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FIREWORKS SAFETY USING PIC CONTROLLER AND GSM MODULE

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ABSTRACT

The scope of our paper is preventing the firework accidents before it happens and minimizing its effects if it occurs. Though there are rules for preventing, it is not followed. We have applied current technology to overcome this fact. The functions of the (PIC16F877A) microcontroller are detecting the devices causing explosion where explosive chemicals are placed ,indicating the improper functioning of the protective devices using LCD display and alarms thus explosion is prevented, unfortunately if accident happened due to some un avoidable reasons it receives signals from the sensors and it controls the fire by operating the fire extinguishers automatically using solenoid valves and also it sends the information to the ambulance, fire service, hospitals, etc. in the form of text using GSM module ,thus people lives saved.

Index terms- vibration sensor, fire sensor, lightning monitor, solenoid valve.

1. INTRODUCTION

In recent days many accidents are happening in fireworks especially in SIVAKASI, Tamil Nadu. We have done a field study in the firework factories. In those factories, only old fashioned technology is used, there is no equipments for preventing and controlling accidents. For preventing the effect of lightening, lightening arresters placed in the firework factories, but it is not maintained properly, which leads to improper functioning of the arrester, it causes 20% of accidents. For drying of explosive chemicals, which explodes, if dried above 37ºC for a long period of time, for determining the temperature, the workers are making an assumption and they are drying the chemicals, it causes 40% of accident. The rules for prevention is instructed by the government, labours are not interested in following it. They usually, not work in the rooms, where the rubber sheets are provided for safety. They used to work in the open atmosphere for their sake; it causes 25% of accident. Usage of mobile phones also causes 5% of explosion because of the microwaves transmitted and received by it. Other unavoidable causes such as Static discharge also causes 10% of accident. If an explosion occurs in a particular room it affects the nearby rooms, it is not controlled from spreading. In order to overcome from all these defects, we are using PIC microcontroller and some sensors. Using LM35 temperature sensor, atmospheric temperature is indicated to the PIC microcontroller, thus the temperature is monitored all the time. Lightning arrester is automatically monitored, if any fault occurs in it, immediately it is displayed on LCD screen and the alarm is turned ON. While, the labours are working, they are monitored by the respective safety officers and supervisors through the webcam, whether they are working inside the safety

room or not. The above equipments are for preventing explosion. If accidents happen due to un avoidable reasons ,fire sensor- senses fire, in case of small fire accidents, in case of explosion, vibration sensor which is placed below the ground level sense the vibration, signals from this sensors is send to the microcontroller which in turn automatically operates the fire extinguishers by opening solenoid valves, which minimizes the effect of fire and also its output is connected to the LCD display, the alarm and to the GSM, GSM decodes the information from the microcontroller and sends it to the ambulance, fire service, hospitals, etc... in the form of text, thus accidents are indicated and controlled.

2. DESIGN STEPS

To achieve a low cost and simple solution for the control and operation of multiple devices used in our project, simple PIC 16F877A microcontroller is designated, to achieve this goal. The first step is to design a circuit that uses the minimum resources of this processor to restricting and controlling fire accidents. This module has to be fully tested and proven effective in controlling. The second step is to design a protocol link that uses the available resources of the controller to conduct the necessary communications between different modules of control through a variety of actions associated with the sensors. The third step is to test the integrity of the communication protocols to ensure there is no miscommunication or unanticipated behavior in the controllers.

3. SOFTWARE DESIGN

Since there are many slaves and a single master in this control system design, two kinds of software are needed for this project. The major proof of concept in this project heavily relies on the software design. This paper will describe the master, slave protocol, and communication

A. Master software

The master is the controlling microcontroller which handles all the controlling sequences, such as the interface between a user and the system, making sure the master controller oversees major system components such as the keypad, LCD, and slave microcontrollers that operates relay, receives signals from sensors. In operation, the master starts with the keypad and LCD display module, handling interactions between the inputs and system's response. The keypad has been used to detect the inputs from sensors. The LCD displays ,the other slaves response. A major portion of the software design in this project is the communication between the master and the two slaves. All the communications are initiated by the singe master has processed an action selected due to sensor input, it determines which action was chosen and transmits the instructions to the appropriate slave using serial communication (SPI). To control all slaves , every slave has a unique slave select pin. There are predefined four bytes on the shared bus lines consisting of a clock, data out, datain.

4. BLOCK DIAGRAM

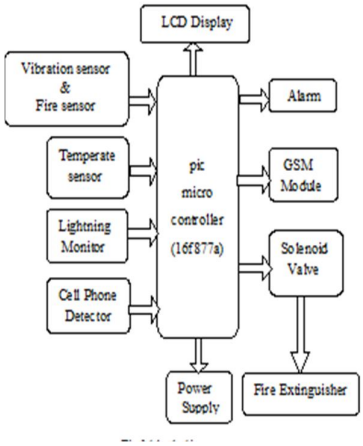


Figure.1 block diagram

A.Vibration Sensor

Vibration sensor is an accelerometer and vibration transmitter. They provide a 4-20mA output signal proportional to the overall vibration level. The 4-20 mA output is commonly accepted by process control systems such as a PLC, DCS or MICROCONTROLLER system, for cost-effective continuous vibration monitoring. We placed this sensor 1 feet below the ground level. When explosion occurs the crystal oscillator in this sensor operates and produces a voltage level of +5v and 4-20 mA, this data is sent to the controller. The 4-20 mA output of the PC423 Series is proportional to vibration. An output of 4 mA indicates a level of 0 ips or no vibration present for velocity output models and 0 g for acceleration output models. A full scale reading of 20 mA indicates that the maximum range (RMS or equivalent peak) of the chosen unit, acceleration or velocity, is present. The dynamic signal output is an optional addition

4. PRINCIPLE OF OPERATION

Depending on how a piezoelectric material is cut, three main modes of operation can be distinguished: transverse, longitudinal, and shear.

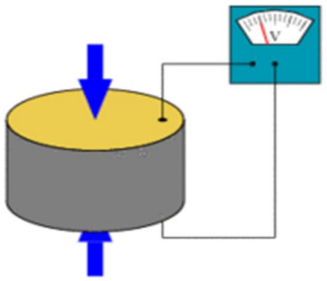


Figure.2 crystal oscillator

Transverse Effect

A force is applied along a neutral axis (y) and the charges are generated along the (x) direction, perpendicular to the line of force. The amount of charge depends on the geometrical dimensions of the respective piezoelectric element. When dimensions a,b,c apply,

$C_x=d_{xy} F_y b/a$

Where

a is the dimension in line with the neutral axis,
b is in line with the charge generating axis and
d is the corresponding piezoelectric coefficient.

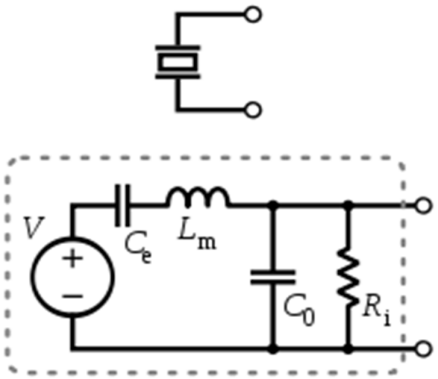


Figure.3 vibration sensor circuit

Longitudinal Effect

The amount of charge produced is strictly proportional to the applied force and is independent of size and shape of the piezoelectric element. Using several elements that are mechanically in series and electrically in parallel is the only way to increase the charge output. The resulting charge is

$C_x=d_{xx}F_x n,$

Where

d_{xx} is the piezoelectric coefficient for a charge in x-direction released by forces applied along x-direction (in pC/N).

F_x is the applied Force in x-direction .

[N] and n corresponds to the number of stacked elements force applied and the element dimension.

Fire Sensor

Flame detector is used to sense the fire. One of the key elements in any combustion safety system is the flame monitor. Flame monitor controls and flame detection principles, are generally less understood than other parts of the system. We used Eclipse Combustion Controls flame safeguard equipment. We placed this flame detector where explosive chemicals are more.An ideal flame detector would reliably sense a flame of interest, while totally ignoring all other flames or signal sources and would, in the process, be totally unaffected by ambient operating conditions. That characteristic of a flame most useful for its detection is the electromagnetic radiation produced by it. This radiation covers the spectral range from infrared to far ultraviolet. Infrared and visible radiations are functions of flame temperature and emissivity.

Discrimination between flames strictly on the combined bases of flicker and directivity is made difficult, by the fact that the flame portions exhibiting the largest flicker component (the periphery of the flame envelope) are those most apt to intrude into the region scanned by an adjacent burner's sensor. Improvements in this regard can be achieved by the use of spectral filters and by electronic filters designed to pass flicker frequencies which are predominantly stronger in some regions of the flame than in others. Because flame characteristics may vary considerably with burner adjustment, change in firing rate, fuel composition, etc., any critically selective system may randomly and unpredictably, either provide inadequate signal from the flame of interest, or unwanted signal from other flames. If

Ultraviolet radiations of extremely small magnitude are also temperature-dependent emissions of ordinary fuel flames. With commercially feasible sensors and signal processors, this signal is too small for practical use. Other and Stronger (though still very small) UV emissions are produced by the ionization which accompanies, and is a part of the oxidation of, fuel in a flame. The source of these emissions is strongest in the very early stages of combustion and therefore in an area relatively closes to the nozzle. The outer portion of the flame, where combustion is mostly complete, emits substantially less UV. It will be evident that there is a flame characteristic which is not synthesized by heated furnace and burner parts and, being more localized, makes discrimination between adjacent flames more easily accomplished. The only non flame source of UV in all but very high temperature furnace walls (2500° F. and up), is the spark from an electric igniter, which radiates very strongly in the ultraviolet and must be shielded from the sensor's view.

Temperature Sensor

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling.

The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially

easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range (−10° with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

Lightning Arrester Monitorin

The resistance of the lightning arrester is measured instantly and it is compared with the reference voltage Vref set in the comparator of the controller, if controversy occurs then the controller displays the data using LCD display and alert by alarm

Cell Phone Detector

This handy, pocket-size mobile transmission detector can sense the presence of an activated mobile phone from distance of one and- a-half meters. So it can be used to prevent use of mobile phones in examination halls, confidential rooms, etc. It is also useful for detecting the use of mobile phone for spying and unauthorized video transmission. The circuit can detect the incoming and outgoing calls, SMS and video transmission even if the mobile phone is kept in the silent mode. The moment the bug detects RF transmission signal from an activated mobile phone, it starts sounding a beep alarm and the LED blinks. The alarm continues until the signal transmission ceases. An ordinary RF detector using tuned LC circuits is not suitable for detecting signals in the GHz frequency band used in mobile phones. The transmission frequency of mobile phones ranges from 0.9 to 3 GHz with a wavelength of 3.3 to 10 cm. So a circuit detecting gigahertz signals required for a mobile bug. You may use a short telescopic type antenna. Use the miniature 12V battery of a remote control and a small buzzer to make the gadget pocket-size. The unit will give the warning indication if someone uses mobile phone within a radius of 1.5 meters.

GSM Module (SIM300/900)

GSM/GPRS RS232 Modem is built with SIMCOM Make SIM900 Quad-band GSM/GPRS engine, works on frequencies 850 MHz, 900 MHz, 1800 MHz and 1900 MHz It is very compact in size and easy to use as plug in GSM Modem. The Modem is designed with RS232 Level converter circuitry, which allows you to directly interface PC Serial port .The baud rate can be configurable from 9600-115200 through AT Command. Initially Modem is in Auto baud mode. This GSM/GPRS RS232 Modem is having internal TCP/IP stack to enable you to connect with internet via GPRS.

It is suitable for SMS as well as DATA transfer application in M2M interface. The modem needed only 3 wires (Tx, Rx, GND) except Power supply to interface with microcontroller/Host PC. The built in Low Dropout Linear voltage regulator allows you to Connect wide range of unregulated power supply (4.2V -13V). Yes, 5 V is in between!! .Using this modem, you will be able to send & Read SMS, connect to internet via GPRS through simple AT commands.

5. CIRCUIT DIAGRAM

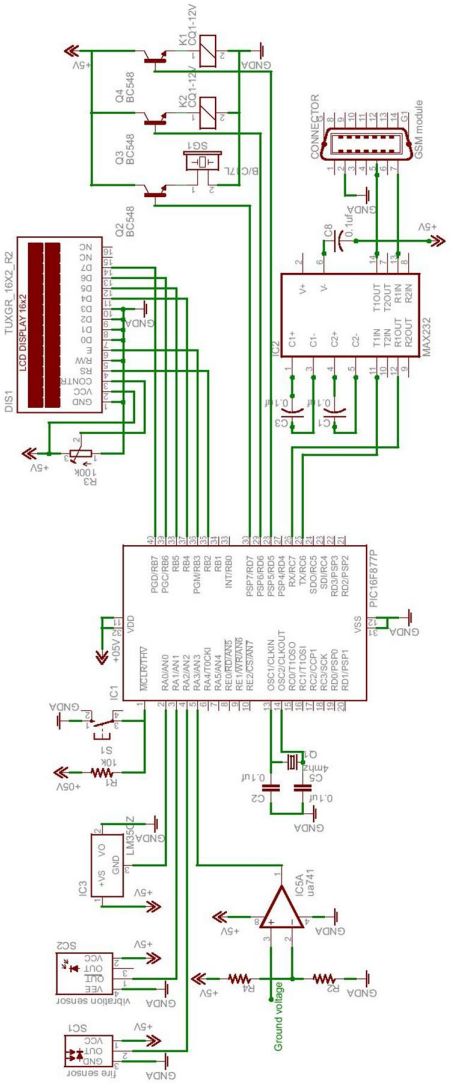


Figure.4 circuit diagram

A. Solenoid Valve

One call to Danfoss gives you access to an entire range of high-quality industrial controls. The Danfoss line encompasses components for industrial monitoring and control systems based on the principles of pressure and temperature measurement, electrical power, and fluid control, and includes:

- Electronic contactors and motor controllers
- Pressure and temperature switches
- Pressure transmitters
- Temperature sensors and transmitters
- Externally operated valves

Given their important monitoring and control functions, Danfoss components are designed for accuracy, reliability and long life. And our determination to guarantee a high-quality product is matched by an equally strong commitment to customer service. A specialist in the Danfoss industrial controls group can advise you on product selection and configuration, based on long experience in your industry. You'll find that with sales and service centers in over 100 countries, Danfoss is usually only a local call away.

Flexible and Userfriendly

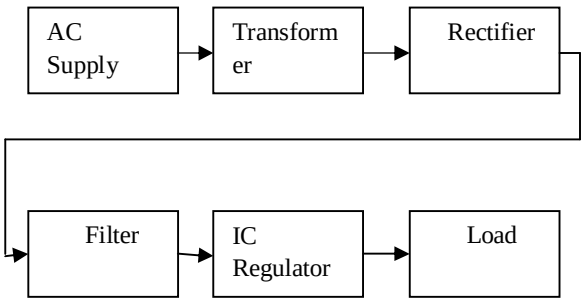
Danfoss solenoid valve bodies and electrical coils are normally supplied separately and then combined together. They are assembled quickly and simply without any tools. This provides optimum product flexibility and availability. If a coil does need to be replaced then it can be done without stopping or draining any system. The solenoid valves are also available as assembled units if required.

LCD Display

A liquid crystal display is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals (LCs). LCDs do not emit light directly. Liquid crystal displays (LCDs) are a passive display technology. This means they do not emit light; instead, they use the ambient light in the environment. By manipulating this light, they display images using very little power. This has made LCDs the preferred technology whenever low power consumption and compact size are critical. They are used in a wide range of applications, including computer monitors, television, instrument panels, aircraft cockpit displays, signage, etc. They are common in consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones. LCDs have displaced cathode ray tube (CRT) displays in most applications. They are usually more compact, lightweight, portable, less expensive, more reliable, and easier on the eyes.

Power Supply

The ac voltage, typically 220v is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units



6. CONCLUSION AND FUTURE WORK

Firework is a cottage industry. So many ignorant and illiterate people are working in it. Though, awareness programs are conducted by the government. Accidents are happening because of their carelessness and their ignorant nature. Workers are usually not following the rules formed by the government.In this research we have provided a web cam to monitor them and so human errors is eliminated. Sensors eliminate the natural causes for accidents. Though, the accidents are not completely eliminated. Our research will help a little to minimize it.The main source of income for these rural people is from the fireworks factories, they are working in a dangerous environment. Through our research we believe it can be minimized to a certain extent. Thus we ensure safety for the firework factory workers. Our work in future would be the long-term objective of this research that is to develop a control over static charges causing accidents and 2- Software Design can be Improved by using a fuzzy logic microcontroller which combine the idea of fuzzy logic in microcontroller to improve the system performance or implement the conventional fuzzy PID controller with PC as a controller. To monitor the performance of the system, use Visual Basic 6.0, this program is able to send data (desired speed from user) to microcontroller and plot a graph of detected speed versus time this is done by using RS232 for serial communication interface with PIC microcontroller.

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