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APPLICATION OF PLC TECHNOLOGY FOR AUTOMATION OF LIGHT

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Abstract: In India there is a huge amount of electricity is used apart from that most of the electricity get wasted. Therefore the requirement of electricity is increasing day by day and in today's world in every sector we require the huge amount of electricity. Large amount of electricity is consumed by lightning system like street light, commercial light, industrial light, etc. So we need to decrease the consumption of electricity by automation of light we use programmable logic controller (PLC) system, by using this we optimize the power and save upto 40% of electricity consumed by normal one. In this proposed paper by using PLC we control the street lights and optimize the power.

Keywords : PLC, Lights



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INTRODUCTION

The use of electricity is increasing as the population of the world is increasing; also we have to increase the power generation to overcome this demand of electricity this power generation is mainly done in thermal power stations. Now a day's some part of electricity is generated by hydro power plant and some in nuclear power plant, a very small power is generated in solar power plant.

The Control engineering has evolved over time. In the past humans were the main method to control a system. Recently electricity has been used for control and electrical controls were based on relays. Relays are used to make simple logical control decisions. Programmable Logic Controller (PLC), the advent of the PLC starts in the 1970s, and has become the most preferable choice for control manufacturing process. PLC's have been gaining popularity on the factory floor. Most because of the advantages they offer. Today, "Electricity is one of the largest requirements and this requirement of electricity is one of the biggest problems". So, it is very essential to take seriousness on power saving .that is why we are proposing a PLC based system which will reduce unnecessary wastage of electricity. In this project by using PLC technology we are doing power management for street lights.

1.1. Programmable Logic Controller (PLC):-

Programmable logic controllers (PLC) are important factor of the computer family, using integrated circuits instead of electro-mechanical devices to performing control functions. They are capable of storing instructions, such as timing, arithmetic, counting, sequencing, communication, data manipulation, to control industrial machines and processes.

For automation of industrial processes digital computer is used like Programmable Logic Controller, such as control of machinery in factory area. The PLC is designed for multiple I/O arrangements, increased temperature ranges, immunity to electrical noise, and resistance to vibration. To control machine operations programs are stored in non-volatile memory. However, In simple terms PLC can be thought as industrial computers with specially made designed architecture in both their central units (the PLC itself) and their connecting circuitry to field devices (input/output connections to the real world).

1.2. PIR Sensors:-

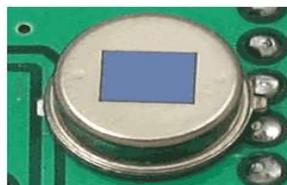


Fig 1. PIR Sensors

The PIR sensors allow you to sense motion, almost always used to detect whether a human body is in the sensors range. They are compact, inexpensive, required less power, easy to use and don't wear out. For that reason they are found in appliances and gadgets used in homes or businesses. They are often referred to as "Passive Infrared", IR motion sensors.

1.3. Timer:-



Fig 2. Timer

This Panel-mount Digital Timer series can be operated in 4 separate power supplies, this ranges from 240 V ac to 12Vdc. Output format can be produced to be volts-free or voltaic-output. Batteries of Lithium CR2032 or rechargeable V80H available for option which is for option which is retaining the programming during operating power of Timer disconnected. This Digital Timer is accurate to the minute, designed with either 6 or 8 ON/OFF (task) per day.

1.4. Relay Driver:

This 4-channel TTL relay board provides three different relay coil voltage (5, 12, 24VDC) for selection allowing you to switch high-current loads like AC appliances and motors. This board has four SPDT relays with screw terminal

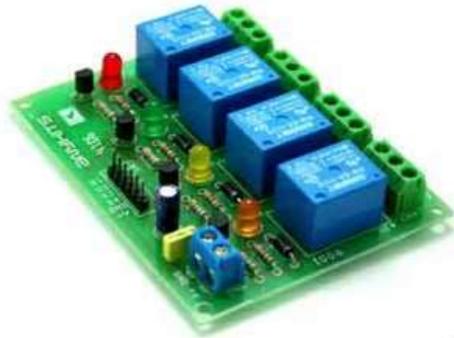


Fig 3. Relay Driver

connections for the inputs and contacts. It also contains active driver circuitries which pass lower current input signals such as 5V TTL to be used. The relay contacts are electrically isolated from the remaining board making the board a valuable tool for AC and DC loads. The status of each relay is indicated by LEDs. With this relay board, any logic-level signal (5V) or higher-voltage signal (up to 30V) can be used to control a relay.

1.5. Switched Mode Power Supply (SMPS):-



Fig 4. Switched Mode Power Supply (SMPS)

The switch mode power supply (SMPS) is an extraordinary array of high frequency alternative supply. In addition the Power Supply SMPS can step-up, step-down input voltage. Switching

regulators are a circuit that uses capacitors, inductors, and transformers as storage elements for energy and transfer energy from input to output.

2. Ladder Programming Of PLC

The subroutine password is used to protect subroutine programs when you upload programs from PLC without comments and symbols. Users need to download the program with subroutine password to PLC first. When users upload the program from PLC without comment and symbols, all of the POU's will be assigned this password to prevent users from opening it.

Users can adopt this function to set the subroutine password in the project.

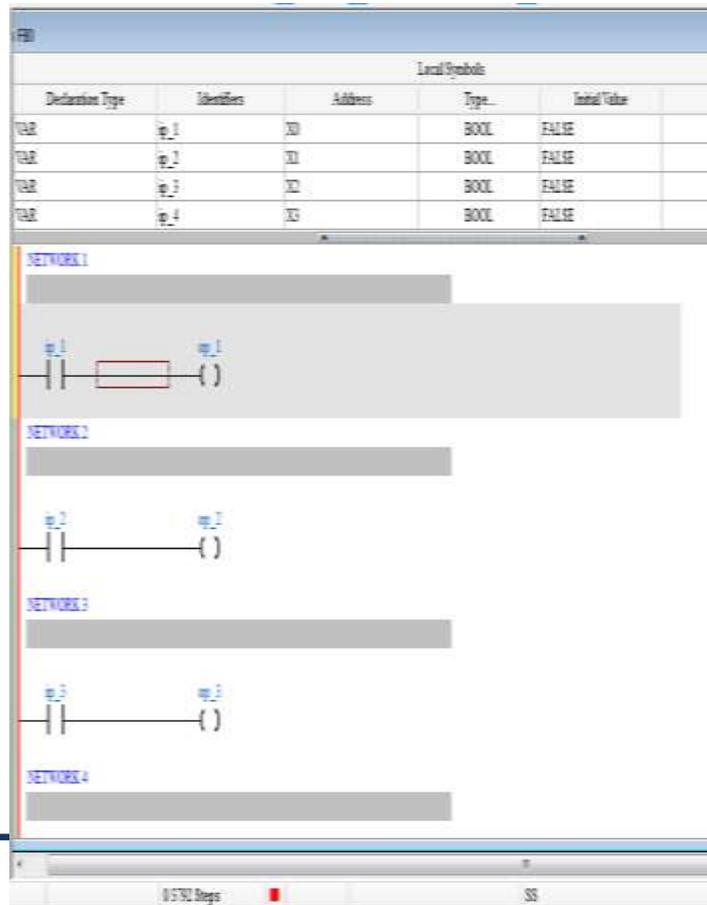


Fig 5: Ladder Programming of Plc

Step1: Click “Tools” → “Program Setting” → “Subroutine Password Setting”.

Program ID Setting:

You can use this function to set the program ID in the project. If you want to download the program to the PLC and the program is set. The program ID of the project must be consistent with the PLC. Otherwise, a message will show up to inhibit downloading.

Step2: Enter the password and confirmation. The password must be 4 to 8 characters. Then press “OK”. If the subroutine password is set successfully, the window will change to unlock password window and the status bar will show the string of “locked”.

Step1: Click “Tools” → “Program Setting” → “Program ID Setting”.

Step2: Enter, check and confirm the ID number of program (setting range: 4~8 characters), and the status bar will show us “Program ID Enabled” after clicking on OK.

Off-line Password Setting

Click “Tools” > “Program Settings” > “Off-line Password Setting”- to display the setting dialog.

Write and enter a password into both fields (setting range: 4 characters) and click OK to complete the setting. When Off-line password is locked, you can decide to check “Synchronize Project and PLC Password” in transfer setup block when downloading or uploading programs. When the item is checked, the PLC password and the retry times for entering password will be synchronized with project password settings.

Users can set the RTC settings of DVP-SA/SX/SC/EH/EH2/EH2L/SV/ES2/EX2 models to be the same as computer RTC or defined by user.

Step1: Click “Tools” → “Set RTC...”

Step2: you have to Select the item in the dialog and click Synchronize.

3. System Architecture:-

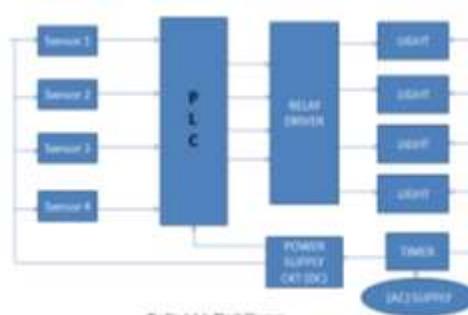


Fig 6. Diagram showing Architecture of Optimization of Power Using Plc Technology

The complete system architecture of the optimization of power by using PLC technology is as shown in figure. The sensors are connected to input side of PLC. PLC is placed at the centre and acts as control unit. The programming done by PLC delta software which is assembled in computer. Here relay is used as a normally closed or normally open function. Timer is also used to set the time for particular time period. The lamps are connected to output side. PLC requires 24V DC power supply.

4. Working:-

The entire circuit operation of the proposed system is divided into three parts.

- Input section
- Controlling section
- Output section
- Power supply section

Input section-

At the Input side, PIR sensor is used to sense presence of any person in corridors of hostel. If there is no one in corridors, there will be no output signaling from sensor to PLC, therefore, tube light will be in off position. As soon as the presence of any person occurs in corridor, it

will be automatically detected by PIR sensors. Then all sensors are interfaced with the PLC unit then by the controlling action light will turn ON.

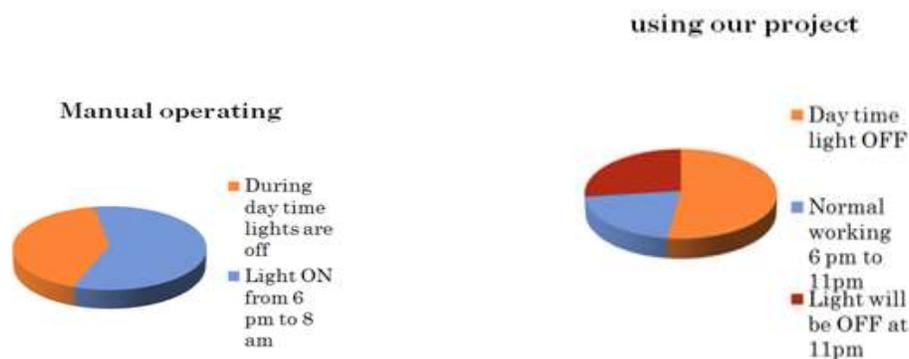
Controlling section-

In the controlling section, the PLC module will act as a main controlling unit where the output from PIR sensors is given as input to PLC module. PLC (Programmable Logic Controller) unit is a powerful tool used in industry to automate any system it has capability to control devices in accordance to logic build in memory of PLC unit. In the PLC module, the desired programming is burned. Then, according to programming, the PLC module will take action.

Output section-

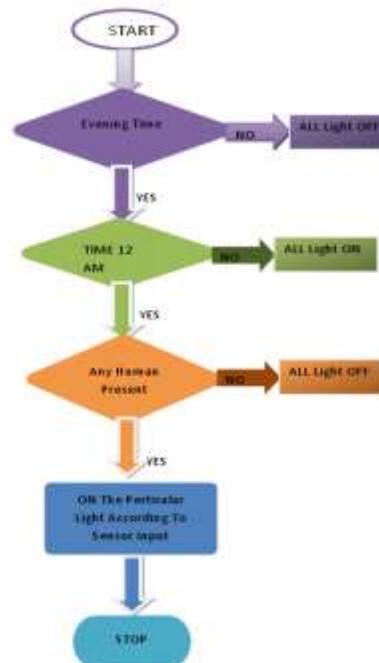
The output section mainly consists of relay channel board. It consists of single pole double throw relays and switching transistors. The controlling output from PLC module is given to the base of specific transistor which will activate corresponding relay than that relay will switch ON or OFF the particular tube light.

Power supply section-



The 230 volt AC supply is given to Switch mode power supplies (SMPS) are an extraordinary array of high frequency alternative. These are Switching Regulators which offers higher efficiency than linear regulators. In addition the Power Supply SMPS can step-up, Step-Down and invert the input voltage. This SMPS power supply will down convert the 230v AC supply which is used to supply power to various components in the circuit.

4.1. Flowchart



5. Advantages:-

- **Saves Electricity-**

It can save up to 50% of electricity. Very large amount of electricity can be saved if it is used in large extent. And it also reduces the carbon dioxide emission due to burning of coal in power plants.

- **Provide Full Automation-**

As the total system is fully automatic man power required will less and also money saving can be done.

- **Compact Size-**

As the size of component used is very compact so it can be installed at any location also plc is very immune to any weather so can be installed in smaller places.

- **Reprogrammable-**

The plc can be easily reprogrammed for different settings as required according to application. We can save the data of usage of electricity per day using computer and

connecting it with plc. By using another plc we can extend this circuit to more number of outputs.

- **Space Efficient-**

Now a days Programmable Logic Control memory is getting larger amount this means that we can generate more contacts, coils, timers, sequencers, counters etc. We can connect thousands of contact timers and counters in a single PLC. Imagine what the help of single panel we can perform so many operations.

- **Testing-**

A PLC program can be evaluated as well as tested in a lab. The program can be tested and corrected saving very valuable time.

- **Visual Observation-**

While running a PLC program a visual operation can be seen on screen. Hence Troubleshooting a circuits is really quick, easy and simple.

1. Applications:-

- This project can be used automation purpose i.e. employed in the industry for controlling of machinery.
- This we can use in the hostel corridors for efficient use of electricity in that premises.
- The application area of this proposed model can be extended in shopping malls and hospitals etc where the maximum unnecessary wastage of electrical energy takes place.
- This model can also be employed in street light.
- It can be used in restaurants.
- It can be used for home automation.
- It can be used in museum and bank offices.

2. Conclusion:-

Our project will reduce the energy consumption in lighting in following ways.

Total power consumption by 5 lights of 200w in ON time During 6pm to 8am	$200 \times 5 \times 14 = 14\text{kwh}$	Cost of 1 kwh = Rs7	Cost of One day = $14 \times 7 = \text{Rs}98$	In One year = $365 \times 98 = 35770$
After using our project light will on from 6pm to 11pm and then switch on system	so total use of maximum 7 hour = 7 kwh	Cost of 1 kwh = Rs7	Cost of One day = $7 \times 7 = \text{Rs}49$	In One year = $365 \times 49 = 17885$
So total saving of 7 hours			Per day saving Rs 49	And per year =17885

Fig 7.1 Power Saving Calculation

In this way for five lights we can save 7kwh per day that is 2555kwh per year which has the price of Rs 15330 Which is not a small amount. This system can effectively work in areas where electricity is used in large amount especially, during night time in corridors of hospitals, hostels, etc. The proposed PLC based system will remain OFF when there is no human being and ON (activated) when the person arrives under a specified area. This presence will be detected by PIR sensor at input side of PLC. The fact that by detecting the presence of person whenever enters in the area of corridor under sensors range, the tube light will remain ON, otherwise it will remain OFF. The extra use of electricity will surely be reduce and prevent the adverse effect of extra uses due to which we suffers a lot because of this proposed model.

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