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DESIGN OF FIRE DETECTION AND ALARM SYSTEM USING PLC SCADA FOR SHOPPING MALL

Megha Bakshi^{*1}, Prof.B.N.Phadke², Prof.Praveen Patel³

Department of Fire Technology and Safety Engineering, Institute of Engineering & Science
IPS Academy, Indore M.P.

meghabakshi3@gmail.com

Abstract

PLC (Programmable logic controller) has now become a phenomenon concept when it comes to safety and long term product usability. In this paper we have presented design of fire security system based on programmable logic controller, several design guidelines have been shown in this paper. Also critical issues like selecting appropriate sensor and PLC has also been mentioned. Also a strict observation of the type of PLC used and its advantage are highlighted throughout the paper

Keywords: PLC (Programmable Logic Controller); fire sensor; ladder logic; SCADA (Supervisory Control and Data Acquisition); GX Developer; ST Language

I. INTRODUCTION

Fire detection systems are designed to detect fires early in their development when time will still be available for the safe evacuation of occupants. Early detection also plays a significant role in protecting the safety of emergency response personnel. Property loss can be decreased and downtime for the operation minimized through early detection because control efforts are started while the fire is still small. Most alarm systems provide information to emergency responders on the location of the fire, speeding the process of fire control. Fire detector are designed to respond at an early stage to one more of the four major characteristics of combustion, heat, smoke, flame or gas. There are many types of fire detectors have been used for different types of premises & fires. In this paper, we are discussing the design of a fire detection system using PLC SCADA for shopping mall.

II. ABOUT PLC

A programmable logic controller (PLC) or programmable controller is a digital computer used for automation of industrial processes, such as control of machinery on factory assembly lines. Unlike general-purpose computers, the PLC is designed for multiple inputs and output arrangements [1], extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in battery-backed or non-volatile memory. A PLC is an example of a real time system since output results must be produced in response to input conditions within a

bounded time, otherwise unintended operation will result.

A programmable logic controller is a specialized computer used to control machines and processes. It therefore shares common terms with typical PCs like central processing unit, memory, software and communications. Unlike a personal computer though the PLC is designed to survive in a rugged industrial atmosphere and to be very flexible in how it interfaces with inputs and outputs to the real world.

III. MELSEC FX FAMILY

The FX3U [2] is the latest addition to Mitsubishi Electric's FX PLC Family. It provides increased networking and positioning control solutions. The FX Family of PLCs is the PLC of choice across the world, industries and applications. The FX Family of PLCs has been an important part of control engineering for over 25 years. Throughout its history, the product has evolved from the original F Series into today's new FX3U. The FX Family has proven to be highly reliable and it consistently improves its compatibility with previous PLC generations. In our design we have used FX15 series of PLC. These PLC have 30 input-output pins. They have a cycle period of 0.55 μ s and a program memory of 2 kilo bytes. Micro PLCs have opened up a world of opportunities in Industrial Automation due to their small size and low cost. Now many applications [3] benefit from enhanced performance, easier manufacturing, maintenance and greater reliability. The FX Family has been a part of this revolution for over 25 years and has developed and redeveloped a range of products to suit most

applications. The FX Family consists of four main ranges which are distinct and independent but compatible. Figure 1 below shows a typical FX micro PLC.

IV. 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 trades people was greatly reduced.

Modern control systems [4] 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 Figure 10. 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

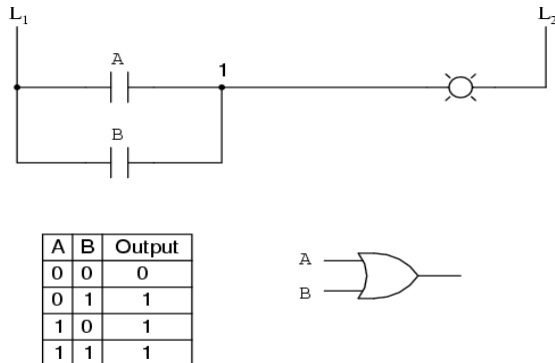


Fig.2 OR gate Ladder Logic



Fig.1 A Typical FX micro series PLC

contacts are shown with two lines with a diagonal line through them. When the input [5] coil is not energized the normally closed contacts will be closed (conducting). Fig. 2 below shows a typical ladder logic example an OR gate.

V. GX DEVELOPER

GX Developer has the following features[6].

1. Common software

GX Developer can create the data of the Q series, QnA series, A series (including the motion controller (SCPU)) and FX series, with their setting operations common, and is abbreviated to GPPA. Note that this does not apply to the A6GPP / A6PHP-compatible software package. Data can be converted into an SW-GPPQ GPP function software package (hereafter abbreviated to GPPQ) format file and edited on GPPA or GPPW. When the FX series is selected, data can be converted into a DOS version programming software (hereafter abbreviated to FXGP(DOS)) or SW0PC-FXGP/WIN programming software (hereafter abbreviated to FXGP(WIN)) format file and you can edit data on FXGP(DOS) or FXGP(WIN).

2. Advantages of Windows are utilized for dramatic improvements in operability Comment data created on Excel, Word or the like can be copied or pasted for data diversion.

3. Standardized programs

(1) Label programming
By using label programming to create sequence programs, you can create standard programs with labels without being conscious of device numbers. The programs created by label programming can be compiled for use as an actual program.

(2)Function block (hereafter abbreviated to the FB)
The FB is a function developed to improve the efficiency of developing sequence programs. The ladder blocks of a sequence program that are used repeatedly for sequence program development are converted into components to facilitate sequence program development. Also, the conversion of ladder blocks into components prevents sequence program inputting mistakes when they are utilized for other sequence programs.

(3) Macros :- By naming any ladder patterns (macro names) and registering them to a file (macro registration), merely entering simple instructions allows the registered ladder patterns to be read and the devices to be changed for data diversion.

Photo-electric smoke detectors measure the scattered light from smoke particles. They are most sensitive to larger, cooler, smoke particles typical of smoldering fires

such as plastics. Don't locate in area's subject to steam to prevent unwanted false alarms Often called optical or photo-optical detectors.

4) Linear beam smoke detectors

Linear beam smoke detectors measure the reduction of intensity of a beam of light due to the presence of smoke particles. They have broad response to a wide range of smoke types, and are particularly useful for detection applications in large spaces. Require careful installation.

5) Aspirated smoke detectors

Aspiring-type systems e.g. (Vesda Systems) are more effective in detecting smoke than point type detectors in many applications. The sensitivity of the actual 'sampling points' is dependent on the sensing chamber sensitivity and the design of the aspiring pipe network. Physical or electronic filtration of the air drawn through the sensing chamber and processing of the output signals has been showed to reduce spurious alarms caused by pollution, smoking [10]and dust particles.

6) Carbon Monoxide (CO) fire detectors

CO fire detectors respond to the presence of carbon monoxide (CO) in fires involving carbon based materials. CO is produced due to incomplete combustion during smoldering or slow burning fires. Not suitable for the detection of slow burning fires. Currently should not be used as a sole detector for early warning, but used in combination with other early warning detectors as part of a fire engineering design. Ongoing tests are being carried out to improve these type of detectors.

7) Combination (multi-criteria) detectors

These type of detectors are available as part of an analogue addressable fire alarm system. They vary of the type of combination, and can involve up to 4 separate sensing elements, such as CO, Infra- Red Sensing, Optical and Heat detection.

The integration of continual monitoring of all the major elements of a fire allows a quick response [11] to any fire and the reduction of nuisance alarm activations (false alarms) Discuss the type of detector required with your fire alarm company to ensure the most suitable detector for the location. A combination of detectors ensures the

property has the best coverage for the detection of fire.

VI. CONCLUSION

In this paper we started by giving a basic idea about the programmable logic controllers that are now a leading industrial backbone of automated industries. We also described Mitsubishi Micro Series PLC and its development environment namely the GX developer. No discussion of PLC could be complete without the ladder logic hence a subsection about ladder logic has also been added. Lastly the paper describes different type of fire sensors available in the market that could be deployed with PLC.

VII. REFERENCES

- I. Dr.J.P.Karun, J.Jathunathanan, M.Suhinthan, K.Thishokumar and F.S.Cassim. "Power Line Based Intercom"
- II. M.P. Sanders and R.E.Ray, "power line carrier channel & application considerations for transmission line relaying" Florida. Pulsar Technologies, Inc.
- III. L.E.Frenzel. (2001). Communication Electronics Principles and Applications. 3rd Edition. USA. Mcgraw Hill Companies.
- IV. Hui Xiao, Xuebin Wu, Xiaojiao Tong, Rong Lian, Zeng Xiangjun, Sheng Su . (2005). Application of Spread Spectrum Communication in Medium Voltage Power Line Carrier . IEEE/PES Transmission and Distribution .
- V. Petrus A. Janse van Rensburg and Hendrik C. Ferreira. (2010). Design and Evaluation of a Dual Impedance-Adapting Power-Line Communications Coupler. IEEE Transactions on Power Delivery, Vol. 25, No. 2. The Institute of Electrical and Electronics Engineers (IEEE).
- VI. Chong-Yeun Park, Kwang-Hyun Jung, Won-Ho Choi. (2008). Coupling Circuitary for Impedance Adaptation in Power Line Communications using VCGIC. IEEE Journal. South Korea. Department of the Electrical and Electronic Engineering Kangwon National University.

- VII.** Won-ho Choi, Chong-yeun Park. (2007). A simple line coupler with adaptive impedance matching for Power line communication. IEEE ISPLC. pp.187-191.
- VIII.** Francisco Javier Canete Corripio, Jose Antonio Cortes Arrabal. (2002). Broadband modelling of indoor power-line channels. Customer electronics, IEEE transactions. Vol. 48. pp. 175-183.
- IX.** Li Qi, She Jingzhao, Feng Zhenghe. (2004). Adaptive Impedance Matching In Power Line Communication. International Conference on Microwave and Millimeter Wave Technology Proceedings. Beijing, China. Department of Electronics Engineering , Tsinghua University.
- X.** Mathas Goet& Manuel Rapp, Klaus Dostert, (2004) Power Line Channel Characteristics and Their Effect on Communication System Design. IEEE Communications. Volume 42, No. 4.
- XI.** Jorg Bausch, Timo Kistner, Marko Babic, Klaus Dostert. (2006). Characteristics of indoor Power Line Channels in the Frequency Range 50-500kHz. IEEE ISPLC. pp.86-91.