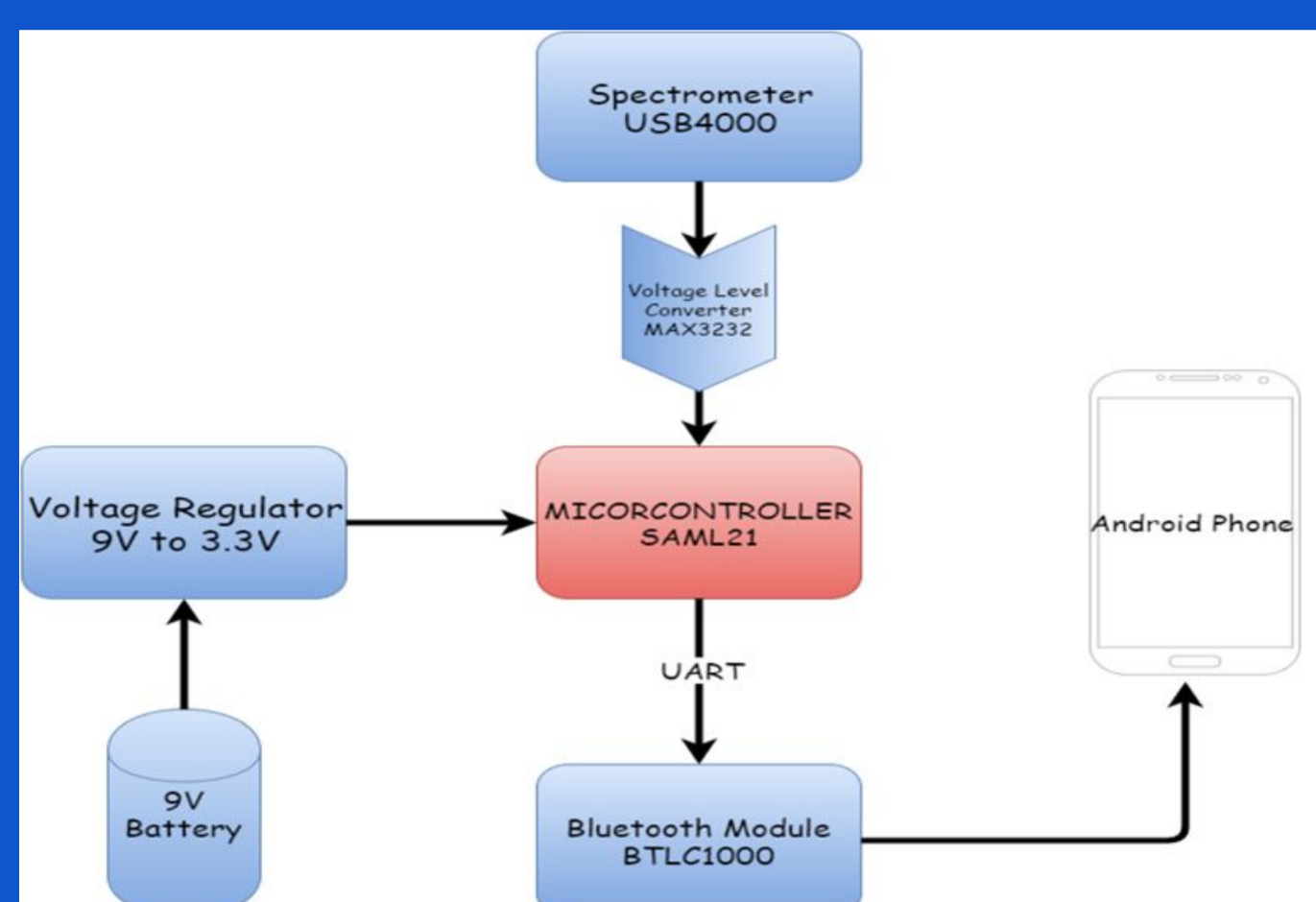


PORTABLE NUTRIENT DATA COLLECTION SYSTEM

Problem Statement

Managing nutrients in agriculture continues to be a major challenge in ecosystem science. In this project, we will design a portable system to address this problem using integrated MEMS micro plasma-based sensors and a spectrometer with a microcontroller to collect and transmit data wirelessly to a smartphone app with an easy-access interface.

Block diagram



- User to device: Android device to microcontroller via Bluetooth
- Start micro discharge device and voltage booster via microcontroller
- Send optical information from micro discharge device to spectrometer
- Send spectrometer data to microcontroller
- Display results on the android application

Requirements

Functional Requirement

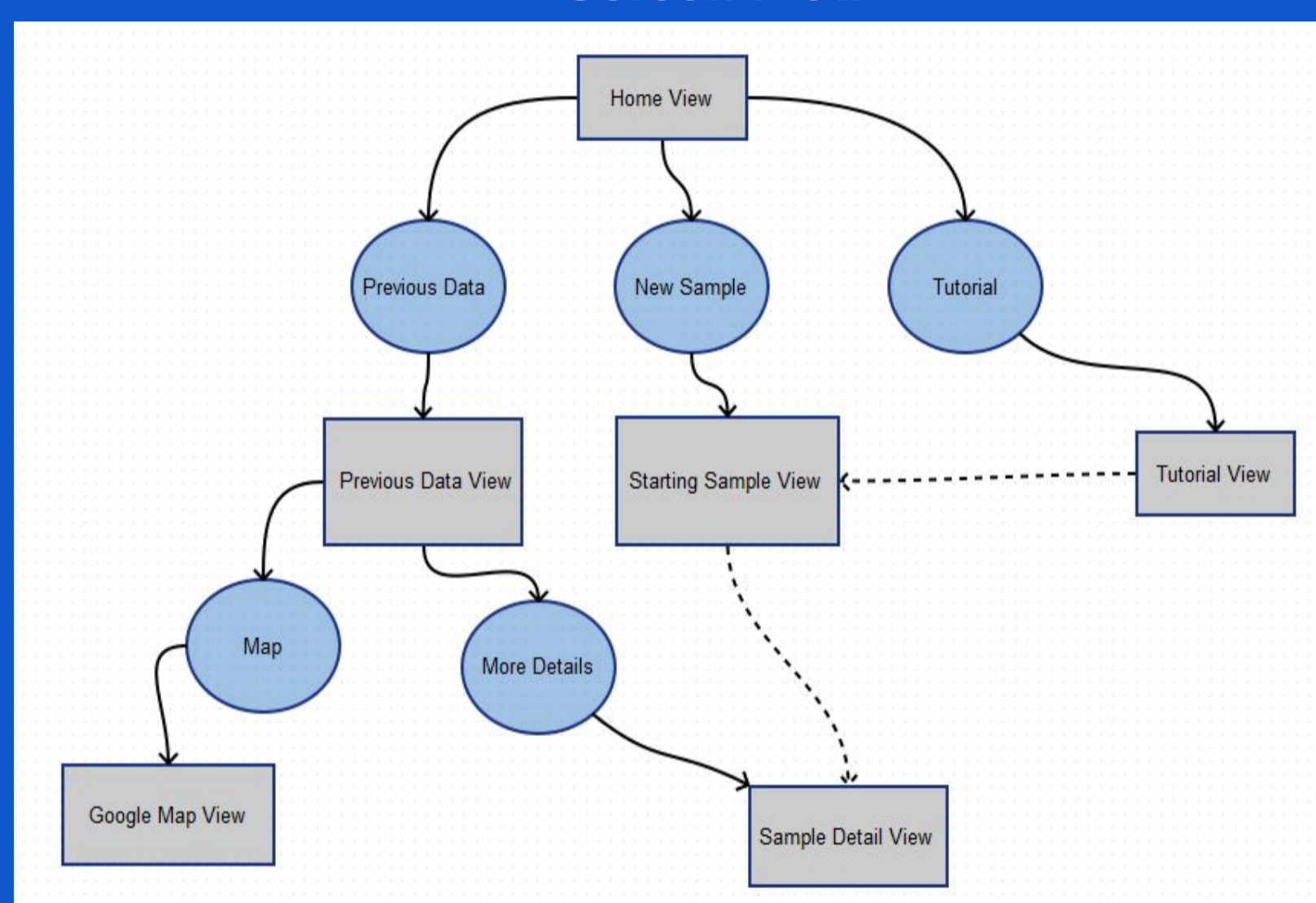
- The whole process should take less than 30s
- Display concentration of different elements(N&P) in water sample with precision
- Accurately distinguish between good/bad measurements
- Transmit data wirelessly to smartphone
- With water and soil proof
- Application is based on Android
- Have database for the history

Nonfunctional Requirement

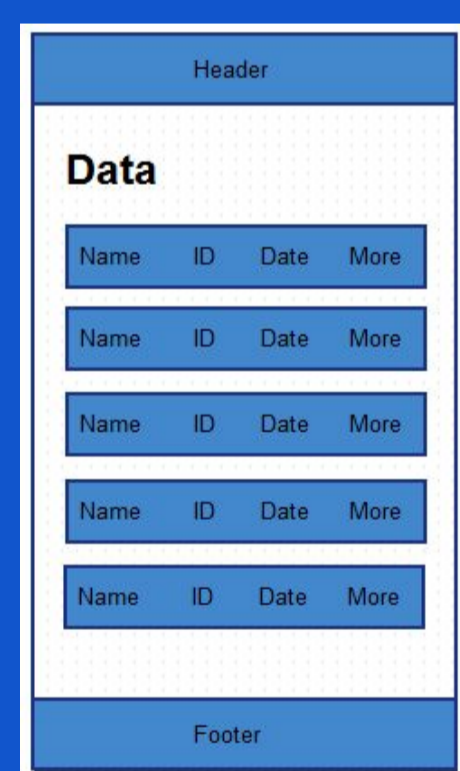
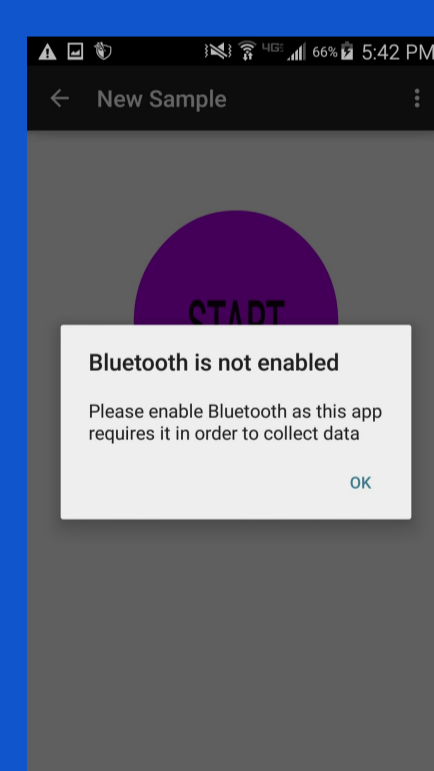
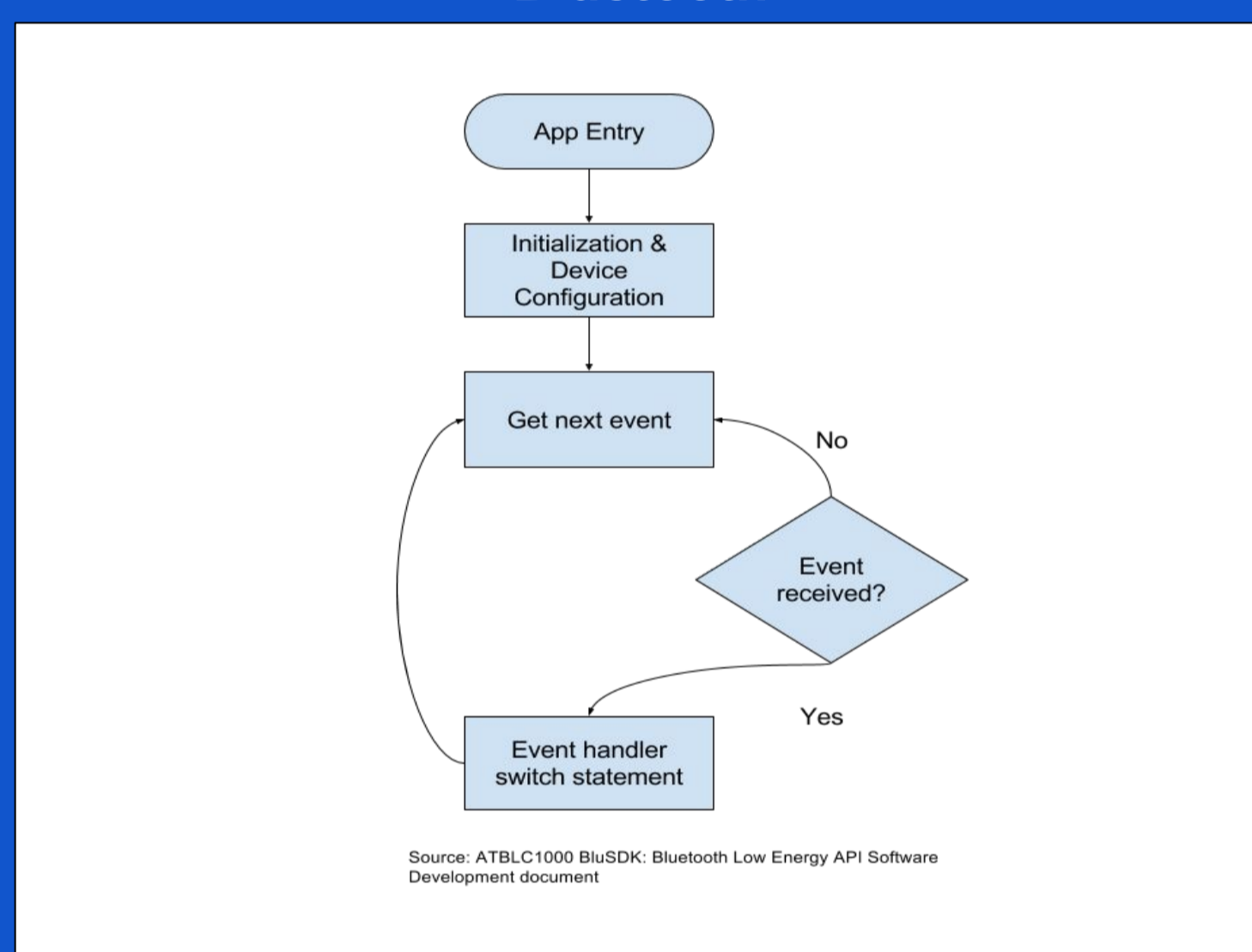
- Portable, low power and safe
- Easy-use-interface. (tutorial, easy to find settings)
- Be shielded from water and dirt damage
- 10ml water is acceptable amount to test with
- Be able to remain powered wirelessly for 1000 trials
- 90% accurate with reading
- Smartphone app size should be less than 6MB
- Total time of analyzing water sample on smartphone application should take less than 30s
- Communication from device to smartphone should take less than 2s
- Wireless range should be up to 2m

Android

Screen Flow

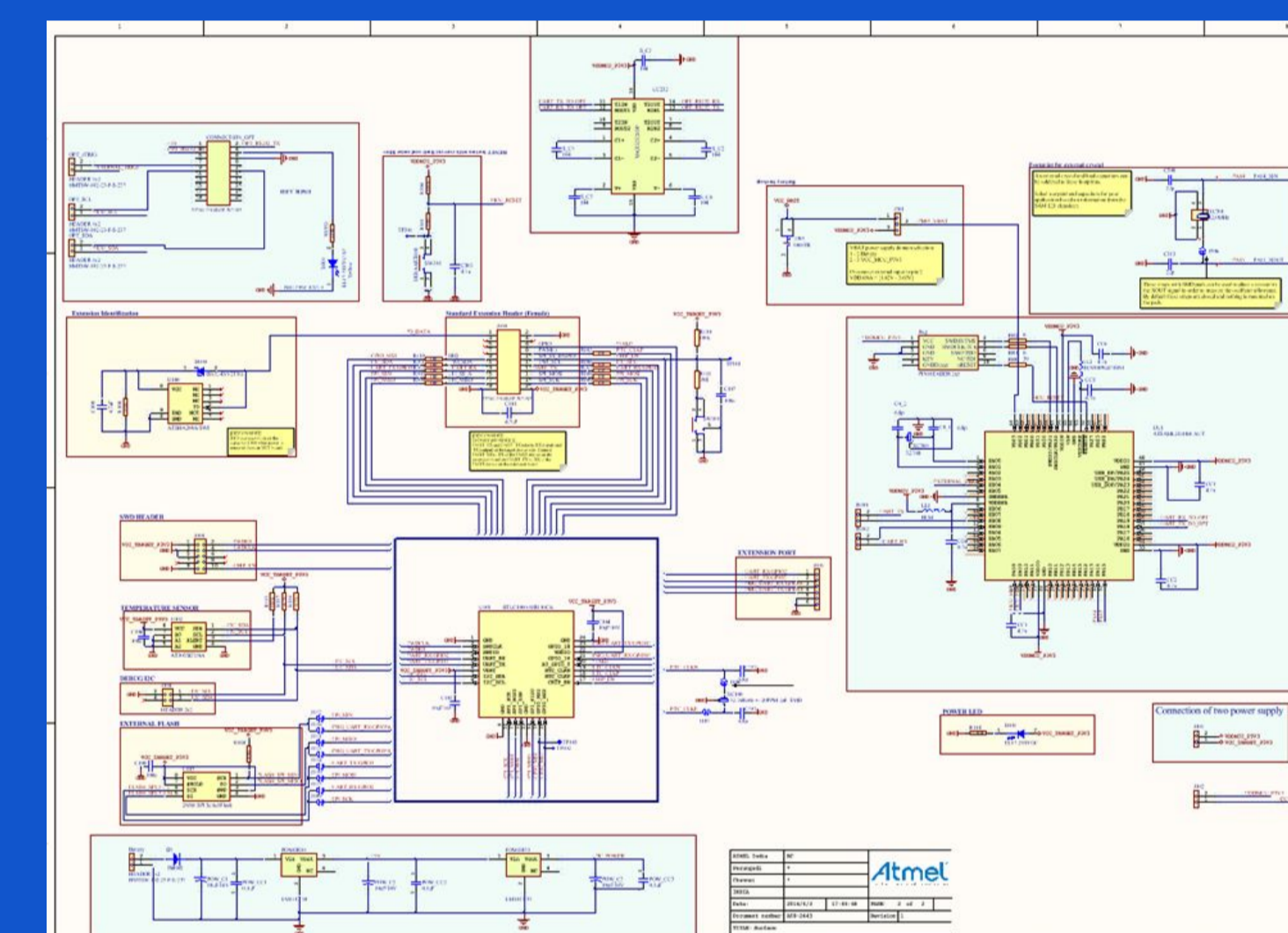


Bluetooth

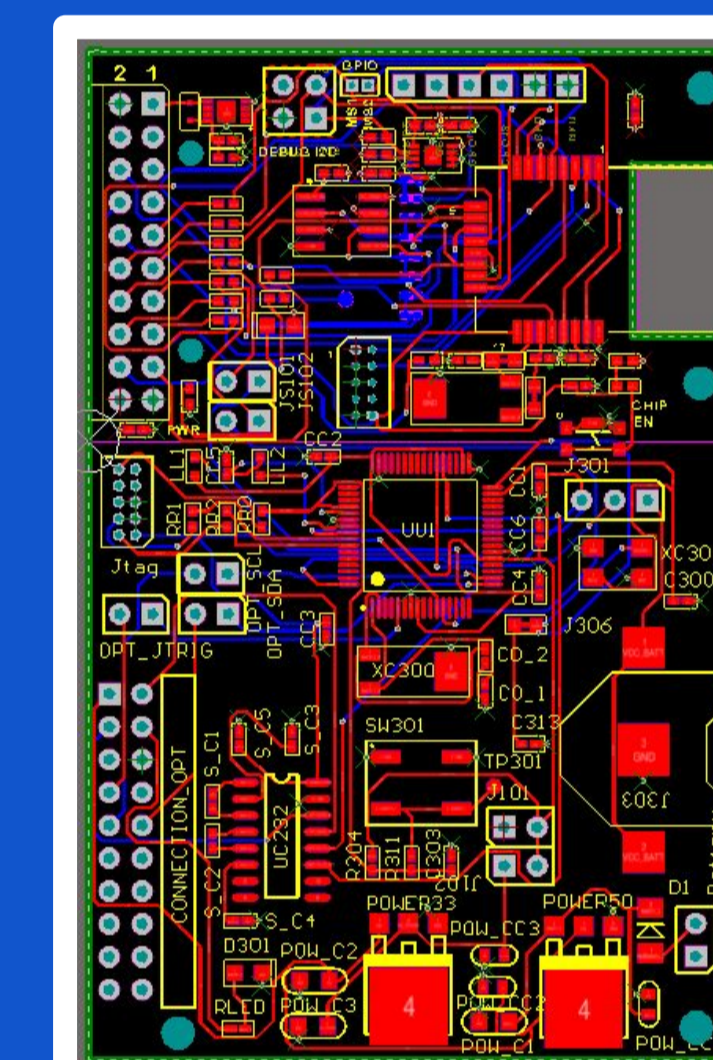


Printed Circuit Board (PCB)

Schematic Diagram



2D view of PCB



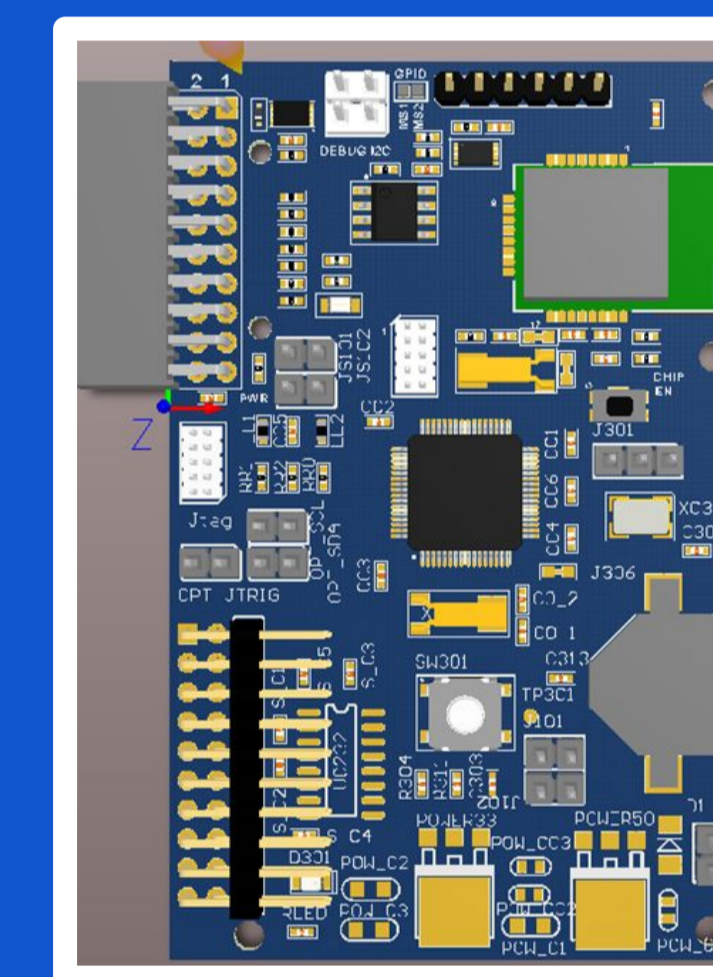
PCB Details:

There are totally 4 layers

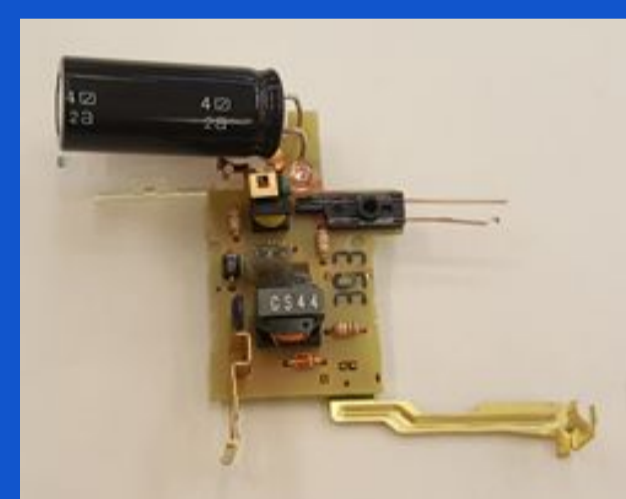
1. Top layer
2. Bottom layer
3. Ground layer
4. Power layer

Size of the PCB:
44mm*78mm

3D view of PCB



Voltage Booster



Voltage Booster can generate the 300V voltage pulse which is as the input of the Microdischarge Device.

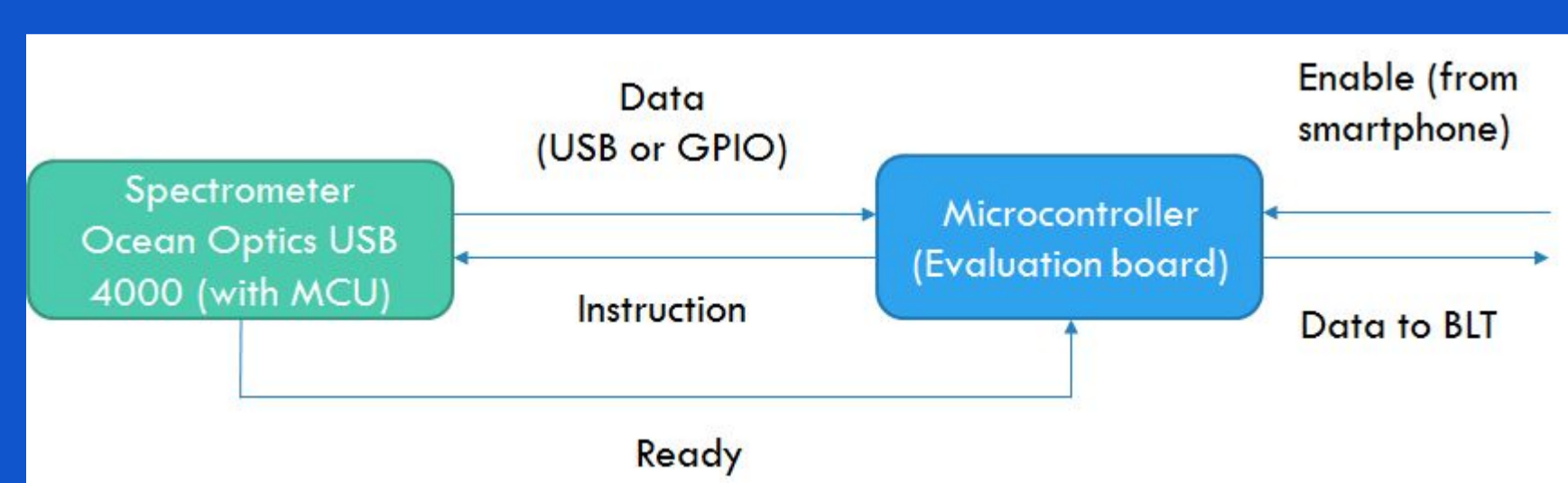
Microdischarge Device



Microdischarge Device use the pulse voltage as the input to stimulate the fluorescence in the water which is detected by the spectrometer.

Interface Between Spectrometer and MCU

Transfer digital signal through TX and RX port, like handshaking communication.



Test Plan

- Turn on App and turn on Device
- Verify Bluetooth connection (Android Settings)
- Verify spectrometer connection (LED lights up)
- Place sample in device
- Start Voltage Booster
- Verify voltage booster $280V \pm 20V$
- Wait for spectrometer reading to complete (around 5 seconds, LED flashes)
- Verify that data was transferred from device to Android phone in under 15 seconds (Time from LED flash stop to App refresh)
- Verify that data conversion is within 90% accuracy of known element distributions
 1. Base case – no elements
 2. Mostly Phosphorous
 3. Mostly Nitrogen
 4. Half Nitrogen, Half Phosphorous
 5. Random distribution between Nitrogen and Phosphorous
- Verify app is reliable (doesn't crash) during entire test
- Verify that data is stored accurately (time, location, element distributions)
- Verify entire test takes under 30 seconds
- Verify that device can remain powered after 50 trials

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