

# Urban Data Hardware Structure, Modules and Energy Consumption

## Structure and Protocols:

The hardware structure is made from sensors, which transfer the necessary information with different Serial communication protocols to the ARM1176JZF-S processor on a Raspberry Pi model B, that is also keeping stored all the data and measures on a SQL local data base, and will send them through Wi-Fi according to the 802.11 IEEE standard (using both 2,4 Ghz & 5 Ghz simultaneously) to be used.

Hardware Internal communication protocols are the following:

**I<sup>2</sup>C** (*Inter-Integrated Circuit*): Its main characteristic is that it uses two lines to transfer information: One is for the data and the other for the clock/time signal.

A third line is also necessary, but this is only reference (mass). Due to the circuit communication in the same plaque that share the same mass, the third line is usually not necessary.

The lines are named:

SDA: Data

SCL: Clock

GND: Ground

**1-Wire**: Serial communication protocol, designed by Dallas Semiconductor. Based on a bus, a master and different slaves on a single data line. In fact, it needs a common reference to ground for all the devices.

The lines are named:

DAT: Data

GND: Ground

**SPI** (*Serial Peripheral Interface*): is a communication standard, mainly used for information transfer between integrated circuits on electronic equipment. The interface bus of serial peripheral or SPI bus is a standard to control almost any digital electronic device that allows flux of serial bits regulated by time clock.

The lines are named:

SCLK: Clock

MOSI: Master Output Slave Input

MISO: Master Input Slave Output

CS: Chip Select

GND: Ground

**UART** (*Universal Asynchronous Receiver Transmitter*): is the key component for the serial communication subsystem of a computer.

UART takes data bytes and transmits the individual bytes by sequence.

Normally it does not directly generates o receives external signals among the different modules of the equipment. Usually separated interface devices are used to convert logical level signals from UART to and from external signal levels.

The lines are named:

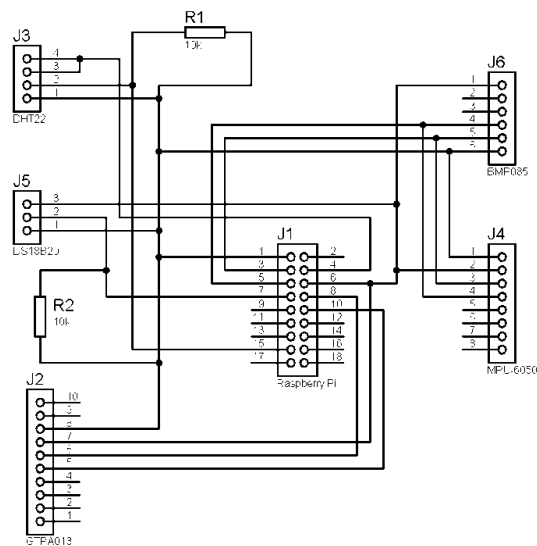
Tx: Transmitter  
Rx: Receiver  
GND: Ground

According to the manufacturer, the modules and sensors used for the variables measurement with defined communication protocols are the following:

1. **BMP085** (Digital Barometric Pressure sensor) – **I2C**
2. **MPU6050** (3 axis Accelerometer and Gyroscope module) – **I2C**
3. **DHT11 – 22** (Temperature and Humidity sensor) – **1Wire**
4. **DS18B20** (Temperature sensor) – **1Wire**
5. **GTPA013** (GPS module) - **UART**
6. **MQ-Series** (Gas sensor modules) - **SPI**

Note: Review data sheets from used resources in “Datasheets” folder.

The way to link the Raspberry pi with the sensors by the communication protocols was done by the Raspberry Pi GPIO port, the following is the sensors schematic diagram:



## Camera Module

To use the camera, the CSI (Camera Serial Interface) port from the Raspberry Pi is used, its characteristics are the following:

- Length x Width x Depth: 25 x 20 x 9 mm
- 5 megapixel of Resolution, rear-facing camera with 720p video capture
- Photographs to 2592X1922 pixels

## Energy Consumption:

One way to optimize the energy consumption from the batteries is to obtain solar energy with two solar cells

The specifications for the solar cells to be used are the following:

ITEAD STUDIO PET Solar Cell with USB Cable

- Rated Power : 3W
- Operating Voltage: 5V
- Operating Current: 600mA
- Open Circuit Voltage: 5.85V
- Short Circuit Current: 636mA
- Solar Cell Material: Monocrystalline Silicon
- Panel Dimension: 120\*180\*3mm
- Weight: 70.0g
- Model: IM120906007

The specifications for the battery to be used are the following:

**iBattz Universal Dual USB Battery Pack**

- Impact and Splash resistant.
- Dual USB Output for simultaneous charging of 2 devices.
- Torch Light.
- Support Pass Through Charging.
- Automatic Power Off when connected devices are fully charged.

### POWER SPECIFICATIONS

- Input : 5V DC, 1<sup>a</sup>
- Output 1 : 5V DC, 1A (2.1A for 12000 mAh)
- Output 2 : 5V DC, 500mA (1A for 12000 mAh)
- Battery Cell : Lithium-Ion
- 8,400mAh

### PHYSICAL MEASUREMENTS

- Length x Width x Depth: 110 x 69 x 22.5 mm
- Weight: 210 g