Build The Universal Alarm System

Nothing has more appeal than an alarm system that can be used anywhere you can think of and is very affordable! One of my favorite engineering tasks in life is to take ‘devices’ that most people can’t afford and make it possible for you to 'build your own’. In other words, I try to make a version of a ‘commercial’ product (which is overinflated in price, as you know) for the average electronics experimenter that you can build yourself. Most ‘commercial’ versions are produced under OEM (Original Equipment Manufacturers) license which allows ‘companies’ to produce devices for ‘pennies on the dollar’ over what you pay retail!

OK, now back to the subject at hand. How many times have you ‘needed’ a simple yet effective alarm system? Without quoting all the statistics available, people feel a certain ‘need’ to ‘protect’ their belongings since theft is all too common an occurrence. Hence, an industry (namely, security) is born! What I present to you now, is a device which you can use everywhere. Originally designed for a vehicle, this project lends itself rather nicely to a number of applications. Here is a list of ‘desired features’ that I built into the project.

The first, and foremost feature, of an alarm system is the ‘ability’ to ‘announce’ that an alarm condition exists. This system does this thru two separate methods, audible and visual. The system produces a digitally generated (as in no distortion) audio signal whose output is solely limited by supply power, up to a maximum of 1,400 watts (not a misprint!)

Secondly, a visual indicator (a LED for ‘cost effectiveness’) to let you know what is going on. And, of course, lots of ‘additional options’ that you can ‘customize to your liking’. Such as indicators of such conditions as “Arming’, ‘Bypass’, ‘Ready’, “ Tripped’, and ‘Alarming’! Each of the above mentioned ‘status’ conditions will produce an ‘output’ which you can taylor to your own needs, hence the title “Universal Alarm System”. Now, here’s how it works and how to build it!

CIRCUIT DESCRIPTION

The circuit is shown schematically in figure 1. As you can see, the circuit is based on a Microchip Technology PIC 16C54 microcontroller chip which is clocked by a 4 Mhz ceramic resonator. Also contained in the circuit are four 78L05 voltage regulators, a red LED, two resistors, and a special logic level HEXFET transistor for driving the audio output! The actual audio output power is solely controlled by speaker impedance and supply voltage. More on this later under **OUTPUT POWER.**

The alarm system will first be described as a vehicle system to illustrate all the 'features'. The 'door' input typically goes to your door switch which controls the dome light wiring. Door switches typically complete a circuit by 'grounding' the switch wiring whenever the door is opened. That's why the pull-up resistor on VR1 is there. Otherwise, you'd be shorting + 12 VDC to ground! This system is designed to operate in fail-safe mode. In other words, if the loop is 'opened' either by tampering or being 'triggered' the system will initiate the 'tripped' status.

The 'key' input goes to the ignition switch and is 'energized' whenever the key is turned on. This input serves to both initiate the system and reset the system in case of an alarm. The final optional input 'bypass' is wired to + 12 VDC thru a normally open push-button switch and located in an easily accessible location. The LED is mounted in a highly visible location to 'indicate' the 'mode' of operation as well as to act as a 'deterrent' for a would -be thief! Now, lets discuss the actual operation of the system.

SYSTEM OPERATION

Now that we've terminated all external wiring, we're ready to go thru the modes of operation. Please note that I've provided optional outputs, as noted on the schematic, to indicate the 'mode' status for 'arming', 'bypass', 'ready', 'tripped', and 'alarming' status. Lets start with you in your car with the system hooked up for the first time. If your ignition key is off, and the doors are all closed, the LED will light steadily.

This 'mode' of energizing the alarm after the key and door conditions are met is called 'arming' mode. After you turn off your key, you have 30 seconds to 'leave' your vehicle and close all doors. Please note that many modern cars have 'fader lights' that slowly dim the dome lights after you shut the door. Please take into account this additional time delay since this feature can affect you exit timing from your vehicle. If you do this successfully, the system will step to 'ready' mode. If you don't, the LED will extinguish and you will have entered the 'tripped' mode.

The ‘ready’ mode begins after successfully completing the ‘arming mode’. The LED will flash on and off at 1 second intervals to let you and others know that your alarm system is working and ready for an alarm! The system will stay in this ‘mode’ indefinitely until the door is opened! Then you will have entered the ‘tripped’ mode.

The ‘tripped’ mode, as mentioned above, will immediately extinguish the LED. It will also start a 30 second delay timer. After the alarm system is tripped, you will have no more than 30 seconds to put your key in the ignition and turn it on. This resets the system, which will then recycle to the ‘arming’ mode when the door and key requirements are once again met. Until then, the LED will remain extinguished.

The ‘alarming’ mode will occur if the ignition isn’t switched on within 30 seconds of tripping the alarm. At this point, a digitally produced alarm signal will be fed to the HEXFET switching transistor, which drives the output speaker. This will continue indefinitely, regardless of door or bypass input status. Only the key input will reset the alarm.

The optional’ bypass’ mode was designed to defeat the alarm system for a number of reasons. There are many times that you may want the doors open for more than 30 seconds after the ignition is turned off. For example, loading groceries or cleaning the inside of your vehicle. Because of this a ‘bypass’ mode was added. If the ignition key is on, pressing the ‘bypass’ mode push-button will put the system in bypass mode as soon as the ignition key is turned off. The LED will flicker rapidly (as opposed to flashing in the ‘ready’ mode) and the system will remain in this mode indefinitely until the ignition key is once again turned on. The system will reset and function as if the ‘bypass’ mode had never been entered. In other words, the system resets automatically the next time you drive your vehicle.

The key to this whole system is having protection without any hassles. The timing requirements (30 second entry/exit) seems to work well for most people. This gives you time to discretely enter and exit your vehicle in a casual manner yet still remain protected. The voltage regulators on the three inputs (namely, door, key, & bypass) provide noise, surge, and supply voltage fluctuation immunity to guarantee a reliable system! As of this writing, I have had the system installed and running in my car (1983 Nissan 280ZX) for over 2 years and I have never had a failure or false alarm. Another system protects my house, and once again, I haven’t had a single problem! Which leads us to our next application.

PROTECTING YOUR HOME

Originally, I designed this alarm system for my car, but I also use it in my home. The only modification to the original circuit was to break the connection between the 2.2K resistor and input (pin 1 on VR1) of the door input. Since this is a fail-safe normally closed system, as mentioned earlier, I put a series of normally closed magnetically operated door switches (Radio Shack # 49-532 @ $4.99 ea.) or wide gap (Radio Shack # 1162-5571 @ $6.49 ea.) in series with each other to form a continuous loop. That way, if any switch opens, the system will be tripped.

OUTPUT POWER

Power MOSFET switching transistors have been around for some time. Basically, they consist of thousands of switching transistors in parallel in a single package. This results in a ridiculously low 'on' resistance between source and drain.
The only drawback used to be that it took around 10-12 V on the gate to achieve this low 'on' resistance. International Rectifier has since solved this problem. Their logic level HEXFET devices have overcome this problem and we use one of these devices in this project. The IRLZ-34 (Digikey # IRLZ34N-ND @ $1.37) has an 'on' resistance of only .035 ohm! That's right, this device only has 1/30 of an ohm of resistance! It also can withstand 55 VDC and currents of 27 Amps. Now, lets put it to work!

If you use 4 ohm speakers, and a 12 VDC power supply, using Watts Law (Voltage squared divided by Resistance) will allow us to calculate the power at 36 watts. If you use 8 ohm speakers, it would be 18 watts! If you double the voltage to 24 VDC, the calculations would be as follows. If you use 4 ohm speakers, it would be 144 watts. If you use 8 ohm speakers, it would be 72 watts.

And if you took it to maximum voltage (54 VDC) and maximum current (27 Amps) you would be using a paralleled speaker impedance of 2 ohms, then you power output would be 1,458 watts! Much louder than a rock concert, and less than 2 bucks for the switching transistor! Of course, you'd better have one humungous heat sink! Or you could simply use four 12 VDC batteries, two 8 ohm speakers wired in parallel, and produce 576 watts of power! Anyway, you get the picture.

OTHER FEATURES

Well, I didn't get you excited about the output power capability that you could generate and then leave you hangin'! Here's some other 'useful' features. Remember all those other output 'modes' that I built in? I have two other projects that interface rather nicely with this project. The first one is the Audio Annunciator and the second one is the Autodialer.

The Audio Annunciator is a 4 channel @ 5 second message/channel digital recording and playback system. Simply wire the appropriate ‘mode’ you wish to annunciate and record the appropriate message! If the ‘mode’ condition is still active 30 seconds later, the system will reannounce that mode! Any change of mode hooked up to the Annunciator will be announced immediately. Now whenever the alarm system enters this ‘mode’ the system will announce it thru an external amplifier system. This could be your home stereo if the system is in your house, for example.

The Autodialer system may also be interfaced in a similar manner, except this time you are going to phone your security patrol, voice pager, or local Police Dept. By the way, don’t forget to tell them where you live! Just remember, you can tie several inputs together to lengthen the message block to 10 or 15 seconds. Also, please remember, the number will be redialed every 10 minutes if the ‘mode’ is still active. The number will immediately be redialed if another ‘mode’ occurs that is connected to the Autodialer. If the alarm resets, the autodialer will reset itself automatically.

IN CONCLUSION

I certainly hope that you have as much fun building and using this project as I did. As mentioned above, this project takes a basic building block approach so that you can “add on” later as needs and budget allows. Please feel free to apply this system in any manner you wish. In the case of a home system, don’t forget to have a ‘backup’ power system in case someone turns your power off (either intentionally or by accident). Enjoy!

PARTS

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