

ECE 480 – Team 5

Wireless Sensing System for Concrete Curing FS-11

Team Members

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Introduction

- **Background**
- **Design Specification**
- **Tools**
- **Proposed Design Solution**
- **Risk Analysis**
- **Budget**
- **Reflection**

Background

Concrete Curing Process

- **Hydration Process**

- **Formation of Crystals**
- **Dependent on Temperature and Humidity**
- **Optimal Ranges:**
 - **Temperature: 60-85 Degrees**
 - **Humidity: Less than 70% R.H.**



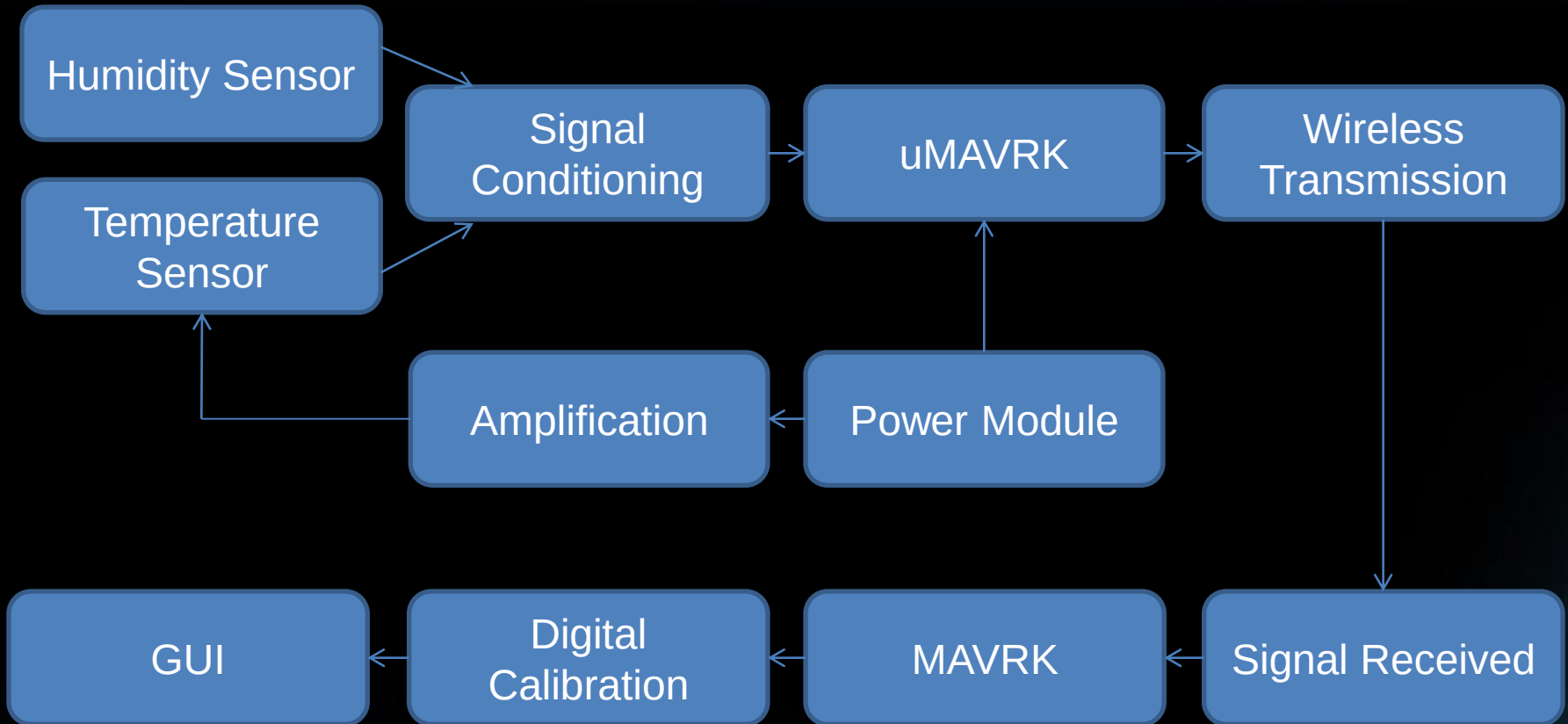
Problem & Goal

- Problem - abstract period of curing process
 - Early cure : loss of expense
 - Late cure : safety issue
- Goal – remote sensor to monitor concrete condition
- Tool – MAVRK development KIT



Design Specification

Functional Block Diagram



Design Specifications

- **FUNCTIONALITY**

- Sense Temperature/Humidity of Concrete
- Communicate with uMAVRK
- Send Signal to MAVRK
- calibrate data received

- **ACCURACY**

- ± 1 degree tolerance on temperature
- 1~3% RH humidity error
- multiple data point for comparison

- **COMPATIBILITY**

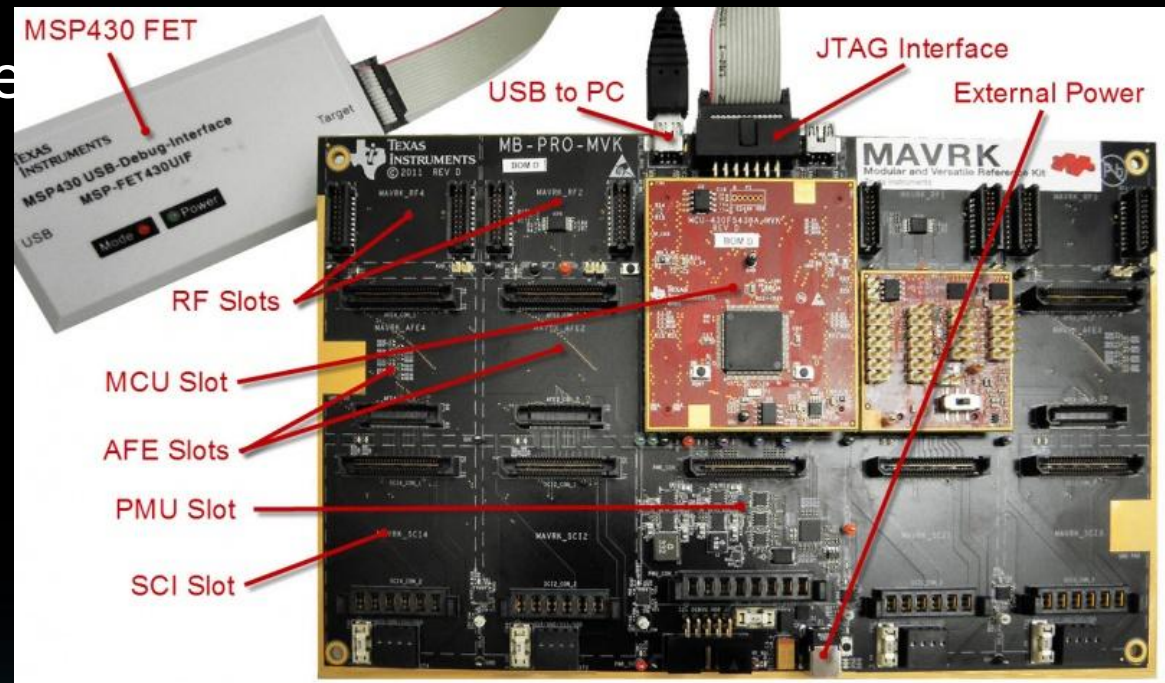
- Small enough to be embedded into concrete
- Power source lasting at least 3 weeks
- End product that can be shown on public demonstration

Background MAVRK

- MAVRK

- Modular and Versatile Reference Kit

- Hardware prototype platform from TI

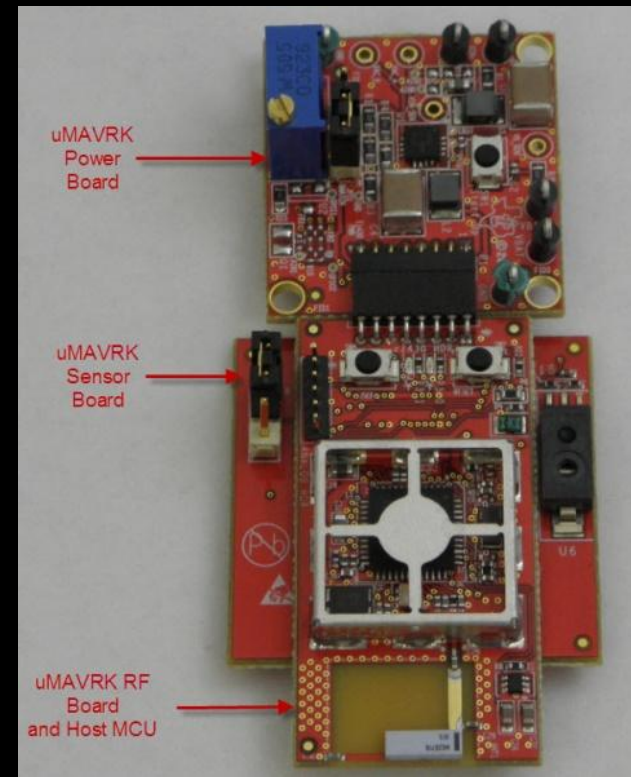


Hardware Specification

uMAVRK

- **uMAVRK**

- **Low Power Remote monitoring system**
- **Communicate with MAVRK through RF**
- **Target energy harvesting applications**



Simulation & Fabrication

- **TINA**

- TI software
 - Powerful circuit simulation tool based on a SPICE engine.
 - Saves Time.
 - User friendly.

- **Allegro**

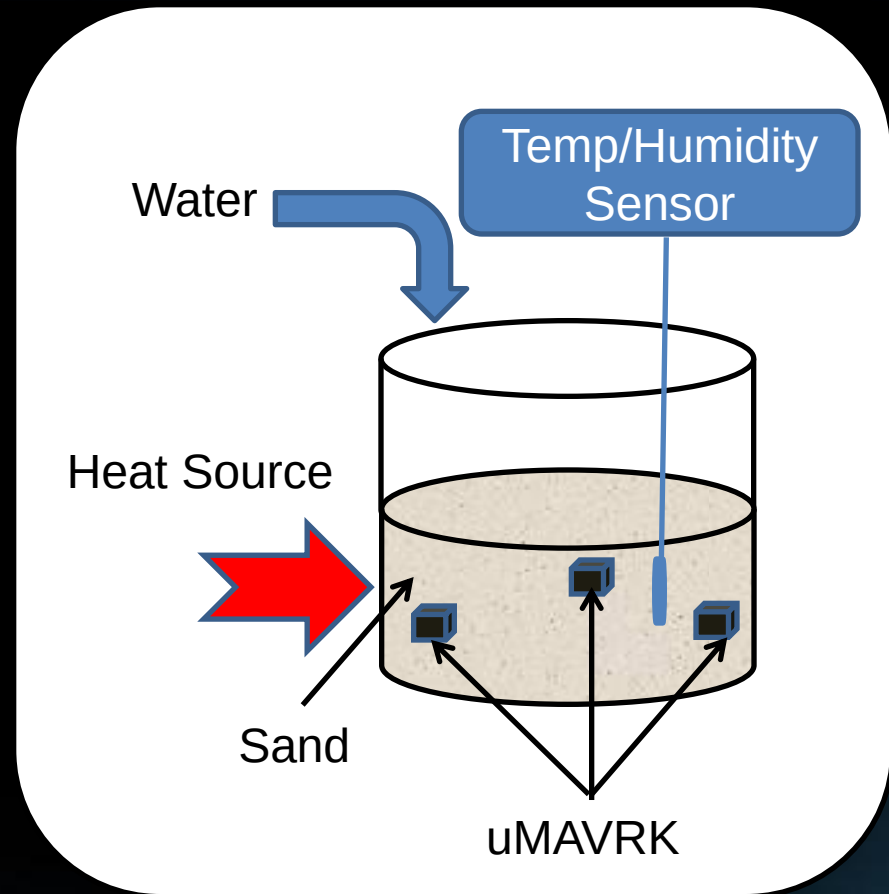
- Cadence Software utilized for PCB fabrication.

Proposed Design Solution

Demonstration Environment

- **Baseline Reference:**

- All components except Portland cement Sources
- Home Heater
- Saturating components
- Transparent Container (fish bowl)
- Temperature reference: Thermocouple
- Humidity reference: Add known quantity of water to dry components to calculate ratio

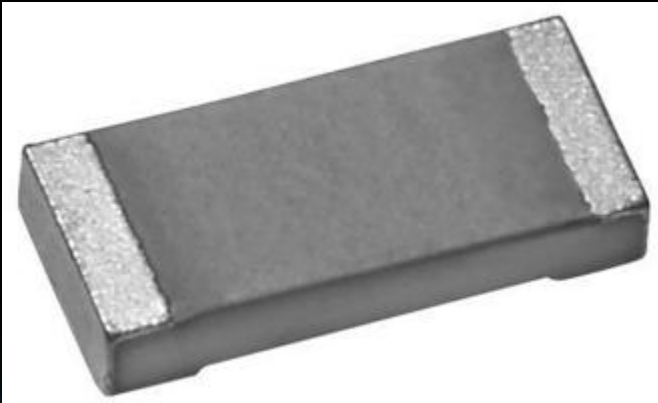


Proposed Design Solution

Sensor Selection

- **Temperature Sensor – PTS0603**

- Resistive sensor(RTD)
- Has very Linear output
 - $\pm 0.78\text{ C}^\circ$ error max
- Quick response time $< 0.1\text{ms}$
- Humidity/shock friendly



- **Humidity Sensor – CHS-UGS**

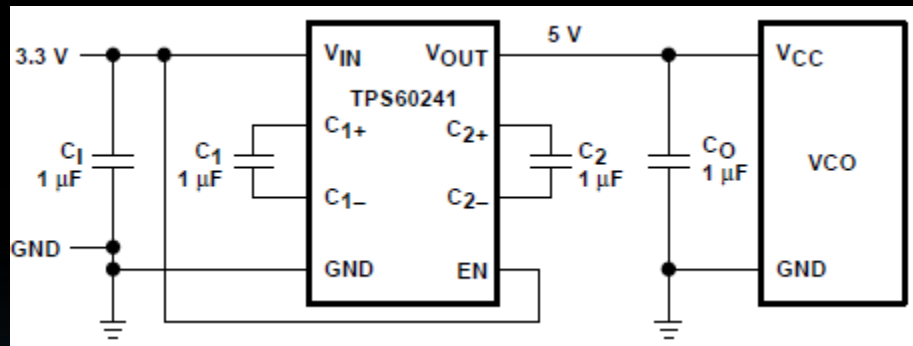
- Resistive Sensor
- 3-pin interface
- Linear voltage output
- Built-in integrated circuit



Proposed Design Solution

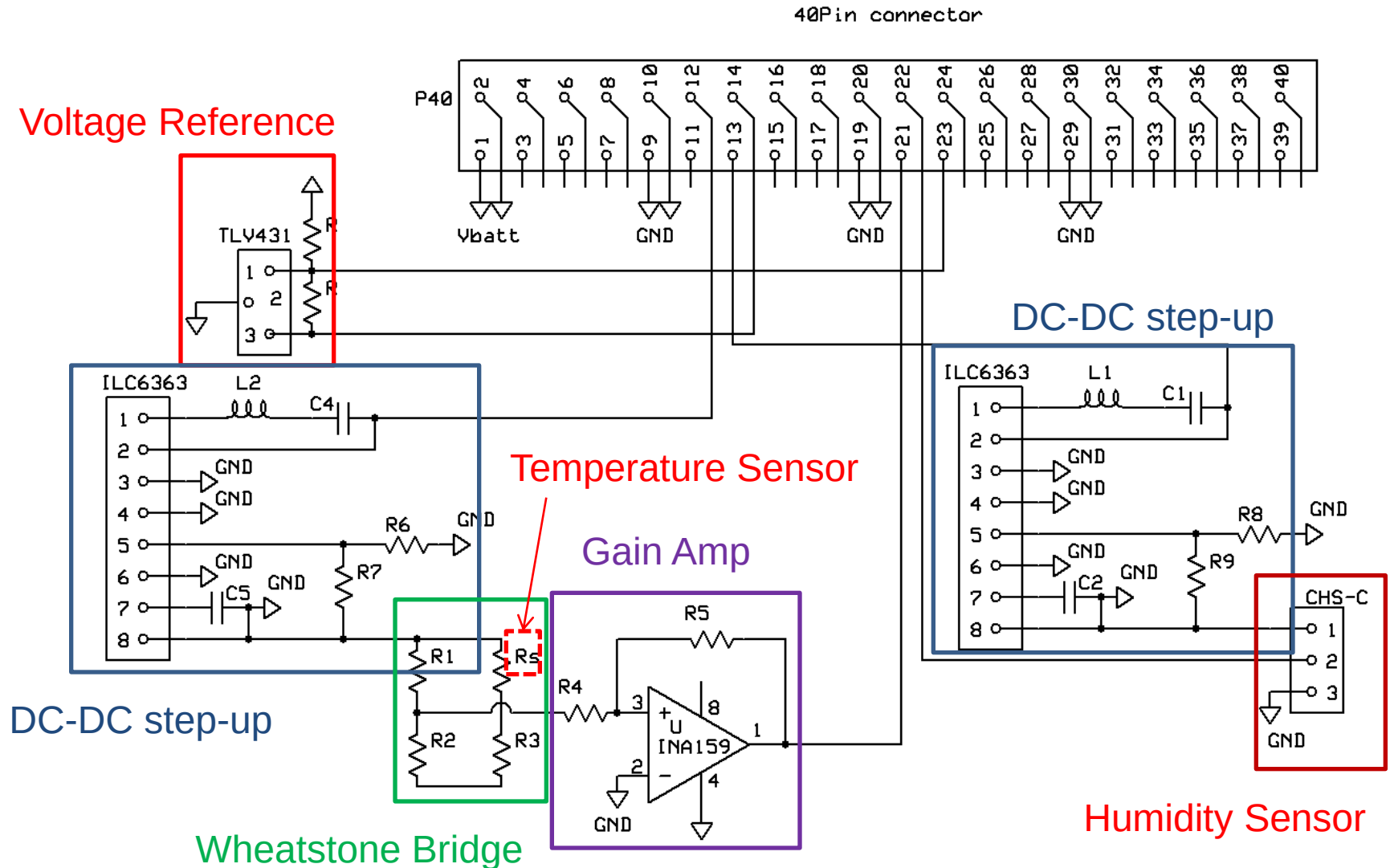
DC-DC Step up booster

- **TPS60241**
 - **Wide input Voltage Range**
 - **Regulated Voltage output**
 - **90% Efficiency**
 - **Minimum number of External component**



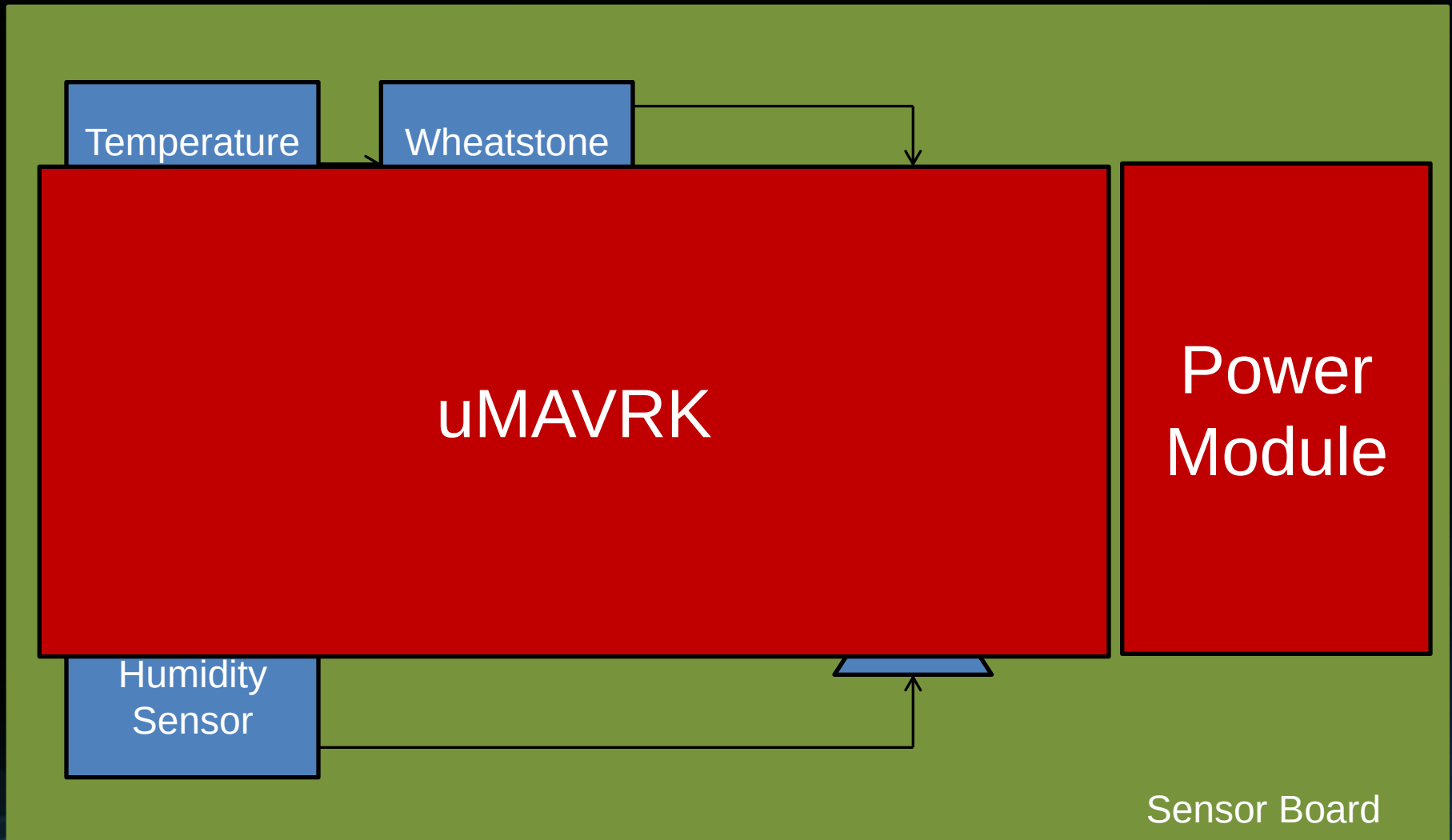
Proposed Design Solution

Schematic



Proposed Design Solution

Conceptual Layout of Component



Software Flow chart

uMAVRK Sensor Application

- CC430F5137
- Continuous measurement of temperature and humidity in 15 minute intervals
- Send to MAVRK via RF UART



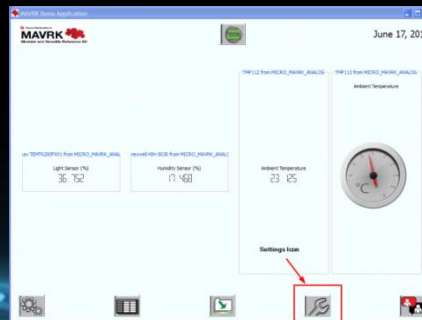
UART Passthrough Application

- MSP430F5348A
- Take bytes from RF UART
- Send to PC via TUSB UART



MAVRK QT Demo

- PC
- Receive bytes from the TUSB UART
- Display with a user-friendly GUI.



VOC

		Parts Selection	High Level Design	Signal Conditioning	Time between Data Acquisition
Functionality	5				
Cost	2				
Accuracy	4				
Low Power	4				

Minutes

Budget

Part Name	Quantity	Cost
40-pin Male Serial Adapter	3	\$12.50
Temperature Sensor	3	\$3.25
Humidity Sensor	3	\$96.30
Differential OP AMP	3	\$9.09
3 pin connector	6	\$3.03
Plastic Enclosure	3	\$4.15
Plastic Enclosure modification	1	Free(ECE SHOP)
Container	1	\$10(Estimate)
Heat Source	1	Free(Mech Lab)
Humidity source	1	Free
Material	1	\$5(Estimate)
PCB Fabrication Cost	3	\$150(estimate)
Total	29	\$293.32

Reflection

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Questions

