SMART HOUSING LIGHTING SYSTEM

Mohd Khairul Anuar Bin Abd Razak

Bachelor of Mechatronic Engineering

May 2010

"I declare that this report, submitted in partial fulfillment for the award of the degree of Bachelor of Mechatronics Engineering"

Signature : .....

Supervisor's Name : Cik Aziah bte Khamis

Date : 22 April 2010

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MOHD KHAIRUL ANUAR BIN ABD RAZAK
B010610116

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FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

APRIL 2010

I declare that this report entitle Smart Housing Lighting System 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 : .....

Name : MOHD KHAIRUL ANUAR ABIN ABD RAZAK

Date : 22th April 2010

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ABSTRACT

The Smart Housing Lighting System is actually a system that combine construction of software and hardware. This project generally solving the problem by managing the electrical usage by adapting lighting at home with human attendance and surrounding light intensity. In the software development, the scope of work will be on constructing a C language source code of the program to be burned on to the PIC microcontroller, but before that the source code will be undergoing simulation process to ensure that the program are correct and could be function as expected when connected to the circuit board. While in the hardware development process, the scope of work will be constructing an electronic circuit board to integrate the program burned on to the 16F877A PIC with the connected input and output device. Other electronic component will be connected to the PIC to adapt the environment light intensity and human attendance with the output respond. A prototype of a simple house plan will also be build to present the project, and a control panel will also be designed to control the project's circuit board.

ABSTRAK

Sistem Pintar Pencahayaan Rumah ini adalah sebuah sistem yang menggabungkan proses pembinaan perisian dan perkakasan. Secara umumnya projek ini menyelesaikan masalah dengan menguruskan penggunaan tenaga elektrik dengan cara menyesuaikan kecerahan cahaya di dalam rumah dengan kehadiran manusia dan kecerahan cahaya persekitaran. Kerja-kerja yang dilakukan dalam proses pembinaan perisian adalah berkaitan pembinaan kod sumber dengan bahasa C untuk dipindahkan ke dalam mikropengawal PIC, tetapi sebelum itu, kod sumber itu perlu menjalani proses simulasi untuk memastikan program tersebut adalah betul dan dapat berfungsi seperti dijangkakan apabila disambungkan dengan papan litar. Manakala dalam proses pembangunan perkakasan, kerja-kerja yang akan dilakukan adalah membina sebuah papan litar elektronik untuk mengintegrasikan program yang telah dipindahkan ke dalam 16F877A PIC dengan perkakasan masukan dan keluaran. Komponen elektronik lain juga akan disambungkan dengan PIC untuk menyesuaikan kecerahan cahaya sekeliling dan kehadiran manusia dengan respon keluaran. Prototaip sebuah rumah juga akan dibina untuk mempersembahkan projek ini, dan sebuah panel pengawal juga akan direkacipta untuk mengawal papan litar projek ini.

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IR	-	Infrared
PIR	-	Passive Infrared
PIC	-	Peripheral Interface Controller
PWM	-	Pulse Width Modulation
ADC	-	Analogue Digital Converter
USART	-	Universal Asynchronous Receiver/Transmitter

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CHAPTER 1

INTRODUCTION

This project is focusing on developing and constructing a house lighting system to control the electrical usage of a house by controlling one of the elements of a house needs, that is the lighting. By controlling the conventional system, by adapting the lighting in the house with the surrounding parameters, the efficiency of power usage while using the conventional lighting system could be increase.

1.1 Background of the Project

The simplest and often, most effective way to save energy on lighting is by turning lights off. In commercial environments it can be difficult for users to remember to turn off unneeded lighting. Automatic lighting controls offer an inexpensive, effective way to minimize lighting costs, by turning unneeded lights off, or in some cases, dimming lights. There are three basic categories of automatic lighting controls: timers, daylight harvesting controls and occupancy/vacancy controls. The project will consist of two part, that is the software part, and the hardware part. Software part includes C program language that is constructed, simulated, tested, and downloaded using appropriate computer software while the hardware part is the control circuits, input and output transducers, circuit panel, and the house prototype. The project will be tested on the prototype first to make sure that it will meet the objectives when installed on the real house.

1.2 Objective

The main aim of this project is to design a control device that could control the lighting system of a house by interact with surrounding light intensity and human attendance. In order to achieve it that goal, specific objectives should be achieved first, that is:-

i) To design smart lighting system that give feedback with the surrounding intensity's changes, and person's presence in a specified space.

ii) To design the source code of the PIC base on the developed flow chart.

iii) To simulate the constructed source code using appropriate software.

iv) To construct a simple house prototype to present the project.

1.3 Scope

In the software development, the scope of work will be on constructing a C language source code of the program to be burned on to the PIC microcontroller, but before that the source code will be undergoing simulation process to ensure that the program are correct and could be function as expected when connected to the circuit board.

While in the hardware development process, the scope of work will be constructing an electronic circuit board to integrate the program burned on to the PIC. Other electronic component will be connected to the PIC to adapt the environment light intensity with the output respond. A prototype of a simple house plan will also be build to present the project. A control panel for the user will also be design to control the whole project.

The system designed will only be tested on the prototype constructed with the most suitable plant design. The sensors to detect human attendance will be replace with mid-range infra red sensor, while high resistant light dependent resistance (LDR) will be replaced with low resistant LDR, the system designed are not much be changed to be implemented on the real house.

1.4 Problem Statement

The main problem that are going to be solve, by developing this smart lighting system is energy wasting. Energy wasting could happen due to many reasons. Here, several examples will be discussed to support the main problem statement.

Sometimes when peoples go out for holiday for a long period, the light are going to be switch on for the whole day and night just to frighten outsiders and avoid trespasser.

Second scenario happen when peoples go out to work, some of them forgot to switch off the light.

Third example is happening when peoples does not notice that the lamp are still switch on while the light intensity outside house are high.

Wonder someone who are searching for lamp's switch at home at night to do something important. Anything could happen in dark. This could become a trouble if something bad happened.

The last scenario, happened many times, and sure, everyone has experienced it. When there is no one in a certain room at home, but the light in it are still switch on as example, in the bedroom with no one, but the light is switch on.

Several example that have been discuss above has one thing in common, that is the inefficiency of the conventional lighting system that lead to waste of electrical energy and increase your monthly payment to electrical service provider.

CHAPTER 2

LITERATURE REVIEW

In this chapter, a review of previous research project that are related of this project will be discussed. The information about project or product that uses automatic lighting switching will be described below.

2.1 Detection and Automatic Lighting System (Hager)

Basically, this product together all the devices for automatic control of lighting in both the residential and private/public industry sectors. It was done by enhance security for exterior accesses to residential homes, garages and halls, and guarantee significant savings in lighting power consumption by illuminating only when necessary. Besides, this product also Increases your security by dissuading undesirable visitors.

One of the sensor used in this product is the infrared (IR) detectors, that is used by the interior and exterior lighting. Several features of the IR detectors are sensitive to infrared radiation linked to heat emitted by any body in movement such as people, animals, etc. The devices are designed for the automatic control of lighting around or inside the home. It is also easy to install for any type of mounting.

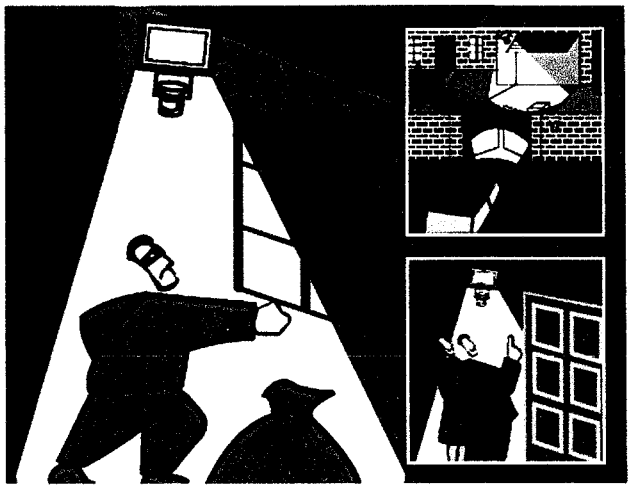

Figure 2.1 : Interesting feature of Detection and Automatic Lighting System

In the interior part the sensor Infrared movement detectors will be used. The first one is called, Tectomat 360.Some interesting feature of this detector is, it will detect movement in walk circulation zones. It also has an adjustable integrated twilight switch function. The walk circulation zone are as in Figure 2.2.

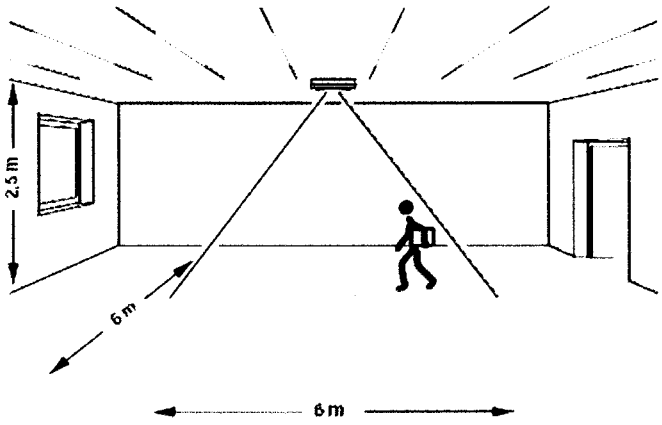

Figure 2.2: The circulation zone of the Tectomat 360.

Compare to the first movement detector, the second one called Tectomat Presio has double lens of the Tectomat Presios (Flash patent) offers an exceptional fineness in infrared

detection. Micro movements are sufficient to switch on and maintain the light on. Lights are inhibited from being switched on if natural light is sufficient in the room. The flexible head of the detectors allows adapting the detection zone according to the room's configuration as in Figure 2.3.

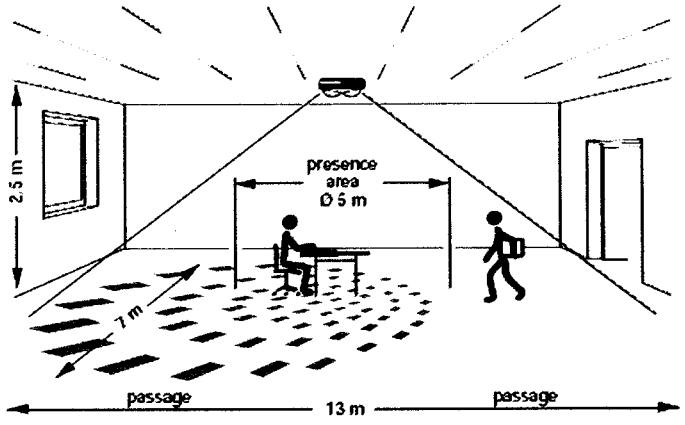

Figure 2.3: The detection zone of Tectomat Presio.

2.2 Alarm System: Motion Detector (Cytron Technologies)

This project is actually a simple alarm system that detects motion using Passive Infrared (PIR) sensor. This sensors measure infrared radiation emanating from objects in the field of view. If the PIR sensor set, the buzzer will buzz. The process flow of the alarm system is such below.

One of the best features in this project is, it uses Passive Infrared (PIR) motion detector. This sensors measure infrared radiation emanating from objects in the field of view. It only has one output pin and another two pins is connected to 5V and GND separately. Apparent motion is detected when an infrared emitting source with one temperature, such as human body, passes in front of source with another temperature, such as wall. The unit output is high whenever there is motion detected. If the motion is continuous, the output remains

high. After motion stops, the output remains high for a few seconds (depend on the variable resistor adjusted). It will remain high for longer if H from the jumper is selected.

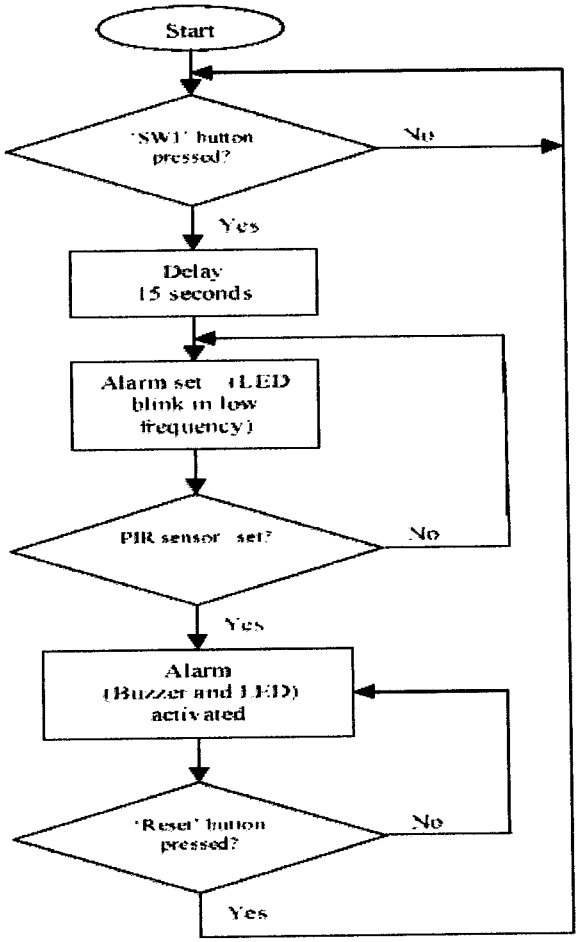

Figure 2.4: Process flow of Alarm System: Motion Detector

As in Figure 2.4, the programs runs when SW1 which is a push button pressed. After pressed, the program will be delay for 15 seconds before the alarm is set, which user could know by the low frequency blinking of the LED. If any motion detected by the PIR sensor, the program will activate the buzzer and LED. Buzzer will make sound and LED will be blinking in high frequency until the Reset button is pressed.

2.3 Automatic Lighting Controls (Efficiency Maine)

This review is on an article entitled Automatic Lighting Controls produce by a company called Efficiency Maine. In this article, it describes the simplest way to save energy on lighting, by turning lights off. In commercial environments it can be difficult for users to remember to turn off unneeded lighting. Automatic lighting controls offer an inexpensive, effective way to minimize lighting costs, by turning unneeded lights off, or in some cases, dimming lights. There are three basic categories of automatic lighting controls: timers, daylight harvesting controls and occupancy/vacancy controls.

The timers controls allow the user to turn on lights for a specific time period. The controls range from simple twist knob controls to micro-processor based lighting scheduling systems. Timers can be very effective for applications where occupancy sensors do not have an adequate view of the area, and for spaces that are occupied for predictable time periods.

For spaces that receive significant daylight, daylight harvesting controls can be used to keep lights off, or to dim lights, when there is sufficient available daylight. The simplest systems simply turn off the lighting circuit when a pre-determined level of daylight is achieved. Because these systems require a high level of daylight throughout the space, systems that turn off only a portion of the lights are often more effective.

Motion sensors and occupancy controls are the most widely used form of automatic lighting control. These sensors can be used in a variety of spaces to keep lights off when they are not needed. Most occupancy sensors detect motion based on passive infrared and/or ultrasonic methods of operation. Depending on the space type, the sensor can replace wall mounted light switches or can be mounted remotely, retaining the normal switching for use as override switches, which allows the lighting to be kept off even when the space is occupied.

2.4 Microcontroller PIC 16F877A

Microcontroller is an Integrated circuit which is designed to be all in one. No other external components are needed for its application because all necessary peripherals are already built into it. Thus, we save the time and space needed to construct devices. Peripherals are the functions or service that built in the microcontroller to do its work.

The most widely used microcontroller nowadays is PIC 16F877A.This microcontroller has 40 pins terminal which is each pins has its own assignation. The 40 pins make it easier to use the peripherals as the functions are spread out over the pins. This makes it easier to decide what external devices to attach without worrying too much if there is not enough pins to do the job. The assignations of the pins are as in Figure 2.5.

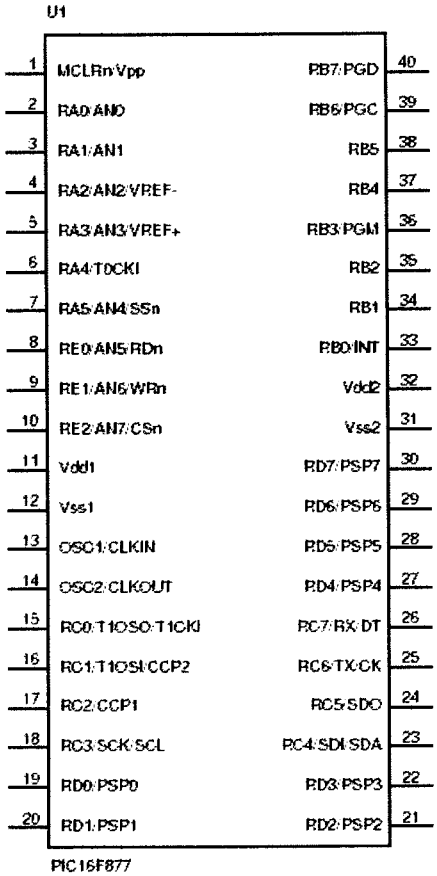

Figure 2.5: The assignation of 16F877A pins.

Some of the most important peripherals that are offered by this microcontroller are USART, Timers, ADC input, Analogue comparator, and CCP. These peripherals could be accessed using the programming developed. Peripherals used are base on the project. Each peripherals has its own programming method. Figure 2.6 shows the features of PIC 16F877A and peripheral its offer.

It can be conclude that the PIC that we are going to use in this project is PIC 16F877A

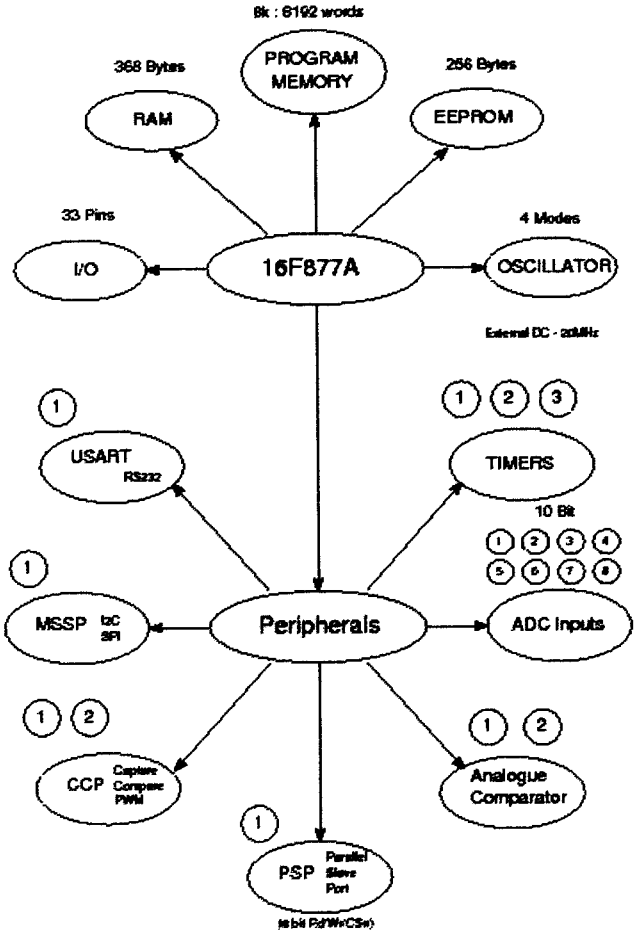

Figure 2.6: Features and peripherals of PIC 16F877A.

2.5 Sensors and Relays Review

Basically in this project, there is 2 type of sensors used , and relays used as input and output component. These 2 type of relay is Infrared (IR) sensor and Passive Infrared (PIR) sensor while relay will be the output device of the PIC 16F877A that we chose as the microcontroller.

2.5.1 PIR Sensor

The PIR (Passive Infra-Red) Sensor is a pyroelectric device that detects motion by measuring changes in the infrared levels emitted by surrounding objects. This motion can be detected by checking for a high signal on a single I/O pin. The product features include:

1. Single bit output
2. Small size makes it easy to conceal
3. Compatible with all types of microcontrollers
4. 5V till 20V operation with <100uA current draw

The dimensions of the sensor as shown in Figure 2.7.

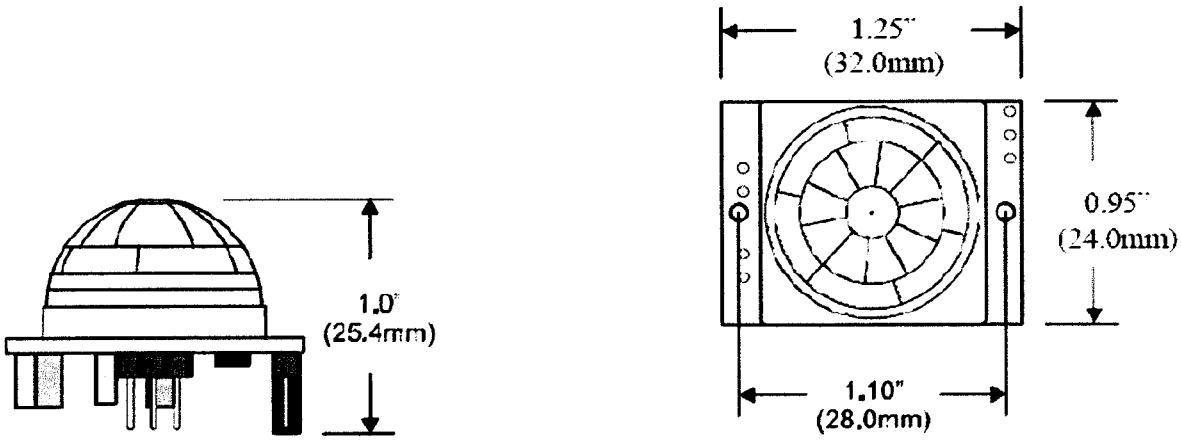

Figure 2.7: The dimensions of PIR sensor