Automatic Power Saving System using PLC (Programmable Logic Controller)

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Abstract— Design & Development of PLC Controlled Power Saver System Automation & Control for Room Occupancy Count & Appliance Control. This paper is based on application of the PLC in daily life. In our daily life we normally forget or don't care to switch off the electrical devices used at our homes i.e. fans, tubes, bulbs etc. Every device has a particular power ratings according to which it consumes electricity now the working of these devices without any use will lead to wastage of power and ultimately to the electricity bills. This project can be used to avoid this problem. In this project every room will be monitored by a PLC and the PLC will keep the record of the number of persons in every room and when it finds the no of persons in a room to be zero then it automatically cut the power line for that room. We can also use a SCADA, which will display the status of every room.

Key words: Programmable logic controller (PLC), IR sensor, Bidirectional Counter, Power saving system

I. INTRODUCTION

As their is a lack in production in electricity by conventional sources in India and generation of electricity according increasing demand has become a problem for all the Electricity department. So, as to provide electricity to all the Indians. Therefore, Production of energy at a reasonable price so as we know that saving of energy is also a type of energy generation. So this project is oriented to save the energy using electronic equipment so as to reduce the wastage of energy. As the wastage of energy can be reduced the their will be reduction in power demand therefore peak demands will reduce and the coal burn will decrease this will further reduce carbon credit of India. So this can be a profitable project for power saving using PLC and SCADA. To save electricity without human interference to optimize the system usability.

This paper is based on concept that aims at developing a Density Based Room Power Saver System, which involves a PLC to control the number of devices switched on/off at a particular instant of time. For implementing that we need to have two sensors at the entrance and the exit terminals. The entrance or the exit of a person in the room is detected by using two infrared modules at each room. Each module will contain an IR transmitter and an IR receiver, which are mounted on the two sides of the door. Now whether a person enters or exits, the module will give output which is attached at the input of PLC, from that input PLC works according to ladder logic.

Objectives of Research:

1) To develop an automatic power cutting system.
2) To develop an energy saving system.
3) Monitoring system to counting the persons inside a room or hall with security.

II. THEORY

A. *Programmable logic controller:*

Control engineering has evolved over time. In the past humans were the main method for controlling a system. More recently electricity has been used for control and early electrical control was based on relays. These relays allow power to be switched on and off without a mechanical switch. It is common to use relays to make simple logical control decisions. The development of low cost computer has brought the most recent revolution, the Programmable Logic Controller (PLC).

PLCs have been gaining popularity on the factory floor and will probably remain predominant for some time to come.

Fig. 1: PLC Micro logix1100 (4 I/P and 4 O/P)

Most of this is because of the advantages they offer.

- Cost effective for controlling complex systems.
- Flexible and can be reapplied to control other systems quickly and easily.
- Computational abilities allow more sophisticated control.
- Trouble shooting aids make programming easier and reduce downtime.
- Reliable components make these likely to operate for years before failure.

B. *Ladder logic:*

Ladder logic is the main programming method used for PLCs. As mentioned before, ladder logic has been developed to mimic relay logic. The decision to use the relay logic diagrams was a strategic one. By selecting ladder logic as the main programming method, the amount of retraining needed for engineers and tradespeople was greatly reduced.

Modern control systems still include relays, but these are rarely used for logic. A relay is a simple device that uses a magnetic field to control a switch, as pictured in See Simple Relay Layouts and Schematics. When a voltage is applied to the input coil, the resulting current creates a magnetic field. The magnetic field pulls a metal switch (or reed) towards it and the contacts touch, closing the switch. The contact that closes when the coil is energized is called normally open. The normally closed contacts touch when the input coil is not energized. Relays are normally drawn in schematic form using a circle to represent the input coil. The output contacts are shown with two parallel lines. Normally open contacts are shown as two lines, and will be open (non-conducting) when the input is not energized. Normally closed contacts are shown with two lines with a diagonal line through them. When the input coil is not energized the normally closed contacts will be closed (conducting).

Relays are used to let one power source close a switch for another (often high current) power source, while keeping them isolated. An example of a relay in a simple control application is shown in See A Simple Relay Controller. In this system the first relay on the left is used as normally closed, and will allow current to flow until a voltage is applied to the input A.

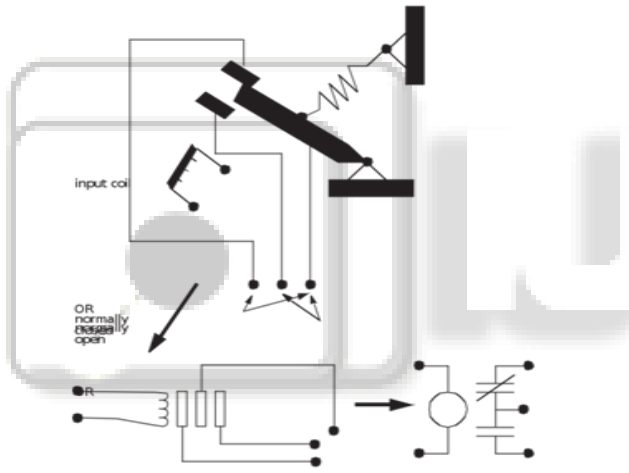

Fig. 2: Simple Relay Layouts and Schematics

The second relay is normally open and will not allow current to flow until a voltage is applied to the input B. If current is flowing through the first two relays then current will flow through the coil in the third relay, and close the switch for output C. This circuit would normally be drawn in the ladder logic form. This can be read logically as C will be on if A is off and B is on.

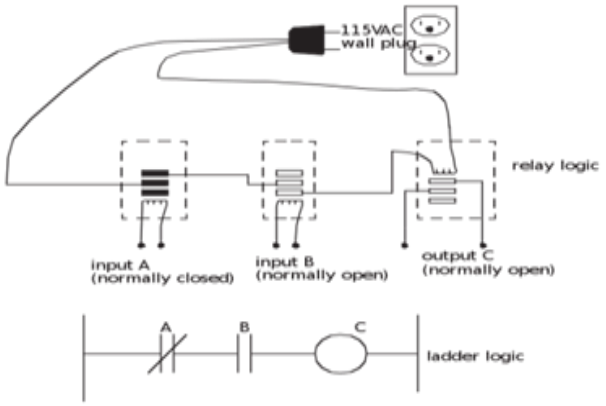

Fig. 3: A Simple Relay Controller

The example in See a Simple Relay Controller does not show the entire control system, but only the logic. When we consider a PLC there are inputs, outputs, and the logic. See A PLC Illustrated with Relays shows a more complete representation of the PLC. Here there are two inputs from push buttons. We can imagine the inputs as activating 24V DC relay coils in the PLC. This in turn drives an output relay that switches 115V AC, that will turn on a light. Note, in actual PLCs inputs are never relays, but outputs are often relays.

The ladder logic in the PLC is actually a computer program that the user can enter and change. Notice that both of the input push buttons are normally open, but the ladder logic inside the PLC has one normally open contact, and one normally closed contact. Do not think that the ladder logic in the PLC needs to match the inputs or outputs. Many beginners will get caught trying to make the ladder logic match the input types. Many relays also have multiple outputs (throws) and this allows an output relay to also be an input simultaneously.

The circuit shown in See A Seal-in Circuit is an example of this, it is called a seal in circuit. In this circuit the current can flow through either branch of the circuit, through the contacts labelled A or B. The input B will only be on when the output B is on. If B is off, and A is energized, then B will turn on. If B turns on then the input B will turn on, and keep output B on even if input A goes off. After B is turned on the output B will not turn off.

In ladder logic there are multiple types of outputs, but these are not consistently available on all PLCs. Some of the outputs will be externally connected to devices outside the PLC, but it is also possible to use internal memory locations in the PLC. Six types of outputs are shown in See Ladder Logic Outputs. The first is a normal output, when energized the output will turn on, and energize an output. The circle with a diagonal line through is a normally on output. When energized the output will turn off. This type of output is not available on all PLC types.

When initially energized the OSR (One Shot Relay) instruction will turn on for one scan, but then be off for all scans after, until it is turned off. The L (latch) and U (unlatch) instructions can be used to lock outputs on. When an L output is energized the output will turn on indefinitely, even when the output coil is de energised. The output can only be turned off using a U output. The last instruction is the IOT (Immediate OutpuT) that will allow outputs to be updated without having to wait for the ladder logic scan to be completed.

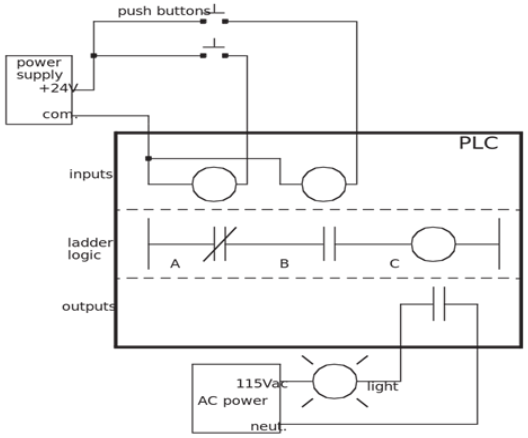

Fig. 4: A PLC Illustrated With Relays

C. Circuit Introduction:

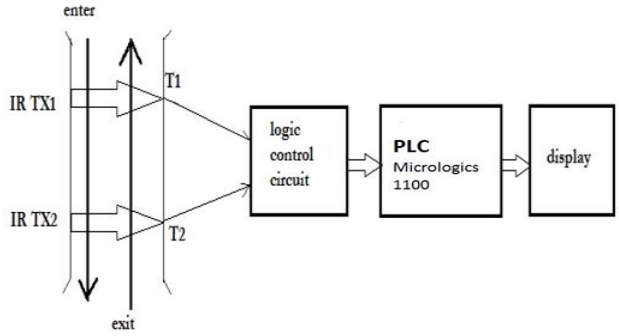

Fig. 5: Block diagram

IR LED transmitter & receiver:

An IR LED, also known as IR transmitter, is a special purpose LED that transmits infrared rays in the range of 760 nm wavelength. Such LEDs are usually made of gallium arsenide or aluminium gallium arsenide. They, along with IR receivers, are commonly used as sensors.

The appearance is same as a common LED. Since the human eye cannot see the infrared radiations, it is not possible for a person to identify whether the IR LED is working or not, unlike a common LED. To overcome this problem, the camera on a cell phone can be used. The camera can show us the IR rays being emanated from the IR LED in a circuit.

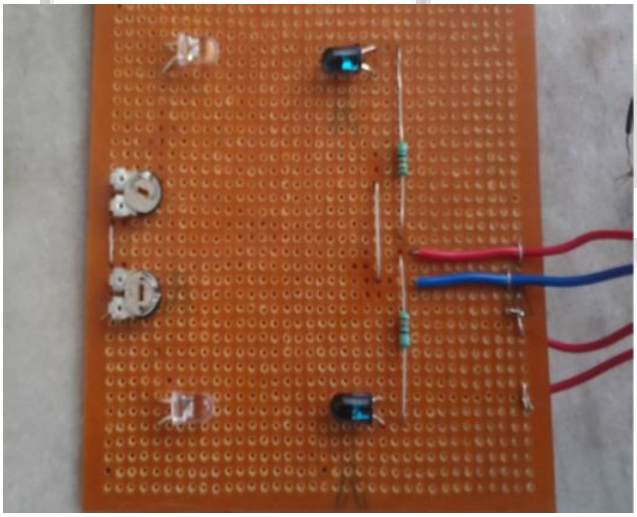

Fig. 6: IR LED circuit

D. Working principle of system:

- Bidirectional sensor at door sense the entry and exit of person inside or outside the room
- When counting is other than zero power supply of room is on switched automatically by PLC
- When counter increasing density increasing inside the room
- When person get outside the room counter count negative and PLC comparator compares result of bidirectional counter and show density of people inside room
- If it results zero inside the room then power will cut automatically.

III. RESULT AND DISCUSSION

A. Limitation:

1) It is a theoretical circuit and may require few changes in practical implementation.
2) It is a low range circuit and cannot be implemented at large areas.
3) More than one candidate should not enter or exit the room. If it happens it will count it as a single person.
4) With frequent change in the count value, after a certain time the output may look confusing

B. Advantage:

1) The Most advantage is that it will help to save electricity. When no one is there in room the appliances will be off.
2) For School/colleges/companies it will help to check if somebody is there in the zone or not.If the data on display unit is zero the peons or security guards can shut the gate easily.
3) Whole system will work automatically so it reduces the human work.

IV. CONCLUSION

Thus we have completed the research study about automatic power saving system using programmable logic controller (PLC).We have implemented it practically by design a model. Main purpose of this concept is use to cut power when that is not utilize. One point is here that it can be use basically where security system is available and entry of person is one by one so counting of the person visiting is easy and for future implementation by using SCADA we can get imaginary data of visiting scenario by SCADA monitoring system using HMI.

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