ENERGY SAVING SYSTEM FOR PUBLIC LIGHTING

AND

RESIDENTIAL VILLAGES USING COMBINATION OF SENSORS

By

SAPAR YULDASHOV

FINAL PROJECT REPORT

Submitted to the Department of Electrical & Electronic Engineering
in Partial Fulfillment of the Requirements
for the Degree
Bachelor of Engineering (Hons)
(Electrical & Electronic Engineering)

Universiti Teknologi PETRONAS

Bandar Seri Iskandar

31750 Tronoh

Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

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Approved:

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Dr. Mohamad Naufal Bin Mohamad Saad

Project Supervisor

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

May 2012

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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Sapar Yuldashov

ABSTRACT

The world electrical energy consumption statistics shows that consumption of electricity is growing gradually each year, and more over the rates are also increasing, because of increasing in prices of natural gas and oil, which are the major raw materials for production of electricity. Since raw materials are not infinite, world is looking for alternative source of energy, and while researches are being done in order to bring consumption of electricity to minimum level in Universiti Teknologi Petronas residential villages new combination of sensors based system needed to be applied.

The purpose of this project is to show the efficiency of a new system, which is going to save more electrical energy. Motion and light sensors are main devices which are going to be involved in this project. A standard 40 watt fluorescent lamp consumes electricity per month is around 10 ringgits when it is turned on. Here in UTP there are several blocks in each village. Let’s say 50% of one block left lights of corridor and lights in stairs turned on during day time, which will mean for those 50% of lighting electricity will be wasted. Using motion and light sensor based switches for lighting in places such as corridors, stairs and rest rooms the electrical energy will be used just as much as it’s needed. This means normal switches are going to be fully automated, so that there will be no need to switch lights on and off manually, as a result the system will be consuming only when it is dark and when motion is detected, which means the system will not be operating during day time in respective areas.

ACKNOWLEDGEMENTS

Praise to Allah for His guidance and blessings He has given me throughout this Final Year Project. It's the strength from Him that is what keeps us going in everything we do in our lives. My greatest appreciation goes to my supervisor, Dr. Mohamad Naufal Bin Mohamad Saad for giving me such tremendous helps, advices, opinions and courage all the way through the completion of this project. I appreciate the time he allocates for me, to sit and discuss the problems I've faced along the way. A million thanks to him for having such confidence in me.

Special thanks to my parents for the continuous support and courage they gave me, which always drives me to keep on going whenever I fall. Last but not least, I also want to thank everybody who have involved directly and indirectly in helping me along this project. Thanks again to all, your kindness and helps will always be remembered.

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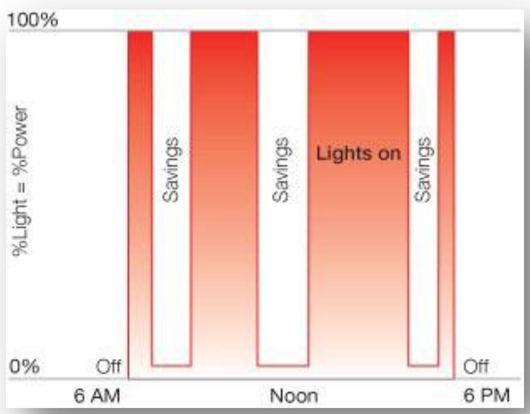
CHAPTER 1

3. INTRODUCTION

PIR (motion) sensors are usually used in indoor areas to control lighting of inside area. When no motion is detected, the system gives signal that the space is not occupied, and thus does not need to be lit. In such circumstances turning off the lights can save considerable amounts of energy. The sensor and its field of view of must be cautiously selected or attuned so that it responds just to motion in the space which is served by the controlled lighting. As an example, occupancy sensor controlling lights in residence should not detect motion outside the block. Placement of the sensors are never perfect, therefore generally systems add in a time stoppage before switching. This stoppage time is regularly user-selectable, but a usual default value is 15 minutes. This means that no motion must be detected by sensor for the entire time delay before the lamps are switched. Generally systems switches off lights at the end of the time delay, but more complicated systems with dimming capability reduce lighting slowly to a least amount level (or zero) over several minutes, to minimize the possible disruption in closest spaces. In case when lights are off and a resident re-enters a space, mainly contemporary systems switch on the lights again when motion is detected.

3.1 Background Study:

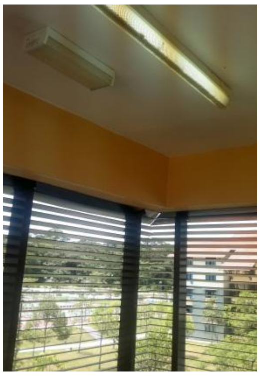


Sensor Technologies: Presence or absence of person is detected by occupancy sensors, using combination of several methods. The largely well known methods are ultrasonic and PIR (passive infrared). Both methods has their advantages and disadvantages that makes them more suitable for some applications than others.

***P*IR Occupancy Sensors**: The heat emitted by humans in motion and the difference from the background space is sensed by PIR occupancy sensors. The motion is being detected by this sensors within a area of view that requires a line of sight, any obstacles will prevent detection.

The sensor's lens detects its coverage area as a series of fan-shaped coverage zones, with short gaps in between, and is mainly sensitive to motion that occurs in between each zone. Gaps between these zones become wider the farther one is from the sensor, which effects in less sensitivity proportional to distance and can result in nuisance switching-off.

3.2 Problem Statement



There are numbers of residential villages in UTP which are being used by hundreds of students. One of the annual expenses of villages is electricity, which is usually being misused by its residents. If we take a

walk during the day time, even at that time there can be seen many fluorescent lamps and sealing fans in kitchens are on, which means the waste of energy. Considering that TNB rates are increasing, useless expenses will also increase as long as the grid electricity will be used. The major factor of electrical energy waste is the way of its usage by residents inappropriately, meaning that light switches for stairs and corridors of residential blocks are being left on, because some students forget to switch them off during day time when no lights are needed. Electricity consumption for one standard fluorescent lamp for one month is around 10 ringgits, in one block of village 5 there are five stairs and five levels, in each level and in between levels there are one fluorescent lamp, totally in one village 5 block there are 40 lamps placed for public lighting. The main problem is that some residents forget to turn them off in the morning, and even at night time there is no need for lights to be on unless someone is going down or up from the stairs.

Below are the rates of Tenaga Nasional Berhad:

TARIFF CATEGORY	UNIT	RATES (MYR)
Tariff A - Domestic Tariff		
For the first 200 kWh (1 - 200 kWh) per month	*sen/kWh*	*21.8*
For the next 100 kWh (201 - 300 kWh) per month	*sen/kWh*	*33.4*
For the next 100 kWh (301 - 400 kWh) per month	*sen/kWh*	*40.0*
For the first 100kWh (401 - 500 kWh) per month	*sen/kWh*	*40.2*
For the next 100 kWh (501 - 600 kWh) per month	*sen/kWh*	*41.6*

For the next 100 kWh (601 - 700 kWh) per month	*sen/kWh*	*42.6*
For the next 100 kWh (701 - 800 kWh) per month	*sen/kWh*	*43.7*
For the next 100 kWh (801 - 900 kWh) per month	*sen/kWh*	*45.3*
For the next kWh (901 kWh onwards) per month	*sen/kWh*	*45.4*

The minimum monthly charge is RM3.00

3.3 Objectives

1. To analyze the current system of public lighting in UTP, residential villages
2. Figure out solution to make the current system for public lighting in UTP more efficient in electrical energy usage
3. Choose appropriate sensors to replace current switches of public lighting in UTP
4. To combine sensors, for making necessary automated switch
5. To choose right place for placing sensor based switches

3.4 Scope of study

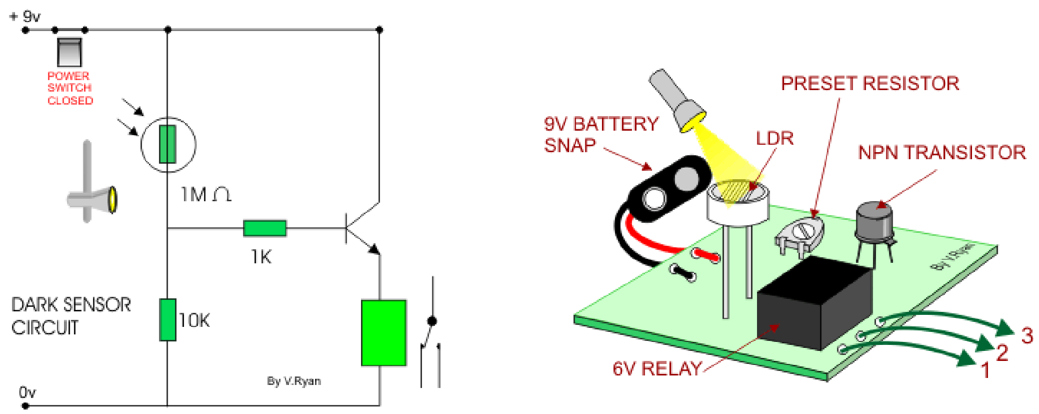
This project will focus on reducing the usage of electrical energy in UTP residential villages, by using the combination of sensors. Light sensor will be combined with motion sensor through the logical gate AND to construct automated switch which will be operating fully automatically, switching lights on and off in stairs and corridors of respective villages to increase efficiency for electrical energy usage.

CHAPTER 2

4. LITERATURE REVIEW

4.1 Light sensor

A light sensors will sense the light and send a signal to AND logic gate, which is going to be one of the inputs of that gate. Construction of light sensor is shown in picture below.



(4.1.0 - Construction of light sensor circuitry)

This circuit can be redesigned in such a way, that it can become light sensor or dark sensor. But in current research paper we need the device to detect the light.

4.2 Motion sensor switch

Motion sensor switches are very effective in conserving electricity especially if the main problem is remembering to turn off the lights when leaving a room or house. Such switches mostly suitable for low traffic areas like restrooms, basement or corridors but can be used nearly anywhere you wish to implement the switch. On detecting vacancy, the sensors switch-off the lights. When presence detected, automatically switches lights on.

A field study done by National Research Council Canada In 2004, 33% of the total energy accounted for Canadian office buildings used by the commercial/institutional sector, with lighting accounting for 10% of the total building energy use, and 24% of the electricity use (National Research Council Canada 2006). Several research studies have generated promising results suggesting that electrical energy use can be substantially reduced by using lighting control systems such as daylight-linked dimming and occupancy sensors. Individual (personal) dimming controls have also been shown to reduce energy use, while increasing occupant satisfaction.

4.3 Lumex LED

One more way to make light usage efficient is using LED (Light emitting diode). Comparing present fluorescent light bulbs and LED bulbs, conducted tests shows that LED bulbs uses at least 50% less power than current luminous light bulbs, but this newly found efficient light bulbs are quite expensive to replace present fluorescent bulbs, and LED light bulbs luminosity is a bit less than the present fluorescent light bulbs.

Each of this LED light bulbs are costing in average RM 40. So for the time being since this kind of efficient light bulbs are still being developed, we can still reduce usage of electrical power by using the combination of sensors which are motion and light sensors. Several lamps can be controlled by single sensor and prices are less than the LED light bulbs.

CHAPTER 3

5. METHODOLOGY

As our objective is to save electrical energy for residential villages the ordinary motion sensors will be modified so that lights going to be provided at a right time. Usual motion sensor switches are to switch the lights on/off. In order to make our system more efficient and automated, an auxiliary light sensor will be combined with motion sensor. There will be several steps to accomplish the whole energy saving system for public lighting areas.

1 - Design the flowchart and truth table

2 - Construction of light sensor circuit

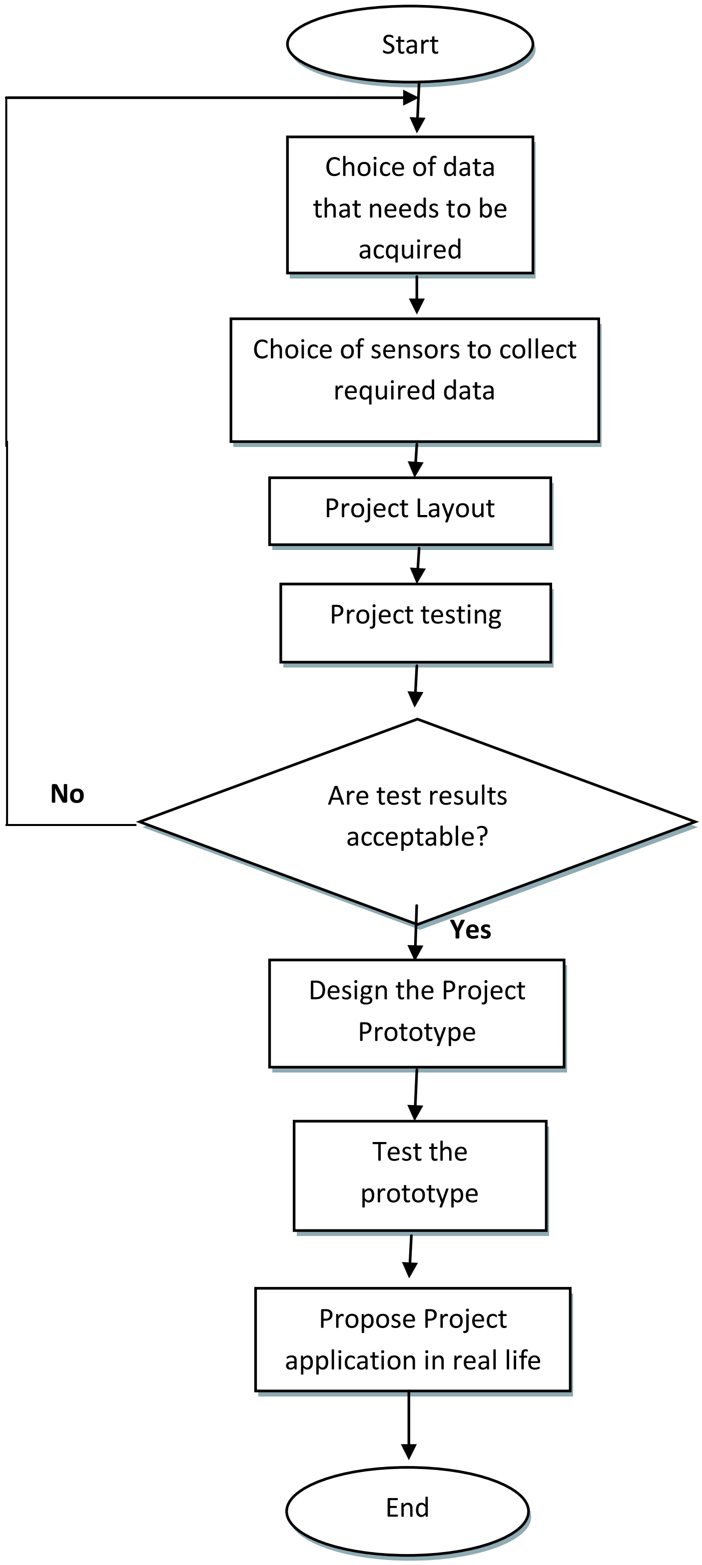
3 - Choosing suitable motion sensor switch

4 - Analyzing current wiring for lamps

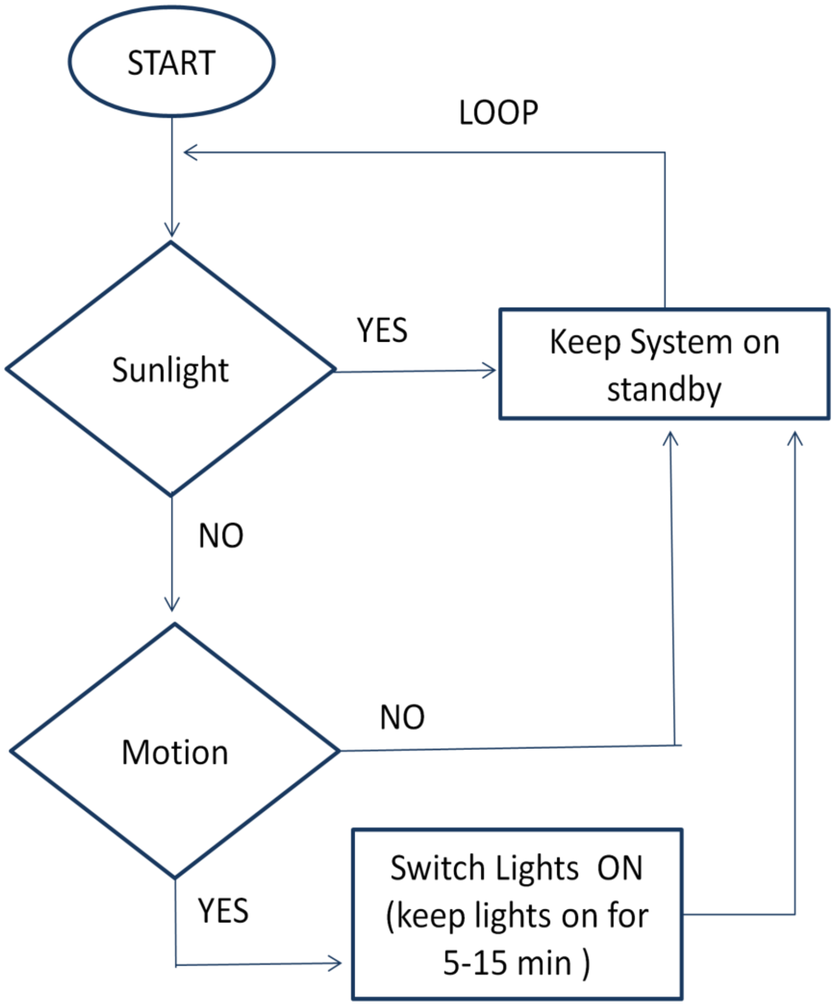
5 - Decision on placement of sensors

6 - Application

5.1 Designing the flowchart for project, for system and truth table:



(flowchart of the project 5.1.1)



(flowchart for system 5.1.2)

TRUTH TABLE FOR A AND B INPUTS

A \ B	0	1
0	0	0
1	0	1

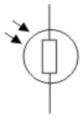
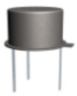
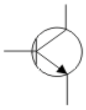
(Truth table for system 5.1.3)

- From the table above we can see that lamps will be on only when both conditions are reached, which are motion and no sunlight conditions.

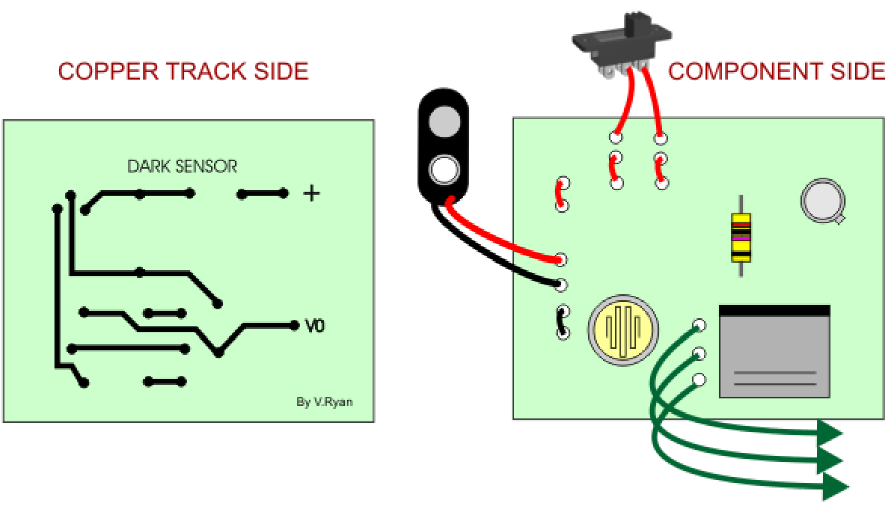
5.2 Construction of a light sensor:

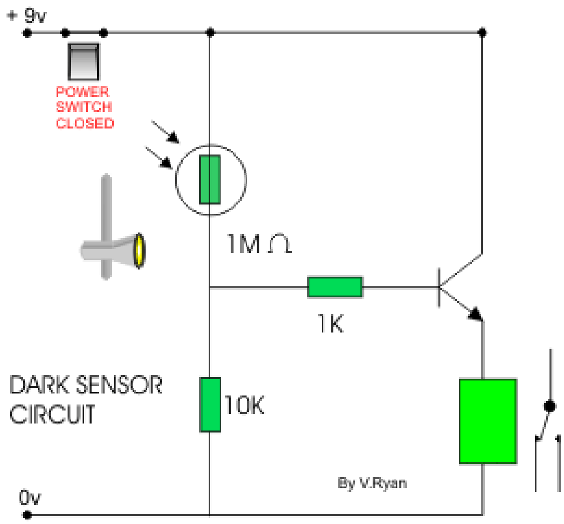
The overall system is going to be designed in such way that priority of activation of system is going to be dependent on light sensor, because we need the system to be turned off during day light.

Components used in construction of light sensor circuitry:

PICTURE	SYMBOL	COMPONENT	DETAILS
		RELAY	
		RESISTOR	
		LIGHT DEPENDENT RESISTOR (LDR)	
		TRANSISTOR	
		SWITCH	

(components for light/dark sensor circuit 5.2.1)





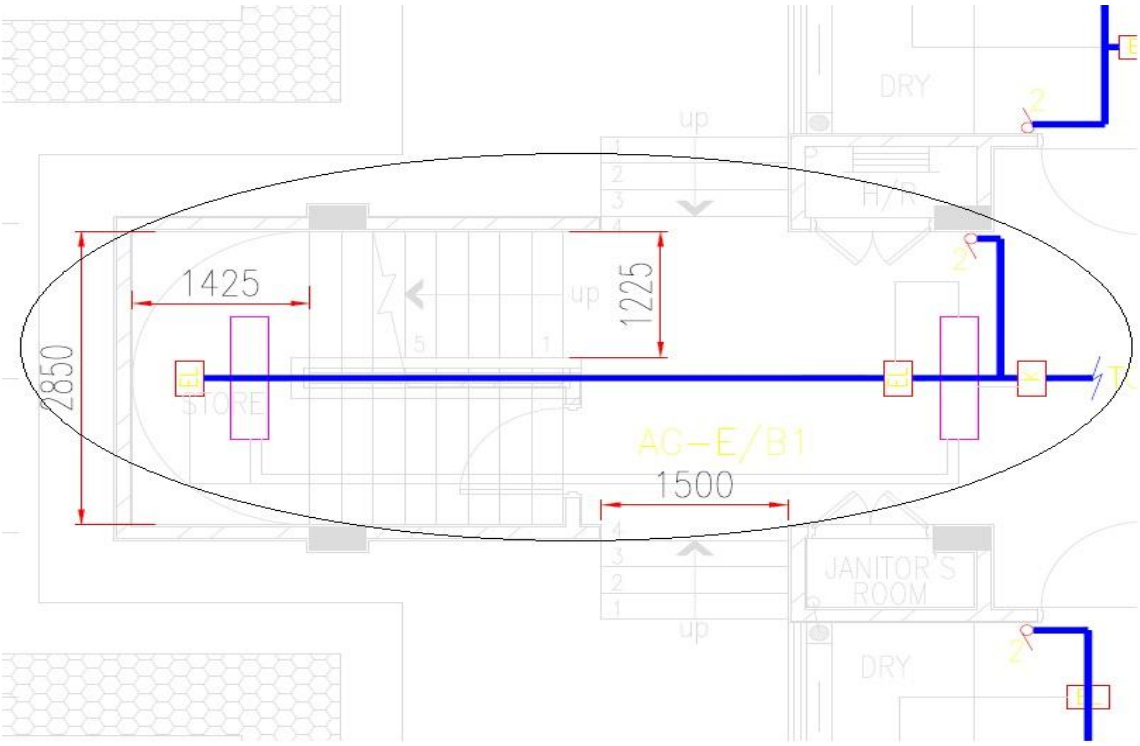
(Light/dark sensor circuitry 5.2.2)

5.3 Choosing suitable motion sensor :

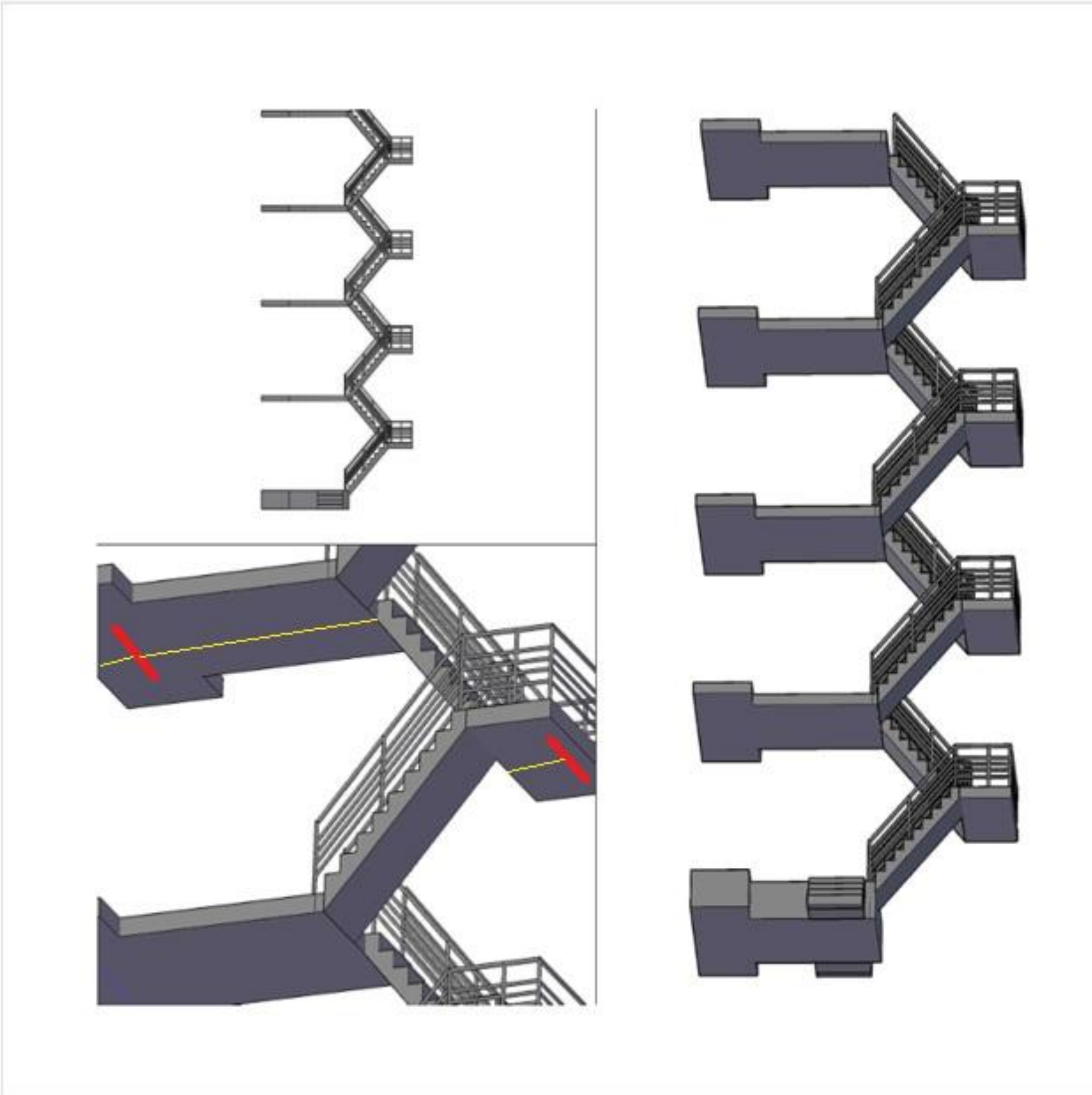
As we can see from the picture below (Village 5 block E, stairs), we choose the wall mount type, PIR motion sensor, the reason is to cancel interruption of unrelated motions which will be provided by a person passing near by the stairs, and on following levels this type of motion sensor will be more efficient to use because it will be directed to sides of the entrance of stairs.

(pictures of V5E stairs 5.3.1)

5.4 Analyzing current wiring for lamps:

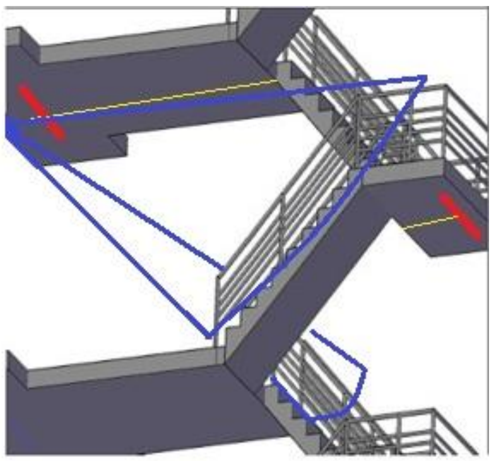


(wiring of lamps for the stairs in V5 hostels 5.4.1)



(interconnection between lamps 5.4.2)

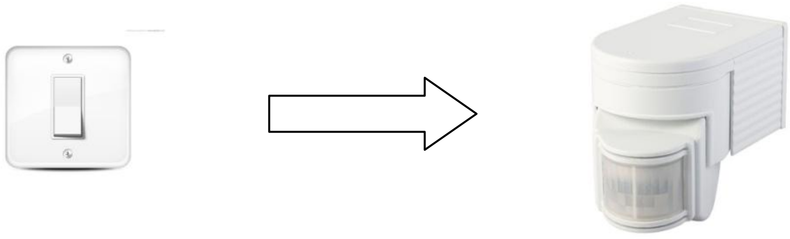
5.5 Decision on placement of sensors



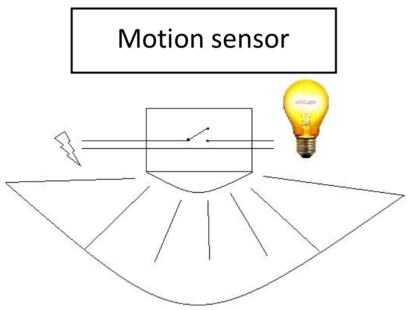
Nevertheless according to research done for perfect placement of motion sensor, ended up with the result that placement of motion sensor is never perfect. So for this project motion sensors will be placed on maximum efficient areas, such as stairs and corridors where the motion occurs the most in the hostel.

5.5.1 Connection of a motion sensor with lamps

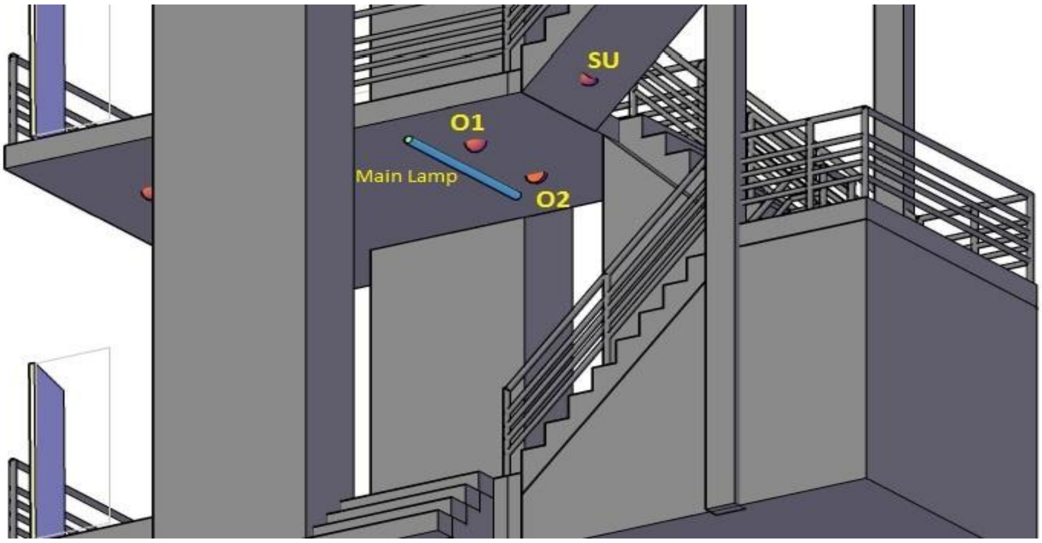
After deciding on placement of a motion sensor, now it is necessary to plan on connection of it with lamps so that lights will be controlled by sensor, meaning the current manual switches will be replaced with sensors.



In the current wiring system, switches will be removed and wires will be connected as if there were no switch, then in the loop of wiring between power supply and lamps, motion sensor will be plugged into the new wiring system.



5.5.2 Analyzing the various scenarios by floors



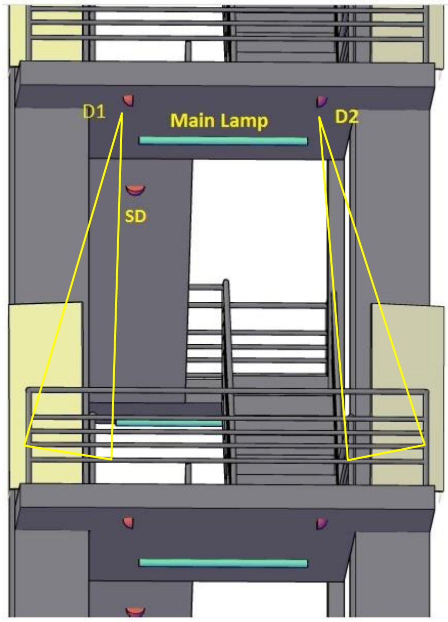
(figure 5.5.2.0 - Labelling of sensors and main lamp for ground level)

FLOOR	SENSORS						MAIN LAMP		LAMPS				Light sensor	
	O1	O2	D1	D2	SU	SD			STAIRS UP		STAIRS DOWN		Yes	No
GROUND	0	0	1	0	1		ML0	1	SL1	1			0	1
GROUND	0	0	0	1	1		ML0	1	SL1	1			0	1
GROUND	1	0	1	0	0		ML0	1	SL1	0			0	1
GROUND	0	1	1	0	0		ML0	1	SL1	0			0	1
GROUND	1	0	0	1	0		ML0	1	SL1	0			0	1
GROUND	0	1	0	1	0		ML0	1	SL1	0			0	1
GROUND	1	0	0	0	1		ML0	1	SL1	1			0	1
GROUND	0	1	0	0	1		ML0	1	SL1	1			0	1
GROUND	0	0	1	0	1		ML0	0	SL1	0			1	0
GROUND	1	0	0	1	0		ML0	0	SL1	0			1	0

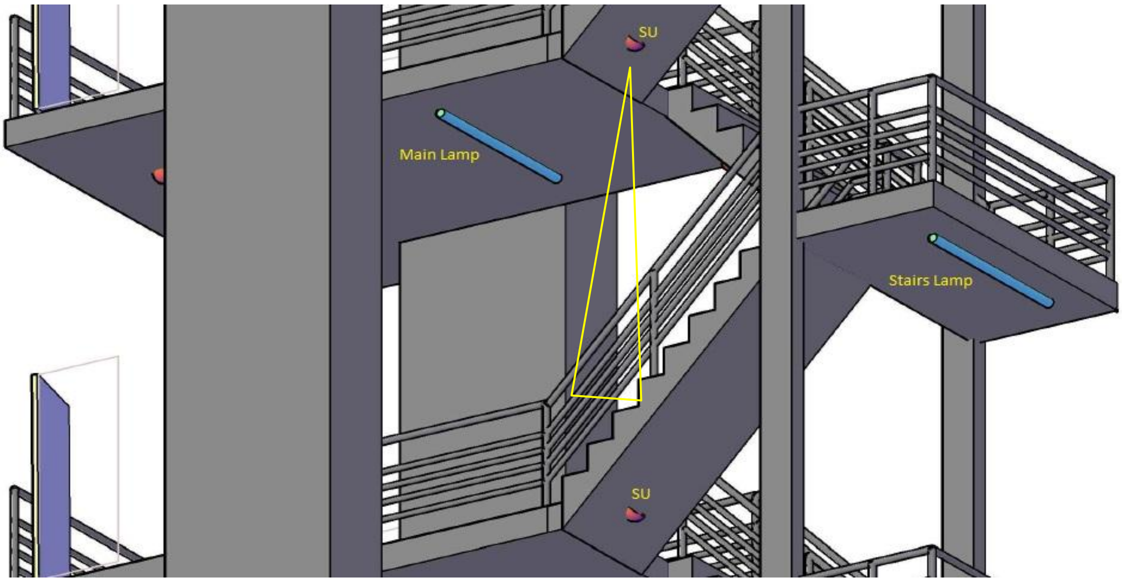
(Table 5.5.2.0 - analysis of ground floor)

In the table above we can see several labelled sensors for ground level such as out 1 and 2 (**O1/2**), door 1 and 2 (**D1/2**), stairs up (**SU**) and stairs down (**SD**). When any of sensors will detect the motion, signal will indicate digital 1, else it will be digital 0 which means opposite, no motion. **ML0** is main lamp for ground level and **SL1** is the lamp in between ground level and level 1, this lamps will respond to the combined signal from motion and light sensors. 1 will be indicating lights on and 0 will show that lamp is switched off. Light sensor will be giving information about light, and control whole the system. When there is light, sensor will turn off the motion sensor switch, and turn on the system when it is dark outside, so that lamps will be switched on when there is motion detected. Comparing gray cells with normal we can approximate efficiency. Red cells are items which are not existing for respective floor.

Lets analyse first row. O1 and O2 are 0 which means nobody is entering from there, since D1 is 1 so we know that somebody comes out from door 1 and goes to stairs up, because SU is also 1, so in this case our main lamp MLO and stairs lamp SL1 will be switched on.



(figure 5.5.2.1 - Labelling of sensors and main lamp for 1st floor)



(figure 5.5.2.2 - Labelling of stairs lamp)

FLOOR	SENSORS						MAIN LAPMS		STAIRS UP		STAIRS DOWN		Sunlight	
	O1	O2	D1	D2	SU	SD							Yes	No
1			1	0	1	0	ML1	1	SL2	1	SL1	0	0	1
1			1	0	0	1	ML1	1	SL2	0	SL1	1	0	1
1			0	1	1	0	ML1	1	SL2	1	SL1	0	0	1
1			0	1	0	1	ML1	1	SL2	0	SL1	1	0	1
1			1	1	0	0	ML1	1	SL2	0	SL1	0	0	1
1			1	0	1	0	ML1	0	SL2	0	SL1	0	1	0
1			1	0	0	1	ML1	0	SL2	0	SL1	0	1	0
1			1	1	0	0	ML1	0	SL2	0	SL1	0	1	0
1			0	0	1	1	ML1	0	SL2	0	SL1	0	1	0
1			0	1	1	0	ML1	0	SL2	0	SL1	0	1	0

(Table 5.5.2.1 - analysis of 1st floor)

For the table above, since there is no out 1 and out 2 we do not consider O1 and O2 sensors for this level.

FLOOR	SENSORS						MAIN LAPMS		STAIRS UP		STAIRS DOWN		Sunlight	
	O1	O2	D1	D2	SU	SD							Yes	No
2			1	0	1	0	ML2	1	SL3	1	SL2	0	0	1
2			1	0	0	1	ML2	1	SL3	0	SL2	1	0	1
2			0	1	1	0	ML2	1	SL3	1	SL2	0	0	1
2			0	1	0	1	ML2	1	SL3	0	SL2	1	0	1
2			1	1	0	0	ML2	1	SL3	0	SL2	0	0	1
2			1	0	1	0	ML2	0	SL3	0	SL2	0	1	0
2			1	0	0	1	ML2	0	SL3	0	SL2	0	1	0
2			1	1	0	0	ML2	0	SL3	0	SL2	0	1	0
2			0	1	0	1	ML2	0	SL3	0	SL2	0	1	0
2			0	1	1	0	ML2	0	SL3	0	SL2	0	1	0

(Table 5.5.2.2 - analysis of 2nd floor)

FLOOR	SENSORS						MAIN LAPMS		STAIRS UP		STAIRS DOWN		Sunlight	
	O1	O2	D1	D2	SU	SD							Yes	No
3			1	0	1	0	ML3	1	SL3	1	SL2	0	0	1
3			1	0	0	1	ML3	1	SL4	0	SL3	1	0	1
3			0	1	1	0	ML3	1	SL4	1	SL3	0	0	1
3			0	1	0	1	ML3	1	SL4	0	SL3	1	0	1
3			1	1	0	0	ML3	1	SL4	0	SL3	0	0	1
3			1	0	1	0	ML3	0	SL4	0	SL3	0	1	0
3			1	0	0	1	ML3	0	SL4	0	SL3	0	1	0
3			1	1	0	0	ML3	0	SL4	0	SL3	0	1	0
3			0	1	0	1	ML3	0	SL4	0	SL3	0	1	0
3			0	1	1	0	ML3	0	SL4	0	SL3	0	1	0

(Table 5.5.2.3 - analysis of 3rd floor)

FLOOR	O1	O2	D1	D2	SU	SD	MAIN LAPMS		STAIRS UP		STAIRS DOWN		Sunlight	
													Yes	No
4			1	0		0	ML4	1			SL4	0	1	1
4			1	0		1	ML4	1			SL4	1	1	1
4			0	1		0	ML4	1			SL4	0	1	1
4			0	1		1	ML4	1			SL4	1	1	1
4			1	1		0	ML4	1			SL4	0	1	1
4			1	0		0	ML4	0			SL4	0	1	1
4			1	0		1	ML4	0			SL4	0	1	1
4			0	1		0	ML4	0			SL4	0	1	1
4			0	1		1	ML4	0			SL4	0	1	1
4			1	1		0	ML4	0			SL4	0	1	1

(Table 5.5.2.4 - analysis of 4th floor)

5.5.3 More detailed analysis by floors in order to increase efficiency

FLOOR	SENSORS						MAIN LAPMS		LAMPS				Sunlight
	O1	O2	D1	D2	SU	SD			STAIRS UP		STAIRS DOWN		
1			01				ML	1	SL	0	SL	0	0
					10		ML	0	SL	1	SL	0	0
1					01		ML	1	SL	1	SL	0	0
						10	ML	0	SL	0	SL	1	0
1					01		ML	1	SL	1	SL	0	0
			10				ML	0	SL	0	SL	0	0
1			01				ML	1	SL	0	SL	0	0
				10			ML	0	SL	0	SL	0	0
1						01	ML	1	SL	0	SL	1	0
					10		ML	0	SL	1	SL	0	0
1			01				ML	0	SL	0	SL	0	1
					10		ML	0	SL	0	SL	0	1
1					01		ML	0	SL	0	SL	0	1
						10	ML	0	SL	0	SL	0	1
1					01		ML	0	SL	0	SL	0	1
			10				ML	0	SL	0	SL	0	1
1			01				ML	0	SL	0	SL	0	1
				10			ML	0	SL	0	SL	0	1
1						01	ML	0	SL	0	SL	0	1
					10		ML	0	SL	0	SL	0	1

(Table 5.5.3.0 - detailed analysis of 1st floor)

FLOOR	SENSORS						MAIN LAPMS		LAMPS				Sunlight
	O1	O2	D1	D2	SU	SD			STAIRS UP		STAIRS DOWN		
2			01				ML	1	SL	0	SL	0	0
					10		ML	0	SL	1	SL	0	0
2					01		ML	1	SL	1	SL	0	0
						10	ML	0	SL	0	SL	1	0
2					01		ML	1	SL	1	SL	0	0
			10				ML	0	SL	0	SL	0	0
2			01				ML	1	SL	0	SL	0	0
				10			ML	0	SL	0	SL	0	0
2						01	ML	1	SL	0	SL	1	0
					10		ML	0	SL	1	SL	0	0
2			01				ML	0	SL	0	SL	0	1
					10		ML	0	SL	0	SL	0	1
2					01		ML	0	SL	0	SL	0	1
						10	ML	0	SL	0	SL	0	1
2					01		ML	0	SL	0	SL	0	1
			10				ML	0	SL	0	SL	0	1
2			01				ML	0	SL	0	SL	0	1
				10			ML	0	SL	0	SL	0	1
2						01	ML	0	SL	0	SL	0	1
					10		ML	0	SL	0	SL	0	1

(Table 5.5.3.1 - detailed analysis of 2nd floor)

FLOOR	SENSORS						MAIN LAPMS		LAMPS				Sunlight
	O1	O2	D1	D2	SU	SD			STAIRS UP		STAIRS DOWN		
3			01				ML	1	SL	0	SL	0	0
					10		ML	0	SL	1	SL	0	0
3					01		ML	1	SL	1	SL	0	0
						10	ML	0	SL	0	SL	1	0
3					01		ML	1	SL	1	SL	0	0
			10				ML	0	SL	0	SL	0	0
3			01				ML	1	SL	0	SL	0	0
				10			ML	0	SL	0	SL	0	0
3						01	ML	1	SL	0	SL	1	0
					10		ML	0	SL	1	SL	0	0
3			01				ML	0	SL	0	SL	0	1
					10		ML	0	SL	0	SL	0	1
3					01		ML	0	SL	0	SL	0	1
						10	ML	0	SL	0	SL	0	1
3					01		ML	0	SL	0	SL	0	1
			10				ML	0	SL	0	SL	0	1
3			01				ML	0	SL	0	SL	0	1
				10			ML	0	SL	0	SL	0	1
3						01	ML	0	SL	0	SL	0	1
					10		ML	0	SL	0	SL	0	1

(Table 5.5.3.2 - detailed analysis of 3rd floor)

FLOOR	SENSORS						MAIN LAPMS		LAMPS				Sunlight
	O1	O2	D1	D2	SU	SD			STAIRS UP		STAIRS DOWN		
Ground			01				ML	1	SL	0	SL		0
					10		ML	0	SL	1	SL		0
Ground					01		ML	1	SL	1	SL		0
		10					ML	0	SL	0	SL		0
Ground					01		ML	1	SL	1	SL		0
			10				ML	0	SL	0	SL		0
Ground			01				ML	1	SL	0	SL		0
				10			ML	0	SL	0	SL		0
Ground	01						ML	1	SL	0	SL		0
					10		ML	0	SL	1	SL		0
Ground			01				ML	0	SL	0	SL		1
					10		ML	0	SL	0	SL		1
Ground					01		ML	0	SL	0	SL		1
		10					ML	0	SL	0	SL		1
Ground					01		ML	0	SL	0	SL		1
			10				ML	0	SL	0	SL		1
Ground			01				ML	0	SL	0	SL		1
				10			ML	0	SL	0	SL		1
Ground	01						ML	0	SL	0	SL		1
					10		ML	0	SL	0	SL		1

(Table 5.5.3.3 - detailed analysis of ground floor)

FLOOR	SENSORS						MAIN LAPMS		LAMPS				Sunlight
	O1	O2	D1	D2	SU	SD			STAIRS UP		STAIRS DOWN		
4			01				ML	1	SL		SL	0	0
						10	ML	0	SL		SL	1	0
4						01	ML	0	SL		SL	1	0
				10			ML	1	SL		SL	0	0
4			01				ML	1	SL		SL	0	0
				10			ML	0	SL		SL	0	0
4			01				ML	0	SL		SL	0	1
						10	ML	0	SL		SL	0	1
4						01	ML	0	SL		SL	0	1
				10			ML	0	SL		SL	0	1
4			01				ML	0	SL		SL	0	1
				10			ML	0	SL		SL	0	1

(Table 5.5.3.4 - detailed analysis of 4th floor)

CHAPTER 4

RESULT AND DISCUSSION

Throughout the project several steps have been analyzed, like placement of the motion and light sensors. In this chapter we will see if we reached the objectives or not. In the beginning of the project the expected efficiency of power usage was at least 50% but looking at the table below we can see without mathematical calculations that efficiency is in the range of 70%-80%.

FLOOR	SENSORS						MAIN LAPMS		LAMPS				Sunlight
	O1	O2	D1	D2	SU	SD			STAIRS UP		STAIRS DOWN		
1			01				ML	1	SL	0	SL	0	0
					10		ML	0	SL	1	SL	0	0
1					01		ML	1	SL	1	SL	0	0
						10	ML	0	SL	0	SL	1	0
1					01		ML	1	SL	1	SL	0	0
			10				ML	0	SL	0	SL	0	0
1			01				ML	1	SL	0	SL	0	0
				10			ML	0	SL	0	SL	0	0
1						01	ML	1	SL	0	SL	1	0
					10		ML	0	SL	1	SL	0	0
1			01				ML	0	SL	0	SL	0	1
					10		ML	0	SL	0	SL	0	1
1					01		ML	0	SL	0	SL	0	1
						10	ML	0	SL	0	SL	0	1
1					01		ML	0	SL	0	SL	0	1
			10				ML	0	SL	0	SL	0	1
1			01				ML	0	SL	0	SL	0	1
				10			ML	0	SL	0	SL	0	1
1						01	ML	0	SL	0	SL	0	1
					10		ML	0	SL	0	SL	0	1

So we can say that our objectives are obtained and necessary efficiency reached.

CHAPTER 5

CONCLUSION

As our main objective is to make usage of electrical power for public lighting areas more efficient, we went through several steps like analyzing two ways of making efficient usage and compared them, which are LED light bulbs and combination of sensor switch. As a result we decided to use the second way which is sensor based switch, because of the economical reasons, efficiency of power usage is expected to be at least 70%.

Throughout methodology switch activation cases have been discussed, by using logic gate and truth table. As we can see from our project two unrelated sensors will be combined so that they will become a light switch which is going to turn lights on only when all conditions are fulfilled: 1 - when there is no sunlight, 2 - when there will be motion. The priority for light to turn ON/OFF will be given to light sensor, so that there will not be any waste of energy by using lights during daytime, and as a result the system will supply residents with just as much light as they need it, which removes all previous forgotten "lights switched ON/OFF" problems. One more minor effect of the system, is that it is going to be helpful for security officers during the holidays, since if two condition will occur they can easily identify if there is somebody or not, when actually the block should be empty.

For placement of the motion sensor we chose the place in between two levels of the building, because it will be able to control the lights for two levels at a time, so motion sensors will not be used for every level or floor of the block, and one light sensor for each stairs or for each 4 four motion sensor, which makes less expensive this project comparing with LED light bulbs.

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