Higher Colleges of Technology – Al Ain Women's College

ELEC 349 –Engineering Project

Course Code:	ELEC 349- Integrative Project
Report Title:	Final Technical Report
Project Title:	Sensor-Controlled Lighting System
Purpose:	To redesign a system for lightning cities and highways, in order to reduce power, save the environment, increase the lightning level and the width of the area that will be illuminated.
Student Name:	Mouza Saeed Al Khaili
Student ID:	H00083397
Project Supervisor:	Mr. Hamid Khattak
Date:	5th June 2011

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Abstract

This report is presenting a final idea of Sensor-Controlled Lighting system which will be designed to be the best solution to save time, money, electricity and the fossil fuel which is producing it. Also, it presents the technical requirements, theoretical concept and the system designing. To add on, results of testing, troubleshooting and the project reflection is included as well.

Chapter 1

Introduction

This project title is "Sensor-Controlled Lighting System", and it aims to use a renewable source to run it which does not pollute the environment. In the other hand we could have a high and brightness illumination in the streets.

The main parts in the project are sensors, Solar Panels and monitors. Two kinds of sensors will be used which are light sensor and motion sensor.
The light sensor will detect darkness to activate the ON/OFF switch, so the streetlights will be ready to turn on. In the other hand the motion sensor will detect movement to activate the streetlights.
The solar panels will feed the system with solar power, which will be charging the battery during the day. At night the battery will be discharge through the project processes.
The battery and the streetlights will be monitored to observe their level and performance in the operating board.

Researchers have been done about transmission medium which will be wireless by using transmitters and receivers. This medium will allows the information to transfer from part to another in the system.

History of technology

The earliest lamps were invented by Greek and Roman civilization, where the light was serving the purpose of security. But the technology kept developing and the first electric street lighting employed arc lamps, developed by the Russian Pavel Yablochkov in 1875.

The idea of designing a new system for the streetlight that do not consume huge amount of electricity and illuminate large areas with the highest intensity of light is concerning each engineer working in this field. Echelon Company have invent a

technology that reduce the amount of electricity which is needed to light up the city but with controlling it remotely and using an LED lights instead of mercury-vapor or high-pressure sodium lamps.

Figure 1-Milton Keynes City

This brilliant technology has been applied in Milton Keynes, UK. Moreover, it have succeeded by having reduced the energy usage by 30%, reduced light pollution and CO2 emissions, reduced maintenance costs and improved driver and pedestrian safety. (City Cuts Energy Use, CO2 Emissions with LonWorks® Network)

In this example the technology that have been used is powered by electricity power, and the Sensor-Controlled Lighting System is solar powered, and the main idea of this project is to replace the electricity which is produced by burning fossil fuel with a renewable one which is environmental friendly.

Project Planning

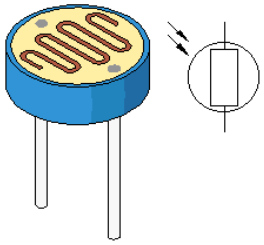
Using the full streetlight efficiency while there is no any kind of transportation on the road is a waste of power, so this project is designed to work only when a car or human crossed the road. And this will happened with the help of motion sensors, also light sensors will be added but to activate the system to be ready for the motion sensors signals which will turn on the LED streetlights. To add on, time relay have been added as well to give the LED streetlight some time before turning them off after the car gone. Solar panels will be with the LED streetlights poles and with the batteries which will be charged at day by it.

Chapter 2

Theoretical Concepts

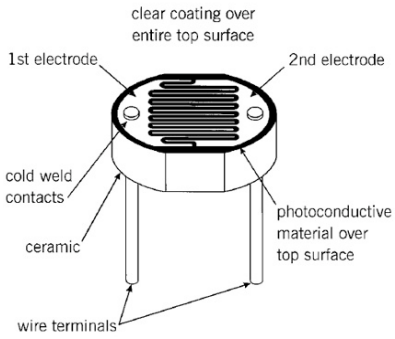
Sensors

Light sensor



The theoretical concept of the light sensor lies behind the LDR (Light Dependent Resistor) which is used in this circuit as a darkness detector.

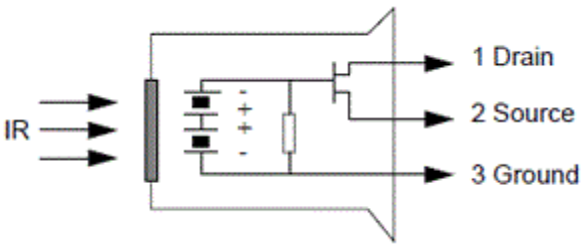
The LDR is a resistor and its resistance varies according to the amount of light falling on its surface.

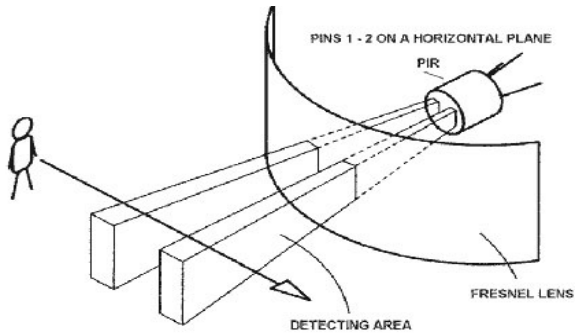


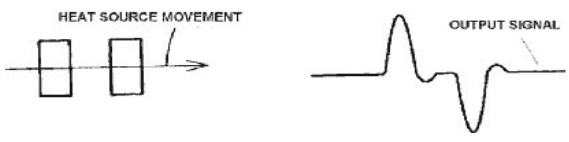
When the LDR detect light its resistance will get decreased, thus if it detects darkness its resistance will increase. (Photocells a.k.a CdS cells, photoresistors, LDR) (Photoresistor)

PIR motion detector

Passive infrared detector which detects the heat (infrared) radiated by humans and animals bodies. When a person in the field of vision of the sensor moves, the sensor detects a sudden change in infrared energy and the sensor



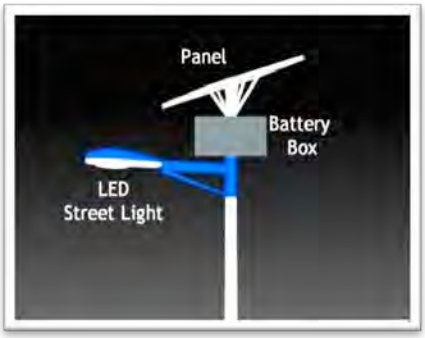




is activated. (PIR motion sensors, 2011)

Solar Panels

The panels will be connected to the battery and from the battery to the streetlights to supply them with power. Furthermore, there are three types of solar panels single crystalline, polycrystalline and thin film and single crystalline have been used in this project. It is the most efficient one and it's able to produce electricity at 15-18% efficiency.

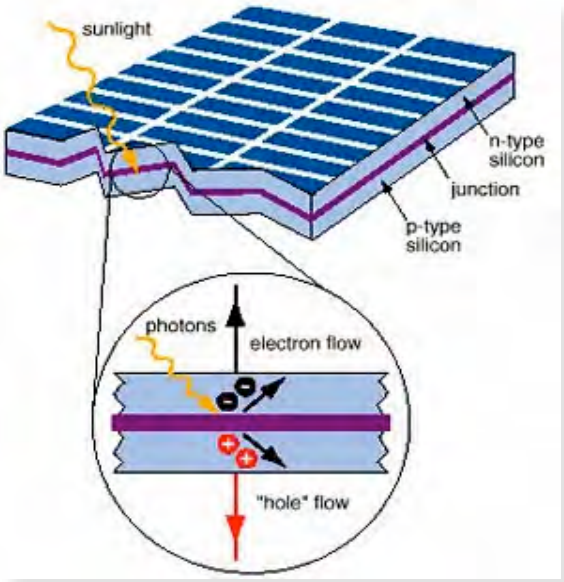


What makes these panels different from the two other types that it's made from one large chunk of silicon crystal. (Wilson)

Also, the single crystalline is available in the college.

The solar panels works in three steps which are:

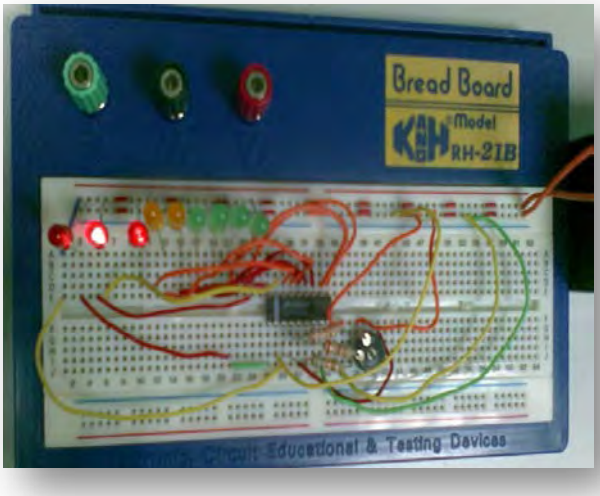
1. Photons in sunlight hit the solar panel and they get absorbed by semiconducting materials, such as silicon.
2. Electrons which are loose from their atoms are allowed to flow through the material to produce electricity. Due to the special composition of solar panels, the electrons are only allowed to move in a single direction.
3. Solar panels convert solar energy into a usable amount of direct current (DC) electricity.

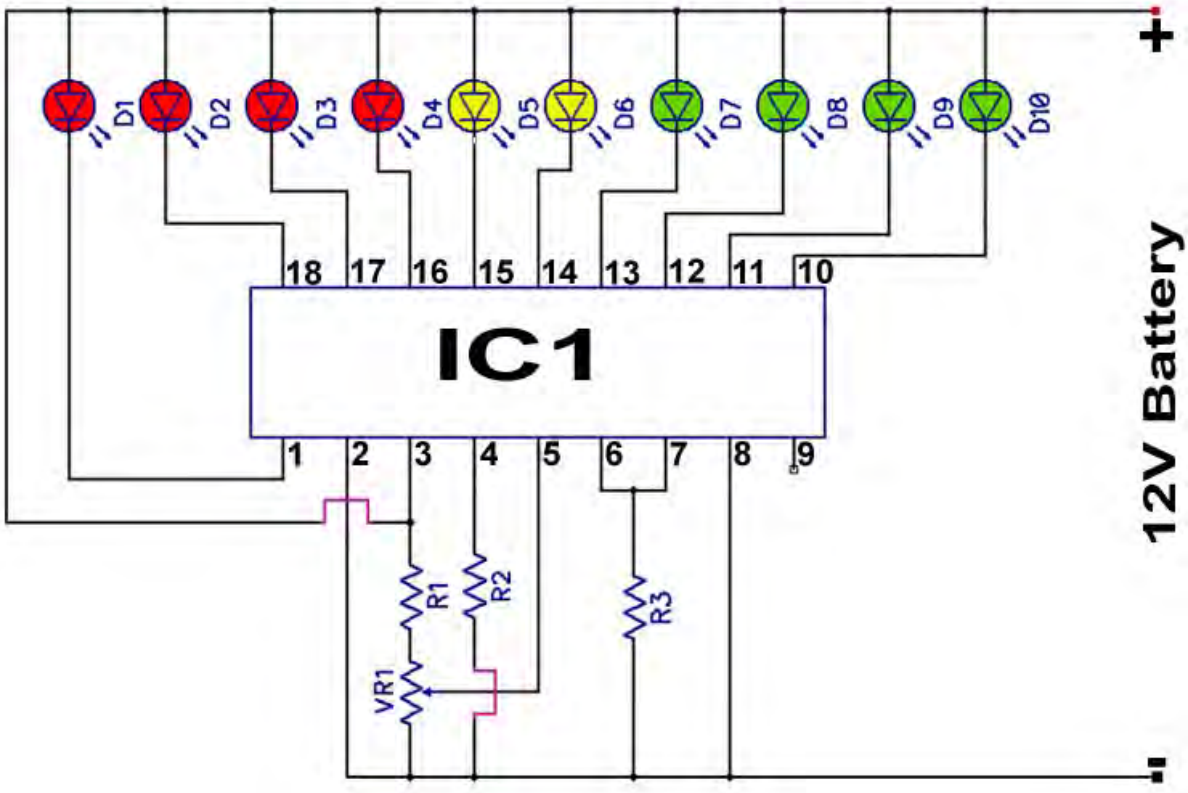


(Solar cell)

Battery Monitoring

The battery monitoring circuit will be connected to the battery to check its status, if the battery is fully charged (12V) the D10 will turn on, if not one of the LEDs will turn on depending on the level of the battery.





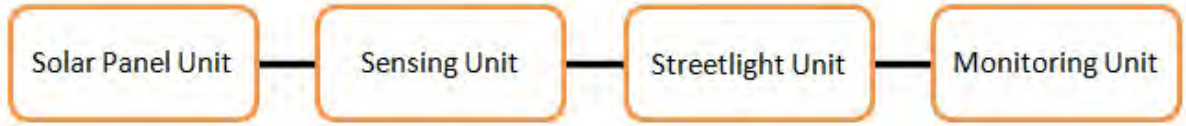
Chapter 3

Block Diagram

The inputs in the Sensor-Controlled Lighting System are light and motion sensors, after dusk the light sensor will activate the system to be ready to detect any movement (by motion sensors) on the road to turn on the streetlights. Solar panels unit, which is responsible of supplying the system with solar power by converting the sunlight into a direct DC current, and then charge the battery with it. (About Solar Energy)

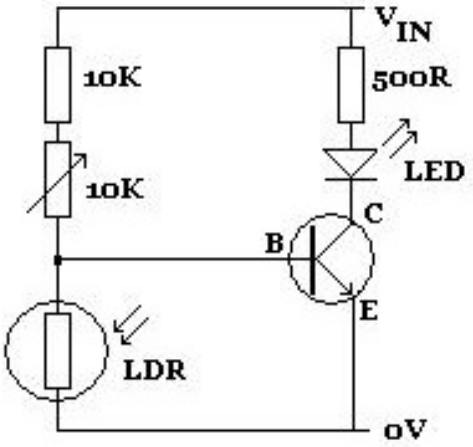
Also, the output is Monitoring unit, which is responsible of monitoring the battery life level.

LED (light emitting diode) will be used as streetlights in this project because of its high efficiency and long life span replacing the mercury vapor or high pressure sodium lamps with it.

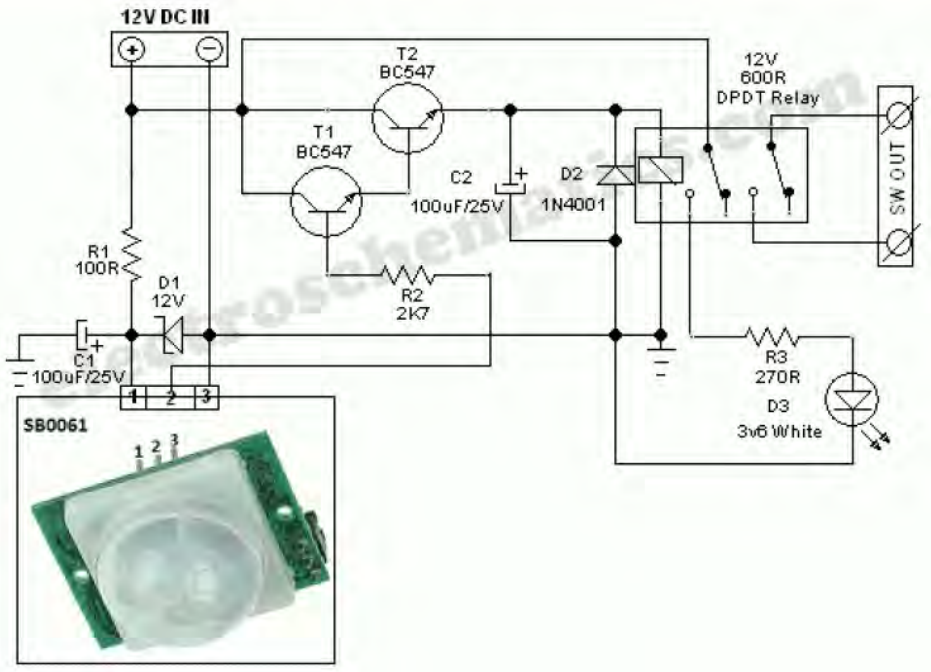


Circuits and Components

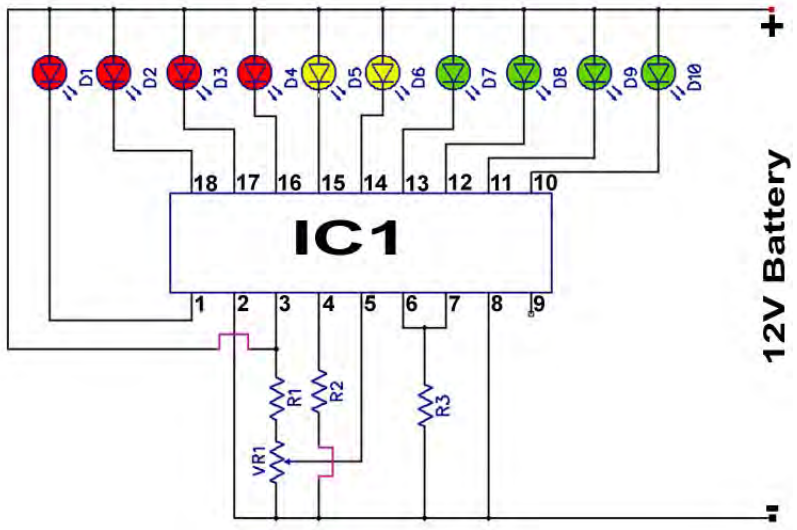
LDR Light Sensor



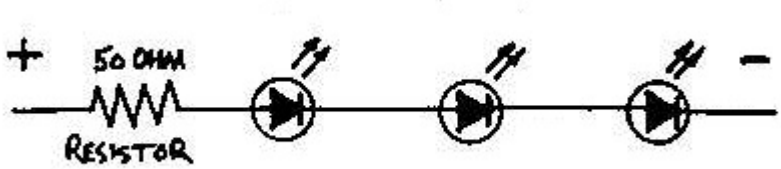
PIR Motion Detector



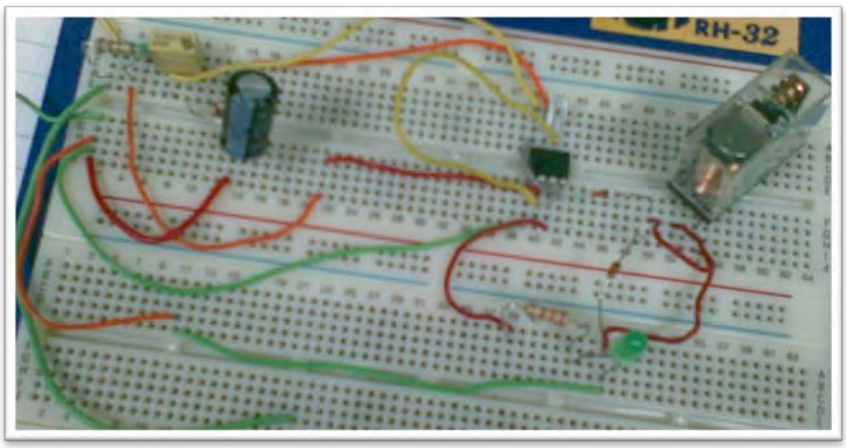
Battery Monitoring



LED Circuit



Relay Timer Circuit



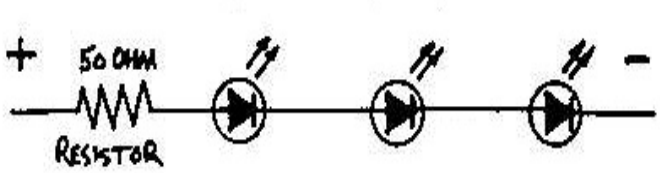
The relay timer circuit have been added to delay the turning off of the LED streetlights

Component list attached in appendix (B)

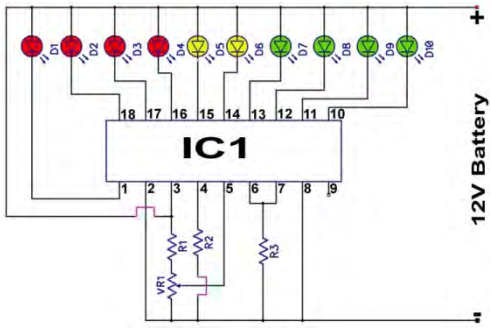
Chapter 4

Testing and Troubleshooting

LED streetlight circuit, the plan was to make one row of three LEDs connected in series, but it did not work because we applied a 5V to it when it needs 12V to work. The problem was that I used the wrong pins from the power supply.

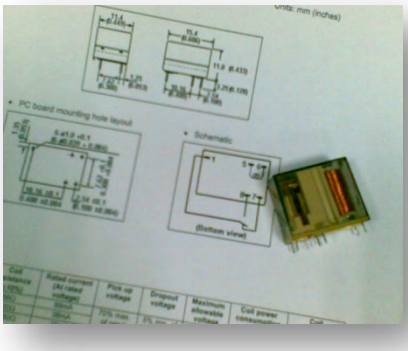


Battery monitoring circuit, the circuit needed a lot of wiring and there were problems with putting the wires in the right holes. Then with following the diagram after installing all the components I found out what caused the problem.



LDR light sensor circuit, there was a problem with the LDR, it was turning on the LED with 5V instead of 12V, this was with using 10kΩ. Then I used 100KΩ and the LED was dim until it reached 9V.

Relay Timer Circuit, all the connections were right, but I did not know how to use the relay 12v then I searched for its datasheet to know its terminals and how to connect them.



Chapter 5

Assessment of Project Goals

The project aims to reduce the side effects of the current street lighting system, and find a solution for fossil fuel future extinction by replacing it with solar power which is a renewable source of power. Also, to increase safety on the roads by increasing

Learning

During the year I have gained a lot of knowledge and skills. I learned how to manage my time, create a plan to reach my goals. Also, I had the chance to apply what I have learned during my education, to work with component, search, test and troubleshooting.

To add on, I worked on Multisim software for building, testing and troubleshooting my circuits, and it was a very useful program.

Future Changes

For enhance this project I am thinking of adding a wireless circuit that sends the information from the battery monitoring to a monitoring board which should be away from each other to make a communication between an internal and external parts of the project.

Moreover, Illumination monitoring can be added but it is a huge challenge and it needs a full time research, this can be added to monitor LED streetlight illumination level and it can be send to the monitoring board via the transmission medium.

Summary

There were a lot of problems with ordering equipments, and the procedure was very long and it takes at least 2 days to receive the order. Also, there are many types of equipment that they are not available in the college, despite of submitting the component list the college did not provide us with.

Also, all the work has been recorded in the log book from first and second semesters.

Student Name: ……

Student Signature: ……

Submission Date: 5th June 2011

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City Cuts Energy Use, CO2 Emissions with LonWorks® Network. (n.d.). Retrieved from ECHELON: http://www.echelon.com/solutions/streetlight/appstories/MiltonKeynes.htm

Photocells a.k.a CdS cells, photoresistors, LDR . (n.d.). Retrieved from adafruit: http://www.adafruit.com/blog/2009/05/21/photocells-aka-cds-cells-photoresistors-ldr-light-dependent-resistor/

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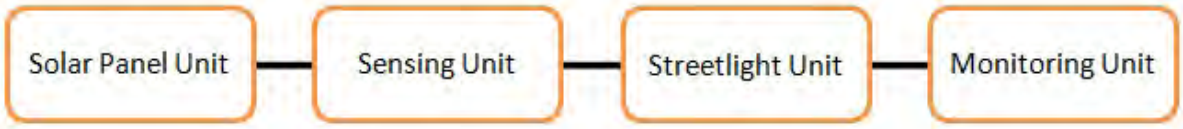
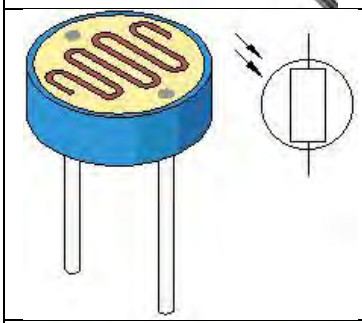
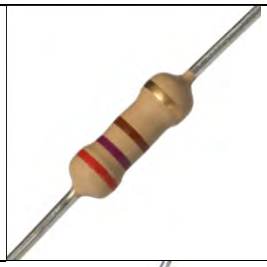
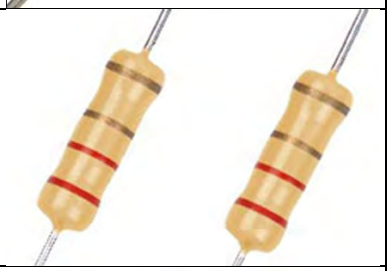
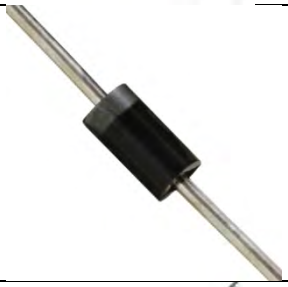
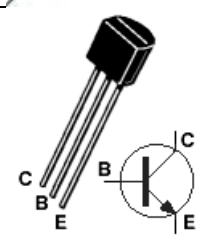
Appendices

Appendix A (Block Diagram)

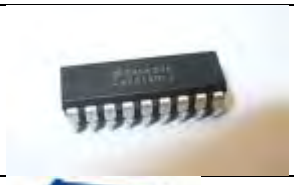


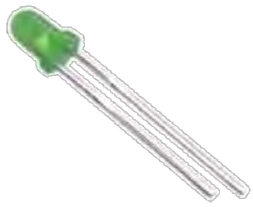
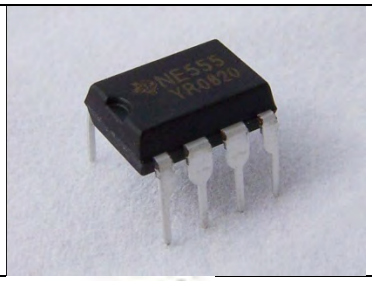
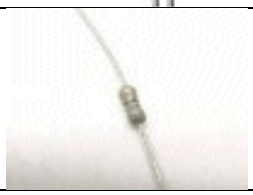
Appendix B (Component list)

Component Picture	Quantity	Component Name	Value/Model	In what circuit
	1	variable resistor	10K	Light Sense Circuit
	1	LED	5mm 30 mA/1.7-2.1V	Light Sense Circuit
	2	standard resistor	10K	Light Sense Circuit
	1	LDR		Light Sense Circuit
	1	Resistor	100 ohm	PIR Motion Sensor Circuit

	1	Resistor	270 ohm	PIR Motion Sensor Circuit
	1	Resistor	2 ohm	PIR Motion Sensor Circuit
	1	DPDT RELAY	HJR1 2C 24V DPDT 24V 2A	PIR Motion Sensor Circuit
	2	Capacitor	25V\100UF	PIR Motion Sensor Circuit
	1	Diode	25V\1N4001	PIR Motion Sensor Circuit
	1	zinner diode	12V	PIR Motion Sensor Circuit
	2	Transistor	BC547-NPN	PIR Motion Sensor Circuit

	1	LED	5mm 20mA/2.8-3.4V	PIR Motion Sensor Circuit
	1	Resistor	56kΩ	Battery Monitoring Circuit
	1	Resistor	18kΩ	Battery Monitoring Circuit
	1	Resistor	3.9kΩ	Battery Monitoring Circuit
	1	Variable resistor	10k Preset	Battery Monitoring Circuit
	4	LED	5mm 30 mA/1.7-2.1V	Battery Monitoring Circuit
	2	LED	5mm 30mA/2.1-2.5V	Battery Monitoring Circuit

	4	LED	5mm 25mA/2.2-2.5V	Battery Monitoring Circuit
	1	Micro controller	LM3914	Battery Monitoring Circuit
	1	Variable Resistor	100K	Relay Timer Circuit
	2	Resistor	1K	Relay Timer Circuit
	2	Diode	1N914	Relay Timer Circuit
	1	Resistor	220 ohm	Relay Timer Circuit
	1	Electrolytic Capacitor	470µF	Relay Timer Circuit

	1	LED	5mm 25mA/2.2-2.5V	Relay Timer Circuit
	1	Bipolar Timer	NE555	Relay Timer Circuit
	1	SPDT Relay	12V	Relay Timer Circuit
	2	LED	5mm 30mA/2.1-2.5V	Street-light Circuit
	1	Resistor	50 ohm	Street-light Circuit

Appendix C (Datasheet)