

INTRODUCTION

IVRS is an important development in the field of interactive communication which makes use of the most modern technology available today. IVRS is a unique blend of both the communication field and the software field, incorporating the best features of both these streams of technology. IVRS is an electronic device through which information is available related to any topic about a particular organization with the help of telephone lines anywhere in the world.

IVRS provides a friendly and faster self service alternative to speaking with customer service agents. It finds a large scale use in enquiry systems of railways, banks, universities, tourism, industry etc. It is the easiest and most flexible mode of interactive communication because pressing a few numbers on the telephone set provides the user with a wide range of information on the topic desired. IVRS reduces the cost of servicing customers.

IVRS BLOCK DIAGRAM

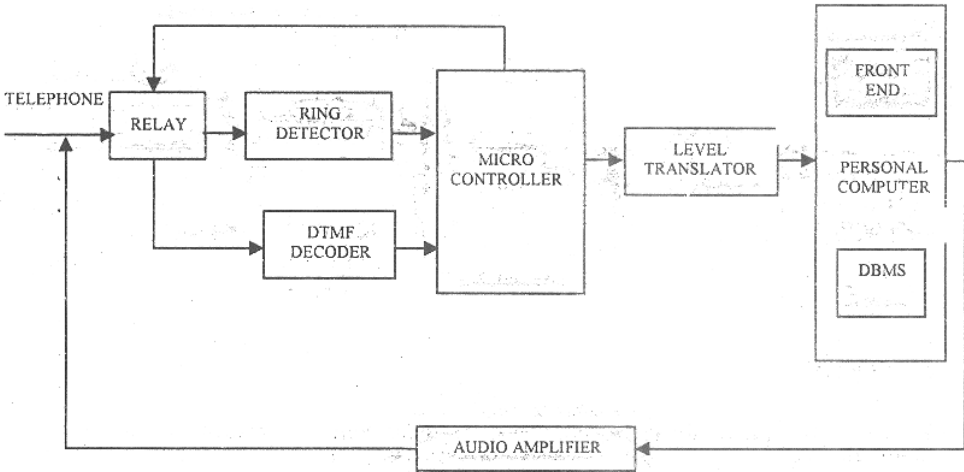


Figure 1

IVRS- INTERACTIVE VOICE RESPONSE SYSTEM

The IVRS on the whole consists of the user telephone, the telephone connection between the user and the IVRS and the personal computer which stores the data base. The interactive voice response system consists of the following parts.

HARDWARE SECTION

1. Relay: For switching between the ring detector and the DTMF decoder.
2. Ring detector: To detect the presence of incoming calls.
3. DTMF decoder: To convert the DTMF tones to 4 bit BCD codes.
4. Micro controller: To accept the BCD calls, process them and transmit them serially to the PC.
5. Level Translator: To provide the interface between PC and micro controller.
6. Personal Computer: To store the data base and to carry out the text to speech conversion.
7. Audio Amplifier: To provide audio amplification to standard output and to act as a buffer between the telephone line and sound card.

SOFTWARE SELECTION

1. Visual Basics 6.0
2. Oracle 8.0
3. Microsoft Agent

OPERATIONS OF IVRS

The user dials the phone number connected to the IVRS. The call is taken over by the IVRS after a delay of 12 seconds during which the call can be attended by the operator. After 12 seconds if the ring detector output is low, it is ensured that the phone has not been picked up by the operator. The microcontroller then switches the relay to the DTMF and sends a signal via RS 232 to the pc to run the wave file welcoming the user to the IVRS. The user is also informed of the various codes present in the system, which the user dial in order to access the necessary information.

Thirty seconds are given to the user to press the codes, failure of which results in switch back of the relay. The DTMF decoder converts the codes pressed by the user to BCD. It is then pressed to the input pins of the microcontroller and is stored in the microcontroller memory. After these codes have been received, they are transmitted serially to the serial port of the PC via max232 IC. Any hardware failure in transmission falls in the lightning of a LED and the relay is switched back.

The serial port of the PC is continually polled by the software used such as Visual Basics and Microsoft Agent program and the received code words are put in the text box from the input buffer. The received personal identification number (PIN) is compared with the stored data base to determine the result. The corresponding wave file is played by the sound blaster card. It is coupled to the telephone line through the Audio Amplifier, which is connected between the sound blaster and the telephone line to amplify the blaster output, drive the telephone line acts as the buffer for sound blaster.

DIFFERENT PARTS OF IVRS

a) MICRO CONTROLLER

THE ROLE OF MICRO CONTROLLER

The 8751 is the heart of the IVRS system. It controls the operation of various parts of the IVRS system. When a telephone call is detected by the ring detector, the micro controller switches the relay to the DTMF and sends a signal to the PC via RS 232 to run the wave file welcoming the user to the IVRS. The number given by the user is decoded by the DTMF IC and is stored in the memory of the microcontroller. The code stored in the microcontroller is send to the serial port. If any hardware failure occurs, it is the microcontroller which is taking necessary measures. The IVRS system makes use of a stand by computer so as to working 24hrs a day for customer satisfaction. In these cases the microcontroller switches from the first computer to the second.

THE BASIC FEATURES

A microcontroller is meant to read data, perform limited calculations on the data and control its environment based on those calculations. The microcontroller consists of an 8-bit CPU in addition to RAM of 128 bytes, ROM, parallel I/O, serial I/O, counters, clock circuits etc, the EEPROM has a memory of 0 to 4kb. There are four register banks with 8 registers each. The control registers used are TCON, TMOD, SCON, PCON, IP and IE. The program counter is 16 bit while the status word and stack pointer is 8 bit. The 8751 has 4 parallel I/O ports. Hence the dual ports of these may be used as general I/O digital lines. A system clock generator using an external crystal and two external capacitors

provide the required clock for the microcontroller. There are 5 INTERRUPT sources used by 8751 and each can be listed under any of the priority levels. The 5 interrupts are listed below.

Source	Description
INTO	Internal Request from P3.2 pin
Timer O	Overflow interrupts from timer O activated by flag TFO.
INT I	External request from P3.3pin
Timer I	Overflow interrupts from timer I
Serial Prot	Completion of transmission and reception of one serial frame activates TI and RI

b) RING DETECTOR

The ring detector is connected directly to the telephone line through the relay which is controlled by microcontroller (8751). The function of the ring detector is to detect if the telephone is ringing or not.

The ring detector consists of op-amp LM 311 which acts as a comparator to convert 98 V (rms, 130 V_{pp}) ring signal to -5V (low level) step signal for the microcontroller's INTO pin. The output of the comparator goes high when the operator picks up the telephone provided along with the IVRS. The presence of the ring detector output for 5 sec enables the micro controller to switch the relay to the dual tone multi frequency (DTMF 8870). The capacitor C1 blocks incoming DC and resistors R_A and R_B are the voltage dividers to reduce the incoming voltage of 13V_{pp} to 15V. Diode D passes only the positive

half of the sine wave during which C_2 gets charged to maximum value and acts as the DC value for the input signal which triggers the comparator. This charge does not get discharged easily due to high resistance R_3 , R_4 and R_5 are used as voltage dividers to provide reference voltage of 2.5V to pin 2 of LM 311.

RING DETECTOR

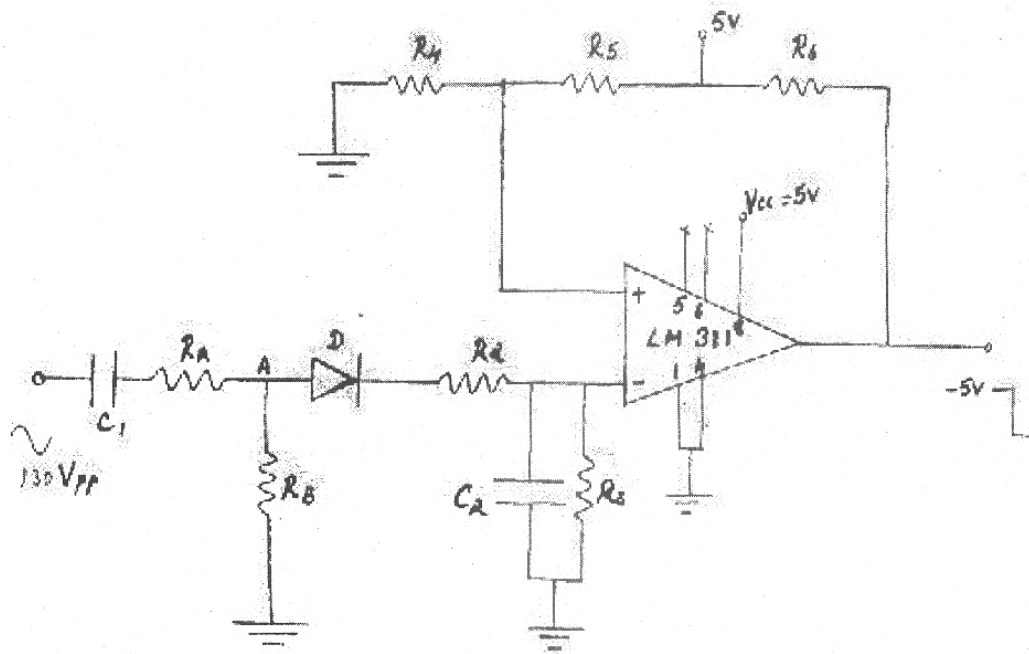


Figure 2

c) DTMF DECODER 8870

The DTMF (Dual Tone Multi Frequency) decoder is a specific IC which performs the function of converting the DTMF frequency tones into BCD codes. These BCD codes are fed to the microcontroller to process the data and take necessary action. DTMF decoder 8870 IC has an external crystal oscillator to generate the clock signal, the pins to detect the presence of DTMF tone at its inputs and pins to transmit the BCD codes to the microcontroller,

The input signal from the telephone line is fed to the IN-pin of the DTMF after blocking all the DC in the line. These frequencies are compared with the Vref at the IN+ pin. This comparator pin output is then filtered and fed to the digital detection algorithm within the IC. It then passes to the code converter where it is converted into 4 BCD codes. The resistors R1 and R2 determine the gain of the differential amplifier incorporated in the IC.

DTMF DECODER (8870)

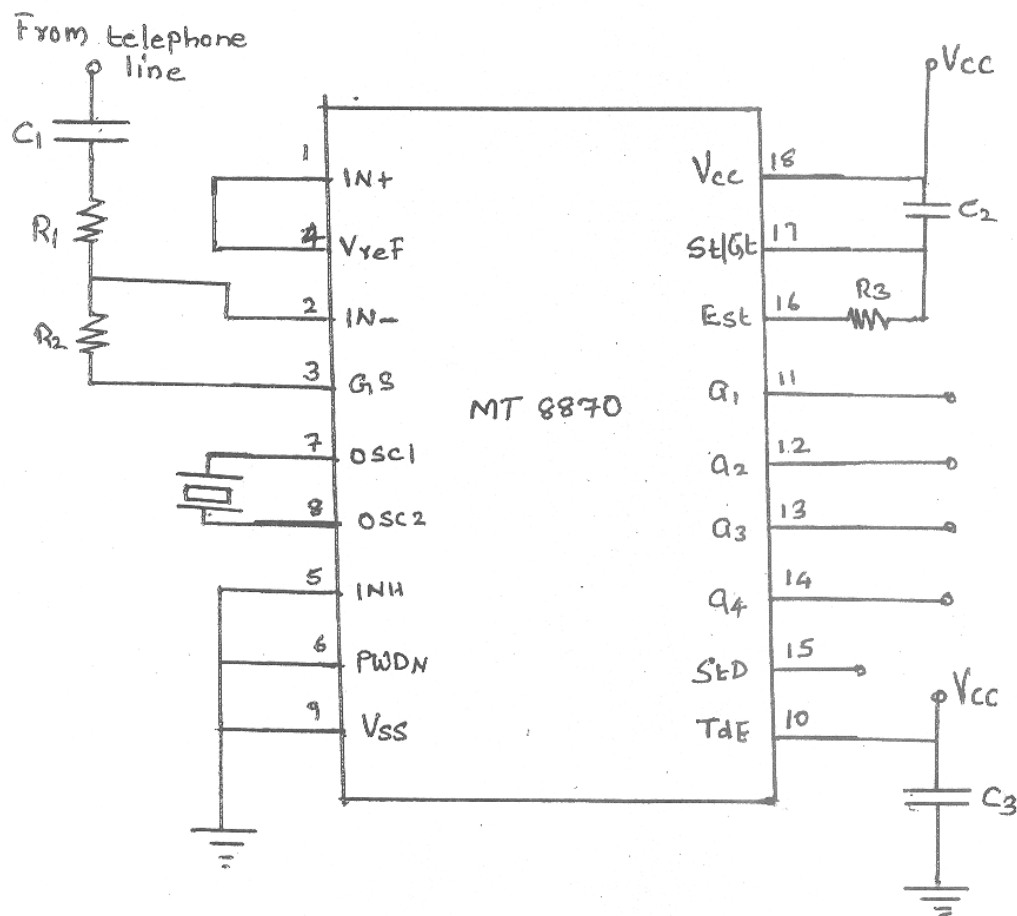


Figure 3

d) AUDIO AMPLIFIER

The audio amplifier, TDA 2006 can amplify the output of the PC's sound card 12W thereby making the PC output audible on the telephone line. In addition the audio amplifier acts as a buffer between the telephone line and the sound card thereby protecting the sound card from the high voltage present on the telephone line.

Audio Amplifier

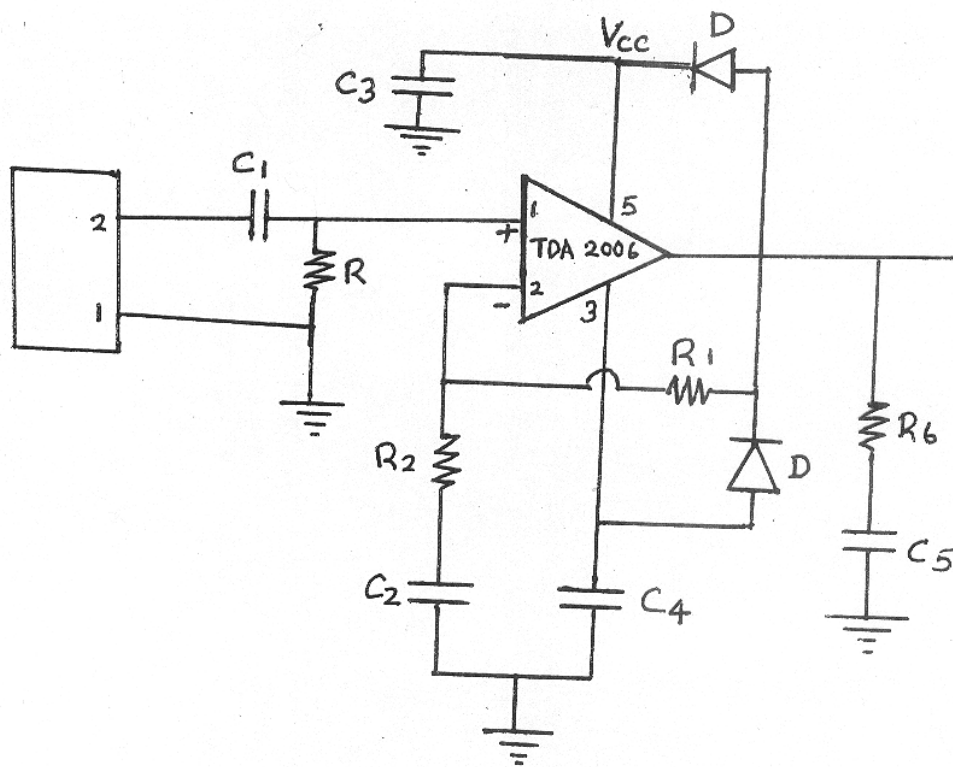


Figure 4

e) **RELAY**

The relay switch is used in IVRS to switch between the ring detector circuits and the DTMF decoder circuit. The relay connects the telephone to the ring detector when the call is not processed by the microcontroller. On receiving a high signal from the microcontroller, the relay switches to the DTMF. Transistor BC 548 is used to drive the relay by providing the required current.

Relay Switching

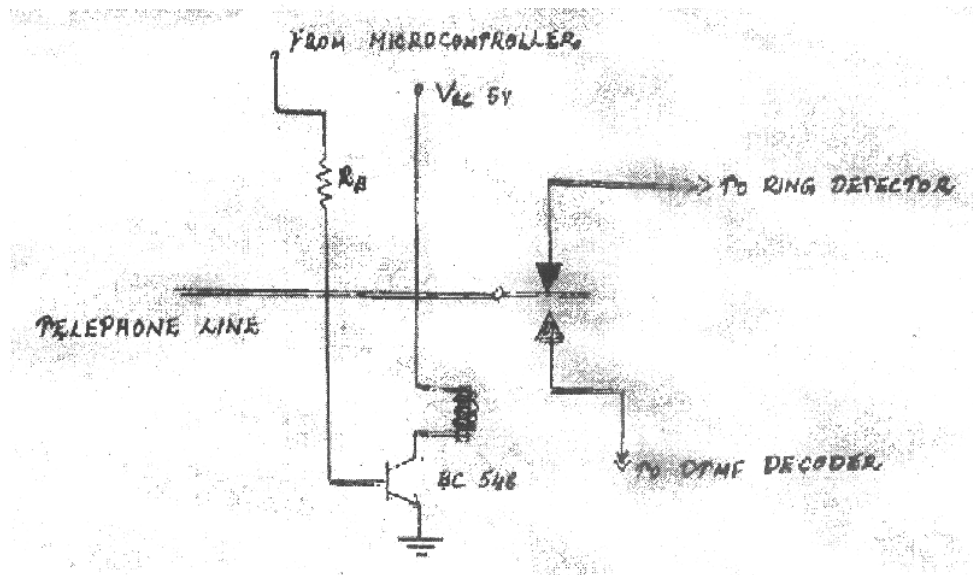


Figure 5

f) **SERIAL COMMUNICATION INTERFACE**

The main purpose of the RS 232 IC is to act as a serial interface between the microcontroller and the PC. It provides the voltage compatibility between the

TxD and RxD pins of the microcontroller and the serial port of the PC. The voltage level of the TxD and RxD pins of the serial port of the PC are 12V. The RS 232 IC therefore provides compatibility required to interface the computer and the microcontroller.

g) PERSONAL COMPUTER

The PC is a very important ingredient of the interactive voice response system. The codes pressed by the user are serially transmitted by the microcontroller to the PC via RS 232. A visual basic program controls MSCOMM and MMCONTROL, continuously polling the serial port for any input, when the microcontroller receives the first input signal the visual basics program runs the welcome wave file. It then waits for the codes which are transferred to the text boxes from the input buffer. This wave file is played by the visual basics program as the output from the sound card of the PC and is suitably amplified and is heard on the telephone.

SOFTWARE SUPPORT

VISUAL BASIC is an ideal programming language for developing sophisticated professional applications. The use of graphical user interface (GUI) enables user to interact with an application. Visual basic enables us to develop application that:

- Create read and write to text, database and binary files.
- Access database in format such as SQL, ORACLE, MS Access etc.
- Communicate with the application through the clip board dynamic data exchange, object linking and embedding.
- Use serial communication ports to communicate with modem and other devices.

The information needed by the user is stored in a database. Visual basic acts as user interface to access the information required by the client.

ORACLE is a programming language in which the required information is stored in a data base which is a collection of inter-related data. This inter-related data and set of programs is essentially a database management system. DBMS organizes and maintains the information.

MICROSOFT AGENT is a set of programmable software services that supports the presentation of interactive animated characters within the windows interface. MS agent enables software developers to incorporate a new form of user interaction known as conversation interface. In addition to the keyboard and mouse input, MS agent includes supports for speech recognition so that so application can respond to voice commands.

RECENT DEVELOPMENTS

SPEECH ENABLED-IVRS

Today IVRS applications allow self service to automated bank, account information, airline schedules and movie times. Automated speech recognition enhances the flexibility and power of IVRS applications. Today IVRS system can be made more attractive by replacing the touch tone interfaces with speech enabled applications. Some applications recognize a very limited set of spoken letters and numbers that primarily represents the touch key pad. Most advanced application can enable recognition of more complex phrases and sentences spoken in conversational manner at a natural speed. With this speech enabled IVRS systems, the caller can obtain information and perform transactions by natural speaking.

The addition of speech recognition capabilities provides opportunities for incremental revenues, increases the variety of automated service delivered over the telephone and increases the demand for telephony equipment just as interactive touch-tone applications fuelled the development of new businesses; speech recognition is creating new opportunities for imaginative entrepreneurs.

COMMERCIAL APPLICATIONS OF IVRS

Business are currently using speech enabled IVRS in the following ways,

- Package tracking
- Stock quotes and trading
- Insurance claming
- Travel booking
- Pharmacy prescription refills
- Restaurant reservation information
- Banking transactions
- Social services administrations
- Delivery by government agencies

ADVANTAGES OF IVRS SYSTEM

- The addition of speech recognition capabilities help IVRS owners derive more benefit from their investment in existing IVRS resource.
- Motivating organizations to embrace speech solutions is the potential for dramatic reductions in operational cost.
- Increased automation frees the customer service agents from any routine administrative tasks and reduces cost related to customer service staffing. That is fewer agents are able to serve more customers.
- Resources that have been developed to support an internet presence can support an IVRS as well. Thus organizations can use some of the same data modules bid for speech enabled IVRS application for their intranets. This could deliver a high degree of code reuse.

DISADVANTAGES

- Defects of the Public Switched Telephone Network (PSTN) is applicable to IVRS also.
- Visual basic, the software used is platform dependent.
- In its present condition IVRS cannot be used in internet applications.
- The security measures adopted are also not up to the mark.

CONCLUSION

Interactive Voice Response System has been the latest technology, each provides the foundation for providing convenient new IVRS services for customers as well as reduced operational costs, improved customer satisfaction and retention, increased return on investment and a stronger market presence for the IVRS services provider. A speech interface gives caller more flexible navigation outputs that are less complex and more rigidly hierarchical touch tone menu options.

IVRS can be used in organizations to know about various departments, mode of working and levels of control. Hardware circuitry of IVRS is very compact and it can be used as a card in computer. By the wide spread of internet it is possible to know information from anywhere in the world with the advanced features of Interactive Voice Response System.

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ABSTRACT

Interactive Voice Response System (IVRS) is one of the most important breaks through in the field of telecommunication. IVRS provide a voice response to the customers and guide them to the information they require. The customers can call up any institute such as banks, universities, tourism industry and obtain any information by simply pressing certain button on his telephone as per the guidance of the voice fed into the computer.

IVRS is an electronic device through which information is available related to any topic. IVRS is usually employed to know more about the organizations and can be modified to respond to voice of the customer for better response customer satisfaction. IVRS can be employed in customer services there by improving its flexibility and efficiency.

CONTENTS

1. INTRODUCTION
2. INTERACTIVE VOICE RESPONSE SYSTEM
3. DIFFERENT PARTS OF IVRS
4. RECENT DEVELOPMENTS
5. COMMERCIAL APPLICATIONS OF IVRS
6. ADVANTAGES OF IVRS
7. DISADVANTAGES OF IVRS
8. CONCLUSION
9. BIBLIOGRAPHY