Faculty of Electrical and Electronic Engineering Technology

ENERGY SAVING DEPARTMENTAL STORE SYSTEM USING EFFECTIVE ENERGY CONSUMPTION SYSTEM

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Bachelor of Electrical Engineering Technology (Industrial Power) with Honours

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in partial fulfillment of the requirements for the degree of
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DEDICATION

I am deeply indebted to my family especially my father, Khalid bin Abu Bakar, and my mother, Rosnani bt Ab Halim, whom have always give the support that I need. Also to my supervisor, Ts. Zaihasraf bin Zakaria for his guidance, suggestion and encouragement throughout the course of this project.

ABSTRACT

Departmental store has become one of the essentials that most of the human population depends on. In this paper, the possibilities of amplifying the user comfort and the cost of smart departmental store is explored. This project introduces utility-based departmental store that able to sense human presence in each section and a control system that automatically make adjustments according to situation including human presence, daylight availability, the surrounding humidity, and the temperature of the refrigerator. The variability of products needs a thorough maintenance in terms of temperature and humidity. So, with the help of multiple sensors, the humidity can be stabilyze, thus, help to maintain the quality of the ambience. This project suggest a smart lighting control system with the help of external factors such as sensors and Graphical User Interface (GUI) by the mean to lower the energy consumption and operational cost, including using daylight optimally.

ABSTRAK

Pasaraya merupakan salah satu kepentingan asas dalam kehidupan seharian umat manusia yang telah menjadi kebergantungan bagi mereka. Dalam projek ini, peningkatan tahap keselesaan pengguna dan kos pasaraya pintar dikaji. Projek ini mengemukakan idea pasaraya yang berasaskan utiliti mampu untuk mengesan kehadiran manusia di setiap lorong dalam pasaraya dan sistem kawalan secara automatik yang seterusnya membuat penyesuaian mengikut keadaan termasuklah kehadiran manusia, cahaya matahari, kelembapan sekeliling, dan suhu peti sejuk. Produk dan perkhidmatan yang pelbagai memerlukan penyelenggaraan yang teliti dari segi kelembapan. Oleh itu, dengan bantuan pelbagai peranti pengesan, kelembapan dapat dikawal supaya berada ditahap yang stabil seterusnya, membantu menjaga kualiti suasana persekitaran. Projek ini mencadangkan sistem kawalan pencahayaan pintar dengan bantuan faktor luaran seperti pelbagai jenis peranti pengesan dan Antaramuka Grafik Pengguna (AGP) dengan tujuan untuk mengurangkan penggunaan tenaga dan kos operasi sesebuah pasaraya, termasuklah penggunaan cahaya pada siang hari secara optimum.

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LIST OF SYMBOLS

V	-	Voltage
C	-	Celcius
R	-	Resistance
°	-	Degree
A	-	Ampere
%	-	Percentage
W	-	Watt
μ	-	Micro

LIST OF ABBREVIATIONS

Cases

AC : Air Conditioner 23
CFL : Compact Fluorescent Lamp 35
DC : Direct Current 37
GND : Ground 29
HDTV : High Definition Television 38
HVAC : Heating, Venting and Air Conditioning 13
IC : Integrated Circuit 30
ICT : Information and Communication Technology 13
LDR : Light Dependent Resistor 32
LED : Light Emitting Diode 14
PCB : Printed Circuit Board 27
PID : Proportional Integral Derivative 16
PIR : Passive Infra Red 25
PWM : Pulse Width Modulation 31
RGB : Red Green Blue 38
TFT : Thin Film Transistor 37
USB : Universal Serial Bus 37
WiFi : Wireless Fidelity 17

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CHAPTER 1

INTRODUCTION

1.1 Background

In this modern age, majority of the population of the Earth who lives in the urban area get their daily needs from the supermarket since it is more convenient. This is because, they come from working class people that mostly having a nine to five job. Since they spent their whole day at the work place, so they did not have the time to grow their own crops or breed their own livestock. So, they have to get their source of foods from the market. The easiest and most convenient way to get their daily needs is from the departmental store. The high demand from the people open up opportunity for the conglomerate to establish more departmental store across the country. With the increasing amount of departmental store, the power consumption is also increasing. The rising of power consumption has leads to multiple complication. It is very crucial that we control this issues before it get out of hand. The automated control system is a fruitful idea that helps reduce the power consumption that will minimize the cost of production. Furthermore, this automated control system does not require human interaction to be executed.

1.2 Problem Statement

Day by day, the Earth is facing an imminent threat due to over usage of energy. When we consume more energy, the amount of toxic fumes release by power plant is also increasing, perishing the earth's natural resources and destructing ecosystems. Including thermal plants and renewables, there are approximately 30,000 power plants from 164

countries throughout the world [1]. Most power plants burn oil, fossil fuel and coal to generate energy. The result of this combustion, carbon dioxide, sulphur dioxide and nitrogen oxides are release to the air that we breath. The greenhouse effect is a natural phenomenon that causes the temperature of the earth's surface to rise. Carbon dioxide is a greenhouse gas that leads to majority of air pollution. Since the power plants burning more fuel to generate more energy, too much heat trapped by the extra carbon waste. The greenhouse gas emissions affecting the earth by rising the temperature, heat waves and drought. Other than making the sea level higher, it also increases the intensity of natural disaster such as haze and acid rain.

Nowadays, most of the people are struggling to live their daily life. This is due to the fact that their daily expenditure increased or their monthly income has decreased. In this Covid-19 era, we have heard a lot of individual that lost their job because their company cannot survive the lost that hit them. In order to lift a little bit of burden upon the shoulder, this automated system can help lower the daily expenditure by decreasing the groceries' price in the departmental store. If the power consumption of a certain departmental store is high, the electricity bill will also be high. When the energy consumption is reduced, less amount of cost needed for the departmental store to be paid to the electricity provider. Hence, it can lead to departmental store lowering the price of daily needs that is sold in the departmental store.

1.3 Project Objective

The main objective of this project is to lower the energy consumption of departmental store. In order to do that, these objectives are to be achieved:

a) To design an intelligent system that aims to minimize the energy consumption.

b) To develop a system that automatically control the output of appliances.

c) To compare the energy usage before and after the energy saving system has been implemented.

1.4 Scope of Project

For this project, the scope is to develop an energy saving departmental store system using effective energy consumption system. In order to do so, Arduino Uno is chosen to be the microcontroller connected to electronic circuit, multiple sensors, and outputs. The presence of human in a certain area is to be detected by a motion sensor that will send a signal to the Arduino. The air moisture surrounding the fruits and vegetables section will be detected by humidity sensor that will send a signal to the Arduino. The temperature inside the refrigerator is to be detected by a temperature sensor. Then, Arduino will control the respective output device such as lights, air humidifier, and refrigerator depends on the situation with the help of relay.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, the original concept structure, specification, theory and other data related to the project will be explained. Previous projects or publications and research papers related to this project were reviewed and studied. Hence, there is a little bit of similarity between this project and the previous related papers. The objective of this research is to develop and produce an energy saving departmental store as well as to make sure it consumes energy effectively. Furthermore, it is also a system that is automatically controlled based on the current situation such as the presence of people, the level of moisture in the air, and the temperature inside the refrigerator.

Before this project take place, literature review and technical research are first to be performed. Literature review is revolving around previous projects that has been done and somehow related to this project. On the other hand, technical research will cover about electronic components that is related to this project, programming language and other devices that may be related to this project. The research is done by obtaining the source from the websites, articles and publications. For this project to be completed, this information is very useful in helping and become a guidance throughout the journey of making of this project.

2.2 Smart Building

One of the most popular alternative to save energy is by developing a smart building. There is various way to implement this method. According to a paper by Jennifer King and

Christopher Perry (2017), using information and communication technologies (ICT), smart buildings are able to automatically control the buildings operation [2]. While using less energy than a conventional building, they can intensify peoples comfort and productivity. Smart buildings use ICT to connect building systems together to improve operations and performance, meanwhile standard buildings operate their systems independently. Smart buildings also provide their occupants with visibility into its operations by allowing operators and occupants to interact and collaborate with the buildings. Nowadays, it is increasingly important for smart buildings to communicate with the power grid, so it is a feature that is practical for smart buildings to own. The use of smart buildings is expanding constantly in all building types although the biggest involvement of smart technologies in existing buildings has been in offices.

Smart heating, venting, and air conditioning (HVAC) systems use several sensors for control and monitoring. While improving occupants comfort, various sensor helps software to interpret information to optimize the HVAC system's operation. Smart HVAC controls help to restrict energy consumption if building zones are unoccupied, faults are detected and reduce the usage of HVAC specifically during peak times of energy demand.

Smart lighting includes advanced controls that contain dimming functions, daylight presence and human occupancy to eradicate over-lit spaces. Smart lighting systems can manage lighting systems by programming and can be controlled wirelessly. Lighting management platforms let user access control through web-based dashboard, meanwhile wireless control made it easy to modify.

Table 2. 1: Energy Saving from Smart Building Technologies **[2]**

Building Type	Floor Area (sq. ft,)	Smart Building Technology	Average energy consumption (kWh/year)	Percent Savings	Average Savings (kWh/year)
Education	100,000	Occupancy Sensors Web-based lighting control management system	190,000	11%	20,900
Office	50,000	Lighting controls Remote HVAC control system	850,000	23%	200,000
Hotel	200,000	Guest room occupancy control	4,200,000	6%	260,000
Laboratory	70,000	Air quality sensors Real time ventilation controllers	980,000	40%	390,000
Hospital	120,000	Lighting control + LED upgrade Data analytics software package	7,900,000	18%	1,400,000

Another paper written by Jong-Won Lee and Young Il Kim (2020), suggest that using motion sensor that has been installed in underground parking lots, lecture rooms, and dormitories of a university building to study the effect of a motion detector sensor [3]. A comparison has been made before and after the motion sensors were implemented. As the result, they found that there is a different in energy used before and after the motion sensor was installed.

Table 2. 2: Percentage of energy saved after using motion sensor **[3]**

Area	Percentage of Energy Saved
Underground Parking Lot	77.6%
Classroom (Lighting)	32.4%
Classroom (HVAC)	27.9%
Dormitory	28.2%

2.3 Temperature Controller

In industry, it is critical topic to reduce the energy consumption of refrigeration systems. Refrigeration systems is the main electrical appliances that contribute to energy consumption. to make sure the power consumption is at minimal level, it is crucial to control the refrigeration systems. A paper by Miklos Kassai, Laszlo Kajtar, and Jozsef Nyers (2019), compares the optimization of energy consumption for direct current refrigerator by PID controller tuning with On/Off refrigerator [4]. This study claims that by tuning of the PID controller, the energy consumption has decrease by 62.4% as opposed to the On/Off refrigerator.

Table 2.3 : Result of the experimental test

Parameter	On/Off	PID
Maintaining air temperature (°C)	0	0
Mean air temperature (°C)	-0.203	-0.103
Energy consumption (kWh/day)	14.65	5.5

Meanwhile, Hazim Moria, Munner Ahmed, Ashraf Alghanmi, Taib Iskandar Mohamad, and Yusli Yaakob (2018), in their paper suggest using thermoelectric effect for solar based refrigerator [5]. The compressor-less refrigerator will be using thermoelectric cooler operates by Peltier effect for the solar thermoelectric refrigerator. The usage of solar panel as the crucial source of energy in the study will converts the light energy into electrical energy that will powers the refrigerator.

Another paper written by K. O. Daffallah, M. Benghanem, S. N. Alamri, A. A. Joraid, and A. A. Al-Mashraqi (2017), suggest to harness the solar power to power up the refrigerator using the photovoltaic panel [6]. The power generated from the PV operate the refrigerator and the remaining power produced by the PV are reserved in the battery. When there is no source of light, the refrigerator will operate using the power stored in the battery.