PLC based College Automation with RF Controlled Labs

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Abstract— Now a day's electricity is very important thing in human being's life. It's our responsibility to save the electricity as much as possible. The unnecessary wastage of electricity, water happens due to the mistakes or the laziness of human being, that's why we are trying to develop the theoretical concept of the automation of college based on the PLC. As well as, we are reducing the human efforts for saving the electricity and the most valuable time. To increase the efficiency of the system by using PLC instead of using the microcontroller/PIC due to the advance features of the PLC. We are developing automation for gate control, water tank, campus light and theft security of college using PLC S-1200 and the sensors like photo sensors, LDR sensors, water level sensors. Also we are using RF transmitter and RF receiver for remote controlling of electric appliances like fan, lights, computers, laboratory equipment's. In an extremely mechanized world such as today's it is most important to make our life better, convertible and economical. This is the purpose for which automation of college is developed.

Key words: RF Controlled Labs, PLC

I. INTRODUCTION

A programmable logic controller (PLC) is a industrial computer control system that continuously monitors the state of input devices and make decisions based upon a custom program to control the state of appliances.

It is designed for multiple inputs and output arrangements, high temperature ranges, immunity to electrical noise, and resistance to vibration and impact.

Almost any production process can highly enhanced using this type of control system, the biggest benefit in using a PLC is the ability to change and replicate the operation/process while collecting and communicating vital information.

Another advantage of a PLC is that it is modular. i.e. you can add and match the types of input and output devices to best suit your application.

Fig. 1: Physical structure of PLC.

II. BLOCK DIAGRAM & DESCRIPTION

The circuit diagram of the project "College Automation" mainly consist of PLC based design. At the output of PLC there is auxiliary circuitry, driver circuitry and relay bank is available. The detailed description of each block and its application can be given in details as below.

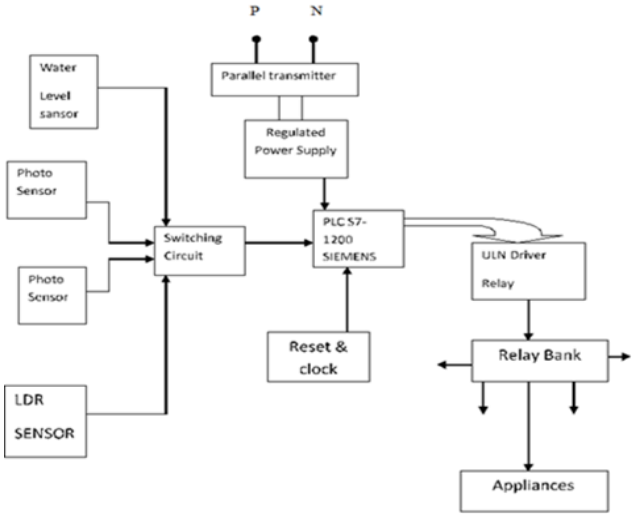

Fig. 2: Block diagram of PLC based college automation.

The main blocks are:

1) Water level monitoring & controlling system.
2) Remote appliance system using RF /IR transmitter and receiver.
3) Photo electric transmitter detector for person entry detection in the gate entrance.
4) PLC & its associated circuitry.

A. *Water Lever Monitoring & Controlling System*

The output relay which is used to drive the motor in above circuit is used to provide a logic pulse to the PLC. Depending upon the logic pulse available the PLC takes an appropriate decision to drive the water pump.

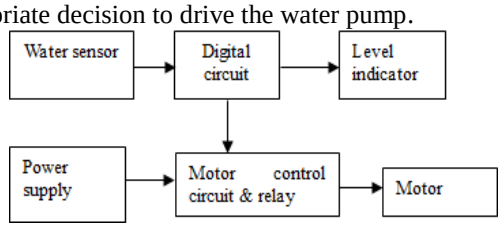

Fig. 3: Block diagram of Water Level Controller.

B. *Remote Appliance System Using RF /IR Transmitter and Receiver*

With RF transmitter and receiver, in order to switch ON and OFF the appliances and the gate motor the IR receiver and transmitter may not be suitable because

1) IR rays are obstructed if a wall type rigid object comes in between. Such type of limitation is not there in RF receiver and transmitter.
2) Also beyond 30 angle the IR transmission and reception becomes un-controllable. The range of RF Rectifier and Transmitter may be increased as per the requirement.

Hence we use RF receiver and transmitters which are based on ASK modulation. The modulation frequency is 434 meters. Here in our application, the transmitter module

will acts as a remote key-board. The operating user will be having this remote key-board. It will be provided with four similar tactile keys. One encoder chip i.e. 12E and it will be followed by a transmitter module. It is a hybrid module developed using the SMD technology.

At the receiver end, one RF receiver module is used which will be developed using the similar technology, having the same frequency. The module is followed by the decoder chip i.e. 12D. The chip will decode the data which will be transmitted from the remote transmitter. For the proper decoding of the data, the address selection of the encoder and decoder chip should be same.

The decoder is followed by a MUX and them by a ULN driver which will be having a Darlington pair array inside. This Darlington pair array will be dependent on the common transmitted form the RF transmitter's keyboard. Thus, without a wired connection we will send a command to receiver and the receiver will send it to the PLC. The PLC will be programmed to takes further actions as per the requirement.

C. Photo Electric Transmitter Detector for Person Entry Detection in the Gate Entrance

1) Block Diagram of Photo Sensor

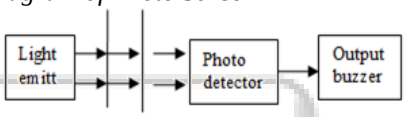

Fig. 4: Block diagram of Photo Sensor.

R1 and R2 form a potential divider network here. Vout plays an important role here. As its valve increases and decreases depending up on the value of R1 and R2 i.e.

$$V\ out = \frac{R2}{R1 + R2} \times V\ in$$

The V out voltage is used to switch ON a transistor, which provides a logic pulse to micro controller.

The illumination LED and the photo-detector are installed in a proper alignment in front of each other so that the light is incident on the photo detector. The alignment is done in the entrance. If nobody is there in the gate, the light emitted is totally incident on LDR. The LDR resistance value will be minimum which will result to produce minimum potential divider output i.e. this output will not be sufficient to drive the transistor and the transistor will be OFF the collector will be at logic high potential. This logic high level will go to PLC indicating the healthy condition.

In the case, if a person enters the gate, the light incident on LDR is obstructed. This causes the LDR value to increase drastically which will result the potential divider output to increases more than 0.7V. This will cause the transistor to be switched ON and the collector will go at logic zero potential. This will be fed to PLC input port as unhealthy condition. The PLC will take an appropriate action as per instructed in the software program.

D. PLC & Its Associated Circuitry

The output from the switching circuit goes to PLC. The PLC is programmed with LADDER language. It has SEVERAL I/O LINES.

1) PLC

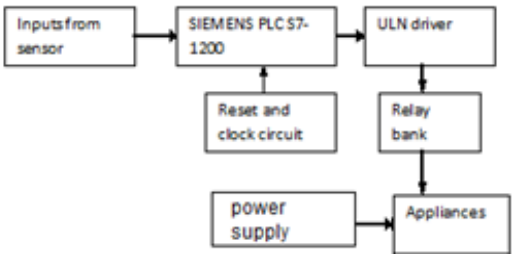

Fig. 5: Block diagram of PLC.

A Programmable Logic Controller, or PLC for short, is simply a special computer device required for industrial control systems. They are used in many industries such as oil refineries, manufacturing lines, convey or systems. Where ever there is a need to control devices the PLC provides a flexible way to "software" the components together.

The basic units have a CPU (a computer processor) that is dedicated to run one program that monitors a series of different inputs and logically manipulates the outputs for the desired control. They are meant to be very flexible in how they can be programmed while also providing the advantages of high reliability (no program crashes or mechanical failures), compact and economical over traditional control systems.

III. SOFTWARE LOGIC DETAILS

1) Initially at power on, the PLC pins will go high & then low as written in the software.
2) Then read input port of PLC.
3) If the inputs to PLC are high, all its corresponding outputs will be low. All windows will be off and audio siren will be off and motor for water sprinkler will be off.
4) If any of the inputs go low, its corresponding window will be glowing.

This will happen continuously.

A. Ladder Diagram

The most common method used for programming PLCs is based on the ladder diagrams. Writing a program is then equivalent or resembles to drawing a switching circuit. The ladder diagram consists of two vertical lines on both sides representing the power rails which are positive and neutral. Circuits are connected in the rungs of the ladder which are horizontal, between these two rails. Ladder logic was basically a written method to document the design and construction of relay racks as used in manufacturing and process control. Every device in the relay rack would be represented by a symbol on the ladder diagram with connections between those devices shown. In addition, other items external to the relay rack such as pumps, heaters, and so forth would also be shown on the ladder diagram. The diagrams themselves have been used since the days when logic could only be implemented using switches and electromechanical relays, the term 'ladder logic' was only latterly adopted with the advent of solid state programmable logic. Ladder logic acts as a programming language that represents a program in the form of graphical diagram based on the circuit diagrams of relay logic hardware and used in industrial control applications.

The name Ladder Logic is appropriate as it resembles a ladder with two vertical rails on either side with a series of horizontally connected rungs between them. The system used in the ladder diagram form will be programmed into the PLC. Once the programs have been downloaded into PLC, it can be monitored in the Diagram Workspace during execution. The RS logic provides the easy user interface to burn the program, to upload the program, and to go back at online mode to see program desirable state.

IV. CONCLUSION

While looking out for the PLC as the area of interest, we studied the various concept of the College Automation System is based on the control system. In electrical design, the features and functions of the electrical components are required to determine the system requirement.

Furthermore, the theoretical of the wiring system is required for connecting the inputs and outputs devices to PLC. In programming design, Understandings of the desired control system and how to use the Ladder Diagram to translate the machine sequence of operation are the most important parts, because it has direct effect on the system performance. The main aim in this process is to apply PLC to design College Automation system and all objectives in this project were successfully done as planned. Finally, the basic control system and logic design application can be used as a reference to design other applications of automation system, and can also be used as a teaching material for the Industrial Control subject.

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