Simple “emergency” charger for small batteries

I recently needed to charge a small NiMH battery but had no charger on hand. So I quickly whipped up the following circuit using an Arduino board. Practically any microcontroller with an internal analog-to-digital converter (ADC) could be used similarly.

A low-value resistor is connected between the ADC-capable pin and the positive end of the battery. This pin must also be capable of being used as a digital output. The negative battery terminal connects to the microcontroller’s ground.

The Arduino sketch works as follows. The pin is initially configured to measure the voltage, using the ADC, to determine the battery’s stage of charge. The resistor has a low impedance compared to the ADC, so it does not affect the voltage reading.

If the battery is below its fully charged voltage, the pin is then driven high, putting energy into the battery via the resistor. Or, if the battery has reached its target voltage, the pin remains in a high-impedance state.

In either case, after a brief period, the pin is switched back to being an analog input and the process repeats. The Arduino’s onboard LED is used to indicate whether charging is occurring or has completed. The ADC voltage can also be displayed to the serial monitor if more detailed information is needed.

The sketch is available for download from the Silicon Chip website. Its default threshold is 1.4V, to suit a single NiMH or Nicad cell.

Assuming a 5V microcontroller, the threshold can be adjusted to suit LiPo (4.2V) or $LiFePO_4$ (3.6V) cells, or a battery of a few NiMH or NiCad cells in series.

The resistor value should be chosen to suit your micro and battery. Determine the micro’s maximum I/O pin current (40mA for an Arduino Uno and most Atmel AVR micros), then divide this by the difference between its supply voltage and the battery’s minimum (fully discharged) voltage.

So for example, if the battery could be as low as 1V, for an Arduino you could use 100Ω ([5V - 1V] ÷ 40mA). We’ve shown 150Ω in this case to be safe, as the cell could possibly be below 1V, and the micro’s supply could be a little bit above 5V. This limits the maximum current to around 33mA in the worst case.

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