

Medical Delivery

IoT - Finale presentatie

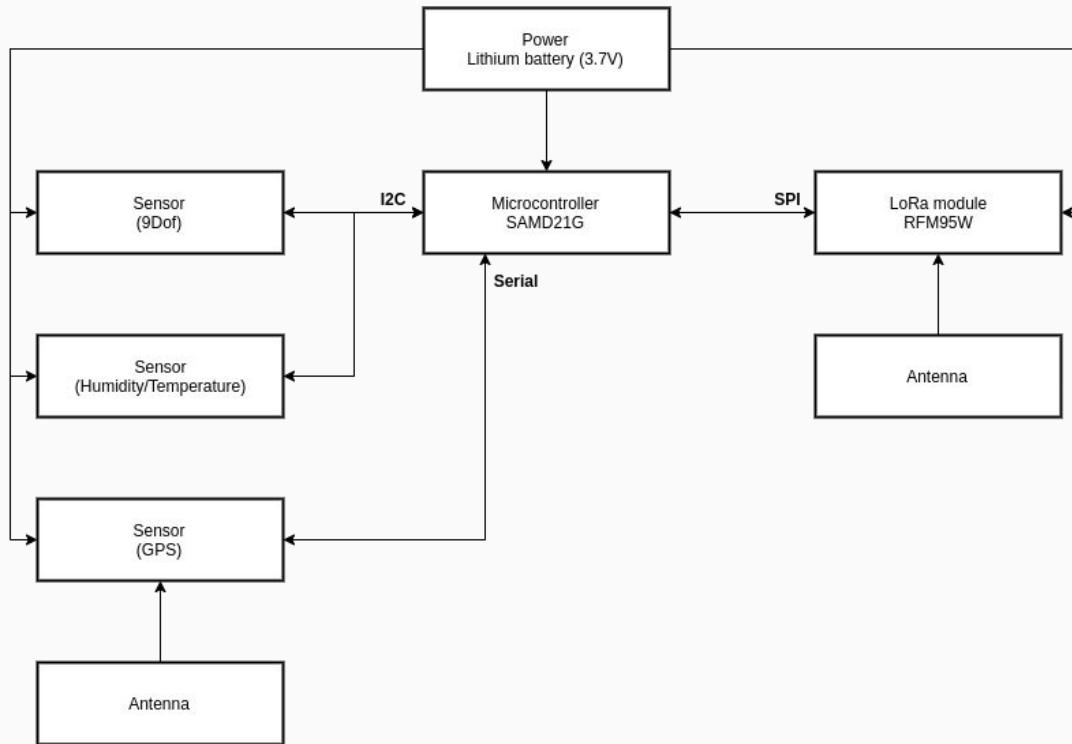
Jarno, Oussama, Imdad & Cristian

Concept

Algemene Architectuur



Blokschema



Hardware

Testplan MCU

- [] Test wire connections
 - [] VDD
 - [] Input supply between +2.5V & +12V
 - [] Humidity 3.3V
 - [] 9DoF 3.3V
 - [] GPS 3.3V
 - [] LoRa Module
 - [] GND
 - [] RX, TX
 - [] SDA, SCL
 - [] Reset
 - [] Switch
- [] Measure input supply voltages
- [] Measure voltages between VDD's and GND's
- [] Burn bootloader via [jp19-luwb burn bootloader doc.](#)
- [] Program blink led on MCU port PA12 [SWD Programming 2.1.](#)
- [] Program LoRa library on MCU and send hardcoded string to LoRaWAN network.

Componenten

Microcontroller SAMD21G

"The Atmel® | SMART SAM D21 is a series of low-power microcontrollers using the 32-bit ARM® Cortex®-M0+ processor, and ranging from 32- to 64-pins." - Datasheet ATMEAL SAM D21

- SERCOM
- 2 MCU's



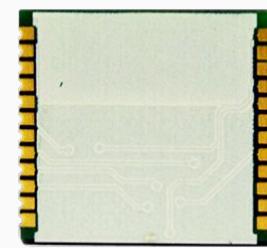
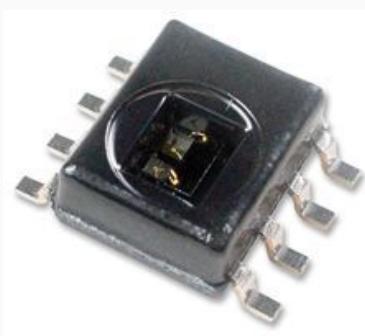
LoRa Module RFM95W

The RFM95W-868S2 transceivers features the LoRa™ long range modem that provides ultra-long range spread spectrum communication and high interference immunity whilst minimising current consumption.



Sensors

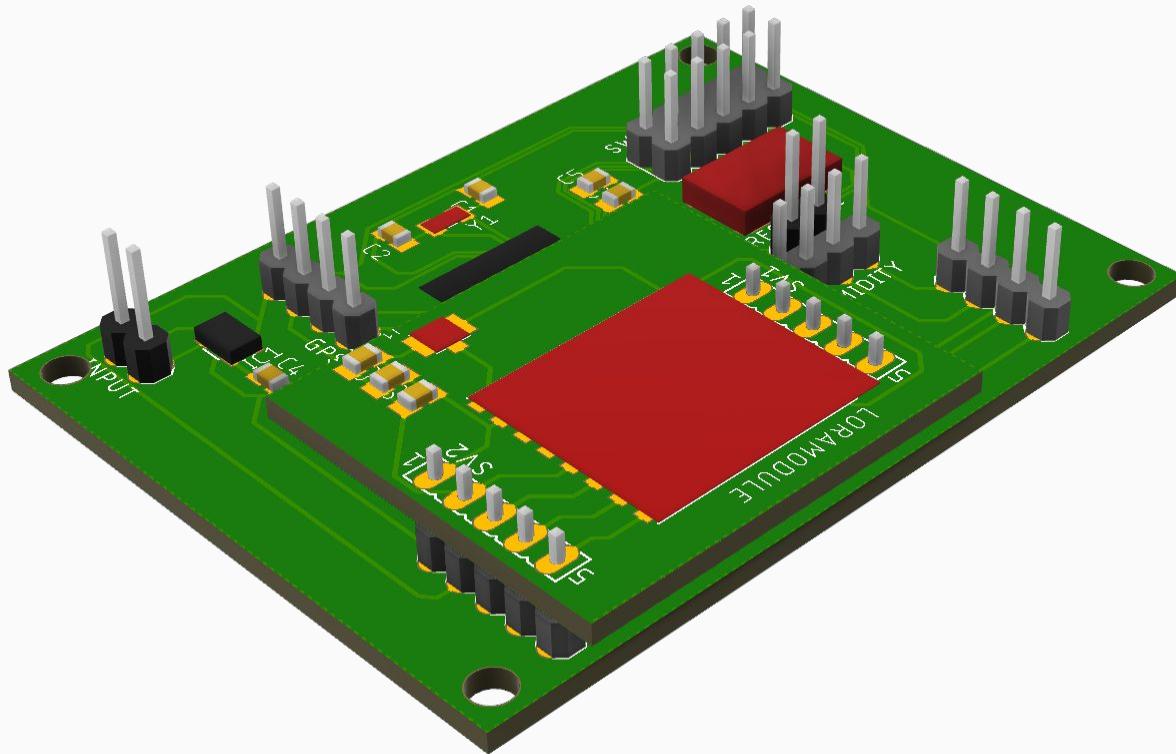
- 9DoF stick **Shock detector**
- Honeywell HumidIcon™ HIH6000 Series **Humidity/Temperature**
- Telit SL876Q5-A **GPS**



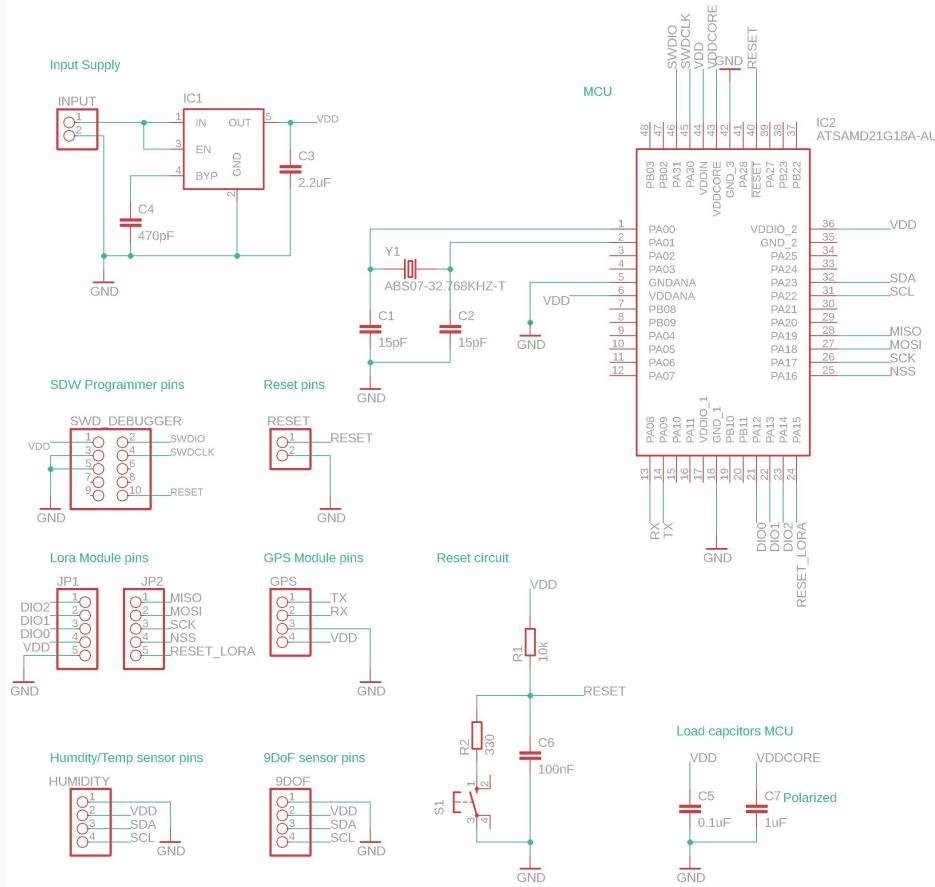
PCB's

MCU

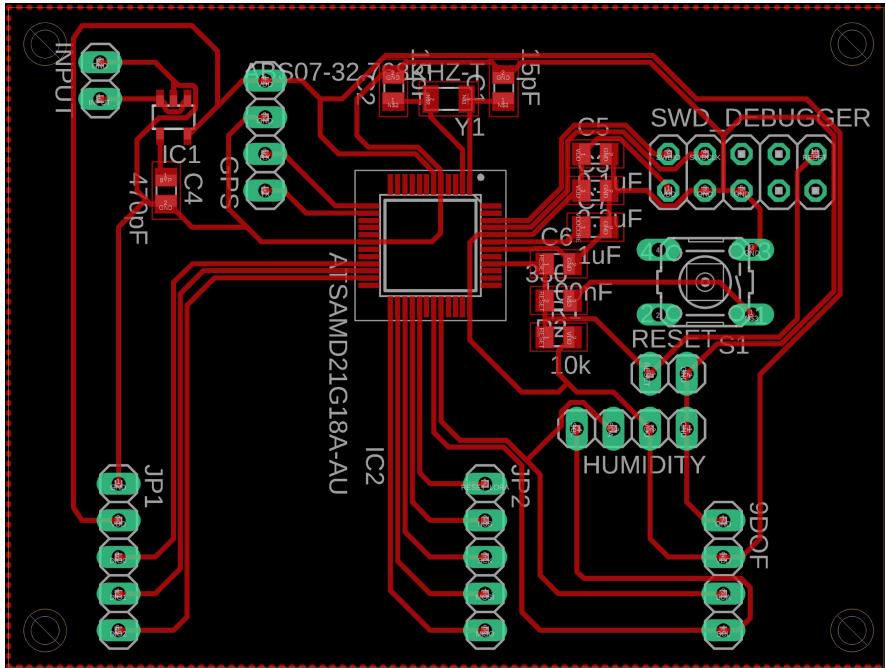
MCU PCB



MCU Electrical scheme

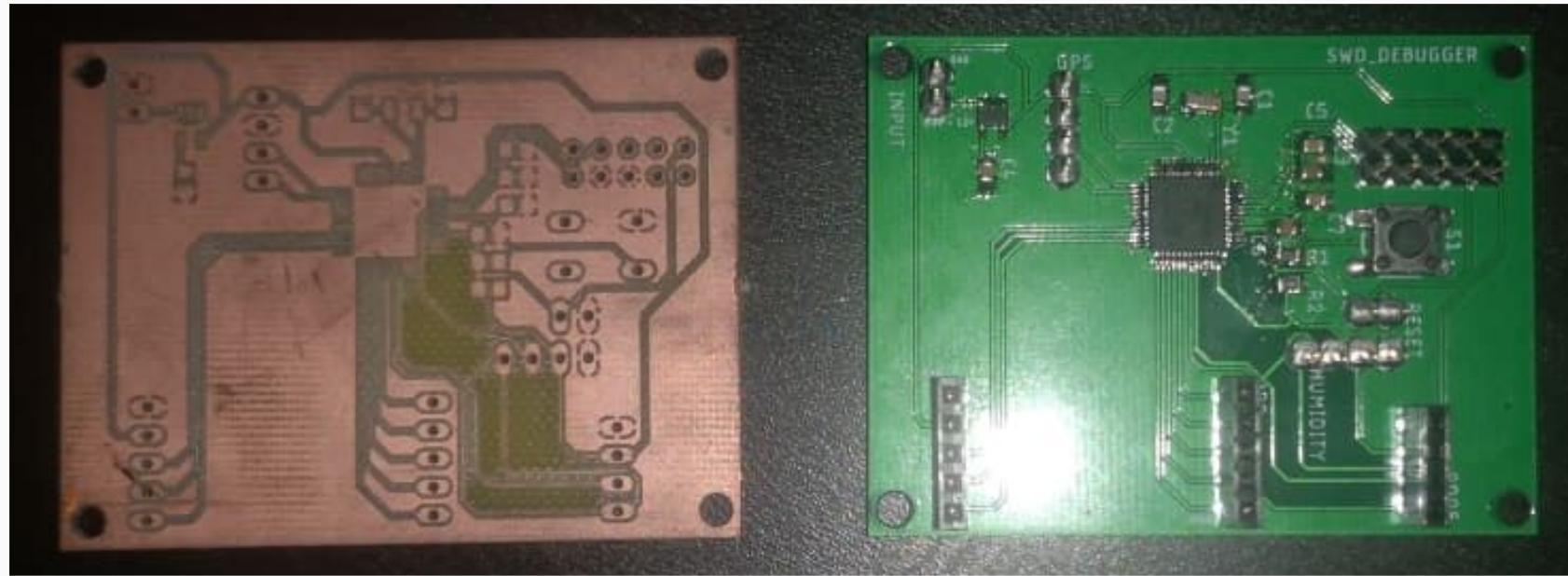


MCU PCB Schema



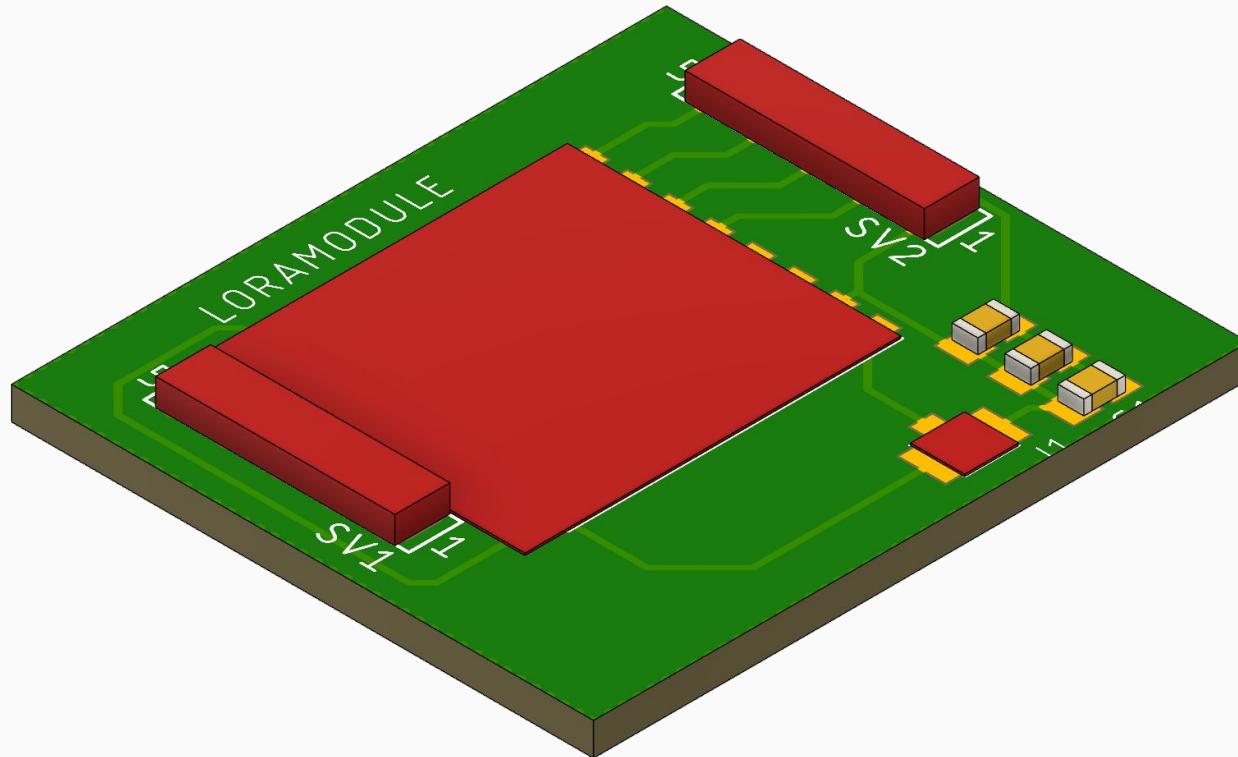
- Reset switch
- SERCOM => SPI

PCB

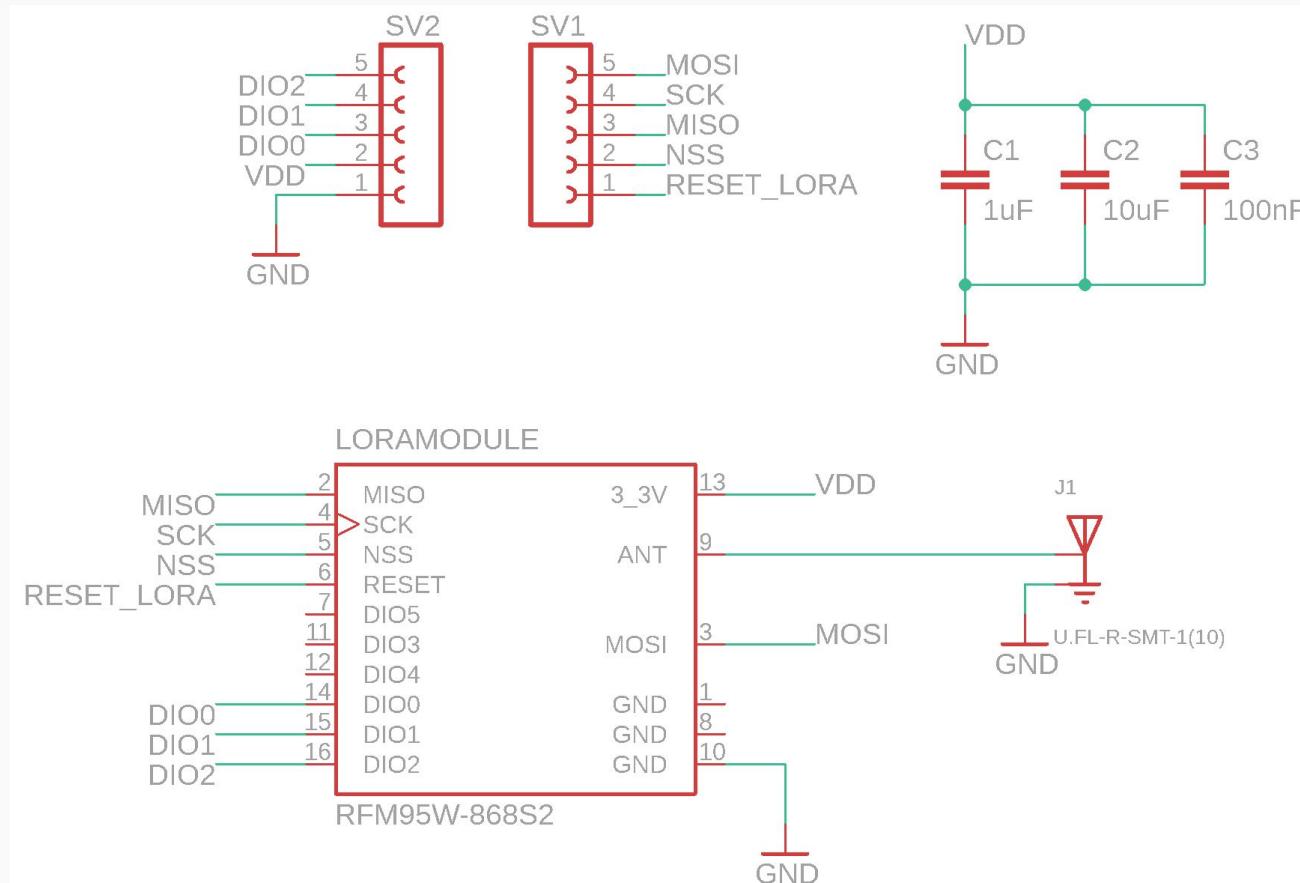


LoRa Module

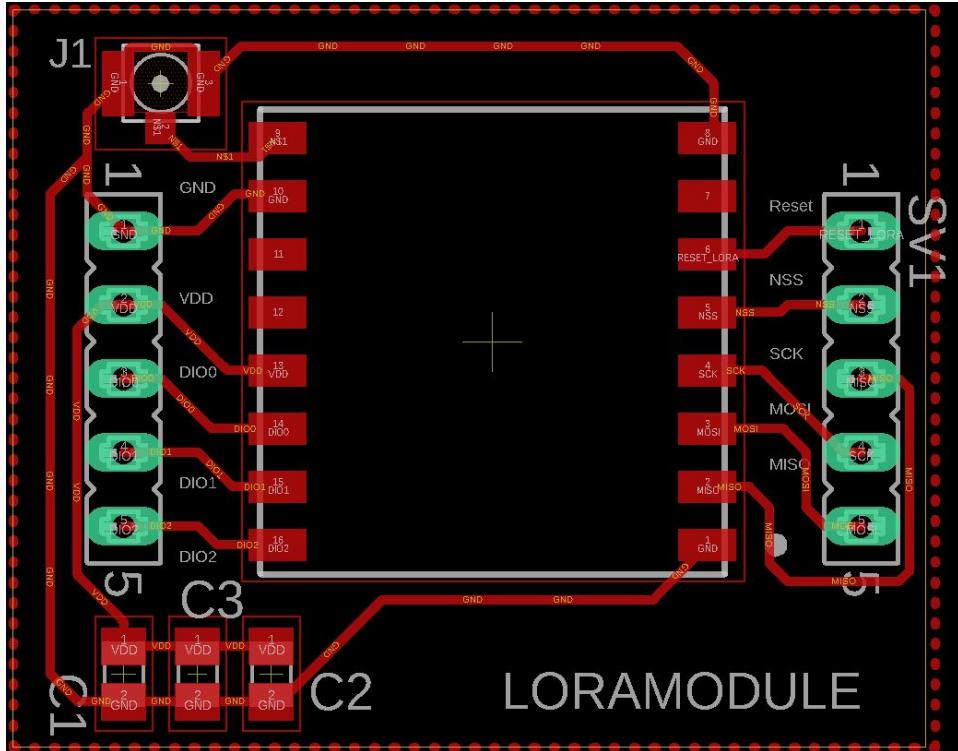
LoRa Module PCB



LoRa Module Electrical scheme

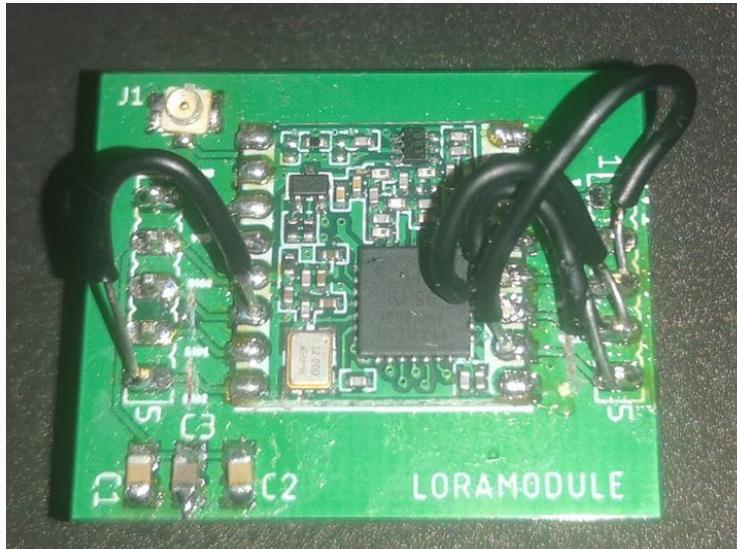


LoRa Module PCB Schema



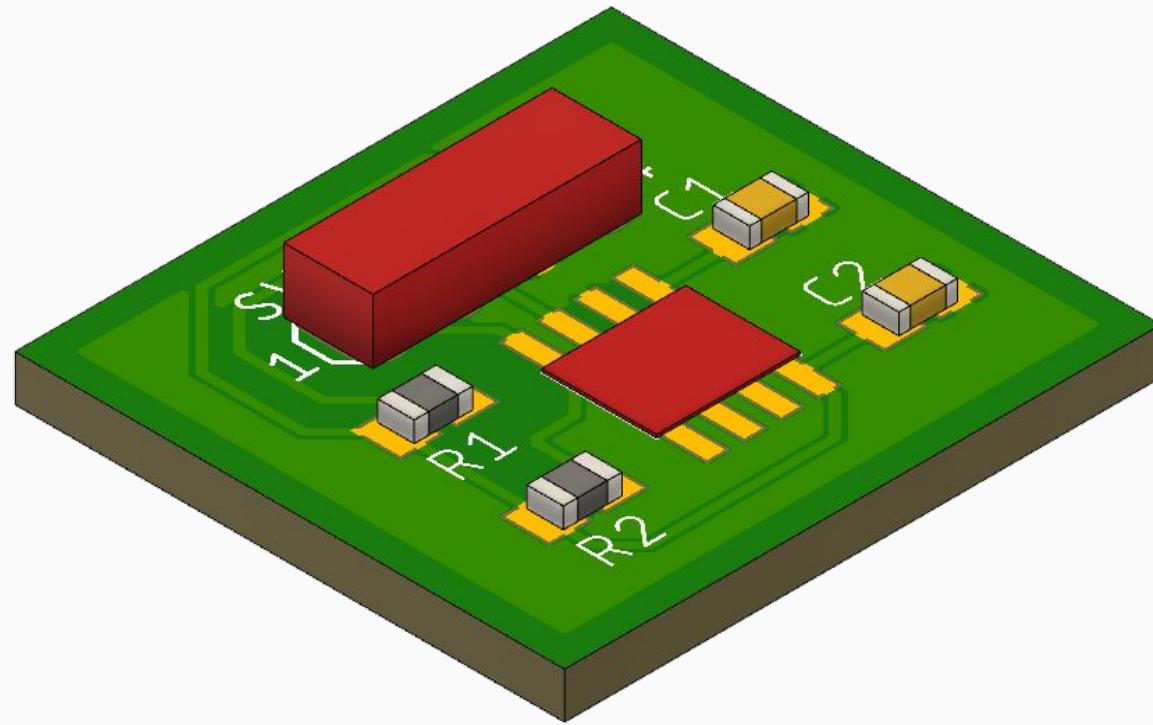
- SERCOM => SPI
- Kabels opnieuw gelegd dunne kabels werkten niet

PCB

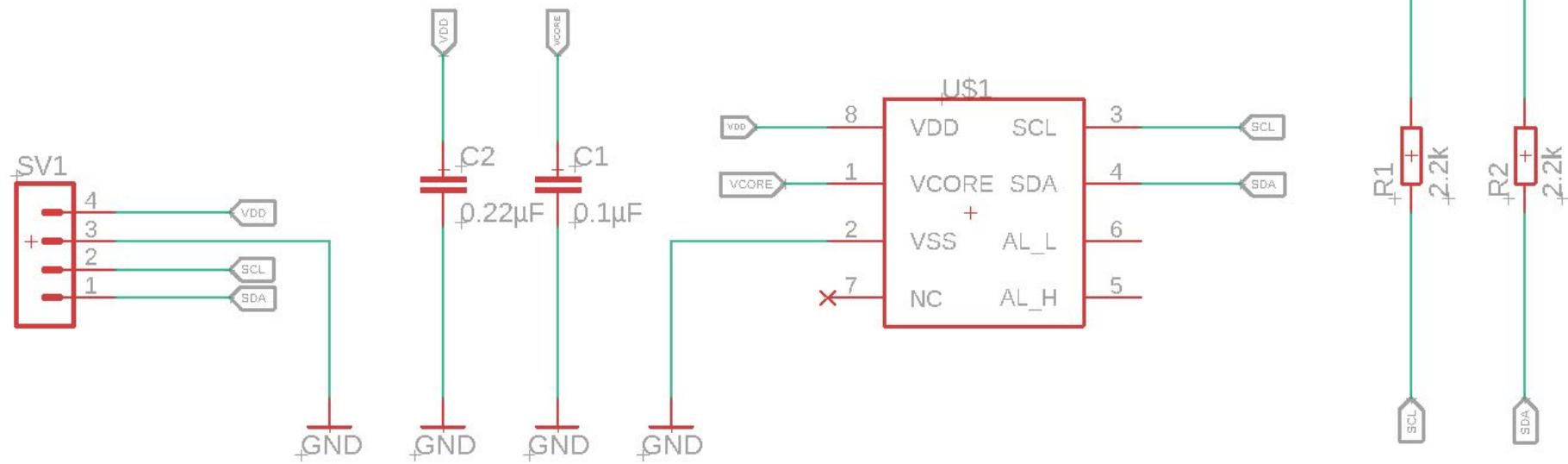


Humidity/Temperature

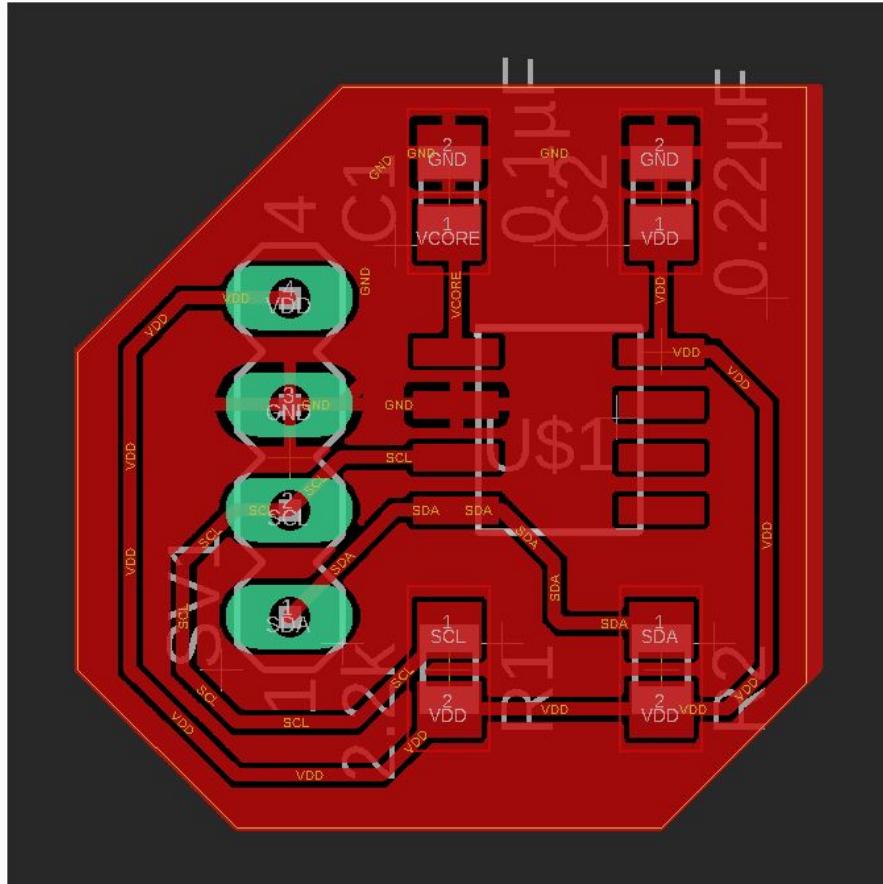
Humidity PCB



Humidity Electrical scheme



Humidity PCB Schema

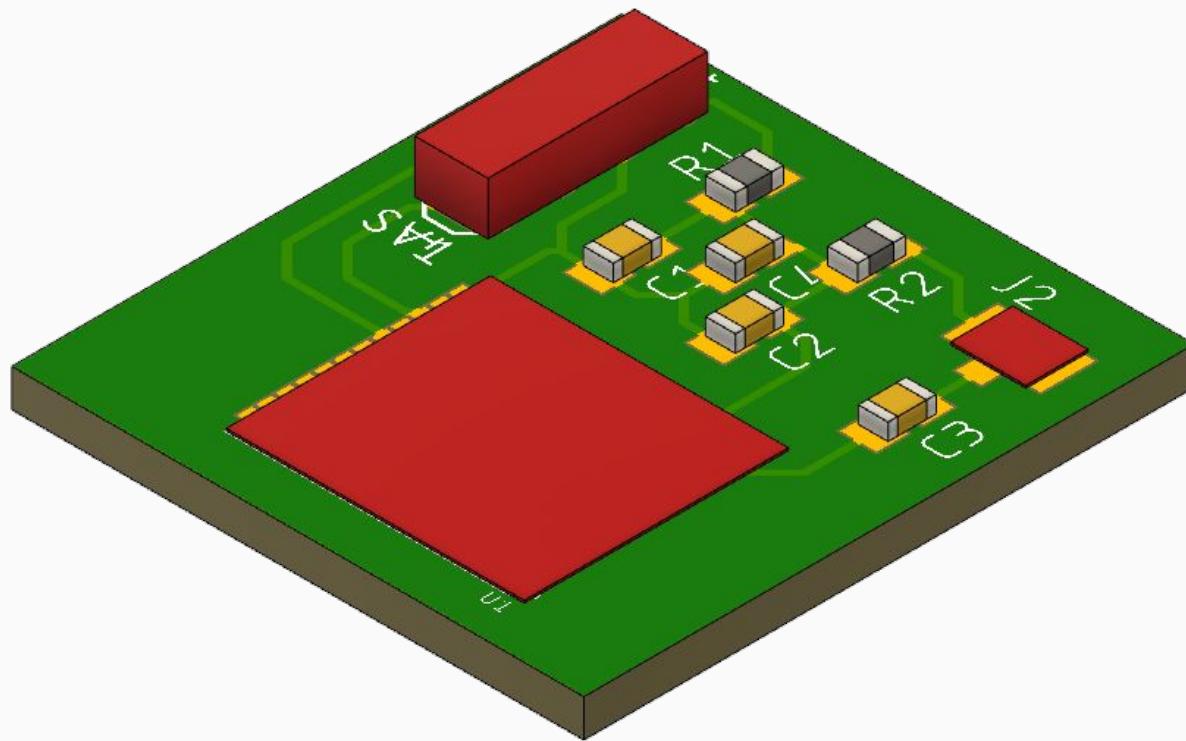


PCB

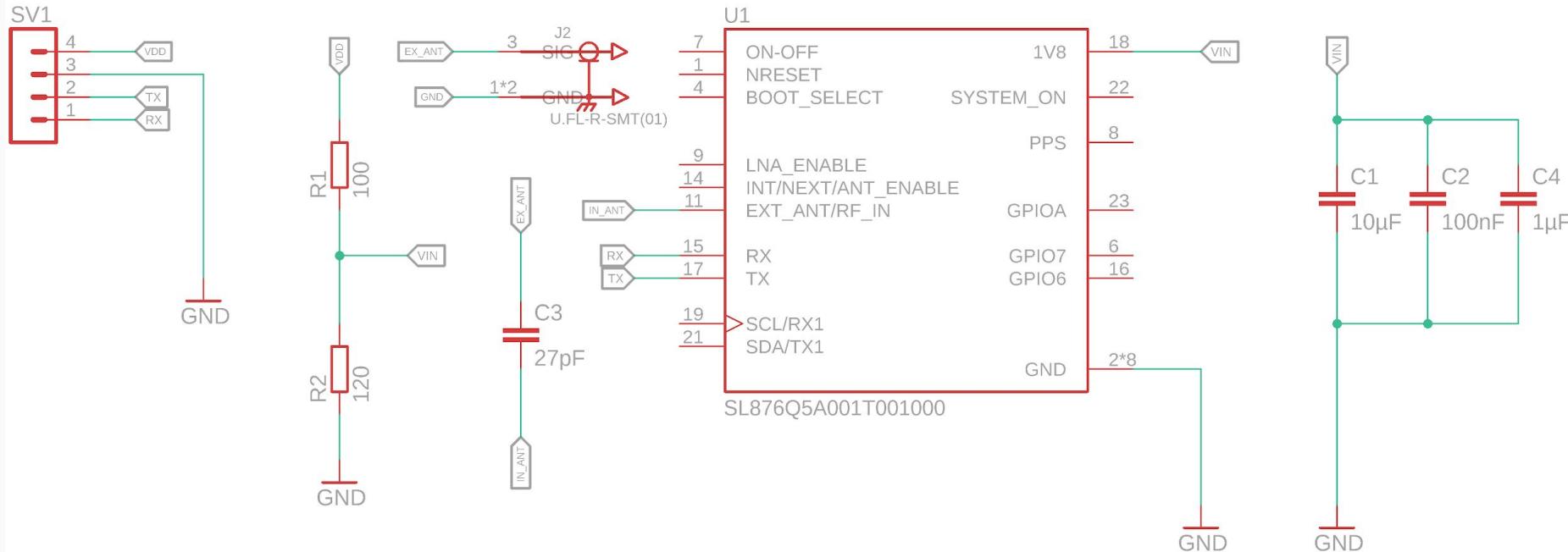


GPS

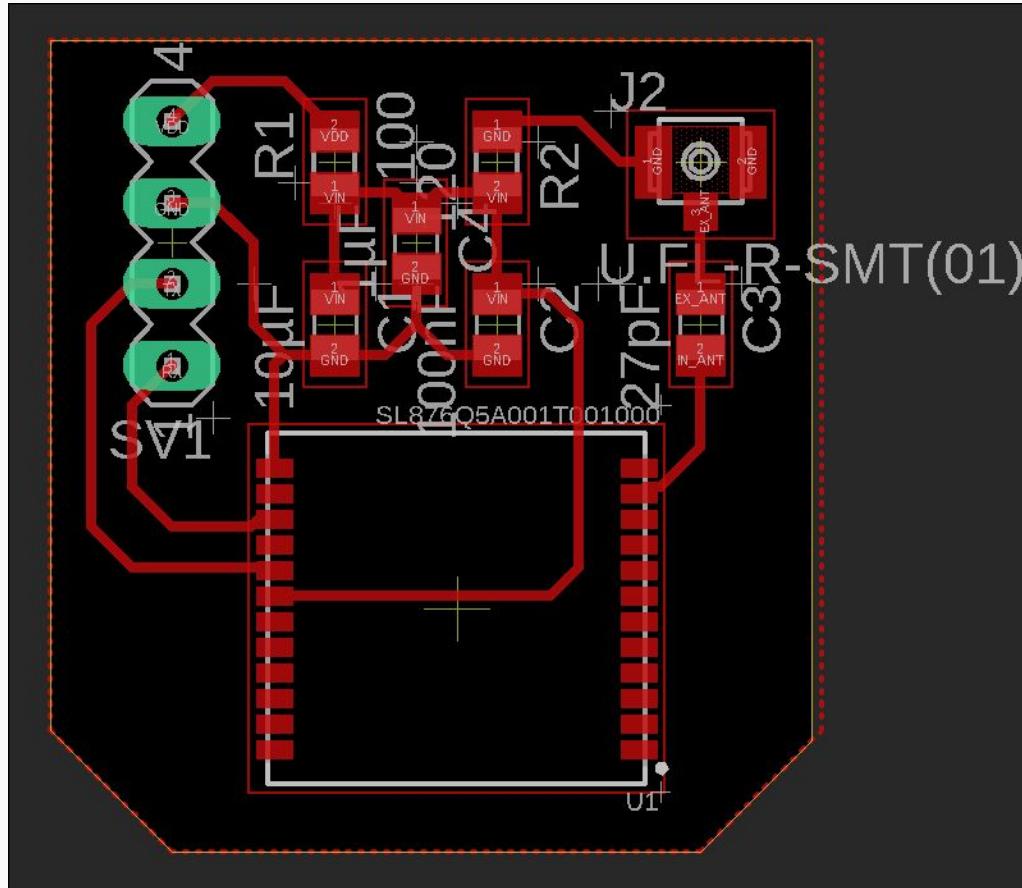
GPS PCB



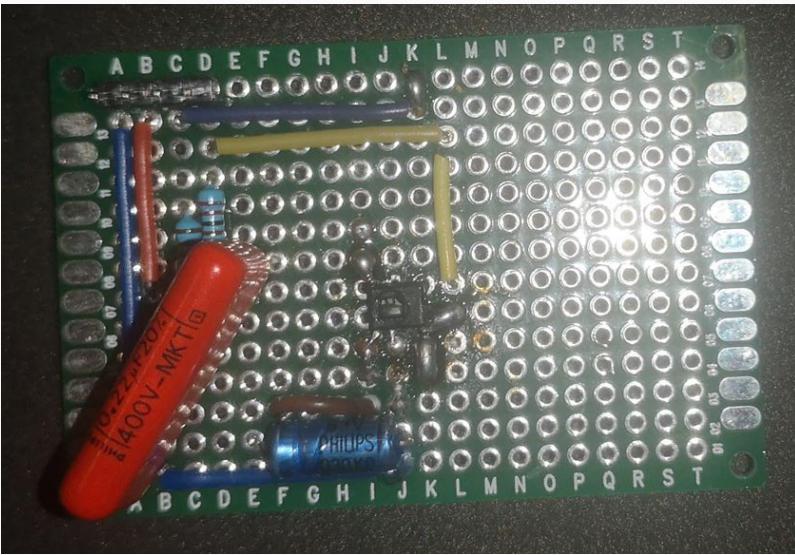
GPS Electrical scheme



GPS Schema



PCB



Volgende versie PCB

- 2 Microcontrollers
- USB
- SPI poorten
- TX RX leds
- TX RX pins
- Extra pins

Software

Embedded Software

MCU

```
1 #include "wiring_private.h"
2
3 Uart GPSSerial(&sercom2, 3, 4, SERCOM_RX_PAD_1, UART_TX_PAD_0);
4 void SERCOM2_Handler()
5 {
6     GPSSerial.IrqHandler();
7 }
8
9 void setup()
10 {
11     pinPeripheral(3, PIO_SERCOM_ALT);
12     pinPeripheral(4, PIO_SERCOM_ALT);
13 }
```

LoRa Code

Libraries: `arduino-lmic`, `LoraEncoder`

Library aangepast SPI naar SPI van SERCOM. Niet Legacy SPI gebruikt.

hal.cpp

```
1 SPIClass SPI3(&sercom1, 10, 13, 11, SPI_PAD_0_SCK_1, SERCOM_RX_PAD_2);
2
3 static void hal_spi_init()
4 {
5     SPI3.begin();
6     pinPeripheral(10, PIO_SERCOM);
7     pinPeripheral(11, PIO_SERCOM);
8     pinPeripheral(13, PIO_SERCOM);
9 }
```

LoRa Code

```
1 void do_send(osjob_t *j)
2 {
3     if (LMIC.opmode & OP_TXRXPEND)
4         Serial.println(F("OP_TXRXPEND, not sending"));
5     else
6     {
7         encoder.writeTemperature(Temperature);
8         encoder.writeHumidity(relativeHumidity);
9         encoder.writeLatLng(Lat, Long);
10        encoder.writeBitmap(IsTemperatureOutOfBoundary, IsHumidityOutOfBoundary,
11                            IsTiltedOutOfBoundary, ShockDetected, false, false, false, false);
12        LMIC_setTxData2(1, payload, sizeof(payload) - 1, 0);
13        Serial.println(F("Packet queued"));
14    }
15 }
```

9DoF Code

Library: **Sparkfun LSM9DS1**

```
1 float shockDetector()
2 {
3     float accel_z = imu.calcAccel(imu.az);
4     if (accel_z > 1.5 || accel_z < 0.5)
5     {
6         Serial.print("Shock detected with a value of: ");
7         return accel_z;
8     }
9     return -1000;
10 }
```

```
// Calculate pitch, roll, and heading.
// Pitch/roll calculations take from this app note:
bool calcTilted(float ax, float ay, float az, float mx, float my, float mz, float boundaryDegrees)
{
    float roll = atan2(ay, az);
    float pitch = atan2(-ax, sqrt(ay * ay + az * az));
    float heading;
    if (my == 0)
        heading = (mx < 0) ? PI : 0;
    else
        heading = atan2(mx, my);

    heading -= DECLINATION * PI / 180;

    if (heading > PI)
        heading -= (2 * PI);
    else if (heading < -PI)
        heading += (2 * PI);

    // Convert everything from radians to degrees:
    heading *= 180.0 / PI;
    pitch *= 180.0 / PI;
    roll *= 180.0 / PI;

    bool outOfBoundsRoll = (roll < boundaryDegrees && roll > boundaryDegrees * -1);
    bool outOfBoundsPitch = (pitch < boundaryDegrees && pitch > boundaryDegrees * -1);
    if(outOfBoundsRoll && outOfBoundsPitch){
        Serial.println("Not tilted facing top.");
        return true;
    }
    Serial.print("Tilted beyond boundary.");
    return false;
}
```

Humidity Code

Library: HIH61xx

```
1 void readhumTemp()
2 {
3     if (samplingInterval.isExpired() && !hih.isSampling())
4     {
5         hih.start();
6         samplingInterval.repeat();
7     }
8     hih.process();
9     if (hih.isFinished())
10    {
11        relativeHumidity = hih.getRelHumidity() / 100.0;
12        Temperature = hih.getAmbientTemp() / 100.0;
13        if (relativeHumidity < HumidityBoundary[0] ||
14            relativeHumidity > HumidityBoundary[1])
15            IsHumidityOutOfBoundary = true;
16        if (Temperature < TemperatureBoundary[0] ||
17            Temperature > TemperatureBoundary[1])
18            IsTemperatureOutOfBoundary = true;
19    }
20 }
```

GPS Code

Library: TinyGPS++

```
1 void readGPS()
2 {
3     while (GPSSerial.available() > 0)
4         gps.encode(GPSSerial.read());
5     if (gps.location.isUpdated())
6     {
7         Lat = gps.location.lat();
8         Long = gps.location.lng();
9     }
10 }
```

Back-End

Schema



Front-End

Website



Medical Delivery

Add Transporter +

Transporter Info

From: Ghana Hospital To: Ghana Hospital 2

Transporter: Tabo

Boxes 2

[Delete Transporter](#) [Add new Box to Tabo](#)

A map of a city area showing streets and landmarks. A green dashed line highlights a specific route from 'Ghana Hospital' to 'Ghana Hospital 2'. The map includes a zoom control (+, -) and a legend icon.

24°C Temperature

37% Humidity

0.3 G force

Boxes

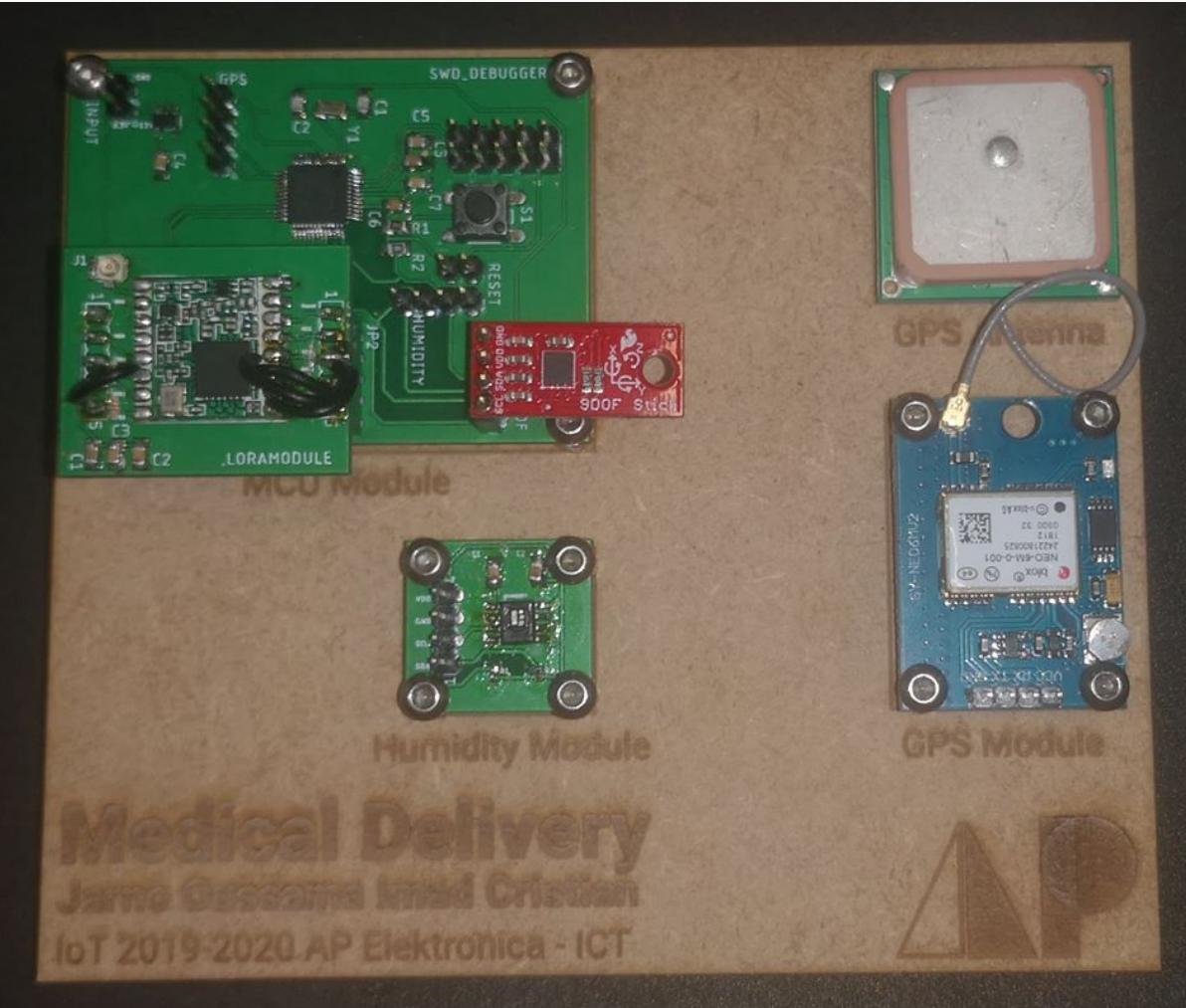
md-node1 [Info](#)

md-node3 [Info](#)

Description
High shocks cause failure

Github & Jira

Demo



APPLICATION DATA

|| pause  clear

Filters

uplink downlink activation ack error

time counter port

▲ 15:02:41	0	1	retry	devid: md-node3	payload: 0A 28 AC 0D	Humidity: 35	Temperature: 26
▲ 15:00:37	0	1	retry	devid: md-node3	payload: 09 60 74 0E	Humidity: 37	Temperature: 24
▲ 14:54:01	0	1	retry	devid: md-node2	payload: 09 60 74 0E	Humidity: 37	Temperature: 24
▲ 14:51:31	0	1	retry	devid: md-node2	payload: 09 60 74 0E	Humidity: 37	Temperature: 24
▲ 14:49:13	0	1	retry	devid: md-node2	payload: 09 60 74 0E	Humidity: 37	Temperature: 24
▲ 13:30:11	5	1		devid: md-node1	payload: 09 60 74 0E	Humidity: 37	Temperature: 24

Demo video

<https://youtu.be/BNx2Xx2pW8E>