HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY
FACULTY OF COMPUTER SCIENCE AND ENGINEERING

EMBEDED SYSTEM

Smart Lighting System First Report

Lecturer: Pham Hoang Anh
Author: Vuong Le Huy
Nguyen La Thong

May, 2020

Table 1: GROUP'S MEMBERS

No.	Name	ID
1	Vuong Le Huy	1652252
2	Nguyen La Thong	1752522

Contents

1 Problem Statement

Nowadays, people leave their house without switching off the home appliances such as fans and lights due to busy life style. Such a careless behavior does not only result in wastage but also bring potential danger to the home. Owing to the above problems, an automated home control and monitoring system is needed to keep the wastage and danger to the very minimum.

Home automation has been a trend since the 1980's; with the introduction of networking, home automation has become much more practical. Smart lighting is a key component for upcoming traits in society. There exist many versions of smart lighting that come in various forms (e.g bulbs, hubs, switches).Existing smart lighting systems typically feature control from smartphones.

For this project, the team created a smart system for controlling home lighting. With conventional lights, it is not possible to control home lights from a distance. It is a challenge to control high voltage lights from a sensitive controller board. Lighting systems that learn the patterns for home lighting usage do not exist. A significant amount of energy is wasted when lights are left on in unoccupied rooms.

2 Requirement Analysis

Table I shows the functional requirements and constraints of the system. These characteristics are very general. Below, is a much more detailed explanation of the individual functional requirements and constraints.

TABLE I. FUNCTIONAL REQUIREMENTS AND CONSTRAINTS

Characteristics	F	C
Embedded Debian Linux platform		X
Motion sensor shutoff	X	
Controllable via Android application		X
Manual button and switch control		X
Recognize and utilize light usage patterns	X	
Controls home lights		X
System fits in 1 gang work wall electric box		X
Easy to use	X	
Configurable modes	X	
Communication, and sensors are optional		X
System is safe	X	

Functional Requirement (F), Constraint (C)

Embedded Debian Linux platform
The system is controlled by an embedded Debian Linux platform. The Debian Linux platform is programmed and wired to control all other subsystems of this project. The Debian Linux platform provides framework for communication with other subsystems.

Motion sensor shutoff
The system uses a motion sensor that can see motion in the room of the system's installation. If the motion sensor detects no movement in a room fora period of time, the lights in the room are turned off by the system.

Controllable via Android application
The system is controllable by an Android application. The Android application was developed by the team, and is only for communicating with the system. The Android application also has access to a record of all lighting and system control events.The feature for viewing and setting light changing events was not completed in this project.

Manual button and switch control
At all times, the system is able to be user controlled via manual buttons and switches. The buttons and switches are always visible to users. Control from the manual buttons and switches overrides any other control requests provided to the system.

Recognize and utilize light usage patterns
The system recognizes and utilizes light usage patterns. Any event of button, switch, or other

control requests is recorded with a timestamp. The status of the system and room lights is recorded in 15 minute intervals.The system records time and day of the week information in the pattern recognition. If desired by a user, the system can make suggested changes to the room lights based on the recognized light usage pattern.This feature was only completed and tested in simulation.

Controls home lights
Upon installation, the system is replacing an existing light switch. The lights controlled by this switch must be able to be controlled by the system.

System fits in work wall electric box
A one-gang work wall electric box is a standard home installment for placing light switches to control home lights. The system fits in a 1 gang work wall electric box, because this is the most common type of housing for home light switches. This feature was not in the scope of this project.

Easy to use
Using the system is intuitive. It is important that users are not frustrated when interfacing with the system.

Configurable modes
The system has configurable modes. The functionality of the system is not always the same. Users are able to configure the system according to their preferences. The various modes will be explained at greater depth in the “System State Diagram” portion of this proposal.

Communication and sensors are optional
The user is able to disable or enable: the Android application communication, and the motion sensor. These features may prove to be undesirable by some users, and therefore must be optional.

System is safe
After installation, the electrical components of the system should be not visible or touchable by users. It is important that no users are harmed when interacting with the system.This feature is out of scope for this project.

3 System Design Proposal

In our proposed model there are few components but the most important components are PIR, micro-controller, relay, opto coupler, The other components are very common like voltage regulator ICs like LM7805 is used to give micro-controller 5V constantly and LM7812 to give 12V constant supply to the relay as this ICs have high power dissipation capability, internal thermal over-load protection, and internal short circuit current limiting.

PIR which means Passive Infrared Sensor is a sensor that is used to sense motion within a range. It is also known as PID which stands for Passive Infrared Detector. Any motion of an object having a temperature above absolute zero is detected by PIR. PIR stands for Passive Infrared. Here the word passive is used for the reason that instead of emitting microwave energy the sensor is simply sensitive to the infrared energy emitted by the particle. Any object having a temperature above absolute zero radiates some energy in the form of infrared when it makes a move. PIR senses this infrared. The sensor is typically sensitive to a wavelength of 8-12 micrometer. Generally human skin having temperature approximately 93F- 99 F radiates infrared having wavelength 9-10 micrometer. Each model is having a particular range of detecting infrared.

If any motion is detected within the range the output pin becomes HIGH. As long as the sensor detects motion it is giving a pulse or signal which is causing to remain the light ON.

Figure 1 shows the general pin configuration of PIR model.

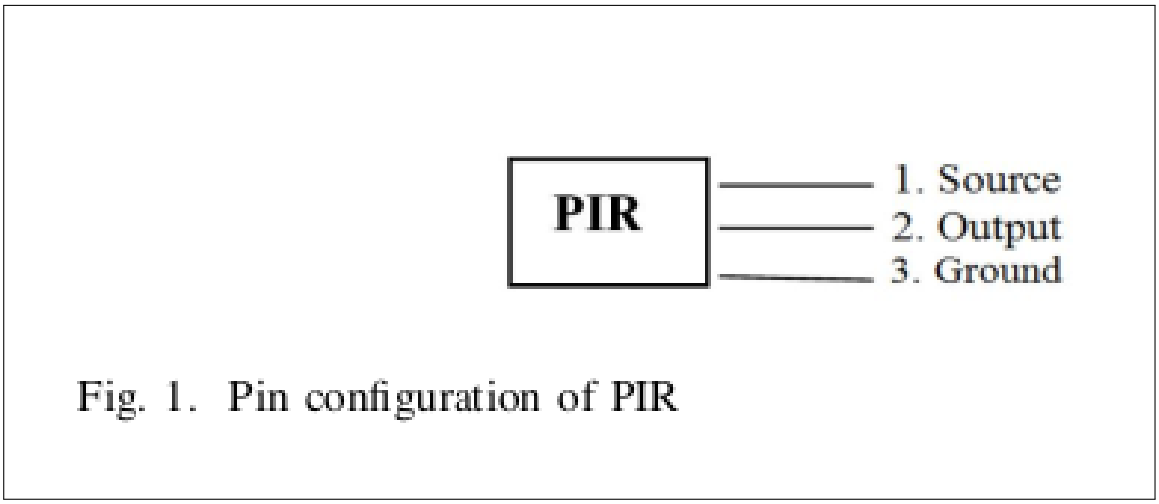


Fig. 1. Pin configuration of PIR

A complete block diagram of the proposed model is shown in Fig. 2. If the PIR detects a motion the output pin will be HIGH. The signal from the PIR is very small and we need to amplify this signal for further procedure .An op-amp is used to amplify the signal from PIR. The amplified signal will be an input for the microcontroller. When the input pin of the microcontroller receives a signal the output pin will energize the relay to make the light on. In the block diagram we are using the term load to indicate any electric load we are expecting to control with PIR. 5V DC voltage is needed to make the microcontroller ON.12V DC voltage is needed to make the relay ON.

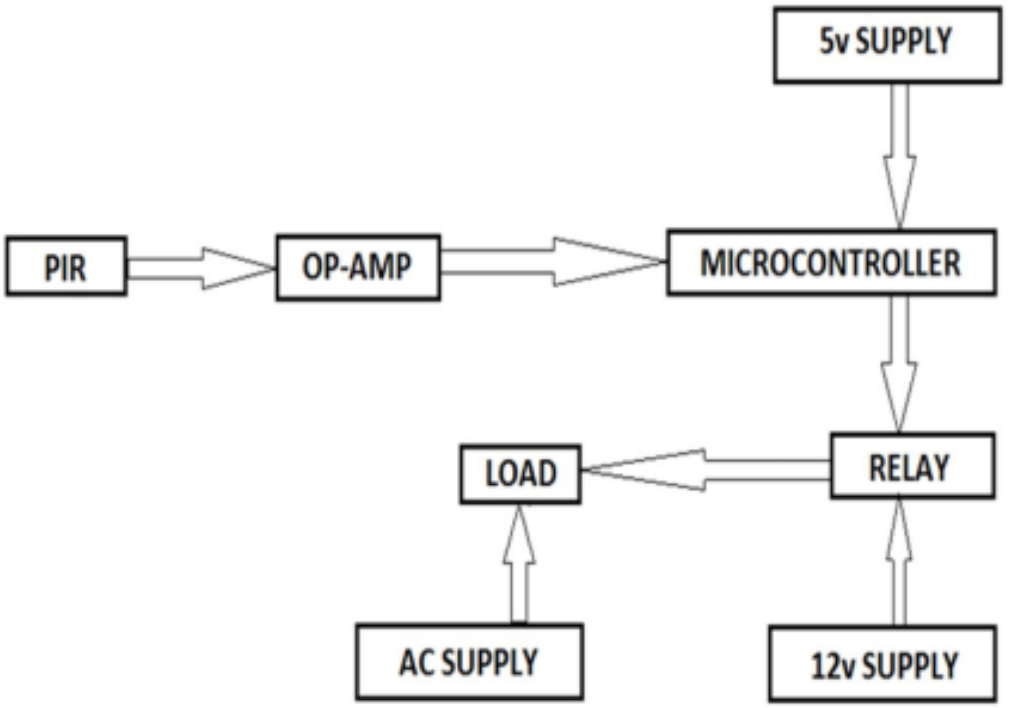
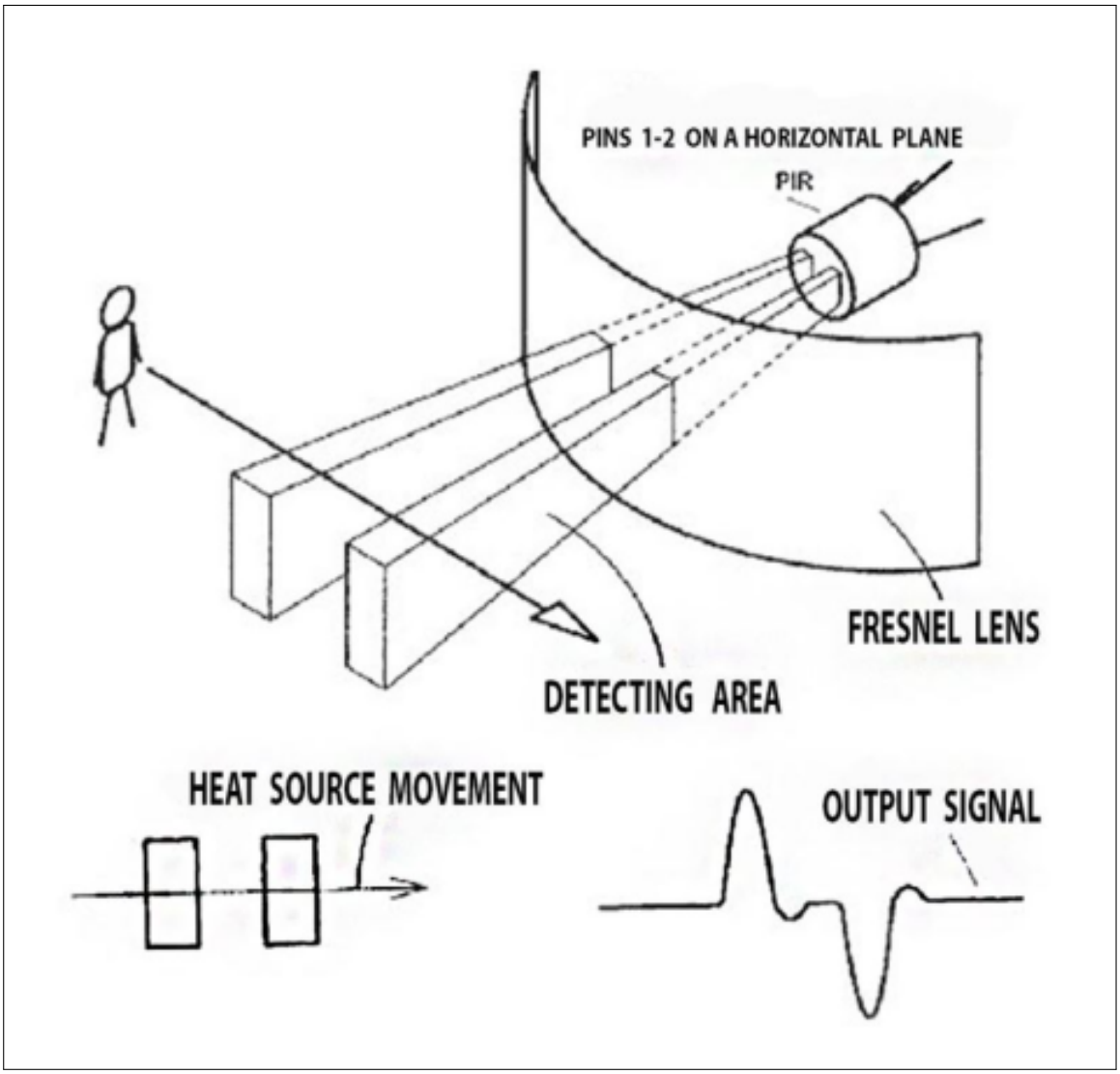


Fig. 2. Block diagram of the proposed model

PIR works on getting any pulse by moving in front of it. x'Especially human movement is detected quite well. But every PIR sensors has its definite range. It works only within the ranges. So choosing a PIR is very important thing in this project. As PIR has range in angles we have to calculate the angles where it works properly. PIR sensors working principle is shown below by the figure 3.



4 References

R. Heukels, Predicting user behavior using transition probability, 1st ed. Drienerlolaan: University of Twente, 2015.

MSP430-PIR motion sensor development board user manual, https://www.olimex.com/Products/MSP430/Starter PIR/resources/MSP430-PIR.pdf