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PLC-Based Home Automation System

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Abstract— This paper is projected as an overview of home automation system. The aim is to introduce in brief the fundamental theory, main and practical results of home automation. The designed control module comprised of software and hardware. The correct incentive for applying automation is to increase productivity and quality that is possible with current human labour levels so as to realize economies of scale and realize predictable quality levels. Home automation identifies a rising practice of features in residential dwellings and increased automation of household appliances, particularly through electronic and electrical means that allow for impractical things , highly expensive or simply not possible in recent past decades.

Index Terms—Home automation, Programmable Logic Controller (PLC), RSLinx, RSLogix500

I. INTRODUCTION

Over the years, there has been a continuous evolution in control system engineering. In the past main methods for controlling a system was manual. Nowadays control of any system is done through electricity and the basic electrical control was based on relays. Without a mechanical switch these relays enables power to be turned on and off. The use of relays to make simple logical control decisions is common. The advent of low cost computer has brought the recent revolution, the Programmable Logic Controller (PLC), which began in the 1970s and has become the most preferred choice for manufacturing controls. In this study the controller was designed to provide an automated home security system at an affordable price. The parameter sensors connected to the controller will provide the required signals that activate controller processes to and take the specified action. **[1]**

A. Features of PLC

The main difference from other computers is that PLCs are protected from severe conditions (such as cold, moisture, dust and heat) and have the features for extensive input/output (I/O) arrangements. A connection between PLC to sensors and actuators is done through these connections. PLCs read limit switches, analog process variables (such as temperature and pressure), and the positions of complex positioning systems. Some use machine vision. **[2]** On the actuator side, PLCs operate electric motors, pneumatic cylinders, solenoids, magnetic relays or analog outputs.

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The PLC may have external I/O modules connected to a computer network that can be plugged into the PLC. Very complex process control, such as those used in the chemical industry, may require algorithms and performance beyond the capability of even high-performance PLCs. Very high-speed or precision controls may also require customized solutions; for example, aircraft flight controls. Single-board computers using semi-customized or fully proprietary hardware may be chosen for very demanding control applications where the high development and maintenance cost can be supported. "Soft PLCs" running on desktop-type computers can interface with industrial I/O hardware while executing programs within a version of commercial operating systems adapted for process control needs.

B. Advantages of PLC

• Economical control of complex systems.
• Can be reapplied to control other systems easily and quickly.
• Sophisticated control can be done with computational abilities.
• Programming is easier and reduces downtime through troubleshooting ability.
• Reliability and durability of the components make PLCs likely to operate for years.

II. RELATED WORKS

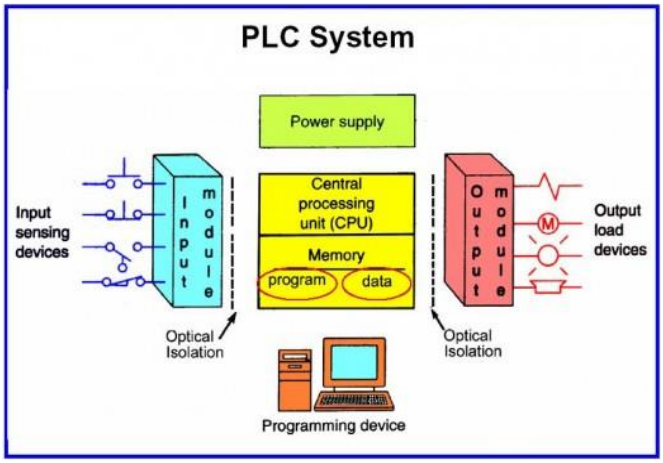

Fig.1. Major PLC components [3]

The design criteria for the first programmable controller were specified by the Hydromantic Division of General Motors Corporation in 1968. **[4]** The initial PLCs only had the feature for controlling relay functionality and were programmed in RLL (Relay Ladder Logic).

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PLCs offered the automobile industry quick change for year to year models changes. In addition, PLCs were modular and easily understood by plant floor personnel. The first programmable controllers were known as PCs. The acronym PLC for programmable logic controller was actually a trade name used by Allen-Bradley. With the introduction of personal computers known as PCs the term PLC became the common term to avoid confusion.

III. PROPOSED WORK

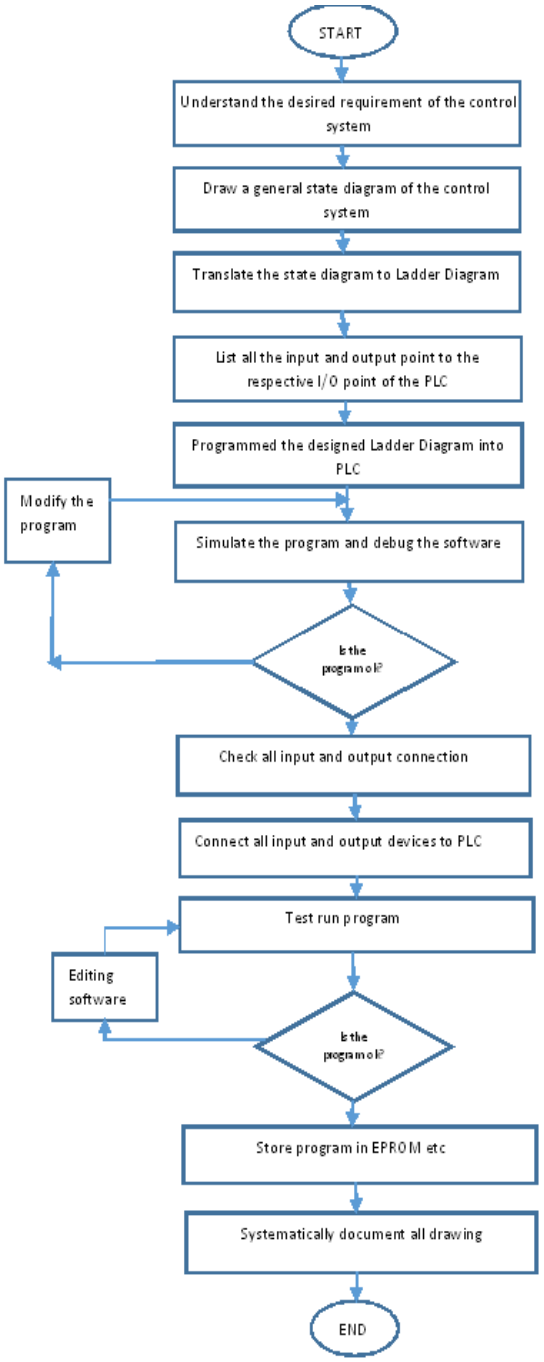

Fig.2. Flowchart

A systematic approach of control system design using programming logic controller is presented in this paper. As a rule, the layout of the entire of Home Automation System using PLC is designed before implementing programming development process. The Ladder Logic is created using RSLogix 500 while RSLinx is a driver software which is used to communicate the PLC and the PC.

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 either side 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. **[5]** Ladder logic was originally a written method to document the design and construction of relay racks as used in manufacturing and process control. Each 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.

Although 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 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 RSLogix provide the easy user interface to download the program, to upload the program, and to go back at online mode to see program desirable state.

B. Assignment of Inputs and Outputs

After the system sequence of operation is determined, all external input and output devices connected to the PLC must be determined and assigned the number corresponding to the input and output number. Table 1 and 2 shows the assignment of inputs and outputs.

Table I: Input Description

Name	Address/ Value	Comments
Proximity Sensor 1	I:0.0/0	For opening main gate
Proximity Sensor 2	I:0.0/1	For closing main gate
Proximity Sensor 3	I:0.0/2	For second room

Table II: Output Description

Name	Address/ Value	Comments
Motor 1	O:0.0/0	For Gate Opening
Motor 2	O:0.0/1	For Gate Closing
Motor and Light	O:0.0/2	Room 1 Fan and Light
Motor and Light	O:0.0/3	Room 2 Fan and Light

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IV. RESULT

During the operation, all activities that occur can be observed by the computer using RSLogix. The system needs to debugged along the way and fine-tuned if necessary. The system is test run thoroughly until it is safe to be operated.

A. The Prototype

The prototype was mainly built by combining the mechanical design and the electrical design. The system requires external power supply of 24 V DC and 220 V AC. The requirement of 24 V DC voltages is fulfilled with the help of SMPS.

Fig.3. Experimental setup

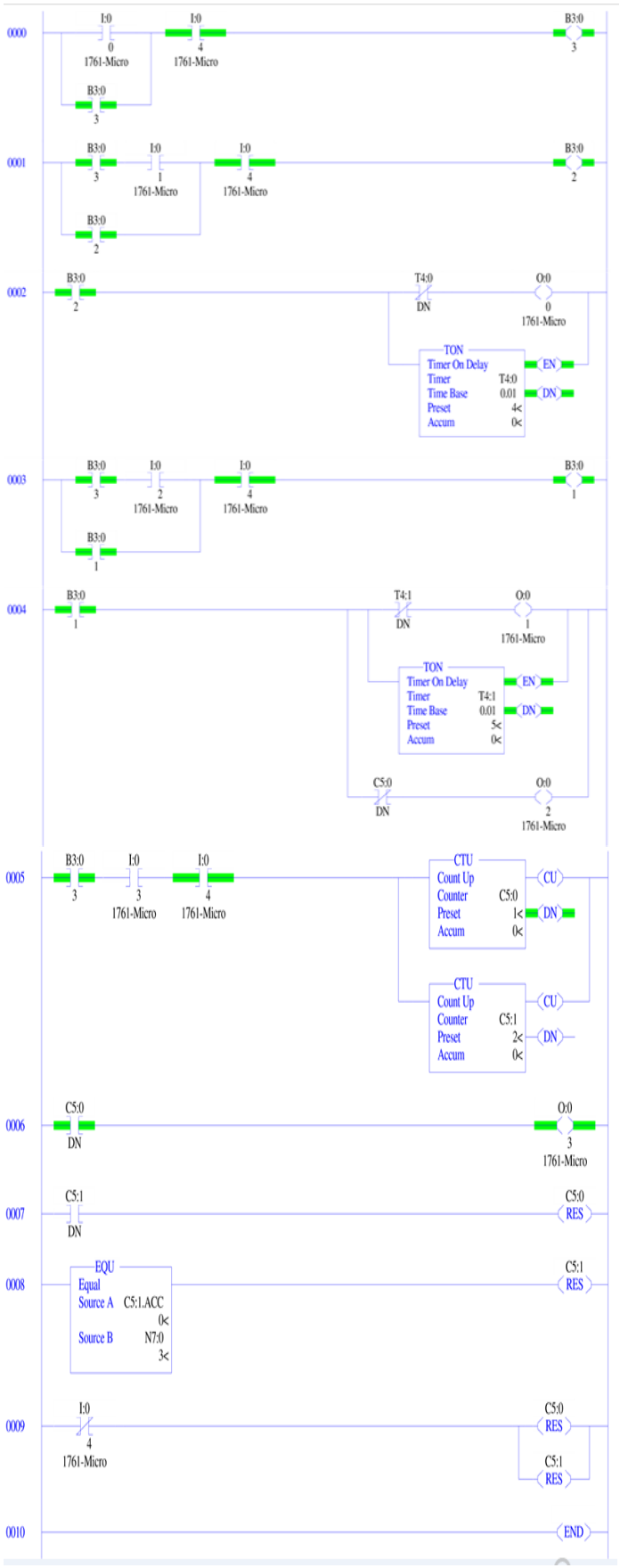

Fig.4. Ladder Logic on RSLogix 500

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B. The Wiring System

The external power supply of 240 V AC is converted into 24 V DC through SMPS. The reason of choosing external Power Supply is that the PLC is operated on 24 V DC which is not available without any SMPS or external Power Supply.

Fig.5. Side view

V. CONCLUSION

The theory and concept of the Home 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 Home 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.

A. Future Recommendation

Actually, a lot of weakness from the project can be taken as future works so that the improved system will be better in terms of performance. So there are several recommendations or suggestions that we can take to increase performance in this project. The performance of Home Automation System can be increased based on two recommendations which are

• The system that is proposed now is using only one sensor that is IR sensor to detect position of the person. It will be better if we add more equipment in this system like CCTV camera. Thus, the system will be more sensitive as there will be more sensing points.

• We can overcome the shortcomings by including proximity sensors, LDR sensor, and smoke detector for detecting fire.

• Besides using PLC as a controller, the other controller that can be used in future work is microcontroller. However, many factors must be considered like cost, feasibility and others.

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