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GSM BASED ENERGY METER BILLING VIA SMS

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ABSTRACT

The energy meter is designed for reading electrical energy consumed in units and in rupees to display on an LCD screen to the user. This data is also provided to the electrical department using GSM technology for billing purposes. Owing to high electricity cost these days it becomes necessary for the consumer to know as to how much electricity is consumed to control electricity bill within his budget. In this proposed system, the consumer will get his energy consumption data on real time basis on a LCD display. The same data is sent through GSM modem to the electricity department via SMS. A microcontroller of 8051 family is interfaced to the energy meter to get the Watt Hour pulses. The microcontroller then processes these pulses according the program written in it, to calculate the units consumed and cost involved. Further it gives command to the SIM loaded GSM modem for sending the data to the electricity department via SMS.Further this project can be enhanced by to control the electrical appliances remotely via SMS. Also, the electricity department can send the bill amount over SMS to the receiving unit for consumer information.

Keywords: DB9 Connector, GSM Modem, Keil compiler, LDR, Max232

I. INTRODUCTION

The Electrical metering instrument technology has come a long way from what it was more than 100 years ago. From the original bulky meters with heavy magnets and coils, there have been many innovations that have resulted in size & weight reduction in addition to improvement in features and specifications. Resolution and accuracy of the meter have seen substantial improvements over the years. Introduction of the digital meter in the later part of last century has completely changed the way Electrical parameters are measured. Starting with Voltmeters & Ammeters, the digital meter has conquered the entire spectrum of measuring instruments due to their advantages like ease of reading, better resolution and rugged construction of particular significance is the introduction of the Electronic Energy Meter in the mid-eighties. Now a day, the energy consumption and energy distribution has become a big subject for discussion because of huge difference in energy production and consumption. In this regard, energy consumers are facing so many problems due to the frequent power failures; another important reason for power cuts is due to the un-limited energy consumption of rich people. In this aspect, to minimize the power cuts and to distribute the energy equally to all areas, some restriction should have over the power consumption of each and every energy consumer, and according to that the Government should implement a policy, by introducing Autonomous Energy Meters everywhere in domestic sector. Hence, the need has come to think on this line and a solution has to be emerged out.

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Today the metering instrument technology grown up significantly, such that the Consumed energy can be calculated mathematically, displayed, data can be stored, data can be transmitted, etc. Presently the microcontrollers are playing major role in metering instrument technology. The present project work is designed to collect the consumed energy data of a particular energy consumer through wireless communication system (without going to consumer house), the system can be called as automatic meter reading (AMR) system [1, 2]. The Automatic Meter reading system is intended to remotely collect the meter readings of a locality using a communication system, without persons physically going and reading the meters visually.

II. SYSTEM ARCHITECTURE AND DESIGN

The electricity consumption meter shown in the figure facilitates the billing of energy meter along with load control using wireless GSM technology [3]. This is a GSM based wireless energy meter here 8051 microcontroller is used for controlling the entire system. The GSM based wireless energy meter block diagram is shown in Fig.(1). This GSM based wireless energy meter consists of major components or blocks such as microcontroller, relays, loads, electricity consumption meter, LCD display, power supply circuit, GSM modem, DB9 connector, MAX232, and relay driver.

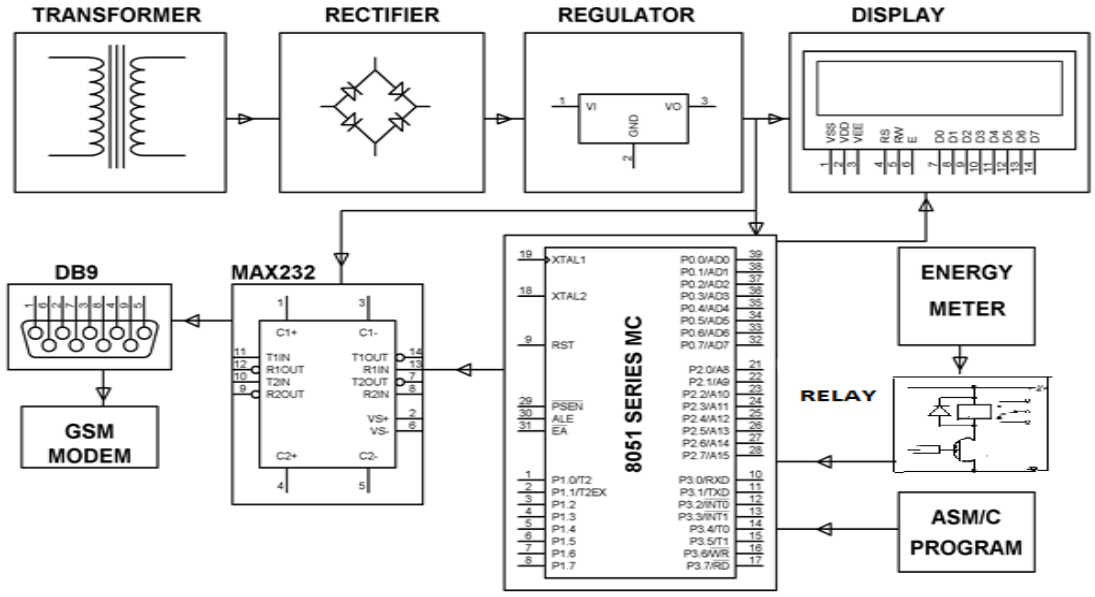

Figure 1: GSM Based Energy Meter Block Diagram

2.1 Power Supply

Any invention of latest technology cannot be activated without the source of power. So in this fast moving world we deliberately need a proper power source which will be apt for a particular requirement. All the electronic components starting from diode to be only work with a DC supply ranging from 5V to 12V.We are utilizing for the same, the cheapest and commonly available energy source of 230V-50Hz and stepping down, rectifying, filtering and regulating the voltage. The Block diagram for power supply is shown in Fig.(2).

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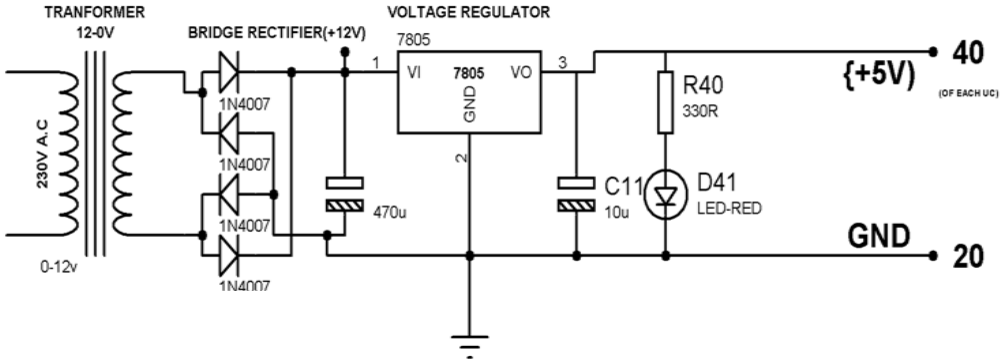

Figure 2: Power Supply Block Diagram

2.2 Energy Meter

An energy or electric meter which is shown in the Fig. (3) is a device that measures the amount of electrical energy consumed by a residence, business, or an electrically-powered device.Electric meters are typically calibrated in billing units, the most common one being the kilowatt hour.

Figure 3:Energy Meter

2.3 Max232

The MAX232 is an integrated circuit that converts signals from an RS-232serial port to signals suitable for use in TTL compatible digital logic circuits which is shown in the Fig. (4).The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals .When a MAX232 IC receives a TTL level to convert, it changes a TTL Logic 0 to between +3 and +15V, and changes TTL Logic 1 to between -3 to -15V, and vice versa for converting from RS232 to TTL.

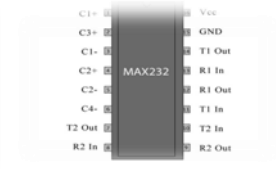

Figure 4: MAX232

2.4 Microcontroller

The AT89S51 shown in the Fig. (5) is a low-power, high-performance CMOS 8-bit microcontroller with 4K bytes of In-System Programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard 80C51 instruction set and pinout. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with In-System Programmable Flash on a monolithic chip, the Atmel AT89S51 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications. The AT89S51 provides the following standard features: 4K bytes of Flash, 128 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, two 16-bit timer/counters, a five-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S51 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning. The Power-down mode saves the RAM contents but freezes the oscillator, disabling all other chip functions until the next external interrupt or hardware reset.

Figure 5: AT89S51 Microcontroller

2.5 Db9 Connector

The term "DB9" refers to s common connector type,one of the D- Subminiature or D-Sub types of connectors. DB9 in the Fig. (6) has the smallest "footprint" of the D-Subminiature connectors and houses 9 pins(for the male connector) or 9 holes (for the female connector). DB9 connectors were once very common on PCs and servers .DB (connectors are designed to work with the EIA/TIA 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. DB9 connectors were commonly used for serial peripheral devices like keyboards, mice, joysticks, etc. Also they are used on DB9 cable assemblies for data connectivity. Today, the DB9 has mostly been replaced by more modern interfaces such as USB, PS/2, Fire wire, and others. However, there are still many legacy devices that use the DB9 interface for serial communication.

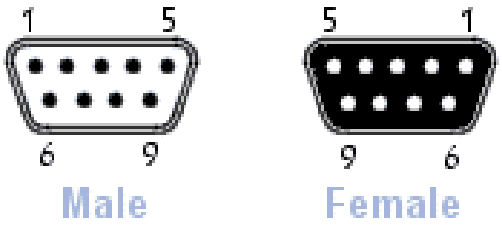

Figure 6: DB9 Connector

2.6 Relay

A relay is an electrically operated switch shown in the Fig. (7). Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays.Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal.Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults.

Figure 7: Relay

2.7 Gsm Modem

GSM stands for Global System for Mobile Communications. GSM networks operate in a number of different carrier frequency ranges (separated into 2G and 3G). GSM networks operate on the 850MHz, 900MHz, 1800MHz, and 1900MHz frequency bands. Most 3G networks in Europe operate in the 2100 MHz frequency band.GSM module is device that communicates over GSM network. This GSM Modem shown in the Fig. (8) is used to send units bill to subscriber's phone number or to a utility company. AT commands are used to communicate with modem.

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 a computer, this allows the computer 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.

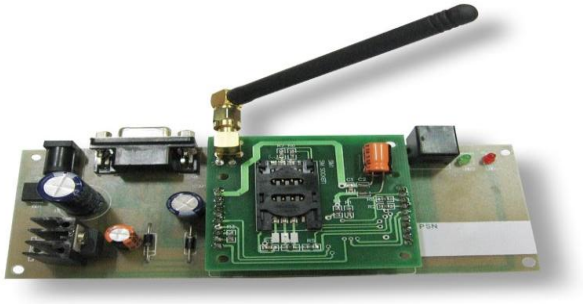

Figure 8: GSM Modem

2.8 LCD Display

A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other.

In this paper we use a 16x2 LCD shown in Fig. (9), means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

Figure (9):LCD Display

2.9 Kiel Compiler

Keil an ARM Company makes C compilers, macro assemblers, real-time kernels, debuggers, simulators, integrated environments, evaluation boards, and emulators for ARM7/ARM9/Cortex-M3, XC16x/C16x/ST10, 251, and 8051 MCU families.Compilers are programs used to convert a High Level Language to object code. Desktop compilers produce an output object code for the underlying microprocessor, but not for other microprocessors.

III. SYSTEM IMPLEMENTATION

The main objective is to develop an energy meter that informs the consumer the exact consumption and billing that the load consumes through SMS [4]. The blinking LED as seen on the front panel is directly proportional to the power consumed. More the power drawn faster becomes the LED blinking pulses. One sensor is placed above such blinking LED to derive the real time units consumed whose output goes to an 8051 microcontroller. Whenever the LED blinks, it then gives an interrupt signal to the microcontroller of the 8051 family and thus the program of the microcontroller counts the pulses and displays the reading on the LCD duly interfaced to the microcontroller for every minute / daily / weekly or monthly as programed which is sent to the cell phone of the user by an SMS through a GSM modem, which is interfaced to the microcontroller via a level-shifter IC and RS232 link. The desired cell number is auto saved on the microcontroller over a missed call by the user for sending SMS to that number only. The Prototype of the system is shown in the Fig.(10).the power supply consists of a step-down transformer 230/12V, which steps down the voltage to 12V AC. This is converted to

DC using a bridge rectifier and it is then regulated to +5V using a voltage regulator 7805 which is required for the operation of the microcontroller and other components.

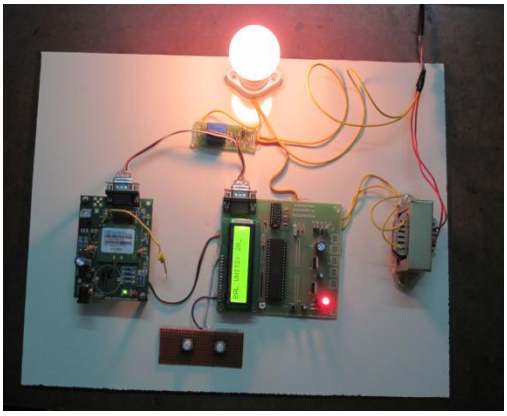

Figure (10): Prototype of the proposed system

IV. CONCLUSION

The monopolistic power distribution market in Asia is gradually transforming into a competitive marketplace. Differentiation in service is going to be the key competitive factor to the improve market share in the deregulated power markets prepaid meters with their advantages over conventional ones are likely to help power distributors to differentiate and offer value –added services to consumers. Encourage consumers to opt for prepaid meters on a voluntary basis and offering tariff or non-tariff incentives to those consumers who prepaid their power changes would help the utilities to implement this system.

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