IoT Implementation in Industrial Automation

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Abstract : The need for a centralized control system has been long identified in office and industrial application. Thus a wireless appliance control system for the industry is proposed in this paper. Iron manufacturing, cloth industries, and other such industries are the main concentrate here. AGSM based wireless automated industry is being demonstrated in the paper. The system includes a PIC that performs all the functions of monitoring, switching and controlling. The temperature of the industrial environment is checked and alterations are made accordingly based on the observed readings. Interfacing between the human controller and the system is employed via GSM Technology. IoT helps to streamline, collapse, and create system architectures that are effective, affordable and responsive. The major aim is to create frictionless communications and interaction from manufacturing field input/output including analyzers, actuators, robotics etc to enhance flexibility and increased manufacturing. Using IoT, the industrial automation has leveraged commercial technologies in major applications and these examples include PLCs displacing banks of relays.

IndexTerms **- IoT, PCB, Automation, GSM Technology.**

I. INTRODUCTION

Automation is the use of control systems and information technologies to reduce the need for human work in the production of goods and services. In the scope of industrialization, automation is a step beyond mechanization. Whereas mechanization provides human operators with machinery to assist them with the muscular requirements of work, automation greatly decreases the need for human sensory and mental requirements as well. Automation plays an increasingly important role in the world economy and in daily experience.

Automation has had a notable impact in a wide range of industries beyond manufacturing(where it began). Once-ubiquitous telephone operators have been replaced largely by automated telephone switchboards and answering machines. Medical processes such as primary screening in electrocardiography or radiography and laboratory analysis of human genes, sera, cells, and tissues are carried out at much greater speed and accuracy by automated systems. Automated teller machines have reduced the need for bank visits to obtain cash and carry out transactions.

The main advantages of automation are:

- Replacing human operators in tasks that involve hard physical or monotonous work.
- Replacing humans in tasks done in dangerous environments (i.e. fire, space, volcanoes, nuclear facilities, underwater, etc.)
- Performing tasks that are beyond human capabilities of size, weight, speed, endurance, etc.
- Economy improvement: Automation may improve in the economy of enterprises, society or most of humanity. For example, when an enterprise invests in automation, technology recovers its investment; or when a state or country increases its income due to automation like Germany or Japan in the 20th Century.
- Reduces operation time and work handling time significantly.

The main disadvantages of automation are:

- Security Threats/Vulnerability: An automated system may have a limited level of intelligence, and is, therefore, more susceptible to committing an error.
- Unpredictable development costs: The research and development cost of automating a process may exceed the cost saved by the automation itself.
- High initial cost: The automation of a new product or plant requires a huge initial investment in comparison with the unit cost of the product, although the cost of automation is spread among many products.

In manufacturing, the purpose of automation has shifted to issues broader than productivity, cost, and time.

II. PROPOSED SYSTEM

Since ancient days, various types of industries have been quite common and of vital importance to the Indian economy. Till the recent days, whatever be the industry and however risk it may be to work in that particular environment; all the works were done manually. Machines, toxic elements, and high voltage devices were handled and controlled manually. This has proven to be a very dangerous situation, which implies the urgent implementation of a centralized and automatic industrial environment.

To eliminate all the risk factors encountered till the present day, a solution to the problem which is both user-friendly and at the same time economical for a developing country like India has been considered. This involves automatic switching of appliances in an industry such as an Iron or Cement Manufacturing industry where the manufacturing or processing area has to be isolated from human interference. Switching is the basic and most important problem in these industries along with the fire production due to short circuit or other such causes, hence overload detection is also very important. Both these have been taken care of in this project. Along with this, the maintenance of the required temperature range within the manufacturing area is done.

Here We have done a project on how to wirelessly control electronic appliances from a remote place by using GSM technology. For this GSM wireless appliances control system, we designed and developed the required hardware. This system has a circuit on the transmitter side alone, whereas the receiver side here using the mobile phone, which is the interface between the user

and the transmitter circuit. A PIC is used to check and control the switching circuits and also takes care of the temperature control. A current and voltage sensing has also been included to sense any kinds of load variation, due to electrical shortages, etc.

It is utilized to control many appliances with the help of microcontroller. This includes the circuit with the PIC as the main component and controlling element. The working statuses of the machines are noted and switching is done accordingly. The temperature of the working environment is noted using a sensor; any alterations from the desired value are compensated by a fan or cooling device included within the system. This can be done automatically.

III. BLOCK DIAGRAM

The below illustrated is the block diagram of the transmitter unit to be implemented in the manufacturing section. The main component is a PIC microcontroller, which performs the function of monitoring and controlling of various parameters. This unit has got four stages in total. In the first stage, the temperature sensor senses the temperature of the working environment. In case of any alterations from the predefined range, the temperature is to be brought within the desired range.LM35 senses the temperature and only monitors the degrees. Normally iron temperature ranges -55°C – 150°C for commercial Quality. The above function of monitoring and controlling can also be viewed from anywhere with the help of GSM. In addition to this, the statuses of the machines or appliances connected to the load are checked and depending on the input, the machines are switched ON and OFF.

The second stage includes the current sensor (ACS712). If an overload occurs, or another voltage variation is produced, then it is sensed by the sensor, which the microcontroller detects, and gives instruction to the relay coil.

The third stage is included to switch ON the output whenever necessary. If the ACS712 is observed to cross the desired range of current, then the microcontroller causes the relay to turn off, as the resulting load goes off. If we can need again to ON output, the state is sent by SMS through GSM in the request. If the overload is offline, the industry can be powered via SMS or by manual means.

All these information's are stored in the memory of the manufacturing unit itself. And the same is sent to the GSM, and the details are transmitted via the SMS. It can also be viewed at the LCD placed in the manufacturing unit itself.

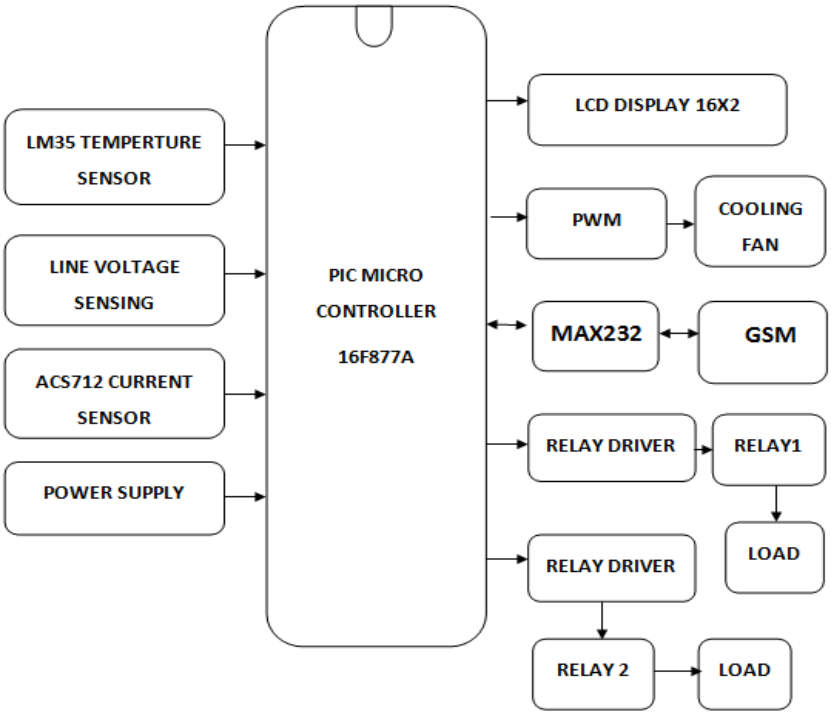

Fig:1 : Block Diagram of the Circuit

IV. REQUIREMENTS

a) **Hardware requirements**

Microcontroller PIC16F877A, ACS712 current sensor, LM35 temperature sensor, Line voltage sensory circuit, Power supply, SIM900 GSM module, MAX 232,LCD display 16x2, Cooling fan, Relay, diodes, transistor, resistor, capacitor, crystal oscillator, LED.

b) **Software requirements:**

Compiler employed: Micro C PRO for PIC v6.0

Circuit design: Express PCB

V. CIRCUIT DESCRIPTION

Provided in Figure 2 is the circuit diagram of the proposed industrial automation control system. The main component is a PIC microcontroller, which performs the function of monitoring and controlling of various parameters. Here PIC16F877A is used as the controller as it meets the current project requirement. The project aims the controller to take control over temperature, voltage and current in integration with GSM technology.

The overall system can be classified into two sections; transmitter section and remote control section. The transmitter section is core part where all the implementations are made. Dealing with sensor parts, the sensor used for temperature determination is LM35. Several other sensors are available for temperature determination like a thermistor, thermo coupler, etc... However, LM35 is used because it is readily calibrated and provides accurate readings. The output of LM35 is a voltage proportional to the temperature determined. For the controller to read this, the analog to digital conversion of LM35 output is done. For this conversion

to be done, the output pin of LM35 is connected to ADC pin of PIC. Here pin 2 (RA0/AN0) of PIC is used. The corresponding actions to overcome temperature is done by employing a cooling fan with speed control performed by Pulse Width Modulation (PWM). The PWM is done by connecting the cooling fan to PWM pin of PIC. Pin 17(RC2/CCP1) of PIC performs PWM.

The line voltage sensing is done by designing a voltage divider network in which one is a fixed resistor and the other is a tunable one. The potentiometer in the voltage divider circuit is tuned manually for the first time to a voltage level proportional to the line voltage. For the next time, the network tunes automatically. The voltage division is done here to bring the line voltage level to the level that PIC can accept. For the controller to read this, the analog to digital conversion of voltage output is done. Here pin 3 (RA1/AN1) of PIC is used. The corresponding action for high voltage is done by switching a relay which is connected to the load. The relay switching signal is provided through pin 40(RB7) of the PIC.

The current sensor used here is ACS712.ACS712 is a calibrated sensor. The output of the current sensor is a voltage proportional to the line input. For the controller to read this, the analog to digital conversion of ACS712 output is done. Here pin 4 (RA2/AN2) of PIC is used. FF

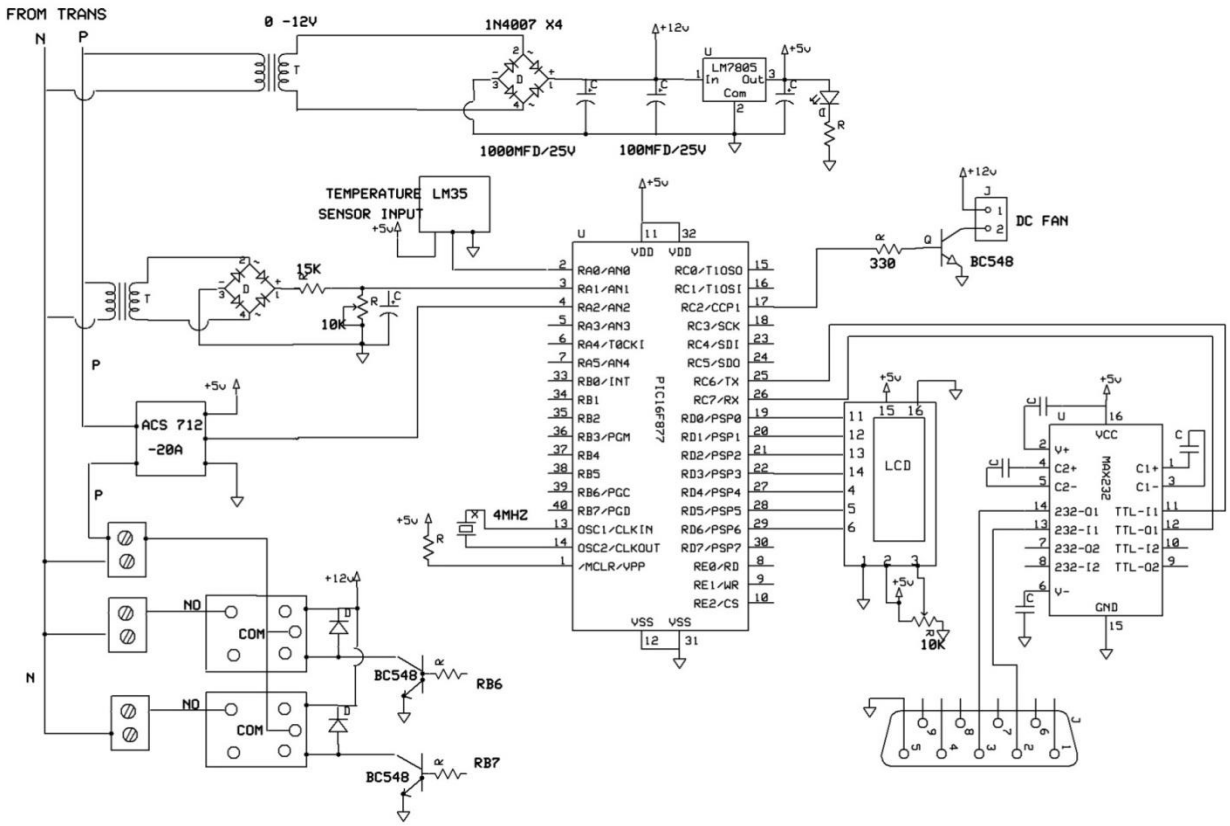

Fig:2 Circuit Diagram

The corresponding action for high overload current is done by switching a relay which is connected to the load. The relay switching signal is provided through pin 39(RB6) of the PIC. The overall sensed values and details are displayed on a 16x2 LCD display at the transmitter section. The PIC pins 11-14(RD0 –RD3) are used for data communication with the LCD.

GSM module plays an important in automation. All the information's stored in the memory at the manufacturing unit is sent to the GSM, and the details are transmitted via SMS.SIM900 is the GSM module used here.Max232 IC is interfaced between controller and SIM900 in order to perform TTL to RS232 conversion and vice versa. The serial communication (USART) pins 25(TX/RC6) and 26(RX/RC7) are connected to corresponding MAX232 pins 11(T1 IN) and 12(R1 OUT). The corresponding MAX232 pins 14(T1 OUT) and 13(R1 IN) are connected to SIM900 via DB9 connector.

Two types of voltage levels are provided. A 5V supply for PIC microcontroller, MAX232, LM35, LCD display, and 12V supply for relay driver, GSM modem and cooling fan. Two transformers are used in the system. One is dedicated to the voltage sensing circuitry to avoid voltage variations in case if the same transformer is connected to drive the load. The other transformer is used to drive the remaining section. NPN configured transistors are employed as switching elements to power the relay and DC fan.

At the remote section, a mobile phone with SIM card is provided. The system provided is programmed in such a way that the variations in temperature, voltage and current are sent to the assigned mobile user under specified conditions. The switching of the relay can also be done by sending SMS from the remote section under specified conditions. All the control actions are employed by programming the PIC microcontroller.

IV. RESULTS AND DISCUSSION

The sensor based automation system can collect sensor data intelligently. It was designed based on PIC16F877A and the application of wireless communication. It is very suitable for real-time and effective requirements in data acquisition system in industrial environment. Different types of sensors can be used as long as they are connected to the system. We can monitor the plant environment through GSM.The project provides risk-free industrial environment, provides safety in terms of material and human involvement in industrial area, system status check and control from remote control via GSM, the control system performs repeated monitoring and automatic actions. More sensory and control mechanics can be added.

In this work, the sensors are successfully implemented and interfaced with the PIC16F877A. The data or values received from the sensors were displayed on the 16X2 LCD display and also controlling the corresponding devices according to the plant operation on the basis of received data. The snapshots and figures show the optimized results. Figure 3 shows the system.

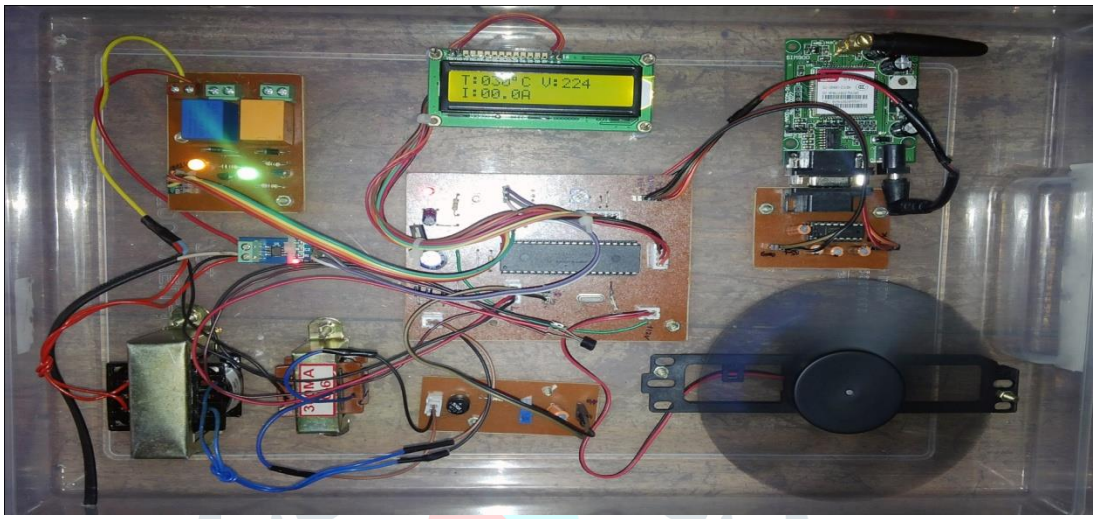

Figure 3: Industrial automation system

Fig 4 shows the resultant values of temperature, voltage and current sensed displayed on 16x2 LCD

Fig:4 Sensor values displayed on LCD

Fig: 5 show the snapshot of the SMS received to the user informing production details

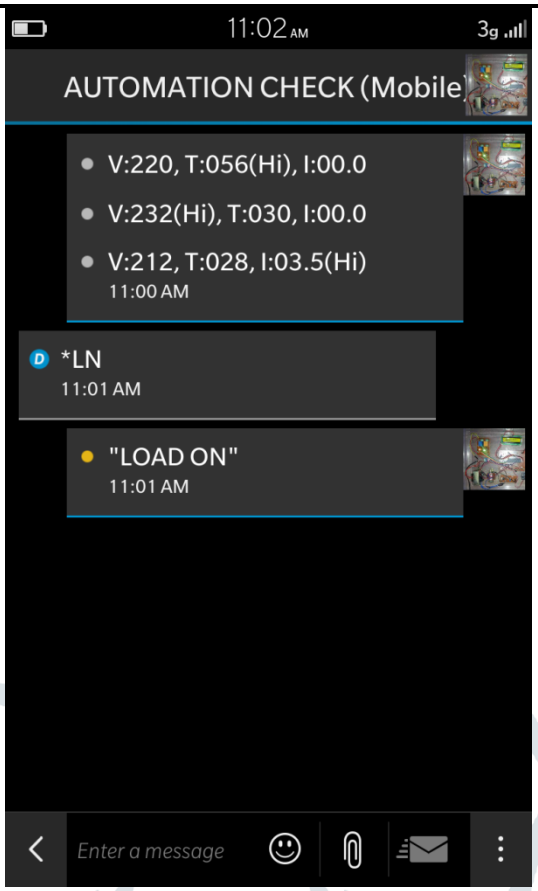

Fig 5: SMS displayed on user mobile phone

V. FUTURE ADVANCEMENTS

- Automation can be enhanced by collaborating with artificial intelligence.
- Control of multiple industrial sectors from single remote server by integrating network broadcasting.
- Current system configurations can be made upward compatible with technological developments.

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