Raspberry PI based Wireless Load Control and Monitoring Using Interactive Voice Response System

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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 paper, 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 any time as per the requirement aiding convenience. The system permits the user direct devices through his mobile by sending voice commands using IVRS system. It also enables the user to monitor the status of loads with SMS update. A detailed system analysis is carried out and presented in this paper. .

Keywords: **Interactive Voice Response System (IVRS); GSM; Raspberry Pi; Wireless Networks.**

I. INTRODUCTION

Wireless technology has served in the field of automation since a long time. With the advent of technology and introduction of network enabled automation system in every sector, devices can be controlled and managed from remote location. This can be achieved by implementing networks with the support of various wireless technologies such as ZigBee, Bluetooth, DTMF based mobile and UWB etc. There has been a rapid expansion and a potential augmentation of such automated systems since it facilitates the user to organize the appliances and devices as per his convenience.

Such automated systems deals with providing a network in an environment which links computers peripheral equipment, smart chip bearing appliances and sub-systems. With such deployed system, it promises controlling of electric city operated devices cautiously in real time even being physically away from the site. But again these implementations require either radio link communication or wired communication to direct the devices to operate accordingly. Be it wired or radio link communication, each has its own limitations such as complex wire deployment, maintenances, range restrictions, low data rate, high cost, software arrangements etc.

The different systems have been proposed and implemented in area of automation. There have illustrated the DTMF tone generated automation system that suggests a method for controlling electronic systems remotely. An effort has been made to tackle issues related to automation system based on dual-tone multi-frequency remote control method for industrial and domestic applications. The paper proposing another such system is implemented using ZigBee wireless personal area network which facilitates intrusiveness of the respective system installation. Also home automated systems based on Bluetooth technology enabling devices to be controlled using Personal Area Network (PAN) is presented. The network communicate the information to remote users via Internet. All these papers suggesting systems have certain limitations since the nodes deployed can cause network congestion, entire infrastructure has to be laid down from initial stage which is time consuming and is complex in nature.

Hence we have implemented the GSM based IVRS incorporated system which enables user to control and monitor the loads/appliances remotely. The GSM based home automation system is developed and implemented which exploits the well-developed infrastructure of GSM cellular system. Moreover, the user do not require dedicated transceiver as the GSM mobile can be used as commanding device. As a result, no extra device has to be purchased from the user side. The GSM network that relies on radio wave communication conveying information in a real-time process to control devices remotely is the most apt alternative among all the wireless

technologies. The IVRS system enables user to interact with system which eases the control operation. Mobile communication network coverage is bigger than that of Local Area Network (LANs), thus user can take benifit of portable phones to organize the system.

II. SYSTEM METHODOLOGY

The system consists of two main sections namely; the transmitter side Commanding Unit (CU) which is basically a GSM enabled mobile phone and the receiver side Appliance Control Unit (ACU). The system is as depicted in Fig.3.1. The ACU manages devices and loads those need to be monitored and controlled through IVRS voice commands.

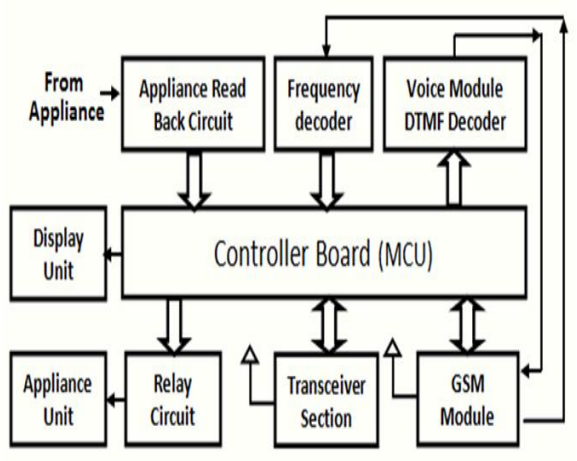


Fig. 1. Block Diagram of the ACU System

The set of commands for turning On and turning Off the appliances and for status check are configured in micro controller and each symbol or combination of two & more symbols of mobile keypad are assigned for particular command. Whenever any appliance has to be controlled; the user calls on GSM Subscriber Identity Module (SIM) number. The IVRS system sends the prerecorded voice messages to user viz. 1.To turn On load1 press *1* 2.To turn Off load1 press #1#. Then user can proceed with an appropriate command using CU which would be received at ACU via GSM. These commands, in particular the Dual Tone Multiple Frequency (DTMF) encoded instructions; directed towards the frequency decoder. These commands are further processed by the MCU and the relay circuitry is controlled accordingly. Ultimately the particular load/appliance is turned on or turned off which action would be notified to user. For the status update, SMS feature of the GSM is exploited in the system. As depicted in block diagram, the system consist of various Units of which IVRS System plays a major role.

III. IMPLEMENTATION OF IVRS SYSTEM

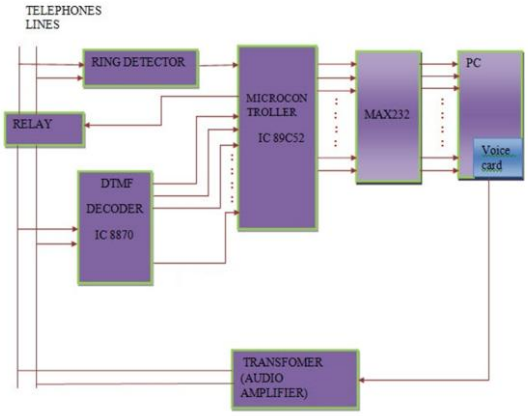


Fig. 2. Block Diagram of IVRS System

The main blocks of the system are as follows:

- Ring Decoder
- DTMF Decoder
- MICROCONTROLLE R
- MAX 232
- Relay
- Isolation Transformer
- Voice Card

Implementation of IVRS section enables the user to take appropriate control action according to the present status of parameters such as fan ON/OFF, Water Tap status, AC coolness etc. Block diagram of IVRS system is as depicted in Fig. 2. It also enables the user PRINCIPLE OF IVRS to interact with the system, so that ambiguity in performing selected tasks is avoided and the process is synchronized.

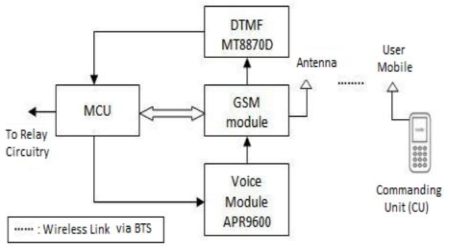


Fig: 3. Implementation of IVRS system

In order to assist the user various messages are prerecorded as well as stored on the Voice IC APR9600 which is the heart of IVRS system. Whenever the legitimated user calls on the SIM card no. which is inserted in GSM, the prerecorded messages are transmitted to user via GSM Network radio link. In our system MOD8 is selected which provides capacity to record 8 messages which are as follows:

- Immediately after call: Enter your password.
- If password is wrong: Password wrong, try again.
- For inappropriate user input: Command error, try again.
- If password is right: Select the room to control its appliance.
- After selection of the room select the appliance to control.
- If device is Off: Press 1 to switch On the device.
- If device is On: Press 2 to switch Off the device.

Interfacing diagram of Voice Module APR9600 with main PCB. Circuit is designed to provide various functions such as:

- Mode selection viz. MOD8, MOD4, MOD2 accordingly 8, 4, 2 messages can be recorded.
- MIC interfacing for audio input.
- Voice quality control, determined by sampling rate which can be varied from 4 to 8 KHz and it depends on pot PR1.
- SW1 to select Read or Write mode.
- SW2 to select the chip.
- SW3 to enable the message recording.
- 8 messages can be recorded by closing SW3 and connecting jumper from M1 to M8 pin respectively.

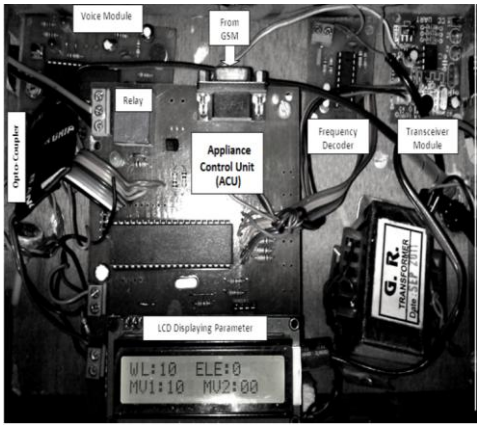
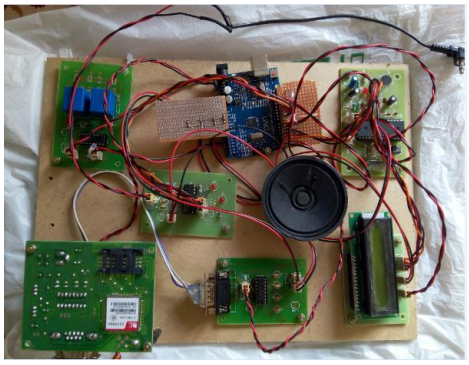


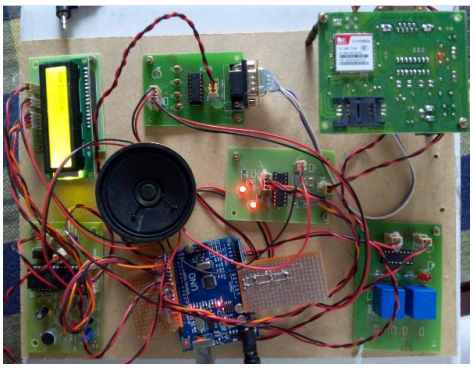
Fig: .4. Interfacing diagram of Voice Module with main PCB

IV. SIMULATION RESULTS

Step 1: Connect all the modules such as GSM Module, Transceiver modules, Frequency Decoder, IVR System to the main Appliance Control Unit.



Step 2: Give the power supply by connecting adapter.



Step3: Press RESET button, it will start execution by giving instructions as send message for registering your mobile number. After registering my mobile number it will show the output as LIGHT ON on the LED and also we get Voice response from IVR System.

V. CONCLUSION

The system elaborately described in the above sections makes efficient use of the latest technology to aid users in order to control the operation of the desired appliance or load in real time from remote location. It can be contemplated as an incredible solution to the woes faced by the occupants of the house who are not physically present at the location but can control the devices providing a real-time automation. The paper provides the designing and implementation of GSM based real time automation

system. It also elaborates the Interactive Voice Response System (IVRS) designing integrated with Voice IC circuitry which is the unique feature of the implemented system. Furthermore, the latency involved in the execution of the operation is estimated and the detail analysis is demonstrated. Hence an IVRS based system facilitates user to interact with the system and it enables the user to control the loads remotely.

VI. REFERENCES

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