Guideline on Energy Monitoring and Management for Energy Saving in University of Malaya

UM LIVING LAB GRANT: SMART MODULAR ELECTRICAL ENERGY MONITORING AND MANAGEMENT SYSTEM (LL014-16SUS)

Introduction:

Cost of Electricity bills represents one of the major components of operating cost across various types of buildings and facilities. Inefficient use and improper management of electricity will not only cause higher operating budget but also waste of natural resources and unnecessary CO2 emissions. The main contributors for energy usage in office buildings are air conditionings and lightings [8, 9]. In university of Malay the number of split air-conditioning units are quite significant, and most of the lightings are using manual switches. Such conventional setups fully rely on human factors hence there are tendencies of non-optimize use of energy. A smart power monitoring and power management system can be one of the solution to address this problem.

Proper management of electrical power has become crucial nowadays due to its significant impact in reducing the consumption of energy, reducing electricity bills and at the same time lowering CO2 emissions. Collected data and findings from literatures indicated that there are still significant percentage of users (approximately more than 30%) of users are not really care to turn off switches. In addition, implementation of smart space or smart office over existing building often incur high starting investment as a result such solution is not been fully adopted.

This Project proposed a quick and simple approach to reduce unnecessary energy usage by using novel modular electrical energy monitoring and power management system featuring easy installation without the need of major renovation and rewiring. This system is developed in-house by UM researchers; therefore, we have full control over the sub components to be used which then allows us at some extend control the overall cost of the system. Results from our first phase study indicated that under well controlled environment it is possible to achieve approximately 34% reduction of electrical energy usage for lightings and approximately 47.8% for air-conditioning. In addition the proposed system has made it convenient to the space occupants since all the switching and temperature setting and regulations are automatically taken care of. The use of the proposed system at more locations will bring better impact on energy savings and CO2 reductions thus benefits the Institution and promotes sustainability.

Guidelines & Good practice:

1. It is a good practice to utilize the available sunlight for lightings. When light intensity in a certain location increases due to the sunlight, the lights can be switched-off or set to be dimmer. A system that uses photocell sensor with regulator can be employed.

2. Electrical energy consumption can be reduced by simply change the type of lamp used e.g. from the fluorescent lamps to LED lamps (light emitting diodes). This approach demands quite high initial investment [3] but will benefit in long run.

3. A straight forward method that detect space occupancy and switch appliances such as light and Air-conditioning unit (AC) can be a good approach for spaces such as lecturer office, and lecture halls.

4. Heating and cooling is the main source of power consumption that contribute to the high electricity bills. Recently Universiti Teknologi Petronas (UTP) have come out with a method of energy saving which is accessed via a simulation of energy for a centralized HVAC (system for heating, ventilating, and air conditioning) in academic building. They utilized adaptive cooling technique for continuous cooling load [4].

   Since the academic building is not always occupied, the presence of occupants in a building has an important impact on the required cooling of a building [5,8]. This implies that, cooling load in a building is mostly driven by the number of recipient. In addition, occupancy pattern in an academic building especially laboratory, workshop, and classroom is likely to change every semester or academic year. Therefore, it needs appropriate design and analysis tool to optimize the performance of the system [6].

5. It has been reported in [7] that there are quite a significant percentage (about 30%) representing number of users that do not really care to turn off switches. Therefore, a solution such as autonomous switching is needed to address this 30% category.

6. Although there are plenty of efforts in improving efficiency and reducing the unnecessary electrical usage, however most of the existing techniques are not convenient and costly due the need of high initial investment, involve major renovations due to the need of hacking the walls for installation of energy saving system. The modules as indicated in Figure1 developed under UM-LIVING LAB can be employed to address some of these concerns.

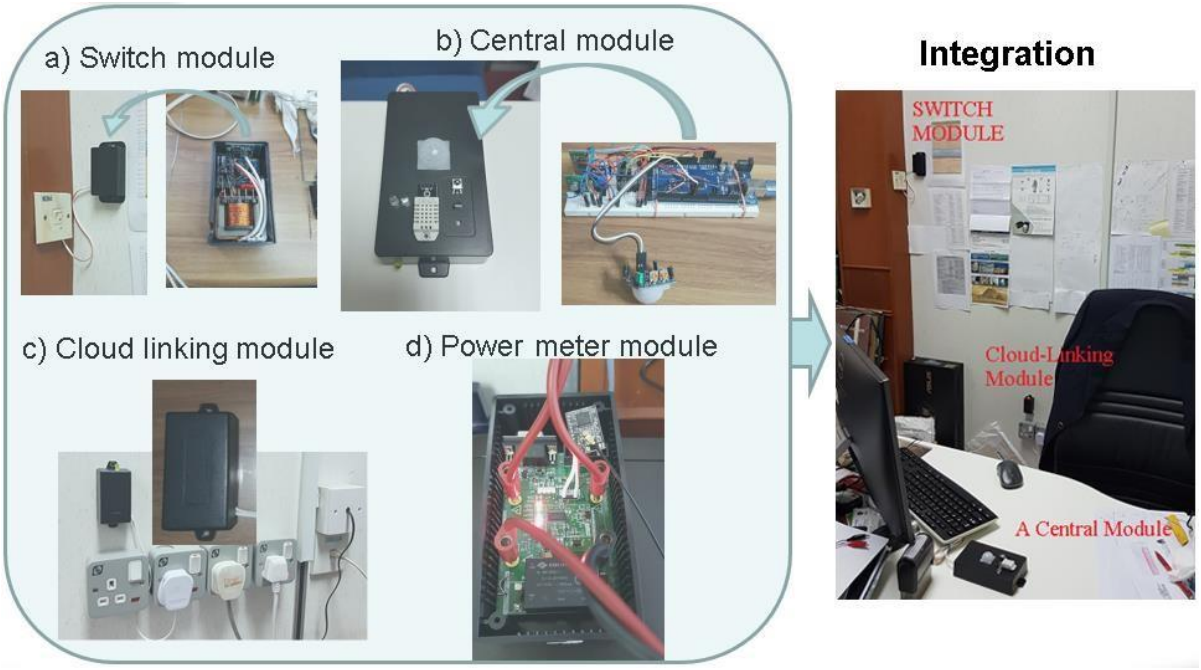

Figure 1: Modules of Smart Modular Electrical Energy Monitoring and Management System and the integration of modules to control a lecturer room.

Results indicate that, under a controlled environment this system can offer greater than 10% energy savings

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STRATEGI PERANCANGAN PROGRAM/PROJEK DI BAWAH PERUNTUKAN GERAN UM LIVING LAB
(LL014-16SUS, Smart Modular Electrical Energy Monitoring and Management System, PI: DR. MOHD YAZED AHMAD)

STRATERGIC PLAN

1. Make the proposed modules robust and deploy the modules to more locations in UM for better energy reduction impact.

SMART ENERGY SYSTEM IS NEEDED

2. Systematically evaluate/audit energy usage in UM & discover ways for energy savings
(e.g. data would suggest certain appliance not efficient, inappropriate A/C settings, cold air leakage, etc.)

ACHIEVED SAVINGS: Lighting(34%); Air Cond (47.8%)

ACTIVITIES & METHODS

1. ***Identify key potential areas in UM through site visits & Online Surveys;***
2. ***Collaboration with JPPHB, PTM, PTJs, other researchers, & professionals to install modules.***
3. ***Utilize industrial standard components/materials for robust modules.***

The proposed modules (simple to be installed in existing/future buildings)

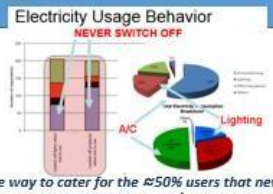
1. ***Utilize the developed power meter modules (to be benchmarked against data from commercial unit sponsored by JPPHB) .***
2. ***Remotely collect energy usage data .***
3. ***Analyze the collected data.***

The proposed power meter module; Integratable with open source systems

IMPACTS/BENEFITS

1. ***Effective way to convert existing room/building to be SMART.***
2. ***Contributes to "Smart Building implementation" required in UI GREENMETRIC.***
3. ***Contribute to energy usage data & Savings necessary for UI GREENMETRIC.***
4. ***Reduction of CO2 emissions.***
5. ***Guidelines to the University on ways to save on electrical energy usage based on the collected evidences.***

(note: With just 4.2% electricity usage saving, Financially we could save around RM120,000.00 per year (Engineering Faculty alone). ROI can be achieved within less than 3-5 years.



Effective way to cater for the ≈50% users that never turn off switches!!, Outcomes: Savings, ↓Electricity & ↓CO_2, Sustainable campus.