A survey on human behavior towards energy efficiency for office worker in malaysia

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Abstract. Green environment has become an important topic around the world. This campaign can be realized if everybody understands and shares similar objectives on managing energy in an efficient way. This paper will present and analyse the survey on energy usage by office workers in Malaysia. The survey will focus on the workers in government sector. In social science surveys, it is important to support the tested data for a project. For issues related to human behaviour we must compare with real situations to verify the tested data and the results in energy monitoring system. The energy monitoring system will improve energy usage efficiency for the basic human activities in different situations and environments.

1. Introduction

A smart home management technique based on a set of sensors is presented that can be adapted according to habitant's behavior. Human habits cannot be controlled because it changes according to our life so the change of power consumption is related to the change of numbers of hours spent in each room and thus saving in KWH. The results are satisfactory and indicate that smart home based on a set of sensors could perform energy management which is not only an individual need but economical target [1]. Wireless architecture has an intelligent control device called WEEMAN (Wireless Enabled Electricity Manger) that monitors the energy consumption of a single device or a set of device [2]. This provides a unique attribute for the user to set their expected monthly electricity bill amount and proactively control the operation of all appliances according to the amount. Table 1 was shown the usages of appliance are different and different time. There will be some change for the weekend days, mainly in the time period of 10 am -4 pm (2). So, from table 1, shows that the availability management algorithm is designed to stay close to the user and learns the common behavior of human inside the house irrespective of personal identity. The algorithm will auto learn the importance of an appliance in the home based on their usage time and how frequently human uses that appliance.

Table 1. Time based usage of an appliance [2]

Appliances	Timings			
	6am – 10 am	10am- 4pm	4pm-10pm	10m-6am
Lighting	10%	5%	40%	7%
Entertainment	30%	30%	25%	10%
Kitchen	10%	5%	5%	3%
Heating	10%	5%	5%	2%
Cooling	5%	30%	10%	78%

Practical and efficient use of electricity is not only kinder to the environment, it is also kinder to get saving money and bringing more profits. Reducing electricity consumption requires surprisingly minor changes in human daily work, and perhaps some wiser decisions when choosing and installing new devices. TNB has to generate a higher amount of electricity to meet the demands of our usual work day [3]. Addition that, more electricity is required, so more power plants are fired up to generate more supply [3]. By re-scheduling the peak hours (8.00 a.m.-10.00 p.m.), that will reduce the amount of electricity required during the day, and making the most of electricity generated at night. Then, fewer power plants will need to be turn on which is good for the environment. Based on TNB Off-peak tariff Rider (OPTR) scheme, up to 20% savings for electricity usage during off-peak hours [3].

SmartCharge cuts electricity bills by storing energy during low-cost periods for use during high-cost periods. The total possible savings each day is a function of both the home's rate plan and its pattern of consumption [4]. The eGauge energy meter is used to instrument the home to measure electricity [4][5]. SmartCharge's primary benefit is that it does not require consumers to alter their electricity usage to reduce their electric bill under market-based pricing plans. Instead, SmartCharge reduces costs by determining when to switch a home between using (and storing) grid power and using previously stored power from a battery array. Since electricity prices are largely set in day ahead markets [4][5], next day prices are well-known. Then predict next day consumption by developing statistical machine learning (ML) to build a model based on important predictive metrics, such as weather, time of day, day of week, and etc. By combining SmartCharge with market based pricing is capable of reducing electricity costs for consumers over the short-term , consumers save by storing energy during low cost periods for use during high cost periods and long term, as Smart Charge penetration increases, average price will fall due to significant reduction in peak demand. In order to know better, SmartCharge's potential for savings, it is useful to consider a worst-case scenario where 100% of the home's consumption occurs during the day's highest rate period [4].

The Modern technology implicated in greenhouse environment can improve the production efficiency and security, and also reduce production cost. Besides that, green technology also can promote the improvement of agricultural automation degree; still can reduce the production strength; improve employee management level; and thus bring huge economic benefits and social benefits. Greenhouse environment monitoring has a very important role, but only for the accurate extraction of greenhouse environment information can better use modern technology to manage the greenhouse environment. Mobile phones as daily life necessary communication tools, mobile platform as the receiving system, can reliably and effectively monitor real-time data everywhere its portability is self-evident [6].

Human movement analysis is an emerging field, which involves not only medical branches, but even more technology and engineering sciences [7]. Many investigators study and analyze human movement and activities in order to improve a system especially in energy monitoring. Human behavior will analyze to get the efficient energy control. Nowadays, energy consumption and energy saving depends on human daily routine. Few papers discusses about human daily routine in case of smart house, and also at medical organization to monitor patient. This paper present the survey and analysis that have been done on the government workers especially those work in office environment. This investigation of the relationship between daily physical activities requires an objective method to assess physical activity under daily living conditions. The question in the survey form is focused on the activities that related to the energy usage which represent the worker's behavior himself. The

information from survey will be used by energy monitoring system to predict and manage the energy with more efficient.

2. Survey Form

The questions in the survey form are design to acquire the feedback from workers in government sector according to their daily activities which related to the energy usage. The questionnaire is focused on the worker in workplace to know their activity during working at 8 am until 5 pm. There are following question in survey form:

2.1. Question 1

Ask about usual time comes to the office. This question will be used to record the time for staff coming to work. There are 3 categories of arriving time available for sorting purposed.

2.2. Question 2

Ask about making a coffee or tea itself in the office. There are given condition to choose whether Yes or No, if said yes must to write the proper time. This question would be ask because to see their activity and also to see whether using water heater or not in the office.

2.3. Question 3

Ask about breakfast. There also has a condition to choose whether Yes or No; If Yes must to write that time. This question would be asked because to know the time their go for breakfast and to know how many people currently like go for breakfast.

2.4. Question 4

Ask about listening to the music during do a work. This question to know whether worker like or not to listen the music, so that will shows that worker are using a device or electrical appliances.

2.5. Question 5

Ask about usage others appliances included with charging handphone, mp3, mp4, camera battery, using own laptop or tablet and also use the projector. This question because to see how many worker a like to use the devices selected and to combined for electrical appliances calculation.

2.6. Question 6

Ask about usual time go to the restroom and how long a worker spent in the restroom. This question to see the specific time them go the restroom and to categories the types of worker whether in person A, B or C.

2.7. Question 7

Ask about usual time for lunch or pray and how long a worker spent for lunch and pray. This question to see the specific time them go for lunch or pray and to categories the types of worker whether in person A, B or C.

2.8. Question 8

Ask about usual time going to the living room and how long a worker spent in the living room. This question to see the specific time them go to living room and to categories the types of worker whether in person A, B or C.

2.9. Question 9

Ask about activity worker in living room. This question to see how many workers like to read newspaper or magazines, watching TV, Make a coffee, or do small meeting. That also can be shows the electrical appliances used.

2.10. Question 10
Ask about type of lighting that workers prefer during working whether normal, dimmable or brightness. This question to know because want to choose the best lighting are worker prefer in the office.

2.11. Question 11
Ask about automatic control for lighting and air-conditional. This question will help to decide the right type of switch (manual or auto control).

2.12. Question 12
Ask about temperature level that workers prefer in office. This question will help to set the temperature and to know how many much prefer to use fan in office.

3. Data Survey Analysis
Human is unique and each person have different behaviour either at working place or at their home. Based on survey, 54 workers have respond with positive feedback from 3 government school located in Penang and Malacca, Malaysia. There are 42 and 12 respond recorded for female and male respectively. Figure 1 to Figure 15 show the analysis for each question in the survey form.
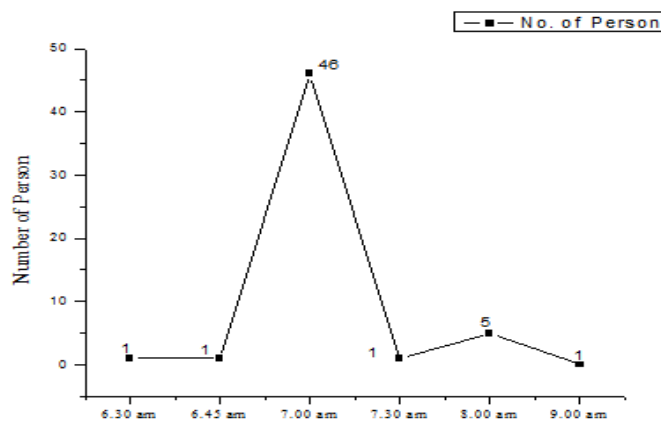
Figure 1. Time worker come to the office
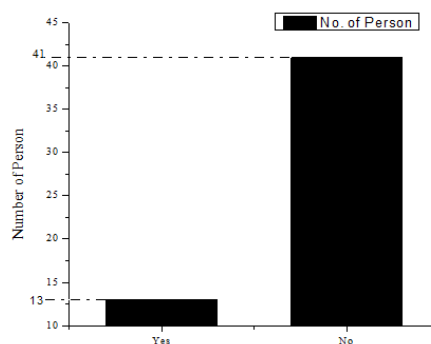
Figure 2. Workers like to make a coffee/ tea itself
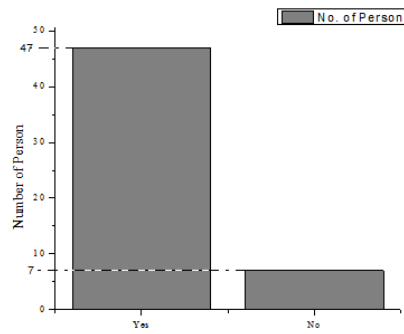
Figure 3. Worker like go to the breakfast
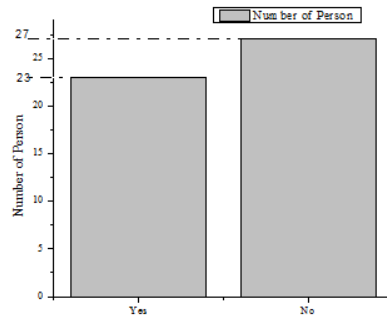
Figure 4. Worker don't like to listen music during do a work and 23 worker like to listen music
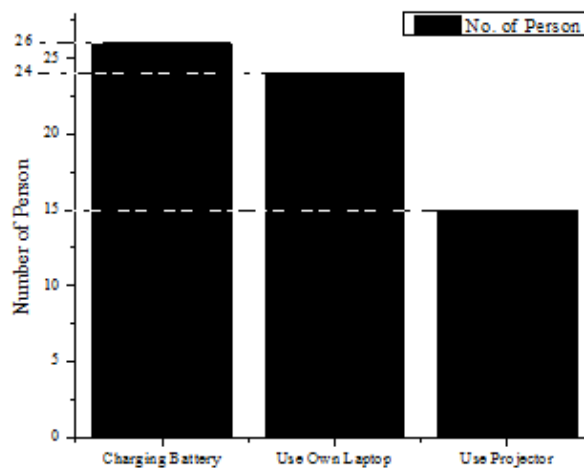

Figure 5. Worker is charging battery, use their own laptop and the projector in office
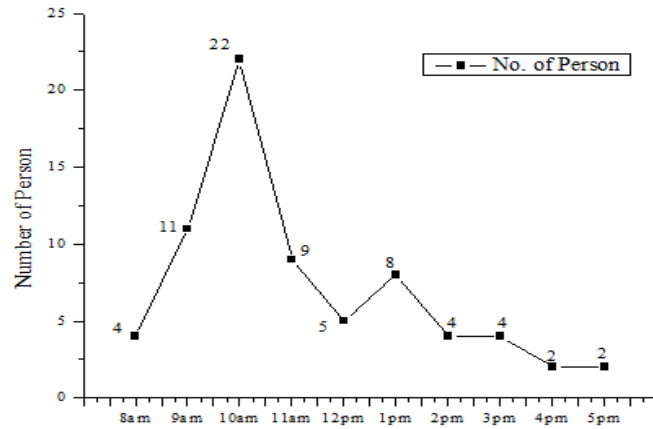
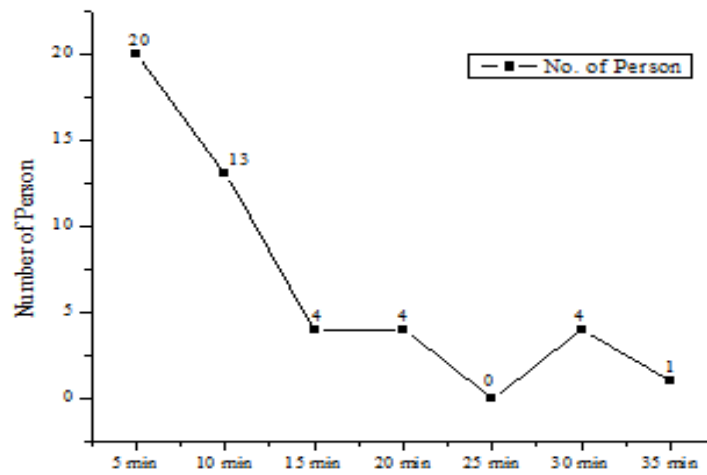**Figure 6.** Worker like go to restroom at 10.00 am
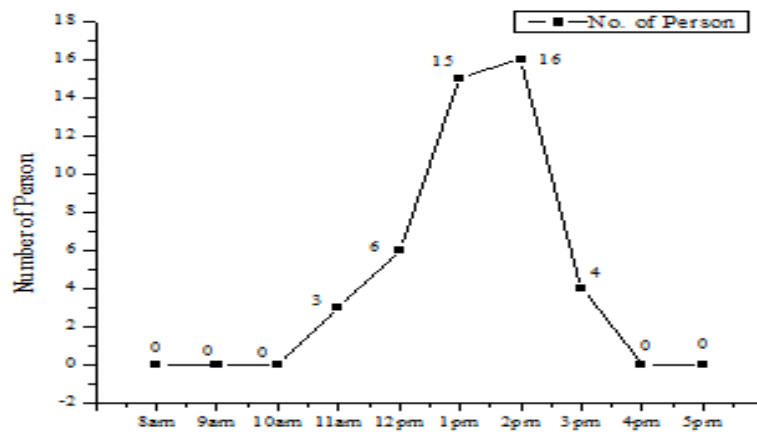

Figure 7. Time spent in the restroom
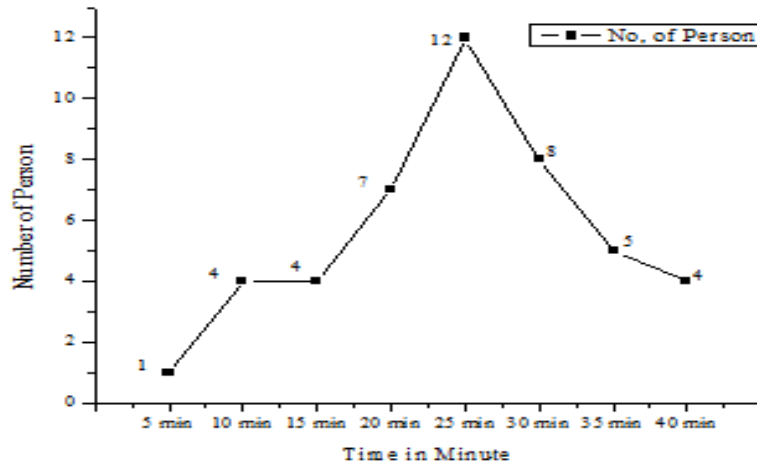

Figure 8. Time for lunch and pray

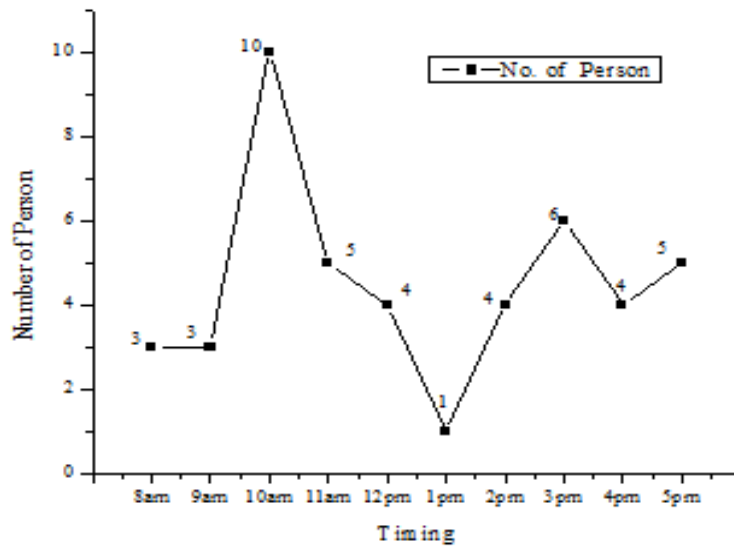**Figure 9.** Time spent for lunch and pray

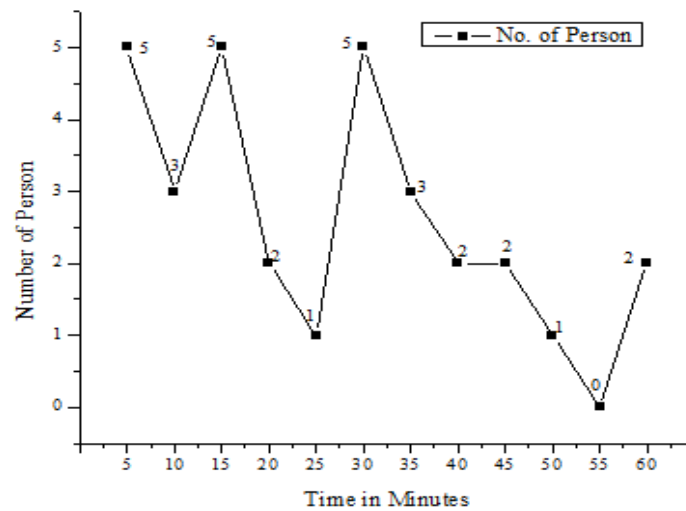**Figure 10.** Time used to living room

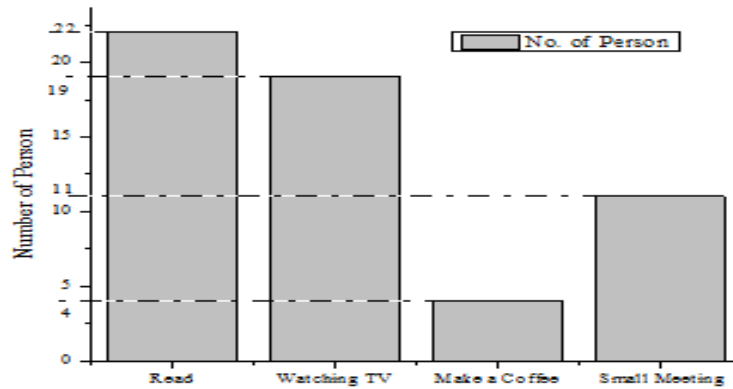**Figure 11.** Time spent in living room

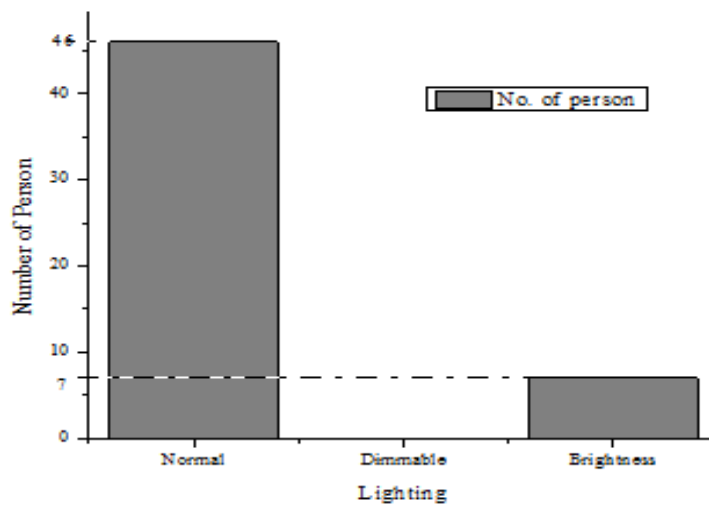**Figure 12.** Activities in living room

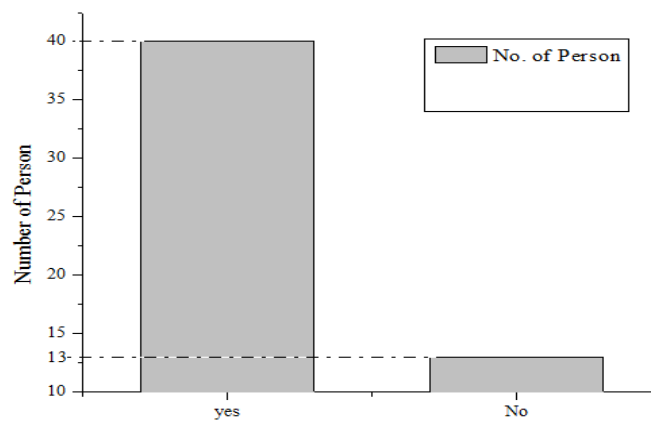**Figure 13.** Lighting condition

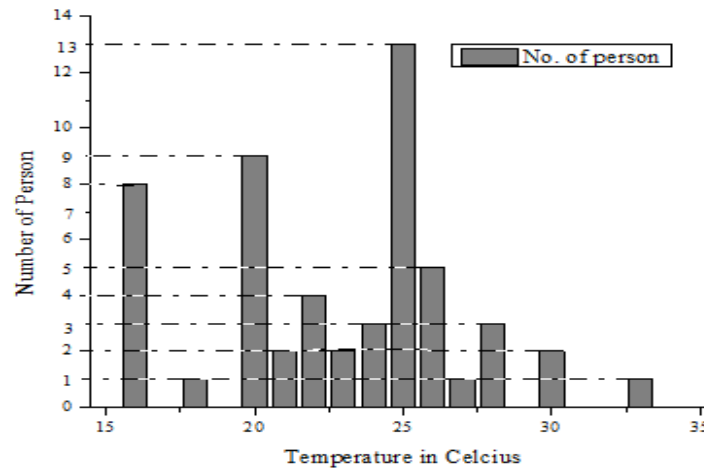**Figure 14.** Automatic 'ON and OFF' lighting and air-conditional

Figure 15. The temperature in a room

The proposed data from survey form will be used as input information to energy monitoring system based on human behaviour design at our Research Lab at Faculty of Electronic & Computer Engineering, Universiti Teknikal Malaysia Melaka (UTeM). This survey is very important in order to verify the reliability and accountability of the design system. Moreover, the human behaviour has been categorized as unique information and required continuous monitoring. The efficiency of the energy usage will help the administration to reduce the operational cost and improved the productivity.

4. Conclusion

Human activity cannot be control in most of the time and places. However, the information on human behaviour can be uses to create the algorithm that very useful in energy monitoring system. The survey data are combined to identify the human behaviors. The used of low price devices will not ensure the energy efficiency and power saving. Thus, the information of human behaviour in their working place are very important to plan the energy saving and higher efficiency on power consumption. However, the continuous recorded system on human behaviour is still needed to improve the system reliability. So, this survey is an important step towards green environment and better life in the future. By capturing human movement based on ambulatory technology is a relatively new field of research since it is directly related to the recent advances in miniature devices and sensors, new technologies for powerful microcontroller, high capacity memory and small power sources.

5. Acknowledgement

6. References

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