UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND DEVELOPMENT OF SOLAR POWERED SMART DUSTBIN FOR DOMESTIC APPLICATION

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Power) with Honours.

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ABSTRACT

This study is based on the problems that often faced by UTeM students in the hostel. The overflowing garbage is not only on weekends but also occurs during office hours, Monday to Friday. Due to the irresponsible attitude of the student and also the certain individuals, the project "Smart Dustbin" specially designed to overcome these problems. Smart dustbin are to alarm the student to clean up the garbage as well as to help keeping the surrounding clean. The concept applied is that a dustbin that could give a warning alarm if the trash is approaching the full level to prevent overflowing dustbin. ARDUINO microcontroller to be used so that the sensors can detect the level of the existing waste. Solar energy will also be applied as the power source to the control circuit.

ABSTRAK

Kajian ini berkaitan adalah dengan masalah yang kerap kali dihadapi oleh pelajar UTeM di kolej kediaman. Masalah ini berkenaan dengan sampah yang melimpah keluar dari tong sampah di kolej kediaman bukan hanya pada hujung minggu namun juga berlaku pada waktu pejabat iaitu Isnin hingga Rabu. Oleh kerana sikap pelajar atau individu yang tidak bertanggungjawab, projek "Smart Dustbin" direka khas bagi mengatasi masalah tersebut. Tong sampah ini mapu untuk mambantu menggera para pelajar untuk membersihkan tong sampah yang penuh sekaligus untuk mengekalkan kebersihan di sekeliling. Projek ini berkonsepkan tong sampah yang mampu menjadi penggera jika tahap sampah di dalam tong sampah tersebut menghampiri tahap penuh bagi mengelakkan sampah melimpah keluar. Mikropengawal Arduino akan digunakan supaya sensor dapat mengesan tahap sampah yang ada. Tenaga Solar juga akan diaplikasikan sebagai bekalan kuasa kepada litar kawalan.

DEDICATION

For my supervisor,

Madam Emy Zairah Binti Ahmad.

ACKNOWLEDGEMENT

First and foremost, I would like to thank the Creator, without His blessings and mercy I would not have made it. I would like to commend the efforts of my supervisor Madam Emy Zairah Binti Ahmad and also for my academic advisor Madam Intan Mastura Binti Saadon who has not only dealt with me professionally but also has been parental figure. I shall never forget the level of maturity and professionalism, which they showed during my stay at UTeM. I am grateful to my parents Mr. Kasing Emang and Mrs. Senorita Binti Atong, for all their prayers and for giving me the gifts of life and education. I couldn't have reached what I have achieved in life without their sacrifices. I can never forget my housemate, Charisa Charlseak who instilled in me values of conviction, persistence, and hard work. They have always been a source of inspiration and courage for me and I can never thanks or repay them enough for the virtues they have given me. Finally, I would like to dedicate this thesis to everyone I mentioned above and all those who prayed for me throughout my project and have been supporting, encouraging and sacrificing for me.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

PV	-	Photovoltaic
PSH	-	Peak Sun Hour

CHAPTER 1

INTRODUCTION

This chapter will cover the project background, objective, the problem statements and solution to overcome the problem.

1.0 Project Background

In the present day, the world moving reckless along with the rapid run of technology. In addition, people are also not misses out by modernism technology. Within this changing, time is required to make some application or product that worthwhile for all segment of society without thinking of their current status within this new era of technology.

If seen in the market most of dustbins are manually operated to throw the rubbish into it. The dust on the floor need to be sweep by using human energy. People do not

appreciate the properties given for example the garbage bin. They did not care if the rubbish overflowing. This kind of situation is not user–friendly system because it required a lot of task to be done during the cleaning process such as pick up the trash and throw it. This have to be done separately which obviously show that a lot of task and human energy required to do so. Hence, this product designed use stand-alone portable solar PV as power supply to trigger the alarm circuit.

1.1 Problem Statement

Based on the observation in UTeM hostel like Lestari and Emerald Park, this two hostel have the same problem which is with the overflowing garbage disposal and it is also produce a stinks smell which causes air pollution and respiratory diseases as contaminants are absorbed from lungs into other parts of the body. Besides causing all sorts of health and environmental issues, overflowing garbage is a public nuisance and eyesore.

In this project, the aim at an automatic garbage level detecting system by informing the concerned authorities timely. Whenever the garbage almost reach the full level, it will warn the authority by send signal using Yellow LED so that information can be send to the concerned authority to clean the bin. If the dustbin reached its full level, it will produce an irritating sound so that student nearby take some effort to clean the dustbin rather than disturb by the alarm sound. The alarm triggered used the solar powered power supply. The dustbins are provided with ultrasonic sensor which helps in level of the garbage bins and so that it is easy to identify which garbage bin is full.

Thus, this design and development of auto dustbin project can make the work clean faster and easier. Lastly, this project is also to attract the people attention to use dustbin because it very easy to use and it is a very modern system.

Figure 1.1 Overflowing garbage in Lestari Hostel, UTeM

1.2 Scope project

There are several objective needed to be achieved and because of that this project has some scope and limitation. This paper focuses on the design auto dustbin powered by portable solar that can be used daily in UTeM to help the cleaning process and keep the surrounding clean.

1.3 Objective

The purpose of this project is to develop a prototype of smart to dustbin using the new technology and combination in the field of renewable energy solar system which are:

i. To design a smart dustbin that will automatically send signal monitoring system, when the trash inside the dustbin is full which detects by the sensor system.

ii. To develop a solar system which is renewable energy as power supply to energize the auto dustbin.

CHAPTER 2

LITERATURE REVIEW

This chapter will cover the explanation about the main source for the auto dustbin design including type of solar panel, as well as component include in the stand alone system. Besides, this chapter discuss about the previous study regarding this project.

2.0 Smart Dustbin

From the previous study, smart dustbin were design and develop to monitor the level of garbage and generally use GSM (Global System for Mobile Communication) to send a signal to the Cleaning Department to clear up the dustbin. Almost all of the dustbin powered by direct electric energy.

Therefore, Ravichandran, S., (2016) design an intelligent dustbin to detect and identify Materials. He states that the smart dustbin 100 has on its top surface a solar panel 101 that is used as to power it. Solar panels produce voltage which is stored inside the batteries in the smart dustbin. The designed purpose of this dustbin is to consume less quantity of electricity. Moreover, these batteries can be charged by main power supply which is solar energy as an additional power source.

2.1 Controller Component

2.1.1 Ultrasonic sensor

Kulkarni, P. et al., states that the ultrasonic sensor is worked on property of sound and frequency there are two terminals of sensor which is echo and trigger. This sensor has two pins which called Trigger and Echo. Trigger used to calculate the distance of the object by generating sound waves and also to calculate the time taken for the echo to generate. The reflected waves that are captured by the trigger are transmit by echo. The trigger captured signal send to the micro controller. When micro controller sense the signal and immediate response the signal taken.

Figure 2.1 Ultrasonic sensor

2.1.2 Arduino UNO

Arduino UNO is a device that have two main part which is Arduino IDE for software and Arduino board for hardware. All the program that will be used in the project are write in the Arduino IDE and all the function of devices connected to it are define in the program. Arduino IDE has its own program language which called sketch. The Arduino board is a microcontroller circuit board. There are 14 digital pins that can be used as INPUT and OUTPUT and each pins have specialized functionality depend on the PIN define in program. There are also a RESET button that used to reset data receive by the Arduino.

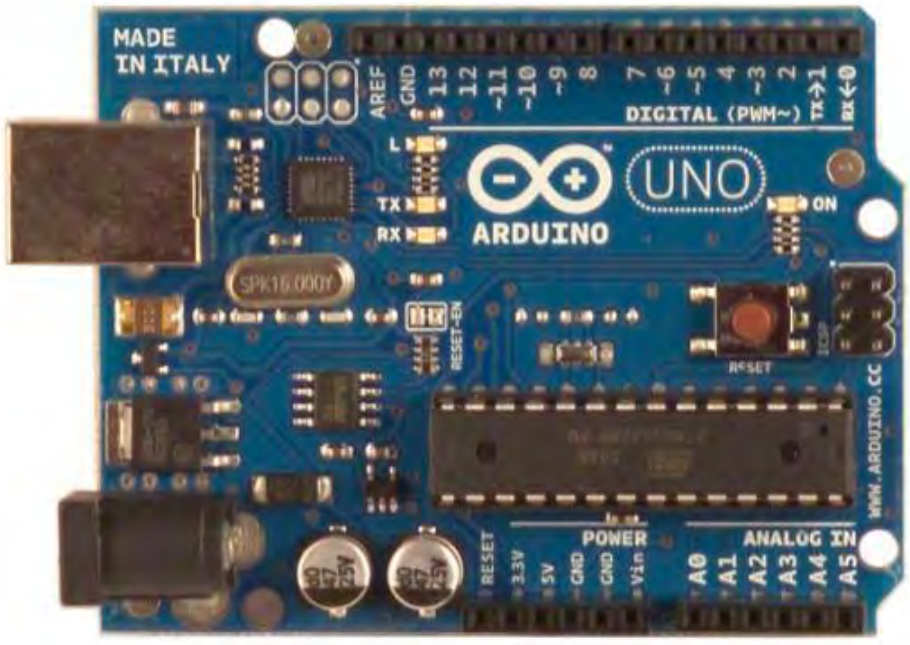

Figure 2.2 Arduino UNO

2.2 Renewable energy

Renewable energy is one of the main source of energy in the world. Renewable energy is the type of energy that can be reused or recycle for the loose term. The sources are such as sunlight, wind, geothermal tides and biomass. The non-renewable energy is energy that required a very long time to reproduce energy again. For example, fossil fuel such as petroleum, gas and coal. Nowadays, fossil fuel are decreasing as the time passing by as there a lot of product needed to use fossil fuel and the price also increases.

Besides, society will faces a hard time in the future if there is running out non-renewable. This scenario makes the society realize how important to make use of the existing renewable energy. According to Lim C.H *et. al* (2006), the potency of renewable energy increasing nowadays especially in Europe and America but in Asia especially in Malaysia, this type of energy is concentrated to be commercial due to lack of knowledge and high production expenses of the renewable energy. For this project, solar PV is chosen as source of electricity to power up the auto dustbin due to its simplicity process.

2.3 Solar system

Solar system is one of the renewable energy source. Guide, E., defines that solar power is widely available over most of the earth representing a consistent and renewable source of energy. The most important purposes is that there is never run out of sunlight energy. Solar power is a clean source of energy because solar system operates without the air and water pollution issues related with burning fossil fuels.

Sunlight is the main source of solar system which using solar panel to convert the direct sunlight into electricity. According to Cotar, A., Filcic, A. & Jardas, D., (2012),

solar photovoltaic modules, which are a result of combination of photovoltaic cells to increase their power, are highly reliable, durable and low noise devices to produce electricity. The fuel for the photovoltaic cell is free. The sunlight and its unlimited energy is the only resource that is required for the operation of PV systems.

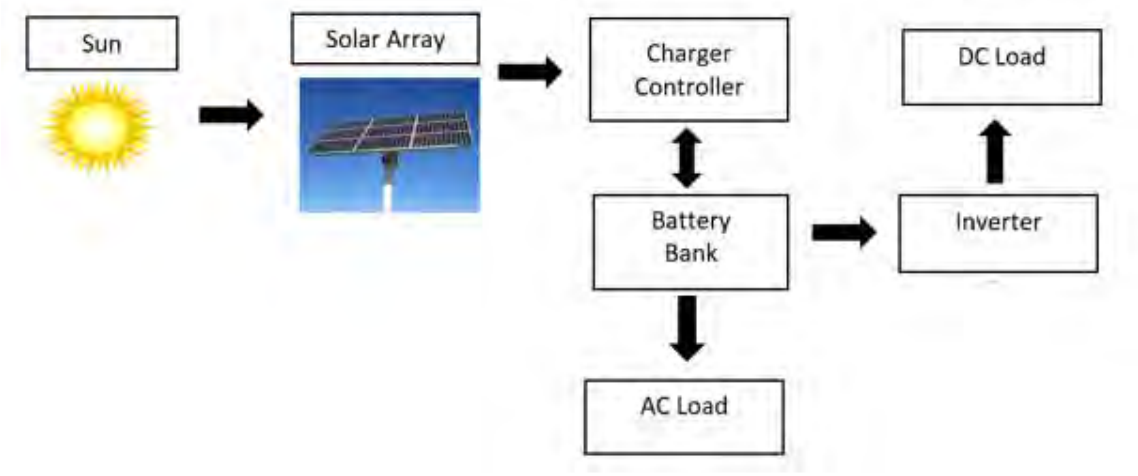

Figure 2.3 Solar System Block Diagram

2.4 Photovoltaic (PV) system

PV system commonly divide into two basic category which is ON-Grid and OFF-Grid. The selected system is dependent on the operation or function of the system requirement because both type of PV have a lot of different according to the type and the method of connecting to the network or way of storing energy on independent system.

ON-Grid is a system that connected to a public electricity network and there is no battery bank required. The mode of operation is required for the inverter to convert DC current to AC current.

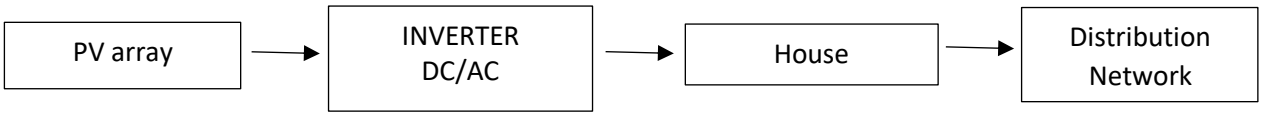

Figure 2.4 ON-Grid system

Cotar, A., Filcic, A. & Jardas, D., 2012 stated that OFF-Grid is a systems are used in rural areas where there is no electricity network and infrastructure. It is also known as Stand-alone PV. Stand-alone PV is a systems that are ideal for remote rural areas. Its applications where other power sources are unavailable to provide power for lighting, appliances and other uses. These PV modules were combined in a single array to bounce the desired power output. An automatic solar system that produces electrical power to charge banks of batteries during the day for use at night when the suns energy is unavailable is known as a simple stand-alone PV system is. The electrical energy supplied by a PV panels or array that stored by the rechargeable batteries are employs by the stand-alone small scale PV system

2.5 Types of Solar Photovoltaic cells

There are four type of solar panel which is Polycrystalline, Mono crystalline, bar crystalline silicon and thin-film Technology.

2.5.1 Polycrystalline

This type of cell is made up from silicon off cuts, mounded to form a block. According to Sangster, A.J., 2014, said that in a polycrystalline thin-film cell the top layer is made of a different semiconductor material than the bottom semiconductor layer. The process allow multiple crystalline structure to develop within the cell. The production of these cells is economically more efficient compared to monocrystalline. It is also easier to implement this cell and lifespan is expected to be between 20 and 25 years. Sangster, A.J., 2014 also stated this cell can convert solar radiation of 1.000 W/m2 to 130 W of electricity with the cell surface of 1m2.

Figure 2.5a Polycrystalline cell

2.5.2 Mono crystalline

Monocrystalline is the first generation of solar technology and the conversion efficiency for this type of cells ranges from 13%to 17%. The maximum efficiency of mono-crystalline silicon solar cell has reached around 23% under STC, but the highest recorded was 24.7% (under STC) which were stated by Akarslan, F., 2011. The cell are grown from a single crystal. It can generally be said to be in wide commercial use. In good light conditions it is the most efficient photovoltaic cell. This type of cell can convert solar radiation of 1.000 W/m2 to 140 W of electricity with the cell surface of 1m2. The manufacture of monocrystalline Si cells requires a completely pure semiconducting material and this method are difficult and costly. The expected lifespan of these cells is typically 25-30 years and, of course, as well as for all photovoltaic cells, the output degrades somewhat over the years.

Figure 2.5b Mono crystalline cell