GSM Based Industrial Data Communication Using EKK LM3S8962 Embedded Processor

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***Abstract*— In any Industry or Plant the data acquisition and its communication is very important factor for the maintenance of the plant. This data give the information regarding the current status of the running plant and by manipulating of this data one can control the component of the plant. This paper describes the industrial data acquisition and communication using GSM module with user interface. It is data logger which can be used for the plant monitoring and controlling using GSM communication. Our objective of the work is to provide an approach that helps to monitoring the running plant by collecting the current data and give controlling output as feedback to plant. This system is closed loop system which include embedded microcontroller and also provide user interface through LABVIEW module. Sensors which are generally used in plant are part of the system which provides the interface to real plant environment. So Controller system comprises processor module. GSM module, sensors, memory device.**

***Keywords*— data communication system , LM 3S8962(CORTEX M3),sensor interface, GSM**

I. INTRODUCTION

In current scenario, various sensors of plant are connected to the PLC for the data communication and PLC is programmed such that it gives controlling output according to the threshold value of sensors. In this if the value of sensor is below or above the threshold value then it gives the respective output. This output is nothing but the controlling output from the PLC which gives signal to controlling device like valve or alarm etc. Also SCADA provide the Graphical user interface to the PLC unit so that any person can see the process graphically with the help of SCADA. In Plant, SCADA and PLC are connected to each other which make a whole system for data communication and its controlling. There are various types of PLCs are available in the market. The selection of the PLC can be done as per the requirement of number of input and output associated with the plant.

A. Technical Background

The industrial plant have many type of Analog data like temperature sensor, level sensor, flow meter, pressure sensors etc. So in plant this type of data should be analyzed and then Processed to achieve some specific action regarding it. The data can be processed with the embedded processor. The embedded processor must be programmed such that the data can process and give the require output. This system is a data logger for the plant data which has embedded processor as central unit which has power to manipulating it. It has various facility like online data logging and offline data logging. The intension of the project is to communicate the industrial data (temperature sensor, level sensor, flow meter etc.) between plant and embedded processor. Embedded processor control various activities like sensor data communication, data storing and controlling signal regarding the sensor data. These systems have the global communication capability using GSM data communication with mobile handset device. So data can also communicated to mobile handset via SMS service. Also controlling signal can be send through mobile handset for controlling purpose. The system has online data logging which is nothing but the pc interfacing to system which result the data acquisition in personal computer. These systems also provide offline data logging with micro SD card interfacing so that data can be stored in it

B. Proposed Solution

Our approach is to replace this PLC Module with the embedded processor (EKK LM3S8962) and SCADA interface can be replaced by LABVIEW designed GUI software to provide data communication with low cost.

C. Organization of the Paper

In section II, proposed solution is provided for this system. The hardware and software description is provided in section III

II. PROPOSED SOLUTION

The system comprises of component like central processing unit, interfacing unit , communication unit, power supply where in central processing unit includes LM 3S8962 embedded processor, interfacing units includes sensors and relays and communication unit includes PC interface port .sensor provide the real world interface which provide analog output. This analog output is analyzed and gives respective output based on the programing of the embedded processor.

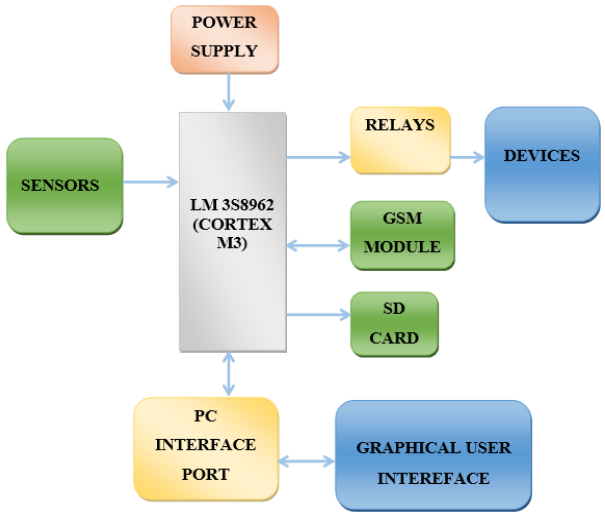

Figure 1. Block Diagram of system

III. IMPLEMENTATION

A. *Hardware Implementation*

1. Microcontroller EKK LM3S8962

These embedded processors have very fast processing speed. LM 3S8962 have many features like 32-bit RISC processor, 41 general purpose input output, internal memory 256KB flash and 64KB SRAM , 16-bit timers are available, supports UART, SSI, I2C, CAN and ETHERNET communication, JTAG interface, three blocks of PWM block and various other features regarding the fast interrupt control.

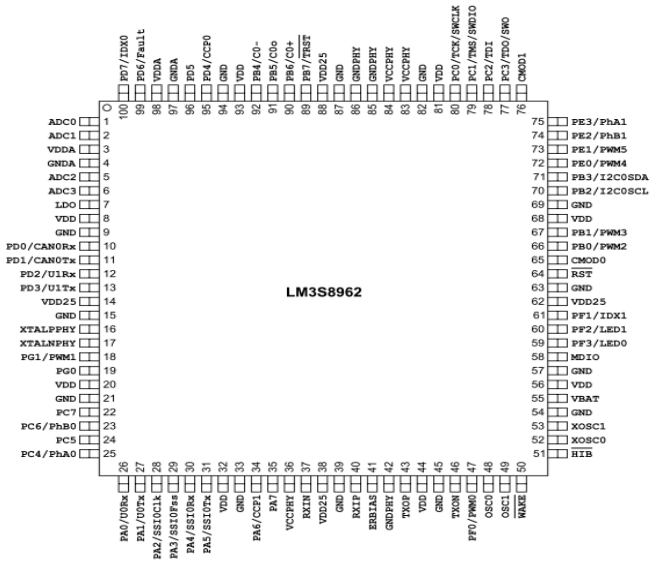

Figure 2. Schematic of LM3s8962

The development board of LM3S8962 contain various inbuilt interface which includes ETHERNET port, JTAG interface for the debugging of the microcontroller, SD card interface by SSI protocol, controller area network (CAN) protocol and micro USB for the programming to the microcontroller.

Figure 3. Evaluation board of Lm3s8962

2. Sensor interface:

This system provides the real world interface through various sensors. This sensor provides the information regarding the plant environment in the form of analog output. In this system two sensors are interface like temperature sensor (LM 35) and humidity sensor to sense the humidity.

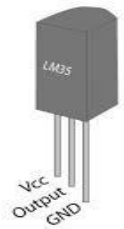

Figure 4. LM 35 & humidity sensor

These sensors are interface to the microcontroller board through analog pin of board. In processor inbuilt

analog to digital convertor is given which convert analog data into digital data. This inbuilt ADC is of 10 bit which gives 1024 levels of digital data.

3. Offline data logging:

A SD card is connected to the system for the offline data acquisition. It is connected to the embedded processor through serial communication protocol. Data of plant is being stored in SD card. The sensor sends data with the period of 1 second into the SD card and it stored the values into the .xls format and also one can store the data in .txt format. The system is program in such a way that the file of data storage getting name as real time and date.

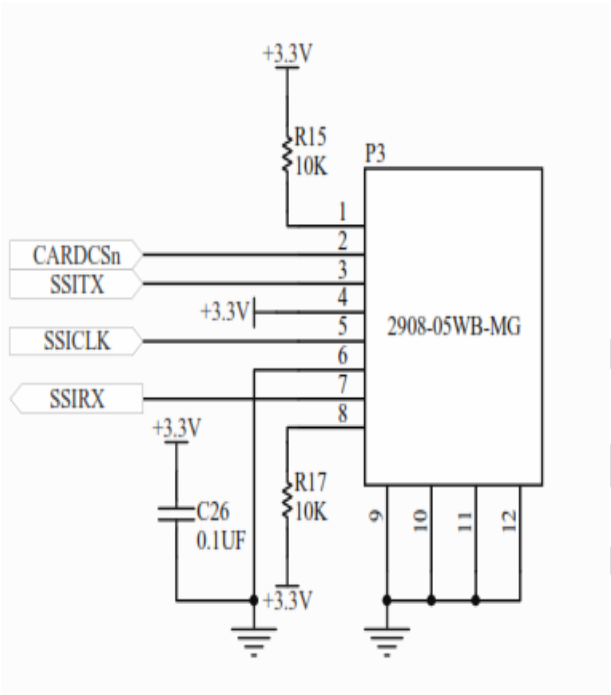

Figure 5. SD Card Interfacing

4. GSM module

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. When a GSM modem is connected to this system, this allows the system to use the GSM modem to communicate over the mobile network. While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also be used for sending and receiving SMS and MMS messages. When system finds any critical situation during its operation then GSM module send an alert SMS to the concern person.

Figure 6. GSM Module SIM900

Problems:

In initial stage we faced problem associated with message sending command ("\A" or its ASCII). We solved this problem by referring the national instruments forum.

Another difficulty during SD card interfacing.SD card and LCD connected on same SSI (synchronous serial interface) bus on developer board. So it did not write data on SD card. This problem solved by giving using suitable chip select signal.

B. Software Implementation

1. LABVIEW software:

LABVIEW (short for Laboratory Virtual Instrument Engineering Workbench) is a system-design platform and development environment for a visual programming language from National Instruments. LABVIEW is a programming language which provides the graphical user interface and use to program the system as per the requirement. LABVIEW is commonly used for data acquisition, instrument control, and industrial automation on a variety of platforms including Microsoft Windows, various versions of UNIX, Linux, and Mac OS X.

The programming language used in LABVIEW, also referred to as G, is a dataflow programming language. Execution is determined by the structure of a graphical block diagram (the LABVIEW-source code) on which the programmer connects different function-nodes by drawing wires.

In this system LABVIEW provide the graphical user interface to analyses the industrial data and give the defined output. Below flow chart explain the whole process of this system.

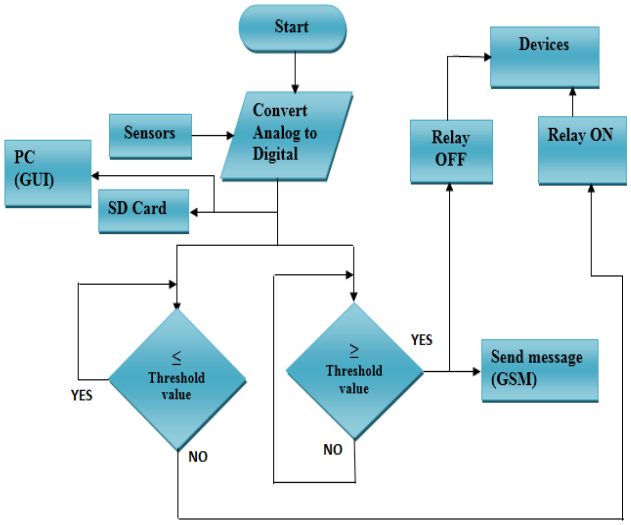

Figure 7. Flow chart

The system is interface with sensors having analog output. the data from sensor is converted into digital data through analog to digital convertor and stored into SD card and it also display on GUI in LABVIEW. Sensor data is continuously check and if the value of data goes above the threshold value then an alert SMS is send to the concern person in the plant and take appropriate action.

IV. RESULTS

The below GUI represent the sensor values in which "sensor 0" represent the ADC level of the sensor data and "temp in C"-Represent the temperature in Celsius.

When the value of sensor data goes above the threshold value then it gives alert message in "string". This alert message is also send to concern person through GSM module so that appropriate action can be taken.

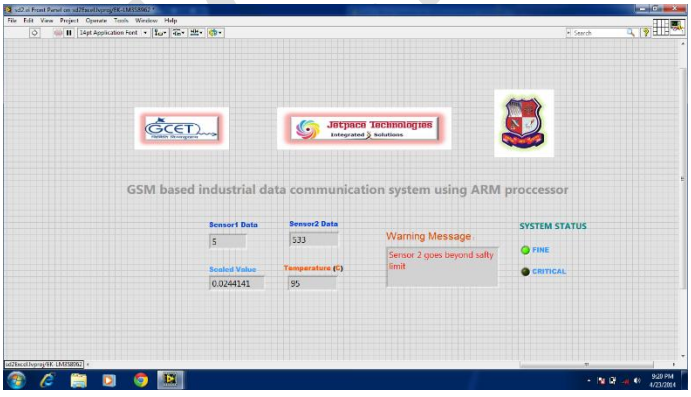

Figure 8. GUI

This system stores the sensor data into excel file with name same as present date and time which shown as below.

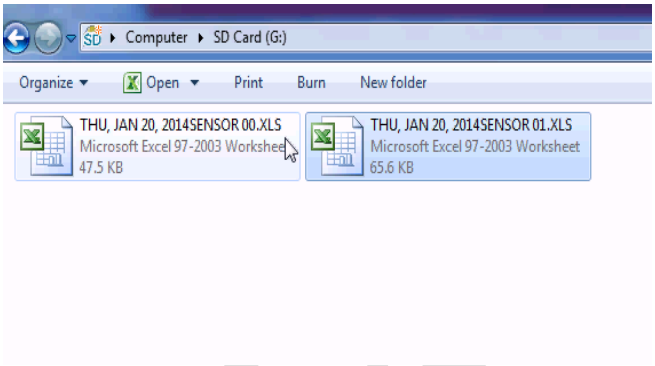

Figure 9. SD Card data

When value of sensor data goes above the threshold value then an alert sms is send to the respective authority supervisor.

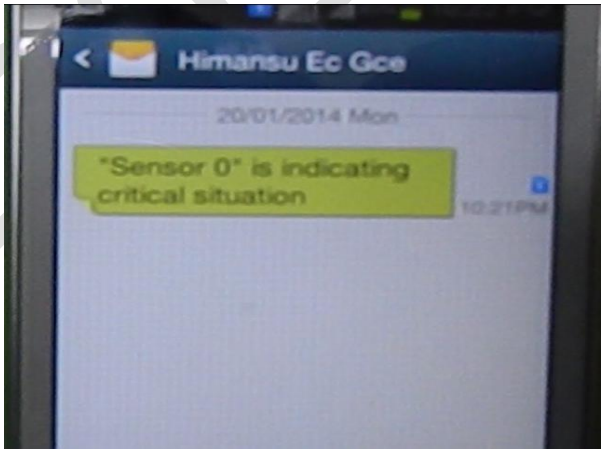

Figure 10. Alert sms

V. CONCLUSIONS

This project is aimed for the Industrial data acquisition, communication and its controlling at low cost. The cost and complexity of the system is very less and it is effective due providing the user interface through LABVIEW software. The proposed system gives the power to manipulated the plant data and controlling it. It also provide the global connectivity through GSM through which supervisor can control the system with the help of SMS service. In this supervisor need to send the command through SMS and according action will be taken in the system. System also connected to the personal computer to provide the GUI interface and also data acquisition in it so user can easily access the data through personal computer. Also data can be stored into the SD card so that analysis of data can be done in future.

This system can provide the user interface with data communication and its acquisition so due to that controlling of

various devices in plant can be done. The system provide all these features in cost effective manner and due to fast computing of the embedded processor required analysis can be done very fast. For the future expansions more of sensor interface can be increased with external ADC interface to microcontroller.

This system is work on 0-3.3V so for the use of this system in industry, power supply module is designed in such way that it can reject the external noise around the system provide noise proof output 0-3.3V.

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