



Microcontroller Based IVR System for Result Declaration

Mohammed Nazim Shaikh¹, Aadesh Chauhan², Shubham Tiwari³, Sujit Poojary⁴, Prof. K.N. Attarde⁵

¹Student, EXTC, Theem College of Engineering

²Student, EXTC, Theem College of Engineering

³Student, EXTC, Theem College of Engineering

⁴Student, EXTC, Theem College of Engineering

⁵Asst. Prof & HOD, EXTC, Theem College of Engineering

Abstract – The IVRS i.e. Interactive Voice Response System uses a computer generated message in response to the input given by the caller, this message is pre-recorded and stored in the system. It is a phone technology that allows the computer to detect voice and touch tones using a normal phone call on a normal phone number. The backbone of the whole system is formed by the microcontroller in addition to some other essential key components. Dual Tone Multi Frequency i.e. DTMF is used for acquiring input from the user by simply pressing number pads easily available on the phone. Simply dial a number from your phone, follow the instructions and there you are with the results.

Keywords – DTMF (Dual tone multi frequency); Ring detector; RS-232; Visual Basic.

I. INTRODUCTION

We have already got a brilliant system i.e. IVRS in our hands, taking advantage of the same and using some techniques we have developed a system wherein just a phone call will be able to process the whole phenomenon of the result declaration. The user simply dials a specified number from the number pad of his/her phone, follows a predefined set of instructions and then he/she gets the result. The pressed number is displayed on the LCD used in the system appears across the line and is sensed by the Ring Detector. After a several number of phone rings the line is connected to DTMF decoder, this decoder decodes the number pressed the output is then passed via MAX232 module and given to the microcontroller and by here the brain of has taken control over. Through the voice card the output voice is passed here, the digitized serial data is converted to analog voice.

1.1. Sequence followed in the IVRS service

- Caller dials the IVRS service number associated on the system end.
- The computer waits for a specified number of ringing tones if the system uses a telephone set at the end of which, the connection is established.
- The connection is established by lifting the handset of telephone base from ONHOOK condition and if a mobile equipment is used, auto receive function is activated.
- Now, a pre-recorded voice greets the caller conforming that the number dialed corresponding to the particular service.
- Next, the menu is presented to the caller again in the voice form generated by text to speech function used in visual basics coding, giving him the various options to choose from.
- If the information to be relayed back is confidential, then the system may even ask the dialer, to feed in a password number.
- The database is accordingly referenced by the data received by the user and the necessary information is delivered to the user.
- Next, the same speech information of the main menu is put across to the user in voice.
- The caller generally gets the option by the system to :
 - a. Repeat whatever information was voiced to him/her.
 - b. Repeat the choices delivered in the main menu.
 - c. Break or terminate the call by **restarting** ON-HOOK condition.

Figure.1. describes the block diagram of IVR system. The 8752 is the heart of the IVR system. It controls the operation of various modules of the IVR system. When a telephone call is detected by the ring detector or the call is auto received, the micro controller switches the relay to the DTMF and sends a signal to the PC via RS 232 module to run the wave file welcoming the user to the IVRS. The number given by the user is decoded by the DTMF module i.e. MT8870 and is given to the microcontroller so that it is stored in the memory. 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 24 hours a day for customer satisfaction and system efficiency. In these cases the microcontroller switches from the first computer to the second.

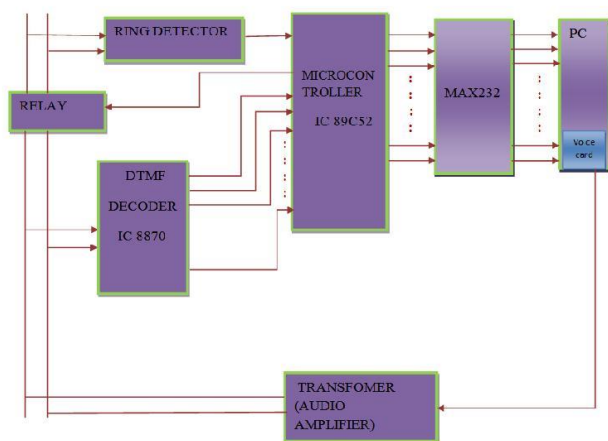


Figure 1. Block Diagram of IVR System.

1.2. Explaining the line

1.2.1. The Ring Detector

It is connected directly to the telephone line through the relay which is controlled by microcontroller (8752). The principle 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 Vpp) ring signal to $-5V$ (low level) step signal for the microcontroller's INTO pin. The comparator output goes high if the operator picks up the telephone provided to the IVR system end. 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 MT8870). The capacitor C1 blocks incoming DC and resistors RA along with RB are the voltage dividers to reduce the incoming voltage of 13VPP to 15V. Diode D bypasses only the positive half of the sine wave during which C2 gets charged to maximum value and acts as the DC value for the input signal which actuates the comparator. This charge does not get discharged because, the high resistance R3, R4 and R5 are used as voltage dividers to provide reference voltage of 2.5V to pin 2 of LM 311 respectively.

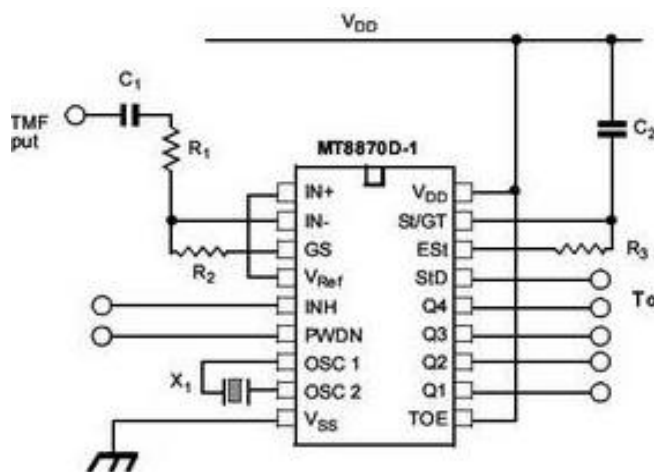


Figure 2. DTMF Decoder (MT8870) Module

The DTMF (Dual Tone Multi Frequency) decoder is shown in fig.2 along with its necessary components. It is a specific IC which helps in converting the DTMF frequency tones into equivalent BCD codes. These BCD codes are then taken by the microcontroller to process the data and perform necessary action. DTMF decoder 8870 module 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 micro controller. The input signal of the telephone line is given to the IN-pin of the DTMF after blocking all the DC in the line. These frequencies is then compared with the V_{ref} at the IN+ pin. This comparator pin output is then filtered and provided to the digital detection algorithm within the IC. It then passes to the code converter module where it is converted into 4 equivalent BCD codes. The resistors R1 along with R2 determines the gain of the differential amplifier incorporated in the DTMF module MT8870.

1.2.2. RS – 232

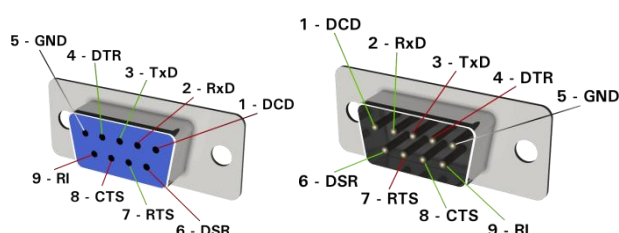


Figure 3. RS 232 Connector.

RS- 232 connector is given in the figure.3. In telecommunications, RS-232 is a standard component for serial communication transmission of data. It formally defines the signals connecting between a DTE (data terminal equipment) such as a computer terminal holding the data, and a DCE (data circuit-terminating equipment, originally defined as data communication equipment[1]), such as a modem/hardware equipment. The RS-232 standard is commonly used nowadays in computer serial ports. This standard defines the electrical characteristics and also the timing of signals, the meaning of signals, and the physical size and pin out of connectors. The currently used version of the standard is TIA-232-F Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data interchange, is issued in 1997.

1.2.3. Visual Basic

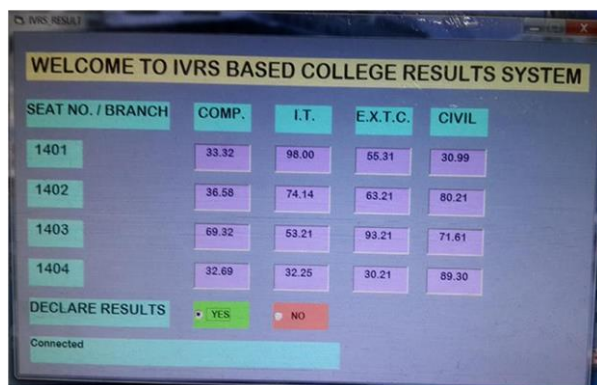


Figure 4. Visual Basic User Interface screenshot.

Like the basic programming language, Visual Basic was designed to accommodate beginner programmers. Programmers can create both simple and complex GUI applications. Programming in VB is a combination of visually arranging components or controls on a form, specifying attributes and actions for those components, and writing additional lines of code for more functionality. Since VB defines default attributes and actions for the components, a programmer can develop a simple program without writing much code. Programs built with earlier versions suffered performance problems, but faster computers and native code compilation has made this less of an issue. Though VB programs can be compiled into native code executable from version 5 on they still require the presence of around 1 MB of runtime libraries. Runtime libraries are included by default in Windows 2000 and later. Earlier versions of Windows (95/98/NT), require that the runtime libraries be distributed with the executable.

II. RESULT DECLARATION

2.1. Actual flow graph of the result declaration.

- When the telephone is in the idle condition i.e. no call is initiated, the voltage will be -48V.
- When the ringing occurs as the user tries to call the IVR system number, it will be 125V peak to peak AC signal superimposed on - 48V.
- The OPTO isolator helps to isolate the microcontroller from high voltage AC signals as it consists of Ga As infrared emitting diode optically coupled to a monolithic silicon phototransistor which cannot resist high AC voltage. The microcontroller will detect the ringing of the call through the port 1.5 and will count the number of rings at the same time.
- After a fixed number of rings from the users end, the microcontroller will send a signal to the relay and then the automatic off-hooking of the telephone system takes place. At the same time, microcontroller will transmit '#' to the computer which is an indication to the visual basics coding to play the 'Welcome' message.
- The relay used is DPDT (dual pole dual throw) type and after automatic off-hooking takes place, the relay initiates the connection of the telephone lines to the decoder IC 8870 and also the isolation transformer.
- The transformer used is a line transformer as it helps in isolating the voice card from high voltages.
- As soon as the telephone lines are connected to the voice card, the caller gets to hear the stored welcome messages and asks the caller to enter the roll number followed by the branch of the student whose result is to be known. After the caller dials the roll number from the touch tone keypad of his telephone, that number will be decoded by the decoder IC 8870 and the decoded data i.e. the equivalent BCD code will be sent to the computer via the microcontroller interface with the RS 232 module.
- Computer while receiving the decoded information will simultaneously check the database in the software to access the result of the student whose roll number is entered by the user end.
- Then the computer will send the user desired information to the voice card of its own system and the caller will get to hear the result of the student on his/her telephone through the voice card placed near the microphone of the telephone set or the mobile equipment.

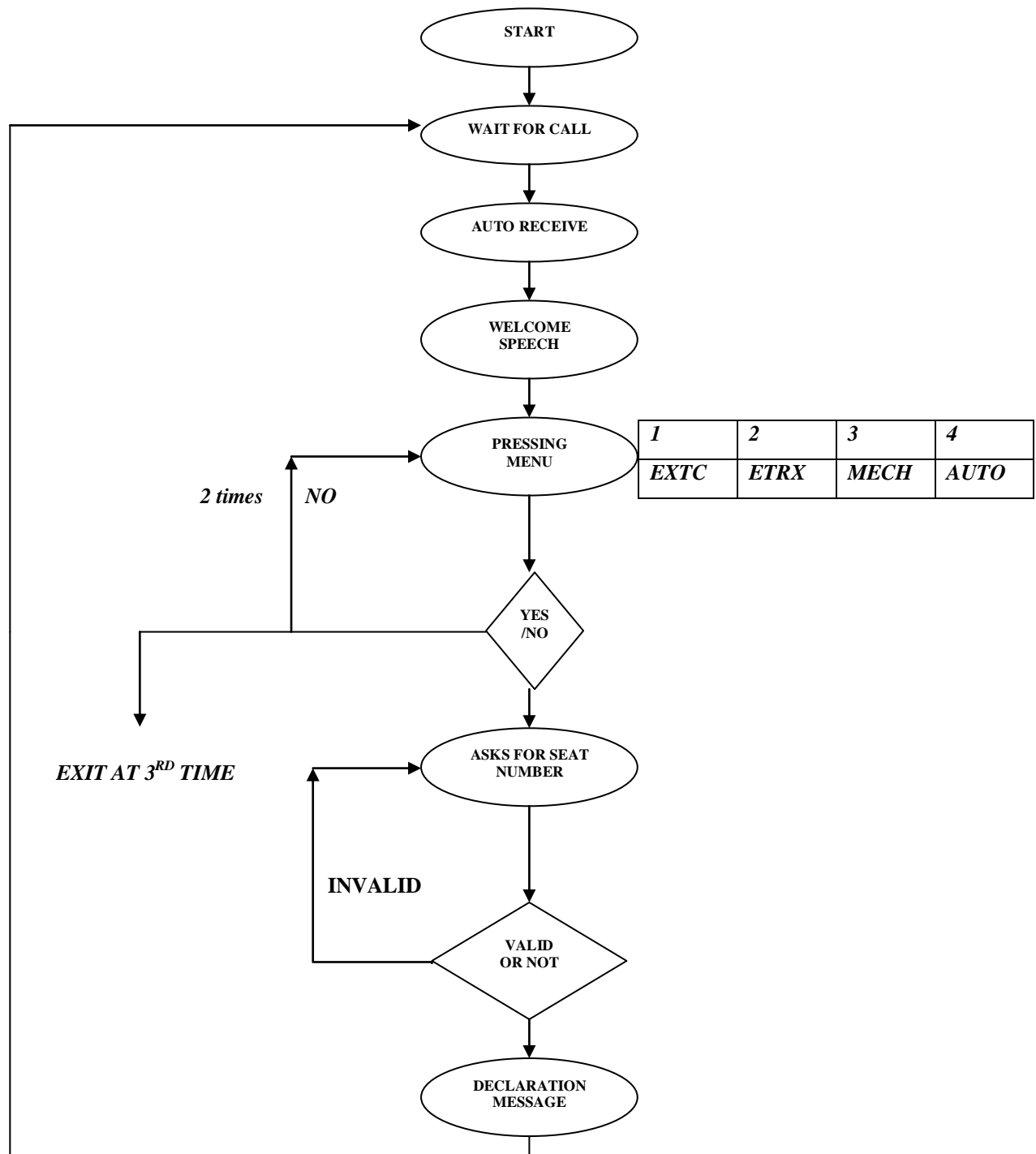


Figure 4. Flow Graph.

III. CONCLUSION

IVRS is known to be the most convenient and efficient telephonic technology as it helps in reducing the human workloads. It is much user-friendly and less tedious. Talking about hardware, it is pretty much compact. The system which we have made is so compact that we can take it anywhere connect with a laptop (it should've drivers installed) and we can demonstrate it anywhere. It can also be used in the organizations to know the ins and outs of various divisions and departments. An advanced system that can be used now and in the coming future with slight technical changes (if required). More cost efficiency, more customer satisfaction, an advanced system that can be used now and in the coming future with slight technical changes.

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