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GSM based Interactive Voice Response System for Wireless Load Controlling and Monitoring

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Abstract: ***With the current advancement in wireless networks and various technologies implemented for automation, more innovative and improved ideas are developed to build automation systems facilitating remote controlling and monitoring of devices. In this project, a GSM based wireless home automation system is proposed and deployed which executes its function of controlling and monitoring appliances remotely. It is compliant, cost effective, low power consumption; highly efficient GSM (Global System for Mobile Communication) based wireless home system. The Interactive Voice Response System (IVRS) is improvised to embellish the system's security and ease of operation. With the help of this system the user can access his home appliances from anywhere and at anytime as per the requirement aiding convenience. The system permits the user direct devices through his mobile by sending commands***

Keywords: Global system for mobile communication (GSM), Interactive voice Response System(IVRS), Relay Driver, Micro Controller

1. Introduction

The Interactive Voice Response (IVR) System serves as a bridge between people and computer databases by connecting the telephone network with the database. The IVR system uses the pre-recorded or computer generated voice responses to provide information in response to an input (given by means of touch tone signal, when a caller presses a key of his mobile) from a telephone caller. A microcontroller we used is 89S52 is to perform I/O operations and to implement special features like counting external pulses, performing serial data transferring or connecting chip to a computer to update the software Embedded system means a
processor is embedded into the required application. An embedded product uses a microprocessor or microcontroller to do one task only. In an embedded system, there is only one application software that is typically burned into ROM. A GSM modem is a specialized type of modem which accepts a SIM card, and operates just like a mobile phone [1]. A wireless modem sends and receives data through radio waves. It limits to process about six to ten SMS messages per minute. The **relay driver** used ULN2003 is a monolithic high voltage and high current Darlington transistor arrays. It has 7 pairs of Darlington transistors each rated at 500mA and can withstand the peak currents up to 600mA. The **APR9600 voice module** offers true single chip voice recording, non-volatile storage and playback capability for 40 to 60 seconds. This design uses a APR9600 voice as a core of the circuit and realizes the function of auto recording and playing back**. Liquid Crystal Display** is a flat panel display or other electronic visual display that uses the light modulating properties of liquid crystal LCDs are available to display arbitrary images with low information content. In this project, we use LCD to show the commands which the micro controller is performing.

2. Existing System

Home automation and industrial automation are types of automation where systems use wireless transmission technologies like Bluetooth, WI-FI or IVRS to send commands to a set of applications or machines and hence these machines respond to them accordingly. Keeping in view these factors, the proposed system intends to be used for home automation as well as industrial automation. It will use GSM technology as a transmission medium to send commands to a set of applications. The GSM technology has the advantage of a worldwide range compared to other transmission technologies which are usually limited to a range of few 100 meters Initially the loads existing at remote locations are controlled by making a call to the sim presented in GSM module. It is considered to a better practice if there exists only single load but in practical scenario multiple loads will be existing which are to be controlled based up on requirements. In that case it is not possible to keep individual GSM modules to each and every load for controlling purpose [3]. So the existing system is being added with Interactive

Voice Response (IVRS) which is used to control multiple loads by single GSM module.

3. Proposed System

The system mainly consists of three sections i.e., GSM Module, Voice module, microcontroller and relay driver.

3.1 GSM Module

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[8]. A wireless modem behaves like a dial-up modem

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Figure 1: GSM module

The fundamental purposes of this unit are

- Allows the user to interact with controller unit to control loads located at remote locations.
- Delivers voice to control the appliance switch ON/OFF status.

1) Whenever GSM receives a call the call will be attended after three rings.
2) A programme is dumped in the microcontroller to in such a way that the call will be lifted after three rings.
3) The loads at remote locations are switched ON/OFF by using numbers on the dial pad of the cell phone .
4) The GSM module acknowledges only specific numbers on the dial pad which are programmed in the microcontroller

3.2 VOICE MODULE

Voice module is a important part of an system to inangurate IVRS which affords real time communication .Rendering to the user command a suitable response which is a prerecorded voice message is produced and transmitted to user via GSM network. The voice module APR9600 used is a true single-chip voice recording IC with play back capability of 40 to 60seconds. APR9600 is a low-cost high performance sound record/replay IC incorporating flash analogue storage technique. Recorded sound is retained even after power supply is removed from the module. The replayed sound exhibits high quality with a low noise level. Sampling rate for a 60 second recording period is 4.2 kHz that gives a sound record/replay bandwidth of 20Hz to 2.1 kHz.

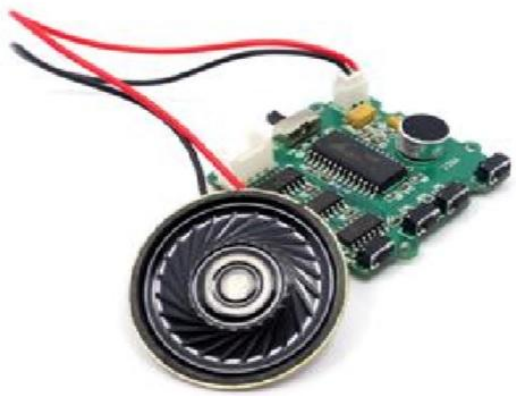


Figure 2: Voice module

Supply voltage is between 4.5V to 6.5V. During recording and replaying, current consumption is 25 mA. In idle mode, the current drops to 1 mA [8]. The APR9600 experimental board is an assembled PCB board consisting of an APR9600 IC, a microphone, and supporting components.

3.3 Micro controller AT89S52

This hard ware implementation employs the 8-bit microcontroller from ATMEL (AT89S52). The microcontroller is used for transmit and receive signals from the GSM modem and also transmit the signals to the relay driver, and the corresponding channels of the voice modem
The AT89S52 provides the following standard features: 8Kbytes of flash, 256 bytes of RAM, 32 I/O lines [5]. In addition, the AT89S52 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 hardware reset. 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.

3.4 Relay Driver

Relay Driver ULN2003 is a high voltage, high current Darlington transistor array containing seven open collector Da1rlington pairs with common emitters. It consists of seven NPN Darlington pairs that feature high voltage outputs with common cathode Clamp diodes for switching inductive loads. The collector current rating of a single Darlington pair is 500mA.

3.5 Hard Ware Implementation

A power supply of 230V, 50Hz is given to the power supply unit. It is given to the step down transformer. The transformer is selected such that its output range is from 10V to 12V. Then it is transformed to the rectifier (we use a bridge rectifier) to get DC supply since microcontroller and GSM modem works on DC supply. The power taken from the rectifier is given to the voltage regulator to avoid voltage drops. The GSM modem needs 12V DC whereas microcontroller needs 5V DC. In GSM modem we insert a SIM card and another SIM is inserted in the user mobile phone such that we can interact. Loads (DC motor and two bulbs used in the kit) are connected to the microcontroller by means of relay module and relay driver. Since microcontroller provides very low current which is insufficient to open or close the relay. So we use relay driver to boast up the power such that relay can operate according the commands given by the micro controller [4]-[5]. In this system we are using an IVR that means before operating the loads we have already recorded the voices in 8 channels of the voice module.

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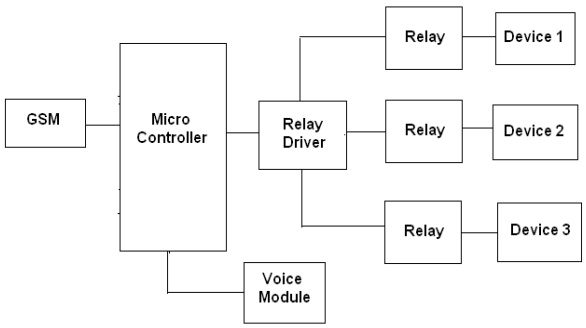


Figure: Block diagram of GSM based IVRS system

So whenever we called the corresponding SIM we can hear the voices then we can operate the required load simply by pressing the corresponding keys in the mobile phone after that the operator can hear either the load is on or off. When we call from the user SIM to the SIM which is inserted in the GSM modem, it gives a set of instructions we have already prerecorded. Then according to it, we press a key such that it transmits that command to the microcontroller and it will process and gives corresponding command to the relay to on or off the load by means of a relay driver. LCD displays the commands which are done by the microcontroller.

3.6 Operation

A 230V AC supply is given to a step down transformer of (12-0-12) V rating. The stepped down voltage is given to a diode bridge rectifier which converts the stepped down voltage into pulsating DC. This voltage will be converted into fixed DC using a capacitor filter. A voltage regulator further modifies the voltage to 5V fixed DC. This 5V is required to operate the microcontroller. In order to operate the GSM modem we are giving a 12v dc. We are using a relay driver in between the micro controller and the relay because the output of the micro controller 5v with too little current delivery and is not possible to operate the relay.
The system uses a GSM modem (SIM900) interfaced to the microcontroller (AT89S52) through a TTL logic. A SIM card will be inserted to the GSM modem. The system uses a GSM modem (SIM900) interfaced to the microcontroller (AT89S52) through a TTL logic.

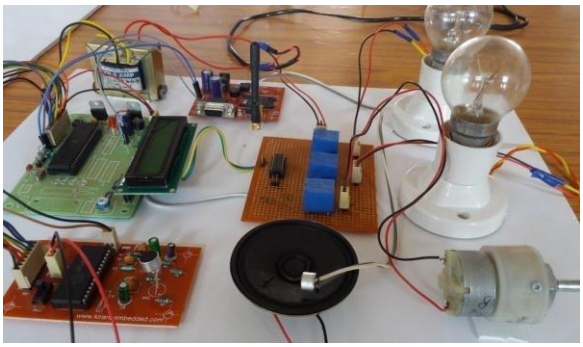


Figure 5: Overall View of Kit

The system uses a GSM modem (SIM900) interfaced to the microcontroller (AT89S52) through a TTL logic. A SIM card will be inserted to the GSM modem. When the GSM modem receives a call from any cell phone, it will communicate that information to the microcontroller through the transmitter and the micro controller receives this signal through the receiver then the microcontroller will process the command and it will drive the relays connected to the loads through the relay driver ULN2003. Loads are turned ON/OFF corresponding to the command sent to the GSM modem.

Table 1: keys allotted for controlling of loads

S. No	Number allotted on dial pad	Task executed
1	Press „1"	Light 1 will be turned ON
2	Press „2"	Light 2 will be turned ON
3	Press „3"	Motor will be turned ON
4	Press „4"	Light 1 will be turned OFF
5	Press „5"	Light 2 will be turned OFF
6	Press „6"	Motor will be turned OFF
7	Press „7"	All loads ON
8	Press „8"	All loads OFF

In this system we are using an interactive voice response that means before operating the loads we have already recorded the voices in the 8chanenels of the voice module [6]. Whenever we have called the corresponding SIM we can hear the voices then we can operate the required load simply by pressing the corresponding keys in the mobile phone after that the operator can hear either the load is on or off.

4. Results

When operated through a mobile the LCD Display will show the following

1) After switching on the circuit a message will be displayed as "GSM Initializing"

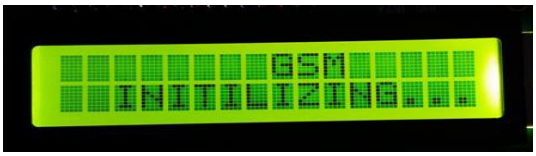


Figure 6: GSM INTIALIZING

2) After three rings of phone call the call gets automatically attended and displays "Call Lifted"

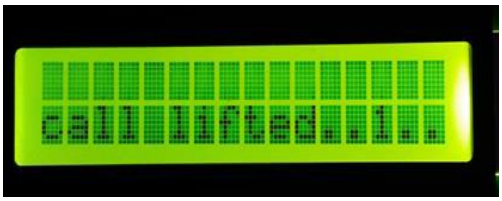


Figure 7: CALL LIFTED

3) After observing the message on the LCD screen press number on the dial pad for which load you want to operate

4) After Pressing 1on dial pad of mobile a message will be displayed on LCD as "Light 1 On"

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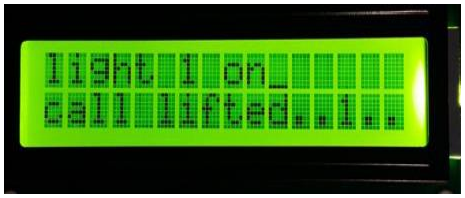


Figure 9: LOAD ON

5) After pressing 3 on dial pad of mobile a message will be displayed as “Motor On”

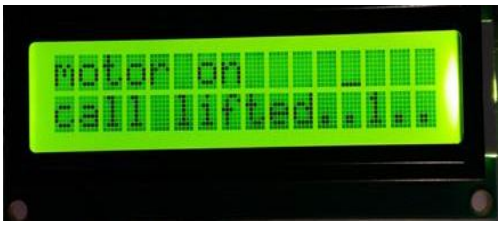


Figure 10: MOTOR ON

6) Press 8 for ALL LOADS OFF:

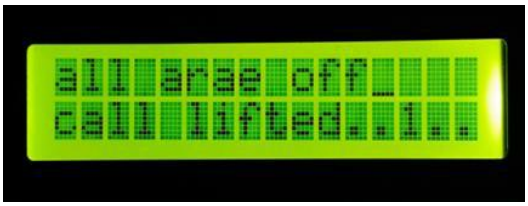


Figure 11: ALL LOADS OFF

Like this all three considered loads will be controlled i.e., turned on and of f by pressing allotted numbers on the dial pad of the mobile which was already programmed and dumped in the micro controller .

5. Conclusion

Finally by using this hardware implementation the loads can be operated through a mobile phone by following the voice commands as shown in the results. According to the proposed system, the load can be operated even if the person is out of home. Hence we can minimize the electricity bill by turning the loads off when not in uses even if the person is not near the home.

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