A PROTOTYPE OF AN INTELLIGENT LIGHTING CONTROL SYSTEM POWERED VIA PHOTOVOLTAIC TECHNOLOGIES

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Specially dedicated to

My loving parent, Seah Mui Hiang;
My lively siblings, Boon Shue Ying

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ABSTRACT

Nowadays, the photovoltaic technology is becoming helpful technique and has a major new technology in green technology. Photovoltaic technology was used not only because it is a renewable energy, but it also gives us a lot of benefits. First of all, it technology bring zero impact to environment. Besides this benefit, photovoltaic system also reduces our living burden or increases our saving. For the overview of this system is combination of photovoltaic system and intelligent control system. The intelligent system need is because of users always easy to forget switch off the lamp can affect the living burden of the users and the power consumption will increased. The significance of this project is the environmental impact getting less. Besides that, this project will create an economical and cost effective system for users.

ABSTRAK

Pada masa kini, teknologi fotovoltaik menjadi teknik membantu dan mempunyai teknologi baru yang utama dalam teknologu hijua. Teknologi fotovoltaik telah digunakan bukan sahaja kerean ia adalah tenaga boeh diperbaharui, tetapi ia juag memberikan kita banyak manfaat. Pertama, teknologi fotovoltaik membawa sifar kesan kepada alam sekitar. Selain manfaat ini, teknologi fotovoltaik juga mengurangkan beban kehidupan kita atau meningkatkan penjimatan kami. Sebagai gambaran seluruhan bagi projek ini adalag gabungan sistem fotovoltaik dan sistem kawalan yang pintar. Keperluan sistem kawalan yang pintar adalah kerana pengguna sentiasa mudah lupa matikan lampu yang membawa akibatnya adalah menambah beban hidup pengguna and penggunaan kuasa akan meningkat. Kepentingan projek ini adalah kesan alam sekitar yang semakin kurang. Selain itu, projek ini akan mewujudkan satu sistem ekonomi dan kos efektif untuk pengguna.

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CHAPTER 1

INTRODUCTION

1.1   Overview

As the national electricity tariff increases, science and technology have assisted the development of control system technology. Development of the control technology have affected every aspect of people's lives, changed the habits of people, and improved the quality of people's life. Intelligent lighting control system refers to use auxiliary technologies of some computers in the room to carry out the control automatically for power line lighting, it can reach the particular lighting effect in special space and time, which can optimize the way of people's life, help people to arrange their time effectively, and even save money for a variety of energy costs. In this project, three research experiments will be conducted to compare this research work with conventional lighting system. Firstly, conventional lighting system structure will be modeled and studied to analyze the energy consumption. Secondly, modeling of an intelligent lighting system with the conventional lighting system and lastly, modeling the intelligent lighting system with photovoltaic (PV) system. First two models will be analyzed to record the energy consumption and based on the energy consumption the third model will be developed using the photovoltaic (PV) system. A sample of lecture room time table will be referred as a guidance to analyze the energy consumption.

1.2 Motivation for Research

As we known, lives of city dwellers mostly are in hurry and filled with stress. Most of time, they will busy with their work or job to make sure they can survive in this city. Therefore, some of they will ignore or forget some trivial thing such as switch off the lamp in the room. There are two problem will come out when the city dweller forget turn off the lamp; first is electricity bill of the city dweller will increase and directly increase the living burden of the city dweller. Second, the city dweller wasting energy and increase the energy consumption. To overcome the problems, we need an intelligent control system to help users switch off the lamp automatically; we also need a renewable energy which photovoltaic technology to reduce the power consumption and indirectly reduce the environmental impact.

1.3 Objectives

The main objectives of the project are:

1. To design and develop an Intelligent Lighting Control System Powered Via Photovoltaic Technology.
2. To study about all the existing automated lighting system.
3. To model photovoltaic system integration with low power AC appliances.
4. To study the characteristic of off-the-shelf sensors.

1.4 Problem Statement

In recent years, energy consumption and global warming have become the major problem which the whole world has to confront. The largest part of the energy consumption in the world is not industry utilization but it is home energy consumption. In general, energy consumption of the lamps or lighting in a typical home cannot be ignored. At the same time, the wastage of electric for the traditional home's lamps or lighting is very high and increasing [1]. This situation occurs because of traditional lamps or lighting is very inefficient in converting electricity

energy to light (95% energy converted to heat) [2]. Besides that, sometimes user will forget to switch off the lighting even though it maybe just for several minutes, that will also cause electric energy wasting [3]. Based on the problem statement, a solution is needed to overcome the increasing electric energy consumption. Hence, in this project an intelligent lighting system powered via photovoltaic technology is design and develop to fulfill the requirement to reduce the electric energy consumption and moderate the global warming issue.

1.5   Scope of Project

The scope of this project is to develop the intelligent lighting system for entrance A and entrance B and powered via photovoltaic technology. This project will divide to two main systems which is power supply system and intelligent lighting system.

For the power supply system, the $12V_{DC}$ to $240V_{AC}$ inverter had designed to convert the 12 direct current voltage from battery to 240 alternative current and supply it to intelligent lighting system. For the intelligent lighting system, the infrared reflectance sensor (or called as infrared proximity switch module) had used to detect human pass by the door.

This project is involved software and hardware developments. For software development, Proteus and CCS C Compiler is used to design, simulation and write programming coding for Peripheral interface Controller (PIC). For the hardware development, the prototype for door will make by using polyvinyl chloride (PVC).

Flow Chart of Photovoltaic System Connected to Control System

```
                          ┌─────────┐
                          │  Start  │
                          └────┬────┘
                               │
                          ◇────────────◇
              ┌──────────►│  Sunlight   │──────────┐
              │           │ availability│          │
              │           ◇──────┬──────◇          │
              │                  │ No               │
              │           ┌──────┴──────┐     ┌──────────┐
              │           │    End      │     │  Charge  │
              │           └─────────────┘     │controller│
              │                               └────┬─────┘
              │                                    │
              │    No    ◇─────────────◇           │
              └─────────►│   Battery   │◄──────────┘
                         │ availability│
                         ◇──────┬──────◇
                                │ Yes
                         ┌──────┴──────┐
                         │  Inverter   │
                         │ 12V_DC to   │
                         │  240V_AC    │
                         └──────┬──────┘
                                │
                    ┌───────────┴───────────┐
                    │ Intelligent Lighting  │
                    │   Control System      │
                    └───────────────────────┘
```
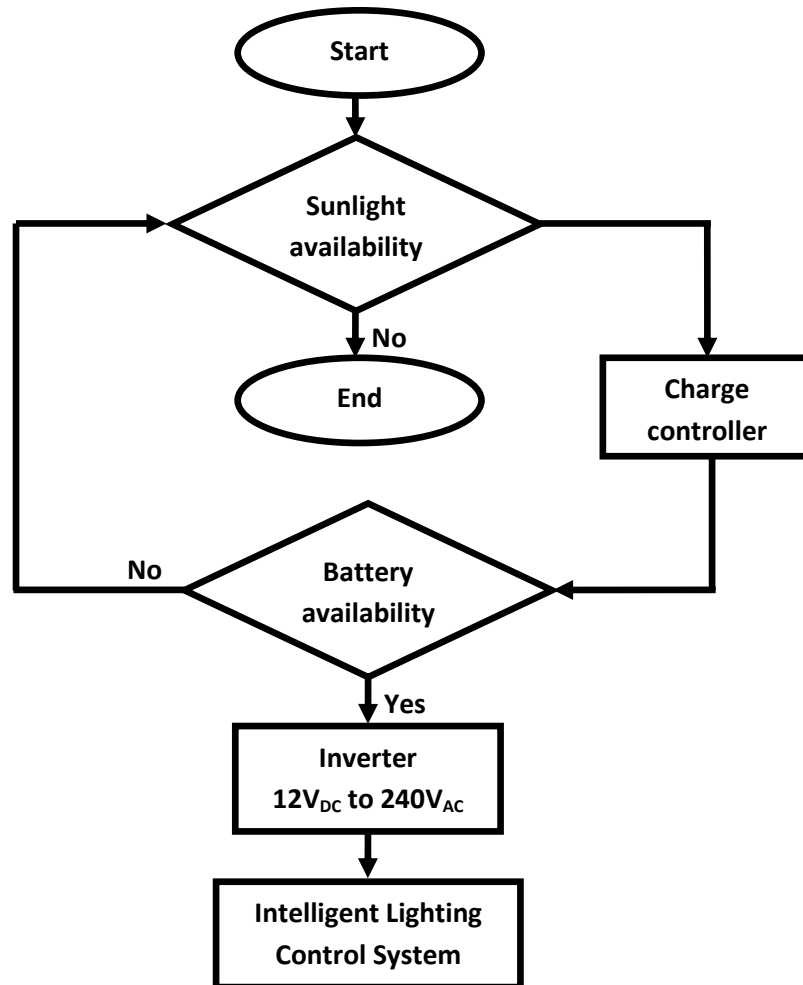
Flow chart of the Program of Intelligent Lighting Control System

```
                        ┌─────────────┐
                        │    Start    │
                        └──────┬──────┘
                               │
                    ┌──────────▼──────────┐
                    │      Sum = 0        │
                    │     (Counter)       │
                    └──────────┬──────────┘
                               │
                    ┌──────────▼──────────┐
                    │     Sensor = 0      │
                    │  (S1+S2  or  S3+S4) │
                    └──────────┬──────────┘
                               │
                          ◇ Sensor detect ───── No
                          ◇     '1'
                               │ Yes
                    ┌──────────▼──────────┐
                    │    Sum = Sum + 1    │
                    └──────────┬──────────┘
                               │
                          ◇ Sum > 0 ───── No
                               │ Yes
                    ┌──────────▼──────────┐
                    │     Lamp 'ON'       │
                    └──────────┬──────────┘
                               │
                    ┌──────────▼──────────┐
                    │     Sensor = 0      │
                    │  (S2+S1  or  S4+S3) │
                    └──────────┬──────────┘
                               │
                          ◇ Sensor detect ───── No
                          ◇    '-1'
                               │ Yes
                    ┌──────────▼──────────┐
                    │    Sum = Sum - 1    │
                    └──────────┬──────────┘
                               │
                          ◇ Sum ≤ 0 ───── No
                               │ Yes
                    ┌──────────▼──────────┐
                    │     Lamp 'OFF'      │
                    └─────────────────────┘
```
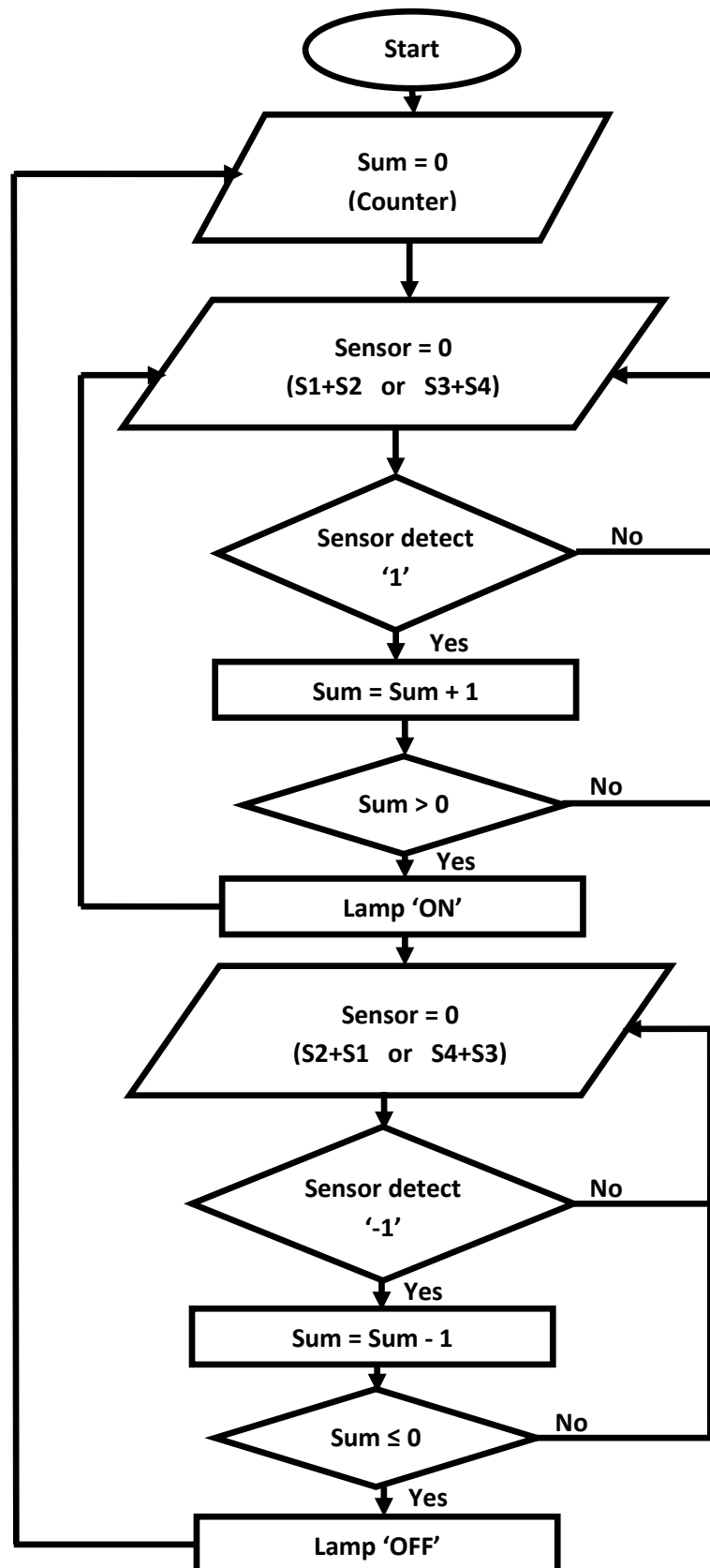
1.6   Thesis Outline

This report is presented into five chapters. The introduction of the project and the objective of the project are outlined in this chapter. Chapter 2 describes about the theory used, background and basic information of this project.

Chapter 3 will be discussing the methodology of this project and implementation of the software and hardware development. The entire circuits had used will shown in this chapter. In chapter 4 will shown the entire simulation result and system tested result. Besides that, this chapter also will include some discussion for this project. Conclusion and recommendations for the entire project are described in Chapter 5.

CHAPTER II

LITERATURE REVIEW

2.1 Automatic Room Light Intensity Detection and Control Using a Microprocessor and Light Sensors

Basically, this paper is proposing a design used a microcontroller and light sensors to automatically detect the intensity of light in the room and control the lighting system of that room. According the author design, a Home Light Control Module (HLCM) is consisting of pyroelectric infrared (PIR) sensor circuit, the light sensor circuit, the microprocessor and the RF module, and this module will install in every light fixture of a family. The PIR sensor circuit needed to detect the presence of human in the detection area. When human in the detection area, the variation of temperature will produce and detected by PIR sensor. Once the PIR sensor detected the variation of temperature, an output will send to microprocessor with several decades mile-voltage. Since output signal from sensor in weak, an amplifier needed to amplify the output to trigger the microprocessor. The main function of light sensor circuit is detected in the intensity of light in the particular room and sends the detected result to microprocessor for further process. The RF module used to communicate between each HLCM in order to pre-control the light in room near to users and support the light intensity to make sure the lowest level light intensity can be achieved. The microprocessor in this module has 3 main functions:

    1. Set the sufficient intensity of light for particular room

2. Analyze the output from light sensor circuit to determine either the intensity of light in the room match the lowest level light intensity set by the microprocessor

3. Analyze the necessary to turn on or off the lamp according the output from PIR sensor circuit and light sensor circuit

Since the idea from author is help users to save energy, therefore the power consumption of HLCM must be low. From the journal, author listed the power consumption of the 4 circuit and the total power consumption in Table 2.1proved the HLCM is low power consumption.

Table 2.1: Average power consumption of the HLCM

Item	Average current (mA)	Operation Voltage (V)	Average Power consumption (W)
RF	33	3	0.099
Microprocessor	36	5	0.18
Relay	68	5	0.34
PIR Circuit	35	5	0.175
Light sensor Circuit	38	5	0.19
Total	210	5 or 3	0.984

Besides that, authors also done an experiment and proved manually switch on/off the light is consume more power compare with the light is switched by HLCM.