buildings as in the following graph.

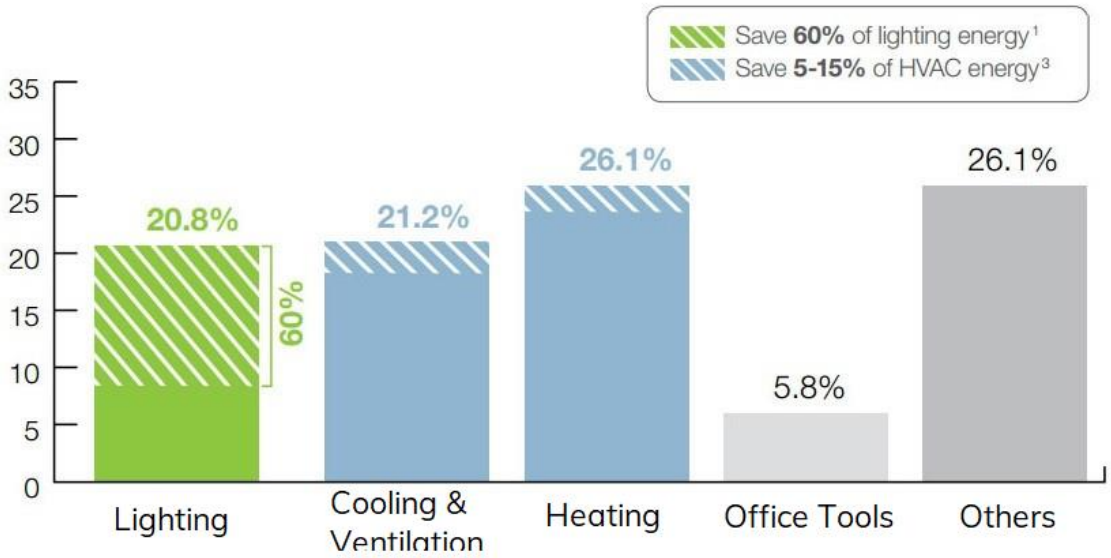

Figure 3. Percentage of Energy Saving in Buildings

(Vincent Bonneaue and Tiana Ramahandry, 2017)

In this system, direct digital control devices are arranged which function as control indicators to regulate energy use according to consumption limits without reducing the function of the equipment used and increasing the ability to carry out building energy management. This energy conservation device scheme uses a smart lighting system consisting of radio frequency (RF) based wireless sensors, switches, dimmers, pico wireless remote controls, and accessories that maximize energy savings, as well as a load control module based on a dimming switching system (EcoSystem with control 0-10V), and the contact closure output module.

Implementing this system in the home allows for significant efficiency. However, the problem you may face is that the electrical installation installed in the house may not support the performance of this system. Adjustments to the electrical installation installed in the house must be done, by studying each existing electrical line and designing a system based on the conditions of each house. As a result, the system applied in each house may be different because it adjusts the electrical installation of each house.

Especially in the current post-pandemic condition, looking at the increasing figure of household energy consumption due to the learning and working from home system, which demands various ways of managing the household economy, it is necessary to install such a system to increase its energy efficiency in order to reduce household electrical loads. The amount of energy saving opportunities in each house varies and depends on various factors, including the efficiency of the process and the equipment used in the house.

In addition, the application of artificial intelligence (AI) and machine learning to smart building systems based on residential energy consumption patterns allows equipment to work optimally with adaptive learning. Adaptive learning allows the system to compare room temperature, outside air conditions, and equipment capability until the equipment can be turned on at the correct timeframe to ensure the room set point is reached before use with control of the installed control algorithm.

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