|| Volume 5 || Issue 5 || May 2020 || ISSN (Online) 2456-0774
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH
AND ENGINEERING TRENDS

PLC BASED AUTOMATIC FIRE DETECTION & CONTROL SYSTEM

C.R.Babar[1], N.R.Chavan[2], D.J.Mulay[3], H.S.Kamble[4], M.P.Bhajekar[5]

Student, *Department of Electrical Engineering, PES's, Modern College of Engineering,Pune-05.*[1,2,3,4]
Assistant Professor, *Department of Electrical Engineering, PES's, Modern College of Engineering,Pune-05.*[5]

chaitanyababar01@gmail.com[1], nikhilchavan1182@gmail.com[2], harshadkamble3012@gmail.com[3], durvamulay@gmail.com[4], mugdha.bhajekar@moderncoe.edu.in[5].

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Abstract: ***The main objective of the study is to assemble a PLC based fire detection and extinguishing system and to find its performance. Such an automated PLC system uses various types of sensors such as smoke detector, heat sensor to detect fire and PLC for control . Whenever fire generates in the zone where automated fire extinguishing system is present, due to fire, generated smoke will be detected by smoke detector and if temperature crosses a certain limit, alarm goes on for warning and solenoid coil get energized resulting in turning ON the valve of the high pressure carbon dioxide to extinguish fire. Latch circuit is incorporated to make alarm continuous. This system is most effective for fire controlling and extinguishing.***

Keywords: - *Fire Fighting System, PLC, Automation, Smoke Detector*.

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I. INTRODUCTION

Fire causes the greatest loss of life and property in urban areas. Urban fires have devastating impact on communities. Unplanned urbanization has intensified the problem further. Due to fire causing in commercial and residential area, large economical loss and massive destruction of property takes place, also there are chances to be get severe injuries which sometimes leads to death.

The technology of twenty first century covers the side of safety and security system field in a very compressing steps, because the development was so fast. Automation is largely used in various industries taking into consideration its various advantages such as, reduction in manpower, improvement in accuracy, efficiency and speed. This project entails how to extinguish fire using Programmable Logical Controller (PLC).

In this research the electronic mechanism used in certain places; the application used is simply detectors/sensors especially of heat and gas. The sensors of heat and gas depend mainly on sensitivity of them; and so the effect reflects on the circuit. Signal found was treated using ladder diagram. When input is found the devices directly gives "buzzer / lamp" signal.

A Fire-fighting system, as the name suggests is a system concerned with extinguishing fire using sensors. Such an automated Programmable Logical Controller (PLC) system uses a solenoid coil to operate CO2 extinguisher. The PLC also monitors the operation of the nozzles. In advent of a fire, there should be a continuous flow of CO2 through the line. Depending upon the magnitude of fire, the PLC is programmed.

II. EXISTING SYSTEM

The existing firefighting system uses Printed Circuit Board (PCB) based panels. This panel monitors the pressure switches on hydrant line. The panel consists of different components like IC 4011, IC 4081, IC 4017, IC 4020, Capacitors and relay cards. The system operates on 24V DC supply.

III. COMPARATIVE ANALYSIS

Most of the existing automated firefighting systems use Printed circuit board (PCB) based panels. Although such panels are reliable and have low cost they have large number of components which makes the circuitry complicated. Such a complicated circuitry once employed cannot be altered to fulfill customer's demands. Large number of components also makes the detection of faults difficult and the faulty part has to be replaced immediately.

In this age of multi-functionality, where expandability of a utility has utmost importance the existing system fails short and there arises a need for a more flexible PLC based system. So PLC based system can be used instead of existing system. Such a system using PLC scans digital and analog inputs through different sensors. It can execute the logic with respect to the scanned inputs, takes necessary decision and sends it to digital/analog outputs. It has the ability to combine Digital and Analog logic which is a powerful tool for the engineers. It is easy to program, debug and download which increases its reliability. It also requires less wiring. A PLC easily accommodates the additional I/O's without requiring changes in the existing wiring.

PLC can perform a wide variety of control tasks, from single, repetitive action to complex data manipulations. A PLC can be used to establish communication between other PLCs which facilitates data collection and information exchange. Due to above mentioned advantages, a PLC based fire fighting system can be proposed to replace the existing PCB based system.

III. BLOCK DIAGRAM

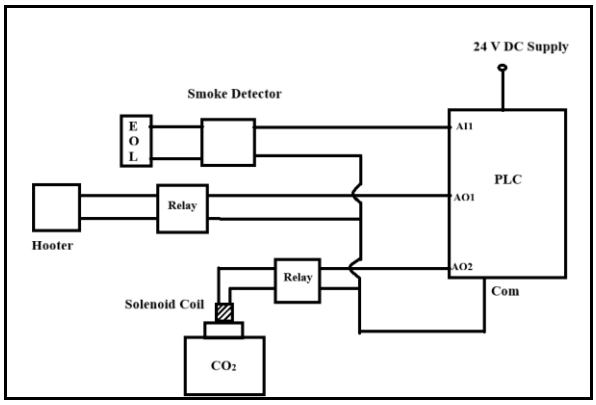

Figure -1: Block Diagram

As we can see in above block diagram the main components of the system are PLC, input devices like smoke/heat detector and output devices like hooter, solenoid coil, etc. The brief description of each component is given below.

IV. HARDWARE DESCRIPTION

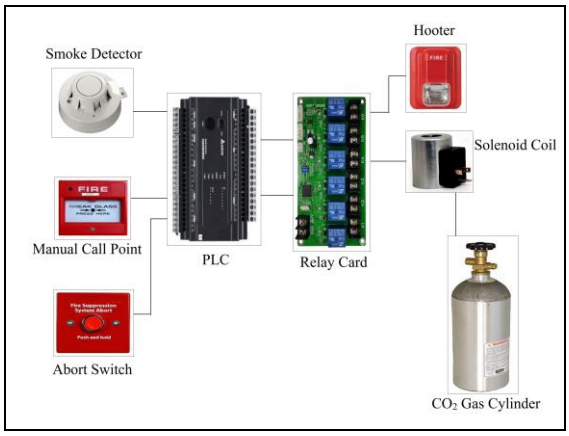

Figure -2: Hardware Connections

1. SMPS: Switching-Mode Power Supply, is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from a DC or AC source to DC loads, while converting voltage and current characteristics. Higher power conversion efficiency is an important advantage of a SMPS. Efficiency is high up to 80%-90%. Here we have used AC-DC type of SMPS.

2. PLC: PLC stands for "Programmable Logic Controller". A PLC is a digital computer; specially designed to operate reliably under harsh industrial environment It is used to automate industrial processes such as a manufacturing plant's assembly lines, parking system etc. PLC has CPU, I/O modules, power supply, memory and programming software. A PLC can be programmed according to the operational requirement of the process. In the manufacturing industry, there will be a need for reprogramming due to the change in the nature of production. To overcome this difficulty, PLC based control systems were introduced. The main advantage of PLC over conventional control system is that you can go back and change a PLC program.

3. Relay Card: A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts. Relays are used where it is necessary to control a circuit by an independent low-power signal.

4. Smoke Detector: A smoke detector is an electronic device that senses the smoke, typically as an indicator of fire. It senses the smoke and send it to controller or rings the alarm itself in small scale installations. There are two basis types of smoke detectors on the basis of working principle: Photoelectric and Ionization. We have used photoelectric type detector. It detects the sudden

5. Manual Call Point: Manual call points are used to initiate an alarm signal, and operate by means of a simple manual button press or when glass is broken revealing a button. They can form part of a manual alarm system or an automatic alarm system

6. .Hooter: Hooter is an alarming device used to alert the people regarding fire. So that people will evacuate the premises. Specification: 24V DC, 120mA, Buzzer level-100Db Solenoid: Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids.

7. Fire Alarm Cable: It is a special type of cable used in emergency applications. We use this cable as it has XLPE insulation. It is physically very strong and can sustain fire up to 2hrs.

V. HARDWARE DESIGN

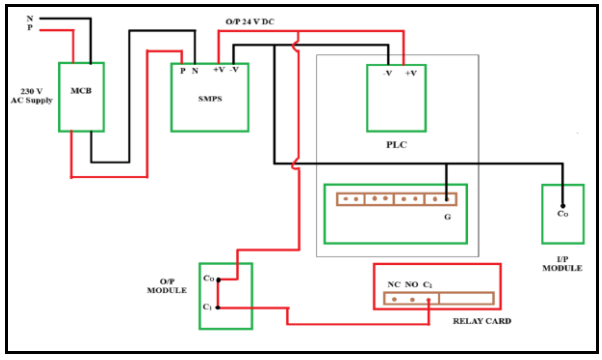

Figure-3: Connection Diagram

Above hardware design is for the DELTA PLC of series DVP-14SS211R which has 8 digital and 6 analog inputs.

VI. WORKING

Above Fig. shows the connection/block diagram of the system**.** System basically uses smoke detectors, manual call points as input devices of PLC and hooter, Solenoid valve as output devices

Whenever any detector detects the smoke; detector sends the signal to PLC. Hence PLC switches ON the hooter. System is also provided with manual call points to send input signal manually. To avoid false alarms we have implemented the cross zoning method. It means fire extinguishing system only operates if two or more detectors detects the smoke/fire. So, if another detector detects the smoke then PLC gives signal to solenoid valve and hence its timer get activated. Timer function is provided as an extra measure to avoid false alarms, so if this command is false we can turn off the timer manually. If not false then after given time setting solenoid valve get activated and CO_2 release will get start.

VII. ADVANTAGES

1. As current fire system controllers are PCB based, so by using PLC we have reduced Complex connections.
2. PLC provides flexibility in programming.
3. PLC programmes are easily correctable and improvable but in PCB we require to change the PCBs
4. Though for small scale cost might appear more but for large projects it will be affordable.
5. CO2 based extinguishing system is very beneficial over water based system because it doesn't damage electronic or other sensitive equipment which get damages due to water.

VIII. APPLICATION

1. IT Sector
2. Server Rooms
3. Computer Labs
4. Biotechnology and forensic Labs
5. Chemical Industry etc.

IX. FUTURE SCOPE

This system can be further modified for the requirements of chemical industry for detecting hazardous gases using gas detectors. If we add LPG gas detector then system will be beneficial in preventing fires causing due to LPG.

Further we can also add GPS, messaging or emergency contact system if needed.

X. CONCLUSION

Here we can conclude that by using PLC instead of existing dedicated controllers we can reduce the complexity of the system. It requires less space and reduces errors in manufacturing of control panels. . It is easy to handle and modify the logic.

Also most of the existing fire detection/alarming systems and extinguishing systems work independently. So, using our system we can interconnect or fetch both the system.

Besides we found that cross zoning is important for avoiding false alarms/signals.

Also we concluded that CO_2 based fire extinguishing system along with PLC is very much useful than water based extinguishing system in places like server rooms, computer labs where contact with water can cause huge economical losses.

Hence, it can be concluded that the system designed and developed works satisfactorily

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