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GSM Based Motor Monitoring and Speed Control

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Abstract - In this paper, the design aspects of an embedded device which can control up to 8 devices by sending a specific SMS message from a mobile phone are presented. This controller is extremely handy at places where we have to control the ON and OFF switching of the devices but no wired connection to that place is available. To implement this, a GSM modem is connected to a programmed microcontroller which would receive the SMS from a reference cell phone. The control signal part of the received SMS is extracted and is changed to microcontroller-preferred format. A PC which is connected to the microcontroller using a serial communication through RS232 can be used for monitoring and transmission of the control signals to the modem. The monitoring is also done by interfacing a LCD to the microcontroller. AT commands were used for controlling the functionality of modem's (Global Systems for Mobile Communication) is vastly used because of its simplicity in both transmitter and receiver design, can operate at 900 or 1800MHZ band, faster, more reliable and globally network. Here the system is capable of controlling the motor by receiving control message from an authorized mobile number. Microcontroller is the heart of our system, which controls the overall operation of our system. System is always alert for receiving SMS from valid number and that message can be displayed on the LCD (Liquid Crystal Display).

In the project work undertaken, GSM technology based automatic control system is designed to monitor and control speed of an Induction motor/DC motor and also performs necessary operation like start, stop, reverse the rotation ext.

Key words - Short Message Service (SMS), Global Systems for Mobile Communication (GSM), AT Command, GSM Modem, monitoring and control, Radio frequency (RF).

I. INTRODUCTION

This Project is a very good example of embedded system as all its operations are controlled by intelligent software inside the microcontroller. The aim of this project is to control i.e. to ON/OFF and speed control of different motors, the electrical or electronic appliances connected to this system from anywhere in the world. For this purpose user can use any type of Mobile. This way it overcomes the limited range of infrared and radio remote controls. Using the convenience of SMS, this project lets you remotely control equipment by sending plain text messages, such as "abcdn1", "abcdnaf3", "abcdf57n142"— all of which can be pre-programmed into the controller and easily remembered later. It can control up to eight external devices Short Message Service (SMS) is defined as a text-based service.

That enables up to 160 characters to be sent from one mobile phone to another. In a similar vein to email, messages are stored and forwarded at an SMS centre, allowing messages to be retrieved later if you are not immediately available to receive them. Unlike voice calls, SMS messages travel over the mobile network's low-speed control channel.

"Texting", as its also known, is a fast and convenient way of communicating. In fact, SMS has taken on a life of its own, spawning a whole new shorthand language that's rapidly Many industries have been quick to make use of this technology, with millions of handsets currently in use. As new models with "must have" features hit the market, older models become virtually worthless and if not recycled, end up in landfill. With this in mind, we've designed the project to work with sim300 GSM modem with simcom technology.

II. SYSTEM COMMUNICATION ARCHITECTURE

As shown in Figure 1 the wireless transference of industrial monitoring messages discussed in this paper is built on the SMS of the GSM network. Data messages produced at one end of the monitoring system are encapsulated into a short message by the gateway and sent to remote monitoring devices at another end. When a short message is received, it can be restored to its original industrial form by removing the SMS PDU head. This is also conducted by the gateway of the monitoring system. If needed, the message content can

be put into other form and forwarded by the gateway through other industrial network. Since the transference is a trans-network task, gateways are required to perform protocol conversion along with other functions. The system makes use of the routing function of the GSM network to deliver a message to another gateway. This is not only controlling and also monitoring different types motors.

Fig. 1 : System Communication Architecture

III. WORKING

In this project we are using the GSM technology. A micro controller (also micro controller unit, MCU or μC) is a small computer on a single integrated circuit consisting of a relatively simple CPU combined with support functions such as a crystal oscillator, timers and etc. Microcontrollers are used in automatically controlled products and devices such as automobile engine control systems, remote controls, office machines, appliances, power tools and toys. The LCD will give the professional look for the project. It also displays the current operation of the system. The micro controller is used to control the relay drivers depending upon the software program. Major role of this project is to receive the SMS to speed control of dc motor and control of induction motor and control for circuit breaker in substation

Initially the SMS is received from the person authorized to use this setup (destination) by the GSM modem (SIM300 MODEM) & is transferred to the microcontroller devices kit with the help of a MAX 232 chip. As per the AT commands given by the microcontroller to the modem, the control signal from the SMS is extracted and is used to control the devices connected to it. We have to convert the 'septets' of the

phone to 'octets' because the micro-controller need bytes with 8 bits length (The 'septet' is 1 byte with 7 bits length and 'octet' is 1 byte with 8 bits length). All this process is necessary to decode the message from SMS. A program (for extracting the control signal part from received SMS) is loaded into microcontroller devices kit, and then the circuit is connected to the modem. The microcontroller now tries to read the SMS from the 1st memory location of the modem and it keeps trying again until the modem receives any (programmed for every one second). Before implementing the control signal part of the SMS, the modem extracts the number from the SMS and verifies if this number has the access to control the device or not. For controlling the devices, the message will be sent in hexa decimal format. The hex data is converted to the equivalent binary and the particular output is enabled. For example if the message is "AB" the equivalent binary is "10101011" this implies that the output 1, 3, 5, 7, 8 are enabled and the remaining ports are disabled. We have connected LEDs to the ports of microcontroller to show the output and their status indicates whether the ports are set to 'ON' or 'OFF'. And speed control like send the message in text format like MOTOR SPEED LOW and MOTOR SPEED MEDIUM and MOTOR SPEED HIGH for different motors.

IV. COMPONENTS USED

Power Supply: 5v and 3.6v and 4.6v, 12v DC

Micro controller: Philips P89V51RD2-8bit.

LCD: 16x2 characters

RS 232 converter: MAX 232

Flash Magic: Vision 2.4

Keil C m-vision: μ Vision3 (IDE-Version)

V. SPEED CONTROL OF A MOTOR

A. Speed Control of a DC Motor

The speed of a motor is given by the Relation

$$N = \frac{(V - I_a R_a)}{(Z\phi)} \quad \text{or} \quad \frac{60A}{P} = K \frac{(V - I_a R_a)}{\phi} \quad (1)$$

From equation 1 Obvious that the speed can be controlled by varying

- Flux/pole, ϕ (Flux Control)
- Resistance R_a of armature circuit (Rheostatic Control) and Applied voltage V (Voltage Control)

1. Speed Control of Shunt Motors:

(a) Variation of Flux or Flux Control Method: By decreasing the flux, the speed can be increased and vice versa. The flux of a dc motor can be changed by changing I_{sh} with help of a shunt field rheostat. Since I_{sh} is relatively small, shunt field rheostat has to carry only a small current, which means $I_{sh}^2 R$ loss is small, so that rheostat is small in size

(b) Armature or Rheostatic Control Method: This method is used when speeds below the no-load speed are required. As the supply voltage is normally constant, the voltage across the armature is varied by inserting a variable rheostat in series with the armature circuit. As controller resistance is increased, voltage across the armature is decreased, thereby decreasing the armature speed. For a load constant torque, speed is approximately proportional to the voltage across the armature. From the speed/armature current characteristic, it is seen that greater the resistance in the armature circuit, greater is the fall in the speed.

(c) Voltage control method: In this method, the shunt field of the motor is connected permanently to a fixed exciting voltage, but the armature is supplied with different voltages by connecting it across one of the several different voltages by means of suitable switchgear.

The armature speed will be approximately proportional to this different voltage. The intermediate speeds can be obtained by adjusting the shunt field regulator.

2. Speed Control of Series Motors:

Flux Control Method: Variations in the flux of a series motor can be brought about in any one of the following ways:

(a) Field Diverters: The series winding are shunted by a variable resistance known as field diverter. Any desired amount of current can be passed through the diverter by adjusting its resistance. Hence the flux can be decreased and consequently, the speed of the motor increased.

(b) Armature Diverter: A diverter across the armature can be used for giving speeds lower than the normal speed. For a given constant load torque, if I_a is reduced due to armature diverter, the ϕ must increase ($T_a \propto \phi I_a$). This results in an increase in current taken from the supply which increases the flux and a fall in speed ($N \propto 1/\phi$). The variation in speed can be controlled by varying the diverter resistance.

3. A Brief Introduction of Induction Motor :

Three-phase induction motors are the most common and frequently encountered machines in industry

- Simple design, rugged, low-price, easy maintenance
- Wide range of power ratings: fractional horsepower to 10 MW
- Run essentially as constant speed from no-load to full load
- Its speed depends on the frequency of the power source
- Not easy to have variable speed control
- Requires a variable-frequency power-electronic drive for optimal speed control

4. A Brief introduction to Microcontroller

Description: The 89C51RB2/RC2/RD2 device contains a non-volatile 16kB/32kB/64kB Flash program memory that is both parallel programmable and serial In-System and In- Application Programmable. In-System Programming (ISP) allows the user to download new code while the microcontroller sits in the application. In-Application Programming (IAP) means that the microcontroller fetches new program code and reprograms itself while in the system. This allows for remote programming over a modem link. A default serial loader (boot loader) program in ROM allows serial In-System programming of the Flash memory via the UART without the need for a loader in the Flash code. For In Application Programming, the user program erases and reprograms the Flash memory by use of standard routines contained in ROM. This device executes one machine cycle in 6 clock cycles, hence providing twice the speed of a conventional 80C51. This device is a Single-Chip 8-Bit Microcontroller manufactured in advanced CMOS process and is a derivative of the 80C51 microcontroller family. The device also has four 8-bit I/O ports, three 16-bit timer/event counters, a multi-source, four-priority-level, nested interrupt structure, an enhanced UART and on-chip oscillator and timing circuits.

The added feature of the P89C51RB2/RC2/RD2 makes it a powerful microcontroller for applications that require pulse width modulation, high-speed I/O and up/down counting capabilities such as motor control.

5. A Brief Introduction of Development Tools

Keil (μ Vision 2):

The Keil C51 Cross Compiler is an ANSI C Compiler that is written specifically to generate fast,

compact code for the 8051 microcontroller family. The C51 Compiler generates object code that matches the efficiency and speed of assembly programming.

Using a high-level language like C has many advantages over assembly language *programming*:

- Knowledge of the processor instruction set is not required. Rudimentary knowledge of the memory structure of the 8051 CPU is desirable (but not necessary).
- Details like register allocation and addressing of the various memory types and data types is managed by the compiler.
- Programs get a formal structure (which is imposed by the C programming language) and can be divided into separate functions. This contributes to source code reusability as well as better overall application structure.
- The ability to combine variable selection with specific operations improves program readability.
- Keywords and operational functions that more nearly resemble the human thought process may be used.
- Programming and program test time is drastically reduced.
- The C run-time library contains many standard routines such as: formatted output, numeric conversions, and floating-point arithmetic.
- Existing program parts can be more easily included into new programs because of modular program construction techniques.
- The language C is a very portable language (based on the ANSI standard) that enjoys wide popular support and is easily obtained for most systems.

VI. A BRIEF INTRODUCTION OF GSM SIM 300 MODEM WITH SIMCOM TECHNOLOGY

GSM modem with RS 232 connector: The Global System for Mobile Communications (GSM) is the most popular standard for mobile phones in the world. It is the European standard for digital cellular service that includes enhanced features. It is based on TDMA technology and is used on 900/1900 MHz. We are using the sim 300, a GSM modem from simcom. This is a powerful GSM/GPRS Terminal with compact and self-contained unit. This has standard connector interfaces and has an integral SIM card reader. The modem has a RJ9 connector through which a speaker and microphone

can be connected allowing audio calls being established, but this feature is not utilized in this project as only data transfer is needed. Following are few technical details of the modem.

1. Interfaces

- TTL Tx,Rx , VCC , GND
- Serial port baud rate adjustable 1200 to 115200 bps (9600 default)
- BRK connector for MIC & SPK, SIM card holder
- LED status of GSM / GPRS module

2. Features

- Data: RS232 9-way (V.28)
- Audio 4-wire Handset Interface (RJ9)
- Antenna: 50_ (FME male)
- This GSM modem is a highly flexible plug and play quad band GSM modem
- for direct and as integration to TTL
- Supports features like Voice, Data/Fax, SMS,
- GPRS and integrated TCP/IP stack.
- Control via AT commands (GSM 07.07, 07.05 and as enhanced AT commands)
- Use DC Power 3.6 - 4.6 Volts Maximum
- Current Consumption in normal operation 250mA, can rise up to 1Amp while transmission.

VII. A BRIEF INTRODUCTION OF AT COMMAND

Shown in Figure 1, the GSM modem and the PC are wire-connected through RS232 serial ports. They communicate with AT commands. AT commands are a set of commands that has been standardized to communicate with terminal equipments such as modem, mobile phone as well as control them. Most GSM modems support AT commands. The command set is quite elaborate. However, only a small part of it is related to SMS operations. The most frequently used commands are:

AT+CMGS: To send a short message

AT+CMGR: To read a short message from the GSM module

AT+CMGL: To list SMS short messages stored in the GSM module

AT+CMGD: To delete a short message from the GSM module

AT+CNMI : Remind mode Setup when receive a new SMS

As the low-level function interface to the GSM modem, these commands play a fundamental role in the software developing of the gateway program.

VIII. FORMAT AND ANALYSIS OF SMS PDU AND TEXT FORMAT

This section discusses the SMS traits that are related with building a monitoring system. Apparently, SMS PDU employs a point-to-point transference scheme. In the GSM network, the target node can be identified by its SIM card number. That is to say, if a short message is not to be forwarded, the monitoring system can quit addressing the supervisory computer and the subordinate computer, as well as other communication nodes, and simply send the message to the target point according to the SIM card number. This method comes handy for most systems. Although this method is convenient, it has a defect that each time the SIM card of a machine changes, the gateway software routine may need to be modified correspondingly. For most systems, there's no such concern. As shown in Table I, protocol data unit (PDU) of a short message consists of multiple fields. This paper will not elaborate on the meaning of each field. Only the ones close to the gateway design of monitoring systems are discussed.

Fie id	SCA	Type	MR	DA	PID	DCS	VP	UDL	UD
length	1	1	1	2-12	1	1	1	1	0-140

Table 1 : The PDU format of a SMS

The UD (user data) field can contain up to 140 bytes of user data. It has no restriction on how the data is coded---User data can be transferred as either ASCII characters or as octet values. In the ASCII mode, a short message is able to contain 160 ASCII characters, that is, 140 bytes with the 7-bit coding method. The octet value mode is also known as the 8-bit coding mode. Comparing to the ASCII mode, a short message in octet mode can carry more information with the limited 140 bytes. It is the first choice for monitoring systems.

In text format sending a message like abcd1 on and abcd1 off and abcd2 on and abcd2 off ext.

The VP field specifies the valid period of a short message. Once a message exceeds its valid period and it still has not reached the destination, it will be dumped by SMSC. The SCTS field of a received message stores

its sending time. On one hand, SMSC dumps messages that have run out the specified time delay; on the other hand, a received short message can be tagged as obsolete according to the SCTS field of its PDU by the gateway.

IX. FLOW CHART AND SOFTWARE IMPLEMENTATION

Software development: The software for the system is developed in Embedded C and Visual Basic. The flowcharts depicting the monitoring and the induction motor control of speed control of dc motor is shown in

Fig. 9 : Software Implementation

Flow chart:

V. CONCLUSION

In the paper low cost, secure, ubiquitously accessible, auto-configurable, remotely controlled solution for automation of different motors has been introduced. The approach discussed in the paper has achieved the target to control industrial appliances remotely using the GSM -based system satisfying user needs and requirements.

GSM technology capable solution has proved to be controlled remotely, provide industrial security and has achieved the target to control different industrial appliances remotely using the SMS-based system satisfying user needs and requirements GSM technology capable solution has proved to be controlled remotely, provide industrial security and is cost-effective as compared to the previously existing systems.

Hence we can conclude that the required goals and objectives of GSM based induction motor monitoring and speed control of dc motors have been achieved.

The basic level of industrial appliance control and remote monitoring has been implemented for agriculture purpose to control and monitor induction motor.

REFERENCES

- [1] Lu, Willie w, open wireless architecture and Enhanced performance, guest Editorial, IEEE Communication Magazine, June 2003
- [2] <http://www.google.co.in>
- [3] <http://www.imagesco.com/catalog/index.html>
- [4] <http://nationalsemiconductors.com>
- [5] <http://www.electronicslab.com/projects/index.html>
- [6] <http://www.electronicsforu.com/electronicsforu/lab/>
- [7] http://www.visualgsm.com/wire_sms_index.htm
- [8] <http://en.wikipedia.org/wiki/Gsm>
- [9] http://www.camiresearch.com/Data_Com_Basics/RS232
- [10] <http://www.beyondlogic.org/serial/serial.htm>
- [11] <http://www.dreamfabric.com/sms/>
- [12] <http://www.nobbi.com/pduspy.htm>
- [13] <http://www.serasidis.gr/circuits/smscontroller/smscontroller.htm>
- [14] <http://www.gsm-modem.de/sms-text-mode.html>