ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 3, March 2016

Energy Efficient Smart Light by Using PLC Technology

Shubham Jaiswal, Shubham Bhad, Sanket Gadkari, Tushar Panghate, Akshata Badwaik, Shruti Lokhande

Department of Electrical Engineering, Datta Meghe Institute of Engineering Technology and Research, Sawangi (Meghe), Wardha, India

ABSTRACT: Electricity is one of the biggest requirements and this need of electricity is one of the biggest problems. And this problem is increasing day after day. It is essential to minimize the power consumption of street light and to automate the system so that to conserve the electricity and increase the efficiency of the street light. It can be done by application of proximity sensors and PLC technology .At first the light sensor will sense the condition whether it is day or night. When there is no proper illumination, that is at evening time the light sensor will give output and the lights turned ON. And whenever any person comes in the range of sensor, sensor will sense human motion and give output to PLC . Relay driver ON light related to that output, light will on for certain time up to which the person reaches the second light. This process is repeated for the operation of second light .

I. INTRODUCTION

In this paper we are using PLC technology to control the switching of street lights. Programmable Logic Controller is a computer used for automation of real- world processes . The PLC usually uses a microprocessor. The program can control sequencing and is generally written by engineers. The program is stored in EEPROMs. Unlike general-purpose computers, the PLC is designed for different temperature ranges, dirty or dusty conditions, immunity to electrical noise and resistant to vibration and impact. By using this project we decreases man power.

This system can effectively work in areas where electricity is used in huge amount especially, during night time in corridors of hostels, hospitals etc. The proposed PLC based system will remain OFF when there is no presence of human being and will activate upon the presence of human being in highlighetd area. This presence will be sensed by sensor at input side. One of the biggest utility concerns is the fact that by sensing the presence of person whenever enters in the area of corridor of premises, the light will remain in ON state, otherwise it will remains OFF. The switching action of light will take place by using relay. This entire process is controlled by programmable controller. Since, this system works in real time application, the power will be utilized efficiently.

II. PROBLEM OF ELECTRICITY

According to current scenario the 19% of the electricity is globally used for the lighting purpose. This 19% is more than the electricity which is produced by the hydro and nuclear power station .The carbon dioxide produced by generating this 19% electricity and is about 70% of global emissions from passenger vehicles, is about 3 times the emissions from aviation. Lighting is one major area of electricity consumption. The problem is that it will be in ON state even though there is no requirement of light and hence it causes loss of power . Yet another problem is that in these systems which is manually operated, when any fault occurs we may not be capable to know about the fault and hence this problem remains won't be rectified.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 3, March 2016

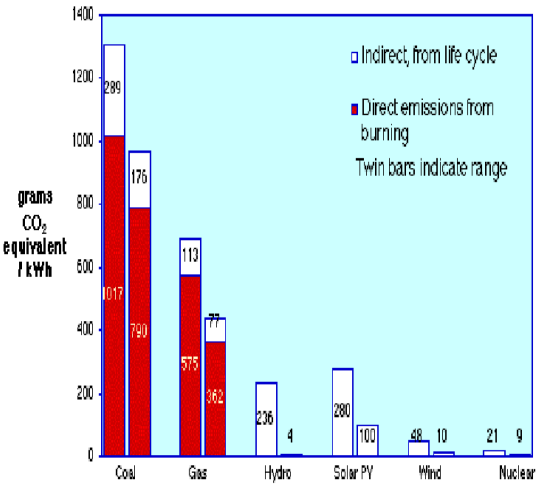
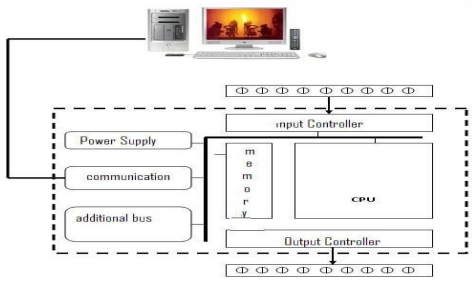


FIGURE 1. GREEN HOUSE GAS EMISSION FROM ELECTRICITY PRODUCTION

III. METHODOLOGY

PLC :-

Programmable controllers are solid-state devices of the computer family, using integrated circuits instead of mechanical devices to implement control functions. They have ability of storing instructions, such as sequencing, timing, counting, data processing, and communication, to control industrial machines and processes. The first PLC's were just replaces relays . Their primarily perform the sequencing operations that were implemented with relays in previous days. These operations included ON/OFF control of machines and processes that needs repetitive operations. However, these programmable controllers were a modification over relays. They were easy to install, used considerably minimum space and energy, had indicators that aided troubleshooting, and unlike relays, were reusable if a project was scrapped.



MICROPROCESSOR:

Very small microprocessors integrated circuits with tremendous computing and control capability—provide the intelligence of modern PLCs. They perform mathematical operations, data handling, and sequential operations that were not possible with relays , the hardwired logic processor. The principal function of the processor is to command and analyse the activities of the complete system. It performs this function by interpreting and executing a collection of such programs known as the executive programs. It is a group of supervisory programs, is permanently stored in the processor and is considered a part of the programmable controller itself. By executing the

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 3, March 2016

executive, the processor can perform all of its controlling, processing, communication, and other household purpose. The executive performs the communication between the PLC system and the user via the PLC device. It also supports other peripheral communication, such as monitoring field devices; reading data from the power supply, I/O modules, and memory; and communicating with an
operator interface. The central processing unit of PLC system may contain more than one processor (or micro) to execute the system's duties and communications, because extra microprocessors increase the speed of
these operations. This approach of using several processors to divide control and communication tasks is known as multiprocessing. Another multiprocessor arrangement makes the microprocessor intelligence from the central processing unit moving it to an intelligent module. This technique uses intelligent input output interfaces, which contain a microprocessor, inbuilt memory, and a mini- executive that performs independent controlling tasks. Typical
intelligent modules are PID control modules, which perform closed-loop independent controlling of the CPU, and some stepper motors and servo motor control interfaces.

SWITCH MODE POWER SUPPLY(SMPS):- THE SYSTEM POWER SUPPLY

D.C. to D.C. converters and inverters belong to the
category of Switched Mode Power Supplies (SMPS).The various types of voltage regulators fall in the category of dissipative regulator, as they have a voltage control element like transistor and zener diode which dissipates power equal to the voltage difference between an unregulated input supply voltage and fixed supply
voltage multiplied by the current through it. The switching regulator acts as a variable power converter and hence its efficiency is affected by the voltage difference. Hence this regulator is also known as non- dissipative regulator. In a switch mode power supply, the active device that provides regulations always operated in cut-off or in saturation mode. The control element to be switched ON/OFF. The control element usually consists of a transistor, an inductor, and a diode . The major feature of SMPS is the elimination of physically power transformers . The net result is compact, lighter and cheap in cost, reducing basically from the elimination of the 50 Hz components. The power received from AC main is converted as high voltage DC. It is then switched at a huge frequency approximately 15 kHz to 50 kHz and given to the primary side of the step- down transformer.The output at the secondary of the transformer is rectified and then filtered. Then it is sent to the output of the power supply. A feedback from the output is sent back to the switch to control the output voltage. switch mode power supply rely on pulse width modulation to control the average value of the output voltage. As load increases output voltage approaches to fall. When the duty cycle is at 50% then the maximum energy will be passed through the transformer. As the duty cycle decreases the power to be transmitted is less hence low power dissipation .

The power supply plays a important role in the total system operation. It can be considered
the manager of system reliability. It not only provides internal DC voltages to the system components but also to monitor and control the supplied voltages and alert the central processing unit if something is wrong. The power supply has the function of supplying well controlled power and protection for other system components. Usually, programmable logic controller require input from an AC source and also some programmable logic controller will accept a DC power. Those that will accept a DC power source are quite appealing for applications such as offshore operations, where DC sources are commonly used. Most programmable logic controllers , however, operates on a 120 V AC or 220 V AC power source, while a few controllers will accept 24 VDC.

Relay Driver:-

A relays are electro-magnetic switches which are useful
if you want to use a low voltage circuit to switch on and off a light bulb connected to the 220 V mains supply.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 3, March 2016

The current needed to operate the relay coil is more than can be supplied by most chips so a transistor is usually needed.

Use BC547 or similar. A resistor of about 4k7 will be better. The diode is used to short circuit the high voltage back emf generated when current flowing through the coil is suddenly switched off.

PIR Sensor

Fig. Capacitive proximity sensor

A PIR sensor is sensor able to detect the presence of nearby objects without any physical contacts. A proximity sensor emits an electromagnetic beam radiation (IR) and looks for changes in the return signal. The human being being sensed is often refer to as the proximity sensors target. We used capacitive sensor of dielectric nature which will sense the nearby object and provide signal to the PLC. Which will turn ON the light.

IV. WORKING OF PROJECT

At first the light sensor will sense the condition whether it is day or night. When there is no proper illumination, that is at evening time the light sensor will give output and the lights get ON.

Lights will be ON continuously from 6 pm to 11 pm as there are less number of people present after 11 pm the light are not required ON continuously. So from 11 pm the light will switch on the plc.

When plc system is ON, first all lights will be in OFF state. Whenever any person comes in the range of sensor, sensor will sense human and give output to plc.

When plc gets input from sensor, it processes it and gives output to relay driver.

Relay driver ON light related to that output, light will on for certain time up to which the person reaches the second light. This duration of time can be calculated from the time required for average person to reach at second light.

When the person reaches second light the above process will happen again and get repeated. This process continuous all night up to the morning.

When the day raises the light sensor senses it and all system will be off. The problem of wastage of electricity can be resolved by using the following methods. Switching over to more efficient light sources like CFL, LED etc. Eliminating wastages in the use of lighting by switch OFF the lights when not needed understand the illumination needs reduce excess light. But the problem cannot be solved in this way also as the lights are ON at evening every day at
6 pm and switch OFF at 8am as nobody present at the place for switching off the light. This causes the wastage of electricity. The real need of electricity is in between
6pm to 11pm when there are most people are present

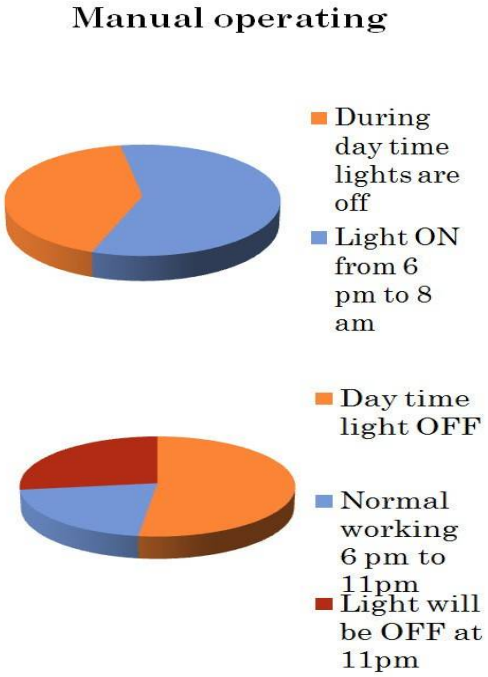
ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 3, March 2016

outside. From the 11 pm to early morning will present there so we doesn't required light to be on state so we can use this proposed project.



V. USING PLC AUTOMATION

There are three main sections :

1. Input section
2. Controlling section
3. Output section

Input section:-

The main supply 230 V, 50Hz 1 phase AC is given to the PLC through SMPS. SMPS converts 230 V AC supply to 24 V DC supply. Input section also consist of sensors and switching devices. We are using capacitive proximity sensor which is connected to the input section of the PLC. The capacitive proximity IR sensor generates a control signal to the PLC under the conditions when the motion is detected. Motion such as moving vehicle or any human body. This sensors can be used at various location such as pole , door , house gate etc.

Controlling Section:-

On-Delay timer-This timer basically delay turn on time. In other words, after our sensor (input) turns on we wait for some time before activating a solenoid valve (output). This is the most common timer.

Off-Delay timer- OFF delay timer and ON delay timer are opposite to each other. This timer simply delays turning off. When object is sensed signal is generated to turn on the output solenoid .When the sensor no longer sense the target we hold the plunger for x-seconds before turning it off. It is called a Timer off-delay and is less common than

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

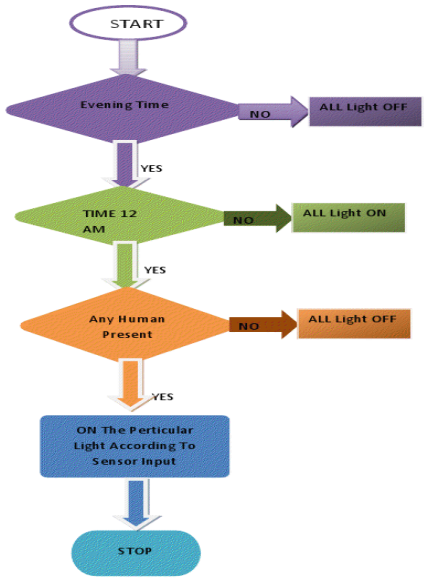
Vol. 5, Issue 3, March 2016

the on-delay type.

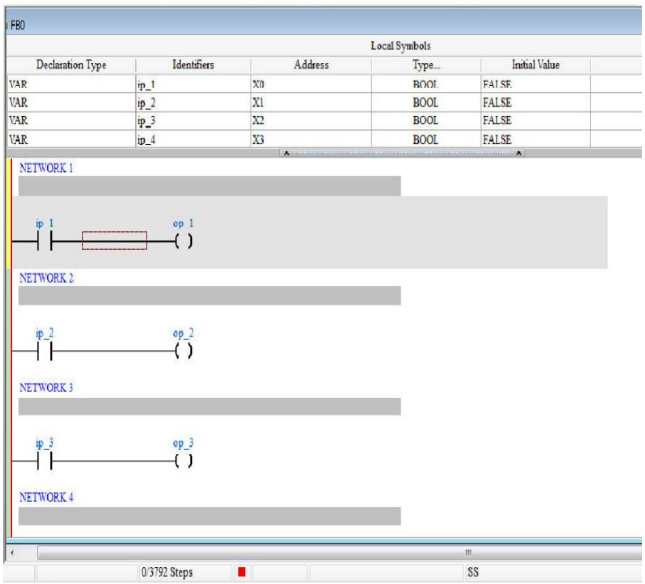
OUTPUT SECTION:

Output generated from the PLC given to the ralay driver which activate the relay coil which when on and off the light according to the signals come from timer for particular time interval .When

FLOWCHART:



LADDER LOGIC:



ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 3, March 2016

ADVANTAGES:-

1. Quick turn ON and OFF: unlike fluorescent lamps , which take time to heat up once switch ON,LED's come on with full intensity instantly.

2. Reduces human efforts or man power.

3. Saves electricity upto 50% electricity.

4. Efficiency and accuracy of the light increases.

5. It can be operated in hazardous conditions.

6. Easy to change the logic.

APPLICATIONS:-

- Industrial applications.
- Commercial applications.
- Street lightning.
- Hostel buildings.\

REFERENCES

[1] Swathi C A, Hemanth Kumar S, Annappa A R, " Smart Street Lighting System Based On Sensors Using Plc And Scada", International Journal Of Mechanical Engineering And Technology (Ijmet), Issue 9, September (2014)
[2] Mehul S. Prajapati, Ashish G. Patel," Plc & Scada Based Automation Of Industrial Reverse Osmosis Desalination Plant", International Journal Of Engineering Research & Technology (Ijert), Issue 3,March (2014)