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Advanced Automation System in Industrial Applications Using PIC Microcontroller and GSM

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Abstract: *The main aim of this paper is to design and develop an advanced automation system in the industries. In this technique we are using the GSM modem which have the SIM card present in it, the user can send message on the 10 digit SIM number using the cell phone from any part of the world. The micro controller is programmed using the embedded C. when the user will send the message to a particular device that particular device will be on or we can also off the device. Example if the motor is in over voltage, under voltage, over current in that time the microcontroller will trip the circuit and give the message feedback to the user. The micro controller will read the temp from the sensor and it will display the same on the LCD when the incoming temp crosses the set limit the micro controller will turn OFF the device and will send the message to owner using the SIM card present in the GSM modem. We can also check the continuous status of the device.*

Key words: *IVRS, PIC Micro controller, GSM Module.*

I. Introduction

An embedded system is a combination of software and hardware which is designed for one specific application in a time domain constraint. Now-a-days the meaning of the embedded system was changed because, it was not designed only for one specific application but, many applications can run with a single embedded system. The best example of an embedded system is a mobile phone which performs the communication, along with the communication one can surf the internet, access the social network sites, play the games and even global positioning system is deployed into such a small device.

The main aim of the paper is to design and develop an Advanced Automation system in Industries Using GSM system in the industries.

In this technology we are using the GSM modem which have the SIM card present in it , the user can call on the 10 digit SIM number using the cell phone or the land line from any part of the world. The micro controller is programmed using the embedded C. When the caller calls this SIM number, the micro controller will get to know the ring and it will pick up the call and the caller can control any of the devices using the keypad present in the cell phone or the land line. The micro controller will read the temp from the sensor and it will display the same on the LCD when the incoming temp crosses the set limit the micro controller will turn OFF the device and will call the owner using the SIM card present in the GSM modem, when the owner picks the call the micro controller will activate the speech IC and the message will be played to the owner telling that the temp has crossed the limit and the system is turned OFF and this can be told in any of the language whichever the owner chooses.

Despite it's relatively old age, the 8051 / PIC is one of the most popular Microcontroller in use today. Many derivatives Microcontroller have since been developed that are based on--and compatible with--the 8051 / PIC. Thus, the ability to program an 8051 / PIC is an important skill for anyone who plans to develop products that will take advantage of Microcontroller. Using these in built peripherals the designing of GSM [1] Based Industrial Device Control achieves its portability. Other peripherals like GSM modem voltage Current and temperature sensor, LCD and PMDC motor are used in this system.

II. Block Diagram And Explanation

2.1 Hardware requirement

PIC Micro Controller, LCD, GSM Module, Power supply Unit, Voltage sensor, current sensor, temperature sensor and Relay Driver

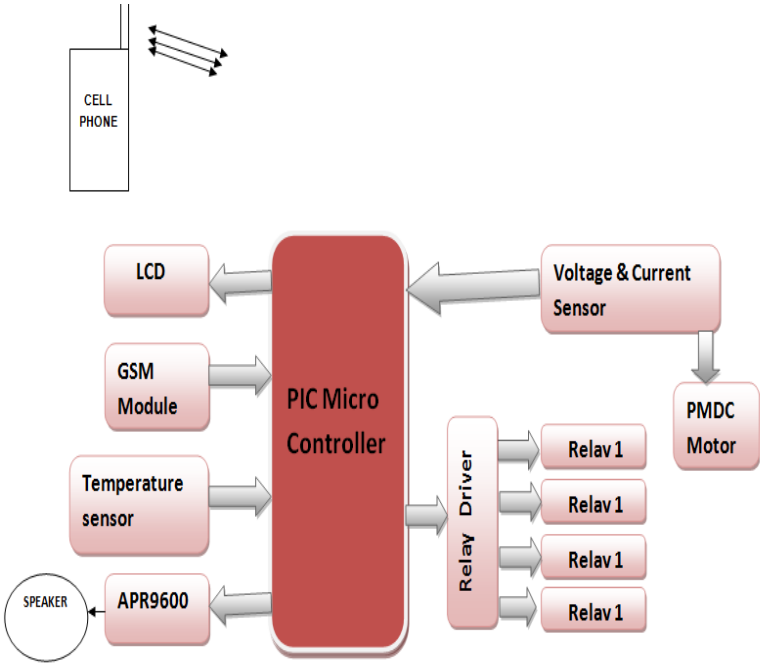


Fig.1. Block Diagram

2.2 Micro Controllers

Micro Controllers are the Heart of the Circuit. In this circuit we are going to use the 8051 MCU. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems.

2.3 LCD (Liquid Crystal 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 even 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.

2.4 Relay Driver IC

Relay Driver IC is a high voltage and high current Darlington array IC. It contains open collector Darlington pairs with common emitters. A Darlington pair is an arrangement of two bipolar transistors. Recommended for high-side switching applications that benefit from separate logic and load grounds, these devices encompass load supply voltages to 50 V and output currents to -500 mA. These 8-channel source drivers are useful for interfacing between low-level logic and high-current loads.

2.5 GSM modem

The GSM modem used by cell phones that provides low cost, long range, wireless communication channel for applications that need connectivity rather than high data rates. The interface between GSM and MUC controller is a textual protocol called Hayes AT- Commands. This particular application connects an ARM controller and Siemens M65 cellular phone using a RS232 based data cable.

2.6 Voltage and Current sensor

VI sensors are use in the project to get voltage and current values for connected load. Sensor is build/designed using resistor network logic.

2.7 Temperature sensor

Temperature sensors are used for getting temperature in the system. Which is countiuonesly monitored, if the temperature goes above predefine value then system will shutdown, which indicates there is fire in the system.

2.8 Voice recorder IC

The APR9600 device offers true single-chip voice recording,-volatile storage and playback capability for 40 to 60 seconds the device supports both random and sequential access of multiple messages. Sample rates are user-selectable, allowing designers to customize their design for unique equality and storage time needs. Integrated output amplifier, microphone amplifier, and AGC circuits greatly simplify system design. The device is ideal for use in portable voice recorders, toys, and many other consumer and industrial applications.

III. Working

The design and implementation of MUC based GSM based devices control system was effectively carried out with the advantages of low cost, low power consumption, high portability and minimum peripheral interfaces.

To start the system first we need to send the SMS for trip setting for device 1 which is in turn connected to motor. SMS sending format is UV=<value>; OV=<value>; OC=<Value>. For ex: UV=18; OV=24; OC=01. After sending sms as above format we need to send one more sms to ON the device, which will in turn on the relays respectively. Suppose to one device1 sms send to send as! DEV1 1 and to off the device1! DEV1 0. Similarly by sending different sms as above format 4 devices can be made on and off. Status of device is also shown in LCD as well as feedback sms for given on which is pre-programmed while coding and speech sound of devices status is also given for any changes is devices status. Like device 1 on, device 1 off etc. which done using IC APV 600 Voices recorder IC.

As soon as device1 gets ON ADC gets activated and immediately voltage and current information's are seen on LCD[2]. If the voltage or current get exceed pre-defined values which is stetted before starting the device1, motor will be turned off and sms is send to a number regarding status of motor.

Temperature sensors are used to sense if any fire in the system. If temperature goes beyond the limit then all the devices get shutdown and immediately sms is sent to a person.

IV. Components

4.1 PIC microcontroller

The PIC microcontroller was developed by General Instruments in 1975. PIC was developed when Microelectronics Division of General Instruments was testing its 16-bit CPU CP1600. Although the CP1600 was a good CPU but it had low I/O performance. The PIC controller was used to offload the I/O the tasks from CPU to improve the overall performance of the system.

In 1985, General Instruments converted their Microelectronics Division to Microchip Technology. PIC stands for Peripheral Interface Controller. The General Instruments used the acronyms Programmable Interface Controller and Programmable Intelligent Computer for the initial PICs (PIC1640 and PIC1650).

In 1993, Microchip Technology launched the 8-bit PIC16C84 with EEPROM which could be programmed using serial programming method. The improved version of PIC16C84 with flash memory (PIC18F84 and PIC18F84A) hit the market in 1998.

4.2 PIC Microcontroller Development

Since 1998, Microchip Technology continuously developed new high performance microcontrollers with new complex architecture and enhanced in-built peripherals. PIC microcontroller is based on Harvard architecture. At present PIC microcontrollers are widely used for industrial purpose due to its high performance ability at low power consumption. It is also very famous among hobbyists due to moderate cost and easy availability of its supporting software and hardware tools like compilers, simulators, debuggers etc. The 8-bit PIC microcontroller is divided into following four categories on the basis of internal architecture:

- Base Line PIC
- Mid-Range PIC
- Enhanced Mid-Range PIC
- PIC18

4.3 Base Line PIC

Base Line PICs are the least complex **PIC microcontrollers**. These microcontrollers work on 12-bit instruction architecture which means that the word size of instruction sets are of 12 bits for these controllers. These are smallest and cheapest PICs, available with 6 to 40 pin packaging. The small size and low cost of Base Line PIC replaced the traditional ICs like 555, logic gates etc. in industries.

4.4. Mid-Range PIC

Mid-Range PICs are based on 14-bit instruction architecture and are able to work up to 20 MHz speed. These controllers are available with 8 to 64 pin packaging. These microcontrollers are available with different peripherals like ADC, PWM, Op-Amps and different communication protocols like USART, SPI, I2C (TWI), etc. which make them widely usable microcontrollers not only for industry but for hobbyists as well.

4.5 Enhanced Mid-Range PIC

These controllers are enhanced version of Mid-Range core. This range of controllers provides additional performance, greater flash memory and high speed at very low power consumption. This range of PIC also includes multiple peripherals and supports protocols like USART, SPI, I2C and so on.

4.6 PIC18

PIC18 range is based on 16-bit instruction architecture incorporating advanced RISC[3] architecture which makes it highest performer among the all 8-bit PIC families. The PIC18 range is integrated with new age communication protocols like USB, CAN, LIN, Ethernet (TCP/IP protocol) to communicate with local and/or internet based networks. This range also supports the connectivity of Human Interface Devices like touch panels etc.

4.7 LCD

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. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

4.8 Relay

Relay is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very useful devices and allow one circuit to switch another one while they are completely separate. They are often used to interface an electronic circuit (working at a low voltage) to an electrical circuit which works at very high voltage. For example, a relay can make a 5V DC battery circuit to switch a 230V AC mains circuit. Thus a small sensor circuit can drive, say, a fan or an electric bulb. A relay switch can be divided into two parts: input and output. The input section has a coil which generates magnetic field when a small voltage from an electronic circuit is applied to it. This voltage is called the operating voltage. Commonly used relays are available in different configuration of operating voltages like 6V, 9V, 12V, 24V etc. The output section consists of contactors which connect or disconnect mechanically. In a basic relay there are three contactors: normally open (NO), normally closed (NC) and common (COM). At no input state, the COM is connected to NC. When the operating voltage is applied the relay coil gets energized and the COM changes contact to NO. Different relay configurations are available like SPST, SPDT, and DPDT etc, which have different number of changeover contacts. By using proper combination of contactors, the electrical circuit can be switched on and off. Get inner details about structure of a relay switch.

4.9 Regulator IC

7805 is a voltage regulator integrated circuit. It is a member of 78xx series of fixed linear voltage regulator ICs. The voltage source in a circuit may have fluctuations and would not give the fixed voltage output. The voltage regulator IC maintains the output voltage at a constant value. The xx in 78xx indicates the fixed output voltage it is designed to provide. 7805 provides +5V regulated power supply. Capacitors of suitable values can be connected at input and output pins depending upon the respective voltage levels.

4.10 Voltage and current Sensor

ADC module of PIC Microcontroller converts the Signals on its analog pin to 10 bit binary data and it has software selectable high and low voltage reference input to some combination of VDD, VSS, RA2 and RA3. The analog input to PIC is limited to VSS and VDD voltages (0 – 5V) of PIC this circuit is designed to measure 0 to 30V. So we will map 0 to 30V to 0 to 5V by using a voltage divider. Current through a circuit can be

measured by introducing a 1 ohm resistor and measuring the voltage across it. To minimize the path resistance we will use .47 ohm special resistor with and current is calculated. Voltage and Current Sampling circuit is shown below.

When the Input voltage is 30V (max) the voltage across 20K ohm resistor becomes 5V which is feedback to the analog pin RA2 of the PIC Microcontroller. The voltage across .47 ohm resistor is also feedback to the analog pin RA3 via 100K ohm resistor. 5.1V Zener Diode is added in parallel to these analog input pins to protect PIC from over voltages. The ADC module of PIC converts analog input to 10 bit digital number. We want to convert this digital to corresponding voltage n decimal.

V. Software Requirement

5.1 Kiel Compiler

Embedded system means some combination of computer hardware and programmable software which is specially designed for a particular task like displaying message on LCD[4]. If you are still wondering about an embedded system, just take a look at these circuit applications using 8051/PIC microcontroller. You can call these applications embedded systems as it involves hardware (8051/PIC microcontroller) and software (the code written in assembly language).

Some real life examples of embedded systems may involve ticketing machines, vending machines, temperature controlling unit in air conditioners etc. Microcontrollers are nothing without a Program in it.

One of the important part in making an embedded system is loading the software/program we develop into the microcontroller. Usually it is called "*burning software*" into the controller. Before "burning a program" into a controller, we must do certain prerequisite operations with the program. This includes writing the program in assembly language or C language in a text editor like notepad, compiling the program in a compiler and finally generating the hex code from the compiled program. Earlier people used different soft wares/applications for all these 3 tasks. Writing was done in a text editor like notepad/word pad, compiling was done using separate software (probably a dedicated compiler for a particular controller like 8051), converting the assembly code to hex code was done using another software etc. It takes lot of time and work to do all these separately, especially when the task involves lots of error debugging and reworking on the source code.

Kiel Micro Vision is free software which solves many of the pain points for an embedded program developer. This software is an integrated development environment (IDE), which integrated a text editor to write programs, a compiler and it will convert your source code to hex files too.

5.2 How to Burn a Micro Controller

Programming or burning a microcontroller means to transfer the program from the compiler to the memory of the microcontroller. A compiler is software which provides an environment to write, test and debug a program for the microcontroller. The program for a microcontroller is generally written in C or assembly language. Finally the compiler generates a hex file which contains the machine language instruction understandable by a microcontroller. It is the content of this hex file which is transferred to the memory of the microcontroller. Once a program is transferred or written in the memory of the microcontroller, it then works in accordance with the program.

In order to know how to program a microcontroller, we need a device called a burner/programmer. A programmer is a hardware device with dedicated software which reads the content of the hex file stored on the PC or the laptop and transfers it to the microcontroller to be burned. It reads the data of the hex file by connecting itself to the PC via a serial or USB cable and transfers the data to the memory of the microcontroller to be programmed in accordance with the protocols as described by the manufacturer in the datasheet.

The programmer and the compiler differ for microcontrollers from different companies. In some cases the compiler has programmer software inbuilt in it. You simply need to connect the programmer hardware and the microcontroller can be programmed from the compiler itself.

VI. Steps Followed In Designing The System

Three general steps can be followed to appropriately select the control system:

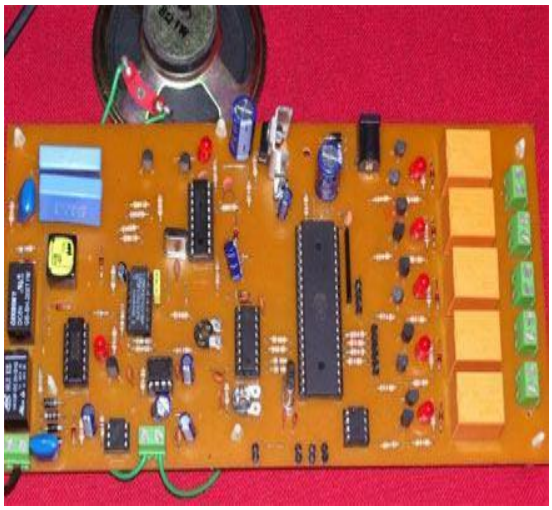
Step # 1: Identify measurable variables important to production. It is very important to correctly identify the parameters that are going to be measured by the controller's data acquisition interface, and how they are to be measured.

Step # 2: Investigate the control strategies. An important element in considering a control system is the control strategy that is to be followed. The simplest strategy is to use threshold sensors that directly affect actuation of devices.

Step # 3: Identify the software and the hardware to be used. Hardware must always follow the selection of software, with the hardware required being supported by the software selected. In addition to functional

capabilities, the selection of the control hardware should include factors such as reliability, support, previous experiences with the equipment (successes and failures), and cost.

VII. Result Analasis



VIII. Conclusion

Advanced automation system can be used in organization to know about various departments, mode working and levels of control. Hardware circuitry of automation system is very compact .by the wide spread internet it is possible to information from anywhere in the world with advanced features of automation System.

It has been the latest technology for industrial application .this provides the foundation for providing service for industrial process application as well as reduced cost, improved man power satisfaction.

A message interface gives user more flexible navigation outputs. That is less complex and more rigidly hierarchical.

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