

Build The UNIVERSAL AUDIO ANNUNCIATOR

Occasionally, a project comes along that sparks the imagination with a myriad of practical uses. This article will detail such a system. Based on a Microchip Technology PIC 16C54 Microcontroller and an Information Storage Devices ISD-1000A Digital Recording Chip (which is available at Radio Shack), this unit will allow you to digitally record and play 4 different messages of 5 seconds duration each. An interval timer will repeat all active alarms every 30 seconds. Any change of input status (new alarm or alarm reset) will immediately reannounce all active alarms. Sound interesting? Lets get started and see how it works.

CIRCUIT DESCRIPTION

The circuit is shown schematically in Figure 1. The 16C54 microcontroller is clocked by a 4 Mhz. ceramic resonator. Since instruction cycles are determined by $F_{osc}/4$, the PIC executes instructions in only 1 microsecond! The PIC takes care of all address decoding, control logic, and timing functions. The ISD-1000A digital recording chip is similar in operation to a tape recorder. By addressing the chip at different memory locations, you are able to position a message anywhere in the 20 second message block.

For example, if address lines A0-A6 were all low (Logic 0), the message would start at 0 seconds on the message block. The actual decoding for this project is as follows:

- | | |
|---------|---|
| Alarm 1 | A0-A2=low;A3-A6=low (message pointer @ 0 seconds) |
| Alarm 2 | A0-A2=low;A3&A5=low;A4&A6=high (message pointer @ 5 seconds) |
| Alarm 3 | A0-A2=low;A3&A5=high;A4&A6=low (message pointer @ 10 seconds) |
| Alarm 4 | A0-A2=low;A3-A6=high (message pointer @ 15 seconds) |

Since the address decoding can be accomplished using just address lines A3-A6, address lines A0-A2 are tied to ground. As you can see in the schematic diagram, address lines A3-A6 are tied to RB7-RB4 respectively. Thats all there is to the address decoding scheme.

In addition to address decoding, the PIC must also control the ISD-1000A. Looking at the schematic, we can see that RB3 is connected to pins 23 & 24 (Chip Enable & Power Down respectively). Lets take a look at this for a moment. The ISD-1000A data sheet states that two conditions must be met in order to use this chip properly. The first requirement is that the address lines need a minimum of 300 nsec. settling time to recognize the logic levels in order to set the message pointer. Therefore, a short time delay must occur between address selection and Chip Enable.

A second requirement relates to the Power Down pin. This pin must be toggled high any time that the message records or plays to the end of memory. Since Alarm 4 does exactly that, toggling this pin for each alarm resets the message pointer. Since Chip Enable is active low and Power Down is active high, connecting these two pins together will automatically reset the message pointer and power down the ISD-1000A after the chip is selected to record or play a message.

At the start of the program, the input register (Port A) is copied to an image table. During the 30 second interval, the program compares the input register to the image table every 50 msec. Any difference between these two registers will cause the program to immediately rescan the input register. This is why the program will repeat all active alarms including any new alarms that may have come in. The system output of 50 mw. is fed to an audio transformer with level control to drive an external amplifier, PA system, radio transmitter, etc.

SYSTEM OPERATION

The logic in the microcontroller was programmed in Parallax assembly language. Parallax is the premier outfit when it comes to PIC devices. I'm convinced that their simulator, which shows all the registers in the PIC, allowed me to find mistakes in the program that I never would have found otherwise!

The system has two modes of operation, namely, record and play. A Red LED is located on the right hand side of the ISD-1000A. Just below the LED is a 2 post header. Placing a jumper across the header will cause the LED to light. This places the system in the Record Mode. All you have to do is plug a microphone, or other audio source, into the phone jack and close the alarm contact for whichever channel you are setting up. You will have 5 seconds to record your message. A second, third, or fourth alarm may be recorded similarly. After all alarms have been recorded, clear all alarm inputs and remove the jumper. The Red LED will extinguish and you will be in Play Mode. Activating an alarm will play the message previously recorded. That's all there is to system operation!

Inputs will accept either a dry contact closure or 5 VDC referenced to system ground. The system draws a mere 4 ma. in standby mode, making it ideal for battery operated equipment. Operating temperature range is 0-70 degrees Celsius, making it well suited for harsh environments.

CONSTRUCTION

I originally built my prototype on a Radio Shack perfboard. IC's were mounted on sockets and the interconnecting wiring was done with 30 gauge insulated wire. This will work just fine but a word of caution is in order. First of all, keep all analog and digital lines separate. Second, keep all leads as short as possible. Also, as noted in the ISD-1000A data sheet, use heavy conductors (# 16 AWG wire) and separate wires for analog and digital power & grounds. Bring all grounded conductors to a single point at the GND terminal of the 7805 voltage regulator. Otherwise, you get into all kinds of problems like noise and ground loops! Obviously, etching your own PCB is the best idea yet!

For those of you inexperienced in PCB fabrication, please read "Expert PCB Prototyping" by Scott Edwards (August 1995, Nuts & Volts). This article outlines a good inexpensive way to make your own board. Scott mentioned an excellent system by DynaArt Designs in Lancaster, CA. Since I only live 90 miles away, I drove over there to check out the products personally. I was so impressed that I bought a whole system. Anyway, if you want to go El Cheapo, you can get some Toner Transfer Paper from them, put it in a good quality copy machine, copy the pattern and use your iron to transfer the toner to a PCB. If you don't have access to a good copier, try an office supply store. They've got the high quality machines necessary for a good transfer. Radio Shack sells a PC Board kit (#276-1576) including etchant for \$ 10.99. So there's no excuse for not doing it right!

APPLICATIONS

My first application for this system was in a Cogeneration Plant. Originally, I programmed the PLC (Programable Logic Controller), which runs the plant, with the code to control the ISD-1000A. Later on, I decided to write the code for the PIC. For those unfamiliar with cogeneration, natural gas is burned in a turbine (jet engine) which is coupled to an AC generator, thus producing electricity. The heat generated by the combustion is used with supplemental heat to produce steam. This steam is injected into the ground to heat oil formations and increase production. This plant is fully automated and is unmanned 16 hours a day. Thus, any major problem needed to be announced immediately.

This was done initially thru a PA system. However, this unit lends itself very well to adaptation by using the control line (remember RB3 ?) to also control a relay. Radio Shack sells a small reed relay (#275-232) for \$ 1.89. The relay only draws 20 ma. and pin RB3 will sink 25 ma. safely so you can install this between RB3 and + 5 VDC at the voltage regulator output. Be sure to wire a diode across the coil with the cathode (bar end) of the diode going to the regulator. This will allow remote locations with radio transmitters to announce important alarms over the air! You could also use the relay to operate an autodialer and send alarms over the phone lines to an office, or better yet, a talking pager! Great application for fire alarm & security systems.

In industrial plants and refineries, annunciators are installed in a control room. These normally sound a bell, horn, siren or other signaling device. When personnel are out in the plant, the operator has to run to the control room to see what the alarm is before they can respond to it. If the alarm was announced over the PA system, they could respond to the condition immediately! Another application is automotive. I'm sure that most readers can figure out how to use this for low oil pressure, low battery voltage, high water temperature, low fuel level, etc. If you need to reduce voltage on the alarm inputs simply use a 78L05 voltage regulator. This will accept an input voltage up to 30 VDC and output 5 VDC to the alarm input of the audio annunciator.

IN CONCLUSION

One more thing I'd like to mention in closing is appending alarms. Suppose, for example, that you needed to announce something that took longer than 5 seconds. The answer is simple. Just jumper two or more alarms to the same input and the recording and playback can be extended to 10, 15, or 20 seconds of continuous message! You must use sequential alarms since the scanning sequence is alarm 1, alarm 2, alarm 3, alarm 4. For example, jumpering alarms 1 & 2 together will provide a 10 second message.

PARTS

A preprogrammed PIC 16C54 microcontroller chip with 4 MHZ ceramic resonator is available for \$ 15.00 postpaid in the continental United States only. Please specify part # as DIALER. Method of payment includes cash, money order, certified check(sorry, no personal checks due to time delays for processing)

Please remit to:

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4115 Kilterbury Lane # B
Bakersfield, CA 93311

<http://home.att.net/~dennis.shepard>