LAN Based Industrial Automation with GSM Connectivity

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ABSTRACT: A new approach for the development of remote monitoring of industrial loads by using GSM and local monitoring of industrial loads by using local Ethernet connected PC is described in the project. Here, two types of control technique for the same industrial loads is designed the operator can select the type control mode he requires, a switch is provided for purpose of selection of control mode and two different LED's to indicate the same. Depending upon the type of mode selected. The Input commands are different for GSM and PC mode. In GSM mode predefined commands are sent from mobile phone to operate the loads. In PC mode the commands are sent by clicking on the control panel. The feedback message about the load being operated is received to the mobile phone. Feedback sensor arrangement is the important aspect of the design

KEYWORDS: GSM MODULE, SENSOR, MICROCONTROLLER

I.   INTRODUCTION

There is a growing interest in the field of industrial automation. Efforts are exercised to build efficient low cost smart automation suited to custom and regional requirements. In this project Remote control of loads by using GSM (Global system for mobile communication) and PC(Personnel computer) based control using local area network with closed loop control to update the status of the load being operated is designed, thus providing two ways of control technique for the system and allowing the operator to select the type of control he require i.e. GSM based control, PC based control are the important aspects to be considered for implementing LAN based industrial automation with GSM connectivity.[1].

In GSM (Global system for mobile communication) based control the different loads are operated through predefined messages i.e. ON / OFF commands are sent from the predefined mobile number to the GSM modem SIM number this in turn sends it to the controller . The controller based on the embedded program takes suitable action on the input message and operates the relay to turn ON /OFF the device. once the load is operated the feedback sensor will sense the changes in load and intimates to the controller the controller sends an acknowledgement message to the operator through GSM modem to the predefined mobile number about the present status of the device being operated.[2]

In PC based control graphical user interface of visual basics 6.0 is utilized to create a control panel on the client side. The client should enter the password to view the control panel. The control panel contains the details of the different loads with ON and OFF buttons. when the client operates the buttons (ON/OFF) the WIZ110SR Ethernet to Serial converter will sent it to the controller the controller will take suitable action based on the embedded program and operates the relay to turn ON/OFF the device once the load is operated the feedback sensor will sense the changes and intimates to the controller the controller will take suitable pre-defined actions and sends an acknowledgement message through GSM modem to predefined mobile about the present status of the device being operated. In PC based control, the control panel shows two different colors to indicate the ON/OFF status of the load and there is a separate button to update the present status of the loads connected .Furthermore, in industrial security aspects, any hazardous fire accidents that might occur in industry at remote locations, or at hazardous locations where human operators usually are not present but the fire accidents should be alerted for taking rescuing measures through SMS is designed in the system. Another aspect which is added to the system is an intruder detecting system in industry

there may be some locations where the entering of human beings is prohibited. But, still some enters the area then the intruder detection system detects the movement of human beings and intimates to the operator via SMS. Whether the control is in GSM based mode or PC based mode the fire detector and intrusion detection system will send SMS to the concerned mobile number about the changed status of their detection.

II. OBJECTIVE

The objective of this project is to design a LAN based industrial automation with GSM connectivity. Here, controlling the different loads of the industry with two ways of control technique is proposed i.e. GSM based control, and LAN connected PC based control. Whenever the operator operates the devices through any selected type of control he will get a feedback message to predefined mobile number about the changed status of the load.

III. PROBLEM WITH EXISTING SYSTEM

In previous systems, GSM based control and PC based control existed separately and there was no link existing between them. There was no feedback sensor system available in both systems. In PC based control there existed a limited interface with low speed, limited range or lack of standard application protocols.

IV. PROBLEM DEFINITION

In GSM based control when command from mobile phone is sent to switch 'ON' the device it goes to the microcontroller through GSM modem, the controller based on the embedded code will energize the relay connected to it. Thus, operating the device connected to 'ON' status but, the question here if there is any problem with load connected it will not switch
'ON'. But, the remote operator assumes that he has switched
'ON' the device.
Example: In this case a simple bulb is considered as a load connected. When the remote operator sends a command to switch 'ON' the bulb the controller will energizes the relay and bulb glows. But, if the bulb is burnt out then the bulb will not glow and the operator assumes that he has switched ON the device.[5]
Thus, the system is open loop there is a necessity for closed loop control and also remote operator should get the information about the status whenever he operates the load. In PC based control there existed a limited interfacing device from microcontroller to the PC and system was open loop.

V. PRINCIPAL OF SERIAL COMMUNICATION

WIZ110SR is a gateway module that converts RS-232 protocol into TCP/IP protocol. It enables remote gauging, managing and control of a device through the network based on Ethernet and TCP/IP by connecting to the existing equipment with RS-232 serial interface. In other words, WIZ110SR is a protocol converter that transmits the data sent by serial equipment as TCP/IP data type and converts back the TCP/IP data received through the network into serial data to transmit back to the equipment.[3][4]
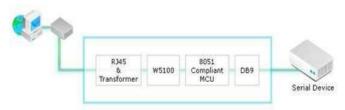

Fig 1: WIZ110SR BLOCK DIAGRAM

WIZ110SR is a protocol converter that transmits the data sent by serial equipment to Ethernet and converts back the TCP/IP data received through the network into serial data to transmit back to the equipment. When the data is received from serial port, it is sent to W5100 by MCU. If any data is transmitted from Ethernet, it is received to the

internal buffer of W5100, and sent to the serial port by MCU. MCU in the module controls the data according to the configuration value that user defined.[4]

VI. ARCHITECTURE OF A LAN BASED INDUSTRIAL AUTOMATION WITH GSM CONNECTIVITY

The architecture of LAN based industrial automation with GSM connectivity after incorporation of features as mentioned above is shown in Figure 2. The microcontroller being the building block becomes the core of the platform and the functionality of the Ethernet and GSM is built around it. Ethernet is connected to the controller through UART0 and GSM is connected to the UART1 of the controller, this is one of the advantage in the controller that it has two UART'S which is used for two way communication in the system.
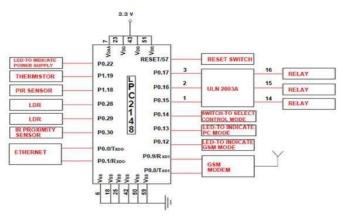

FIG 2: BLOCK DIAGRAM OF LAN BASED INDUSTRIAL AUTOMATION WITH GSM CONNECTIVITY

In order to communicate and control in GSM Mode, the design requires a GSM Modem. SIM 300 is used is used as a GSM modem which is set with the pre required commands using AT-Commands it has SIM card holder to insert the SIM card . This SIM card receives massages from the remote operating phone whose phone number is defined in the program and the controller sends the updated action to the remote user by means of a message through the SIM300 card holder number.[5]

The other mode of communication provided in the system is LAN based system here the design requires a suitable communication medium to convert the commands from the PC to a suitable form to communicate to a controller and vice versa. Keeping this in mind in the design a serial to Ethernet converter such as WIZ110SR which is connected to the PC using RS-232 cable. The WIZ110SR is connected to the controller pin UART0. WIZ110SR is a protocol converter that transmits the data sent by serial equipment as TCP/IP data type and converts back the TCP/IP data received through the network into serial data to transmit back to the equipment.

In many industrial automation applications, it is useful to have a sensor based detecting or alarming system connected to the system. Therefore thermistor as a fire detecting sensor interfaced to microcontroller, and PIR sensor as an intruder detecting system interfaced to microcontroller. Another important requirement of the system is feedback sensor selection and their mechanical arrangement in the system. In the present design LDR and IR Proximity sensors are selected as feedback sensors for loads like bulb and DC motor respectively which detects the changes in the load and sends a feedback signal to the controller. [4]

Thus the system has the ability to interface above said peripherals through Universal Asynchronous Receiver/Transmitter (UART), and General Purpose Input Output (GPIO) pins of the microcontroller. These pins are brought out in the form of expansion connectors and peripherals can be connected to them.[5]

VII.WORKING PRINCIPLE

Microcontroller is the heart of our system to which GSM Modem, Serial to Ethernet converter, switch to select the type of control mode i.e. PC or GSM mode, different sensors are interfaced. The detecting sensor system includes thermistor for fire detection, PIR sensor for intruder detection, and feedback sensor system includes LDR to detect the light intensity of a bulb and observe the changes and intimate user through a message about the status of load, IR proximity sensor used to detect the rotation of motor and intimate the user about the status of motor being operated. Based on the control mode selected the control technique will differ.

In GSM mode: The GSM Modem is used to receive commands from the remote operator to operate the loads connected and sends feedback message to the operator about the status of the load being operated. And also the GSM will send message to the remote operator about fire detection and intrusion detection irrespective of the control mode selected.

In PC mode: The user is provided with control panel to operate the loads. Whenever the user operates ON/OFF buttons in the panel the corresponding changes are conveyed to the microcontroller through WIZ110SR and the corresponding operation will take place and GSM modem will send feedback message to the operator about the changed status.

VIII. DESIGN AND IMPLEMENTATION

Circuit diagram shows hardware connection of LAN based industrial automaton with GSM connectivity. Four sensors are used in this project (incuding both feedback sensors and detecting system sensors). Detecting system has two sensors thermister as a fire detector , PIR as a intruder detector which are connected to Port0 of the LPC2148 micrntroller and two feedback sensors LDR to detect the light intesity of a bulb, IR proximity sensor to detect the rotation of motor are connected to Port 1. The other connection for Port0 are a LED to indicate the power supply in the controller, switch for selection of control mode , two different coloured LED's to indicate the control mode selected, relay driver circuit. The WIZ110SR Serial to ethernet converter and GSM modem is connected UART0 and UART1 of the LPC2148 controller .The system requires different voltage level hence a suitable power circuit is designed using rectifier circuit, filter circuit and regulator . Microcontroller is programmed to operate in both control modes using embedded 'C' and the controller is having two UART's to support for Ethernet and GSM communication.

IX. FLOWCHART OF THE SYSTEM

When the power supply is turned 'ON 'for the microcontroller, GSM Modem, WIZ110SR, the system starts working; initially the system will be in PC Mode this is indicated by green LED, now run the VB program in the PC a window appears asking for the password enter the correct password, then the control panel appears showing the details of loads with ON and OFF buttons, now click on the connect button to establish a connection between PC and controller .click on the 'ON' button and receive message as 'Load turned ON automated sms by LAN connected industrial automation with GSM connectivity 'or else as 'No feedback ..Automated sms by LAN connected industrial automation with GSM connectivity.'

No feedback message indicates there is problem with the load connected. When the system is selected for GSM control, this is indicated by yellow LED now send pre-defined command messages such as <L1ON> to switch 'ON' load 1, <L1OF> to switch 'OFF' load1. Similarly, <L2ON> to switch 'ON' load2 and <L2OF> to switch 'OFF' load2 are send to GSM Modem and corresponding actions will take place and receive feedback message indicating the status of load as 'Load1 turned ON/OFF automated sms by LAN connected industrial automation with GSM connectivity 'or else as 'No feedback

..Automated sms by LAN connected industrial automation with GSM connectivity'. In both the control mode the fire detector and intruder detection system will check for corresponding detections if the fire is detected it will send message as 'fire detected!!! Automated sms by LAN connected industrial automation with GSM connectivity'. And if intrusion is detected it will send message as 'Intrusion detected!!! Automated sms by LAN connected industrial automation with GSM connectivity.' If nothing is detected the controller will not send any message.
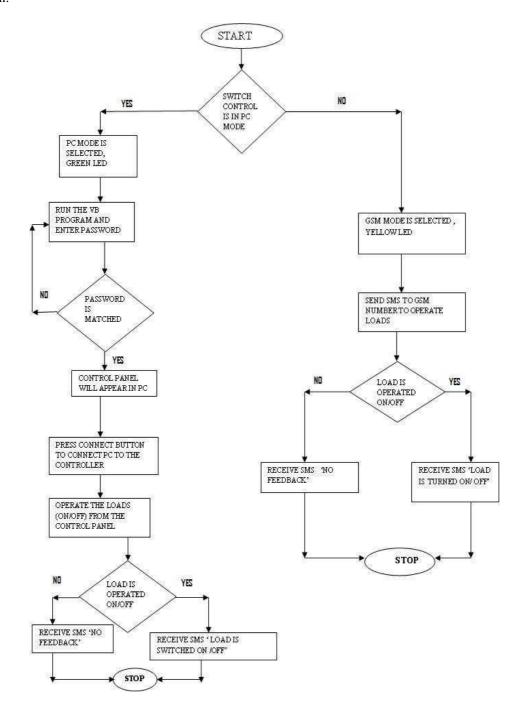
X. RESULTS AND DISCUSSION

This project is basically for industrial load controlling using two different control techniques, i.e. GSM mode for controlling the loads from remote location and local area networked PC for controlling the loads within the specified location of the industry and feedback message about the status of the load being operated is sent to the predefined mobile number and also system designed to alarm the operator about the fire detection and intrusion detection.
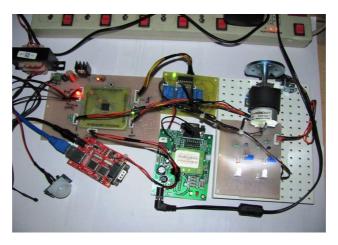
Fig 3: Integrated Circuit

Developing such a system is a type of prototyping as this developed design is so flexible to be used for different automation system such as industrial automation, home automation, remote security alerting system and has got wide area of application. It has been developed by integrating features of all the hardware components used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit.

Hardware with the software finally makes LAN based industrial automation with GSM connectivity to work. After testing of software and hardware separately we should always make sure that they work together in accordance with each other ensuring full functionality of the system. Overall testing will ensure automation system functionality under different working conditions.

The system by default is put under PC mode and it is indicated by yellow LED. The program is executed using visual basic software and correct password is entered to open the control panel. Now, by clicking on the connect button the system will establish connection to the controller. The user will press suitable ON/OFF command buttons and corresponding changes were observed in loads and corresponding message is received to the mobile number.

The GSM mode is selected by pressing the switch provided for the purpose and yellow LED will indicate the same. Now, pre- defined commands are sent to the GSM number and corresponding changes were observed in the load and corresponding message is received to the mobile number. The testing of fire detection is done by keeping thermistor near to the fire and suitable message of fire detection is received to the mobile number alerting the operator. The testing of intruder detection system is done by passing the human beings in the view of PIR sensor and corresponding message is received to the mobile number.

XI.CONCLUSION

A framework has been presented that incorporates the uses of sensors in developing a low-cost, high-accuracy Industrial automation system, using GSM and Ethernet connected PC. The proposed system provides two different types of control modes to the user with a feedback message about the status of the load being operated. The system has been tested and the results have proven the accuracy and reliability of the proposed system. This LAN based Industrial automation with GSM connectivity is of better choice in terms of cost, portability, and status updating capability. The designed feedback sensor system, fire detection and intruder detection system can find a wide application in different areas, especially where it is needed to monitor and send feedback data to the user and intimate the user about fire accidents, intruder detection for different industrial practices.   The main feature of feedback sensor is how they are being placed near the load in order to sense the changes in load when it is operated from different modes of control. The other part of the sensor system is the fire and intruder detection system which are placed in suitable locations where the occurrence of fire and unwanted human entering is to be intimated to the operator

The different uses of the system are, firstly as a model that is used for educational purposes as a practical model for representation of simple automation technology, secondly in the industrial automation, home automation and in other technological operations, where it is necessary to monitor and control the different types of loads and get the status of the load as a feedback massage to the user mobile phone.

XII. FUTURE WORK

The emergency conditions such as fire and intruder detection can be upgraded to intimate the user through pre-recorded voice call. The local Ethernet connected PC control can be upgraded to web based control by using the dedicated IP for that purpose and having an internet facility at load side and user side. Many more detecting systems can be added to the system as per the requirement.

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