scientific reports

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An approach to energy conservation in lighting systems using luminaire-based sensor for automatic dimming

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Lighting systems account for a significant proportion of energy consumption in buildings. Therefore, energy conservation within these systems can greatly enhance overall building energy efficiency. This study proposes a control strategy for LED lamps by adjusting lighting intensity and improving the performance of electric luminaires. The approach involves implementing an automated dimming system that adapts lighting intensity based on surrounding light levels. A system comprising an ambient light sensor, microcontroller, power supply module, dimming controller, and lamp was developed. The sensors measure brightness within a specified range in real time, and the microcontroller analyzes and compares this data against the brightness settings for specific areas. The designed control system was tested in a laboratory setup to demonstrate its effectiveness in a controlled environment. Results showed a 75.65% reduction in power consumption compared to standard lamps in a simulated environment, highlighting its potential for significant energy savings in buildings and its contribution to environmental sustainability.

Keywords Automatic Lighting Control, Daylighting, Energy saving, Lighting

The increase in global population and urbanisation have driven energy consumption to unprecedented levels, with buildings making a significant contribution to this rising demand. As the world faces the urgent challenges of climate change and dwindling natural resources, the need for sustainable energy practices has intensified[1]. Energy consumption in buildings has reached alarming proportions, and accounts for a substantial proportion of total global energy consumption. According to recent estimates by the International Energy Agency (IEA)[2], the operation of buildings accounts for 30% of the global final energy consumption and 26% of global energy-related emissions. This remarkable figure highlights the impact of building operations on environmental sustainability. In Thailand, the growth rate of energy consumption of medium-sized businesses has increased by 4.34%, which accounts for a significant proportion of total energy consumption[3]. In addition, the demand for energy technologies such as electric vehicles are increasing in the modern world. Consequently, it is critical to implement energy-efficient strategies in the building sector to minimise environmental harm and reduce the financial burden associated with energy expenditure.

To promote a sustainable built environment, it is imperative to synchronise building design with the surrounding ecosystems, carefully considering climatic variations, geographical features, and available resources. Such harmonious integration requires a multidisciplinary approach that includes architectural, mechanical, and electrical considerations to optimise energy use. Important considerations include effective insulation techniques, the use of natural ventilation mechanisms, and skilful placement of windows to take advantage of daylighting opportunities[4]. Energy-efficient buildings should minimise reliance on artificial lighting, heating, cooling, and other energy-intensive processes, to reduce overall energy consumption[5]. Furthermore, the integration of renewable energy sources, such as solar photovoltaic panels, in conjunction with advanced energy

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