

PLC BASED SECURITY SYSTEM IN SHIP

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Abstract— Over the years the demand for high quality, greater efficiency, and automated machines has increased in the controlling and monitoring purpose. Ship requires continuous monitoring and inspection at frequent intervals. There is possibility of error in measuring parameters at various stages involved with microcontroller. This paper demonstrates a PLC (Programmable Logic Controller) based security system in ship. Security system for entire ship is big task so we focus on fire sensitive areas, restricted area where few authenticated peoples are allowed like control room, artillery room in ship. This paper includes fire detection as a safety parameter which is a major issue. We are using 2-3 sensors to cover entire control room. Second parameter is Face Authentication, in which we are taking a still photograph of a person and checking for authentication. After authentication system allows entering in restricted region. This face detection method avoids need of operator for continuous monitoring door status of control room.

Index Terms— Fire detection, face authentication, HMI, PLC.

I. INTRODUCTION

Accurate fire detection & controlling in ship becomes a difficult task due to harsh environments. In ships fire may be caused by impact of projectile, electrical sparks, etc. The combination of heat, fumes etc inside ship accounted for most false alarms or failures of conventional smoke/heat sensors. Other conventional methods for fire detection such as smoke sensors rely on chemical reaction and therefore have too slow response time. So we are using infrared sensor for fire detection, which purely detects the fire and gives immediate response. Second parameter is Biometric Authentication. For this we have done analytic survey of existing system in terms of accuracy and cost, finally we selected face authentication for door opening action of a control room in ship. We are using PLC of B&R Industrial Automation Pvt. Ltd. which is an Austria based company and Pune office is located at Wakdevadi. It has 12 digital inputs and 12 digital outputs.

II. LITERATURE SURVEY

We started hunting for various ideas on the World Wide Web. Starting from initial stages we were interested in Automation area. Automation is largely implemented in various industries, taking into consideration various factors such as reduction in manpower, avoid risk at hazardous

places, improve accuracy, increase speed of production, safety measures etc.

We discussed lots of Project ideas with our internal guide, including Industrial projects, societal based project which can be designed using PLC. While searching the information for developing some idea we came across ‘Sindhurakshak submarine incident’, so we felt that why not to work on some parameter of ship. Then we start searching paper on security parameters in ship. During search we came across parameter like fire control, authentication, etc. We also paper on fire detection and other security parameter. Then we finally decided to implement a “PLC Based security system in ships”

Before selecting this as a project we found that usually CCTV cameras are installed in ships. If any intruder tries to go into unauthorized place the CCTV (close circuit television) camera won’t take any actions, but if we use biometric authentication then the intruder will not be entertained anywhere, so the security will be held at a very high level. Also we can recommend this system as a successful experiment to be used.

We had undergone the training session and its coding part and how to design the HMI (Human Machine Interface). After that we had started working on the project

III. BLOCK DIAGRAM AND WORKING PRINCIPLE

A. Block diagram

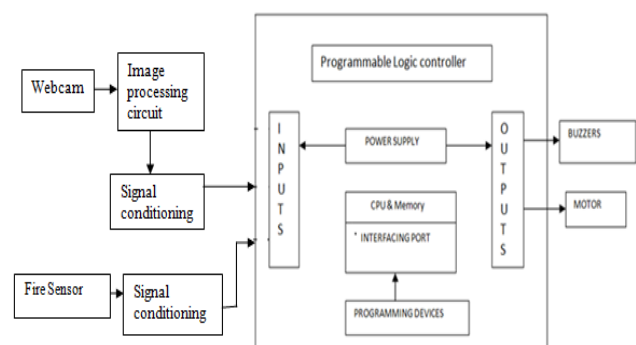


Fig- 1: Block diagram

B. Element of block diagram

1. Power panel (PLC + HMI)
2. Fire sensor
3. Image processing circuit
4. Signal conditioning circuits
5. Motor and buzzer

C. Block Diagram Explanation

A programmable logic controller (PLC) or Programmable Controller is a digital computer used for automation of electromechanical processes such as control of machinery on factory assembly line, amusement rides or light fixtures. PLC is used in many industries and machines. Unlike general purpose computer, PLC is designed for multiple input and output arrangement, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in memory backed up or non volatile memory. A PLC is an example of a hard real time system since output result must be produce in response to input condition within a limited time, otherwise unintended operation will result. Our project deals with providing the security in terms of interface with authorized vault. We are using Image processing for allowing only authorized persons to enter into specific area. In image processing we are using the concept of verifying the face of person with reference face & only matched person will be permitted to enter the room. Fire sensor module is used for fire detection purpose. It is infrared sensor works on line of sight range. So 2-3 sensors are required to cover whole control room.

IV. HARDWARE IMPLEMENTATION

A. Fire sensor

The Fire sensor, as the name suggests, is used as a simple and compact device for protection against fire. The module makes use of IR sensor and comparator to detect fire up to a range of 1m. The device, weighing about 5 grams, can be easily mounted on the device body. It gives a high output on detecting fire. This output can then be used to take the requisite action. An on-board LED (Light Emitting Diode) is also provided for visual indication.

1) Pin Configuration and Maximum ratings

Table -I: Pin configuration

Pin.	Function	Description
1	o/p	Digital o/p
2	Vcc	High
3	GND	Low

Table -II: Maximum rating

Function	Minimum	Typical	Maximum
o/p	4.2	4.5	4.7
Vcc	4.5	5	5.5
GND	-	0	-

2) Fire sensor module

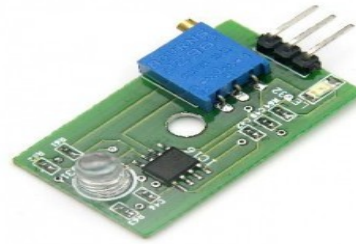


Fig- 2: Fire sensor module

B. Image Processing Circuit

In image processing we are storing 2 database images. For authentication, person needs to compare his image with stored database images. Result of comparison will be conveyed to the microcontroller via serial communication through MATLAB(Matrix laboratory). Later microcontroller signal will be given to the plc. If person is authorized only then he will be allowed to enter the cabin.

1) Serial communication circuit:

Below shown circuit is interfaced with microcontroller to generate PLC compatible signal.

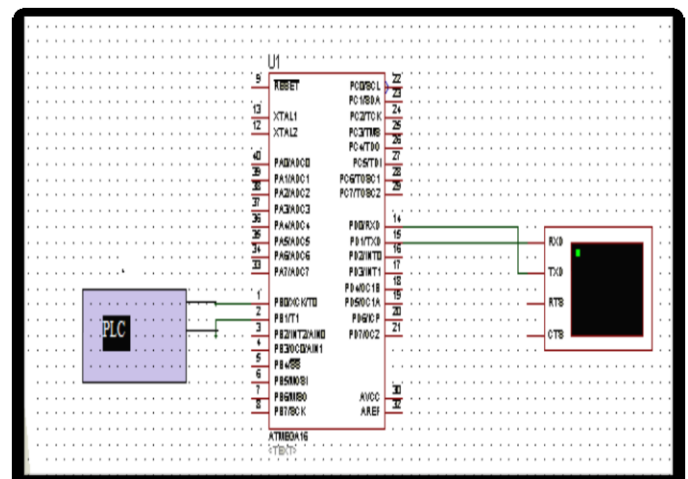


Fig- 3: signal acquisition circuit

This circuit act as intermediary in PLC and computer. This circuit is used due to absence of serial communication port in PLC.

V. SOFTWARE IMPLEMENTATION

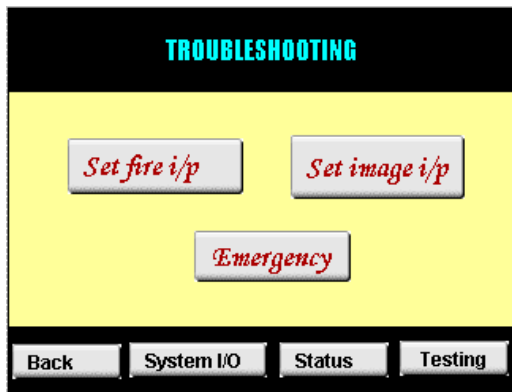
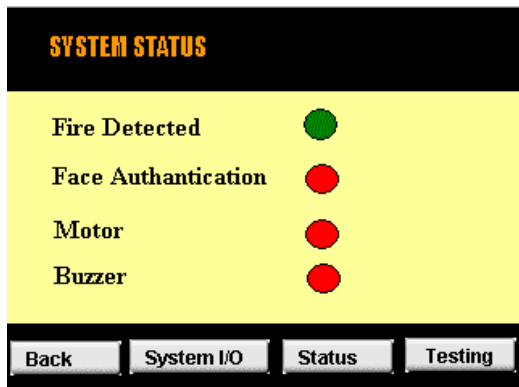
A. Software tools required

- 1) Matlab
- 2) Automation studio 2.0.7.1 version

Matlab is used for implementing image matching algorithm and Automation studio is used for PLC programming and HMI designing. Few HMI slide are added below.

VI. RESULT

B. HMI design



C. Implemented algorithm

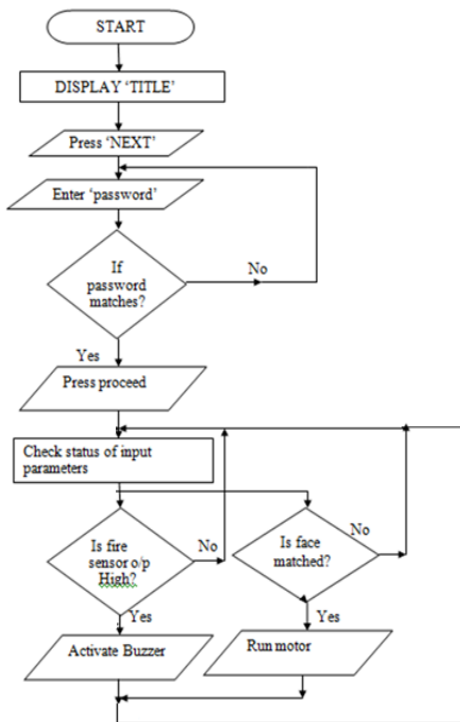


Fig- 4: Flowchart of the system

A. Software testing (simulation) of circuit

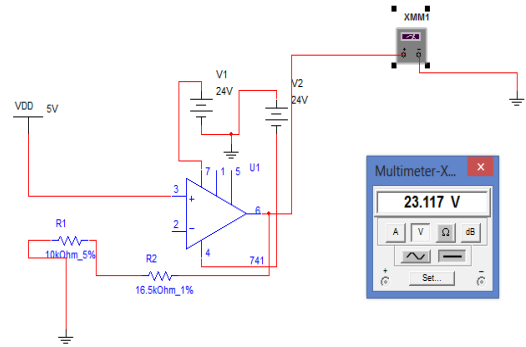


Fig -5: Signal conditioning circuit

B. Actual testing of Fire sensor



Fig- 6: Fire circuit testing

C. Testing of Serial Communication circuit

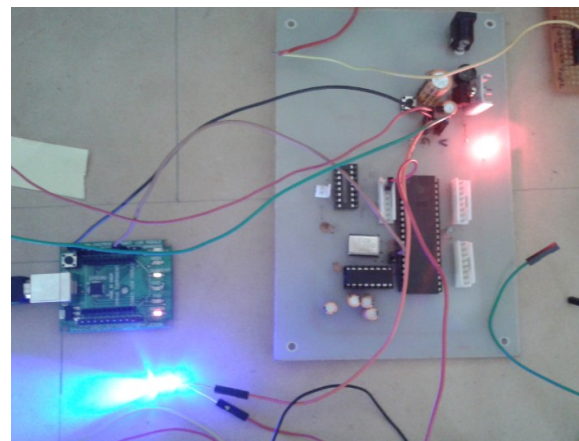


Fig- 7: Testing of serial communication

After image comparison if image matches with stored image, a character is send to PLC through signal conditioning circuit. Fig-7 shows character is received from computer.

D. Motor Driver Circuit

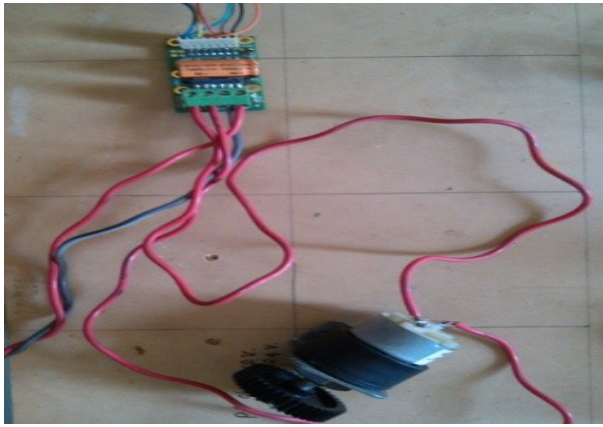


Fig-8: Motor driver assembly

E. Result Table

Table III. Fire sensor

Parameters	Output
Fire detected	Voltage given by sensor is 3.5 volt
Fire absent	Voltage given by sensor is 0 volt

Table IV. Face recognition

Parameters	Existing System	Proposed System
Security	Good	Better
Accuracy	Good	Better

VII. APPLICATIONS

- 1) In ship.
- 2) In the Aeroplane.
- 3) In submarine.
- 4) Image processing can be used almost in all types of security systems

VIII. FUTURE SCOPE

Presently our system includes only two parameters. But we can increase security parameters to improve internal security. In this project we are using simple algorithm for image authentication which is having only 2 database images, we can increase this Number.

IX. CONCLUSION

In various ships, Automation is used to improve accuracy & avoid manual errors. Thus our project is an attempt to provide a solution to security problems which is a major issue nowadays in the world. Also we are trying to provide one of the solutions to ship security. Through this project we are trying to save manual efforts to a great extent.

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A. Reference papers

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- [2] Cheng Caixia, Sun Fuchun, Zhou Xinquan "One Fire Detection Method Using Neural Networks", TSINGHUA SCIENCE AND TECHNOLOGY ISSN1 11007-0214/105/171 lpp31-35 Volume 16, Number 1, February 2011

B. Training modules of B & R Industrial Automation Pvt. Limited, Austria

- 1) Automation basics(TM247)
- 2) Ladder (TM240)
- 3) The basics of automation studio(TM210)
- 4) Automation studio diagnostics(TM223)
- 5) The basics of visualization(TM600)
- 6) Automation runtime(TM213)
- 7) Programmable Logic Controller by John Web

C. Web-sites

- 1) <https://www.br-automation.com>
- 2) <https://www.alldatasheets.com>
- 3) <https://www.futuronix.in/industrial-projects.html>.

D. Reference person

Mr. Mahesh Patil (Manager, Goa Shipyard)