Pimp your Shoes

Trendy shoe adornment

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Shoes that light up? No problem, these days you can buy (almost) anything. But it is of course much more fun and challenging to enhance a pair of shoes yourself with these trendy lights, using a clever little circuit and some LEDs.

The idea behind this mini project is to provide your shoes with a string of LEDs. The well-known firm Nike sells several types of shoe with lights in the heels that react when you hit the ground hard enough with your shoe. There are several video clips on YouTube made by proud owners of such shoes *(for example www.youtube.com/watch?v= m46jJupXEic and www.youtube.com/watch?v=_z-VHNWyxOQ).*

It isn't exactly an easy task to turn normal shoes into Christmas lights, but we've assumed that Elektor Electronics readers have enough ideas to implement this is in some way (e.g. cut out part of the heel, put the PCB inside and let the LEDs 'look' out through small holes in the sides).

The circuit described here provides a running light with 18 LEDs. We've even designed a small (double-sided) PCB, with all components as SMD devices (apart from the LEDs and the battery), but this is intended to be built by more experienced constructors. The soldering of these small surface mount devices isn't very easy.

The PCB is small enough to fit inside the heel. For the battery a button cell is used, which can be stuck to the solder side of the board and connected to the circuit via a short length of wire.

An on/off switch isn't included on the board since it's unlikely that it would be accessible from the side of the shoe. You will have to think of an alternative method to add this.

Circuit diagram

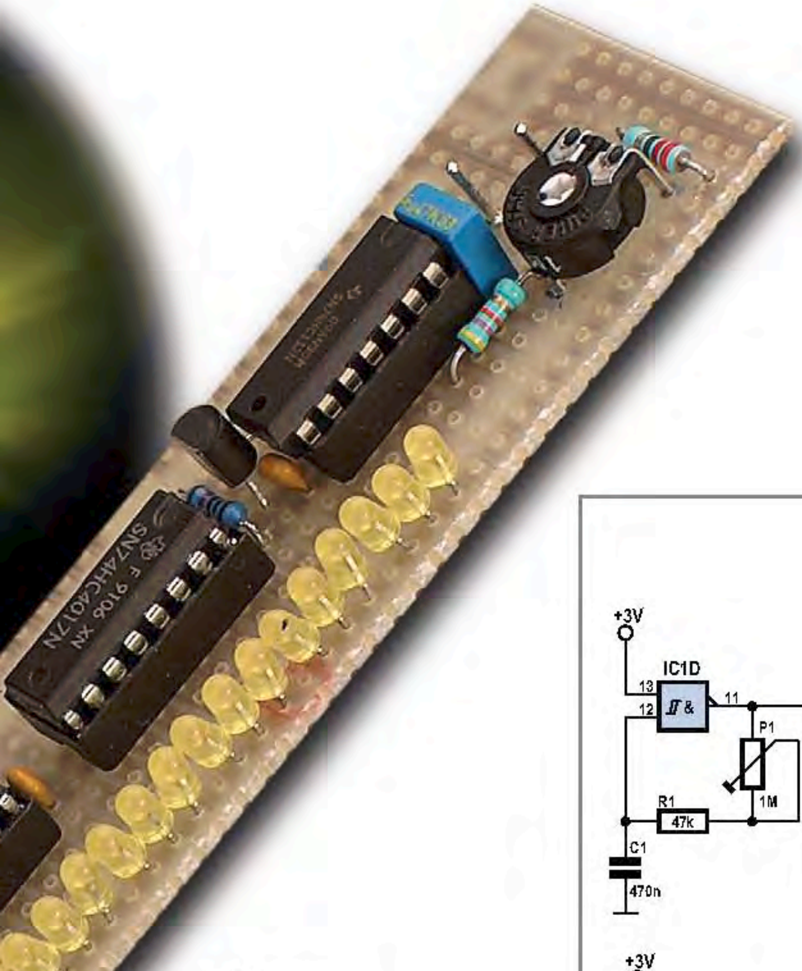
The circuit consists of a few standard ICs from the well-known 4000 series. The advantage of these ICs is that the circuit can be easily adapted for use with different supply voltages in the range from 3 to 15 V (R4 is the only component that needs to be changed). For running lights using LEDs the 4017 (a decade counter with 10 outputs) is just perfect. The ten outputs go momentarily high one after the other, at the rate of the clock input. To expand the running lights (i.e. have more than 10 LEDs) we've added a second 4017 in series. However, this requires some extra logic and a clock signal. For this we've used a 74HC132, which has 4 NAND gates with Schmitt-trigger inputs. A simple RC oscillator was made with one NAND gate (IC1D). The other three are used to control the counters. In fact we need two AND gates for this. These were created here using three NAND gates and a discrete inverter made with a transistor (T1, a BC547, or a BC847 in SMD packaging) and two resistors.

The operation of the circuit is fairly straightforward.

When the power is turned on IC1C and IC1B pass on the clock pulses generated by IC1D to the first counter (IC2). When the tenth output (pin 11) in the first counter goes high it results in clock pulses being passed through NAND gate IC1A to the second counter. The second output of the second counter then goes high. The first output of the second counter goes low and thereby stops the clock signal reaching the first counter via IC1C. It's only when the second counter has completed a full cycle and the first output goes high that the first counter receives clock pulses again; the tenth output of the first counter is low again and the whole process starts from the beginning.

We have also added a flashing effect to the circuit. The flashing is implemented by connecting the common connection of the LEDs via R4 to the clock signal. The flashing makes the LEDs even more conspicuous and as a bonus halves the current consumption.

The oscillator has been designed to have an adjustable frequency from 2 Hz to 42 Hz. Everybody should be able to find a frequency to their liking within this range. You'll find that at higher speeds of the running lights the flashing of the LEDs becomes almost unnoticeable.



Practical issues

In the photo you can see the prototype that we built onto a piece of stripboard. In this version we used yellow LEDs. At 3 V the current consumption was about 2.3 mA. When R4 has a value of 220 Ω the current through a yellow LED is about 3.5 mA. It is therefore essential that you use low-current versions for the LEDs. If a CR2032 type battery is used, which normally has a capacity of about 220 mAh, then the expected life span of the battery is four days (with continuous use). That is quite a long time, but we'd still recommend that you fit a switch in the shoe that turns off the running lights when the shoes aren't worn.

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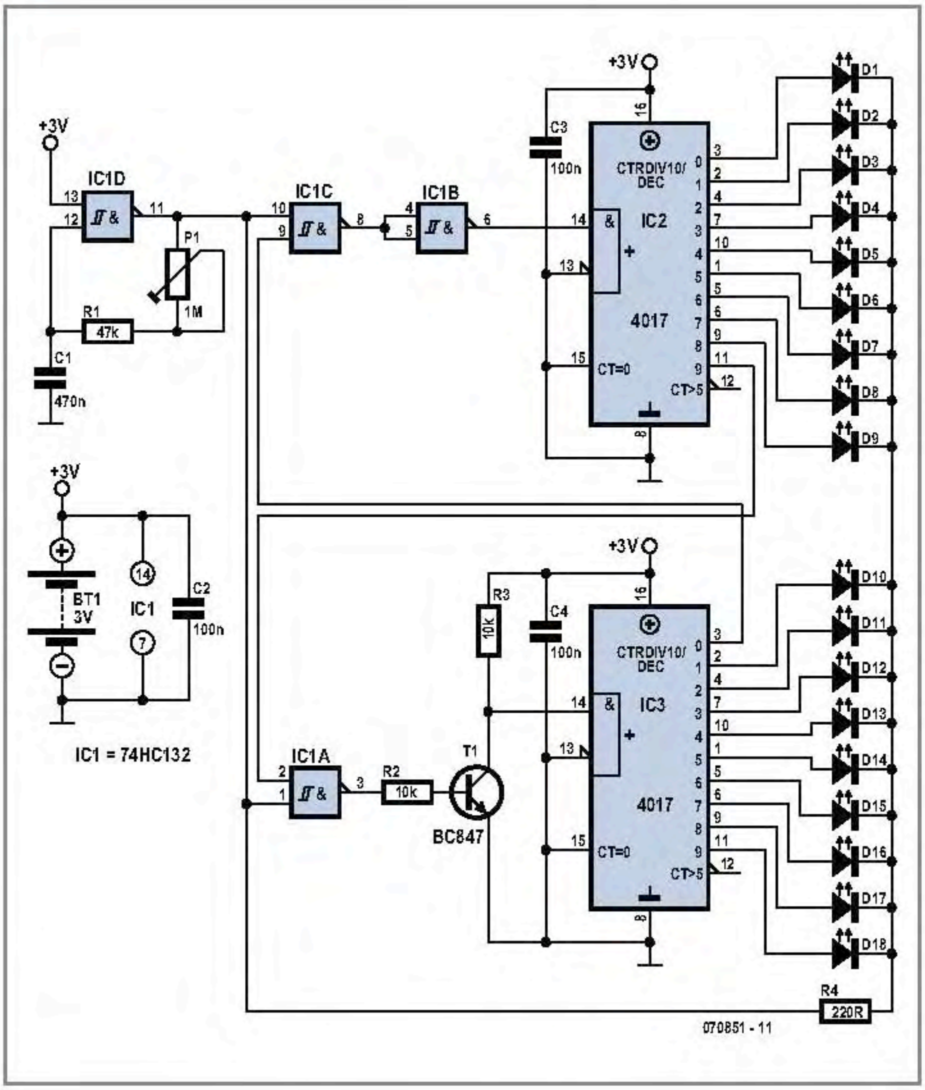

Figure 1. The circuit diagram for the 18-channel running lights: three ICs, a transistor and a few passive components.

COMPONENTS LIST

Resistors
R1 = 47kΩ (SMD 0805)
R2,R3 = 10kΩ (SMD 0805)
R4 = 220Ω (SMD 0805)
P1 = 1MΩ preset

Capacitors
C1 = 470nF (SMD 0805)
C2,C3,C4 = 100nF (SMD 0805)

Semiconductors
D1-D18 = low-current LED *
T1 = BC847 (SMD)
IC1 = 74HC(T)132 (SMD SO14)
IC2,IC3 = 74HC4017 (SMD SO16)

Miscellaneous
BT1 = 3V Lithium button cell *
PCB, ref. 070851-1, free artwork download from www.elektor.com

* see text

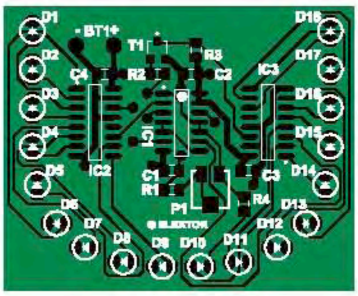

Figure 2. The whole circuit fits on this double-sided PCB, using SMD components. Some experience required here!