PROJECT

Game Timer

Speed up the moves with this easy-to-build timer.

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When playing a game where one person has to make a move at a time, disputes sometimes arise because one player seems to take very much longer than other players. This timer has been designed to indicate that a set time has expired by sounding a buzzer.

Theory

This circuit uses the 555 timer IC, but in this project it is used in a different mode than is usually found. This time the circuit is used in the monostable mode with the IC connected as in Fig. 1. In this mode the output from the integrated circuit is in the Off state until the circuit is triggered by a negative-going pulse applied to pin 2. Immediately, the output from the IC goes to the On state and remains there (provided that pin 2 has been returned to a state where it is not connected to 0 volts before the expiry of the timed period) for a period determined by the values of R and C according to the formula:

$$T = 1.1 \times R \times C$$

where T equals the time in seconds, R equals the resistance in ohms and C equals the value of the capacitor in farads.

Circuit Description

The circuit diagram for the Game Timer is shown in Fig. 2. VR1 and R1 form the timing resistor which is equivalent to R in Fig. 1. The inclusion of VR1 in series with R1 allows the circuit to be adjusted so that timings of different length can be set. C1 is the timing capacitor which is equivalent to C in Fig. 1. With the component values shown in Fig. 2, the timer is adjustable from a minimum setting of approximately ten seconds and a maximum setting of approximately one minute.

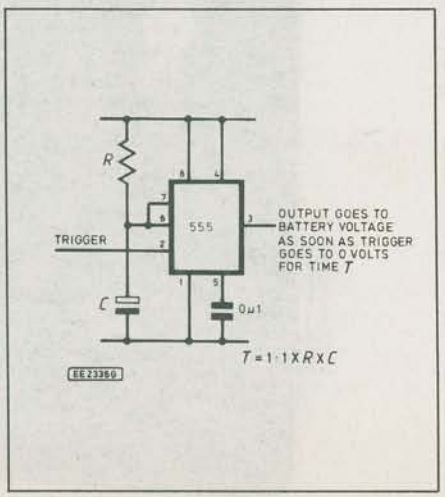

Fig. 1. Basic 555 timer circuit.

Components

R2 and C2 form a negative pulse-generating circuit which is used to trigger the integrated circuit as soon as power is applied to the circuit when S1 is closed. When the circuit is first turned on, C2 is discharged, which causes the voltage at pin 2 to be at ground potential (0 volts). As soon as the circuit is switched on, current from the battery flows through R2 to C2, causing the

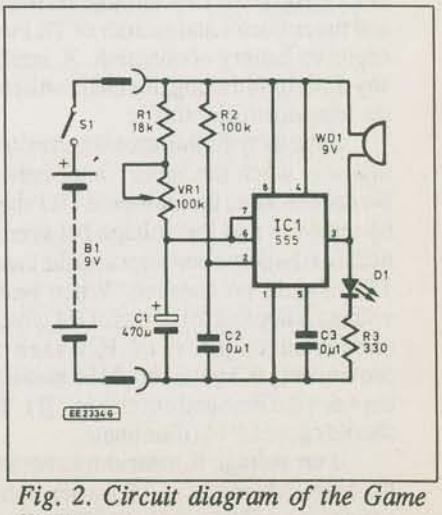

Fig. 2. Circuit diagram of the Game Timer.

Game Timer

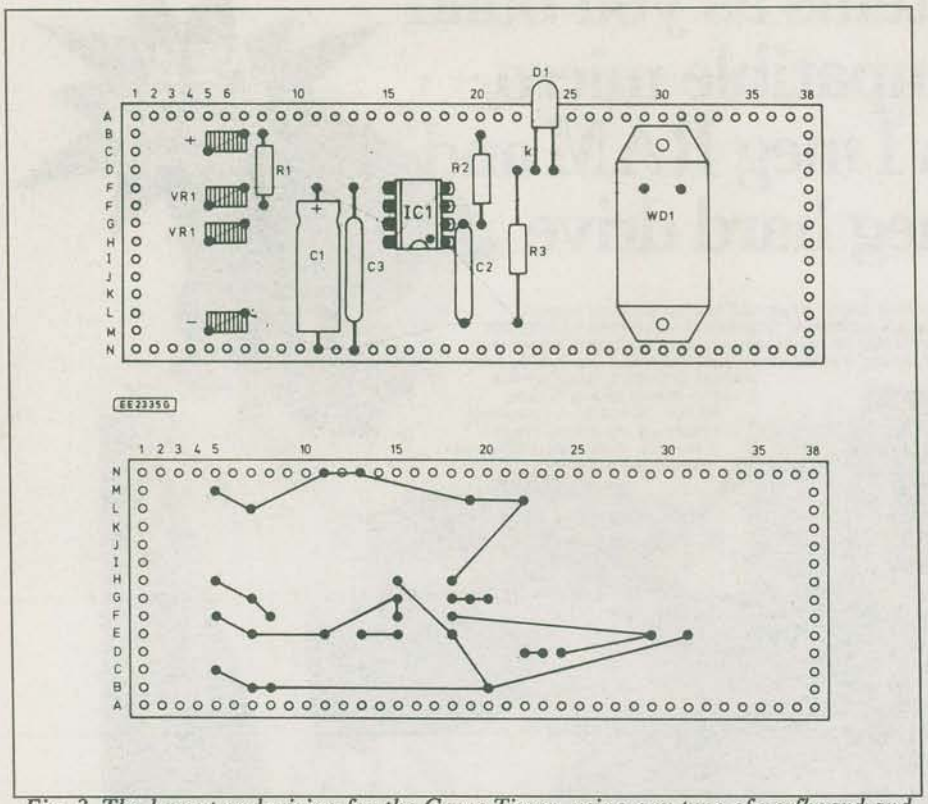

Fig. 3. The layout and wiring for the Game Timer, using any type of perfboard and point-to-point hookup wire underneath.

capacitor to rapidly charge, and thus bringing the voltage at pin 2 to the power supply voltage. This causes a very short negative-going pulse to be applied to pin 2 which is sufficient to trigger the circuit, but also ensures that the voltage at pin 2 has risen above 0 volts before the circuit times out. C3 is a decoupling capacitor connected between the ground rail and pin 5 of the IC in order to set the control voltage of the circuit to its optimum value.

As soon as IC1 has been triggered, the output voltage at pin 3 goes to the battery voltage. This in effect shorts out WD1 and causes a current to flow through D1 via R3. This causes the LED to glow; R3 restricts the LED current to a safe level. When the circuit times out at the end of the timing period set by VR1, R1 and C1, the output voltage at pin 3 falls to 0 volts. This effectively shorts out the LED, but allows a current to flow through WD1, which sounds.

Switch S1 is a standard on/off switch which controls the power as required. The circuit is designed to run from a standard 9V battery, shown as B1 in the circuit diagram.

Construction

This project has been designed to be constructed using any type of perforated board. The first step is to obtain a board with at least 38 by 14 holes. Insert the components into the board according to Fig. 3, observing polarity for components such as IC1, C1 and D1. Turn the board over and trim the leads to a length of about 1/8" (3mm).

Now you can connect the points together as shown at the bottom of Fig. 3, using either hookup wire and soldering, or a commercial wirewrap tool.

Before testing or installing the battery, check for wiring errors or components that have been inserted with the wrong polarity.

Testing and Troubleshooting

Before the circuit can be installed into its case, it should be tested to ensure that it works as described in the circuit description.

If the circuit does not work correctly, it will be necessary to check logically through the circuit. The first step is to repeat the visual checks on the circuit to ensure that it actually conforms to the diagram and that, where required, the polarity of the components is correct.

If a visual check produces no indication of what the fault may be, then the battery should be checked with a voltmeter to ensure that it's providing adequate output both when connected and disconnected. If the voltage is low when disconnected, the battery should be replaced. If the voltage is correct when disconnected but falls considerably when connected, the most likely cause is a either a wiring fault, causing a short circuit between the supply rails, or connection of a polarity- sensitive component the wrong way around.

The first stage of circuit testing is to check out the circuitry associated with IC1; check that the battery voltage is measurable between pins 1 and pins 8 and 4 of the IC. If these checks do not reveal the presence of the battery voltage, then the connections between these points and the battery should be checked for continuity with the test meter. All of the connections to IC1 should also be carefully checked for errors and short circuits.

The next stage is to check that a voltage of about 2/3 of the battery supply voltage can be measured between pins 1 and 5 of IC1. If this voltage cannot be measured, then the connections to and through C3 should be checked.

Next check that the circuit through R1 and VR1 to pins 6 and 7 of IC1 is correctly made, remembering that these connections also pass through the connectors on the board and the wires connecting them to VR1. If these connections are correct, then the voltage across C1 should be seen to rise steadily to the same voltage as that across C3 when the circuit is turned on. If this doesn't happen, then a temporary short circuit should be made between pins 1 and 2 of IC1 to see if this starts the circuit operating. If this technique does cause the circuit to start, then the connections associated with R2, C2 and pin 2 of IC1 should be checked.

If a rising voltage can be measured across C1, then the voltage at the output (pin 3) should switch from 0 volts to the battery voltage as soon as the circuit is switched on and should drop to 0 volts as soon as the voltage measured at pins 6 and 7 rises to about 2/3 of the battery voltage. If this doesn't happen, then the connections associated with pin 3 of the IC should be checked to ensure that there are no wiring errors or short circuits to either of the supply rails.

If the output of the IC switches between 0 volts and the battery voltage correctly, but the output devices do not operate properly, then the connections between pin 3 and the devices should be checked, as well as the polarity of D1 and WD1.

The most likely causes of the LED not

working are either that it has been inserted incorrectly, or there is a poor connection between the LED and R3. If necessary the output components can be tested directly by shorting the connection to pin 3 to the opposite power rail to which the suspect component is connected. If this course is taken, it is suggested that IC1 be removed from the circuit before this is done.

Case Mounting

Once the project has been tested, it can be mounted in the case of your choice. Some small utility boxes have grooves in the side for holding circuit boards, and the board can often be cut to fit these. D1 should protrude through a hole in the front panel, and it can be extended with a pair of wires if necessary. Mount potentiometer VR1 in a suitable hole in the front panel. The battery can be secured with foam (such as self-adhesive foam weatherstripping) or you can use a proper plastic or metal battery holder.

In Use

To use the circuit it is necessary to set VR1 to an appropriate setting and operate S1. At this point D1 should light and the buzzer shouldn't sound. After the timing period has elapsed, the LED should go out and the buzzer should sound until the timer is switched off.

Parts List

Resistors

R1 ..... 18k
R2 ..... 100k
R3 330
All 1/4w, 5%

Capacitors

C1 ..... 470u 10V
C2,3 ..... 0.1u

Potentiometer

VR1 ..... 100k linear

Semiconductors

D1 ..... red LED
IC1 ..... 555 timer

Miscellaneous

S1 ..... SPST switch
B1 ..... 9V battery, connector
WD1 ..... 9V buzzer

Perfboard, wire, case to suit, knob for VR1.