bliplace.1.0

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Overview –

Bliplace is a wearable, hackable, sound-activated blinky light toy. It uses a small microcontroller and a mix of hardware and software feedback to automatically synchronize with and adapt to the sounds around it – it should pulse along with the ambient noises around you no matter if you're in a quiet park or a thunderously loud concert.

Bliplace uses ubiquitous CR2032 coin-cell batteries, which should be available virtually anywhere. The average power draw of Bliplace is well under 2 milliamps – a single battery should power it for around 150 hours, or a week of continuous use.

The Bliplace design is open-source, and all schematics and firmware are freely available.

Parts List –

1x Bliplace board

1x ATTiny25v microcontroller, pre-programmed (board label Bliplace)

1x electret microphone capsule (board location MIC)

3x ultra-bright white LEDs (board locations L1, L2, L3)

1x 0.1 microfarad ceramic capacitor (board location CN)

1x 47 microfarad, 6.3 volt capacitor (board location CP)

1x 4.7 microfarad, 50 volt capacitor (board location CF)

2x 100 ohm resistors (Brown Black Brown Gold, board location R2. You'll only need one of the two)

2x 1,000 ohm resistors (Brown Black Red Gold, board locations R3 and R1)

2x 10,000 ohm resistors (Brown Black Orange Gold, board locations RU and RD)

1x Battery Holder

1x CR2032 battery

Assembly Step 1 – Mount Chip

Insert chip into the center of the board, following the printed outline. Orientation _does_ matter - the top of the chip has a circular mark in one corner, and the pin next to this mark goes in the square hole. Solder the chip into place and cut the leads as flush as possible against the board without cutting into the board itself.

Step 2 - Resistors & Ceramic Capacitor

Bend the leads of the resistors down next to the resistor body so they form a staple shape. Insert the resistors and capacitor into their marked locations until they sit flush with the board (orientation does _not_ matter), then bend the leads flat against the board to hold them in place. Solder & clip the leads. The board has a small error – the hole labeled “SCK” on the back of the board is slightly too close to one of the resistor leads, so take care not to accidentally get solder onto it.

Step 3 - LEDs, Electrolytic Capacitor, Microphone

Orientation for these parts _does_ matter. Also, the two electrolytic capacitors look nearly identical so be sure to double-check their labels before mounting them. Insert the LEDs with their long lead in the _round_ hole and bend them flat against the board. Insert the capacitors with their long lead in the _square_ hole and bend the leads flat against the board. The microphone mounting point has two sets of holes, insert the mic into the bottom set and bend the leads flat against the board. Solder and clip all leads, being careful not to overload the microphone pins - the solder can leak down through the hole and short out against the metal case of the microphone.

Step 4 – Smoke Test & Battery Holder

Place the battery into the battery holder with the battery's label facing out. Then insert the battery holder into the back of the board - the pin at the squared-off end goes into the holes labeled PWR, the round end goes to GND. There are two holes for each of those labels, the battery holder fits in the rightmost of each pair – when mounted, the battery holder should be centered on the board.

Hold the board with one hand and twist the battery holder with the other so that the pins make contact with the sides of their holes – the LEDs should light up, do a short test pattern, and then begin responding to sound. If anything doesn’t seem to work, go to the Troubleshooting section. If everything seems OK, remove the battery and solder the battery holder leads into place from the front side of the board. Replace the battery, and you’re done!

Hacking Ideas

The top two holes can be used to connect the board to an external power source. Anything from 2.6 to 5 volts will work, though the LEDs will be dim at 2.6.

The side mounting holes can be used to reprogram the chip or to trigger external devices. Use test clips and follow the labels on the back of the board to connect the board to any AVRISP-compatible in-circuit programmer - the chip should be programmed at a ISP rate of 125 khz or less, otherwise the firmware may be corrupted. The holes labeled MOSI, MISO, and SCK are connected to pins 5, 6, and 7 of the ATTiny and can be used as general-purpose I/O pins.

The mounting holes are large enough to pass a small needle, allowing them to be sewn onto clothing. With some care and a reel of electrically-conductive thread, you can both bind the Bliplace to a shirt or jacket and power it at the same time. Standard 22-gauge insulated wire will also just barely fit – run a loop of wire through a hole and you can wear your Bliplace as a necklace, just be sure not to short out the pins by connecting them to bare wire or anything metallic (a metal necklace chain would be a bad idea).

Bliplaces are already quite bright, but they can be hacked to be much, much brighter. Replacing the included R1/R2/R3 resistors with lower values will increase the amount of current going through the LEDs – they'll run brighter, but the batteries won't last as long. Resistor values down to 33 ohms should be fine, though the Bliplace's internal feedback loop may become unstable (the LEDs will pulse even if there's no sound) if the LEDs draw more than 5 milliamps of current.

If you would like to use the Bliplace board to drive even higher power LEDs or other peripherals, consider driving them off a separate power supply and using a logic-level MOSFET with its gate connected to a positive LED pin or IO mounting hole on the Bliplace to control them. One of the ground holes on the Bliplace board must also be tied to the power supply's ground. Bliplaces have been used to sound-activate many watts' worth of LEDs and incandescent bulbs using this setup.

The analog input pins on the microcontroller can accept standard line-level audio signals – if you'd prefer to plug your Bliplace into your sound system instead of having it listen via microphone, the mounting holes for the ceramic capacitor (label CN) can be used to attach a standard RCA cable. The black wire of the cable should be attached to the left side of CN, the red wire to the right side.

With a bit of software modifications, Bliplace's microphone can be used as a button – when the microphone is touched or tapped, the sound of that tap shows up as a spike in the digitized audio signal. By adding some spike-detection code to Bliplace's main loop, you can make it change patterns or modes whenever the mic is tapped.

Troubleshooting –

Before you freak out, double-check your soldering. There should be solid connections to all the chip, LED, capacitor, and resistor pins – from the back of the board, all the mounting holes should appear full of solder and any remaining bit of pin or lead should be completely covered. If the hole looks hollow, add a small drop of solder.

Nothing happens when I insert the battery

Check that the battery is fully seated in the holder, flat side out. Check that the holder pins are making solid contact with their mounting holes. Check that the battery voltage is at least 2.6 volts. Check that the chip is oriented with the circular mark on the bottom left.

One of the LEDs doesn’t light up

Check the orientation of the LEDs – Hold the board horizontally so that you're looking at the LEDs from the outside. In each LED you should see a small metal wedge - those wedges should be pointing LEFT – RIGHT – RIGHT.

Check for shorts between the R1/R2/R3 resistors and neighboring pins. If you find a short, wipe it away with a clean soldering iron.

The LEDs light up, but the Bliplace doesn’t seem to respond to sound

Check capacitor placement – the 47 microfarad capacitor goes on the left and the 4 _point_ 7 microfarad capacitor goes on the right. The stripe marking on both capacitors should be facing towards the outside of the board.

Check for shorts against the microphone case – If you went overboard with the solder while attaching the microphone, some might have leaked down through the hole and down onto its metal case. Using a multimeter, check the resistance between the two microphone mounting holes – it should be around 1,000 ohms. If it’s less than 100, the microphone case is probably shorted against the board. If it’s more than 10,000, the microphone is likely damaged and should be replaced.