Prototyping a device for monitoring in apiculture

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1 The device

The device is based upon a NodeMCU wi-fi board[1]: sensors to measure weight, temperature and humidity are used, which will be described in the following; see appendice LINKS to see some further implementations of a battery-level monitor and a resting capability.

1.1 NodeMCU

Programming the NodeMCU is as easy as writing Arduino code, provided that the support for Esp8266 is installed and the appropriate board is selected[2].

1.2 Weight - load cells + HX711

A Wheatstone bridge configuration for four load cells is used[3][4]; see Figure 1. Since the signal is too weak to be detected directly by the board, a HX711 amplifier is used; in the figure the schematics of connections to the board are shown.

In order to make the HX711 work, the library `HX711.h` is used[5]. The code highlights follow:

```
#include "HX711.h"
// set the pins used by the amplifier
#define HX711_SCK_PIN  D1
#define HX711_DOUT_PIN D2
// create a HX711 object
HX711 scale;
scale.begin(HX711_DOUT_PIN,HX711_SCK_PIN);
scale.power_up();
// the value of myscale is obtained by calibrating
//   the scale with known weights
scale.set_scale(myscale);
// reset the scale to 0
scale.tare();
// get weight (tare and scale)
float weight = scale.get_units();
```

[1] This choice has been guided exlusively by the smaller dimension and cost of this board; an Arduino board with an appropriate wi-fi shield can of course do as well.

[2] `https://www.instructables.com/id/Quick-Start-to-Nodemcu-ESP8266-on-Arduino-IDE/`

[3] `https://www.aliexpress.com/item/1PCS-DIY-50Kg-Body-Load-Cell-Weighing-Sensor-Resistance-strain-Half-bridge/32597969753.html?spm=2114.13010608.0.0.pC56uP`

[4] `http://www.instructables.com/id/Make-your-weighing-scale-hack-using-arduino/,https://www.sparkfun.com/products/13878?_ga=1.186640489.1126097763.1485380550`

[5] `https://github.com/bogde/HX711`

Figure 1: The Wheatstone bridge configuration for load cells, connected to the HX711 amplifier

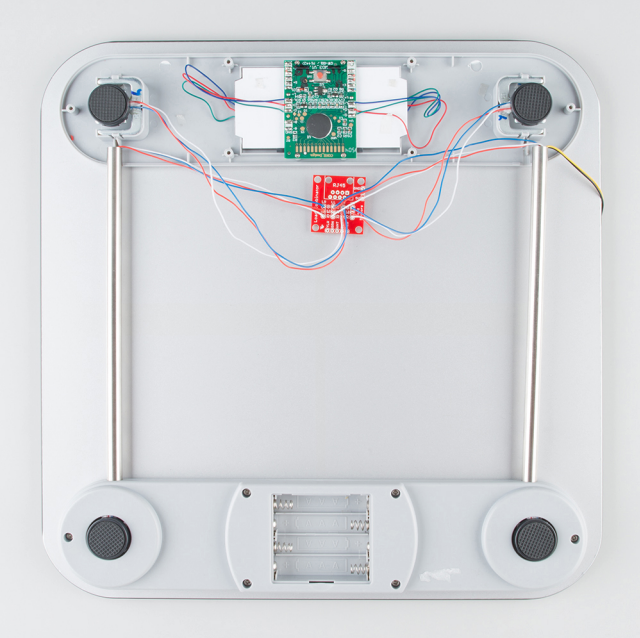
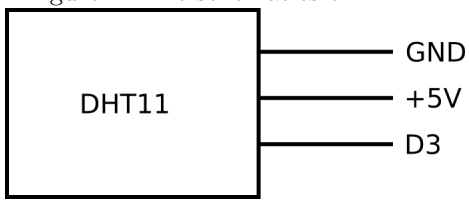


Figure 2: The schematics of DHT11



1.3 Temperature and humidity - DHT11

A DHT11 sensor is used to get measures of temperature and humidity. The related schematics is in Figure 2.

The library used is `DHT.h` and the relevant code is[6]:

```
#include "DHT.h"
#define DHTTYPE DHT11
#define DHT11_PIN D3                  // signal pin (has to be digital)
DHT dht(DHT11_PIN, DHTTYPE);          // create a DHT11 object
float t = dht.readTemperature(); // read values
```

[6] `https://github.com/adafruit/DHT-sensor-library`, **needs** `https://github.com/adafruit/Adafruit_Sensor`

```
float h = dht.readHumidity();
```