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Industrial Security Solution With Embedded

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Abstract: This paper is about the design, implementation, and testing of an Embedded Based Industrial Security System. This is completely self-contained PIC- Microcontroller based Security System which gives complete security measurements for an Industry. It has the facilities of Intruder Alarm, Proximity Detector, Attendance Entry, Fire sensor. PIC Microcontroller is linked to the PC through the RS-232port, the feature packed enables the Security System to be interfaced with the PC and to provide PC-based output. During Computer, Aided display of the output, the PC takes control and monitor any signal from security systems such as Proximity, Fire Occurrence, Attendance Entry, and Unauthorized Entry. The response of the security system is reflected immediately in the monitor. The user can access the data to get security reports at any time using the display screen of the project.

Keywords: Industrial Security, PIC - Peripheral Interface Control, MCU - Micro-Controller, LDR - Light Dependent Resistor, IR – Infrared, PC - Personal Computer.

I. INTRODUCTION

An Industry is a large area to maintain security measures manually, so the different problems faced by the industries can be overcome by the usage of certain advanced electronic equipment. Such advanced electronic circuits are employed together to implement the security system. The Industrial Security System provides all the facilities for full security necessities in an Industry. Normally the problems in the Industries are due to the Intruders, Fire Accidents, and Improper Attendance Maintenance. This project consists of an Attendance Entry, Unauthorized Entry Alarm, Fire Sensors, Proximity Sensors & Door Open Control (Magnetic Switch).

II. PROJECT DESCRIPTION

A. Attendance Entry

The circuit used for the attendance entry is implemented by the usage of the special circuit employing the IR-Sensor Board consisting of a total number of 8 IR-Sensors. The total numbers of Employers Entry that can be made are of 256.

Each employer's card is provided with a specific number of holes. These holes will allow the IR-rays to pass through them to the detector. The other rays from the Emitters are not allowed to an incident on the detector. Whenever the IR rays flow through the hole, the corresponding output at that location is low, otherwise, it is in the high state.

In the circuit diagram, the R15 resistor acts as a current limiting resistor for the IR-Emitter.

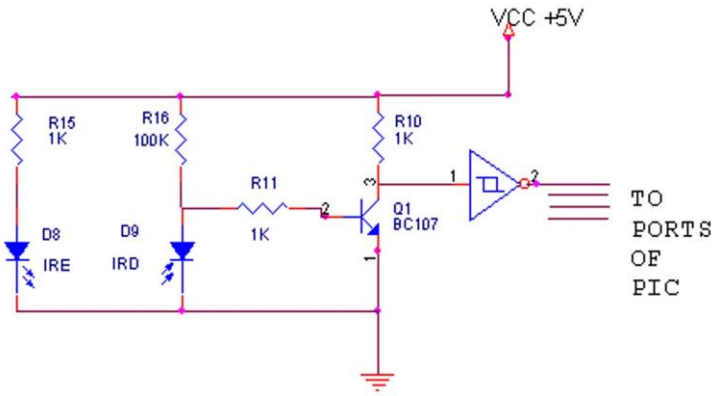


Figure 1 Staff Attendance Circuit Diagram

FLOW OF CURRENT = 5V/1K =5mA.
R16 limits the current output of the IR-emitter. Being IR-detectors are +ve sensitivity elements. We should not consume more current from it. If not then the device will become as a diode.

I=5V/100K=50uA.
So, we consume 5uA from the detector.
R11 is the bias resistor for the transistor.
Whenever IR-Emitter ray's incident on the detector & makes the detector as a conductor.so the junction point's voltage becomes low. That makes the transistor into cutoff condition. The transistor collector becomes logical 5v and Schmitt trigger output becomes logical low. This is purely TTL.

Ultimate Result:
If a card consists of a hole, then the rays pass through it and the output will be low.
Else the output is high. Thus, an Attendance Entry circuit works.

B. Proximity Sensors

The proximity sensor is used to sense the bombs and other explosives like RDX etc. The Proximity Sensors are generally the metal detectors which are sensitive to all the metals.
In general, there are two types of proximity sensors:

- Inductive proximity sensor
- Magnetic proximity sensor

Magnetic proximity sensors are expensive compared with inductive proximity sensors, so we are going in for the use of inductive proximity sensors. It works under any atmospheric conditions.

There are two types of inductive proximity sensors.

- NPN Proximity Sensors

When no metal is approaching the sensors, its output will be high. When a metal approaches the sensor, its output will be low. Induction of the coil will be changed when current passes through it. When the low output signal is given to the base of Q1, it does not conduct. Hence the voltage at point A is high. It is followed by a Schmitt trigger which gives low. It is given to the NPN transistor Q2, does not conduct which gives low. So, the output of the proximity sensor sensing circuit will be logic 0, whenever a metal approaches the sensor. If its output is high, no metal is detected.

- PNP proximity Sensors

When no metal is approaching the sensor, its output will be low. When a metal approaches the sensor, its output will be high. When the high output is given to the base of Q1, it conducts. Hence the voltage at point A is low. Schmitt trigger converts it to high. The voltage at point B is also high when the output of the Schmitt trigger is given to Q2. So, the output of this proximity sensor sensing circuit will beat logic1, whenever a metal approaches the sensor.

C. Fire Sensor

The fire sensors will detect the flames occurring in any part of the industry. The fire sensors make use of the Light Dependent resistors to sense
The YOR colors i.e. Yellow, Orange, and Red. The sensed logic level is sent to the corresponding display screen in the PC's monitor in the corresponding area
SPECIFICATION OF LDR
At ambient lights Resistance = 6 KΩ
At fire conditions = 1.5 KΩ

According to the potential divider formula, for ambient lights we get the

Following results
Case (i): At normal condition:
Vd = {5/ (10+6)}*6=1.875V
Case (ii): At flame conditions:
Vd = {5/ (10+1.5)}*1.5=0.652V

As per Case (i), we get an output voltage of 1.875V. As per Case (ii), we get the output voltage of 0.652V. By viewing the above data, we are clearly known that Case (i) output can drive the subsequent NPN transistor is in conduction, the resistance between emitter and collector is relatively lower. So, that the collector will be low that is fed to the inverting Schmitt trigger to avoid transients and noises. And now the final output of Schmitt trigger will be in the high state. This will not give rise to faulty information to the computer because we have designed the whole system for low logic in failure conditions.

In Case (ii) the final output of Schmitt trigger will low, this creates a fault indication to the computer.

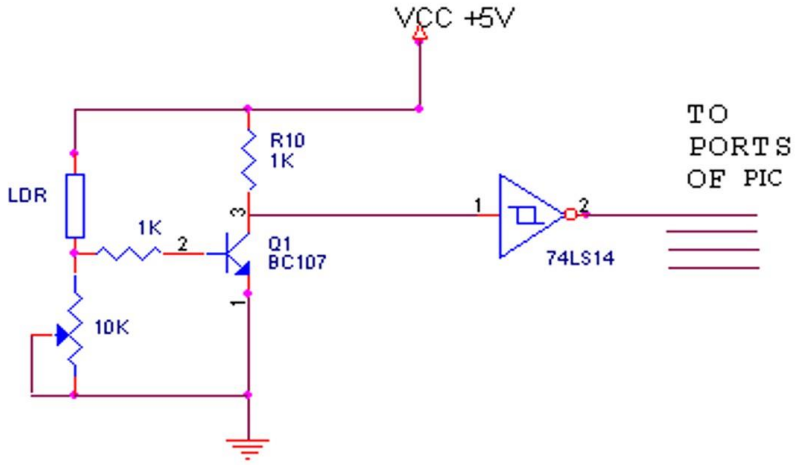


Figure 2 Circuit Diagram for Fire Sensor

D. Unauthorised Entry

The unauthorized entry detector uses the Infrared –Emitters & Sensors that operate for a longer distance than the ordinary IR sensors. Then this sig generated by the sensor circuit is given to the PC then it is indicated as an output in the Display Screen designed for the project output. It can be fixed on the walls to read any entry over the walls.

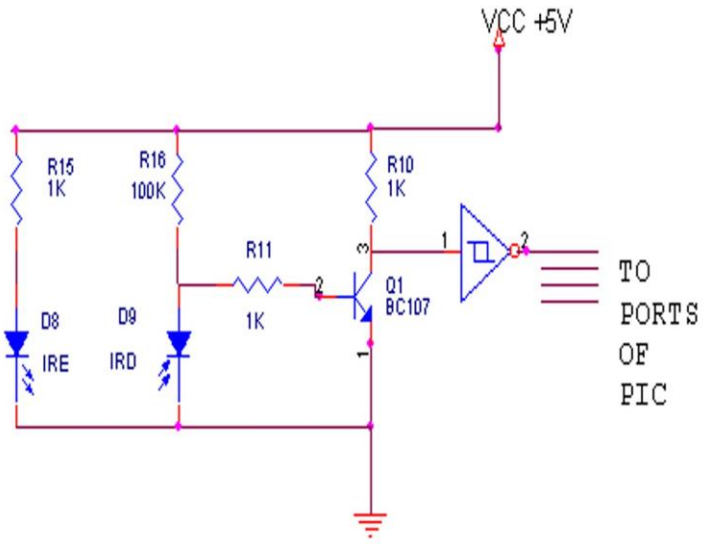


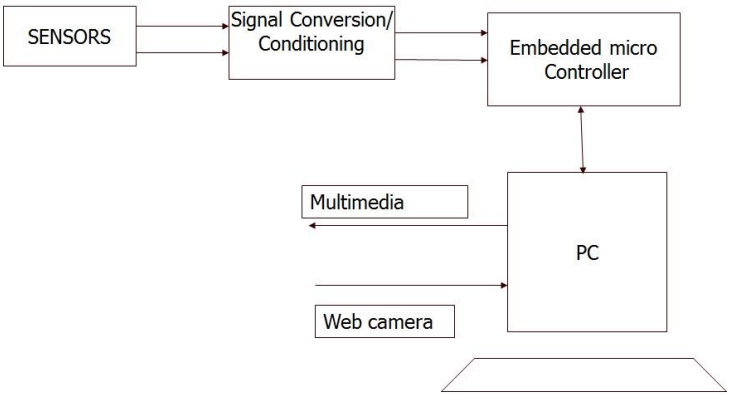
Figure 3 Circuit for Unauthorized entry

E. Door Open Alarm

The magnetic switch is used to sense if any door is opened or not. When a magnet is placed near it the switch is closed, otherwise, the switch will be opened. The magnet is fixed to the door and the magnetic switch is fixed over the door when the door opens the magnet goes away from the magnetic switch and this is indicated on the output screen.

III.BLOCK DIAGRAM

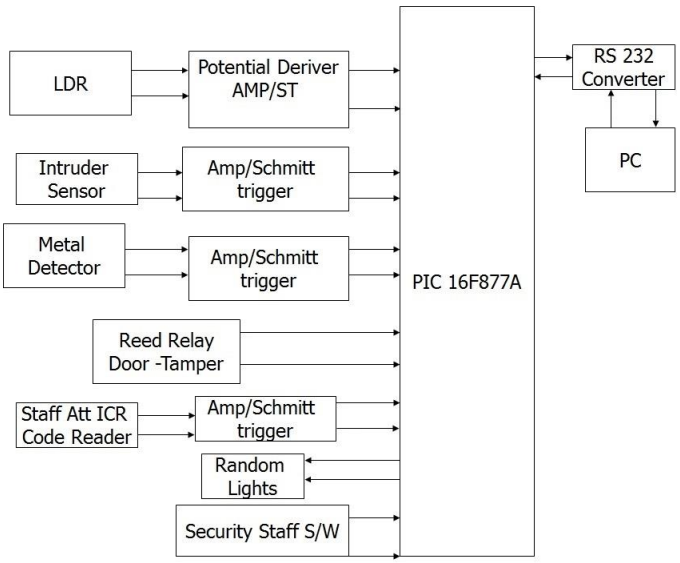
A. Basic Block Diagram



Above figure explains the basic hardware physical connection. It involves sensors getting interfaced with PIC MCU via signal conditioning unit. The embedded controller is then interfaced to PC.

Here PIC MCU of 16F series is being used. All outputs from the sensor are modified and analysed in this block. The serial output is then transferred to PC via RS-232 cable. The output can be seen on the system with system software designed in Visual Basic and Embedded C. This software is a GUI interface with various functionalities which can handle the front end of the project. Future scope of this project can also use a Web Camera getting interfaced with PC via Internet of Things (IOT).

B. Detailed Block Diagram



Above explains the interfacing of all the sensors being used in this project. Some of the sensors like LDR for fire detection, Metal Detector, Intruder Detection and Staff Attendance produces a low voltage signal, so we use transistor amplifiers to amplify the voltage. This amplified voltage is then sent to Schmitt Triggers to convert the signal into square pulses. These pulses are sent to PIC MCU.

Whereas if we see, the Magnetic Reed Relay Switch used for Door Tamper is directly interfaced to the MCU as it acts just like a switch. To check manual attendance of the security guards, here interfacing of switches is also done which are to be pressed by the guards in regular interval of time.

IV. PROCESS INSTRUMENTATION CONTROL

A. Personal Computer

In a personal computer, data transfer takes place serially. The RS-232 standard is used for serial communication. PIC Microcontroller is linked to PC through the RS-232 port. The PC displays the menu for selecting the calibrating equipment and all the calibration results graphically and in tabular form. The user can access the calibration data to get calibration reports, comparison graphs etc. at any time using the menu offered on the PC.

B. RS 232

The most common communication interface for short distance is RS-232. RS-232 defines a serial communication for one device to one computer communication port, with speeds up to 19,200 bands. Typically, 7 or 8 bits (on/off) signal are transmitted to represent a character or digit. The 9-pin connector is used.

C. PIC Microcontroller

The PIC Microcontrollers are supported with a full range of hardware and software development tools. The used PIC16774 device comes in 40 pin package to communicate with the PIC we are using the RS232 port of the computer. So, we must initialize the port before using it.

V. COMPLETE CIRCUIT DIAGRAM

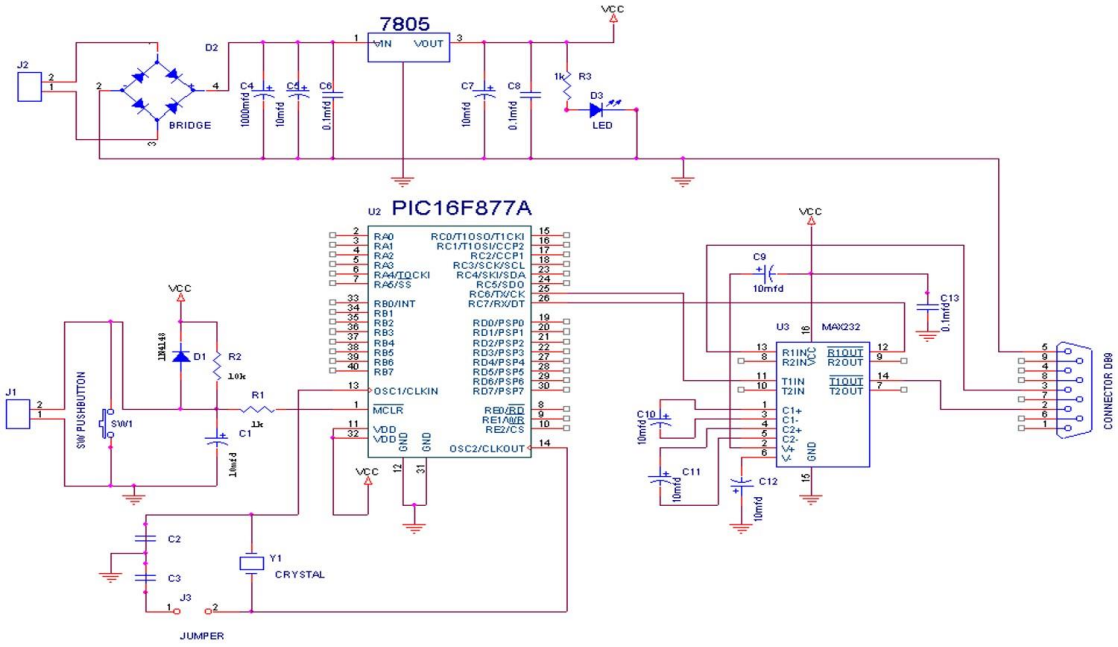
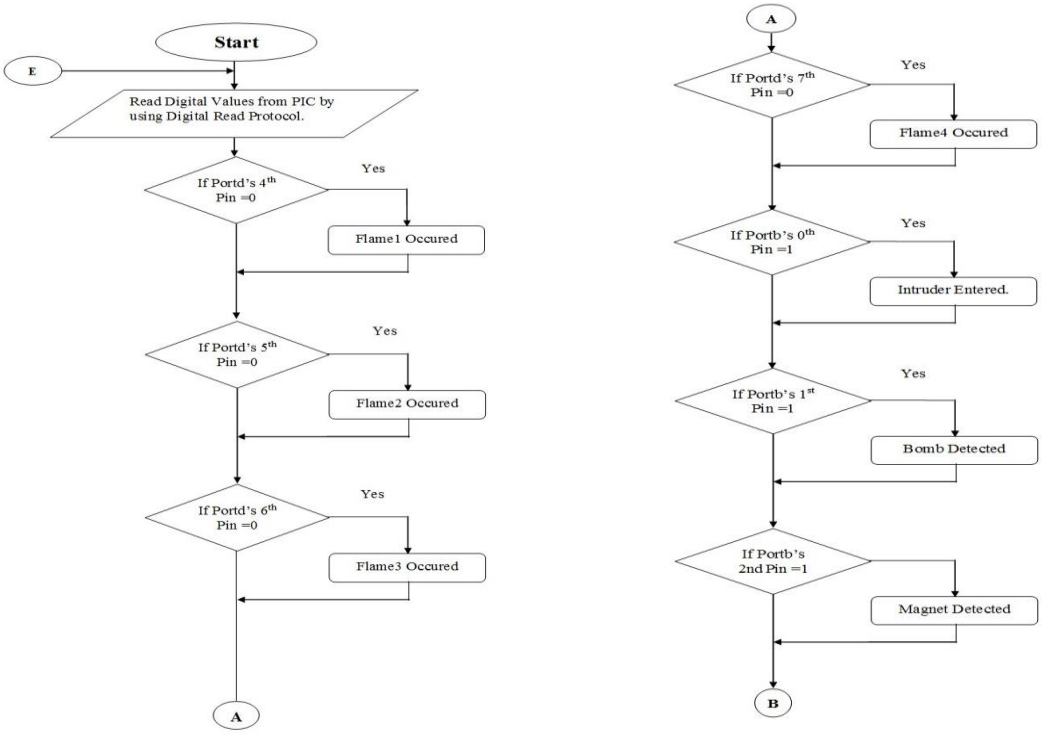
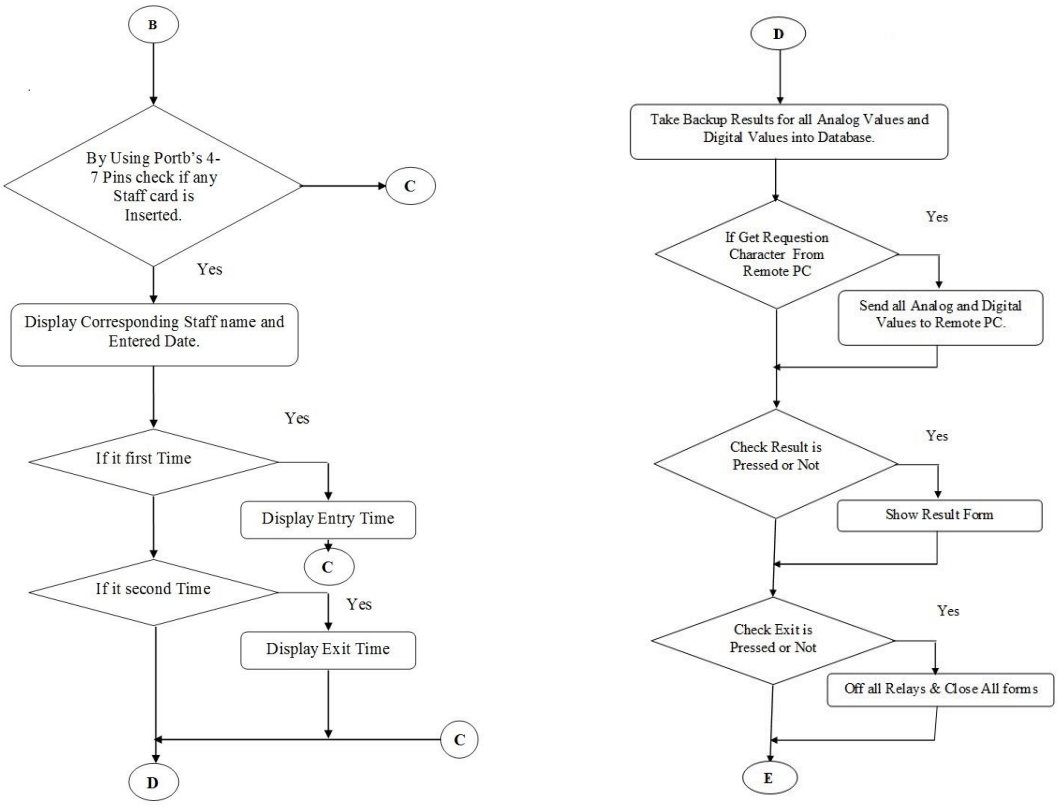


Figure 4 Complete Circuit Diagram of the Project

VI. SOFTWARE FLOW





CONCLUSIONS

A thorough research was done on the existing systems that are used by the industries for monitoring the security of the premises. It was found out that industries use individual systems for monitoring various security issues that include Staff Attendance, Intruder Detection, Fire Detection, Bomb Detection, etc. which can be tedious and sometimes expensive to manage and maintain them.

So, an integrated system was proposed in which all the former mentioned security system can be integrated into a single system so that industries won't have to manage separately. Then the question arises of what technology can be used to integrate all systems together: Embedded system was the answer.

PIC MCU is the easiest and most adaptable embedded system available and hence PIC16F877A was chosen in which both digital and analog inputs and outputs can be obtained. This MCU also has inbuilt Analog to Digital converters and Digital to Analog Convertors which is very useful for various sensors that have both analog and digital outputs which can be converted based on our requirements.

The sensors which are being in the proposed systems give out analog outputs and using Schmitt Trigger they are converted to digital signals which are then fed into the digital ports of the PIC MCU. To monitor all the sensor outputs and make them easily accessible by human these outputs are then required to be sent to a computer through RS232 port.

This concludes that the present work was a success and it will provide a complete method for industrial security. It will ensure that all the hazards which are treated for the industrial security are proper taken care off. If we see the market penetration of this project, it will be quite apt to say that a lot of industries will be able to integrate the product in their premises. This will in turn benefit not only the industry but also create a flawless and transparent system.

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