Journal of Electrical and Electronic Engineering
2021; 9(6): 200-206
http://www.sciencepublishinggroup.com/j/jeee
doi: 10.11648/j.jeee.20210906.14
ISSN: 2329-1613 (Print); ISSN: 2329-1605 (Online)

Design and Implementation of an Automated Lighting System

Raghavendra Dakuri Venkata

Electrical Power Engineering, School of Engineering, University of Greenwich, Kent, UK

Email address:
dakuri@gmail.com

To cite this article:
Raghavendra Dakuri Venkata. Design and Implementation of an Automated Lighting System. *Journal of Electrical and Electronic Engineering*. Vol. 9, No. 6, 2021, pp. 200-206. doi: 10.11648/j.jeee.20210906.14

Received: November 17, 2021; **Accepted**: December 16, 2021; **Published**: December 24, 2021

Abstract: A programmable logic controller is a digitally operated system used in an industrial environment that uses a programmable memory to implement specific functions to control through digital or analogue inputs and outputs of various types of machines. This report used a typical application for PLC's lighting control in a building for an office environment. The proposed design must define an appropriate office with various areas or rooms needing lighting with multiple control signals, the lighting controlled by a Siemens LOGO PLC (type 6ED1 052-1MD00-0BA5). The design has four relay outputs and eight digital inputs configured as analogue inputs. The scheme designed must be unique to meet the minimum requirements, including a provision for emergency evacuation if the radiation levels exceed a critical threshold. The system must use both analogue inputs but used for different purposes, and the analogue input level ranges must be significantly different. The relay logic has controlled by rules derived from an original relay logic using an embedded computer system. It optimises the control tasks to perform rugged designs to withstand vibrations, temperature, humidity, and electrical noise designs that allow a vast expansion. This circuit will be developed and simulated using the LOGO comfort software and then implemented on the PLC hardware. It includes diagrams and a description that clearly describes how the system should operate.

Keywords: Automated Lighting System, PLC Hardware, LOGO Comfort Software

1. Introduction

A programmable logic controller is a digitally operating system designed for use in an industrial environment that uses a programmable memory for internal storage of user-orientated instruction for implementing specific functions. Its widely used in various aspects such as logic, sequencing, timing, counting and arithmetic to control through digital or analogue inputs and outputs. Control systems based on relay logic and PLC's have limited knowledge of programming controlled by a series of rules derived from the original relay logic [1]. System optimised for control tasks and rugged design to withstand vibrations, temperature, humidity and electrical noise and available in a range of sizes and capabilities, modular design allows expansion. The Siemens Logo PLC performs a devised access control system for securing the laboratories. Typically, the PLC device has four relay outputs and eight digital inputs. Two of the inputs have functioned as analogue [2]. The system contains one analogue information with an external amplifier to obtain the maximum possible resolution of input of 0-1V DC. The block diagram clearly explains the outlook of this project. The system inputs are directly assigned to the reactor room and provided with output terminals. Whenever the switch was in on condition, the corresponding door would automatically open. The reactor room performs like when the threshold triggers radiation level exceeds the gates are open automatically. In this paper, the design was developed and implemented according to the blocks requirement [3].

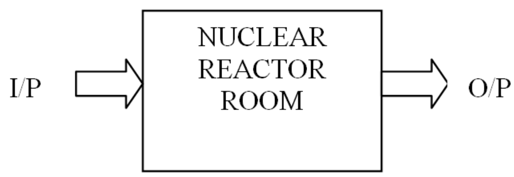

Figure 1. *Block Diagram.*

LOGO! Soft Comfort Software Features:

1) Method to delete user program and password from LOGO!
2) Additional Languages, resolution, and backlight function for the LOGO! Display.
3) It can perform online tests of LAD circuit programs.
4) Display of PI controller analogue output values in a trend view during simulation or online test.
5) Modem communication between a PC and LOGO!
6) USB cable communication between a PC and LOGO!
7) New memory card, battery card for LOGO! Basic Module.

2. Problem Analysis

In this Problem Analysis, The first step was to select the blocks for the circuit diagram by clicking on the icon group that contains the required blocks. According to this concept, some function blocks are analysed and discussed below, essential for this circuit diagram. Input blocks represent the input terminals of LOGO! It can be assigned an input block with a new input terminal. The LOGO! Versions Output blocks represent the output terminals of LOGO! It can be given an output block to a new terminal, provided not yet utilised in the circuit. The output block always carries the signal of the previous program cycle, and this value does not change within the current program cycle. AND Function tool was selected if a standard boolean logic block was placed on the programming interface [4]. The output of an AND function was only one if all inputs are 1 when they are closed. OR function was used when the output of an OR was 1 if at least one input was 1 (closed). Internal relays only exist in the internal memory of the PLC, and they are not associated with any real I/O. Timers are treated as configurable output devices with various available delays ON and delay OFF. The output of the timer appears as a switch elsewhere in the ladder diagram [5].

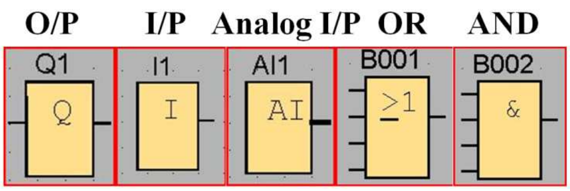

Figure 2. *Function Blocks.*

On delay, the output will not switch ON until the configured delay time has expired. The time Ta was triggered with the 0 to 1 transition at input Trigger. If the status at input stays one, at least for the configured time T, the output is set to 1 when this time has expired. The time reset if the status at input trigger changes to 0 again before T has passed. The output was reset to 0 when the input trigger was 0, and the threshold trigger will be switched ON and OFF depending on two configurable frequencies, and it measures the signals at the input frequency. It will capture the signal pulses during the configurable period of G_T. Q was set or reset according to the set threshold. An analogue signal is a physical quantity that can adopt continuous intermediate values within a given range. The opposite of analogue was digital analogue amplifier amplifies an analogue input value and returns it at the analogue output. The function reads the value of an analogue signal at the analogue input Ax. The value multiplied by the gain parameter A. Analog Comparator output was set and reset depending on Ax-Ay difference and on two configurable thresholds [6]. The function reads the value of the signal of the analogue input Ax. The value multiplies the value of parameter A (gain) and connects the product with Parameter B (offset). Output Q was reset or set depending on Axe-Ay's actual values and the set threshold [7].

3. Problem Solution

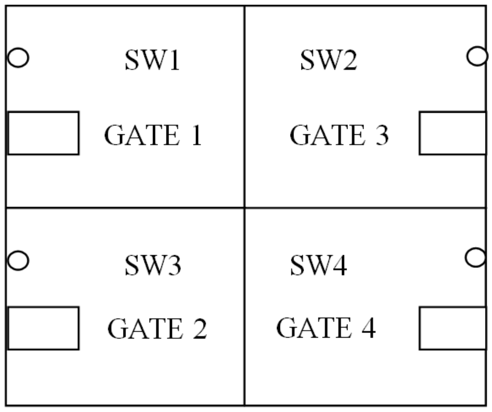

Figure 3. *Diagram of Nuclear Control Room Access.*

The above diagram explains the access in a nuclear reactor room. Whenever the switch is selected, the corresponding door will open automatically. The room was designed like whenever the threshold trigger radiation level exceeds the exit gats will open automatically. Developed the design using Logo comfort software and implemented it according to the blocks analysed in the problem analysis.

4. Problem Implementation

The functional block designing a control system for the final test stage of a surface-mounted PCB, and a delay of 2 seconds was allowed for the needle probes to contact the circuit and for the voltages of the PCB to stabilise. A test is initiated by a low to high output from the PLC. The PLC then checks the following results from the PCB (inputs to the PLC). Pin '1' of the PCB should give logic 1 and pin '2' logic 0. After 5 seconds, the analogue voltage on pin' 3'should is more significant than 4V. The PLC should then report a pass or fail (PLC output to go high for access). Noted the results of the system and described its operation. The blocks are placed in a functional block diagram and connected according to the ON delay input timer. It was connected to the OR gate with a message display and finally connected to the output.

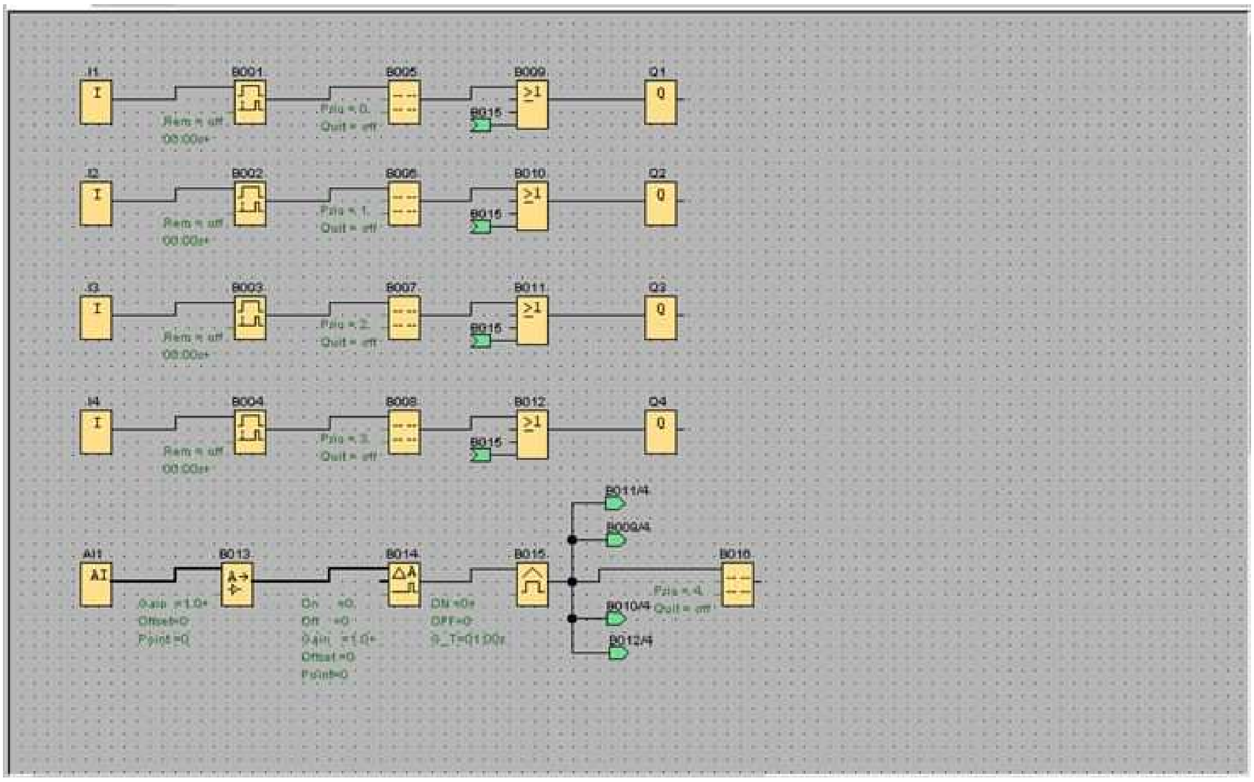

Figure 4. *Modified Blocks in FBD.*

The ladder design is simple relay wiring connections. Generally, vertical lines represent the power flow from left to right across a vertical rung. Each rung defines one operation in the control process. The ladder is read from left to right and top to bottom. When the rung has reached the endpoint, that control process starts again from the top. Each rung must begin with at least one input and end with one output [8].

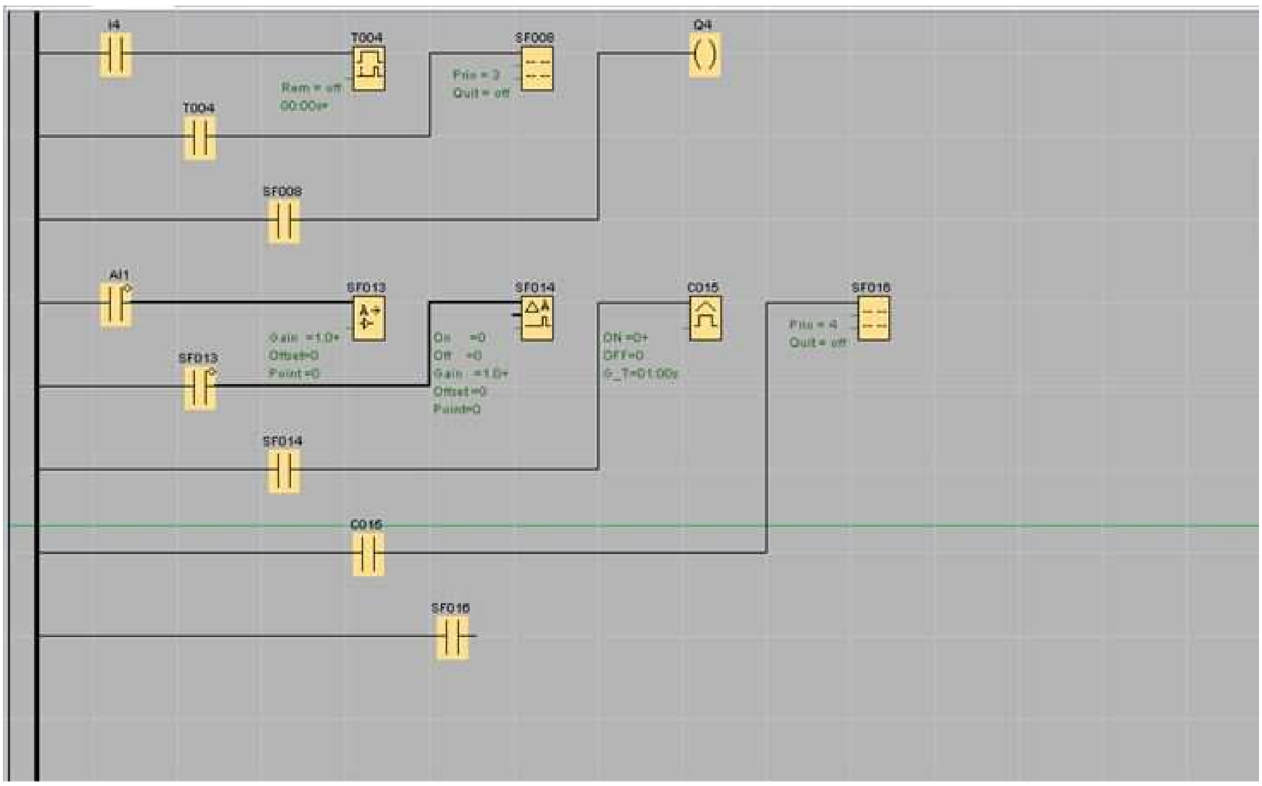

Figure 5. *Connecting Blocks in LAD.*

5. Results

The circuit was designed and analysed in the results section, and the functional block diagram and ladder logic diagram were performed and got the results.

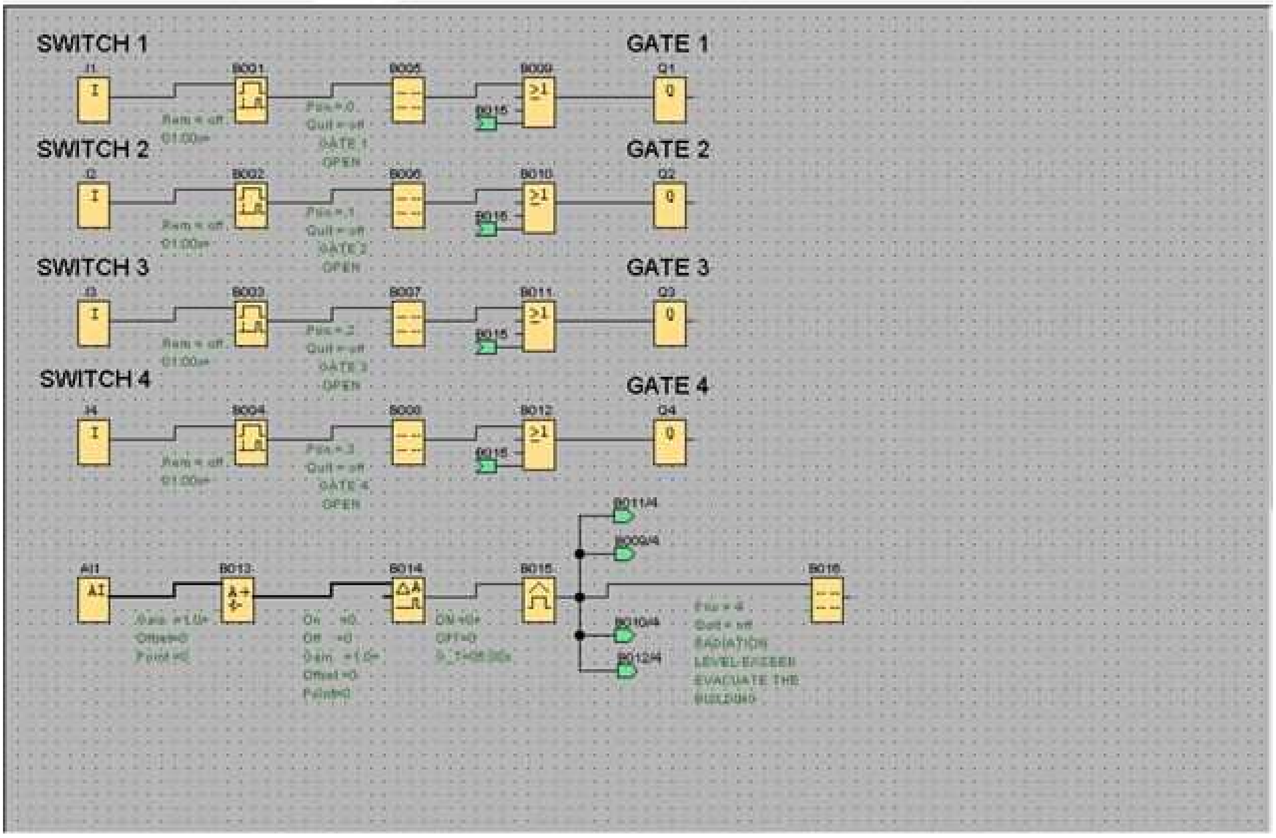

Figure 6. *Final Design of FBD.*

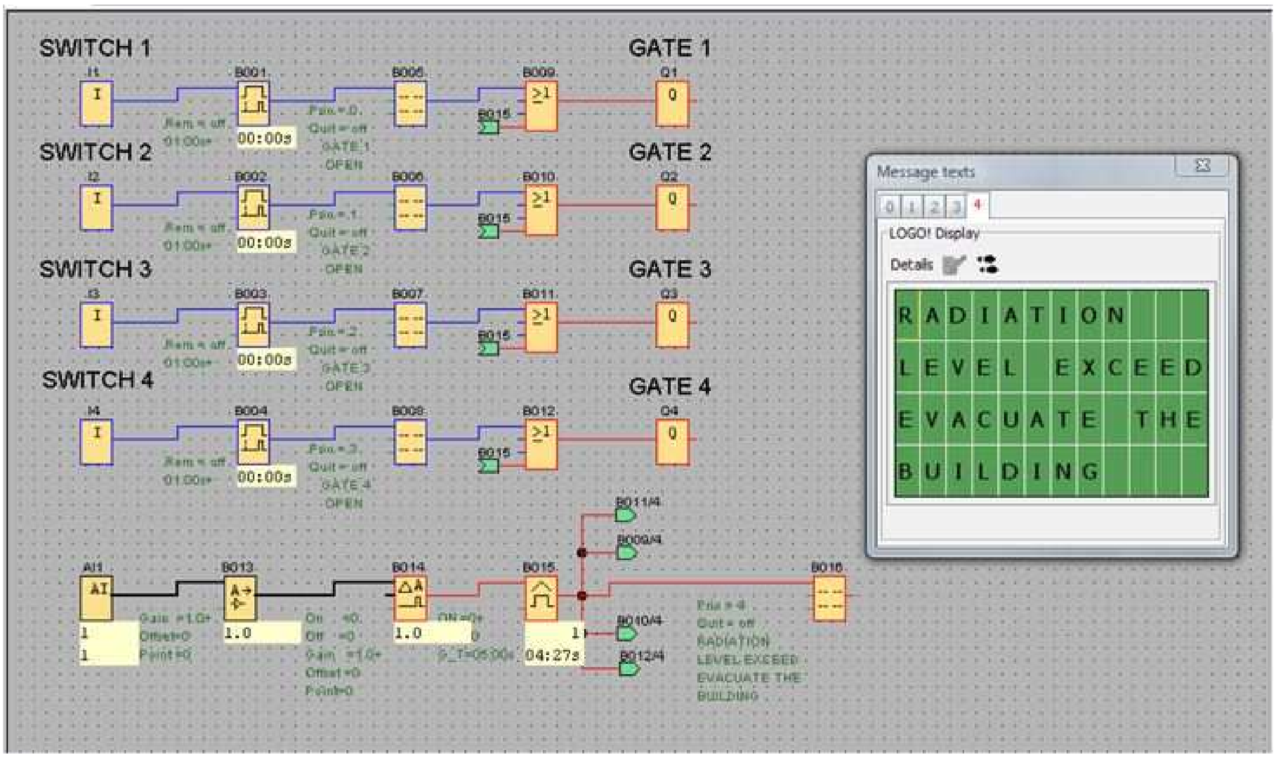

Figure 7. *All Gates are open when the radiation level exceeds FBD.*

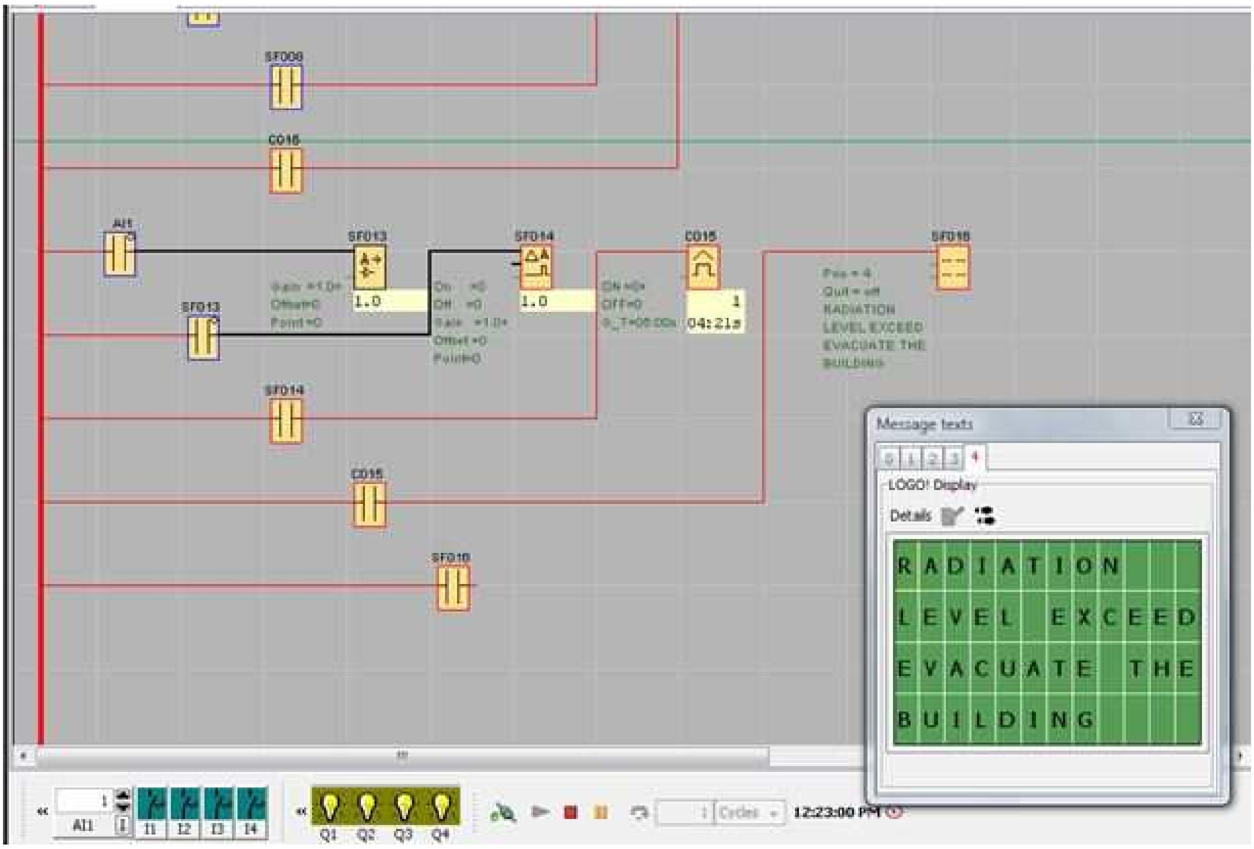

Figure 8. *All Gates are open when the radiation level exceeds in LAD.*

The diagram shows the PLC hardware, and the software was developed and implemented with the help of PLC. The output was obtained and produced in the below diagram.

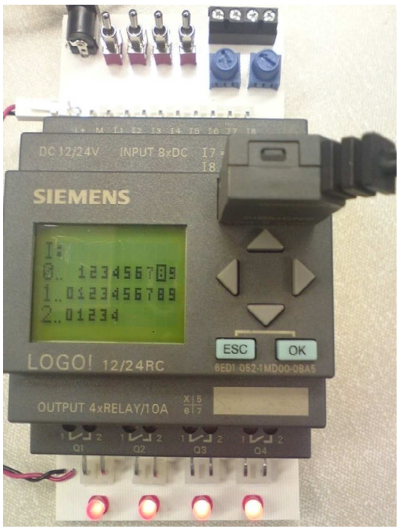

Figure 9. *All gates were open when the radiation levels exceeded.*

Table 1. *Tabular Colum of OR Gate.*

OR Gate:

I/P 1	I/P 2	I/P 3	I/P 4	O/P
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

Table 2. *Tabular Colum of AND Gate.*

AND Gate:

I/P 1	I/P 2	I/P 3	I/P 4	O/P
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

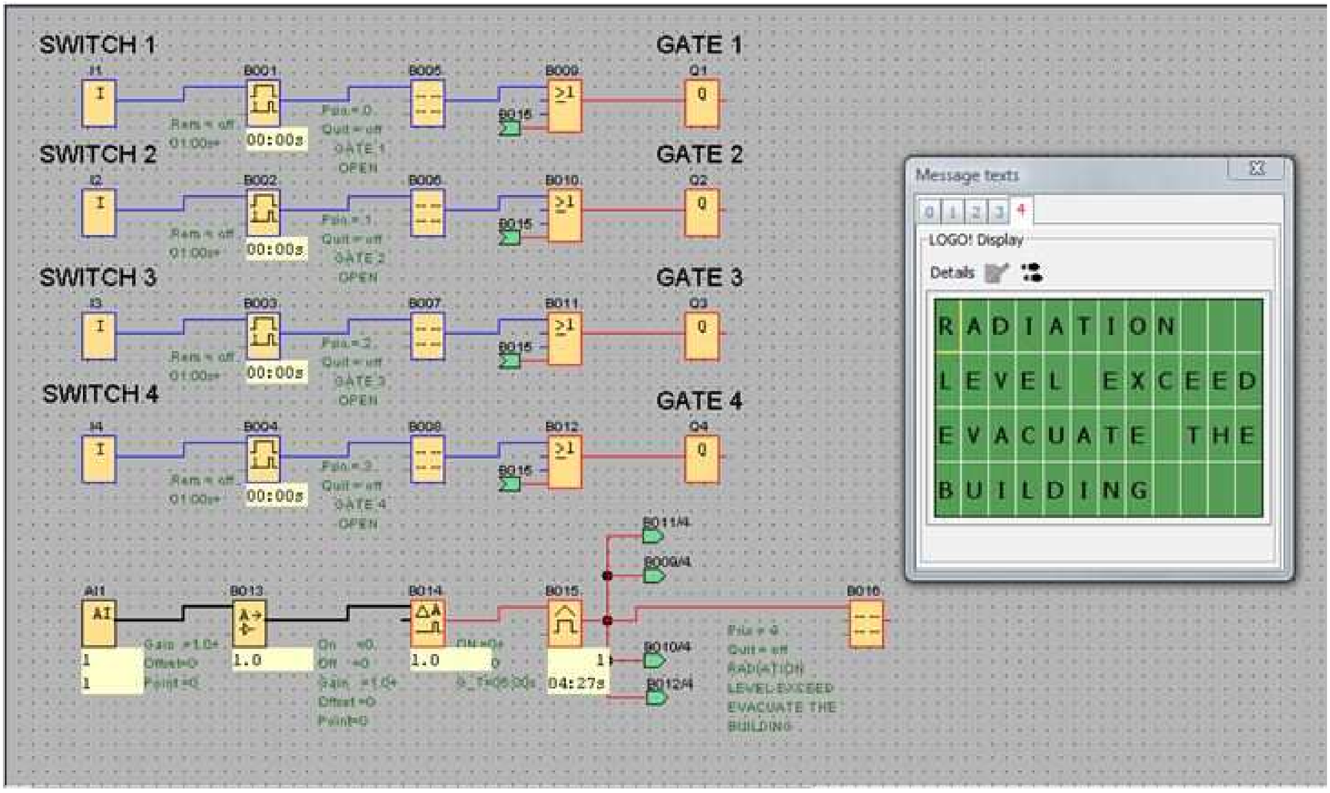

Figure 10. All Gates are open when the radiation level exceeds FBD.

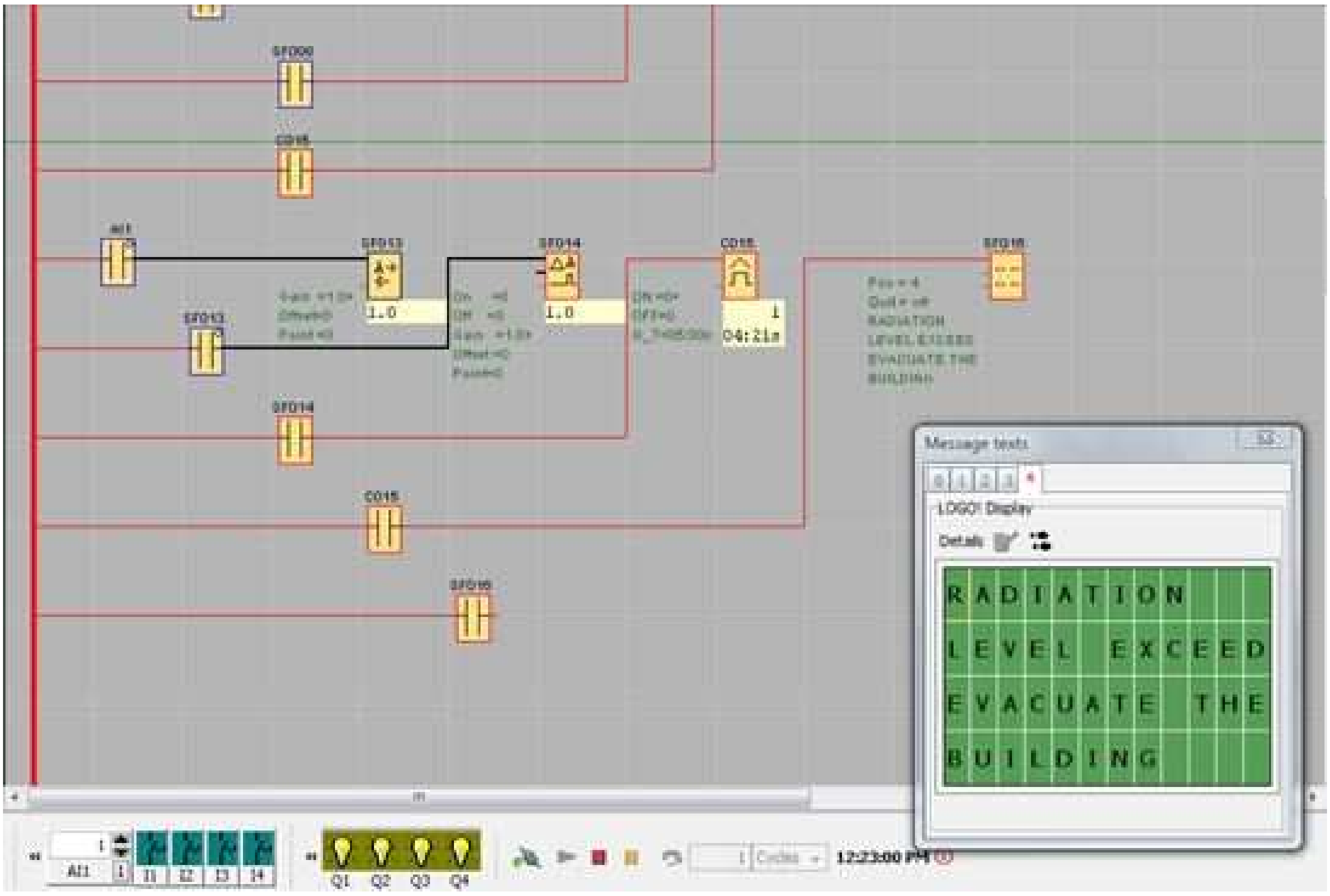

Figure 11. All Gates are open when the radiation level exceeds in LAD.

Figure 12. *All Gates are open when the radiation level exceeds PLC.*

6. Discussion of Results

The functional block diagram (FBD) graphical representation is used in functional blocks and consists of input contacts and output contacts, while the ladder diagram (LD) represents mainly relay logic operations. The network topologies of star and ring topologies utilised to design the system and timers are configurable output devices, a wide variety of delay-on and delay-off implemented [9]. The output of the timer appears as a switch elsewhere in the ladder diagram, and internal relays only exist in the internal memory of PLC. The proposed sensors will provide PLC inputs implemented on sensors and two different functions at different voltages. The communication path of PLC allows remote monitoring and control of intersystem communication. This section successfully achieved and discussed the results of functional block diagram (FBD) and ladder diagrams (LAD) outputs, along with PLC hardware results [10]. Expand the features of devices input and output, and analyses the internal architecture and various ladder programs and functional blocks. Programming the internal relays, timers, counter and fault diagnosis, and critically reflecting the design configuration of the circuits specific requirements of the system to interface into programmable devices and expand the synergy generated [11].

7. Conclusion

The system develops based on the hypothetical requirements for a lighting scheme for a building to have a floor plan showing where the lighting is automatic controlled. The Siemens PLC has a controller and sensors that manage the lighting. The design was developed for an access control system for a secure nuclear laboratory control and configuring the parameters like emergency evacuation and monitoring the temperature levels successfully with '3' relay outputs, and '2' analogue and '3' digital inputs with using of '1' timer and '1' counter. The circuit was developed using LOGO comfort software and implemented in PLC Hardware, and the produced results were accurate. All the contents like PLC hardware and LOGO comfort software were studied and implemented according to the procedure and observed the many new things while configuring the hardware.

References

[1] Fotouhi, M. and Eydgahi, Ali and Cavey, W. "Design of a programmable logic controller trainer". Vol 10, PP 17-20, 2000.

[2] W. Bolton, Programmable Logic Controllers, Fifth Edition, Newnes, 2009.

[3] M. G. Hudedmani, R. M. Umayal, S. K. Kabberalli, and R. Hittalamani, "Programmable logic controller (PLC) in automation", Adv. J. Grad. Res., Vol. 2, No. 1, PP 37-45, May 2017.

[4] Sadegh vosough and Amir vosough "PLC and its Applications" International Journal of Multidisciplinary Science and Engineering, November 2011, Vol. 2, No. 8.

[5] Programmable controllers- Part General information, international electrotechnical commission, IEC 1131-1, 1992 (BS EN 61131: 1994).

[6] W. Bolton "Programmable Logic Controllers" Elsevier Science & Technology, 2011, ISBN: 9780750681124.

[7] V. Pushpa Latha, K. R. Sudha, Swati Devabhaktuni, "PLC based Smart Street Lighting Control in Intelligent Systems and Applications" Vol 06, no 1, pp 64-72, 2013.

[8] Abueldahab, Yasser. "Installing PLC simulator for Ladder logic programming", November 2021.

[9] Wahlisch, Matthis, "Modeling the Network Topology", January 2010, PP 471-486, ISBN: 978-3-642-12330-6.

[10] Tasca, Laurence & Pingnton de Freits, Edison & Wagner, Flavio, "Enhanced Architecture for programmable Logic controllers targeting performance Improvement.", Vol 61, PP 306-315, June 2018.

[11] Wan, Hai & Chen, Gang & Song, Xiaoyu & Gu, Ming. "Formalisation and Verification of PLC Timers in Coq. 33rd Annual IEEE International Computer Software and Applications Conference. Vol 1, July 2009.