Progress in Engineering Application and Technology Vol. 3 No. 1 (2022) 156-162
© Universiti Tun Hussein Onn Malaysia Publisher's Office

PEAT

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/peat
e-ISSN : 2773-5303

A Study on The Implementation of Building Automation System (BAS) at Government Hospital in Johor

Ahmad Amirul Aiman Zul Rashidi[1], Mohd Fahmi Abdul Rahman [1]*

[1]Department of Civil Engineering Technology, Faculty of Engineering Technology, Universiti Tun Hussein Onn Malaysia, 84600 Pagoh, Johor, MALAYSIA

*Corresponding Author Designation

DOI: https://doi.org/10.30880/peat.2022.03.01.018
Received 17 January 2021; Accepted 11 April 2022; Available online 25 June 2022

Abstract: This study will discuss the implementation of Building Automation System. A building automation system (BAS) is an intelligent system of both hardware and software, connecting heating, venting and air conditioning system (HVAC), lighting, security, and other systems to communicate on a single platform. In recent year, the government had to cover the high cost of electricity bills in all government hospitals. Many studies show that the use of BAS can reduce electricity consumption in a building. The key point of thebuilding automation system is focused upon better facilitation to the user in terms of comfort at reduced operation cost. This study was conducted using a questionnaire survey method. The respondents selected for this study consisted of hospital employees who knew about BAS. Overall, this study was conducted to identify the level of consumer satisfaction with the existing BAS and to recommend the BAS devices that needs to be added. Analysis descriptive statistics are conducted because descriptive research has a purpose to systematically describe a fact and the characteristics of the object or subject being examined accurately. If there are results research and would like to present it in the form of distribution frequency, then SPSS is the right choice. The findings of this study show that the level of consumer satisfaction with the existing BAS is at a medium level and the problems with the existing BAS is high. The recommended additional BAS devices are sensor lighting and monitoring CCTV with latest technology.

Keywords: Building Automation System, Energy Consumption, Comfort

1. Introduction

A building automation system may be a system, or set of systems, that offer automatic management and observance among a building. Typical BAS functions include monitoring and controlling heating, ventilation, and air conditioning (HVAC) systems, controlling lighting, security, and security building systems, and automatically reading accountants [1].

*Corresponding author: mohdfahmi@uthm.edu.my
2022 UTHM Publisher. All rights reserved.

Building automation system usually have five components which are sensors, controllers, output devices, communication protocols and terminal interface. On the other hand, the demands of modern residential and commercial buildings to improve comfort, convenience, safety and energy efficiency have led to the development of advanced building automation systems [2]. The energy consumption of a building depends on a combination of good building and energy system design and effective operation and maintenance of the building after use [3]. There are three main starting points for optimizing the energy process. The primary goal is to improve energy efficiency. This includes simple solutions such as monitoring the energy consumption of various systems and identifying improvements and system failures, such as various parts of a building, continuously operating systems, defective accessories and others. More complex methods will be described in the following sections.

There are three main starting points for optimizing the energy process. The primary goal is to improve energy efficiency. This includes simple solutions such as monitoring the energy consumption of various systems and identifying improvements and system failures, such as various parts of a building, continuously operating systems, defective accessories and others. More complex methods will be described in the following sections.

1.1 Problem Statement

The situation in government hospitals is very crowded because they prefer to go to government hospitals rather than private hospitals. This is because in government hospitals, they do not have to spend a lot of money to cover the cost of treatment. To accommodate the large number of patients, the government should provide various facilities for the convenience of users. Due to that, the government has to spend a lot of money to cover expenses such as electricity bills and many more. The government hope to further reduce electricity bills by at least 3 per cent for this year and a minimum of 10 per cent next year.

1.2 Objective

This study aims to achieve the goals consistent with the title of this study which is a Study on the Implementation of Building Automation System at Government Hospital in Johor. The objectives of the study are:

i. To identify the Building Automation Systems used in the hospital.
ii. To assess the level of satisfaction of the hospital residents.
iii. To suggest the additional Building Automation System device in the hospital.

1.3 Project Scope

This research is primarily focused on the Building Automation System in the government hospital in Johor. The scope of this research focusing on occupants in the hospital. This study is conducted during the day and night to identify the existing Building Automation System devices. This is because some of the devices is only works at night. The questionnaires will be used to gather data in order to achieve the objectives of this research.

1.4 Significant of Study

This study is to improve the BAS used in the hospital at Johor by adding a few more BAS to achieve the better effectiveness. BAS has acted as an important system in a building to increase productivity and comfort. In addition, this study is also expected to benefit the hospital residents and also the government. The implementation of BAS has acted as an important system in a building to increase productivity and comfort.

2. Methodology

This research consisted of the level of customer satisfaction with the building automation system available at the hospital. This research involved observations, surveys and some notes were made to obtain information from visitors and employees in the hospital area. The survey was conducted randomly at different times between different age groups. The selection of the chosen location is in hospitals around Johor.

This is research to find a way out for scientific and social problems through objective and systematic analysis. The survey method used in this study is to use a questionnaire survey of employees who know about BAS in the hospital.

This study uses quantitative methods to collect primary data. The reason for doing so is because the quantitative analysis approach is only meaningful when there is a need to summarize the data in a number of iterations of the participatory process. Quantitative methods focus on objectivity and are particularly appropriate when there is a possibility to collect measurable variables and measurable conclusions from a population sample. Quantitative research uses structured procedures and formal instruments for data collection. Data were collected objectively and systematically.

2.1 Questionnaire Survey

This questionnaire and study aimed to analyze the level of consumer satisfaction with BAS in hospitals around Johor and to suggest the additional BAS devices for the hospital. There three parts of question of the questionnaire distributes, and the respondents need to answer all of question given, which are:

I. Part A: Demographic Background
II. Part B: Consumer satisfaction with the existing BAS in the hospital
III. Part C: Problems with the existing BAS and opinions to overcome it

In Part B, the questionnaire focuses on the second objective, to analyze the consumer satisfaction level with the existing BAS in the hospital; therefore, the respondent will be questioned about it. As a result, this section will be divided into eight parts Questions.

Table 1: Question for Section B

No.	Question
B1	The position of the lighting systems are installed appropriately.
B2	The number of the lighting systems installed are sufficient.
B3	The lighting systems are easy to access.
B4	The installed CCTV are adequate to provide the safety of users.
B5	The position of the installed CCTV is strategic.
B6	The ventilation system in the hospital is excellent in improving the air quality.
B7	The air conditioner provides a temperature that is appropriate to the room conditions.
B8	The number of air conditioners installed is able to accommodate the area of each room.

Under Part C, the questionnaire focuses on the third objective which is to determine problems with the existing BAS and opinions to overcome it; therefore, the respondent will be questioned about it. As a result, this section will be divided into eight parts Questions.

Table 2: Question for Section C

No.	Question
C1	Sensor lights or automatic doors cannot detect the presence of people consistently.
C2	The existing sensor and controller components need to be upgrade to the latest system.
C3	The existing lights such as fluorescent lamp are difficult to access as the switch is outreach.
C4	The existing doors make it difficult for patients and staff to move in and out of the hospital.
C5	The use of sensor lighting and automatic door needs to be enhance.
C6	The use of existing BAS devices in hospital still not be able to reduce the rate of energy consumption.
C7	Automatic energy control can be applied in the hospital to minimize the energy consumption.

2.2 Sample Size

Sample size can be found using size calculator sample. Using a sample size calculator is quick and accurate to know the sample size based on population. Sample size can be found by filling in the percentage of acceptable margin of error, percentage of required confidence level, population size and percentage respondent distribution.

Table 3: Sample Size

Population	Sample size
69	59

2.3 Methods

Data collected through the questionnaire is quantitative data, which is using descriptive statistic to get the mean in order to meet the objective that have been set. Using Likert scale, respondents were given the opportunity to indicate the level satisfaction of BAS based on the experiences, perceptions and opinion

3. Results and Discussion

Statistical analysis was conducted based on the two main objectives in this study, which is first stage is to identify the level of consumer satisfaction with the existing BAS in the hospital, and the second stage is problems with the existing BAS and opinions to overcome it. There are 60 of respondents were answered this survey.

The study involved 4 hospitals using the Building Automation System (BAS). This study focuses on buildings or more precisely is a hospital that uses the BAS at government hospital in Johor. The respondent's background was reviewed to ensure that the characteristics of the respondent met the criteria. Sources for analysis of this study is through data from surveys of questionnaires on respondents.

3.1 Results

Table 4: Result for Section B

Question	Mean

B1	3.2667
B2	2.5500
B3	2.7667
B4	3.6333
B5	3.2833
B6	3.6000
B7	3.6167
B8	3.3333

The findings for part B section show the result of mean value in the analysis in the Statistical Package for the Social Sciences (SPSS) software. The range of the mean values for all questionnaires for the second objective are between 2.5500 – 3.6333.

Table 5: Result for Section C

Question	Mean
C1	3.9667
C2	4.2333
C3	4.0833
C4	4.0167
C5	4.5833
C6	4.1500
C7	4.0500

The findings for part C section show the result of mean value in the analysis in the Statistical Package for the Social Sciences (SPSS) software. The range of the mean values for all questionnaires for the third objective are between 3.9667– 4.5833.

3.2 Discussions

For part B section, based on the findings of the study for the first question “the position of the lighting systems are installed appropriately”, overall showing the majority of respondents choose neutral answers. This is because It is important to keep the illumination in the corridors at about the same level as that in the wards, so that when the staff have to move about the building their adaptation level may be maintained constant [4]. Findings for the second question, "the number of the lighting systems installed are sufficient", majority of respondents tend towards disagreement. This is true based on the study by [4], the corridor lighting must provide for the safe movement of patients and equipment at all times. Findings for the third question, " The lighting systems are easy to access", majority of respondents also tend towards disagreement. Generally, lighting sources in a hospital only comes from one or a few points [5]. Findings for the fourth question, "the installed CCTV are adequate to provide the safety of users majority of respondents”, majority of respondents agree with that statement because security cameras positioned throughout a hospital help to prevent crimes and break- ins and also allow operators to watch for troubled patients and monitor for unauthorized visitors in restricted areas [6]. Findings for the fifth question, " the position of the installed CCTV is strategic”, majority of respondents tend to agree with that because the position of CCTV is very important as it can be used as evidence in the event of an incident [6]. Findings for the sixth question, "the ventilation system in the hospital is excellent in improving the air quality”, majority of respondents agree with the statement because based on study by [7] a ventilation system proves effective at reducing hospital infections. Findings for the seventh question, "the air conditioner provides a temperature that is appropriate to the room”, majority of respondents agree because air conditioning systems must meet specific technical and functional requirements, including hospitalization area, where the air conditioning system must ensure adequate thermal comfort and prevent diseases transmission [8]. Findings for the last question, "the number of

air conditioners installed is able to accommodate the area of each room", majority of respondents tend to agree because the resulting temperature must be suitable to the size of the room [8].

For part C section, findings for the first question, "sensor lights or automatic doors cannot detect the presence of people consistently", majority of respondents not satisfied with the sensors because the existing sensors are not able to detect movement efficiently. Findings for the second question, "the existing sensor and controller components need to be upgrade to the latest version", majority of respondents agree because of rapid technological developments nowadays can cause the system to become lagging behind and no longer effective [6]. Findings for the third question, "the existing lights such as fluorescent lamps are difficult to access as the switch is outreach", majority of respondents also agree with that because the position of the lighting switch should be strategically positioned to make it easier for the user to reach it [9]. Findings for the fourth question, "the existing doors make it difficult for patients and staff to move in and out of the hospital", majority of respondents agree because a hospital should have a system that can make it easier for its employees to deal with patients for example automatic doors. Findings for the fifth question, "the use of sensor lighting and automatic door needs to be enhance", majority of respondents agree because based on[10], he state that the use of sensor lights has been proven to benefit the building. Findings for the sixth question, "the use of existing BAS devices in hospital still not be able to reduce the rate of energy consumption", majority of respondents agree that the use of BAS should be expanded in the hospital because the existing BAS because existing BAS are not able yet to reduce electricity consumption. Findings for the sixth question, "automatic energy control can be applied in the hospital to minimize the energy consumption", majority of respondents agree that automatic energy control need to be installed because it can make it easier for the worker to control the system while also saving electricity[10]. Findings for the last question, "opinion what types of BAS device that can be added in the hospital", majority of respondents suggest to use sensor lighting because one of the myths about electricity consumption is that leaving lights on is more energy-efficient than turning them on and back off, because it takes more electricity to turn them back on than it would to just leave them running [11]. The respondents also suggest to monitor the CCTV with the latest technology. This is because the newer alternative to analogue CCTV is the IP camera, which transmits live footage as a stream of data over the internet. These cameras no need to be physically connected to hardware to record and transmit footage, so remote video monitoring is much easier to achieve and is usually of a higher quality [6].

4. Conclusion

This study has been proved that the consumer satisfaction level with the existing BAS in the hospital is at medium level. Problems with the existing BAS and opinions to overcome it is high. For recommendation, the data collection should be done on a regular basis face-to-face to facilitate data collection work. This is because, data collection takes a long time to be found and some respondents do not respond to the questionnaire. If done by face-to-face, every respondent who targeted must answer the questionnaire provided.

Acknowledgement

The authors would like to thank the Faculty of Engineering Technology, Universiti Tun Hussein Onn Malaysia for its support, and also to all of the respondents from every hospital, which has joined the survey studies.

References

[1] F. Shu, M.N. Halgamuge, W. Chen, Building automation systems using wireless sensor networks: Radio characteristics and energy efficient communication protocols. Electron J Struct Eng. 2009;9:66–73.

[2] S.A. Celtek, H. Soy, An application of building automation system based on wireless

sensor/actuator networks. 9th Int Conf Appl Inf Commun Technol AICT 2015 - Proc. 2015;450–3.

[3] Quadrennial Technology Review. Increasing Efficiency of Building Systems and Technologies. An Assess Energy Technol Res Oppor [Internet]. 2015;(September):143–81. Available from: https://www.energy.gov/sites/prod/files/2017/03/f34/qtr-2015-chapter5.pdf

[4] Hospital LOF, Buildings C. Jj.

[5] Emmely Pennings. Hospital lighting and patient's health. 2018;59.

[6] J. Warr, H. Crossen-white, The Appropriate Use of Closed Circuit Television (CCTV) Observation in a Secure Unit. 2017. 1–47 p.

[7] Michele Hogan. A ventilation system proves effective at reducing hospital infections [Internet]. Science Daily. 2019 [cited 2022 Jan 2]. Available from: https://www.sciencedaily.com/releases/2019/03/190328102652.htm

[8] Josephine Strand. Air Conditioning Systems for Hospital [Internet]. MTA Home. 2019 [cited 2022 Jan 2]. Available from: https://www.bing.com/search?q=study+about+air+conditioner+system+in+hospital&qs=n&form=QBRE&sp=-1&pq=study+about+air+conditioner+system+in+hospital&sc=0-46&sk=&cvid=14F650E16B5C469B8271D292BFBE0494

[9] T. Teich, M. Zimmermann, S. Franke, F. Jahn, M. Schrader. Intelligent building automation. Int Conf Autom Robot Control Syst 2010, ARCS 2010. 2016;53–7.

[10] Sandhu JS, Agogino AM, Agogino AK, others. Wireless sensor networks for commercial lighting control: decision making with multi-agent systems. AAAI Work Sens networks. 2017;10(May 2014):131–40.

[11] Ellen Sarkisian. Benefits of Using Motion Sensor Light Switches [Internet]. The Eco Guide. 2016 [cited 2022 Jan 2]. Available from: https://theecoguide.org/benefits-using-motion-sensor-light-switches