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Implementation of a Factory Load Centre Monitoring & Security System Using IOT

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ABSTRACT: A Factory Load-Centre houses the motor control centre, the input/output modules, Servers, Variable Frequency Drives, Gas analysers, and other critical and sensitive equipment used for running the plant. The Factory Load-Centre Monitoring, and Security System is a system that is intended to secure the room, maintain a conducive environment for the equipment and safeguard the huge investment of the owner and make the plant available for production at all times to maximize profit. This is achieved by taking the various input signals from the sensors to the microcontroller which compares the input conditions with the acceptable conditions, and generates the required outputs such as switching on the relays to drive the respective loads so as to normalize any abnormal condition and to alert authorized persons of the occurrence of a breach. For safeguarding this expensive equipment and maintaining the right environment for optimal performance, a system has been designed with the help of the PIC18F4520 Microcontroller, Keypad, Electronic Solenoid Lock, Temperature Sensor, Humidity Sensor, Smoke detector, Light Dependent Resistor, LCD, GSM module, relays, and an alarm system. The system checks the room condition constantly to make sure that the environment is conducive and secured. This is achieved by taking the various input signals from the sensors to the microcontroller which compares the input conditions with the acceptable conditions, and generates the required outputs such as switching on the relays to drive the respective loads so as to normalize any abnormal condition and to alert the environment is conducive and secured. This is achieved by taking the various input signals from the sensors to the microcontroller which compares the input conditions with the acceptable conditions, and generates the required outputs such as switching on the relays to drive the respective loads so as to normalize any abnormal condition and to alert authorized persons of the occurrence of a breach.

KEYWORDS: IOT, Factory Load Monitoring, Security System, Sensors, Microcontroller

I. INTRODUCTION

Nowadays, technology develops and evolves rapidly. With current technology keeps on developing, some of the system has to be constantly evolving in order not to be obsolete. Many years ago, Factory load monitoring system cannot be managed without human operation but with current technology discovery especially on Internet of Things (IoT), it had given a new face for monitoring and security system of factories as well as home. By understanding the basic concept of Industries security using Internet of Things, the concept and its application can be explored. Once this happen, development using the technology concept is possible. Various factory/home security system has been developed where the communication link is using Bluetooth, RFID, Android application and short message services (SMS) [2]. All of this have different approach of home security system but serve the same purpose which is to monitor the security and safety of Gas leakage and fire are a common problem in homes and industries [1].

A classical system for gas leakage can only senses a leakage and alerts an alarm. Whereas, Designof factory security system depending on GSM overtures many more benefits. This workmainly focuses on protecting industries and home against risks (danger and damage) based on Propane gas (MQ-6) and flame leakage detection system, there are two cases to warn; The first case (without mobile phone) to issue a warning aerobically by sound.

A Factory Load-Centre houses the motor control center, the input/output modules, Servers, Variable Frequency Drives, Gas analyzers, and other critical and sensitive equipment used for running the plant.

•The Factory Load-Centre Monitoring, and Security System is a system that is intended to secure the room, maintain a conducive environment for the equipment and safeguard the huge investment of the owner and make the plant available for production at all times to maximize profit.



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•The audible alert came on when the smoke/gas concentration was above 200 ppm and when the door was kept open for more than 10 seconds. Door access was granted only with the entry of the correct password. The light was switched on below 200 Lux and switched off above 500 Lux.

•The various readings obtained were displayed on the LCD and an SMS is sent to a registered mobile number as designed. The responses of the constructed system agree with the design specifications.

Microcontroller also gives a logic high signal to turn on the Air-conditioning systems for room environment control. For lighting, the system does not go into alerting mode but only switches the light on when it senses darkness and turns it off during the day to save energy. Another advantage of the project is the low cost of implementation and minimal maintenance required after the installation.

II. LITERATURE SURVEY

In 2012, V.Ramya and B. Palaniappan, design PIC (Peripheral Interface Controller) 16F877 microcontroller based toxic gas detecting and alerting system. The dangerous gases like LPG and propane were sensed and displayed each and every second in the LCD display. If these gases exceed the usual level, then an alarm is generated immediately and also an alert message SMS (Short Message Service) is sent to the certified person through the GSM [1]. In 2013, Selvapriya et.al, designed a gas leakage detection system contains LPG (Liquefied Petroleum Gas) gas sensor for sensing the leakage and produce the result in audio and visual formats besides alerts human via SMS [2]. In 2014, Nandeesh G S et.al, designed a GSM GPS (Global Position System) based home and industry security system and tested with the mobile network. in this system GPS and GSM were used [3]. In 2015, Pushkar Yelave et.al, proposed technique of security system for oilfield industries using GSM and Zigbee. The system was able to receive all the oil parameters like the current oil level, temperature of oil, leakage of gas [4]. In 2016, Md Iftekharul Mobin et.al, proposed a full fire protection system to prevent fire from extending and does all necessary activities. This system takes input signals from various sensors placed in different position of the monitored area, and combines integrated fuzzy logic to recognize fire breakout locations and severity [5]. This proposed system introduces a new design to alert about the gas leakage and flame via calling by programming microcontroller Arduino with MQ-6 gas sensor and flame.

Different types of sensors are used in security systems. Karri and Lim used more sensors set up in a remote array, a PIC micro-controller and a GSM module to develop a security device which is capable of notifying a person or several persons using an SMS message initiated by one touch dialling [7]. Ms. Gunjan Jewani et al. worked on knock-based security system (KBSS) using piezo sensor and ARDUINO [8]. Kumar and Rajini established smart surveillance system based on the embedded system along with PIR sensor network and GSM [9]. Research of microcontroller-based home security system with remote monitoring feature was done by Agarwal and Nayak in which IR Laser sensors are used to detect any obstacle while monitoring the windows and doors [10]. Passive Infrared Sensor (PIS) was used to develop a security system [11]. Rpindar Singh Brar reported ARDUINO Based Industrial Security System using piezoelectric sensor [9]. Lawate and Ali designed a security system using video camera [12]. Agarwal and Joshi proposed WSN and GSM based remote home security system [13]. Ando Juniors et al. proposed a micro generator piezoelectric for portable device from the energy harvesting [14].

III.PROPOSED SYSTEM

The prototype of leakage system has been tested by sensing a small amount of Propane gas near to the gas sensor and small amount of flame from lighter near to the flame sensor. MQ-6 gas sensor and flame sensor detect the leakage gas and fire consecutively and send a signal to the microcontroller. After that, microcontroller send an active signal to other externally connected devices. As a result, a buzzer rings and a Light Emitting Diode blink.

The hardware of this case consists of Gas sensor (propane gas), flame sensor, microcontroller, mobile phone that is connected with microcontroller through a relay module to control it. When sensor activated the microcontroller control the relay module to make call to a user phone number. The mobile is an important part of the system responsible for communication between the microcontroller and the mobile phone. AT commands are used to interface the module as well as to configure it. AT commands are inserted in C-language as a string of characters which are sent to the module using the terminal program.



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Fig. 2. Block Diagram

A. PIC 18F4520 Microcontroller

- Data Memory up to 4k bytesn Data register map with 12-bit address bus 000-FFF Divided into 256-byte banks.
- There are total of F banks.
- Half of bank 0 and half ofbank 15 form a virtual (oraccess) bank that is accessibleno matter which bank isselected this selection isdone via 8-bits.
- Program memory is 16-bits wide accessed through a separate program data bus and address bus inside the PIC18.
- Program memory stores the program and also static data in the system.
- On-chip External
- On-chip program memory is either PROM or EEPROM.
- The PROM version is called OTP (one-time programmable PIC18C) The EEPROM version is called Flash memory (PIC18F).
- Maximum size for program memory is 2M n Program memory addresses are 21-bit address starting at location 0x000000.



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Fig. 2. PIC18F4520

B. Humidity sensor

DHT11 is a Humidity and Temperature Sensor, which generates calibrated digital output. DHT11 can be interface with any microcontroller like Arduino, Raspberry Pi, etc. and get instantaneous results. DHT11 is a low-cost humidity and temperature sensor which provides high reliability and long-term stability.uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and outputs a digital signal on the data pin (no analog input pins needed). It's very simple to use, and libraries and sample codes are available for Arduino and Raspberry Pi. This module makes is easy to connect the DHT11 sensor to an Arduino or microcontroller as includes the pull up resistor required to use the sensor. Only three connections are required to be made to use the sensor - Vcc, Gnd and Output.

It has high reliability and excellent long-term stability, thanks to the exclusive digital signal acquisition technique and temperature & humidity sensing technology.



Fig. 3. Humidity Sensor

C. GSM Module (SIM800)

This GSM modem has a SIM800A chip and RS232 interface while enables easy connection with the computer or laptop using the USB to Serial connector or to the microcontroller using the RS232 to TTL converter. Once you connect the SIM800 modem using the USB to RS232 connector, you need to find the correct COM port from the Device Manger of the USB to Serial Adapter. Then you can open Putty or any other terminal software and open an connection to that COM port at 9600 baud rate, which is the default baud rate of this modem. Once a serial connection is open through the computer or your microcontroller you can start sending the AT commands. When you send AT commands for example: "AT\r" you should receive back a reply from the SIM800 modem saying "OK" or other response depending on the command send.

Features of SIM800A

- Bands: GSM 850MHz, EGSM 900MHz, DCS 1800MHz, PCS 1900MHz
- GPRS class 2/10
- Control via AT commands (3GPP TS 27.007, 27.005 and SIMCOM enhanced AT command set)



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- Supply voltage 3.4-4.4V
- Coding schemes: CS-1, CS-2, CS-3, CS-4 Tx power: Class 4 (2W), Class 1 (1W)
- Small package: 23 * 23 * 3mm
- Low power: down to 1mA in sleep mode.





D. LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

.A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD.



Fig. 4. LCD Display



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E. Ultrasonic Sensor

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit. The basic principle of work:

- (1) Using IO trigger for at least 10us high level signal,
- (2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.

(3) IF the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning.

Test distance = (high level time×velocity of sound (340M/S) / 2,



Fig. 5. Ultrasonic Sensor

F. Temp Sensor (LM35)

The LM35 sensor is highly used because its output voltage is linear with the Celsius scaling of temperature. It has a wide operating rang. The maximum output is 5V.The output will increase 10 mV for every one degree rise in temperature. The range is from -55 degrees to +150 degrees. There are three terminals as VCC, Ground and the analog sensor. It consumes minimum amount of electricity. Thus, it is energy efficient. It is every efficient in horticulture. It is user friendly to use.



Fig. 5. LM35 Temp Sensor

G. Relay Board

Relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and most have double throw (changeover) switch contacts as Shown in diagram

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LOGIC 1 = ON LOGIC 0 = OFF CONTROL 10K GND

Fig.6. Relay Driver Circuit

H. IOT

Internet of Things (IoT) is a network of physical objects or people called "things" that are embedded with software, electronics, network, and sensors that allows these objects to collect and exchange data. The goal of IoT is to extend to internet connectivity from standard devices like computer, mobile, tablet to relatively dumb devices like a toaster. IoT makes virtually everything "smart," by improving aspects of our life with the power of data collection, AI algorithm, and networks. The thing in IoT can also be a person with a diabetes monitor implant, an animal with tracking devices, etc

ThingSpeak is IoT Cloud platform where you can send sensor data to the cloud. You can also analyze and visualize your data with MATLAB or other software, including making your own applications. The ThingSpeak service is operated by MathWorks. In order to sign up for ThingSpeak, you must create a new MathWorks Account or log in to your existing MathWorks Account.

IV.CONCLUSION

The prototype Factory Load-Centre Monitoring, and Security System successfully designed and built was able to achieve the purpose for the design but the Driver circuit may need relays that can handle the power requirements to drive the actuators for an actual load center. The system was able to measure and control the load-center room temperature, humidity and security. It also monitored Smoke/gas leakage to prevent possible fire outbreak. The reduction of power/energy consumption was achieved through lighting control and the incorporation of an LCD and an alarm system for alerting concerned persons of a breach was also implemented successfully.

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