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Microcontroller Based Industrial Safety System

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***Abstract:*— The objective of this study is to propose a microcontroller based safety ensuring system which is used at shop floor of the Industries. This system consists of sensors installed at the shop floor. These sensors are meant to detect Gas leakage, Fire hazardous, Liquid leakage. In case of adverse condition at the shop floor, these sensors will detect the situation, generate the signals and send signal to the microcontroller. Microcontroller in turn analyzes these signals against safety threshold values and commands the mechanical actuating member to shutdown the leakage source. Hence safety is ensured at the workplace.**

***Keywords:*-- Industrial safety, Microcontroller, Sensors, Interfacing.**

I. INTRODUCTION

The main purpose of this study is to ensure safety at industrial shop floor against Fire and Gas hazards. These hazards are due to leakage of toxic gases or Fire accidents. So to ensure safety at shop floor an equipment based on microcontroller is devised. This equipment consists of a shutter fitted to the window of the shop floor. Shutter is opened or closed using a mechanical driving system which consists of DC Electrical Motor. Sensors like Gas sensor, Temperature sensors, and Fire sensors are installed at the shop floor. Sensors and Motor are interfaced to the Microcontroller. In case of adversity at the shop floor due to leakage of toxic gases or temperature rise because of combustible gases, the condition will be sensed by sensors. Sensors generate electrical signals and send this to microcontroller. Microcontroller is programmed to operate the shutter of window through DC motor. Hence harmful gases are allowed to escape through window providing safety inside the shop floor.

II. LITERATURE REVIEW

W. M. P. STUART [1] proposed a hydraulic drive system which could lower or raise the windows to ensure safety at the shop floor. This system was mechanically controlled. Dough Rasmussen [2] proposed when a body approaches within the operating range of the sensor, it sends a logical command to open the door. The door automatically closes with a fixed time delay. Sumit. P. Patil [3] Designed and constructed Automatic sliding window which is mechanically operated and remote controlled. In our proposed work, Microcontroller based safety equipment is used to ensure safety at the shop floor which opens or closes the shutter of the window automatically according to the status within the shop floor just to allow harmful and toxic gases to escape through window. And also shutdown the leakage source to ensure safety at shop floor.

III. MICROCONTROLLER

The Uno is a microcontroller board based on the ATmega328P [4] shown in Fig 1. It has 14 digital input or output pins of which 6 can be used as PWM outputs, 6 analog inputs, a 16 MHz quartz crystal, a USB connection. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor of a 20-50k ohm.

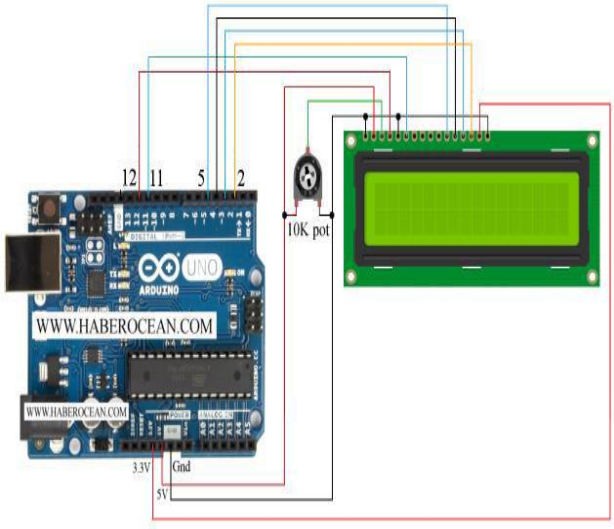

Fig.1.Microcontroller with LCD Display.

Table.1 shows the specification and details of the microcontroller used in the present study. The Uno has a number of facilities for communicating with a computer, another Uno board, or other microcontrollers.

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Table1. Specifications of Microcontroller

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage	6-20V
Digital I/O Pins	14
PWM Digital I/O	6 Pins
Analog Input Pins	6
DC Current per I/O Pin	20 Ma
DC Current for 3.3V Pin	50 Ma
Flash Memory	32 KB
SRAM	2 KB
EEPROM 1	1 KB
Clock Speed	16 MHz

The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0(RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. Initially program is written in ARDUINO software and this program is transfer into ARDUINO chip using RS232 cable.The Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board. A Software Serial library allows serial communication on any of the Uno's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino Software (IDE) includes a Wire library to simplify use of the I2C bus.

IV. SENSORS AND INTERFACING

Sensors are the devises which senses the conditions of working area, generates signals and sends signal to the micro controller. Microcontroller has been interfaced with these sensors and mechanical actuating system [5]. Micro controller in turn gives signal to the mechanical actuating system to shutdown the leakage source. Types of sensors are Gas sensor, Fire Sensor, Temperature sensor, Liquid Sensor.

4.1. Gas Sensor

Gas sensor is used to detect combustible, toxic gases, and oxygen depletion. These detect a Gas leak and interface with a control system so a process can be shut down automatically [6][7]. It has 4 leads which need to be connected with microcontroller. These 4 leads are Vcc, AOUT, DOUT, and GND. Shown in Fig 2. Vcc and GND leads establish power for the sensor. Other 2 leads are AOUT analog output and DOUT digital output. The terminal AOUT gives an analog voltage output in proportion to the amount of Methane Gas the sensor detects. The more methane it detects, the greater the analog voltage it will output. Conversely, the less CO it detects, the less analog voltage it will output. If the analog voltage reaches a certain threshold, it will send the digital pin DOUT high. Once this DOUT pin goes high, the Arduino will detect this and will trigger the LED to turn on, signaling that the methane threshold has been reached.

Fig.2.Gas Sensor

4.2. Fire Sensor

This sensor detects a flame by sensing light wavelength between 760 to 1100 nanometers.[8] Test distance depends on the flame size and sensitivity settings .There are two sensor outputs one Digital – sending either zero for nothing detected or one for a positive detection and another Analog – sending values in a range representing the flame probability or size or distance.

Fig.3.Fire Sensors

4.3. Temperature Sensor

The TMP36 is a low voltage, precision centigrade temperature sensor. It provides a voltage output that is linearly proportional to the Celsius temperature. The output voltage can be converted to temperature easily using the scale factor of 10 mV/°C. [5]

Fig.4.Temperature Sensor

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Interface circuit of Temperature sensor with Arduino and sketch code to display sensor reading in serial port of Arduino is shown in Fig 5. In Arduino board the output terminal of LM 35 is connected to A0 that is analog input pin. +Vcc and GND from the Arduino board can be given to temperature sensor as bias supply.

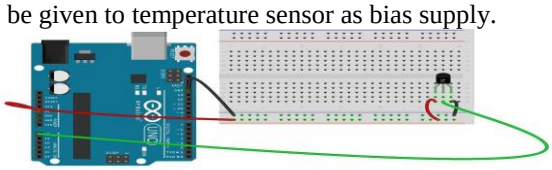

Fig.5.Interfacing of Arduino with Temperature Sensor

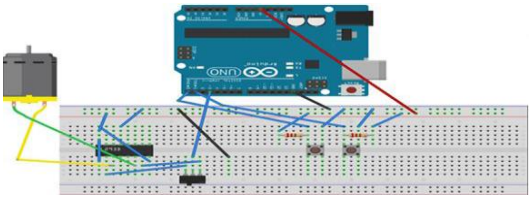

Fig.6. Interfacing of Arduino to DC Electrical Motor

4.4. Liquid Sensor

Liquid sensor brick is designed for Liquid leakage detection. This sensor has series of exposed traces connected to ground and interlaced between the grounded traces are the sensor traces. Sensor trace value reaches high if a drop of Liquid shorts the sensor trace to the grounded trace.

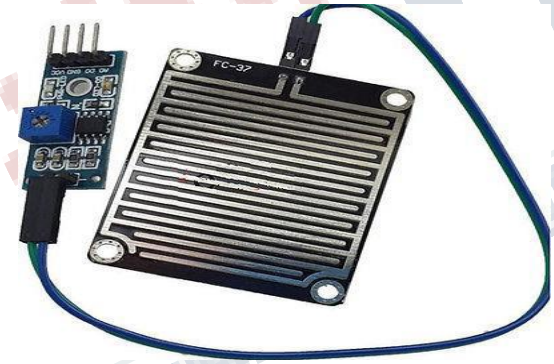

Fig.7 Liquid sensor

4.5. DC Motor

A DC motor is an electrical machine that converts electrical power into mechanical power. Here the DC motor is interfaced to Arduino UNO and its speed is controlled. Shown in Fig 6. This is done by Pulse Width Modulation PWM. Shutter of the window receives mechanical power from this motor and either open or closes depending on signal from Microcontroller.

V. CONCLUSION

In the present work, Microcontroller has been interfaced with electronic and mechanical systems. Compatible electronics and mechanical devises are chosen and implemented carefully. The interfaced system was tested in adverse operating conditions. If the Gas leaks, Flame occurs, Temperature rises, or leakage of Liquids at the shop floor, sensors were able to sense the situation and send signals to Microcontroller .Microcontroller in turn analyze the signals against threshold values of safety limits and accordingly control the motor of the window's shutter either to open or close as well as shutdown the leakage source. Toxic and hot gases are allowed to escape through window of shop floor. Hence safety is ensured at the shop floor.

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