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IOT-Powered Factory Intelligence and Security Hub

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Abstract: *The IoT-Powered Factory Intelligence and Security Hub is prototype with sensors and RTC is a cutting-edge solution that can revolutionize the industrial sector in India. As a developing country with a growing economy, India has a significant demand for industrial automation to enhance productivity, reduce energy consumption, and improve safety in the workplace. The prototype offers a cost effective and reliable solution to address these needs. The prototype consists of various sensors, microcontrollers, and software components that work together to monitor and control industrial loads. The sensors can measure different parameters such as human motions, Light intensity, smoke/gas, and Vibration, and transmit the data to the microcontroller. The microcontroller can analyze this data and make decisions based on pre-defined algorithms and rules. The software component provides a user interface to interact with the system, view real-time data, and configure settings. Data also monitor on IOT web server. RFID tag reader is use to provide security.*

Keywords: Automation, Sensors, Factory Load-Centre, Controller, IOT web, Security

I. INTRODUCTION

The project's primary objective is to optimize energy consumption in industrial operations through real-time monitoring and control of industrial loads. The project uses various sensors, including temperature sensors, motion sensors, and flame sensors, to monitor energy consumption and detect any anomalies in industrial operations. The data collected from these sensors is then transmitted to a central server using Wi-Fi or cellular network. The algorithms provide insights into the efficiency of industrial processes and enable remote control of industrial machines, optimizing energy consumption and reducing costs.

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. Equipment like VFDs have semiconductors, inverters, diode supply unit (DSU) and insulated gate bipolar transistors (IGBT) which generate a lot of heat and thereby increase the room temperature. For safeguarding these expensive equipment and maintaining the right environment for optimal performance, a system has been designed with the help of the PIC18F4550 Microcontroller, Keypad, Electronic Solenoid Lock, Temperature Sensor, Humidity Sensor, Smoke detector, Limit switches, 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 normalise any abnormal condition and to alert authorised persons of the occurrence of a breach. The code for the system was written and debugged in CCS environment while the hardware was simulated in Proteus environment. The system was able to maintain the room temperature between 25°C to 30°C and humidity below 60 %. Door access was granted only with the entry of the correct RFID tag. The various readings obtained were

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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.

II. LITERATURE SURVEY

Many systems that implement only parts of the design being considered have been found in the following literature. Aderibigbeet al. (2018), in their study, presented a model gas leakage detector and evacuation system which monitors only gas leakage. Theophilus and Bhudi (2012) designed and implemented a microcontroller-based room temperature monitoring system, which monitors only temperature. Mohanad (2012) implemented an electronic embedded lock security system that provides a great benefit over traditional locks, which uses only a manual key. Omar et al. (2014) reviewed existing fire-detector types along with the development of a low cost, portable, and reliable microcontroller based automated fire alarm system for remotely alerting any fire incidents in household or industrial premises. Sarguna Priya et al. (2014) designed the monitoring and control system of industrial parameters using CAN bus communication. Jadhavsunny et al. (2014)designed a Remote Monitoring and Control System that is able to acquire, save, analyse, and process real time data used for controlling a particular machine to change related environmental factors and monitoring from a long distance. Pushkarand Amey(2016)designed a system in which an embedded system monitors and controls the microclimatic parameters of a Greenhouse on a regular basis round the clock for cultivation of crops or specific plant species which could maximize their production over the whole crop growth season, and to eliminate the difficulties involved in the system by reducing human intervention to the best possible extent using sensors. The major difference of this system is that it designed for agricultural use.

Nagendra (2017) built an Arduino-based embedded device for monitoring environmental variables: humidity and temperature. The device was built using the microcontroller Arduino and sensors, which could sense the temperature and amount of moisture inside a building and provide information in a serial monitor and a liquid crystal display. Karthikumaret al. (2017) designed a wireless control and monitoring system for various industrial machines based on Zigbee communication protocol for safe and economic data communication in industrial fields where the wired communication is more expensive or impossible due to physical conditions. The system monitors only machine parameters. Oke et al. (2017) designed an application of temperature sensor to free the stress of continuous check on the environment for any change in temperature. An alert sub-system and a Global System for Mobile Communication (GSM) module were incorporated into the design to make it more effective.

Awodeyiet al. (2018)presented a Microcontroller based Automated Intelligent Street lighting System using light dependent resistors and infrared sensors for power conservation, intelligence and fault detection. Adamuet al. (2018) designed an Automatic room Heater Control System, which is a temperature monitoring system, to set a desired temperature which is then compared to the room temperature measured by a temperature sensor. Widyaningrum and Pramudita (2018), in their research, developed an automatic lamp and fan in a smart home using Arduino Mega 2560 microcontroller. This system monitors the brightness and the temperature of a room. The scope of the current research goes beyond any of those that have been considered in the review asnone of them has fully addressed the intended scope of this research which encompasses security, safety, power saving, continuous monitoring and control of environmental condition of a critical room like the load-centre.

III. METHOD OF DISEASE DETECTION

The block diagram of the design is shown in Figure 1.The block diagram shows the main functionality of the System. Five sensors are used to monitor different analog signals including temperature, motion, vibration, light intensity, and smoke/gas. Relay driver circuits are used to control respective loads namely the buzzer, AC, fan, dehumidifier fan, lighting circuit and solenoid electronic lock. Also shown in the diagram are digital inputs and outputs from keypad, RFID Reader, GSM and LCD. RTC is use to set ON and OFF timing of load or industrial machines. RFID reader is use to give permission to valid or authorised person to change the timing of load. Using GSM module we can access internet and data over IOT to monitor different parameter o real time basis.

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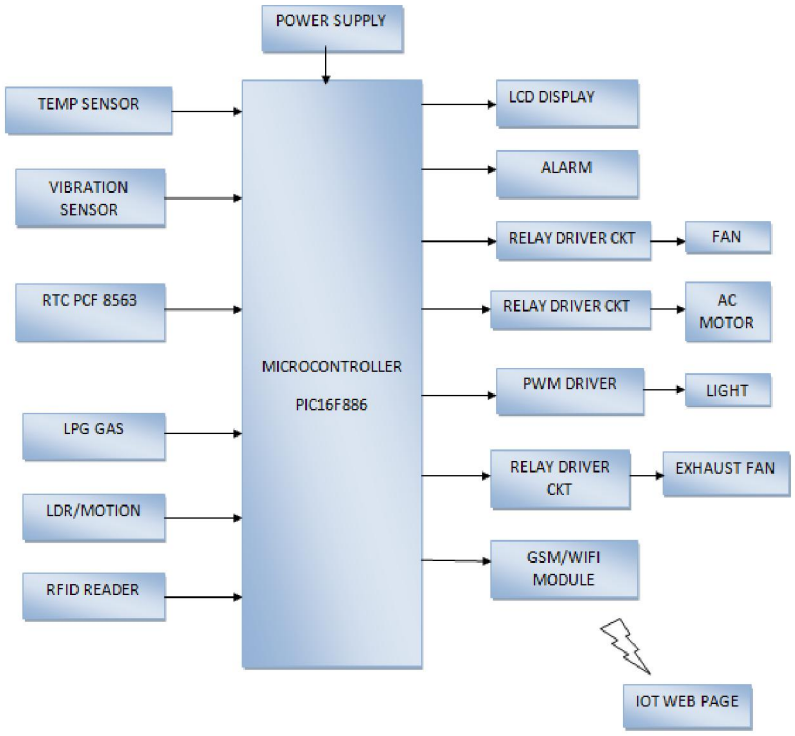

Fig. 1. Block Diagram

The Microcontroller Based Factory Load-Centre Security, Room Condition Monitoring, and Control System is a system that uses electronics and sensors to free the worker from the stress of continuous check on the load-centre for any security breach, and room condition monitoring, and control of the load centre environment. Extremely high temperature or humidity of the load centre can cause damage and also reduce the efficiency and life span of equipment found in the load centre. Therefore, the fast response of the system will prevent serious damage and also alert concerned persons via short message service (SMS). After receiving a logic high signal due to any of high room temperature, high humidity, smoke or the door being kept open for more than ten seconds, the microcontroller goes into alerting mode during which it turns on the buzzer to warn the operator and displays this alert state on the Liquid Crystal Display (LCD). In this condition, the 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.We also implement real time monitoring of entire system over internet of things (IOT).

A. PIC16f886 Microcontroller

The PIC16F886 features 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 11 channels of 10-bit Analog-to-Digital (A/D) converter, 1 capture/compare/PWM and 1 Enhanced capture/compare/PWM functions, a synchronous serial port that can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I²C™) bus and an Enhanced Universal Asynchronous Receiver Transmitter (EUSART). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances or consumer applications.

Special PIC16f886 Micro controller Features

- Power-Saving Sleep mode
- Power-on Reset (POR)

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- Selectable Brown-out Reset (BOR) voltage
- Extended Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- In - Circuit Serial Programming™ (ICSP™) via two pins
- In - Circuit Debug (ICD) via two pins
- High - endurance Flash/EEPROM cell:
- 100,000 erase/write cycle enhanced Flash program memory, typical

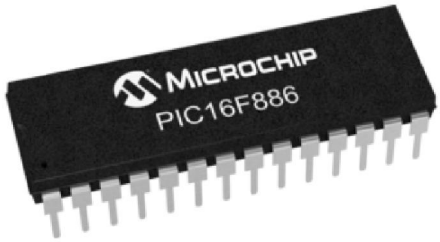

Fig. 2. PIC 16f886

B. RTC PCF8563

The PCF8563 is a CMOS1 Real-Time Clock (RTC) and calendar optimized for low power consumption. A programmable clock output, interrupt output, and voltage-low detector are also provided. All addresses and data are transferred serially via a two-line bidirectional I 2C-bus. Maximum bus speed is 400 kbit/s. The register address is incremented automatically after each written or read data byte.

Provides year, month, day, weekday, hours, minutes, and seconds based on a 32.768 kHz quartz crystal ν Century flag ν Clock operating voltage: 1.0 V to 5.5 V at room temperature ν Low backup current; typical 0.25 µA at VDD = 3.0 V and Tamb = 25 °C ν 400 kHz two-wire I2C-bus interface (at VDD = 1.8 V to 5.5 V)

Fig. 3. RTC PCF8563

C. RFTD tag Reader

HC-05 Radio frequency Identification i.e. RFID is a wireless identification technology that uses radio waves to identify the presence of RFID tags.

Just like Bar code reader, RFID technology is used for identification of people, object etc. presence.

In barcode technology, we need to optically scan the barcode by keeping it in front of reader, whereas in RFID technology we just need to bring RFID tags in range of readers. Also, barcodes can get damaged or unreadable, which is not in the case for most of the RFID.

RFID is used in many applications like attendance system in which every person will have their separate RFID tag which will help identify person and their attendance

Fig. 4.EM18 RFID tag reader

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D. Gas Sensor

MQ An LPG gas sensor like the MQ series (e.g., MQ-2, MQ-5, MQ-6) works by detecting changes in electrical resistance when exposed to LPG gas, essentially acting as a "chemiresistive" sensor; when LPG molecules come into contact with the sensor's sensing material (typically tin dioxide - SnO2), the material's conductivity changes, allowing the sensor to measure the gas concentration based on the change in resistance, which is then translated into a voltage signal that can be read by a microcontroller like an Arduino, PIC, Etc.

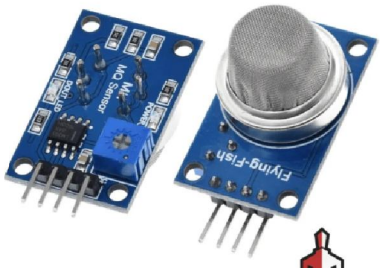

Fig 5: MQ GAS Sensor

E. PIR Motion Sensor

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. PIR sensors are commonly used in security alarms and automatic lighting applications.

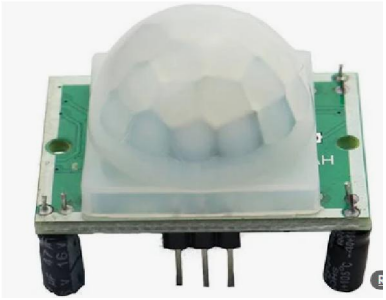

Fig. 6. PIR Motion Sensor

F. LCD Display

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

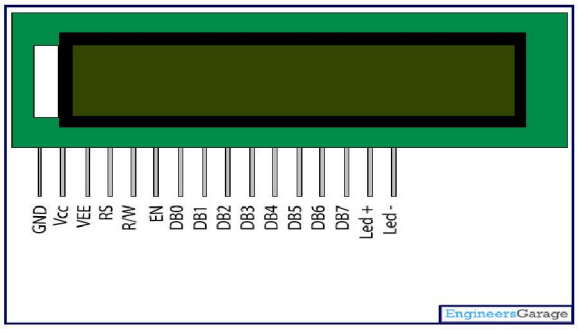

Fig. 7. LCD Display

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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 centre. The system was able to measure and control the load-center room temperature, LDR, vibration 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.We also implement real time monitoring of entire system over internet of things (IOT).

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