# Elimination Game

## A simple game that illustrates the idea of the vibration sensor.

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The festive party game of "Pass-the-Parcel" has entertained children for generations. In this electronic version, children sit in a circle and pass the parcel from on to another. After some unpredictable time, it buzzes loudly – the child holding it is then "out" and withdraws from the game. Play resumes until only the winner remains.

In the alternative mode, the parcel is activated by vibration. Thus, any child failing to pass it with the greatest of care will activate it. This guarantees a breathing space where harassed parents can relax before resuming the more strenuous activities.

The circuit may be switched to operate by time alone, vibration alone or both modes together.

### Circuit Description

The complete circuit is shown in Fig. 1. One half of the dual timer, IC1a, in conjunction with IC2, forms a pseudo-random time generator. This is so called because the times are not really random – they keep repeating but no one will notice.

When the circuit is switched on using S3, IC1a produces a slow stream of pulses from its output (pin 5). The repetition rate depends on the values of preset VR1, resistor R1 and capacitor C1 – VR1 forms the adjustment for this.

These pulses have a large "mark" and a small "space", see Fig. 2a. Transistor TR1 inverts these (a space becomes a marks and vice-versa) so pulses shown in Fig. 2b are obtained at the collector. These pulses are applied to IC2 clock input (pin 14).

IC2 has ten outputs and with the arrival of each pulse, these go high in turn. However, not all ten outputs are connected – the four used ones are outputs 1, 2, 5 and 7 (pins 2, 4, 1 and 6 respectively).

On switching on, output 0 will be high with the IC in the reset condition. Assuming a pulse rate of one every 10 seconds, output 1 will go high after 10 seconds, output 2 after a further 10 seconds, output 5 after a further 30 seconds (since outputs 3 and 4 are missed out) and output 7 after a further 20 seconds. Output 1 will then go high again after a further 40 seconds (since outputs 8, 9, 0 and 1 are missed out).

Diodes D1 to D4 direct a pulse from any high output, via capacitor C3 to transistor TR2 base. This gives a momentary low pulse at the collector which triggers IC1b (S1 disables this section if required). IC1b is connected as a monostable having a time period of one second approximate-

ly. This time depends on the values of preset VR2, resistor R8 and capacitor C5. Preset VR2 can vary the operating time between 0.5 and 2 seconds approximately.

When IC1b is triggered, its output (pin 9) goes high and supplies base current to transistor TR3. This, in turn, operates the audible warning device, WD1 in its collector circuit.

With switch S2 set to the vibration mode and when the "parcel" is moved sufficiently, the sensor contacts close momentarily and IC1b is triggered directly. Switches S1 and S2 can be switched on together if desired so that the circuit triggers in either situation. Note that IC1a and IC1b form two independent sections of the same IC.

## Construction

Construction is based on the Veroboard layout shown in Fig. 3. This is made from a piece of 0.1 in. matrix stripboard, size 17 strips X 34 holes.

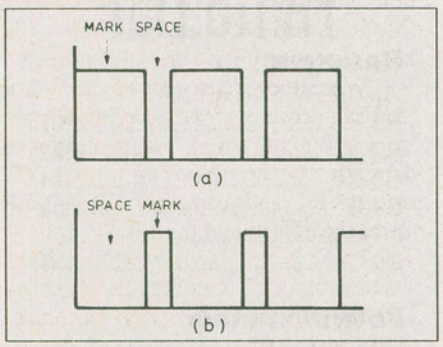


*Fig. 2. Output pulses from the timer IC1a (pin 5) and (b) after inversion by TR1.*

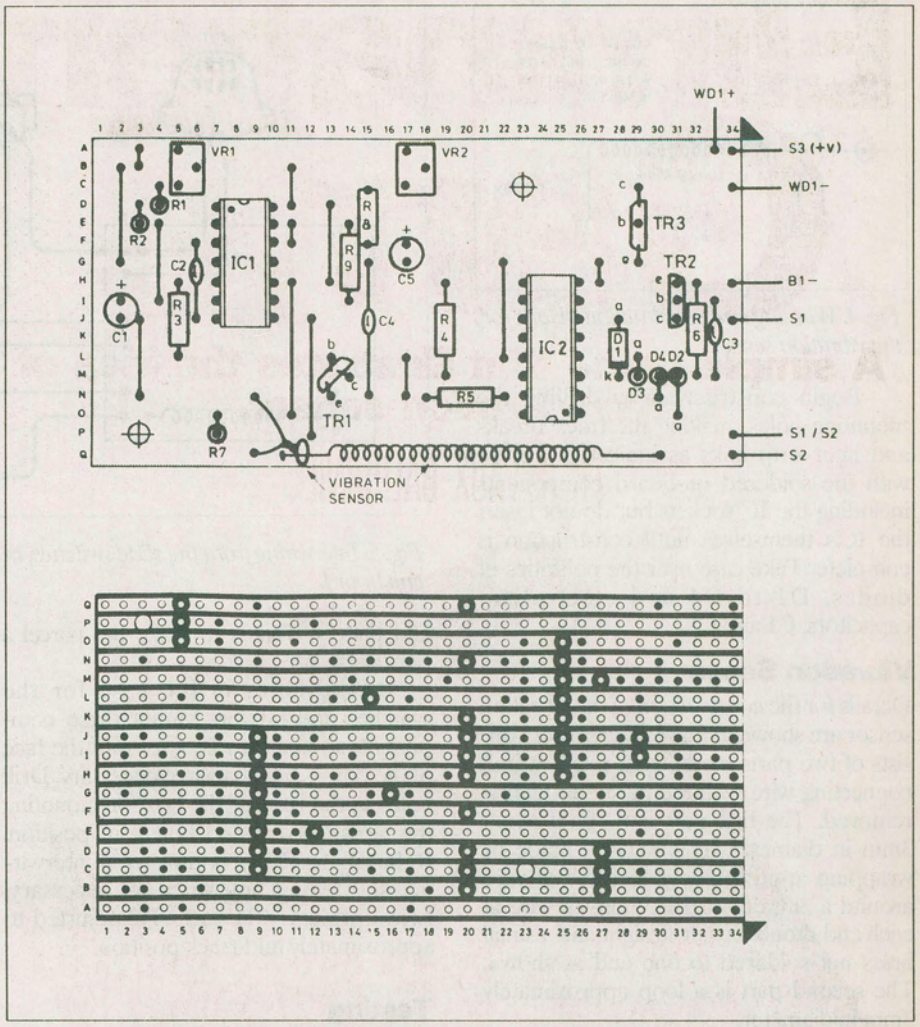


*Fig. 3. Stripboard component layout and details of the breaks required in the underside tracks.*

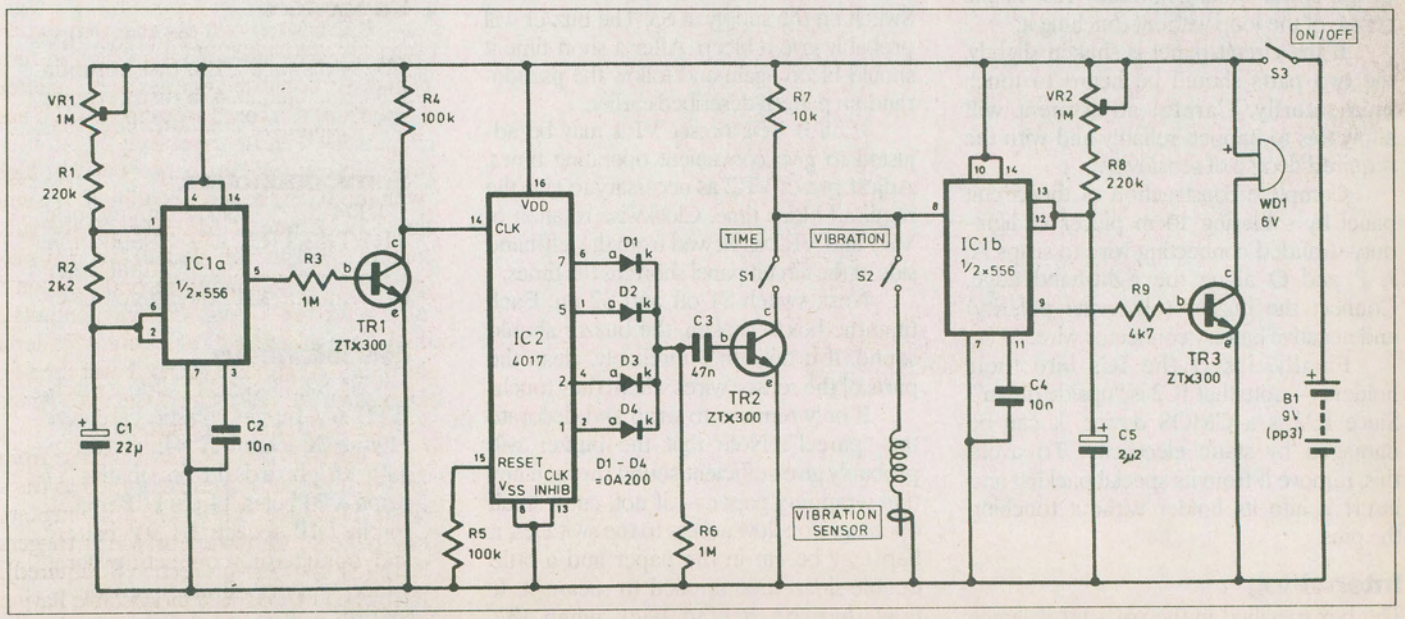


*Fig. 1. The complete circuit diagram of the game.*

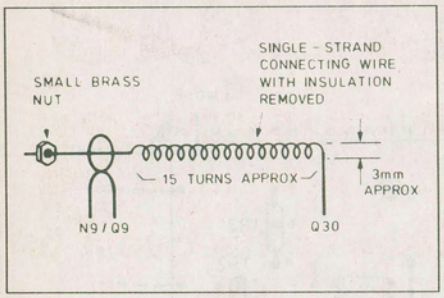


*Fig. 4. Winding and construction details for the vibration sensor.*

Begin construction by drilling the mounting holes, making the track breaks and inter-strip links as indicated. Follow with the soldered on-board components including the IC sockets but do not insert the IC's themselves until construction is complete. Take care over the polarities of diodes, D1 to D4 and electrolytic capacitors, C1 and C5.

## Vibration Sensor

Details for the construction of the vibration sensor are shown in Fig. 4. The sensor consists of two parts made from single-strand connecting wire with the plastic insulation removed. The first part is a spiral about 3mm in diameter. This may be made by wrapping approximately 15 turns of wire around a 3mm twist drill. 5mm of wire at each end should be left straight and a small brass nut soldered to one end as shown. The second part is a loop approximately 3mm in diameter.

These parts are soldered to the circuit panel in the positions indicated. The end of the spiral should normally rest in the centre of the loop without touching it.

If the circuit panel is shaken slightly, the two parts should be heard to touch momentarily. Careful adjustment will allow this to happen reliably and with the required degree of sensitivity.

Complete construction of the circuit panel by soldering 10cm pieces of light-duty stranded connecting wire to strips A, J, P and Q along the right-hand edge. Connect the buzzer (observing polarity) and negative battery connector wire.

Finally, insert the ICs into their holders – note that IC2 is "upside down". Since IC2 is a CMOS device, it can be damaged by static electricity. To avoid this, remove it from its special packing and insert it into its holder without touching the pins.

## Interwiring

The box specified in the parts list is larger than is really necessary to house the circuit and battery. This is to make the parcel a reasonable size.

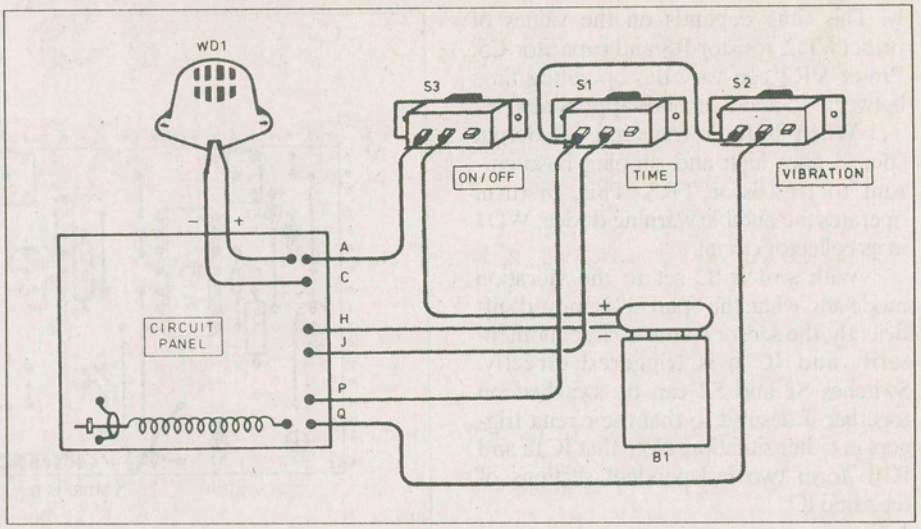


*Fig. 5. Interwiring from the slide switches, buzzer and battery to the component side of the circuit board.*

Make holes in the case for the switches and buzzer. Mount these components so that they lie level with the face of the box – use spacers if necessary. Drill holes in the base of the box for mounting the circuit board and bolt it in position. Referring to Fid. 5, complete all interwiring shortening any wires as necessary. Leave presets VR1 and VR2 adjusted to approximately mid-track position.

## Testing

Connect the battery and secure it to the base of the box using an adhesive fixing pad. Switch S1 (Time) on and S2 (Vibration) off. Switch on the supply at S3. The buzzer will probably give a bleep. After a short time it should bleep again and follow the pseudo-random pattern described earlier.

If all is well, preset VR1 may be adjusted to give convenient operating times. Adjust preset VR2 as necessary to give the required bleep time. Clockwise rotation of VR1 and VR2 as viewed from the left-hand side of the circuit panel shortens the times.

Next, switch S1 off and S2 on. Each time the box is shaken, the buzzer should sound. If it does this unreliably, clean the parts of the sensor wires where they touch.

It only remains to wrap and decorate the "parcel". Note that the buzzer will probably give sufficient sound through any thin wrapping paper – if not, cut a small opening. To allow access to the switches, a flap may be cut in the paper and a little double-sided tape applied to secure it. It may then be peeled back when the switches need to be used. ■

# PARTS LIST

### Resistors

All 0.25W 5% carbon

| | |
|---|---|
| R1,R8 | 220k |
| R2 | 2k2 |
| R3,R6 | 1M |
| R4,R5 | 100k |
| R7 | 10k |
| R9 | 4k7 |

### Potentiometers

VR1,VR2 1M submin. vertical trim

### Capacitors

| | |
|---|---|
| C1 | 22u elec. 16V |
| C3,C4 | 10n disc ceramic |
| C3 | 47n disc ceramic |
| C5 | 2u2 elec. 16V |

### Semiconductors

| | |
|---|---|
| D1-D4 | 1N914 signal diode |
| TR1,TR2,TR3 | 2N3904 *npn* |
| IC1 | 556 dual timer |
| IC2 | 4017 decade counter |

### Miscellaneous

S1,S2,S3 SPDT slide switch, WD1 6V buzzer, plastic case, size 119mm X 99mm X 44mm (external), stripboard 0.1 in. matrix 17 strips X 34 holes, 14-pin DIP socket, 16-pin DIP socket; B1 9V battery and connector, connecting wire, solder, wire for vibration sensor – see text.