Be a real weirdo with these

Mind-blowing Boggle Goggles

What sort of project uses two ICs, six LEDs and a pair of dark glasses? Boggle Goggles — what else! The latest creation to emerge from our laboratory, Boggle Goggles, is a great gimmick for parties and discos. A beady eyeball darts around behind each lens of the glasses making the wearer look like a shifty, evil escapee from a B-grade science fiction movie. So if you want to look just like our editor, read on!

By COLIN DAWSON

Boggle Goggles have no appeal to practicality or good taste; in fact, their only justification is that they are fun. We can almost guarantee that you will be the subject of much mirth if you wear these spectacles into a crowded room or on a busy street. In fact, your students/patients/passengers/jury may never take you seriously again! With a giant leap for mankind (who said backwards?) this project brings "Groucho Marx glasses" into the 1980s.

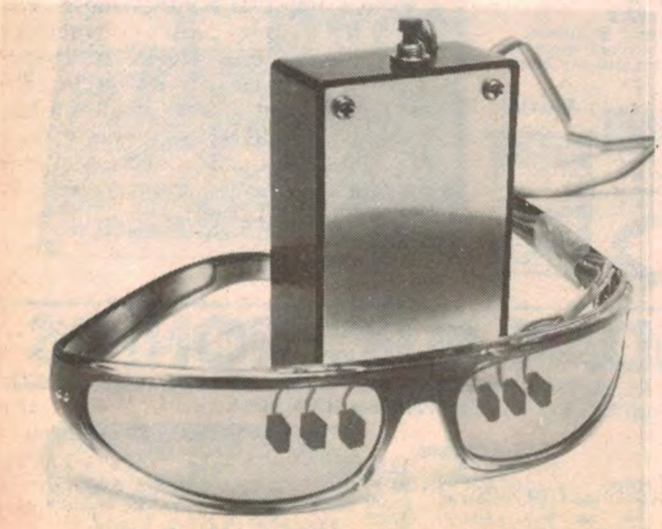
Depending on your leisure time activities, you may or may not have seen novelty dark glasses with a single LED behind each lens. Whilst they are reasonably effective in attracting attention, the single LED can only blink on and off. By comparison, the Boggle Goggles have a much more animated display with the "eyeball" appearing to move randomly from side to side. If the single blinking LED causes people to do a double-take, this moving eye will surely stop them in their tracks!

The project came into being through our desire to present a novelty project for this Christmas issue. The primary objective was for something that would be fun to build and use, and preferrably "different". Fortunately, it was not essential that the project serve any practical purpose. Last year, it was the LED Christmas tree decorations. Subsequently we presented the "Cudlipp Cricket" project (February '82) which, by all accounts, has proven very popular. For this month's project, various types of flashing LED jewellery were considered, but for sheer buffoonery, none could compete with electronic sunglasses.

Having decided on a project, the next problem was to find a suitably novel name. A certain staff member immediately suggested "Boggle Goggles", which was so bad that, inevitably, it stuck. Against this gem of pre-adolescent doggerel, titles like "Bright Eyes" or even "The Evil Eye" had no chance at all. It was even suggested that the name might be abbreviated to "BGs"!

For best effect, the glasses should be of the reflective type favoured by snow skiers. When these are used, the LEDs cannot be seen until they are actually illuminated. Being quite efficient for excluding ambient light, these glasses will unfortunately restrict one's vision somewhat — especially indoors or at night. In fact, with the LEDs flashing vigorously in front of your eyes, it is quite probable that you won't be able to see much at all. In fact, you'll be quite boggled. Hence the wearer should remain stationary whilst demonstrating the Boggle Goggles.

To simulate evil eyes, flitting from side to side, three LEDs are used in each lens of the glasses. The LEDs are wired in pairs so that at any given time, one LED from each eye will be on. A different pair of LEDs will be activated about every 0.5s, giving the impression that the "eyeballs" are alternating between left, right and straight ahead. Whilst we wired the prototype so that the LEDs were synchronised ie, the same LED position from each eye is activated at any given time, there is no compulsion to do this. For example, if the connections to one left and



These "moving" LEDs behind dark glasses should really create a stir. The circuitry is in a compact utility box.

Magazine Promotions staff member Jenny Cardow models the new Boggle Goggles.

one right LED are transposed, the eyes will appear at one moment to be crossed and at another bug-eyed!

(It would be possible to wire the LEDs so that these two options were switchable. However, it would require several additional wires to the LEDs and rather more complex wiring.)

The circuit

The circuit contains two ICs and very little else. IC1 is a 4011 CMOS quad NAND gate and IC2 is a 4017 CMOS decade counter. The sole function of IC1 is to oscillate and thereby provide a "clock" for the decade counter. For this purpose, only three of its gates are required, the fourth gate being tied permanently low. These three gates operate as a conventional three-inverter oscillator.

By connecting the inputs of a NAND gate together, the gate is caused to operate as an inverter ie, its output is in the opposite logic state to its input. Referring to the circuit diagram, it can be seen that three such inverters – IC1a, IC1b and IC1c – are connected in series. A 1μF capacitor and series 220kΩ resistor (R1) are connected between the outputs of IC1b (pin 10) and IC1c (pin 3). Since these two outputs will always have the opposite polarity (let us say initially that pin 10 is low and pin 3 is high), the capacitor will be charged. The 220kΩ resistor provides a time constant of about 0.5s for this charging. After this time has elapsed, the input of IC1a (pins 12 and 13) will be taken past the upper threshold and the gate will toggle with its output going low.

This causes the other gates to simultaneously change states, with pin 10 going high and pin 3 going low. The 1μF capacitor now begins charging in the reverse direction, the time constant of 0.5s again determined by the 220kΩ resistor. After this time period, the charge on the capacitor will fall below the lower threshold of IC1a and it will again toggle. The result of all this is a square wave output at pin 3, which then provides clock pulses for the decade counter.

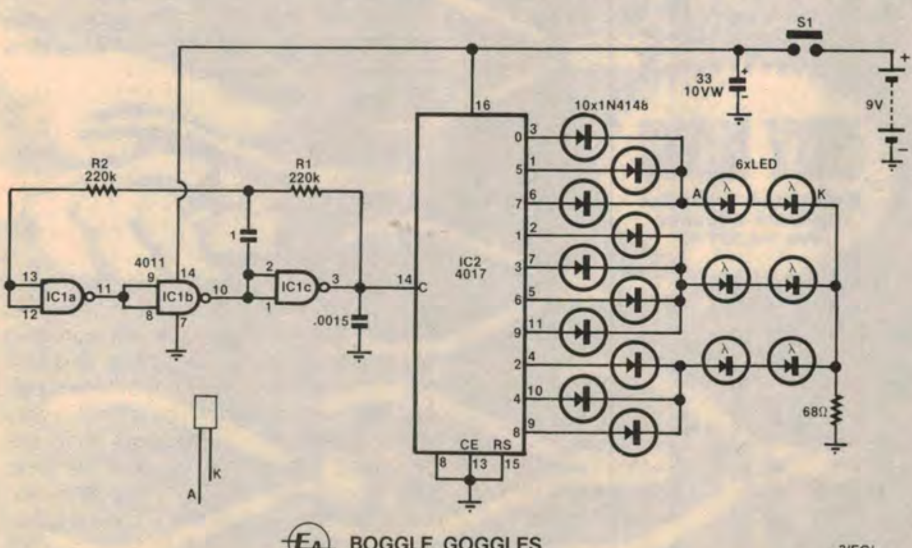
The 220kΩ resistor (R2) feeding pins 12 and 13 is primarily a protective device, needed to avoid damaging the input diodes of IC1a. However, it will also have a small incidental effect on the time constant as determined mainly by the 1μF capacitor and R1. If the time constant has to be changed, changing R1 will probably be sufficient, but R2 could also be changed if necessary.

IC2, being a decade counter, has 10 outputs. These are numbered 0-9 and each one, beginning with 0, goes high in turn. The counter triggers on the positive edge of each clock cycle so that each output goes high for one clock cycle, which in this case is 0.5s. The .0015μF capacitor connected to the clock input of IC2 prevents the counter from triggering on noise which may otherwise cause erratic counting.

Since there are only three pairs of LEDs to be driven and 10 outputs available from IC2, more than one output can be used to drive each LED pair. Actually, three outputs are connected to the LED pair representing eyeballs left, three to eyeballs right, and four to eyeballs centre. Because these outputs can not be connected directly to each other without causing IC2 to malfunction, each output drives through a diode.

By ensuring that none of these commoned outputs are consecutive numbers, the eyes appear to change position with each clock cycle. The sequence is left, middle, right, middle, right, left, middle, left, right, middle. Since it takes around 5s for the sequence to repeat, a casual observer sees the display as being random.

Each LED requires a current of 10mA, and since a pair of LEDs will be on at any given time, the most efficient means of driving them is as a series pair. The current is limited to 10mA by a 68Ω resistor which is common to each pair of LEDs. The total current drain of the circuit is around 11mA, which is quite severe for a type 216 9V battery. In consequence, this type of battery can be expected to give a useful life of no more than 1.5hrs

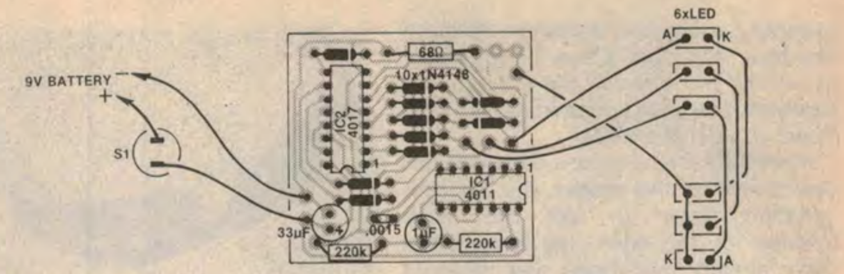


The circuit of the Boggle Goggles contains just two ICs and a handful of other components.

with continuous duty. This should be sufficient for several satisfying sessions of boggle goggling.

Its redeeming feature is, of course, its compact size. In this respect, it is the most practical power source. It can fit into the smallest size "zippy" box, or alternatively, it can be inconsipicuously slipped into your pocket along with the printed circuit board. In any case, we anticipate that the circuit will usually be operated for only 5-10 seconds at a time, in which circumstances the battery life will probably be adequate. If longer battery life is essential, the circuit can be powered from a 6V battery pack such as four "AA" type cells. In this case, the 68Ω LED current limiting resistor would need to be reduced to 47Ω.

> We estimate that the current cost of components for this project is approximately
>
> **$9.60**
>
> This includes the plastic utility box but not battery or glasses.



Parts overlay diagram for the Boggle Goggles. Make sure that all polarised com ponents are inserted the right way round (ICs, diodes, LEDs, electrolytic capacitors).

View inside the prototype, showing how the PCB fits into a small plastic utility box. The battery sits on top of the PCB and should be wrapped in plastic foam to prevent shorts.

Construction

Before embarking on the construction of your Boggle Goggles, you will have to decide whether to use a plastic utility box or not. The printed circuit board (PCB), code 82eg12, measures 47mm x 44mm and was designed to fit into the smallest of these boxes. This box has nominal dimensions of 83 x 23 x 54mm, but different manufacturers provide different PCB mounting slots. This means that the PCB may need to be filed down slightly to fit some boxes.

A momentary contact pushbutton switch is most suitable for this project. If using the "zippy" box, you will probably want to mount the switch on the box, in which case a 7mm mounting hole is required.

A second hole is needed in the box to run the wires to the LEDs. Its size will depend on the type of cable you use. A four-way rainbow cable will require a hole of about 3mm. Another approach would be to use three or four-cored shielded cable which would require a larger hole, but this would be practical only if small gauge, flexible cable can be obtained.

When mounting the 10 diodes on the PCB, take careful note of their polarity. Of the capacitors, only the 33μF electrolytic is polarised. Both of the ICs are CMOS, so it will be necessary to take the usual precautions. Use a clip lead to connect the barrel of the soldering iron to the earth track of the PCB. Solder the earth pins (7 for IC1 and 8 for IC2) first and then the positive pins (14 for IC1 and 16 for IC2). This will minimise the chances of the ICs being damaged by static charges.

A good idea of how the board and other components are fitted to. or in the box, can be gained from the photographs. The board sits on the bottom of the box, with the battery on top of it, to one side. A small piece of plastic foam is wrapped around the battery to insulate it from the board and the metal back of the box. This arrangement is a snug fit so that no mounting screws are really necessary.

A number of considerations will determine the method of affixing the LEDs to the lenses. The most important of these is whether you will want to use the glasses for their normal purpose after Boggle Goggles have exhausted their novelty. If not, it is simply a matter of glueing the LEDs to the lenses. For a less permanent assembly, a strip of styrofoam or cardboard (about 5-8mm wide) can be stuck along the inside top of each lens using double sided tape. The legs of the LEDs can then be glued to this strip without having any permanent effect on the lens. Note that it may be necessary to solder the wires to the LEDs before applying the glue, depending on how short you cut the leads.

If you intend to acquire a pair of glasses specifically for this project, our advice is anything goes. In fact the more outrageous the style, the better. We have already mentioned that mirrored lenses are quite suitable because they hide the LEDs and wiring, but any pair of glasses which is very dark should suffice. Wide framed glasses will make it easier to conceal the wiring, as will the "wrap around" type glasses popular with "new wave" music enthusiasts.

When positioning the LEDs, try to put them as nearly as possible where a normal eyeball would appear. In most cases, this will be towards the centre and upper part of the lens. Locating them elsewhere will tend to destroy the "eyeball" illusion. Although we used rectangular green LEDs, this aspect of construction is completely optional. Rectangular LEDs will usually prove easier to glue to the lens, but you may not find this type of eyeball as appealing. Red LEDs are usually more efficient than green and this can be an advantage with very dark glasses.

(You can, if you like, make one eye red and the other green. This arrangement, coupled with the cross-eyed to bug-eyed connection, should really slay 'em!)

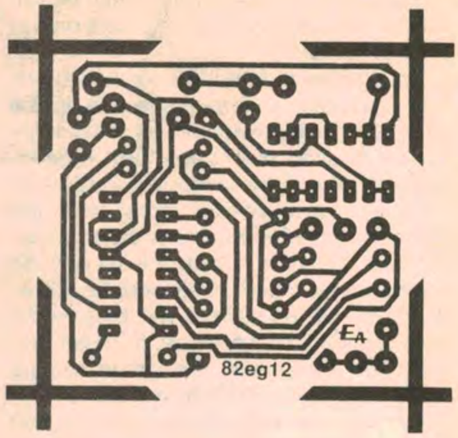
In all cases, the LEDs should be butted up to the lens for mounting. This will keep them as far away as possible from the wearer's eyes. If you are not satisfied with this aspect of construction, it may be necessary to file the epoxy lens of the LEDs down to provide greater clearance. For the same reason the leads of each LED should be bent towards the top of the glasses rather than left pointing back towards the eye. Having outlined these requirements, we can state that most glasses will have an ample amount of clearance for most wearers, but it is up to the constructor to make sure of this.

Four wires must be used to connect the PCB to the glasses. The length should be somewhere between 0.5 and 1m. One of the four wires is the common return – if three-way shielded cable is used, this should be the shield. It is connected to all the LED cathodes on one side (let us say the left side). Each of the other three wires connects to an LED anode on the right side. Each cathode of the right side LEDs connects to an anode of the LEDs on the left side (remember the LED pairs are connected in series).

Even if you decide against mounting the PCB in a "zippy" box, you would most likely still want to use the switch. The impact of the flashing eyeballs will be considerably reduced if you have to fiddle around with the battery connections. The switch – included in the positive supply line to the PCB – could be kept out of sight in your pocket or hand.

So go to it – and have fun!

As shown by the photograph above, the LEDs are glued inside of the lenses of the glasses and the wiring secured to the frame. The full-size printed circuit board pattern is shown at the right.



PARTS LIST

- *1 4011 quad NAND gate*
- *1 4017 decade counter*
- *10 1N4148 diodes*
- *6 light emitting diodes (LEDs)*
- *1 33μF/10VW electrolytic capacitor*
- *1 1μF/10VW non-polarised electrolytic capacitor*
- *1 .0015μF metallised polyester capacitor (greencap)*
- *2 220kΩ resistors (¼W, 5%)*
- *1 68Ω resistor (¼W, 5%)*
- *1 printed circuit board, 47 x 44mm, code 82eg12*
- *1 plastic utility (zippy) box, 83 x 53 x 24mm*
- *1 pair of dark glasses (see text)*
- *1 9V battery, Eveready 216 or equivalent (see text)*
- *1 snap connector to suit type 216 battery*
- *1 momentary contact pushbutton switch*

MISCELLANEOUS
Rainbow cable (see text, styrofoam, epoxy adhesive, solder etc.