Project 2

Ding Dong Doorbell

It's that classic "ding dong" sound everyone loves – but this one is electronic, of course. Why not build one for your front door?

What does it do?

This electronic doorbell simulates the sound of the electromechanical ding-dong doorbell.

The latter uses two plates which resonate when struck by a small soft hammer, one plate producing a "ding" sound and the second plate the "dong". When the doorbell switch is pressed, current flows through a solenoid which activates the hammer to strike the "ding" plate. When the doorbell switch is opened, the solenoid plunger returns by a spring and strikes the second "dong" plate.

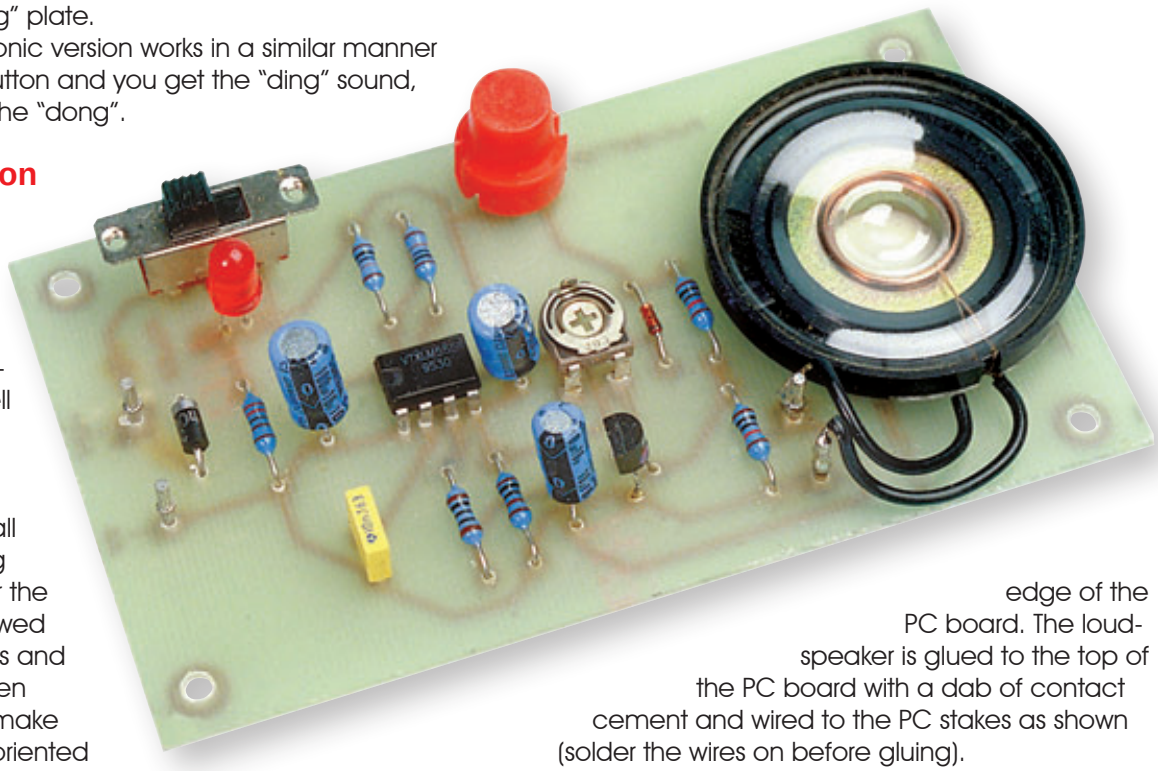
The electronic version works in a similar manner – press the button and you get the "ding" sound, release it for the "dong".

Construction

All parts except the remote loudspeaker are mounted onto the Electronic Doorbell PC board.

Start by installing the PC stakes at all external wiring points and for the speaker, followed by the resistors and then VR1. When inserting IC1 make sure that it is oriented with pin 1 in the position shown. Diode D1 mounts with the cathode (striped end) towards S1 and D2 with the cathode towards Q1.

Install the electrolytic capacitors, LED1 and transistor Q1 with the polarity shown. S1 is installed by inserting the switch pins into the PC board and soldering in place. Switch S1 may be a DPDT type; this doesn't matter. Switch S2 must be correctly oriented with the "flat" side of the switch body towards the edge of the PC board. The loudspeaker is glued to the top of the PC board with a dab of contact cement and wired to the PC stakes as shown (solder the wires on before gluing).



You will need these parts

Resistors (0.25W, 1%)
2 100kΩ 2 10kΩ 1 2.2kΩ
1 1kΩ 1 100Ω
1 20kΩ horizontal trimpot (VR1)

Capacitors
1 100µF 16VW electrolytic
1 47µF 16VW electrolytic
1 10µF 16VW electrolytic
1 .01µF MKT polyester

Semiconductors
1 555 timer (IC1)
1 BC548 NPN transistor (Q1)
1 1N4004 1A diode (D1)
1 1N914, 1N4148 signal diode (D2)
1 red 5mm LED (LED1)

Miscellaneous
1 Electronic Doorbell PC board
1 SPDT slider switch (S1)
1 momentary PC-mount pushbutton switch (S2)
4 PC stakes
1 40mm 8Ω Mylar cone speaker

TECH TALK

The electronic doorbell circuit is based around a 555 timer IC, set up as an oscillator. Its basic operation is similar to the 555 oscillator in project 1, however here there are two tones.

As you may recall from project 1, the oscillation frequency of the 555 depends on the time it takes the capacitor connected to the trigger input (pin 2) to charge and discharge between 2/3rds and 1/3rd the supply voltage.

But there is also another way to control the frequency of oscillation and this is to adjust the voltage at the control pin (pin 5). If we adjust this voltage we also alter the voltage range over which the capacitor is charged and discharged and this changes the frequency of oscillation.

Remember that the reset (pin 4) must be high for the 555 to operate. Normally it is held low by a 1kΩ resistor so the doorbell remains silent.

When pushbutton switch S2 is pressed, it pulls pin 4 high via diode D2 and discharges the 100µF capacitor. IC1 then begins oscillating. Switch S2 also provides base current to transistor Q1 via a 10kΩ resistor.

The transistor turns on, effectively connecting a 20kΩ variable resistance between pin 5 and earth. This resistance alters the pin 5 voltage, so the oscillation frequency is higher than normal. For as long as S2 is closed, the pin 3 output of IC1 drives the loudspeaker to produce a "ding" tone.

When S2 is released, two things happen. First, transistor Q1 switches off since its base is pulled low via the 10kΩ resistor to ground. With Q1 off, VR1 has no effect on pin 5 and IC1 oscillates at its normal frequency. This produces the "dong" tone.

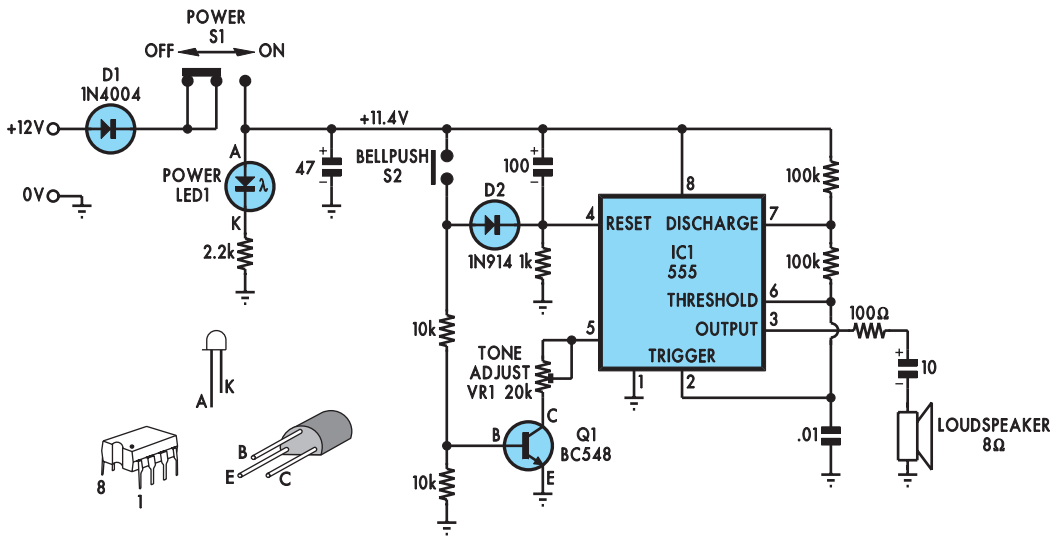
Second, the 100µF capacitor connected to pin 4 starts to slowly charge via the 1kΩ resistor to earth. When the voltage on pin 4 falls to about 1V, the 555 resets and the "dong" tone ceases.

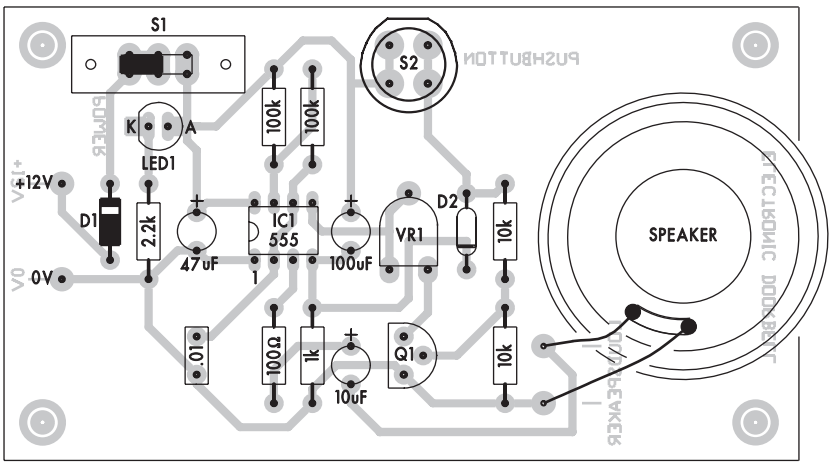
VR1 can be a fixed value resistor but we made it variable so you can set the "ding" frequency which sounds best with the "dong" tone.

Diode D1 is included to provide reverse polarity protection for the circuit. Switch S1 is to connect power, while LED1 indicates when power is applied. The 47µF capacitor smooths the supply rails for reliable operation of IC1.

Checking It Out

Apply power to the circuit and switch on. Check that there is an initial tone from the loudspeaker which lasts for around one second as the 100µF capacitor at pin 4 of IC1 charges. Press the pushbutton switch S2 and check that it "dings", then release it and you should get the "dong". Adjust VR1 for best sound balance between ding and dong.





What to do next

You could use a standard doorbell switch in place of switch S2. This can be wired to S2's copper pads (or to PC stakes in that position) once the switch has been removed. More volume can be obtained by reducing the value of the 100Ω resistor in series with the speaker. Alternatively, or as well, you can use a larger speaker mounted on a panel or in a box.