GSM Based Wireless Control of Electrical Appliances

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Abstract: **It is basically known that any electrical appliance is controlled with a switch that regulates the electricity to electrical devices. As a reason of the latest technological advances, automation and wireless control of devices has becoming more popular. This project puts for the equipment which enables users to control their home appliances using their cellular phone. It shows the construction and working of the device to wirelessly control the home appliances based on GSM networking and 8051 microcontroller. Initially an authenticated signal is sent from the user's cellular phone via Global System for Mobile Communication (GSM) network to the phone which is fixed to the equipment. This signal or code consists of the information about the function or action to be taken place i.e. what appliance should be turned off or turned on. The receiver phone receives the DTMF signal or a SMS message that is send from the user's phone and then sends it to the DTMF decoder or the GSM modem which in turn sends the output digital signal to the microcontroller. Then the microcontroller, based on the received signal, controls the different relays connected through ULN2003 (Darlington transistor) and triggers the required appliance.**

Keywords: **GSM communication, Wireless Control, SMS, DTMF.**

I. INTRODUCTION

During the present days technology is all about the automation and wireless control of all the equipment used in industries, factories and households. Any equipment that can be controlled wirelessly is more easily maintained and it responds very fast comparing to the manual operation of the equipment. It increases safety as well as speed of operation in times of failure or damage. So here we present a design which uses wireless technology for switching of electrical appliances. This project uses the application of wireless communication i,e. GSM network for the wireless control of the electrical appliances.

Wireless communication has become an important feature for commercial products and a popular research topic within the last ten years. There are now more mobile phone subscriptions than wired-line subscriptions. Lately, one area of commercial interest has been low-cost, low-power, and short-distance wireless communication used for personal wireless networks. Technology advancements are providing smaller and more cost effective devices for integrating computational processing, wireless communication, and a host of other functionalities. These embedded communications devices will be integrated into applications ranging from homeland security to industry automation and monitoring. They will also enable custom tailored engineering solutions, creating a revolutionary way of disseminating and processing information. With new technologies and devices come new business activities, and the need for employees in these technological areas. Engineers who have knowledge of embedded systems and wireless communications will be in high demand. Unfortunately, there are few adorable environments available for development and classroom use, so students often do not learn about these technologies during hands-on lab exercises. The communication mediums were twisted pair, optical fibre, infrared, and generally wireless radio.

In this project the applications of GSM network for the design of a circuit to control the house hold appliances is shown, and also the design of the circuit and method to construct the system using GSM modem and 8051 microcontroller is explained. Various uses and limitations of the system are being briefed.

II. CIRCUIT DESIGN AND PROCEDURE

The block diagram of our project is shown below in the fig. It is an outline description of how we have implemented our project and the various steps involved in it. From the block diagram given below, the first mobile station is used as a transmitting section from which the user sends a code that contains commands and instructions to the second mobile station which is based on a specific area where our control system is located, through GSM network. The received code can be in either DTMF format which is send to the DTMF decoder connected via headset jack of the phone or through an SMS.

The DTMF decoder converts it into digital signal and sends it to the microcontroller interfaced to it. Then the microcontroller processes the code and carries out the specific operations. The ULN2003 is used to drive the relay circuits which switches the different appliances connected to the interface.

After connecting the circuit properly and assuming all the connections are right the following steps are to be followed:

- The remote user send authenticated signal including commands to the receiver phone.
- Through the GSM network the signal is received by the receiver phone on the device.
- Then that DTMF signal is passed to the DTMF decoder to convert it to the digital signal, and it sends them to microcontroller.
- Microcontroller issues commands to the appliances and the devices connected will switch ON/OFF.

And if we are using GSM module, that is SMS mode, the signal send in the form of SMS is send to the GSM module and then to microcontroller through serial communication and then microcontroller command the relays to switch the devices.

III. BLOCK DIAGRAM

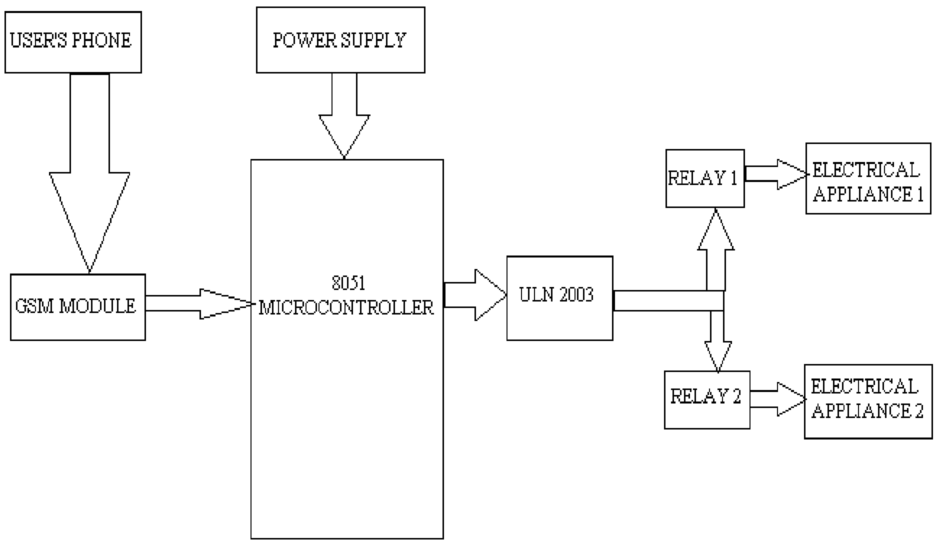

Fig. 1: Block Diagram of GSM Based wireless Controlling of Electrical Appliances

IV. COMPONENTS

The Hardware components used in this project are

- Regulated Power Supply
- Microcontroller
- Relay
- Transformer
- Op-Amp

- Voltage Regulator
- GSM Modem
- Relay Driver(n-p-n transistor)

(i) POWER SUPPLY:

Basically any electronic circuit runs with a power supply. Here we are giving a 5v supply to the various IC's used in the design presented here. We get a 240V supply in our house at any instant. So in order to provide our circuit appropriate supply voltage a different power circuit is to be made based on our requirement. The various steps included in the circuit are explained below stepwise. And also various precautions are to be taken for the safety of the electronic circuit designed. The different stages of the design of the circuit is given below.

(a)TRANSFORMER:

We need a step down transformer of 220/12v output to supply all the electronics involved. Here in this device all the equipment require a DC input of 5v and since the regular input to the houses is 220v we need a transformer to step down voltages.

(b) CENTRE TAP RECTIFIER:

The equipment needs a DC supply, so the output from the transformer is connected to a bridge rectifier to make it DC. A full-wave rectifier appears in Fig. 2 with only two diodes but requiring a centre-tapped transformer to establish the input signal across each section of the secondary of the transformer.

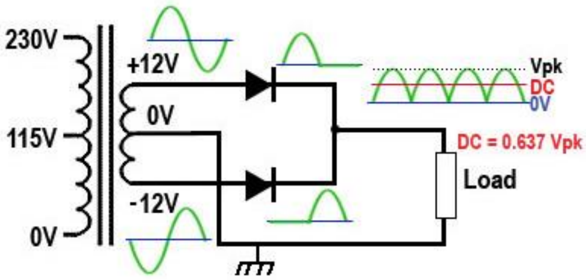

Fig. 2: Centre Tap Rectifier

(c) FILTER CIRCUIT:

A rectifier should provide an output voltage that should be as smooth as possible. In practice, however, output voltage from rectifiers consists of dc component plus ac component, or ac ripples. The ac component is made up of several dominant harmonics. It is more so in single phase rectifiers with R load. The ac component does no useful work. In a dc motor, the required torque is produced by dc current only also in a dc battery, energy is stored by dc current only. AC ripples in rectifier output current do not contribute to motor torque, or to the energy stored in the battery. AC component merely causes more ohmic losses in the circuit leading to reduce efficiency of the system. This shows that it is of paramount importance to filter out the unwanted ac component present in the rectifier output. For this purpose, filters are used. When used on the rectifier output side, these are called dc filters; these tend to make the dc output voltage and current as level as possible. The more common dc filters are of L, C and LC filters.

In this project C filter is used to filter out the AC component. The filter circuit is simply a capacitor of 1000uf associated in parallel to the power circuit. It goes about as a filter that seems to be, it filters outs the ripples present in the circuit brought on throughout the rectification from the diodes in the bridge circuit. Regardless of the amount consideration is taken there are still ripples in the output voltage of the circuit, which is destructive for the IC's utilized. So filter capacitor evokes them, along these lines helping keeping up security in the outlined circuit.

(d)VOLTAGE REGULATOR:

Then at last voltage controllers are associated over the circuit to secure the supplies from any kind of voltage variances. All the gadgets we utilize are delicate and sensitive, so protection from any kind of variances is very important. A voltage controller is intended to naturally keep up a consistent voltage level.

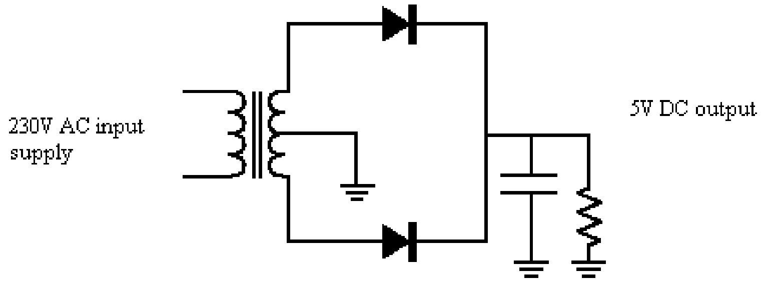

Fig.3: Power Supply Circuit

(ii) MICROCONTROLLER AT89S52:

Description:

The AT89S52 is a low-power, high-performance CMOS 8-bit microcomputer with 8Kbytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel's high-density non-volatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications.

Pin Configurations:

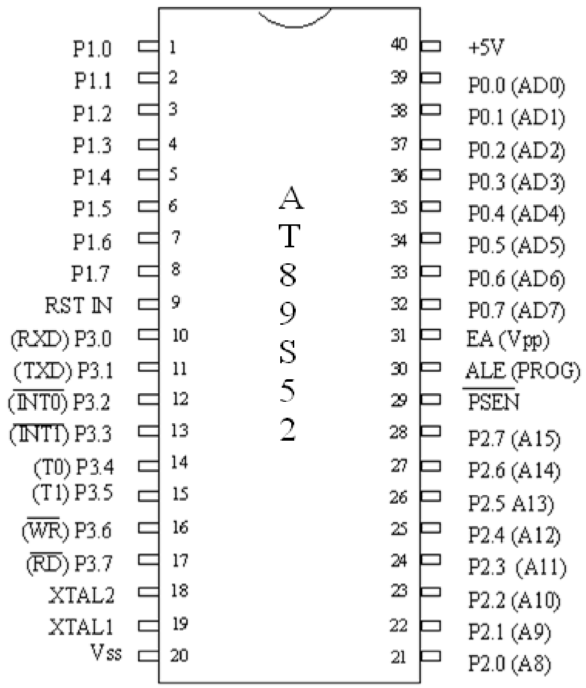

Fig. 4:- Pin Diagram of Microcontroller AT89S52

Pin Description:

Port 0:

Port 0 is an 8-bit open-drain bi-directional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high impedance inputs.

Port 0 may also be configured to be the multiplexed low order address/data bus during accesses to external program and data memory. In this mode P0 has internal pullups.

Port 0 also receives the code bytes during Flash programming, and outputs the code bytes during program verification. External pullups are required during program verification.

Port 1:

Port 1 is an 8-bit bi-directional I/O port with internal pullups. The Port 1 output buffers can sink/source four TTL inputs.

When 1s are written to Port 1 pins they are pulled high by the internal pullups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (IIL) because of the internal pullups.

Port 1 also receives the low-order address bytes during Flash programming and verification.

Port 2:

Port 2 is an 8-bit bi-directional I/O port with internal pullups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins they are pulled high by the internal pullups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (IIL) because of the internal pullups.

Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that use 16-bit addresses (MOVX @ DPTR). In this application, it uses strong internal pull-ups when emitting 1s. During accesses to external data memory that use 8-bit addresses (MOVX @ RI), Port 2 emits the contents of the P2 Special Function Register.

Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.

Port 3:

Port 3 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (IIL) because of the pull-ups. Port 3 also serves the functions of various special features of the AT89C52 as listed.

Table 3.1:- Brief Description of Pins of Microcontroller AT89S52

Port Pin	Alternate Functions
P3.0	RXD (serial input port)
P3.1	TXD (serial output port)
P3.2	$\overline{\text{INT0}}$ (external interrupt 0)
P3.3	$\overline{\text{INT1}}$ (external interrupt 1)
P3.4	T0 (timer 0 external input)
P3.5	T1 (timer 1 external input)
P3.6	$\overline{\text{WR}}$ (external data memory write strobe)
P3.7	$\overline{\text{RD}}$ (external data memory read strobe)

Port 3 also receives some control signals for Flash programming and verification.

RST:

Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device.

ALE/PROG:

Address Latch Enable output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input (PROG) during Flash programming.

In normal operation ALE is emitted at a constant rate of 1/6 the oscillator frequency, and may be used for external timing or clocking purposes. Note, however, that one ALE pulse is skipped during each access to external Data Memory. If desired, ALE operation can be disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction. Otherwise, the pin is weakly pulled high. Setting the ALE-disable bit has no effect if the microcontroller is in external execution mode.

PSEN:

Program Store Enable is the read strobe to external program memory. When the AT89C52 is executing code from external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory.

EA/VPP:

External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH. Note, however, that if lock bit 1 is programmed, EA will be internally latched on reset. EA should be strapped to VCC for internal program executions. This pin also receives the 12-volt programming enable voltage (VPP) during Flash programming, for parts that require 12-volt VPP.

XTAL1:

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

XTAL2:

Output from the inverting oscillator amplifier.

(iii) RELAY:

A **relay** is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. It was invented by Joseph Henry in 1835. Because a relay is able to control an output circuit of higher power than the input circuit, it can be considered to be, in a broad sense, a form of an electrical amplifier.

A simple electromagnetic relay, is an adaptation of an electromagnet. It consists of a coil of wire surrounding a soft iron core, an iron yoke, which provides a low reluctance path for magnetic flux, a moveable iron armature, and a set, or sets, of contacts; two in the relay pictured. The armature is hinged to the yoke and mechanically linked to a moving contact or contacts. It is held in place by a spring so that when the relay is de-energized there is an air gap in the magnetic circuit. In this condition, one of the two sets of contacts in the relay pictured is closed, and the other set is open. Other relays may have more or fewer sets of contacts depending on their function. The relay in the picture also has a wire connecting the armature to the yoke. This ensures continuity of the circuit between the moving contacts on the armature, and the circuit track on the Printed Circuit Board (PCB) via the yoke, which is soldered to the PCB.

When an electric current is passed through the coil, the resulting magnetic field attracts the armature, and the consequent movement of the movable contact or contacts either makes or breaks a connection with a fixed contact. If the set of contacts was closed when the relay was de-energized, then the movement opens the contacts and breaks the connection, and vice versa if the contacts were open. When the current to the coil is switched off, the armature is returned by a force, approximately half as strong as the magnetic force, to its relaxed position. Usually this force is provided by a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly. In a low voltage application, this is to reduce noise. In a high voltage or high current application, this is to reduce arcing.

If the coil is energized with DC, a diode is frequently installed across the coil, to dissipate the energy from the collapsing magnetic field at deactivation, which would otherwise generate a voltage spike dangerous to circuit components. Some automotive relays already include that diode inside the relay case. Alternatively a contact protection network, consisting of a capacitor and resistor in series, may absorb the surge. If the coil is designed to be energized with AC, a small copper ring can be crimped to the end of the solenoid. This "shading ring" creates a small out-of-phase current, which increases the minimum pull on the armature during the AC cycle.

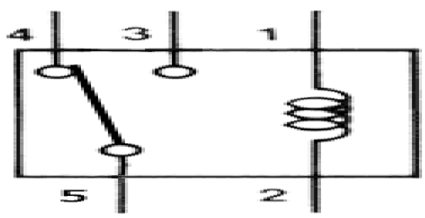

Fig.5: Relay

By analogy with the functions of the original electromagnetic device, a solid-state relay is made with a thyristor or other solid-state switching device. To achieve electrical isolation an opt-coupler can be used which is a light-emitting diode (LED) coupled with a photo transistor.

(iv) TRANSFORMERS:

The transformer is a static electro-magnetic device that transforms one alternating voltage (current) into another voltage (current). However, power remains the same during the transformation. Transformers play a major role in the transmission and distribution of ac power.

A transformer is a device that transfers electrical energy from one circuit to another through inductively coupled electrical conductors. A changing current in the first circuit (the primary) creates a changing magnetic field; in turn, this magnetic field induces a changing voltage in the second circuit (the secondary). By adding a load to the secondary circuit, one can make current flow in the transformer, thus transferring energy from one circuit to the other.

The secondary induced voltage VS is scaled from the primary VP by a factor ideally equal to the ratio of the number of turns of wire in their respective windings.

By appropriate selection of the numbers of turns, a transformer thus allows an alternating voltage to be stepped up — by making NS more than NP — or stepped down, by making it less.

Transformers are some of the most efficient electrical 'machines', with some large units able to transfer 99.75% of their input power to their output. Transformers come in a range of sizes from a thumbnail-sized coupling transformer hidden inside a stage microphone to huge units weighing hundreds of tons used to interconnect portions of national power grids. All operate with the same basic principles, though a variety of designs exist to perform specialized roles throughout home and industry.

(v) OPERATIONAL AMPLIFIER (Op-Amp):

An Op-Amp is a very high gain differential amplifier with high input impedance and low output impedance. Typical uses of an Op-Amp are to provide voltage amplitude changes (amplitude and polarity), oscillators, filter circuits, and many types of instrumentation circuits. An Op-Amp contains a number of differential amplifier stages to achieve a very high voltage gain. In this circuit LM358 type Op-Amp is used for operation.

(vii) GSM MODEM:

GSM modem (900/1800 MHz) Semen's GSM/GPRS Smart Modem is a multi-functional, ready to use, rugged unit that can be embedded or plugged into any application. The Smart Modem can be controlled and customized to various levels by using the standard AT commands. The modem is fully type-approved, it can speed up the operational time with full range of Voice, Data, Fax and Short Messages (Point to Point and Cell Broadcast), the modem also supports GPRS (Class 2*) for spontaneous data transfer. Description of the interfaces The modem comprises several interfaces: - LED Function including operating Status - External antenna (via SMA) - Serial and control link - Power Supply (Via 2 pin Phoenix tm contact) - SIM card holder.

Fig. 6: GSM Modem

(vi) VOLTAGE REGULATOR:

Zener Diode works as a voltage regulator. The location of zener region can be controlled by varying the doping levels. An increase in doping that produces an increase in number of added impurities with increase in zener potential. Because of excellent temperature and current capabilities, silicon is the preferred material in the manufacture of zener diodes. In this project we are using 7805 type voltage regulator.

(vii) RELAY DRIVER:

The n-p-n transistor is used as relay driver in this project. A transistor is a three layer semiconductor device consisting of either two n- and one p- type layers of material or two p- and one n- type layers of material. The former is called an n-p-n transistor and the latter is called a p-n-p transistor. The basic operation of n-p-n transistor is exactly same if the roles played by the electron and hole are interchanged. ULN20031 type transistor is used for operation.

V. CONCLUSION

Design such a project and implement it, we gather great practical experience. We tried to implement our theoretical knowledge successfully. This course teaches us about the far difference between theoretical and practical knowledge. This project increases our ability to work as a group and it helps us in future life. But we face several problems because of unavailability of quality goods, technical support and inexperience. Despite that we enjoyed our work very much and successfully finished that work in perfection. In this dynamic world electrical appliances are the most convenient and useful tool in industry. Large rated motor required flexible control and protection. Automation is required in modern time which is the basic theme of our project to make system reliable and more efficient. Basically automation consist a major portion of electronics engineering along with electrical engineering. So it is mandatory to keep a deep knowledge of electronics for implementation of the project. We hope our project can bring dynamic change in our industrial level electrical appliances controlling system.

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