

Implementation of Energy Meter and Motor Overload Relay Control System using GSM

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Abstract; The aim of this research is to Implementation of energy meter and motor overload relay control system using wireless network, Global System for Mobile communication (GSM) and microcontroller based technology. This can be achieved by sending Short Message Service (SMS) from the GSM SIM modem to the mobile. To implement the setup, a GSM modem is a GSM modem is connected to a programmed Microcontroller VARATMEGA16 which would send SMS from microcontroller to the mobile, this system uses to deliver a targeted to control energy meter and motor over load control. such a way that when energy meter not read then the power turn off .to send message to mobile and to display on the LCD turnoff power. And also the bell give alarm. When the power turn on energy meter reading power. And also when two motor is turn on as same time, occur over load, two motor is turnoff. And to send message to mobile is overload, sound, display LCD overload. When one motor is turn on, motor run good condition, display motor one is normal also to measure voltage, current, power and power factor of any device, motor using micro control.

In this project, the designed system is made up of micro control, VARATMEGA16 CNY17-2,BC547NPN transistor ,LM358,Current transformer, voltage transformer,SIM 900a modem ,GSM modem and relays with control circuitry that integrate the system to have an intended application. A systematic working approach that included literature study together with varieties of phases such as design, experimental, development of prototype and testing are being illustrated in this report.

Keyword: GSM (Global System for Mobile communication), LCD (Liquid Crystal Display) , SMS (Short Message Service) , SIM900modom , CNY17-2 opt coupler and transistor. CT (Current transformer) PT (power transformer)

1. INTRODUCTION

In the world of advanced electronics, life of human beings should be simpler, thus, some activities are automated to have its real time advantage. Integrated energy meter and motor over load relay is a system that delivers a targeted monitor control electrical power and protection of motor, GSM (Global System for Mobile communication) is a member of the class of cellular mobile communication networks that use operating frequencies of around 900 MHz and 1900 MHz Here it uses to Text messages can be sent to mobile phone subscribers all over the World by SMS (Short Message Service).Messages can be up to 160 characters long. The message text is entered using the switch and sent to the desired recipient. Alternatively, SMS Messages can also be sent. When the recipient retrieves the message, it is transmitted

by the serve to the mobile phone, and measure voltage, current, power and power factor to display LCD.

A buzzer is an audio signaling device, which may be used as alternative information provider to owner as it is needed in the system. Liquid Crystal Display (LCD) is the most common message display device used to display ASCII character.

The microcontroller in this project is ATMEGA 16 which has low cost, high clock speed and its code compiler is more user-friendly.it has analog to digital conversion, here it uses to control the relays which system valves that are connected to outgoing energy meter and motor and bank of capacitor.

2. OBJECTIVES

There are some objectives need to be achieved in order to accomplish this project. These objectives will act as a guide and will restrict the system to be implemented for certain situations:

- To develop integrated energy meter and motor over load control system
- To use GSM as a medium to send the message to the owner/technician
- To measure voltage, current, power, and power factor, and display the value on LCD.
- To develop the system that must work effectively.
- to use C(Bascom AVR) language for developing program and system optimization

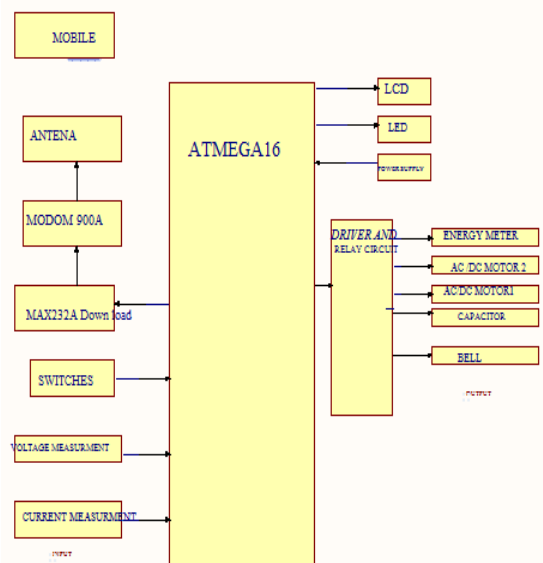


Figure. (1) Block diagram of energy meter and motor overload control circuit

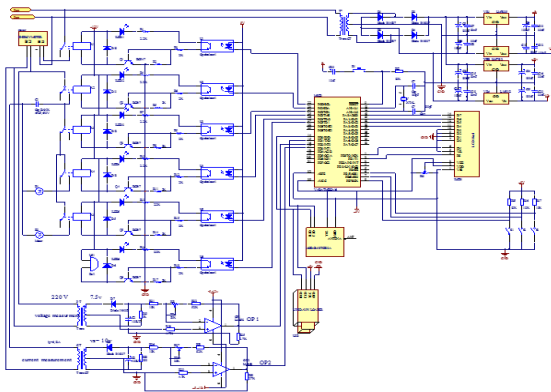


Figure. (2) Circuit diagram of energy meter and motor control.

3. RESEARCH METHODOLOGY

Automatic energy meter and motor over load control System has the following main approaches. These are: Microprocessor to interface between inputs from modem and outputs to relays which Govern electrical power control & motor run good condition Buzzer to give alarm sound as it is programmed, GSM modem to use it as a medium to send the message to owner, LCD uses as common message display device to display ASCII character & LED to indicate that the intended circuit is conducting.

Designing electronic circuit this approach helps to have hardware for the given system and exposes to use different circuit designer software.

Software developing this approach helps to program the system to have an intended real time application

4. EMBEDDED SYSTEMS DESIGN

This field of designing application specific computer systems is called embedded systems development. If the response of the computer system need to be real time and highly reliable then it's called Real Time Embedded System. To define in a sentence, Embedded Systems is a special purpose computer system/board, which encapsulates all the devices such as processor, memory, interface and control in single package or board to perform only a specific application tasks.

4.1 Hardware system

Embedded systems for real-time applications are implemented as used software-hardware systems. Generally, software is used for features and flexibility, while hardware is used for performance. The hardware design and its implementation for this system & its components will be discussed in the subsequent sections.

- (1) Microcontroller AVR atmega16
- (2) Sim900A GSM Modem
- (3) Power Supply circuit
- (4) 1602 LCD Display
- (5) Switches
- (6) Driver, output and relay
- (7) Relays
- (8) The CNY17-2
- (9) NPN Transistor

- (10) DC Motor
- (11) RS-232 Serial Communication Interface
- (12) Voltage and current measure circuit

4.1.1 Microcontroller Circuit (AVRmega16)

atmega16 microcontroller was chosen for this project due the high computation capabilities with relative low cost. This 40 pins 8-bits microcontroller comes with 4 PORTs and able to operate at the speed of up to 40 MHz with high temperature endurences.

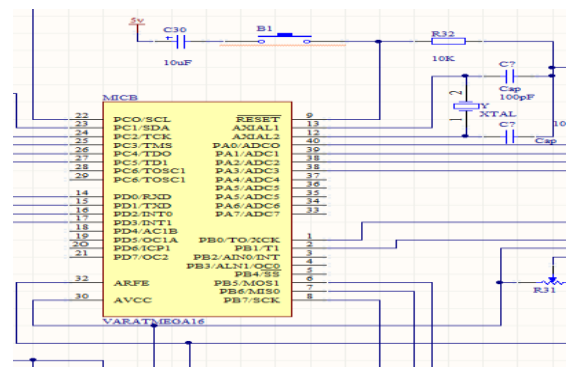


Figure. (3) AVRatmega 16 microcontroller

4.1.2 Sim900 GSM Modem

GSM modem has a variety of value added services such as voice mail, call handling facilities, and SMS messages. [24]

- (I) Support 900/ 1800/ 1900 MHz GSM Tri band.
- (II) Uses AT Command Set.
- (III) SIM card holder/socket ready.
- (IV) Ready with SMA antenna for better signal reception and transmission
- (V) SMS (text) and voice communication is ready.
- (VI) Single board solution.
- (VII) Power with 5VDC.
- (VIII) Ready with UART (2.65V TTL) & RS232 (COM Port) serial interface.

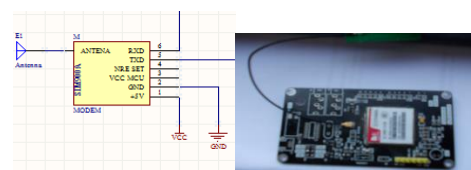


Figure. (4) Sim900 GSM Modem

4.1.3 Power supply circuit

Mega16 microcontroller operates (from the voltage range of 3.3V to 5.V. With the use of 12V DC battery, we require a 5V voltage regulator, LM7805 and 12v voltage regulator, LM7812,-12voltage regulator, LM7912 and -5 voltage regulator, LM7905. In order for the microcontroller to operate, the LM7805 step-down the voltage from 12V TO 5V. LM7805 is capable of handling input voltage ranging from 5V to 18V and output voltage ranging from 4.8V to 5.2V.12v used to operate relay driver and relay. [14]

A diode here is used to protect the power supply circuit if the battery or power source polarity is connected reversely. The diode does not allow current to flow as it only allows electric

current to flow in one direction only and blocks the flow in the opposite direction.

Capacitor is used to filter dc power supply. And LED is used to indicate light

Transformer is used electrical energy convert to electrical energy .from 220 v to 12v and 7.5v .in my project it has two transformers,

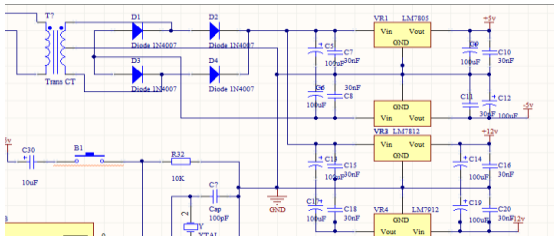


Figure. (5) Power supply circuit

4.1.4 1602 LCD Display

1602 LCD display is used to display. The LCD is a 4 line 16 character displays so it will display the power off, power on ,and overload on the upper line (line 1) and motor 1 is ok and motor 2 is ok message on the lower line (line 2). And power factor (line 3) And to measure voltage, current,(line 4)display LCD.Thus, the user can know measure power, power control and motor over load [18, 19]

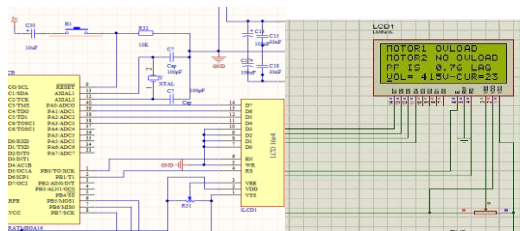


Figure. (6) 1602 LCD Display

4.1.5 Switch inert face with with AVR mega16

Three switches are connect pin of micro control mega16 of pin PB7, PB6 and PB7. It is input of micro control. These switches are control the output device such as EM, motor, LCD, send message to mobile, and buzzer. [15]

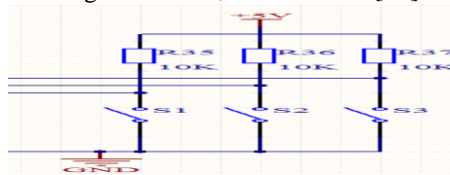


Figure. (7) Switches systematics

4.1.6 Driver, output and relay with mega16 Five LEDs and a Buzzer are used as further indicating unit for the system [10], [11,12]. When energy meter read LED 1 become ON. When motor1 is running LED2 becomes ON and When motor2 is running LED3 becomes ON the When motor1 and motor 2 is running as same time to occur overload, relay 3 is energize the contact point of normal close contact point should be open , two motors are turn off buzzer beeps continuously. And when power is present up to energy meter and two motors are stop and the Buzzer beeps continuously, send message to mobile.

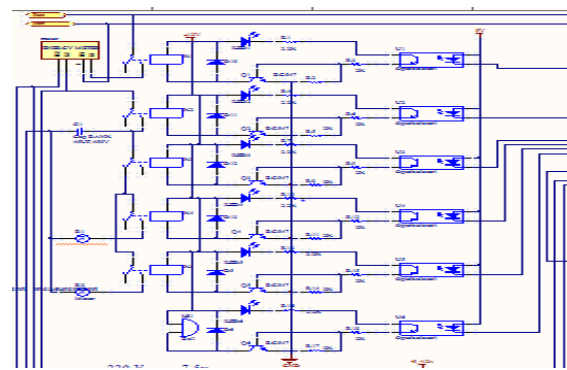


Figure. (8) Driver output and relay schematic

4.1.7 Relay

A relay is a simple electromechanical switch made up of an electromagnet and a set of contacts. Current flow through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts depend the use of output device. [20,21]



Figure. (9) Relays

4.1.8 The CNY17-2

It series of devices each consist of an infrared emitting diode optically coupled to a photo transistor. It series consists of a Gallium Arsenide IRED coupled with an NPN phot It series consists of a Gallium Arsenide IRED coupled with an NPN phototransistor.[22]

They are packaged in a 6-pin DIP package and available in wide-lead spacing and SMD option.

Applications of CNY17-2 is control Power supply regulators, Digital logic inputs, Microprocessor inputs, Appliance sensor systems and Industrial controls

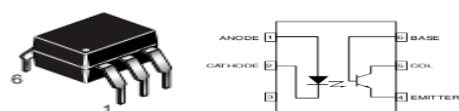


Figure. (10) CNY 17-2 package and schematics

4.1.9 NPN Transistor

A transistor is a semiconductor device used to And amplify electronic signals and electrical power.

It is composed of semiconductor material with at least three terminals for connection to an External circuit. A voltage or current applied to one Pair of the transistor's terminals changes the Current through another pair of terminals. Because the controlled (output) power can be higher than the controlling (input) power, a transistor can amplify a signal. The transistor is the fundamental Building block of modern electronic devices, and is Ubiquitous in modern electronic systems [16]



Figure. (11) NPN Transistor

4.1.10 AC/DC Motor

An electric motor either in Alternating Current (AC) or Direct Current(DC) convert electrical energy into mechanical energy to produce the required torque base on Principle of Lorentz force {Force=electric charge(electric field + (velocity x magnetic field))} or require speed. An electric motor will become a generator such as an alternator or dynamo) by reverse the process of converting mechanical energy to electrical energy usually by turning of a shaft. [17]



Figure. (12) DC motor

4.1.11 RS-232 Serial Communication Interface

A Max232 serial interface driver IC is used to enable RS232 Serial Communication Interface between the microcontroller and the GSM modem. Through this serial communication interface, the microcontroller is able to send SMS (text) message to the one who is responsible for the power control,

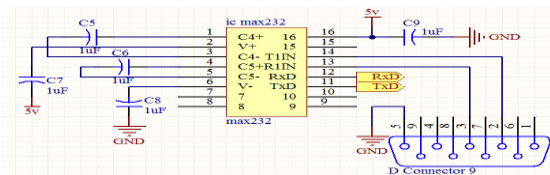


Figure. (13) RS-232 Serial Communication Interface

4.1.12 D9 CONNECTOR

DB9 connectors were once very common on PCs and servers. DB9 connectors are designed to work with the MAX 232 serial interface standard, which determined the function of all nine pins as a standard, so that multiple companies could design them into their products. [23]

The DB9 connector is connected debugger using for Communication between microcontroller and computer.

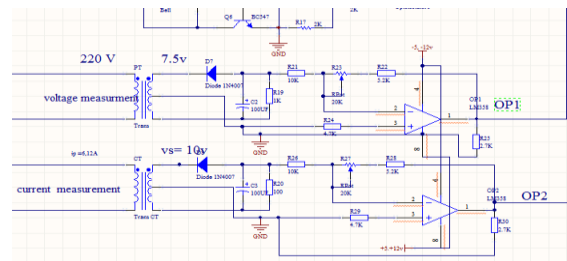


Figure. (14) DB9 connector

4.1.13 VOLTAGE AND CURRENT CIRCUIT

To measure voltage, current, and power, and power factor, in this project .used step down transformer and current

transformer.it is the high voltage is step down 7.5v. Because the any micro control the voltage above 5v should be damage analogue input of microcontroller. so the voltage of micro control it must less than 5v .and also the current transformer is the input current pass through it to generate voltage in secondary winding depend current flow in the load then the output of LM358 is always less than 5v. Also power factor is very important used inductive device, because for protection of dissipate of power between the line and load ckt. Testing device single phase motor, water boiler, charger, soldering iron, fan, and lighting circuit, also test op1, and op2 is $v \leq 5$



5. SOFTWARE DEVELOPMENT

The software programming for the mega16 microcontroller is C-program and will be compiled using viscose compiler of the AVR Integrated Development Environment.

5.1 Process Flow

The picture below shows the process flow diagram of the whole system

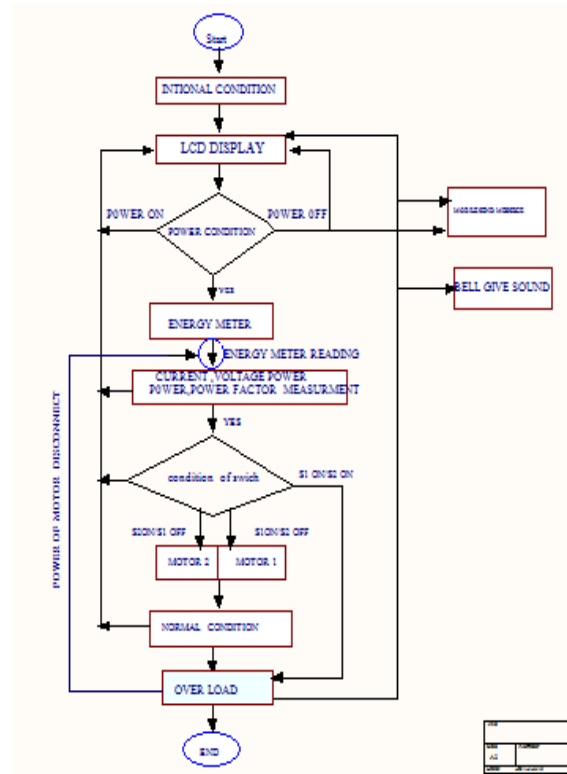
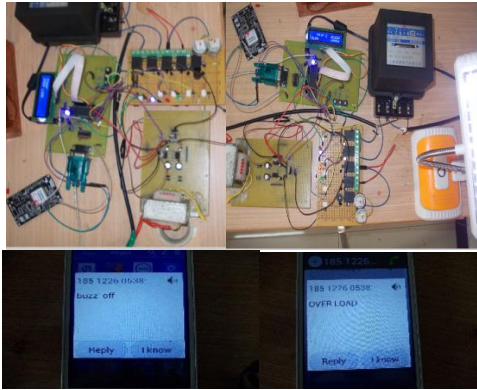


Figure (15) flow chart of control energy meter and motor overload

5.2 Tests

The following shows the tests done to check the hardware and software implementation on the system. This is done to make sure that each of the individual parts and the complete system are working property.

Tests made are power supply, 16*4 LCD display, relay, buzzer, LEDs and sending SMS. Measure voltage, current and power factor



6. CONCLUSION

GSM based Designs have developed another innovative and Public utility product for mass communication. The purpose of this project is to remote monitoring control of Energy meter and overload motor control and measure voltage, current, power and power factor device. It send SMS from micro control to mobile the technician to know about device in working area such as energy meter and motor.

This system also makes use of a GSM modem for remote monitoring control of Energy Meter and control motor over load. and the motor run, when switch on at normal condition, then the two switch press a as same time the two motor turn off, buzzer is give sound, message send to mobile 'over load motor', then normal condition buzzer no sound, The Microcontroller based system continuously no reading energy meter and overload motor be sent to technician on request. A dedicated GSM modem with SIM card is required. The main aim of the project will be to design a SMS electronic energy meter and motor over load relay. Which can replace the electromagnetic protection device, such as circuit breaker. The toolkit send SMS to technical, the system is made efficient by SIMs so that the SMS can be send to mobile from microcontroller AVR mega16 devices boards in a locality using techniques of time division multiple access.

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