# PAR.MA.

PARticulate MAtter monitoring system

Federico Pozzana – federico.pozzana@studenti.polito.it

Electronic systems engineering – Prof. Eros Pasero

# Project overview

- *Purpose* : to monitor the air quality of the environment in which the device is placed in
- *Idea* : To develop a portable, wireless device that allows the user to monitor the air quality with respect to $PM_{2.5}$.
- *Deliverable* : Gerber files and final report

# Introduction

- Air quality is an important factor in determining the quality of life in a city
- Air pollution is a major environmental risk to health. If particulate matter concentration exceed a threshold it can cause illnesses
- European rules determined the threshold for good air quality to be 25 $\mu g/m^3$ (daily mean)

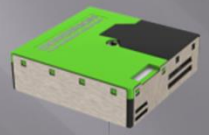
# Features

- Portable
- Battery powered
- Battery indicator
- Wireless (Bluetooth)

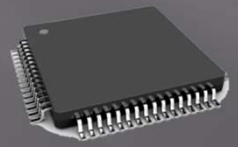
# Block diagram

Environment

User

Pm 2.5 sensor



Micro-controller

BT antenna

# Component selection

- *$PM_{2.5}$ sensor* : Measure the $PM_{2.5}$ concentration in the environment
- *SPS30* – Sensirion
- *Accuracy* : 10 $\mu g/m^3$ up to 100 $\mu g/m^3$ , 10 % up to 1000 $\mu g/m^3$
- *Operating conditions* : 10 – 40 °C , 20 – 80 %RH
- *Output* : UART/I2C
- *Max consumption current* : 80 mA (first 200 ms after start of Measurement-Mode)
- *Price* : 45 $

# Component selection

- *$PM_{2.5}$ sensor* : Measure the $PM_{2.5}$ concentration in the environment
- *SM-UART-04L* – Telaire
- *Accuracy* : 10 µg/m$^3$ up to 100 µg/m$^3$ , 10 % up to 1000 µg/m$^3$
- *Operating conditions* : -10 – 50 °C , 0 – 95 %RH
- *Output* : UART
- *Max consumption current* : 100 mA (60 mA typical, in Measurement-Mode)
- *Price* : 28 $

# Component selection

- *$PM_{2.5}$ sensor* : Measure the $PM_{2.5}$ concentration in the environment
- *GP2Y010AU0F* – Sharp
- *Sensitivity* : 0.5 V/0.1mg/$m^3$
- *Operating conditions* : -10 – 65 °C
- *Max consumption current* : 20 mA (10 mA typical, in Measurement-Mode)
- *Price* : 15 $

# Component selection

- The choice in terms of accuracy is equivalent for the Telaire and Sensirion sensors
- In terms of cost the Sharp sensor is the cheapest with a cost of 15 $, followed by the Telaire sensor with 28 $
- The ouput for the Telaire and Sensirion sensors is digital (easier to manage), while the output for the Sharp sensor is analog (subject to imprecisions of the ADC of the microcontroller)

# Component selection

- Given the previous reasons my choice for the PM 2.5 sensor is the Telaire *SM-UART-04L*
- Possible criticality : find a battery able to deliver 100 mA (LP-402025 LiPo battery is able to deliver 310 mA maximum continuous discharge current)

# Component selection

- Microcontroller : CC2640 SimpleLink™
- Low cost
- Low power
- ARM Cortex-M3 core
- BLE (4.2) built in
- UART/I2C compatible

# Component selection

- *Leds* : used for battery status and operation mode
- *Switches* : used to turn ON/OFF the device
- *Antenna* : PCB antenna
- *Voltage regulators* : 3.3V and 5V rails are needed for the micro-controller and the sensor respectively

# Power estimation

- *Active mode main power consumption terms*

1. Microcontroller : 1,45 mA + 31 µA/MHz
2. P.M. 2.5 sensor : 60 mA typical / 100 mA max. (sampling time in Measurement-Mode is typically 1 s long)

- *Stand by mode power consumption terms*

1. Microcontroller : 12 µA
2. P.M. 2.5 sensor : stand by mode possible, no discharge current specified in the datasheet. Assumed to be 1% of active mode

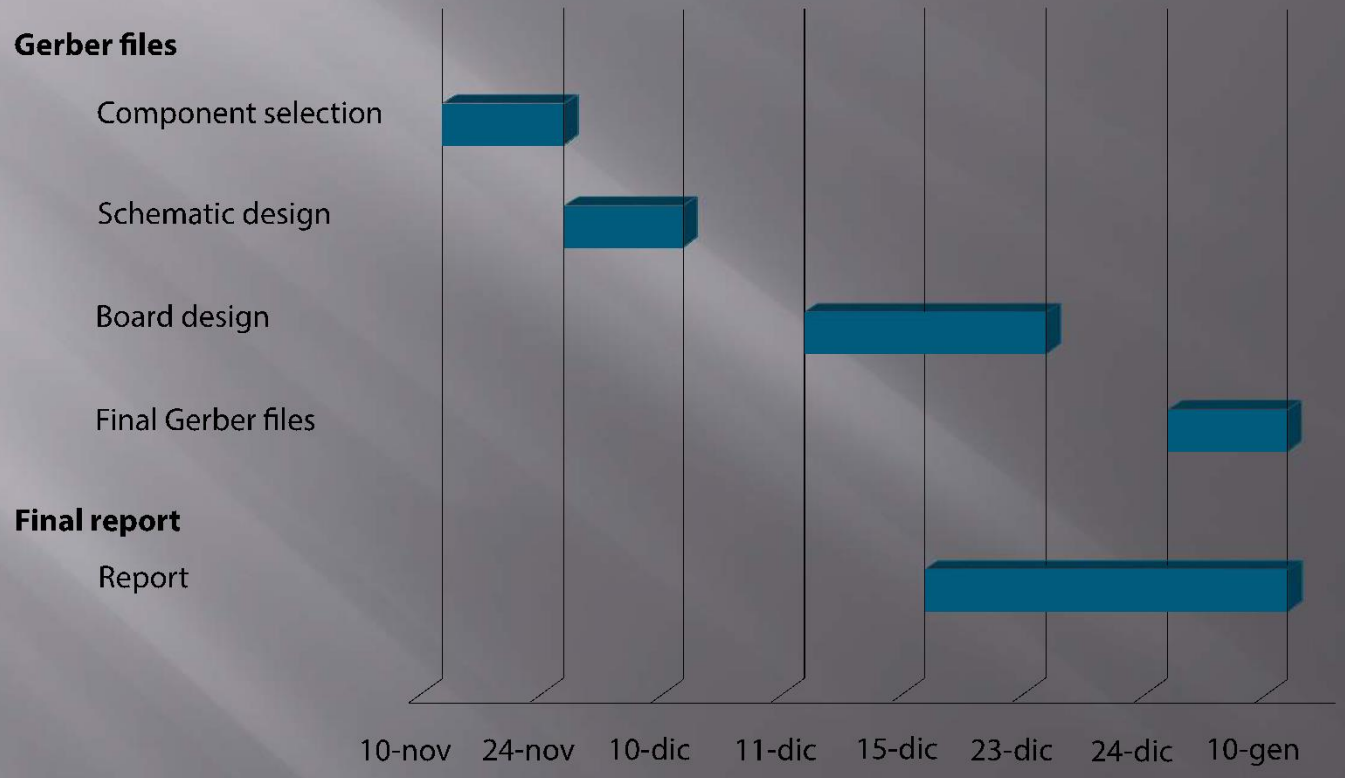
# Power estimation

- With the previous data, a 48 MHz clock, the LP-402025 LiPo battery (subject to change) and a sample every 15 minutes (particulate matter concentration is a slow to change quantity) the battery life is around 240 h (10 days)

# Competitors

- *Kaiterra* : Laser Egg
- *Price* : 160 €
- *Functions* : $PM_{2.5}$ , T&H, Weather forecast

# Estimated deadlines



# Deliverable

- With this project I intend to deliver
  1. Gerber files
  2. Techincal report