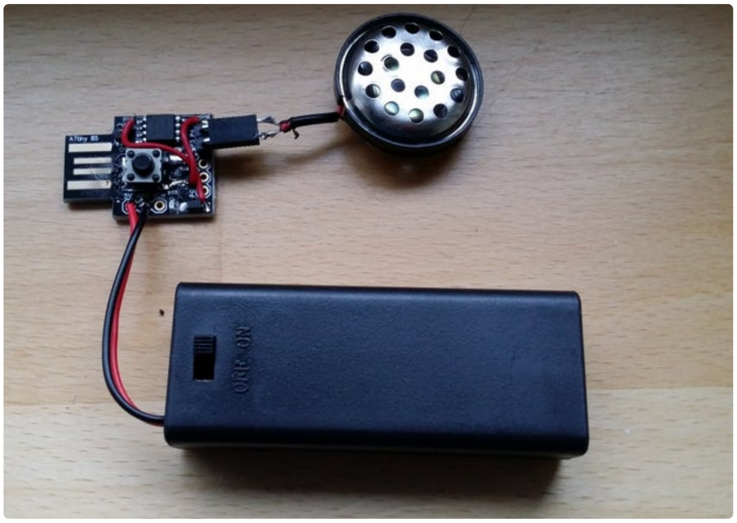
Arduino Open Window Detector - for Winter

by DerGlorreiche

It is getting cold outside, but sometimes I need some fresh air in my rooms. So, I open the window, leave the room, close the door and want to come back in 5 to 10 minutes. And after a few hours I remember that the window is open... Maybe you know this or have children, which give you this experience.

My solution is the Open Window Detector. The battery will last for over a year, so just place it in autumn and remove it in spring.



https://youtu.be/6l_QOM59nyc

Step 1: Parts List

1. **Digispark** board from eBay.
2. Old **headphones.**
3. Tiny **button** for reset.
4. **Connectors** for speaker - otherwise it is not possible to reprogram the board.
5. **Wire.**

6. For power supply you need:

- AAA battery case with on/off switch. You can even use worn out batteries, since the module will operate down to 2.4Volt.

OR

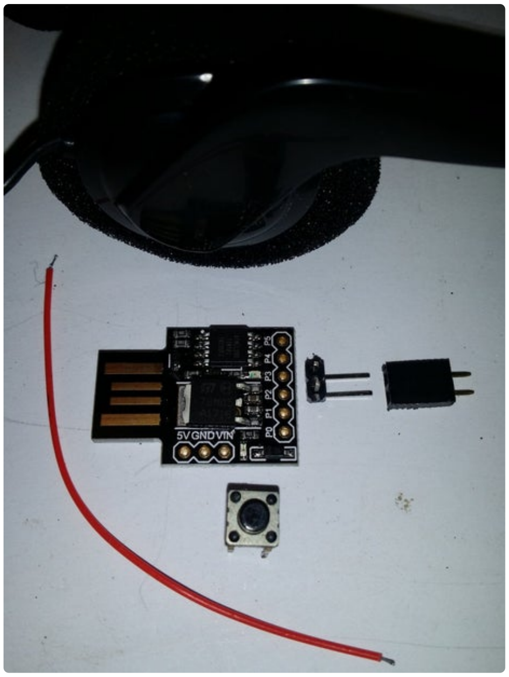
- Old lipo battery (even 30% capacity is sufficient for this purpose) and if you do not already have, a charger for lipo batteries from eBay.

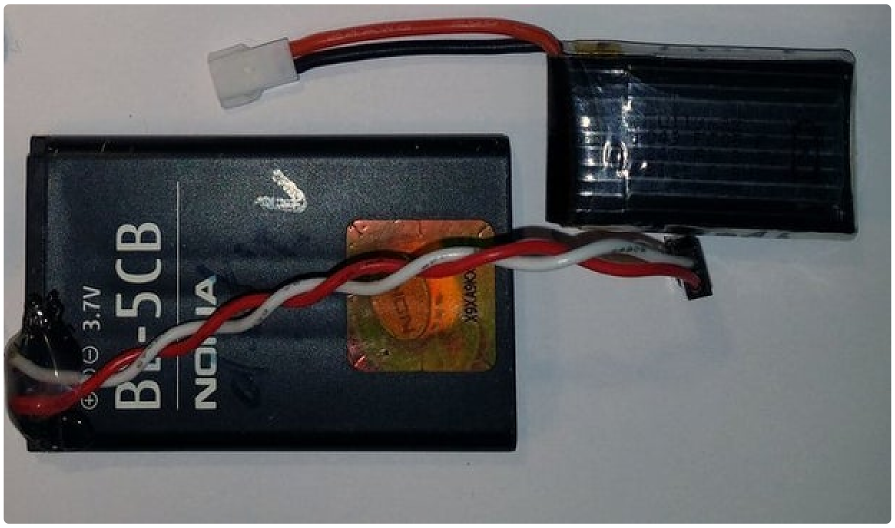
OR

- A holder for CR2032 coin cell

AND

- 1A diode 1N4001 or equivalent -or whatever you have in this size- for reverse polarity protection.





Step 2: Programming the Digispark Board

Driver installation
You must install the **Digispark driver** before you can program the Board. Download it here, open it and run "*InstallDrivers.exe*".

Installation of Arduino IDE
Install the Digispark board for the Arduino IDE as described in http://digistump.com/wiki/digispark/tutorials/connecting

I recommend to use as Digispark board URL in Arduino *File/Preferences* the new **https://raw.githubusercontent.com/ArminJo/DigistumpArduino/master/package_digistump_index.json** instead of **http://digistump.com/package_digistump_index.json** and install the **Digistump AVR Boards** version **1.6.8**.

Since we want to save power, the board clock is switched to 1 MHz in our setup() you may choose **Digispark (1mhz - No USB)** as board in the *Tools* menu.

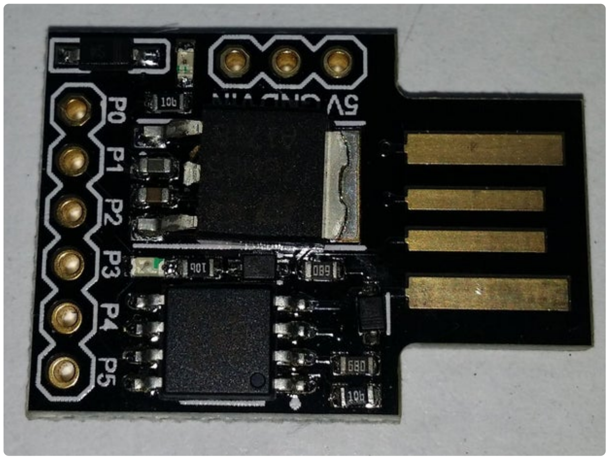
Compile and upload the program to the board

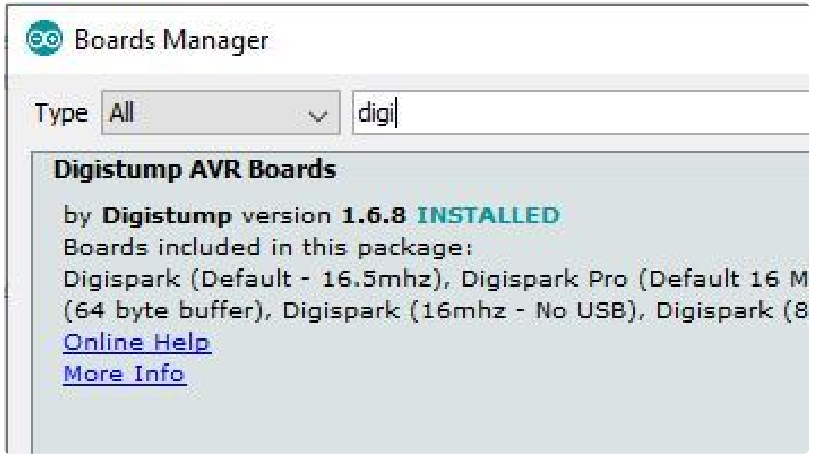
In the Arduino IDE create a new sketch with *File/New* and name it e.g. "*OpenWindowAlarm*". Copy the code from OpenWindowAlarm.ino

OR

Download and extract the repository. Open the sketch with *File -> Open...* and select the "*OpenWindowAlarm*" folder.

Compile and upload it. Keep in mind, that upload will not work if the speaker is connected. If everything works well, the built-in LED of the Digispark will blink 5 times (for the 5 minutes alarm delay) and then start flashing after 8 seconds with an interval of 24 seconds to signal each temperature reading.




Boards Manager

Type All digi

Digistump AVR Boards

by Digistump version 1.6.8 INSTALLED
Boards included in this package:
Digispark (Default - 16.5mhz), Digispark Pro (Default 16 M
(64 byte buffer), Digispark (16mhz - No USB), Digispark (8
Online Help
More Info

Step 3: Power Reduction

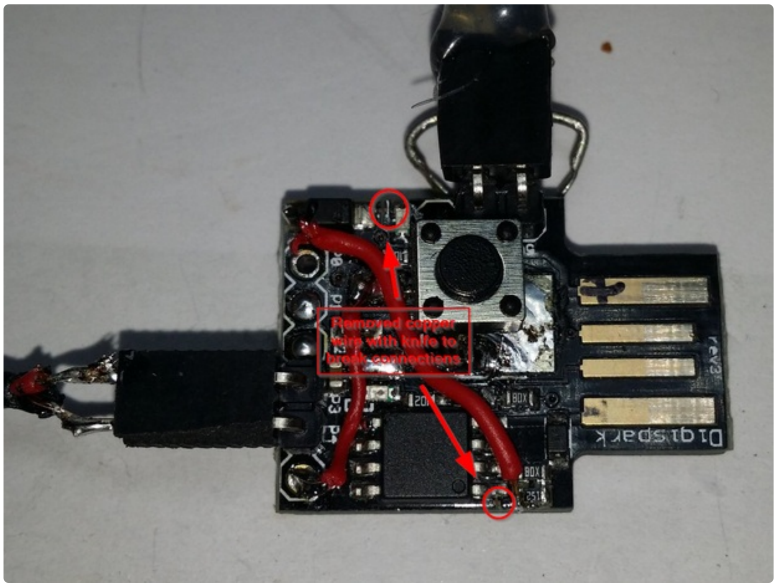
Our Digispark board uses **5mA at 3,0 volt**. With 2 AAA batteries (1000mAh) it will run for 8 days. But it is possible to **reduce power consumption down to 26 µA** in 3 Steps.

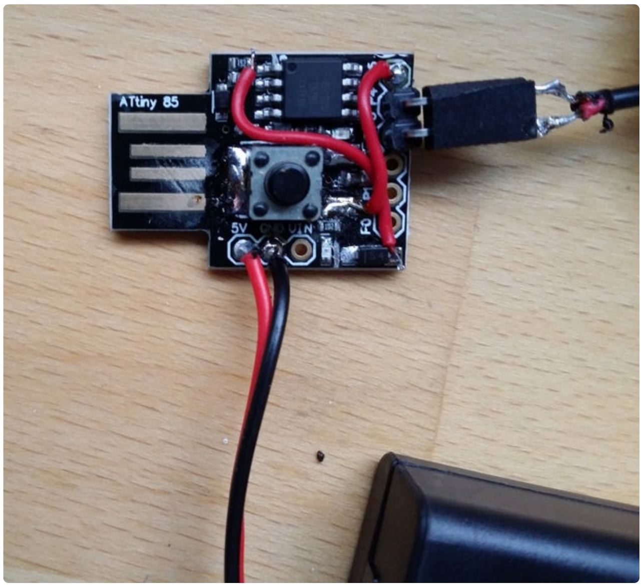
1. **Disabling the power LED** by breaking the copper wire that connects the power LED to the diode with a knife or removing / disabling the 102 resistor saves 1.3 mA.
2. **Removing the VIN voltage regulator** saves 1.2 mA.
3. **Disconnecting the USB Pullup resistor** (marked 152) from 5 Volt (VCC) saves the remaining 2.5 mA. Disconnect it by breaking the copper wire on the side of the resistor that points to the ATTiny. **This disables the USB interface** and in turn the possibility to program the Digispark board via USB. To **enable it again**, but still save power, **connect the resistor (marked 152) directly to the USB 5 volt** that is easily available at the outer side of the diode. The correct side of the diode can be found by using a continuity tester. One side of this diode is connected to pin 8 of the ATtiny (VCC). The other side is connected to USB 5 volt.

Now the USB pullup resistor is only activated if the Digispark board is connected to USB e.g. during programming and the board consumes 26 µA during sleep.

If you **reprogram the fuses**, you can get **6 µA** power consumption.

To reprogram the fuses, you need an ISP (which can be build with an Arduino) and a connecting adapter.
For reprogramming you can use the this script.

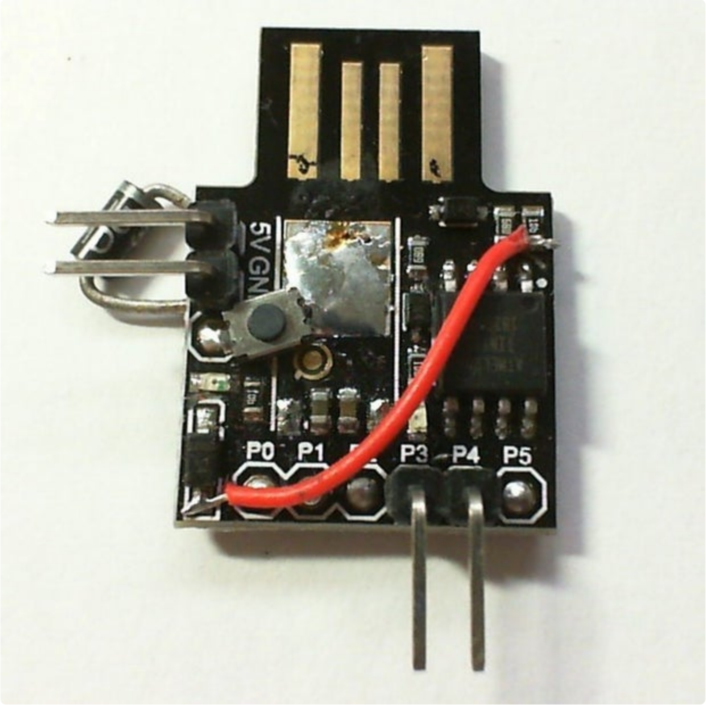


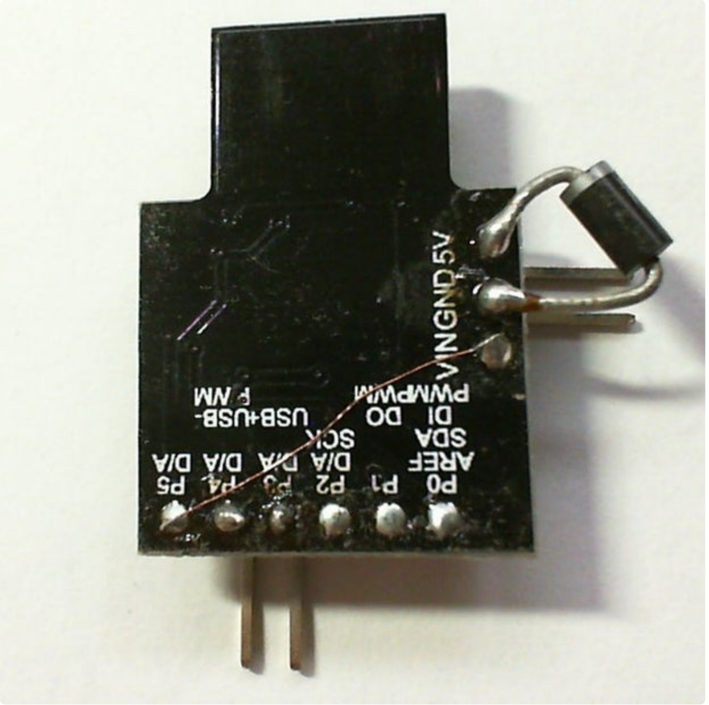


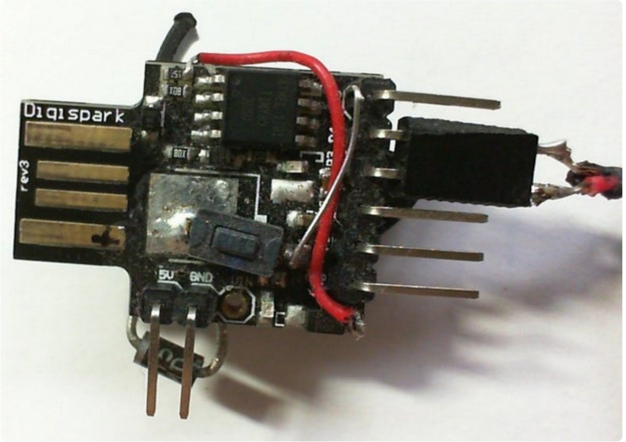
Step 4: Reset Button

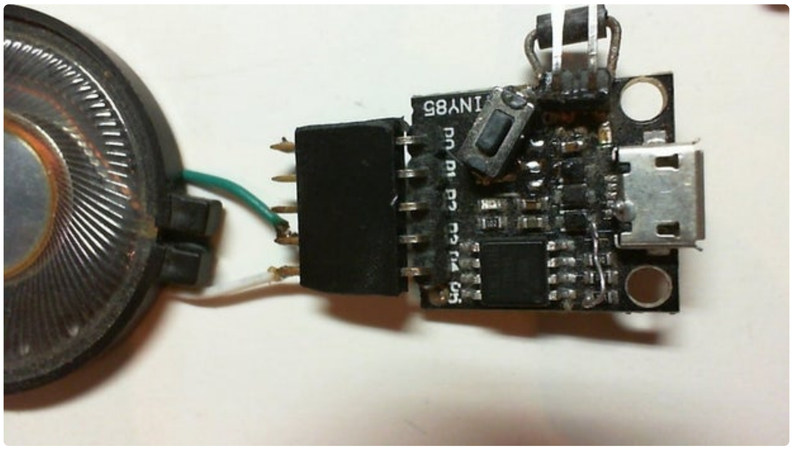
If you do not want to remove power to reset the alarm, connect a reset button between PB5 and ground. I did this by connecting the unconnected VIN copper surface to PB5 and soldering the reset button directly to the VIN pin hole and the big ground surface of the removed VIN voltage regulator.

If you want to **get rid of the 5 seconds wait** for USB connection **after reset**, you can change the micronucleus kernel on the ATtiny85. Run the "0_Burn_upgrade-t85_recommended.*cmd*" script and then reload the OpenWindowAlarm application again with the Arduino IDE.



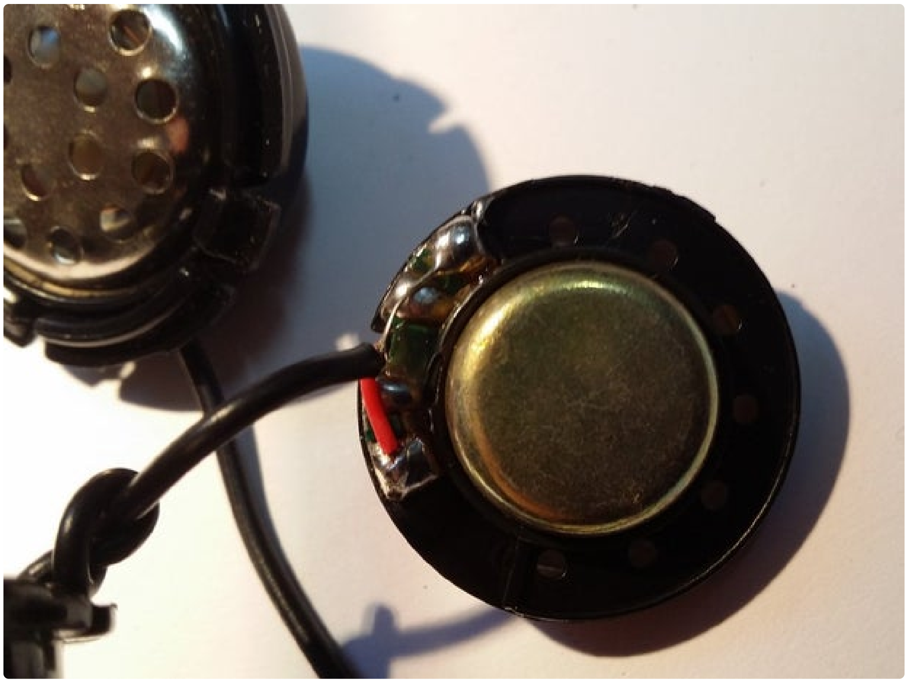


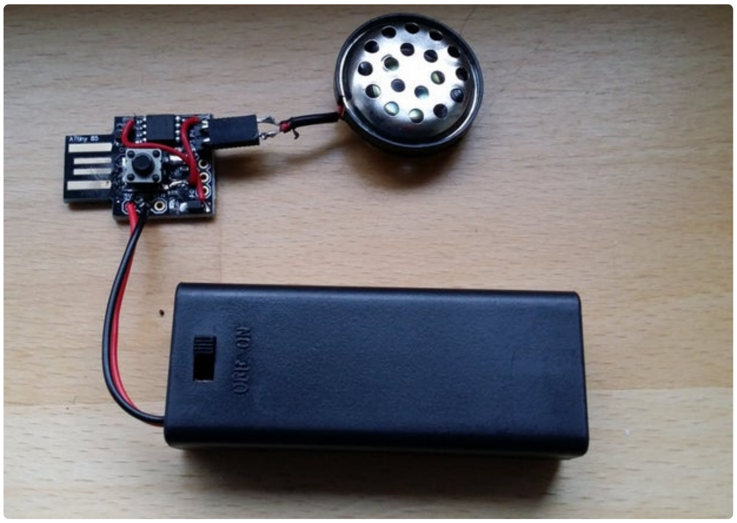




Step 5: Speaker

I disassembled an old headset and connected the male connector to the cable.





Step 6: Operating

To use the board place it on a windowsill and connect it to a battery.
If the temperature on the sill is lower than the temperature where the board was originally located it will take an additional 5 Minutes to intelligently adopt to the new start value.

You will then be alarmed if you leave the window open longer than five minutes.

Internal Operation

- An open window is detected after TEMPERATURE_COMPARE_AMOUNT * TEMPERATURE_SAMPLE_SECONDS (48) seconds of reading a temperature with a value of TEMPERATURE_DELTA_THRESHOLD_DEGREE (2) lower than the temperature TEMPERATURE_COMPARE_DISTANCE * TEMPERATURE_SAMPLE_SECONDS (192 -> 3 minutes and 12 seconds) seconds before.

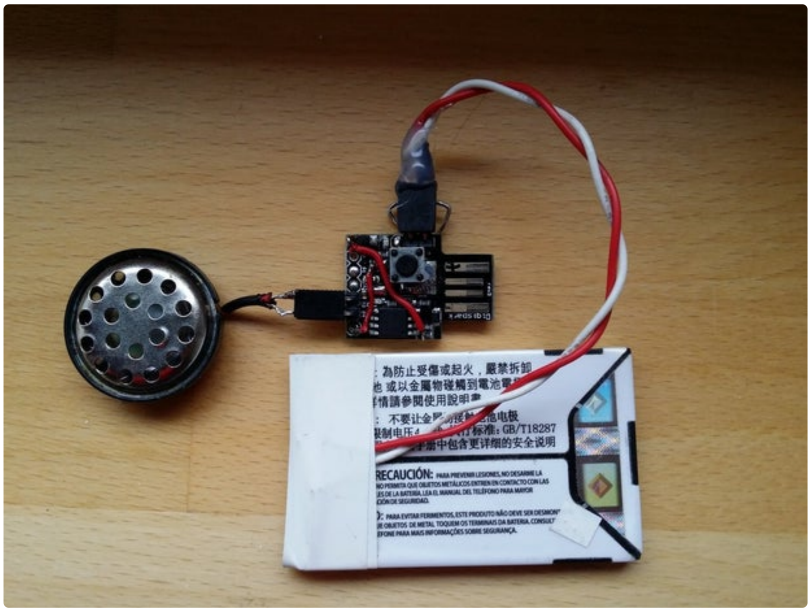
- The delay is implemented by sleeping 3 times at `SLEEP_MODE_PWR_DOWN` for a period of 8 seconds to reduce power consumption.
- A detection of an open window is indicated by a longer 20ms blink and a short click every 24 seconds. Therefore, the internal sensor has a time of 3 minutes to adjust to the outer temperature in order to capture even small changes in temperature. The greater the temperature change the earlier the sensor value will change and detect an open window.
- `OPEN_WINDOW_ALARM_DELAY_MINUTES` (5) minutes after open window detection the alarm is activated.

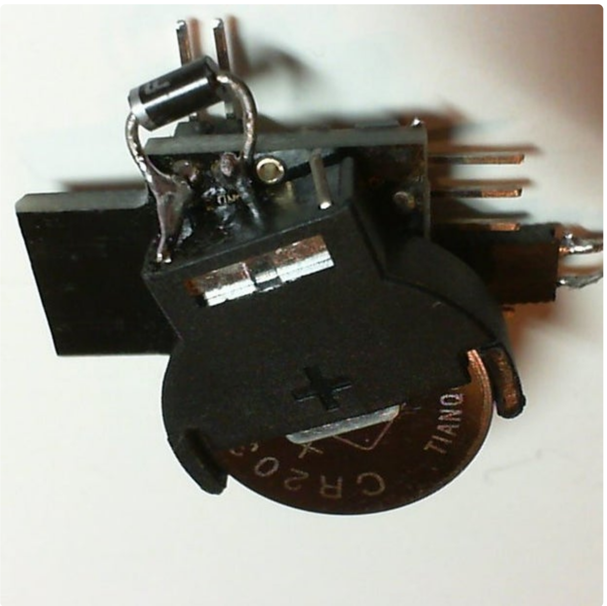
  The alarm will not start or an activated alarm will stop if the current temperature is greater than the minimum measured temperature (+ 1) i.e. the window has been closed already.

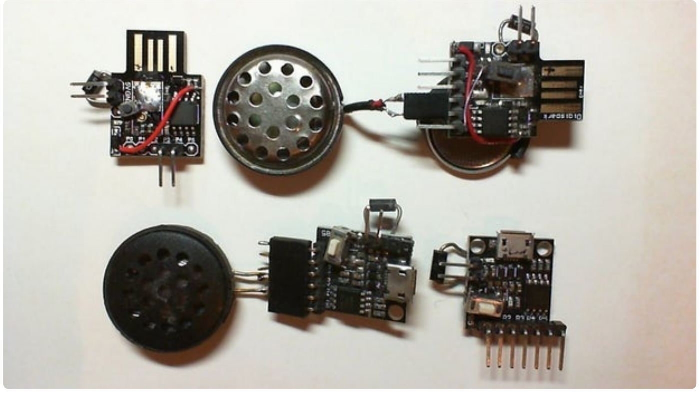
- The initial alarm lasts for 10 minutes. After this it is activated for a period of 10 seconds with a increasing break from 24 seconds up to 5 minutes.

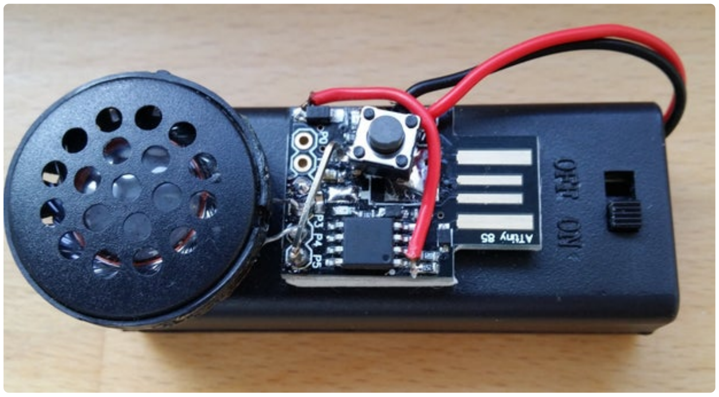
- Every VCC_MONITORING_DELAY_MIN (60) minutes the battery voltage is measured. Depending on the detected battery type at power up (see VCC_VOLTAGE_LIPO_DETECTION (3.6 volt)), a battery voltage below VCC_VOLTAGE_LOWER_LIMIT_MILLIVOLT_LIPO (3550) or VCC_VOLTAGE_LOWER_LIMIT_MILLIVOLT_STANDARD Millivolt is indicated by beeping and flashing the LED every 24 seconds. Only the beep (not the flash) is significantly longer than the beep for an open window detection.

- After power up, the inactive settling time is 5 minutes. If the board is getting colder during the settling time, 4:15 (or 8:30) minutes are added to avoid false alarms after power up.









I could see this being useful. My kids forget windows all the time.