GSM Based Control and Solutions for PLC Applications in Automation Industries

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Abstract— GSM based controlling has become now days a - very effective and easy solution for wireless control of machines or processes. In automation industries it is very difficult to read all the controlling instruments and it is not easy to control the device at any time and in any place. This GSM based device can be used in automation industries as a slave communication device that can communicate to any one Master device through a two-wire RS-485 network with Modbus - RTU Protocol support or GSM mobiles (configured and limited with access rights) with SMS and Data transmission support. The existing Control Access Points (I/O) connected to PLC (Master) can be controlled from GSM mobiles This GSM based solution will fulfill the need for GSM based control in the existing devices without disturbing the actual setup. The device is a robust design in both hardware and software since its going to be used in the industrial environment, the performance of the device should be highly accurate and continues running for years.

Keywords – gsm, modbus-rtu, plc, automation, rs-485, control

I. INTRODUCTION

This GSM based solution which will fulfill the need for GSM based control in the existing devices without disturbing the actual setup and also in the new devices. A well designed, user friendly and properly working devices for years has its own part in the automation field, which can be used in several industries for different purposes. GSM based controlling has become now days a very effective and easy solution for wireless control of machines or processes. In automation industries it is very difficult to read all the controlling instruments and it is not easy to control the device at any time and in any place. This GSM based device can be used in automation industries as a slave communication device that can communicate to any one Master device through a two-wire RS-485 network with Modbus - RTU (Remote Terminal Unit) Protocol support or GSM mobiles (configured and limited with access rights) with SMS, E-mail and Data transmission support. The Existing Control Access Points (I/O) will be connected to Machine (Master) which can be controlled from GSM mobiles.

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Robust Design – Industrial grade standards is being implemented. Perfect Antenna – Since the product is mainly based on GSM the Antenna design should be a perfect one. Constant Power supply – The power supply should be an excellent one to work in the all types of industrial environment. GSM had been used for controlling many machines and its used to communicate between two or more machines which we call it as m2m application i.e. machine to machine application.

Since remote control is used for many processes in the industries now it is the trend to control the machines with a simple or basic mobile phone. Another major advantage is the distance is not restricted between PLC and the mobile phone. The device can be controlled through specific persons only this is an added security to the process.

II. SYSTEM OVERVIEW

This device has a set of User Access Codes which can be configured and used to send from GSM mobiles through SMS to control access points. This device has the facility to configure access rights for the GSM mobiles to the control access points. This device supports a set of predefined commands (in-built) accessed by GSM mobiles. This device is used to send customized alert message to the configured GSM mobile user so that Precious information like Power outage of a system can be communicated. This device has LED indications for Power ON, Network, SIM and (Multi-Color) Statuses.
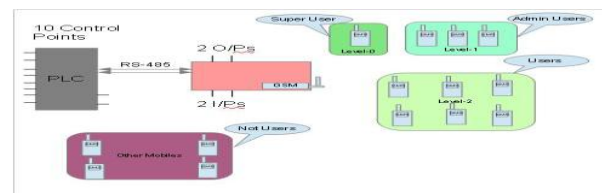

Figure.1 Block diagram of the system

This device has other GSM related facilities like: GPRS Enabled – GSM module will be supported, GSM Antenna (with SMA Connector), SIM Card Holder (Push-Push Type Metal Body), SIM INSERT message and LED indication, Prepaid Balance Check command configurable for the SIM, SMS predefined, SMS alerts for Power Outage conditions, Configuring Phone Numbers, Configuring User Access Codes. Get information like - Configured GSM mobile phone number, Configured UAC used for control action, SIM – Signal Strength Status, SIM – Network information, PLC or Master Device Status (only if possible by Master device), Last

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Event with date-time, Acknowledgment SMS upon user request, Setting Date-Time of Device, Two (2) Digital Inputs and Two (2) Digital Outputs, Factory Reset, PC Applications. This device has predefined communication locations for various Read/Write parameters.

III.   BASIC WORKING PRINCIPLE

PLC having Modbus-RTU Master protocol has to communicate with the   device having. Correct by checking CRC validations and the command parameters are within the range of the support. Initially the PLC has to send broad-cast command so that the I/O status is sent to the and then there will be a read command to monitor any request is found from the user for any control action to be performed in PLC. This will be monitored a specific address having the Status Flag of the. If the Flag corresponding to the Control Request on a Particular I/O is set, then PLC has to understand that there is an action to be performed.
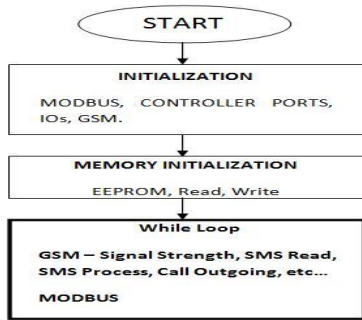

Figure.2 Flowchart of the system process

These two commands (broad-cast and read) should be periodically polled from the PLC. If any information has to be passed from PLC to the user, then there will be a Status Flag in the broad-cast command from which they can understand that there is action to be performed in this device. If the has to send any SMS then it will send the message selected by PLC or PLC defined (Customized) to the Selected user (configured in the). There are few predefined set of commands (UAC) with formats defined by the. They can be used by just passing the index of UAC table. Only from Authorized GSM Mobile number, the commands can be accepted for processing.
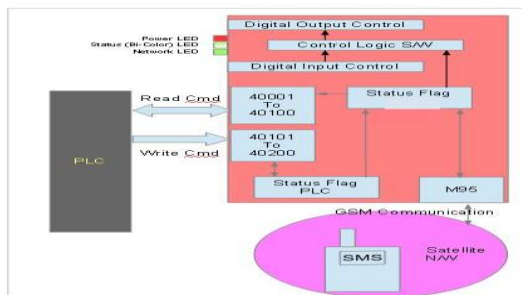

Figure.3 shows how the memory address is used to read and write the parameter in the device.

A. Register information for Sending a SMS:

This device frequently checks the register for any send lag intimation received from PLC or not. If it is so, then pick all data from the other registers to send SMS.

Table.1 MODBUS Register structure shown in following table.

0002- 40009	SMS Destination Address	one number where to send the message. Length 15 characters.
40010-40099	To Send User Data	Text of the message. Length 160 characters. Stored SMS text

B. Register information for receiving a SMS:

Incoming SMS messages are saved into registers in format as shown in below table...

C. Example

(a)How does the GSM send a message from PLC:
Every register of Phone number or Text contains two characters. The string of characters ends with special character 0x00. Examples:
String with one character – "A": 40010 = 0x0041
String "TEXT": 40010 = 0x4554, 40011 = 0x5458,
40012 = 0x0000 String
"HELLO": 40010 = 0x4548,
40011 = 0x4C4C, 40012 = 0x004F

If the length of a phone number is exactly 20 characters (or 160 characters of text) then the character 0x00 at the end is omitted!

Base of Send Record (40001) may be changed to another D or R register via configuration key REGSEND. Only register Send Flag (40001) is changed during sending a message.

(b)How GSM received message from Controller:
Every register of Phone number or Text contains two characters. The string of characters ends with special character 0x00. Examples:
String "TEXT": 40120 = 0x4554, 40121 = 0x5458,
40122 = 0x0000 String
"HELLO": 40120 = 0x4548,
40121 = 0x4C4C, 40122 = 0x004F

If length of phone number is exactly 20 characters (or 160 characters of text) the character 0x00 at the end is omitted!

GSM contains a queue of up to 100 SMS messages. After the queue is full all other SMS messages are discarded. If a power failure occurs all received messages in the queue are lost. Base of Recv Record (40101) may be changed to another D or R register via configuration key REGRECV. No other

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registers are changed than the necessary ones.

IV. HARDWARE DETAILS

Power Supply: The device is having DC input supply and has capability of proper function with the power supply rating of 12V 3A DC. The device is having capability to work under continuous power ON condition.

GSM (GPRS enabled) Section: The GSM/ GPRS Qucetel M95 module which is with the both data and SMS transmission. It should have both GSM and GPRS/EDGE features, SMS features.

SIM Card Section: For placing the SIM Card, a SIM card holder is be provided on the modem and is be accessible from outside without opening the modem enclosure. SIM card is being provided with suitable sealing provision on the device cover, PUSH-PULL 8 pin compatible SIM card holder.

Communication Interface: The device is suitable for PLC application. A RS485 serial link is be provided for PLC interface. The RS232 output is converted from RS485 using Converter RS485 to RS232.

RF / Antenna section: A SMA interface is provided on the modem to which a fixed Dual Band Antenna can be connected.

We have developed industrial grade hardware for modem and Mother Board. IPC-6012B - Qualification and Performance Specification for Rigid Printed Boards has been implemented, IPC-A-610D - Acceptability of Electronic Assemblies been implemented.

V. IMPLEMENTATION AND RESULTS

The device is tested with MODBUS PC application in which the output from the GSM device will communicate with the PC through RS 485 with MODBUS protocol. Below is the output shown which reads the parameter in the device and we can also write the input data for processing. The parameter which we set it is used to make alert to the mobile number which is registered in the device through the MODBUS application.
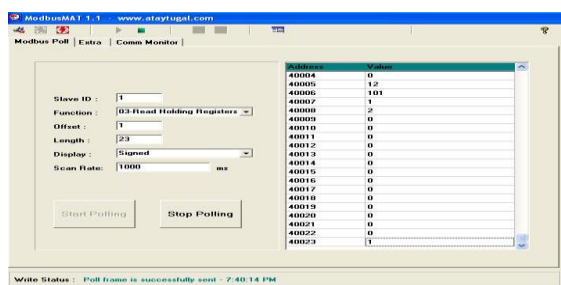

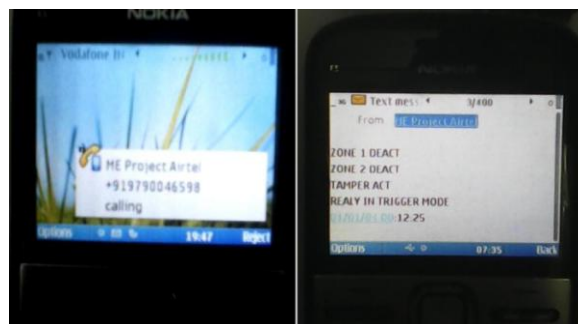Figure.4 shows the call address value is set high to receive call in the mobile

Figure.5 shows the call and SMS in the mobile from the device after the corresponding register is set high

Phone No as digits (max 4 digits in each Register) Message as ASCII (byte) value (2 chars in each Register: LSB-first char, MSB-second char) Balance Code as ASCII (byte) value; like Message

VI. CONCLUSION

This paper opens the new idea to make communication with PLC, GSM device and mobile phone. The output is completely checked, the device is with full security and industrial grade which will leads to make the other devices like PLC to communicate through GSM/GPRS. We conclude that the control and monitor of any m2m (machine to machine) application is possible through this result.

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