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Load Management Using GSM

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ABSTRACT: Power shortage is a major issue in India. As the electric power generation does not satisfy the increasing demand, power shortage occurs, which results in power outage. Presently, the power shortage is managed by supplying power in one area by cutting off power in another area. This will cause a lot of inconvenience for the consumers who are located in the power shutdown area. During summer, the problem would be still worse. We are proposing a solution for this problem using GSM technology. In this proposed system we are reducing the power supply and also the system is capable of monitoring various parameters of electrical energy like Voltage, Current, energy consumption in kWh, cost based on tariff for the energy consumption, etc., and the consumer can take suitable precautions to safe guard and financially plan the consumption of electrical appliances. The consumer can monitor the load during peak hours and become an active part of Energy Management system. The consumers get benefited for limiting the consumption during peak hours, they become vigilant in managing electricity consumption and hence their electricity bill. The proposed system is useful to both utility provider and consumers as it manages energy consumption. The system can take the consumers financial allocation for electricity bill as the input and monitors the load consumption. When the load consumption reaches about 90% of the allotted budget limit, SMS alert is sent to the consumer Via GSM module. Based on priority, the load is shut down for each room or connected load of the residence through relays. The user has the decision to continue the energy consumption by communicating to the Module via SMS. The budget can be set by the user each month, which would be notified to the user via SMS. If the budget is not reset to a new value, the previous set value is taken as default.

KEYWORDS: GSM (Global system for mobile communication), LCD (Liquid crystal display), GUI (Graphic User Interface), RTC (Real Time Clocks), PLC (Programmable Logic Control) SMS (Short Message Service).

I. INTRODUCTION

The Electricity is one of the most important requirements of modern civilization, without which various indispensable applications will bind to bring to a standstill. It can be noticed that the demand for electricity is increasing along with population and its dependency, thus increasing the power consumption. On Application of data analytics to the gathered metering data, via energy meter, awareness of energy consumption is made viable and development of new energy efficiency services. As per the report of CEA, India [23], the gap between the electrical energy supply and the energy demand in July-2014 is -3.9% (MW). Accurate metering, detection of illegal activities and implementation of proper tariff and billing system would manage the consumption of electrical energy.

With the current trend, the advancement in load priority and load management is steadily growing with innovations such as a system that facilitates automatic recognition of switching events of electric appliance [9][16] that applies data analytics to the gathered metering data allowing the system to raise energy awareness by providing better-tailored energy feedback without the need for special purposed hardware. This can be extended to load monitoring in which the system classifies the load based on consumption and records their operating period respectively using signature recognition algorithm. Considering in a larger scale, the concept of load shedding [5][14] paved way for the implementation of the same in automation of home appliances. The GUI (graphic User Interface) is used to notify the user of the consumption which is basically load monitoring in a larger area via smart
grid [17]. The timings of individual areas are set by the user using Real time clocks (RTC) on GUI [17]. The GUI is operated using PLC and SCADA, as it is easier for large data processing and operation. For small scale, in consideration of residential or commercial buildings, the use of PLC (Programmable Logic Controller) and SCADA (Supervisory Control and Data Acquisition) would not be economic. Hence mostly IOT based systems for automation. With the replacement of analog Energy meters by digital meters, the transformation in the energy meter keeps evolving with time. Hybrid and smart energy meters have come into existence [4][12]. With the use of Smart meters the consumer can monitor various parameters of electrical supply and can take necessary precautions to improve power quality and its consumption. The smart energy meter consists of anti- tampering and anti-theft measures that help in billing process for the service providers.

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The proposed System is capable of monitoring various parameters of electrical energy like Voltage, Current, energy consumption in kWh, cost based on tariff for the energy consumption, etc., and the consumer can take suitable precautions to safe guard and financially plan the consumption of electrical appliances. The consumer can monitor the load during peak hours and become an active part of Energy Management system. The consumers get benefited for limiting the consumption during peak hours, they become vigilant in managing electricity consumption and hence their electricity bill. The proposed system is useful to both utility provider and consumers as it manages energy consumption. The system can take the consumers financial allocation for electricity bill as the input and monitors the load consumption. When the load consumption reaches about 90% of the allotted budget limit, SMS alert is sent to the consumer Via GSM module. Based on priority, the load is shut down for each room or connected load of the residence through relays. The user has the decision to continue the energy consumption by communicating to the Module via SMS. The budget can be set by the user each month, which would be notified to the user via SMS. If the budget is not reset to a new value, the previous set value is taken as default.

II. PROBLEM STATEMENT

Power wastage is one of the issue in India. The main goal of the project is to decrease electricity wastage. So this project proposing a solution for the problem using GSM technology. In this project, the power supply reduces to each customer thus increasing the number of consumers. The consumer has to reduce the load in order to get electricity gain.

III. OBJECTIVES AND SCOPE

- Simplicity and cost-effective.
- Smart load management system.
- GSM technology is convenient and having fast communication.
- To access the load in a safe condition even when the operator is far away from the load side.

IV. LITERATURE SURVEY

Paper 1.Leveraging smart meter data to recognize home appliances Weiss,M. Helfenstein, A. and Staake, T (2012).

In this paper a detailed description and evaluation of a system that facilitates automatic recognition of switching events of electric appliances. This objective is achieved by interconnecting components that are becoming ubiquitous in home environments: a smart meter and a smart phone. The signature database is established over time and allowing new devices that is an integral part of fast changing home environment. Applying data analytics to the gathered metering data allows the system to raise energy awareness by providing better-tailored energy feedback without the need for special purposed hardware. In combination with actuation capabilities, we can foresee this information to be used to automatically optimize energy consumption and hence increase residential energy efficiency. In this paper we present an infrastructure and a set of algorithms that make use of smart meters together with smart phones to realize new energy efficiency services (such as itemized electricity bills or targeted energy saving advice). The algorithm was developed based on the data collected by individual appliances and their energy consumption as training sets. The signature recognition i.e. the type of load and energy consumption was 87 % with simultaneous connection of 8 loads. It classifies the load based on consumption, monitors and records their operating periods respectively using signature recognition algorithm.

Paper 2. An Embedded Technology Based Automated City Load Shedding Management Scheme, Abhishek Pawar , Zainab Mizwan (Vol. 6, Issue 10, October- 2018).

Load shedding strategy is applied when there is not enough electricity available to meet Load shedding strategy is applied when there is not enough electricity available to meet the increasing demand of consumers, and an electricity supply or utility company stops the energy supply to certain areas. It is a last option to balance Electricity supply and demand. The process is more prone to hum an errors as an operator has to manually switch the load ON/OFF. In this paper, an automated load shedding management module was developed and used to demonstrate the use of embedded systems concept in the field of Power System Automation. By using low cost components and programmed ARM processor automatic switching operations in various stages of the lab-scale model of the given circuit arrangement is performed and available power is distributed with the automated load shedding plan. The scheme was automated, thus eliminating human error completely. From the graphic user interface (GUI) the relays are turned ON or OFF based on the load distribution. The GUI is also used to notify the user of the consumption. The timings of individual areas are set by the user using Real time clocks (RTC) on GUI.

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V. METHODOLOGY

The system is built sequentially by simulation and coding with the help of Arduino IDE software. The program is dumped to developing board (Arduino Mega) using USB
2.0 cable. By connecting a load (lamp load), the current is drawn through the sensor. On detection of current, the LCD displays the current value. The power consumption displays in LCD is verify with that of the energy meter reading. The keypad is connected to the Arduino board, it is used to set the budget as per consumer need. The Arduino board is connected to the GSM module and it is programmed to send SMS alert to the registered number (Defined in the program) when the load power consumption is reaches to 90 percent of the set value. Once the alert is notified, the load is tripped for the first load which is set in load priority. The load priority list is set by the user to trip in sequential order, so that if any important work or the necessity of power for the particular load is not alerted.

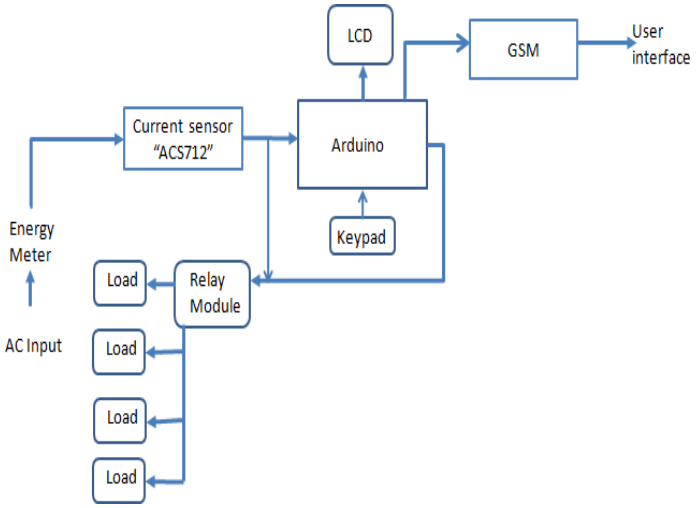

Fig: 1 Block diagram of the system

At the end of the month, another notification is sent to the user to reset the budget for the next month. If the budget is not reset by the user, the previous value that is set by the user is taken for the next month.

VI. COMPONENTS USED

1. Arduino mega 2560

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560.Purpose for using Arduino mega 2560 is where most pins comes in with 54 Digital I/O pins (were 15 of them have PWM) and has 16 Input Analog pins. The Mega has four hardware serial ports, which means maximum speed if you need a second or third (or fourth) port. By turning the power on and off very rapidly, the average power to the motor goes up or down, changing its speed without varying the voltage (that is, except for either full on or completely off). The Mega 2560 has the most SRAM space with 8kB, which is 4x more than the Uno and is more powerful than UNO.

Fig 2. Arduino mega 2560

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Digital Energy Meter:

An energy meter displays the energy consumption of a specific load normally in units of kilowatt-hour KWh. One KWh is equal to 1000 watts 3600 seconds= 3.6 mega joule=3.6 MJ. The digital energy meter measures the energy consumption and displays it in numerical form. The resolution depends in the least digit that can be displayed that is the minimum value that can be displayed. Here digital energy meter is used over analog due to its numerous advantages such as accuracy, auto polarity, current protection, robustness, stable calibration and is user friendly

Fig.3 Digital energy meter

3. Sim 800A (GSM/GPRS module)

GSM is a mobile communication mode, it stands for global system for mobile communication (GSM). A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates. A GSM modem is duly interfaced to the MC through the level shifter IC Max232. The SIM card mounted GSM modem upon receiving digit command by SMS from any cell phone send that data to the MC through serial communication. While the program is executed, the GSM modem receives command 'STOP' to develop an output at the MC, the contact point of which are used to disable the ignition switch. The command so sent by the user is based on an intimation received by him through the GSM modem 'ALERT' a programmed message only if the input is driven low. The complete operation is displayed over 16×2 LCD display. SIM800 is a quad-band GSM/GPRS module that works on frequencies GSM850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz. SIM800 features GPRS multi-slot class 12/ class10 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS- 4.With a tiny configuration of 24*24*3mm, SIM800 can meet almost all the space requirements in user applications, such as M2M, smart phone, PDA and other mobile devices. SIM 800A (GSM/GPRS Module) provides effective, reliable and efficient automatic meter reading, and notification through the use of GSM network through mobile phone, thus reduce human effort in meter reading and manage electricity consumption, this method is very economical and time saving. On implementation of this, the electricity consumption management is more efficient i.e. by managing the loads, and hence reducing the electricity billing. This system is very accurate, simple and low power consumption which is used for the real time applications.

Fig 4. GSM 800A module

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4.ACS712 Current Sensor

ACS712 current sensor consists of a precise, low- offset, linear Hall sensor circuit with a copper conduction path located near the surface of the die. It can accurately detect AC or DC applied current flowing through this copper, conduction path generates a magnetic field which is sensed by the integrated Hall IC and converted in to aproportional voltage. Device accuracy is optimized through the close proximity of the magnetic signal to the Hall transducer. A precise, proportional voltage is provided by the low-offset, chopper- stabilized BiCMOS Hall IC, which is programmed for accuracy after packaging. The maximum AC or DC that can be detected is 30A, and the present current signal is detected via analog I / O port of Arduino.

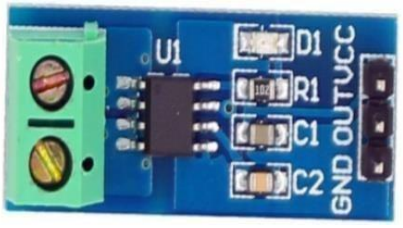

Fig 5. ACS712 Current sensor

5. Keypad 4 × 4

The Here we have used key pad to set the budget per month displayed on LCD screen by the user with password protection by pressing any key where password enter will display where in the user has to enter the password later enter the budget and exit using # button.

Fig 5. ACS712 current sensor

6. 16×2 LCD

16×2 character liquid crystal display (LCD) module is the most basic electronic display module which is widely used. The module will consist of 2 rows each with 16 columns which can display 16 characters. The main advantage of using a character LCD instead of a seven segment display and other multi-segment LEDs is that there is no limitation in displaying special and custom character animations. All character LCDs will have 16 pins among which 8 are data pins through which data or commands are passed into the LCD registers. In this project, it is used to display the meter reading that includes watt/hour, instantaneous current along with the cost consumption per unit. Further with keypad interface the user sets the budget where password protection is also provided.

Fig 7. 16*2 LCD display

7. Two channel relay

A relay is an electrically operated switch that can be turned on or off, letting the current go through or not, and

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can be controlled with low voltages, like the 5V provided by the Arduino pins. This relay module has 2 channels.. This module is powered to 5V, which is appropriate to use with Arduino. Considering a single relay of the module. The high voltage output connector has 3 pins, the middle one is the common pin and from the markings one of the two other pins, it is clear that it is for normally open connection (NO) and the other one for normally closed connection (NC). On the other side of the module there are 4 input pins, a Ground and a VCC pin for powering the module. The next set of pins are 3 in number with a jumper between the IDVcc and the Vcc pin i.e. used for connecting the relays to the circuit. With a configuration like this the electromagnet of the relay is directly powered from the Arduino Board and if something goes wrong with the relay the microcontroller could get damaged.

Fig 8. 2 channel relay module

VII. ADVANTAGES

- From the information of the energy usage and prices, consumers can manage their activities and energy expenditure accordingly.
- The system will display power consumption and cost per unit continuously.
- This provides a smart way to utilize the load and which is helpful to both the supplier and consumer.
- Power shortage will reduce to considerable amount as usage of high electricity consuming products will not be used by the consumers.
- The system will save electricity and mitigate crisis.

VIII. CONCLUSION AND SUGGESTION FOR FUTURE WORK

The designed system is developed successfully with expected results. The display of LCD is used to view the power consumption values, current values, and amount balance. It also exhibited the flow of operation of operating the menu and exiting for each option. The message is sent to the user via SMS for notification and alerts. The load is also tripped when the set value is reached. Since the Arduino board is used, the system function is temporary which can be erased or manipulated.

The function of the system could be programmed permanently into the Arduino board by burning the bootloader, and permanently connecting the system so that the unwanted distortions is removed. The software can also be burned permanently using other development boards. This also increases the chances of commercializing the system.

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With the approval of KEB and other higher officials, it is possible for automatic update of tariff change into the system directly. The program need not be altered every time there is a tariff change. This would be possible by directly sending an update/change to the development board (Arduino MEGA) by the officials via network communications i.e. there would be a link to the electricity board and the consumer. This enables the consumer to be notified of occurring changes instantly and help them in load management.

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