cerberus

electronic watchdog

We live in violent times. The crime rate is on the 'up and up', especially burglaries. More to the point is the fact that petty 'break-ins' are now almost common place. Sophisticated alarm systems exist, but they tend to be expensive and are meant to keep out the professional. What the average householder needs is a simple, good quality, low cost device which detects 'entry' and then scares the living daylights out of the intruder.
Hence Cerberus . . . . . ! A circuit with the added facility of 'barking' every time someone arrives at the door.

A large majority of petty crime is committed by what the criminal fraternity describe as 'amateurs'. The amount of damage they do is often much more serious than the value of the goods actually stolen. Sheer vandalism to say the least. So what do we do to keep them out.
The cheapest method is to make entry as difficult as possible for the thief, and locking the door is a good start. 'Opportunity makes the thief', as the Earl of Essex said four hundred years ago. However, his solution is not really viable in this day and age. Putting bars across windows and so on is not really nice and would probably send the local fire chief into fits. So what do you do?

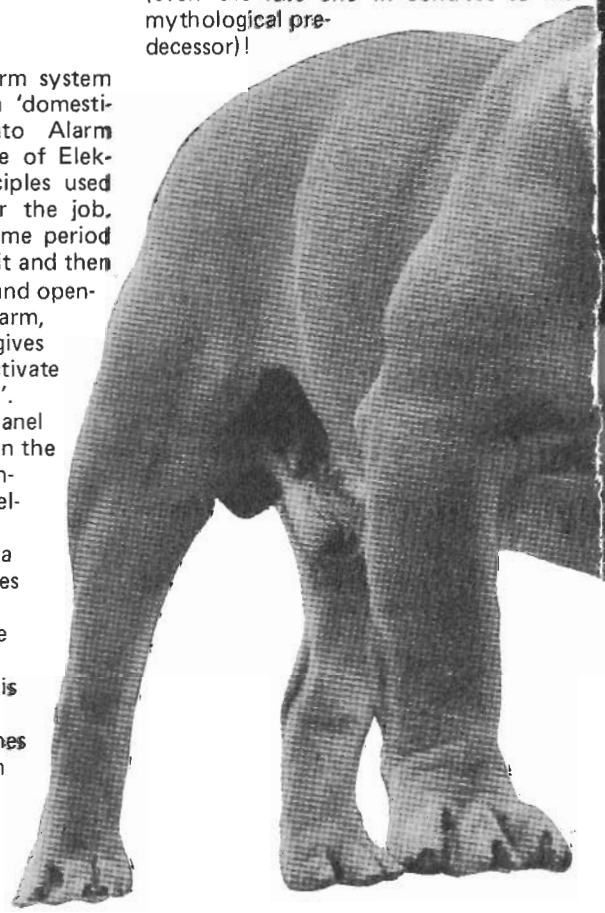
Some kind of electronic alarm system is required. For instance, a 'domesticated' version of the Auto Alarm published in the March issue of Elektor. In fact the basic principles used in that circuit are ideal for the job. The circuit allows a short time period to elapse between activating it and then leaving the house. Returning and opening the door will trigger the alarm, after a very short delay. This gives the lawful owner time to deactivate it, before the 'balloon goes up'. Failure to get to the control panel quickly enough, or punching in the incorrect code, will give any intruder an undesirably noise welcome.
Before we go any further it is a good idea to look at what types of system are available. Home security systems come in three main categories. The first two are 'active', whereas the third is best described as semipassive. The most simple alarms are ones which are set-off by a break in a circuit. These can use light (either visible or infrared), and so on.
The second category detect any movement within a given area. These are very complex affairs, often based on some kind of radar. In general they are too sensitive and expensive for normal home use.
Finally, semi-passive systems are not really alarms in the true sense. They simulate the presence of an accupant by turning lights on and off, opening and closing curtains in a true to life sequence. Hopefully they scare off the amateurs.

The quality of alarms

How sophisticated should a domestic alarm be? This is not an easy question to answer. The better the quality, then normally the higher the price. If you want value for money the points to consider can be itemised as follows.

- Reliability. It must always work at the right time, and never 'for no apparent reason'. Some of the expensive models have been known to be triggered by a fly hitting the window.
- Simplicity. This applies both to installation and operation.
- Economy. It must be independent of the mains supply, but the batteries must last a reasonable length of time. The last thing you want to do is to change them every time you go out.
- Effectivity. In other words, the thief must be made to panic and the neighbours and police should be able to hear it going off.
- Anonimity. The unit should blend in with the decorations and be unobtrusive, while at the same time being accessible to the user.

Cerberus meets all these requirements (even the last one in contrast to his mythological predecessor)!



Working principles

The alarm is switched on by means of a pushbutton (S2). When it is armed, operating a further pressbutton (S3) has the effect of temporarily disabling it for a period of 10 . . . 15 seconds. This allows you to leave the house without waking the dead. Once the door is closed behind you the alarm is reactivated.

Opening the door triggers a second timer, again giving a delay of 10 to 15 seconds. This is sufficient for you to punch in the correct code (using S4 . . . S13) to deactivate the alarm. If you do not get to the box in time or enter the wrong code, the alarm will sound. Another function of the system is to announce the arrival of visitors. In this mode it gives a short bleep whenever the door is opened, in much the same way as the bell that rings when someone enters your local store.

The circuit

Figure 1 shows the circuit in block diagram form. The control panel of the system consists of a keyboard with 12 keys (S3 . . . S14). The only other controls are the pushbutton S2 and the function selector S1 (Alarm or visitor arrivals).

The heart of the circuit is the 'logic and control' section, which consists of a single IC.

The starter is used to arm the system; the delay circuit allows the user to leave

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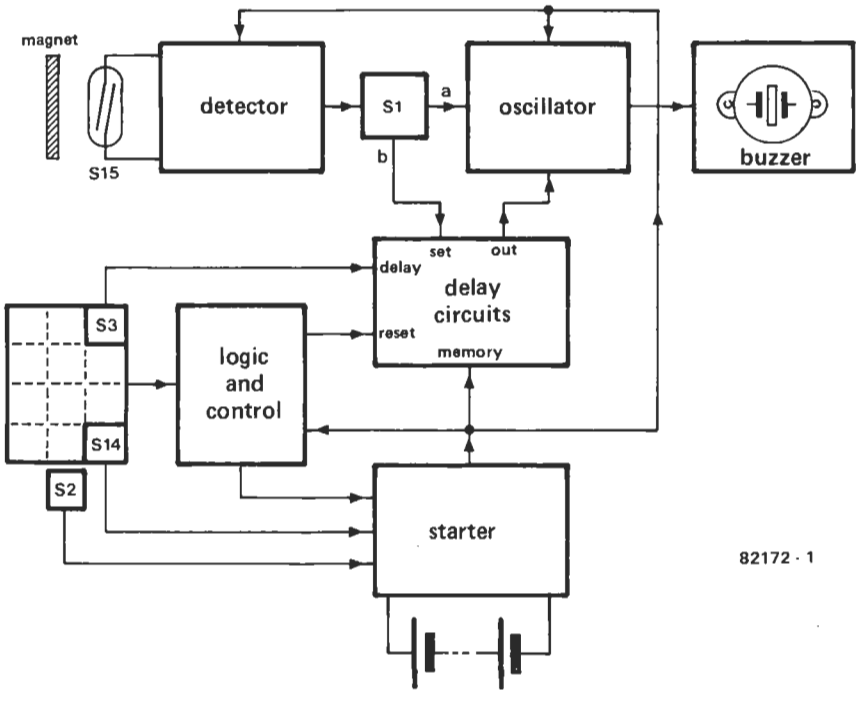

Figure 1. The block diagram shows the principal sections of the alarm system.

and enter without triggering. A detector is required to establish when the door is opened and, finally, an oscillator produces the audio signal that drives the buzzer.

Figure 2 shows the circuit diagram of the complete alarm. As a result of depressing S2, T4 conducts. This in turn provides base drive for T3: the circuit latches 'on'. Initially the input of N2 is pulled high, via C8. This caters for power-up reset, after all we do not want the alarm to sound instantly!

Now let us assume that we want to pop down to the local for a quick pint. Operating S3 sends a trigger pulse to the multivibrator MMV1 (pin 4), initiating the delay cycle. The delay time is defined by the RC network connected to pins 1 and 2. With the values shown in the circuit diagram, the total delay is 12 seconds. Provided the door is opened during this period, the circuit will remain inactive indefinitely, only 'arming' when the door is closed.

Once the circuit is armed, the door causes the reed relay S15 to close. T1 now conducts, sending a pulse to the clock input of the flip-flop FF1 (pin 11). Its Q output now goes 'high' (logic 1), and as a result the monostable multivibrator MMV2 is triggered by the pulse arriving at pin 12. This starts a new delay period determined by the RC network connected to pins 14 and 15. During this time the lawful owner can get to the keyboard and punch in the correct code to disarm the alarm. In the example given in the circuit diagram, the keyboard is wired to give the secret code 3058. Once the correct code is entered, the command circuit IC5 sends a reset pulse to the various parts of the circuit via gates N2 and N3.

Now suppose an intruder gains access to the keyboard, or the householder forgets the code . . . for some reason or other, the correct code is not entered within the delay period. The clock input of FF2 receives a trigger pulse; output Q of FF2 goes high; the oscillator built around N6 . . . N8 is enabled and the alarm sounds.

In the normal course of events it is unlikely that you will forget the code. However, you must bear in mind that you have 10 seconds from the moment you depress the first key, to enter the complete code. If desired this can be followed immediately by key S14 which deactivates the circuit. In that case both inputs of the NAND N4 become logic 1, its output therefore is logic 0, so T4 ceases to conduct. The circuit will remain dormant until S2 is again depressed.

So far we have assumed that S1 is in position 'b' (alarm).

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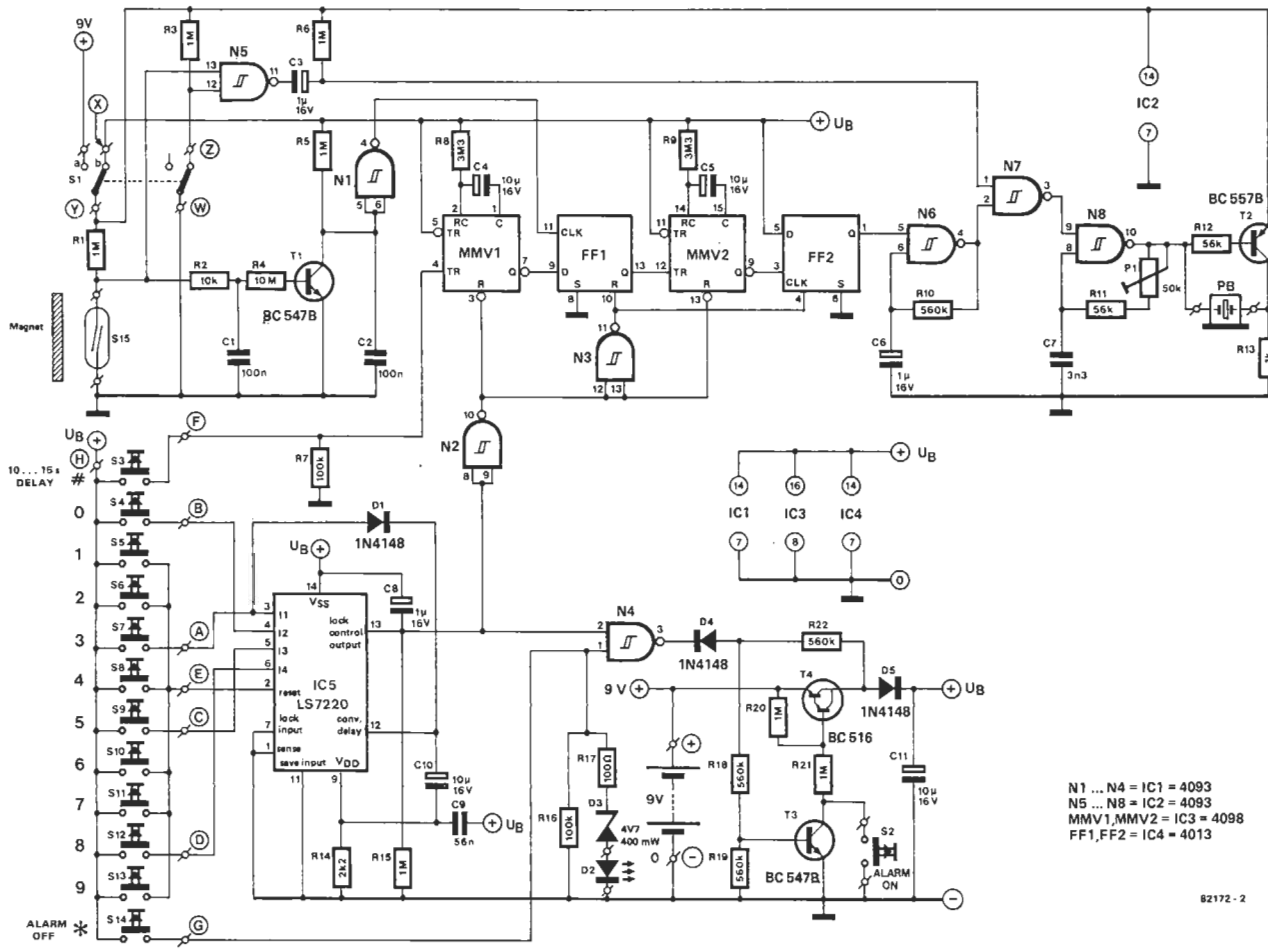

Figure 2. The complete circuit. As drawn here, the code for deactivating the alarm is 3058; this can be changed to any other four-digit number.

• Switching over to position 'a' puts the circuit in 'doorman' mode (arrival announcer). Every time the door is opened the alarm will sound for one second. This will happen irrespective of whether the alarm is activated or not (S2 depressed). With S1 in position 'a' and an activated alarm, both functions are combined: first the buzzer will sound for one second and then 12 seconds later, the actual alarm signal will be emitted.

S14 has two purposes. The first, already described is to deactivate the system (after entering the code). The second is a system check. When S14 is operated to shut down the alarm, LED D2 should light briefly to indicate that the battery is still good. If nothing happens press S2 to make sure the alarm is on, wait a few seconds and then try S14 again. Still nothing? Then what we have is a dead battery or broken LED.

Construction

The printed circuit board is shown in figure 3. Any type of keyboard will do, as long as it is possible for all the keys to be connected to a common rail (see figure 2). For this reason a so called matrix keyboard is unsuitable. The code given by the connections shown in figure 2 is merely a guide line. Any four digit code can be programmed by connecting the appropriate keys to the I1 ... I4 inputs of IC5. Remember to connect all the other keys to the reset pin (E).

Potentiometer P1 is used to set the frequency of the buzzer tone, to obtain maximum output.

Should you wish to extend the time allowed for entering the code and depressing S14 (to deactivate the alarm), then this can easily be achieved by increasing the value of C10. The delay times of MMV1 and MMV2 depend on the values of capacitors C4 and C5.

Installation

The complete circuit including batteries can be mounted in a small box (12x6x4 cms). This makes it suitable for mounting just about anywhere. The important thing is to camouflage the unit reasonably well without making it inaccessible, so that you can get to it during the critical first 10 seconds.

The best position for the reed switch (S15) is in the doorjamb, but, no matter where it is positioned remember to discreetly hide the connection wires. The distance between the reed switch and the magnet should be around 6 mm with a maximum of 8 mm.

The consumption of the circuit in a 'stand-by' situation is around a few

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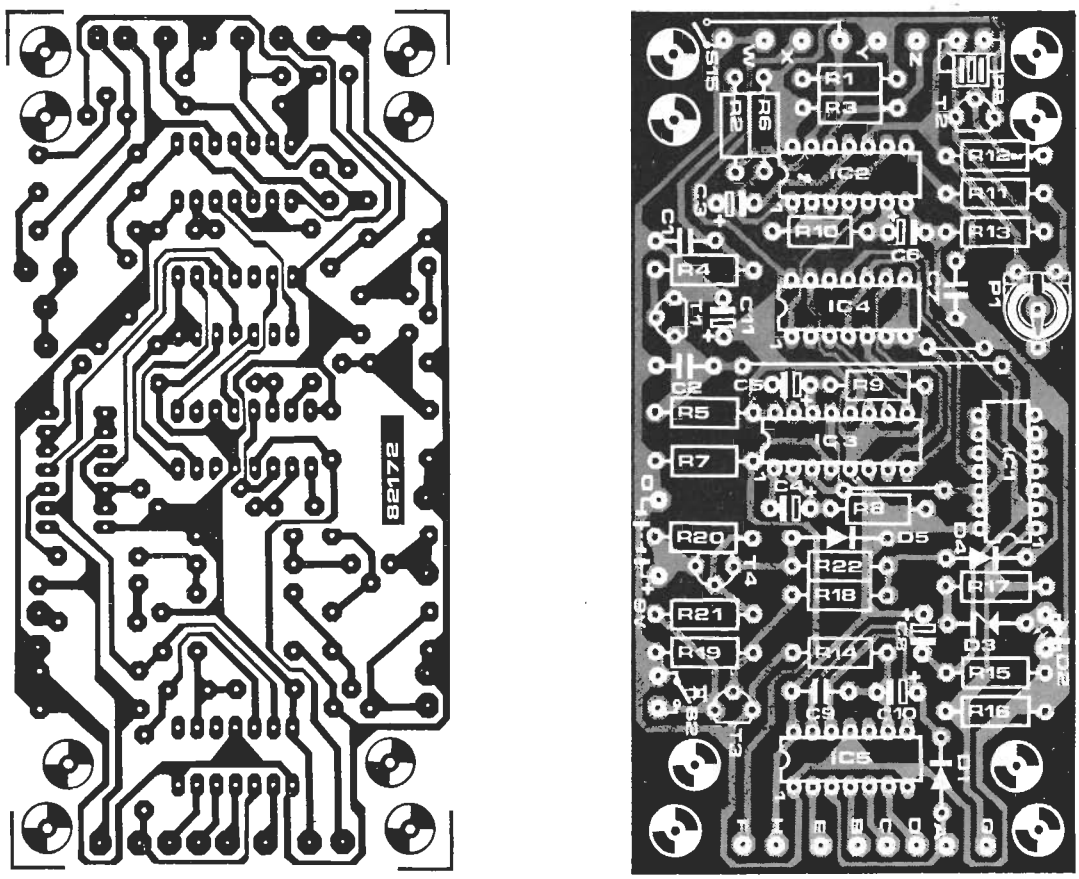

Figure 3. The printed circuit board for Cerburus is shown here. It was designed to fit the type 202-21029J case from Vero. The completed unit should be mounted in a position that is out of sight but can be reached easily in less than ten seconds. All wiring to and from the unit should be hidden if possible.

nA. When activated this increases to about 50 μA , or 10 μA in the 'doorman' mode. For good reliability we strongly suggest the use of alkaline batteries. ⏮

Cerberus: mythological multi-headed dog guarding the entrance to the underworld.

Parts list

Resistors:
R1,R3,R5,R6,R15,R20,R21 = 1MΩ
R2 = 10 k
R4 = 10MΩ
R7,R16 = 100 k
R8,R9 = 3M3
R10,R18,R19 = 560 k
R11,R12 = 56 k
R13 = 1 k
R17 = 100 Ω
P1 = 50 k preset

Capacitors:
C1,C2 = 100 n
C3,C6,C8 = 1μF/16V
C4.C5.C10.C11 = 10μF/16V
C7 = 3n3
C9 = 56 n

Semiconductors:
D1,D4,D5 = 1N4148
D2 = LED
D3 = zener 4V7/400mW
T1,T3 = BC 547B
T2 = BC 557B
T4 = BC 516
IC1,IC2, = 4093
IC3 = 4098
IC4 = 4013
IC5 = LS7220

Miscellaneous:
S1 two way double pole switch
S2 press button
S3 . . . S14 12 key keyboard, one common rail. (e.g. TKC type BLE 2)
S15 = reed switch
PB = piezo buzzer (PB2711)