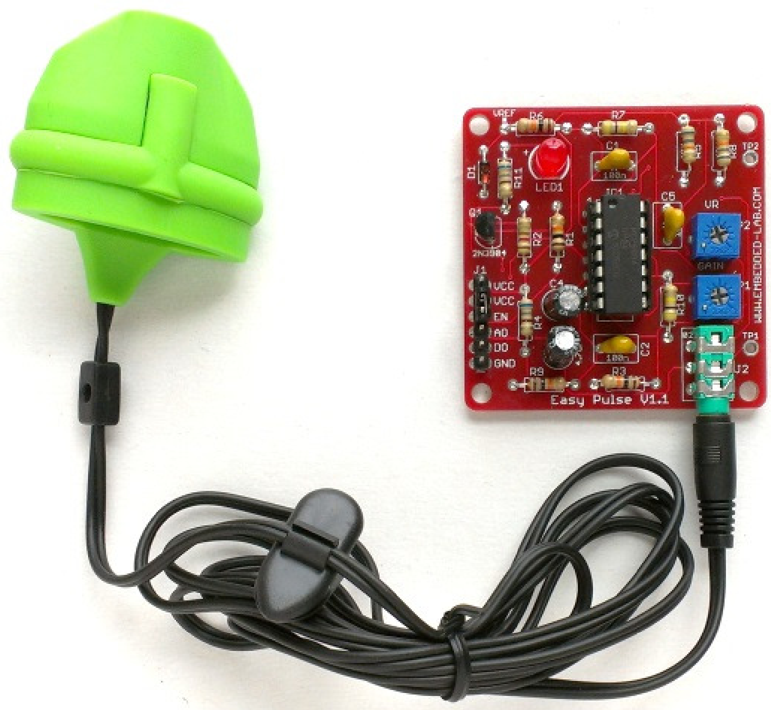
Easy Pulse Sensor (Version 1.1)

Easy Pulse is a DIY pulse sensor that can be used for detecting the cardio-vascular pulse wave from a fingertip. It is designed for hobby and educational applications to illustrate the principle of photoplethysmography (PPG), which is a non-invasive optical technique of retrieving vital information about the cardiovascular system from the skin surface. It uses an infrared light source to illuminate the finger on one side, and a photodetector placed on the other side measures the small variations in the transmitted light intensity. The variations in the photodetector signal are related to changes in blood volume inside the tissue. The signal is filtered and amplified to obtain a nice and clean PPG waveform, which can be thus used to derive the instantaneous heart rate. The Easy Pulse sensor also provides a digital pulse output which is synchronous with the heart beat.



Features:

- Operates at +5V power supply (Do not use USB power source)
- Two stage Filtering and Amplification using MCP6004 Op-Amp
- Rail-to-rail output voltage swing
- Analog PPG and digital pulse output
- Potentiometer based gain control

Tips:

Easy Pulse sensor can be easily interfaced with PIC, AVR, or any other microcontroller platform. Heart beat can be computed using any of the following two approaches:

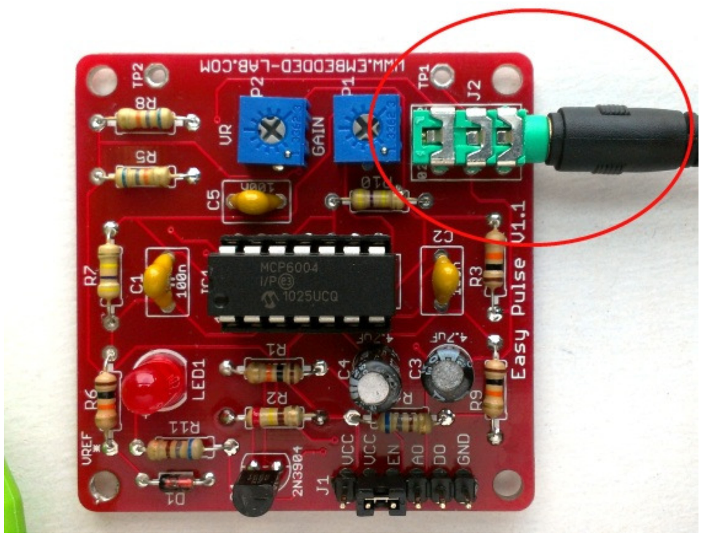
1. By tracking the peaks in the analog PPG waveform.
2. By computing the frequency of the digital pulse output, which is synchronous to the heart beat.

For a full description of Easy Pulse visit http://embedded-lab.com/blog/?p=7336

Test procedures for Easy Pulse Version 1.1 Sensor Board

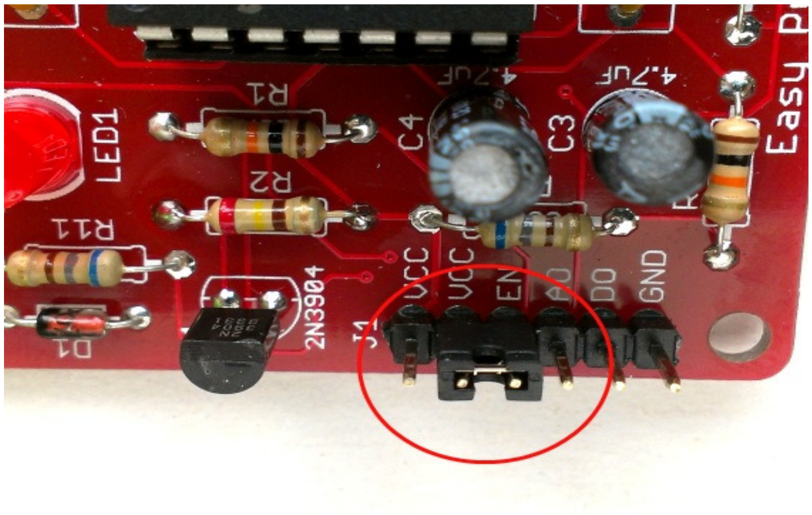
Step 1

Insert the HRM-2511E sensor jack in to the 3.5mm audio connector (J2) on the Easy Pulse board.



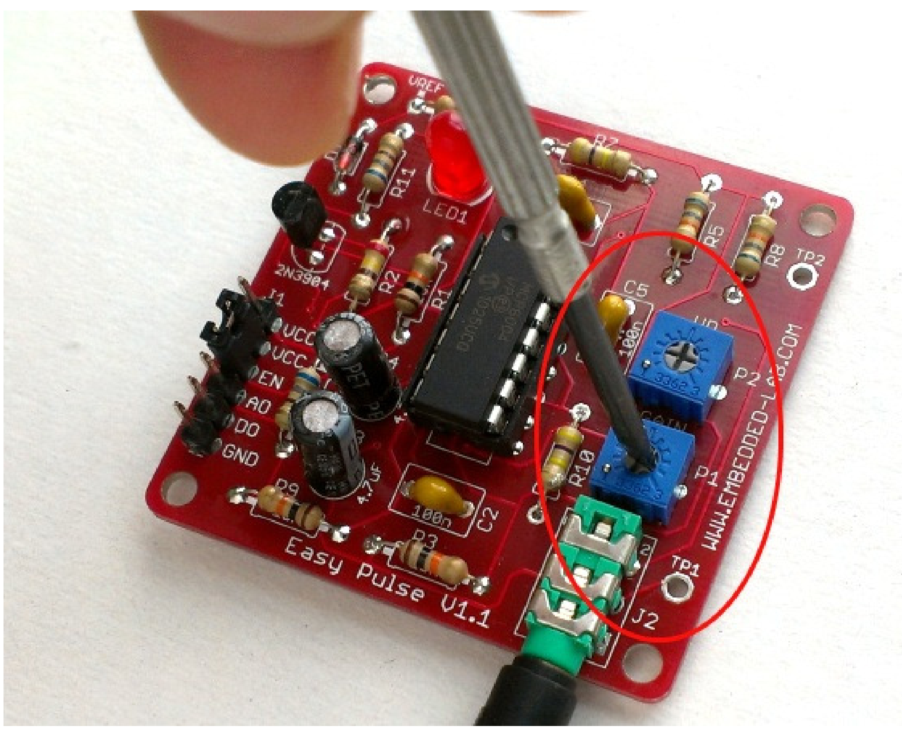
Step 2

Make sure the 2-pin shunt jumper is placed between VCC and EN pins of the J1 header. This pulls the EN signal to VCC, and the IR LED inside the sensor is turned on.



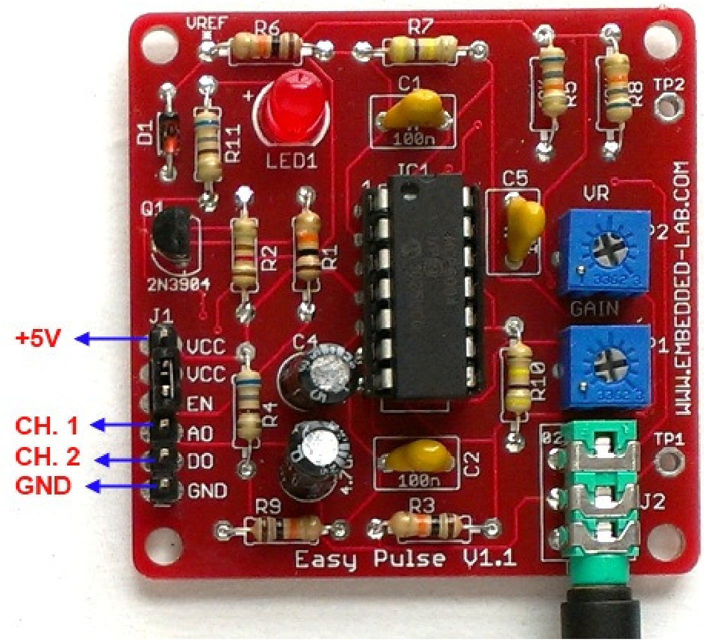
Step 3

Using a screw driver, set the wiper positions of the two potentiometers, P1 and P2, to middle. P1 controls the gain of the PPG amplifier, while P2 controls the width of the digital pulse output at DO pin of J1.



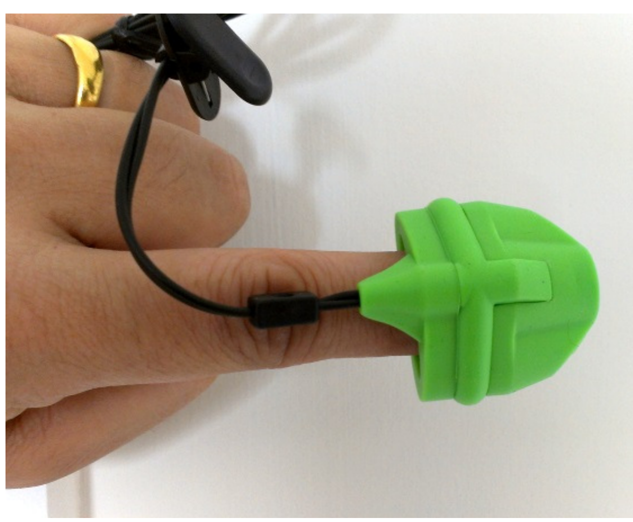
Step 4

Now connect a +5V power supply between the remaining VCC and GND pins of J1. Also connect AO and DO pins to two channels of an oscilloscope. At AO, you will see an analog PPG signal, whereas DO provides a digital pulse wave which is synchronous to the heart beat. If you don't have an oscilloscope, go to next step. **Avoid using USB power supply to power this board. USB port may not provide sufficient current to operate the sensor, which results in poor performance.**



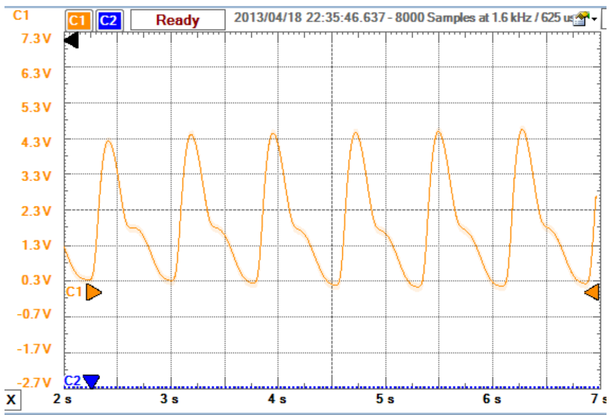
Step 5

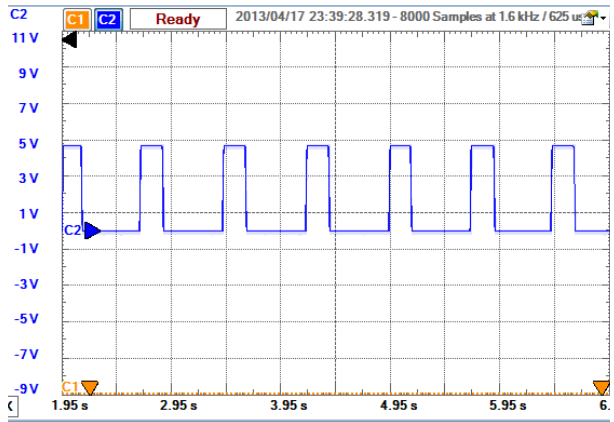
Now plug-in the sensor on to the tip of your index finger as shown below. You should be sitting on a chair in a relax position. Try to keep your hand as still as possible.



Step 6

The sensor takes about 2-3 seconds to stabilize. After that you should be seeing the analog PPG and digital pulse waveforms on your oscilloscope, as shown below. If you don't have an oscilloscope, you can look at the on-board LED (LED1) which should blink synchronously with your heart beat.





Additional Tips

1. If the analog signal is chopped off or saturated, you can reduce the gain by slowly rotating the potentiometer P1 towards anti-clockwise direction. Once P1 is set, you can then play with the potentiometer P2 to obtain a nice digital pulse output at DO pin.
2. If you find the sensor outputs are very poor, noisy, or random, take the sensor out of the finger tip, and squeeze it once or twice as shown below. Then place it back and try again.

For any further question, email **admin [at] embedded-lab.com**