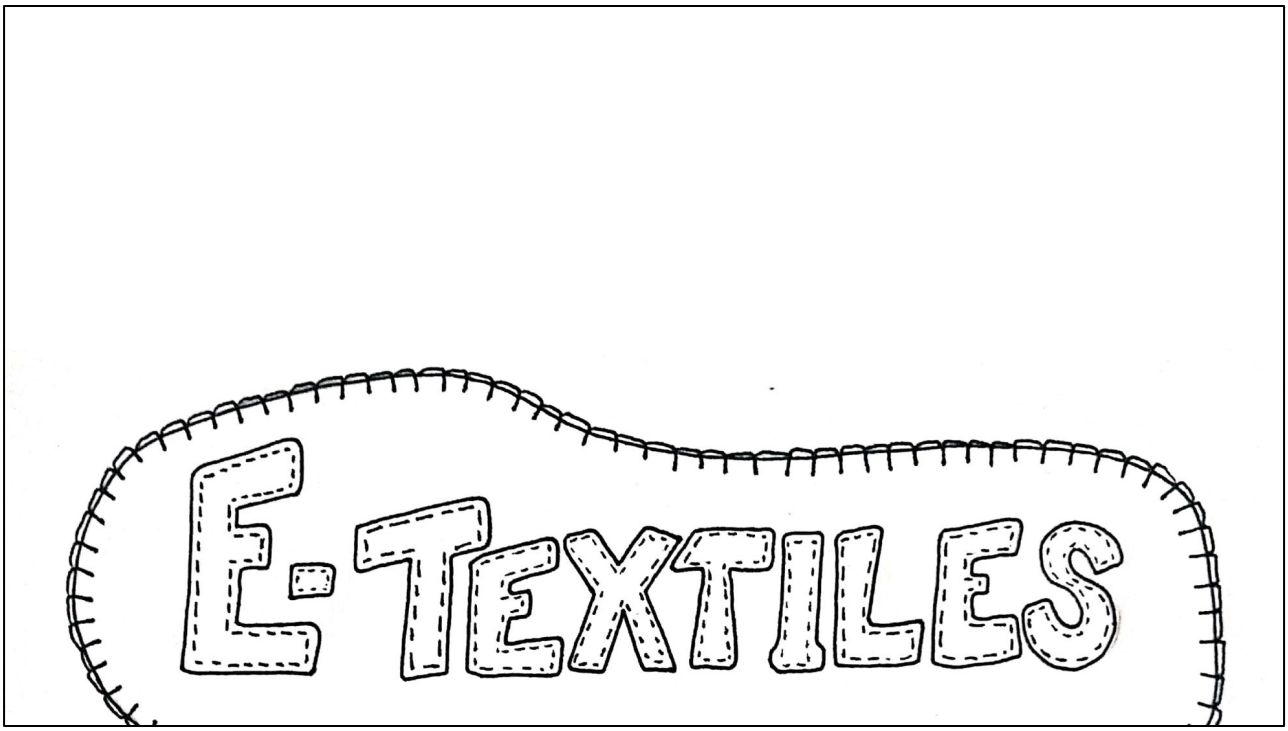
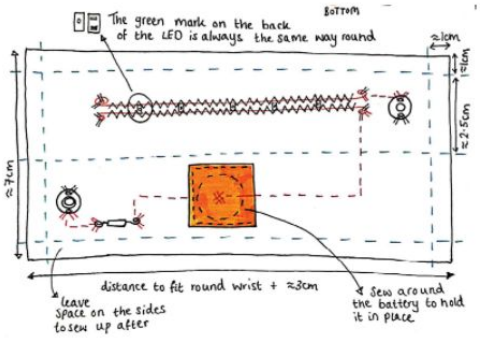
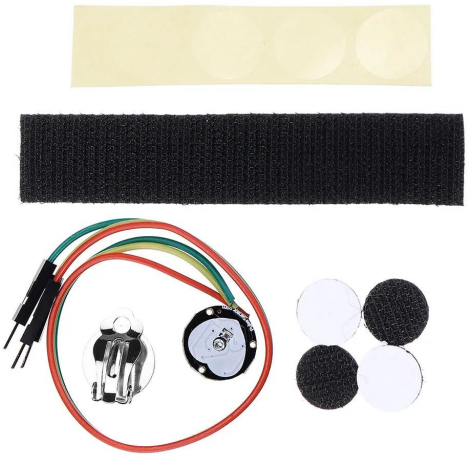

E-TEXTILES

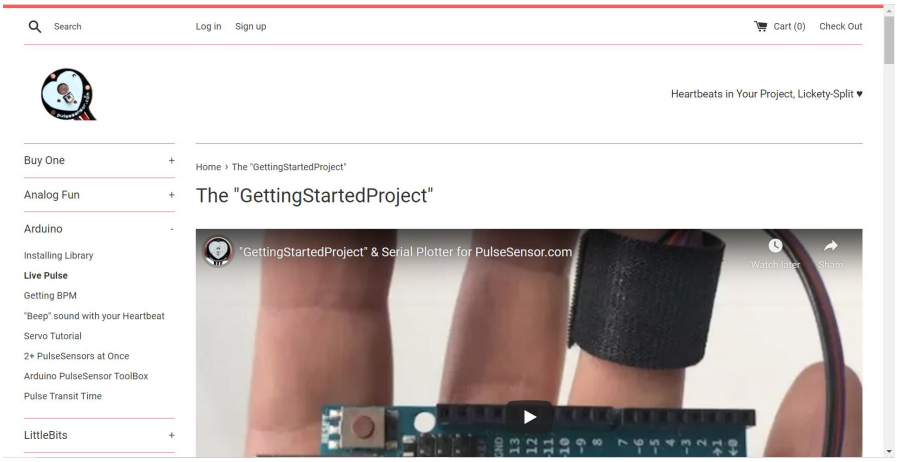


Recap over Day 6:
We looked at the construction of the LED fabric bracelet which involved a simple circuit integrated with E-Textiles.

Pulse sensor

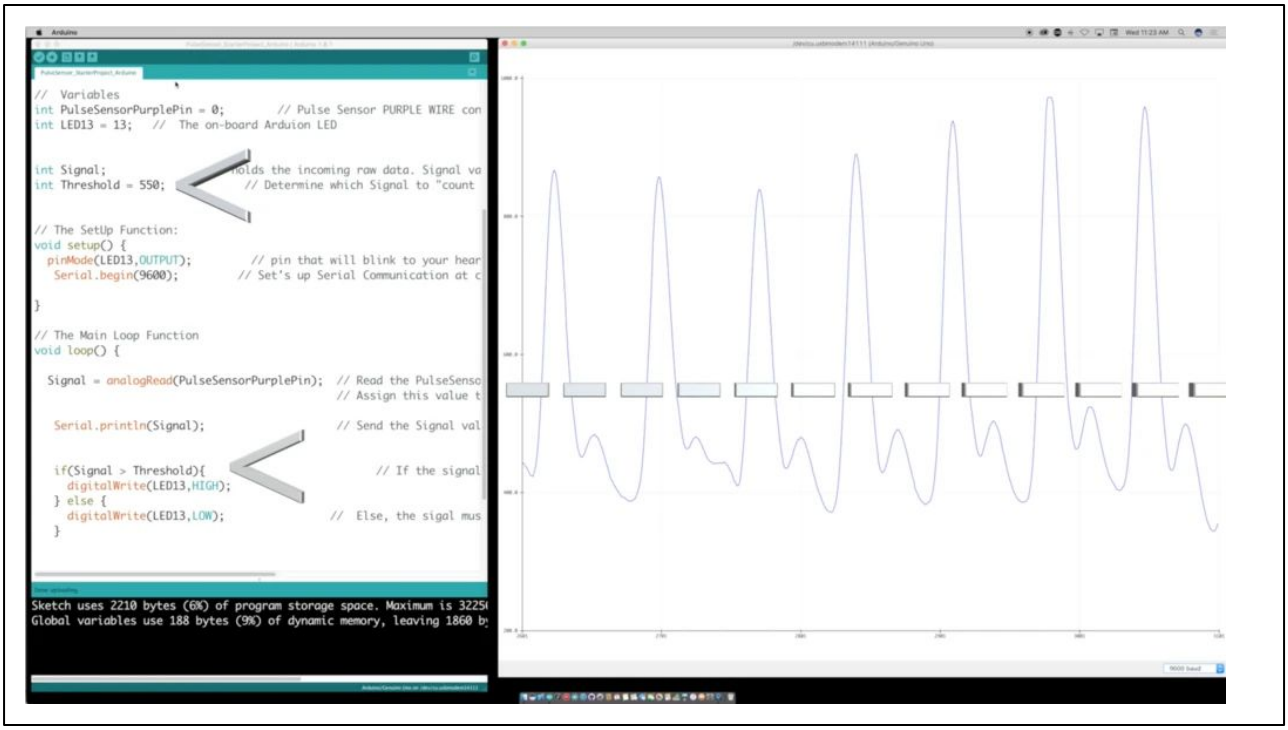


In this session we looked at the pulse sensor and how it works.
The pulse sensor is a component that can be purchased online. It is able to record your heart rate when used with an Arduino.
The following items come with the sensor. To work properly it need to be constructed following the instructions found on the tutorial.



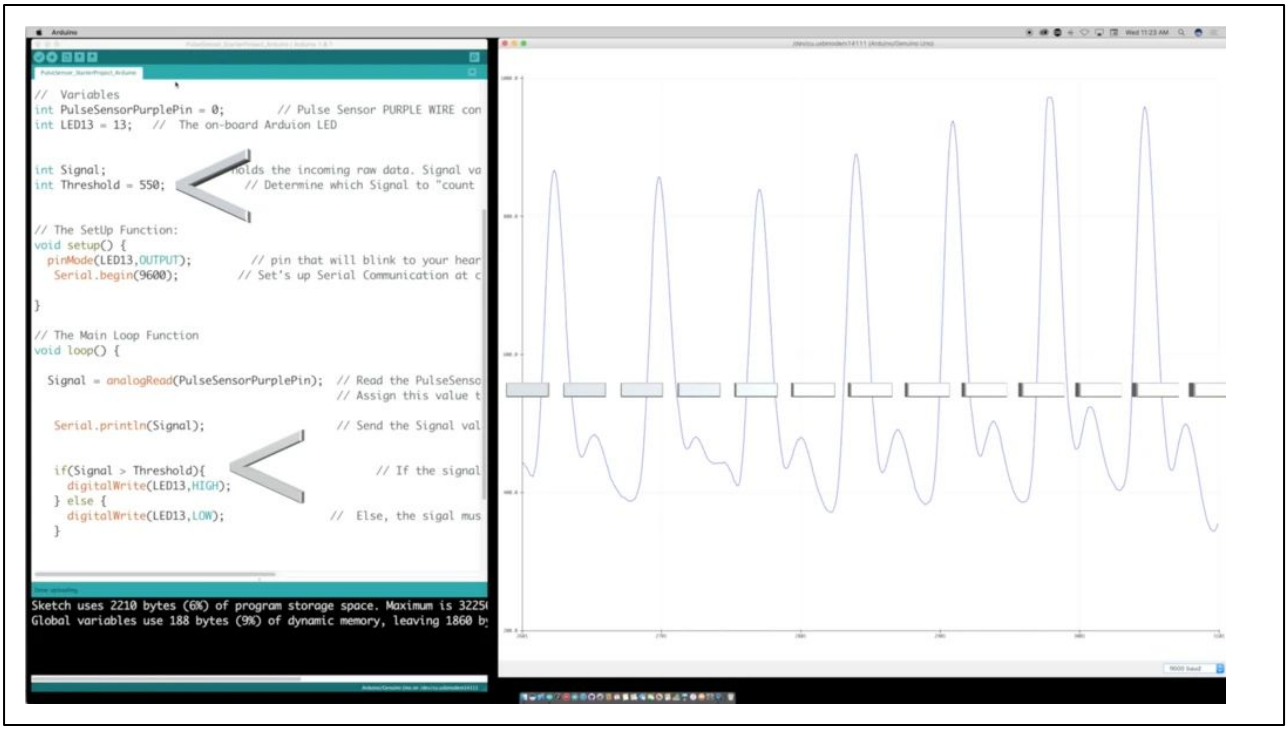
https://pulsesensor.com/pages/code-and-guide

The pulse sensor is an open-source piece of kit. This means that all the information of how to use it can be found online.
You need to download the library in Arduino IDE to be able to access the pre-made codes.
This website then provides all the information to be able to use these codes and for example, be able to read your heart rate using the sensor with Arduino.
For the LED sensor we are only required to look at the ‘Getting Started project’, this project gets an LED to flash every time your heart beats.
This can then be integrated with the fabric bracelet to make the bracelet flash every time your heart beats.



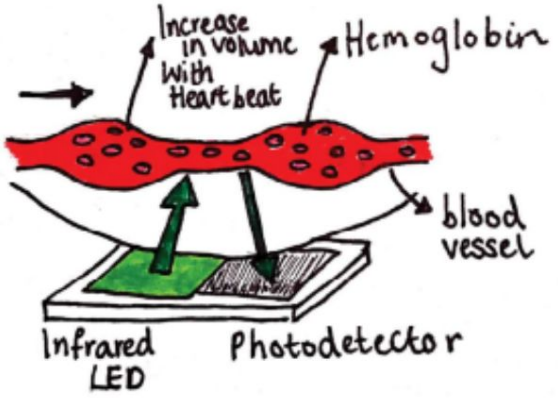
Here is the code for the ‘Getting started project’
This is how it looks in the Arduino IDE window
Once the code is uploaded to the Arduino and the arduino is correctly connected to the LED and pulse sensor (diagram provided in the tutorial), the LED should flash with your heart rate.

The pulse sensor might take some time to settle and for the noise to reduce which will then allow the heart beat to be recognised.
From this image you can see that the signal received from the pulse sensor is provided in a graph.
To access this graph you need to open your serial plotter (tools > serial plotter)
Make sure you have selected the correct baud.
In the code this is defined at ‘Serial.begin(9600)’ so 9600 needs to be selected on the plotter.



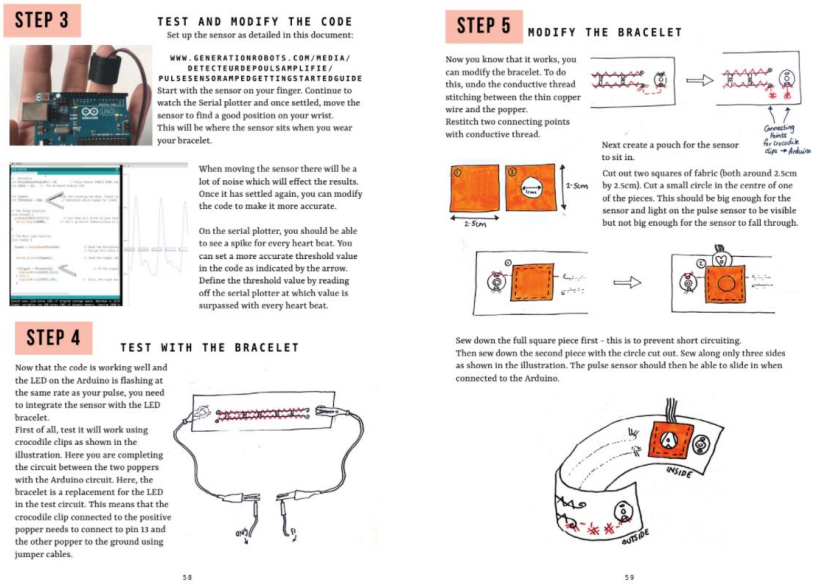
How does the code work?

The arduino is recognising your heart beat by receiving a signal from the pulse sensor.
This signal is then plotted onto the serial plotter.
The led then flashes whenever this signal is greater than a set value which corresponds to the peak in the signal that happens when your heart beats.
As you can see on this image, the first arrow is pointing to the part of the code which is specifying the threshold value
The second area points to the part of the code which is telling the LED to flash when the received signal is greater than this threshold value
On the graph, on the right, it's represented as a dashed line. Everytime our heart beats, there is a large peak in the signal which clearly crosses this line, causing the LED to flash.



How is the signal from the pulse sensor created?

The pulse sensor uses infrared light to create a signal for recognising the heart beat.
As we can see from the image, the infrared light is shone onto the body part (usually a finger or earlobe).
When you shine a light through these parts of your body, you can see that it glows.
This is because it does not block all the light and some light is able to travel through it.
Our pulse sensor is reaching how much light is reflected back from the body part.
Inside your finger, you have your blood vessels where the blood is flowing through.
Everytime your heart beats, more blood is pushed through and the blood vessels increase in volume.
When there is more blood, there is a higher density of blood cells. In particular, there is more hemoglobin. These are oxygen-carrying blood cells, which absorb light.
Therefore, the more hemoglobin there is (the higher the density), the more light is being absorbed.
This means that everytime the blood vessels increases in size, due to a beat of the heat, the more hemoglobin that is present, and the more light that is absorbed.
The results in less light being reflected back to the detector on the pulse sensor.
These fluctuations in the amount of light being detected, help us to see the rhythm of the heart rate.



STEP 3

TEST AND MODIFY THE CODE

Set up the sensor as detailed in this document:

WWW.GENERATIONROBOTS.COM/MEDIA/DETECTEURDEPOULSAMPLIFIE/PULSESENSORAMPEDGETTINGSTARTEDGUIDE

Start with the sensor on your finger. Continue to watch the Serial plotter and once settled, move the sensor to find a good position on your wrist. This will be where the sensor sits when you wear your bracelet.

When moving the sensor there will be a lot of noise which will effect the results. Once it has settled again, you can modify the code to make it more accurate.

On the serial plotter, you should be able to see a spike for every heart beat. You can set a more accurate threshold value in the code as indicated by the arrow. Define the threshold value by reading off the serial plotter at which value is surpassed with every heart beat.

STEP 4

TEST WITH THE BRACELET

Now that the code is working well and the LED on the Arduino is flashing at the same rate as your pulse, you need to integrate the sensor with the LED bracelet.
First of all, test it will work using crocodile clips as shown in the illustration. Here you are completing the circuit between the two poppers with the Arduino circuit. Here, the bracelet is a replacement for the LED in the test circuit. This means that the crocodile clip connected to the positive popper needs to connect to pin 13 and the other popper to the ground using jumper cables.

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STEP 5

MODIFY THE BRACELET

Now you know that it works, you can modify the bracelet. To do this, undo the conductive thread stitching between the thin copper wire and the popper.
Restitch two connecting points with conductive thread.

Next create a pouch for the sensor to sit in.

Cut out two squares of fabric (both around 2.5cm by 2.5cm). Cut a small circle in the centre of one of the pieces. This should be big enough for the sensor and light on the pulse sensor to be visible but not big enough for the sensor to fall through.

Sew down the full square piece first - this is to prevent short circuiting.
Then sew down the second piece with the circle cut out. Sew along only three sides as shown in the illustration. The pulse sensor should then be able to slide in when connected to the Arduino.

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After understanding how the pulse sensor works and how to programme it correctly with the arduino, you will then be able to integrate it with the LED bracelet, to create and interactive wearable item! The tutorials for doing so are provided on huge academy.