

INVESTIGATION AND STUDY SENSOR TO POWER SAVING IN FKE BUILDING

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“I hereby declare that this report entitle “Investigation and Study Sensor to Power Saving in FKE Building” is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

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Date :

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ABSTRACT

Electrical energy is energy that is commonly used at this time. Most of the electricity used is to meet human needs such as watching television, listening to the radio, the use of computer equipment and much more. Therefore, a lot of electricity saving measures was conducted in each building in FKE but the use of sensors in this faculty does not use the maximum potential. This project is a project investigating the various types of sensors such as motion sensors, auto dimming through human sensor, density light detection and so on to achieve energy savings. The idea arises when the motion sensor is used by researchers to capture animal's wildlife. This sensor concept fits nicely with the concept of saving electricity. The goal of this project is to reduce electricity consumption in the faculty as well as the cost of electricity that was charged by TNB. Most of the users do not take care of the energy wasted due to bills paid by the government. Final project outcome are expected to reduce within 5% to 10% of the electrical energy.

ABSTRAK

Tenaga elektrik adalah tenaga yang biasa digunakan pada masa ini. Kebanyakan tenaga elektrik yang digunakan adalah untuk memenuhi keperluan manusia seperti menonton televisyen, mendengar radio, penggunaan peralatan komputer dan sebagainya. Sebagai contoh Fakulti UTeM FKE. Di dalam fakulti, tenaga elektrik banyak digunakan untuk proses pengajaran dan pembelajaran. Oleh sebab itu, banyak langkah-langkah penjimatan elektrik telah dijalankan di setiap bangunan FKE ini tetapi tahap penggunaan sensor di dalam fakulti ini tidak digunakan semaksimum yang mungkin. Projek ini merupakan satu projek yang menjalankan siasatan terhadap pelbagai jenis sensor seperti sensor gerakan, auto pemalapan melalui sensor manusia, ketumpatan pengesanan cahaya dan sebagainya dalam mencapai penjimatan tenaga elektrik. Idea ini timbul apabila sensor gerakan yang digunakan oleh penyelidik untuk menangkap hidupan liar haiwan haiwan. Konsep sensor ini amat sesuai dengan konsep penjimatan elektrik. Matlamat projek ini adalah untuk mengurangkan penggunaan elektrik di fakulti serta pembayaran kos elektrik boleh dikenakan oleh TNB. Jika kita lihat kebanyakan pengguna tidak mengambil penjagaan tenaga dibazirkan disebabkan kepada bil-bil yang dibayar oleh kerajaan. Akhir projek dijangka mungkin 5% hingga 10% daripada tenaga elektrik boleh dijimatkan dan apa yang digambarkan dalam objektif di atas dicapai mengurangkan penggunaan elektrik serta untuk mengurangkan kos pembiayaan tenaga elektrik di fakulti ini.

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LIST OF ABBEREVIATIONS

FKE	-	Fakulti Kejuruteraan Elektrik (Faculty of Electrical Engineering)
PIR	-	Pyroelectric Infrared Detectors
GAN	-	Gallium Nitride
CSNO ₃	-	Cesium Nitrate
IR	-	Infrared

LIST OF SYMBOLS

SYMBOL		MEANING
f_0	-	Actual Frequency
f	-	Frequency
C	-	Speed of the wave in the medium
V_s	-	Speed of the source
Δf	-	Frequency Shift
V_o	-	Observers Velocity
Θ	-	Angle of Frequency
k	-	kilo
W	-	Watt
kWh	-	kilowatt hour
kw/h	-	kilowatt per hour

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E	IR01A Medium Range Infrared Sensors Data Sheets

CHAPTER 1

INTRODUCTION

1.1 Overview

Nowadays, there are many saving equipment in the industry that can apply in facility to reduce the power consumption. But most of the consumer didn't know that sensor can be used in power saving system. Sensor is a device that can be used to receive signal and change it into another signal to process.

In this project, the investigation on sensor due to power saving will be execute to find the potency of any kind of sensor to archive power saving. Power saving is a process that reducing the amount of energy that used in daily time into a new saving rate. At present, the use of green technology was introduced and will be expanded to ensure environmental stability in line with the rapid development of a country.

Green technology is an environmental science applications made to preserve the natural resources and to address the negative impact of human activities. In general, green technology can be interpreted as the application or use of knowledge and skills for practical purposes in various fields of life without causing extinction of resources and pollute the environment.

1.2 Problem Statement

Most of the electricity in the FKE buildings also is used on the pavement in each block. If seen these lights also light up on time should not be. Manpower may be able to switch off the lights but human carelessness will take this situation lightly. Not only in the area, even in the lecture are rooms and laboratories also experiencing the problem. This problem is not only to raise the level of electricity consumption then raises the bill to be paid by the university but also the maintenance cost will be high. With the aid of this system, the problem will be solved. The project needs an analysis and proposal including economic or comparative study to reduce energy consumption of FKE buildings. A case study and proposal development or technology development example like light sensor for hallway, auto-dimmer via human or light density detection or time of the day. This project must be done in several experiment to investigate the performance and the efficient the sensor to achieve power saving.

There are many methods to overcome the problem of wastage of electricity such as using light sensor for hallway, auto-dimmer via human or light density detection or time of the day and much more. For example light sensor for hallway. When there is no human movement detectors are fitted, then the sensors send information to the controller to turn off or disconnect the electricity supply in the area. This is one method that can be used in electricity transmission systems in buildings FKE to reduce electricity usage. All sensors should be investigated advantages and disadvantages in achieving energy savings from various angles such as economic factors, physical factors, factors and also factors efficiency liability. In addition, all sensors must be compatible with environmental factors to be fitted.

1.3 Motivation

The motivation for using sensor in the power saving system is the sensor will let some system to operate if the sensor detects object or signal. Other than that, it can help the system to be more reliable and smooth the system. In the other hand, the sensor can avoid human effort to help reduce power consumption. By this criteria, the reliability of sensor can help to archive power saving.

1.4 Objective

There are several objectives that need to be achieved in order to make this project successfully.

- To investigate and study the comparison about the sensor in power saving system.
- To develop and study the appropriate energy-saving method suitable for FKE buildings.
- To investigate the performance of energy saving by using sensor in FKE buildings.

1.5 Scope of the project

The scope of this project is:

- Detector installation is only done in areas with high facility in Block A, Block B, Block C, Block D, Block E and Block F at FKE.
- This project is focused on the use of the lightings because the lighting is one of the highest generous in the use of electricity
- The project also focused on the use of low voltage scale of 415 V (3 phase) and 230 V (1 phase).

1.6 Summary

This section explains the objective as well as the scope of the project in order to give an insight and the sense of direction of this project. The next subsequent chapter will be literature review section, discussing on the research works previously done by other researchers concerning on the performance of power saving device by the sensor and also the green technology system. Different control strategies are demonstrated by various researchers in the literatures and are evaluated in comparison with other controllers.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

This chapter will cover on the research finding about the performance of the sensor and also the power in distribution system that applied in the facility. There are many techniques or methods that can be used to reduced power consumption that been used by the consumer such as installing the motion sensor, ultrasonic sensor, auto dimmer sensor, capacitor bank and much more. In this report the sensor that has been chosen is motion sensor. This sensor will be investigated from various angles such as the reduction of efficiency in electricity, in terms of equipment durability, efficiency in the detection of objects and also for safety use. Furthermore, theory about the power saving and green technology also will be discuss in this chapter.

2.2 The Use of Sensors in Buildings

To provide a comfort and convenience, resource saving, safety, security, high performance and automation, sensor system in advance intelligent of building is required. According to a Japanese study conducted in 1986 by the Electronic Industries Association of Japan, 20% of sensor production is applied by the consumers especially in home and resident because of the potential the sensor to archive power saving [10]. For example a simple audio/video setup contains at least 6 different sensors. Modern building requires many kinds of sensors.

There are many criteria for the residential to require the usage for sensor. The requirement sensors are for temperature, humidity, wind flow, taste, cooking condition, defrost, frost, water level, dust, rinse, weight, pressure, vision, gas, flame, and gas leak. It also requires sensing for electric power, voltage, current, flow, temperature, water level, water freezing, sun and illumination. There are some requirement system to sensing and transmit the several kinds of signal [9]. The systems are remote monitoring and diagnostic system. The development of sensor systems has progressed rapidly in the last 2 decades. These systems are classified into several principals of sensor. The principal's are mechanical, thermal, electrical, magnetic, radiant, and chemical.

All decades systems are facing a noticeable upward trend in performance requirements for maintenance, down time, reliability, fault tolerance, fault recovery, and adaptability. Because of the cost of the energy that been used, there are a subject that related to the cost pressure that is the industrial applications in the area of consumers good.

2.3 Passive sensing Principle

2.3.1 Pyroelectric Infrared Detectors (PIR)

PIRs are the main components of space surveillance in intrusion protection. In the early days of passive IR intruder detection, highly sensitive thermocouple and bolometer were used. When a person entering the room, these sensors can measured the temperature that increase. There is one type of sensor that more sensitive to the temperature compared to PIR. The sensor is piezoelectric sensor elements which respond to temperature changes. Most sensors that used this kind of system are a PIR based motion detector.

There is one area that allows the infrared signal to detect all the motion. This area is called "face of the sensor. Pyro-electric is the material that used in the construction of the sensor. The material is often used in the construction of a PIR sensor includes Gallium Nitride

(GAN), Cesium Nitrate (CSNO₃), Polyvinyl Fluoride, Phenyl Pyridine Derivatives and Cobalt Phthalocyanine. Sensors are often made as part of the circuit an integrated.

In this PIR sensor, the optical detection and an acoustical detection is the method that this sensor detecting signals. Infrared light and laser technology system are used in the optical detection. There is some device in this PIR sensor that detects the change [7]. The devices are Motion Detection Devices that installed in the sensor.

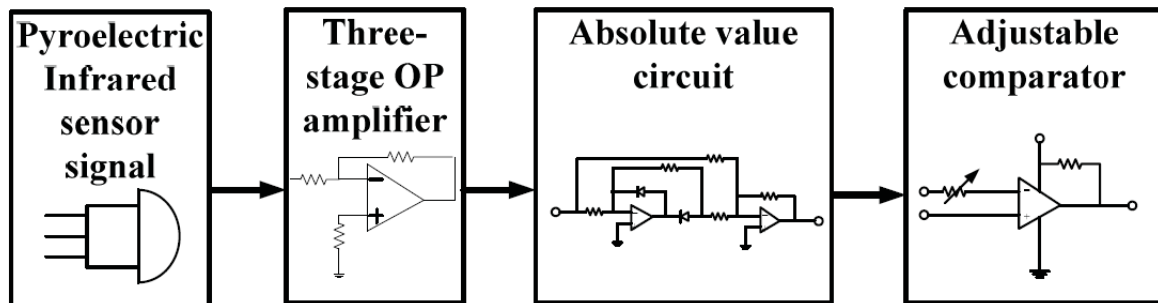


Figure 2.1: Block Diagram of PIR Sensor Circuit [6]

This device work when there are a disruption in the infrared spectrum produced by any movement of objects such human or animal. Once detected, the recorder and the controller will get the command from this devices and it will carry out the next process. The example of the process like catching the picture or trigger the switch for the building circuit system.

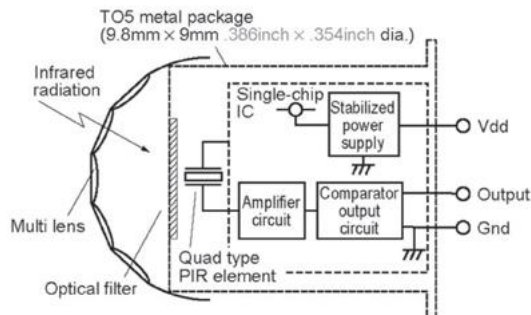


Figure 2.2: Motion Sensor Block Diagram

This Figure 2.2 is referred to Appendix C Maximum radiation in the IR range is at a wavelength of $10\mu\text{m}$. The space is divided into a number of segments by the optical system which is designed and optimized for specific application were involved to use to this PIR system.

2.3.2 Ultrasonic Sensor

Doppler Principle is the method that Ultrasonic motion detector operates. The Doppler Effect, discovered by Christian Doppler in 1842, is the apparent change in frequency and wavelength of a wave that is perceived by an observer moving relative to the source of the waves.

The different of frequency can be evaluated by the between of the transmitted signal and the received signal. The frequency different is evaluated between the transmitted and the received signal [11]. The methods that change the frequency of the area were caused by the humans, animals or objects within the sound field. The detector radically measured the target by shifting the proportional to the speed of movement of the target. The monitored coverage corresponded to a 50 m^2 area.

The ultrasonic detection principal is used in combination with a PIR detector and very seldom as stand-alone detection unit.



Figure 2.3: Ultrasonic Sensor Module Components

If the moving source is emitting waves through a medium with an actual frequency f_0 , then an observer stationary relative to the medium detects waves with a frequency f given by [7]:

$$f = f_0 \left(\frac{c}{c + v_s} \right) \quad (2.1)$$

Where C is the speed of the waves in the medium and V_s is the speed of the source with respect to the observer on the pathway of the source. With V_s is less than C and Δf , the frequency shift and applying in Formula (2.2) Δf is [7]:

$$\Delta f = f_0 \frac{v_s}{c} \quad (2.2)$$

A similar analysis for a moving observer and a stationary source yields the observed frequency (the observer's velocity being represented as V_o) [7]:

$$f = f_0 \left(1 + \frac{v_o}{c} \right) \quad (2.3)$$

The siren will start out higher than its stationary pitch, slide down as it passes, and continue lower than its stationary pitch as it recedes from the observer. The pitch would remain constant until the vehicle hit and then immediately jump to a new lower pitch. The difference between the higher pitch and rest pitch ($V = 0$) would be the same as the lower pitch and rest pitch. The radial velocity does not remain constant, but instead varies as a function of the angle between the line of sight and the siren's velocity [7]:

$$f = f_0 \left(\frac{v}{v + v_s \cos \theta} \right) \quad (2.4)$$

Where θ is the angle between the object's forward velocity and the line of sight from the object to the observer.

2.3.3 Multisensory Sensing

There are two methods that being used in this kind of sensor which is ultrasonic and PIR at the same time. Also well known is the combination of microwave and PIR techniques. The signal evaluation is the key of success factor of multisensory system. For tangential and

medium radial motion, the detection level is generally high for the PIR detection level while ultrasonic detection is low for tangential and high for radial motion.

The principle of high frequency line interference and hot air turbulence is the common disturbance signal to this sensor. For ultrasonic detection there are additional influences such as cold air turbulence, airborne sound, vibrations, curtain movements, moving fan blades and much more [8]. For PIR sensor, it has an additional unwanted signal that can disturb the information of signal detection. It is from white light, hot spot, small animals, temperature variations, and mirror reflection.



Figure 2.4: Multisensor combining PIR and microwave detection technology

The combination of both signals is obviously a very clever combination. This both signal parameters will against the sabotage in term of high level of protection. For instance one can evaluate the following criteria:

1. Frequency shift
2. Distance and speed measurement for the ultrasonic and frequency
3. Amplitude for PIR

Glass breaker detector is another example of multisensing sensor detection. They rely on structure borne sound detection by a piezoelectric sensor combined with the generated audible airborne sound wave detection in the 3 to 5 kHz range by a microphone.

2.4 Reduced Resource Consumption

Legislation, environmental concerns, and cost awareness suggest that resources should be used efficiently even in private homes. Through intelligent controls, a new technology by home and building will offers tremendous potential energy saving. 70% of the area can be actually achieving the power saving by the partial measure such as ventilation on demand. Load management, the main function of which is to cap energy consumptions peaks, achieves financial savings of up to 50% [2]. The real cost factor cannot played in a significant role in the installation of these special construction. The relevant technology has been used in purpose build constructions for a long time [1].

2.5 Optimized Convenience and Comforting the Energy Consumption

Highest level of convenience, safety and security can attract attention the owner of the building or home beside minimizing consumption costs, tariff management and much more that related to energy usage especially electric. The main applications will be as follows:

1. Energy management
2. A healthy living environments
3. Personal safety and security
4. Technical safety
5. Increase convenience
6. Entertainment

In intelligent home, there are many innovation that be made that can help the owner or the costumers to reducing or minimizing their energy consumption. With this innovation, it can help the consumers to allow them to use this kind of product that can help them to improve the savings in their homes [3]. There are nearly no limits to the opportunities for optimizing the convenience of inhabitants.

2.6 Potential for Physical Energy Intensity Reduction

Physical energy intensity also known as the energy use per unit of physical activity. In buildings, some floor areas were used as a proxy for some activity and some by distance travelled by people, the product of distance and mass of good transported and various manufacturing sectors represent other activity levels [3]. The physical energy intensity of each form of secondary energy used divided by the efficiency in converting from primary energy to secondary energy. As incomes and populations grow, the rate of change in economic energy intensity will depend on:

1. Changes in activity levels
2. Changes in the mix of activities
3. Changes in physical secondary energy intensity level
4. Changes in efficiency in converting from primary to secondary energy