











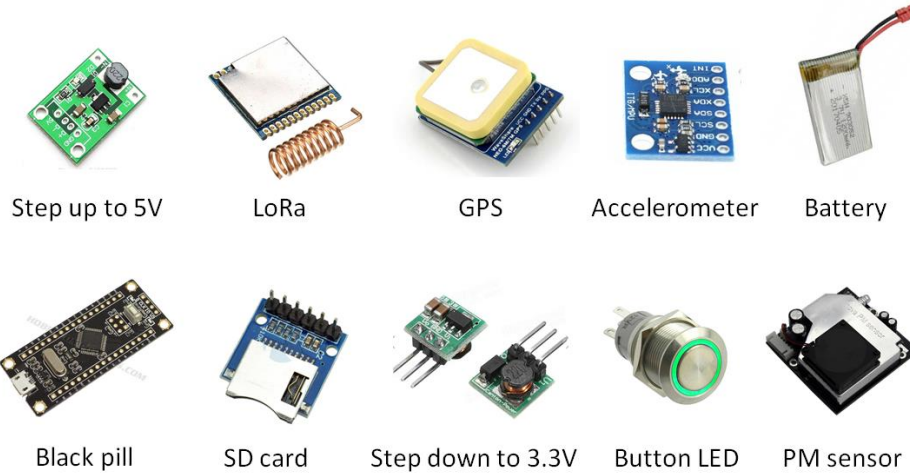
# Assemble your CamBike Sensor hub

## Main components

Below you can find the proposed main components to build the CamBike Sensor hub. They are all off-the-shelf components that can be bought from diverse suppliers. Feel free to get alternative ones if you prefer!

-  **Microcontroller:** STM32F103C8T6, also known as STM32 Black Pill (<https://aliexpress.com/item/STM32F103C8T6-ARM-STM32-Minimum-System-Development-Board-Module-Forarduino/32342717171.html>)
-  **GPS:** NEO-6M V2 GPS, for geolocalisation (<https://aliexpress.com/item/1Set-Ublox-NEO-6M-GPS-Module-GY-GPS6MV2-NEO6MV2-Buit-in-EEPROM-APM2-5-Antenna-3V/32828254679.html?spm=a2g0s.9042311.0.0.dcdb4c4dLz8S2N>)
-  **Particulate Matter (PM) sensor:** SDS011, which measures PM10 and PM2.5 (<https://www.banggood.com/Nova-PM-Sensor-SDS011-High-Precision-Laser-PM2.5-Air-Quality-Detection-Sensor-Module-p-1144246.html?rmmds=myorder>). If you are interested in knowing more about why it is important to measure particulate matter and about how this sensor works, have a look to the Particulate Matter section!
-  **Accelerometer and Gyroscope:** Arduino 6-axis GY-521 (<https://aliexpress.com/item/GY-521-MPU-6050-MPU6050-Module-3-Axis-analog-gyro-sensors-3-Axis-Accelerometer-Module/32340949017.html?spm=a2g0x.10010108.1000016.1.61217c6eY4qKIV&isOrigTitle=true>)
-  **SD card module:** to record all the data (<https://aliexpress.com/item/2PCS-TF-Micro-SD-Card-Module-Mini-SD-Card-Module-Memory-Module-for-Arduino-ARM-AVR/32669487176.html>)
-  **LoRaWAN radio:** NiceRF Lora1276, for low-power wireless transmission of data (<https://aliexpress.com/item/50sets-lot-LoRa1276-long-range-4Km-868MHz-915MHz-sx1276-Radio-transceiver-Lora-modules-with-FCC-certificate/32473481271.html?spm=a2g0s.9042311.0.0.78ca4c4dMo9yOd>). If you would like to know more about LoRaWAN and Low-Power Wide-Area Networks (LPWAN) check out this section!
-  **Battery:** Lithium polymer flat 3.7V 1200 mAh battery with protective circuits against over-charge, over-discharge, short-circuit and over-current (<http://www.sztopenergy.com/lithium-polymer-battery/products-of-lithium-polymer-battery/lp703448-3-7v-1200mah-lithium-polymer-battery.html>)
-  **Step-up voltage regulator:** Boost from 1.5 V to 5 V, to increase the battery voltage from 3.7 V to 5 V. It is needed to power some of the components, such as the PM sensor (<https://aliexpress.com/item/5V-DC-DC-Converter-Step-Up-Power-Supply-DC-DC-Booster-Boost-Buck-Converter-Board-Step/32813355879.html?spm=a2g0s.9042311.0.0.78ca4c4dMo9yOd>)
-  **Step-down voltage regulator:** Buck from 6-3.3 V to 3.3 V, to decrease the battery voltage from 3.7 V to 3.3 V and to power most of the components (<https://www.banggood.com/15pcs-DD0503MA-DC-3.3-6V-To-3.3V-Step-Down-Converter-Buck-Module-For-18650-ESP8266-CC1101-SI4432-p-1226186.html?rmmds=myorder>)

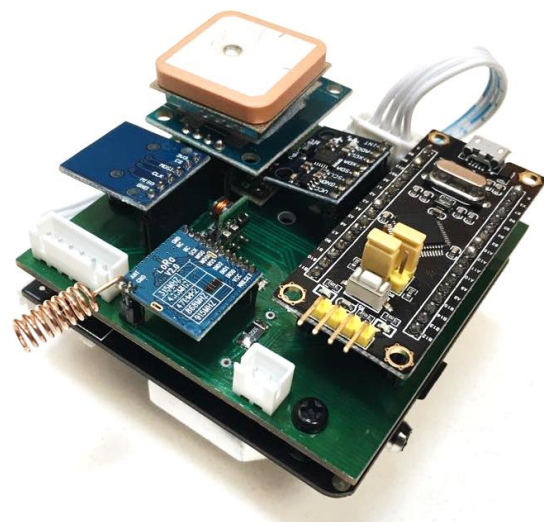
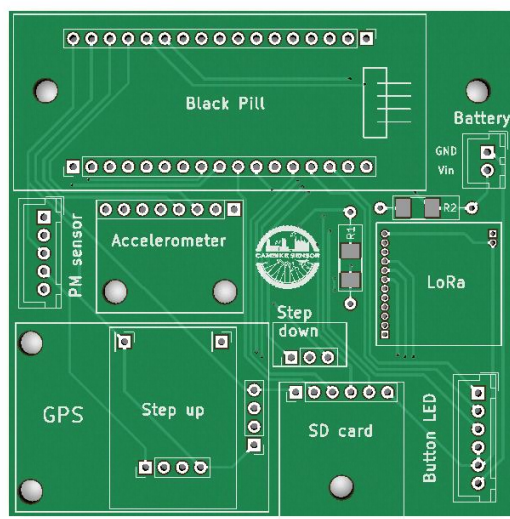
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**Button LED:** RGB LED self-latching push button, to be used as a status LED and master switch of the hub (<https://aliexpress.com/item/19408Z-Best-quality-power-symbol-LED-RGB-tricolor-24v-220v-19mm-metal-flat-head-latching-switches/32822281682.html?spm=2114.search0104.8.7.54b348797RZPhU&priceBeautifulAB=0>)



Most components include pin headers to be soldered in order to plug and use them. Some of them might come with the pins already soldered and some might come without pins. Therefore, be aware that you will probably need to have access to a soldering station and have some spare pin headers to work with.

## Soldering of the Printed Circuit Board (PCB)

We have designed a plug-and-play printed circuit board (PCB) that integrates all the components and fits on the top of the SDS011 PM sensor. The KiCAD files can be found in the PCB folder of our GitHub repository (<https://github.com/sh969/CambikeSensor/tree/master/PCB>). You can get it printed yourself or get one of our assembly kits!



To mount the PCB you will need a few more components, mainly connectors to plug the previously listed components and screws to hold the hub together. If you decided to buy an already assembled kit from us, you can skip this section.

For one PCB, you need:

🔌 Female pin headers (pin sockets), with a pitch of 2,54 mm:

- 🔌 2x 17, for the Black Pill
- 🔌 1x 4, for the GPS
- 🔌 1x 8, for the accelerometer
- 🔌 1x 6, for the SD card module

🔌 Male pin headers, with a pitch of 2,54 mm:

- 🔌 4x 1, for the step-up regulator

🔌 Female pins with a pitch of 1,27 mm:

- 🔌 1x 12
- 🔌 1x 2, for the LoRa radio

🔌 JST-XH connectors:

- 🔌 1x 2, for the battery
- 🔌 1x 5, for the PM sensor
- 🔌 1x 6, for the RGB button LED

🔌 Resistors:

- 🔌 2x 10 kΩ. As long as both are of the same value, any resistor in the order of tens of kΩ works. They can be mounted on the surface (SMD, 1206) or conventional ones (through hole resistors).

🔌 Mounting hardware M3:

- 🔌 3x hexagonal 6 mm with screw
- 🔌 3x hexagonal 10 mm with screw
- 🔌 1x hexagonal 20 mm with screw
- 🔌 4x screws 6 mm
- 🔌 5x nuts



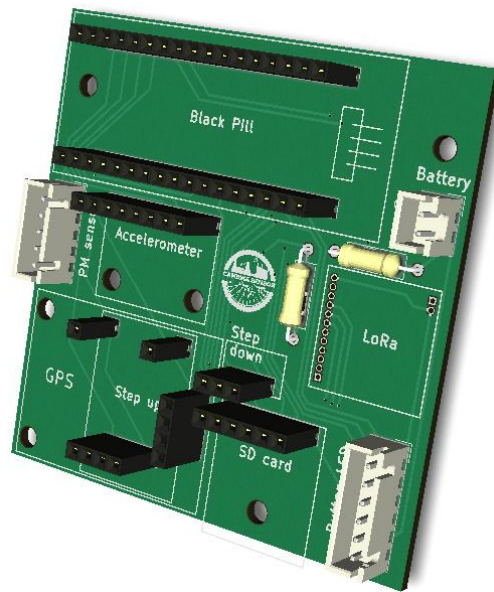
The text on the PCB will guide you on where to solder the pins correspondent to each of the components and where to plug them later on.

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Some pictures, some tips: step up, where to start: resistors. Make sure that you solder the pins exactly perpendicular to the board

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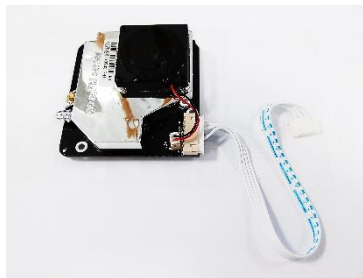
Once finished, it should look like the picture below.



## Mounting the PCB



The PCB is mounted on the SDS011 PM sensor using three screws. As it can be seen on the picture, the PM sensor comes with an extra piece of electronics. It is a TTL Serial to USB adaptor, meant to be used to communicate the sensor with a computer by directly plugging it via an USB port. You won't need it to plug the sensor to the PCB, but you do need the cable that comes with it. The converter will be useful later on to flash the code into the microcontroller.



1. Start placing the 3x hexagonal 6mm screws on the PM sensor:
2. Then place the 2x hexagonal 10 mm screws on the PCB, to hold the GPS and accelerometer in place.
3. Now you can mount the PCB on the PM sensor and screw them together using 2x 6 mm screws for the upper two holes, and 1x hexagonal 10 mm screw for the bottom hole (in the SD card zone). The later will be used as a support for the SD card module.
4. The next step is to plug all the components! Follow the text on the PCB to know where each of them should be placed. Don't forget to plug the GPS antenna with the receiver facing up (as in the picture below). You can also hold the PM sensor cable as we proposed in the pictures, to obtain a more compact hub!
5. Finally, add the 2x 6 mm screws to fix the GPS and the accelerometer.

Once you have your electronics assembled, you can run the first tests to check if it works!

## Checking the sensor hub

### The case

We have designed a laser-cut case made of wood and with a transparent lid, so you can see what's going on with the electronics! You can find the files in the casing folder of our GitHub repository (<https://github.com/sh969/CambikeSensor>).