

Progress Report I

DATE : October 25, 2012

FROM : ECE480 Capstone Project Team 5

TO : Prof. Strangas

SUBJECT : Progress on Wireless Sensing System for Concrete Curing

Purpose Statement

This progress report was created to give the reader an overview of the current status, problem and the future plans regarding the ECE480 Team 5 Capstone Project : Wireless Sensing System for Concrete Curing. Through our internal evaluation, completion of our project is in the range of 60%. Four major obstacles were identified. Of those, we are in progress of discovering solutions to two of them.

Work Completed

I. Sensor Board

All parts needed to build sensor board obtained. RTD sensor is expected to arrive on October 26.

All pins of interest in CC430 uMAVRK DSP / 40-pin analog interface / debugger module have been identified. See reference for each pin of interest.

Made schematic of sensor board with all circuit component value calculated. See reference for links to Data Sheet of individual parts and full schematic diagram.

ADC conversion from LM34 Temperature Sensor to PIC was successful. Temperature Sensor output was in range of 0.74mV to 0.76mV, and ADC conversion output was ranged from 253(00FD in HEX) to 259(0103 in HEX). V_{ref} was set to 3V and 10-bit ADC conversion was used.

ADC conversion from CHS-UGS Humidity Sensor was successful. Humidity sensor Output was in range of 0.3V to 0.7V. 0.7V was measured when humidity was added to the environment of the humidity sensor. ADC conversion output was ranged from 102(0066 in HEX) to 259(00EF in HEX). V_{ref} was set to 3V and 10-bit ADC conversion was used.

Wheatstone bridge circuit was tested on protoboard. Potentiometer was used instead of RTD sensor to test functionality of Wheatstone bridge. Potentiometer was varied from 100 Ω to 123 Ω which is identical to the Resistor Value change of the RTD sensor from 0 to 60°C. V_{out} was ranged from 10mV to 270mV. Digital Multimeter was used to measure V_{out}

II. Testing Environment/ Enclosure

The effective range of the humidity and temperature for concrete curing was determined after a meeting with a Civil Engineer. The effective ranges for concrete are 40F to 120F of temperature and 0 to 70% RH for humidity.

Conceptual Test environment setup has been defined. Humidity will be varied through a known ratio of sand and water. The beaker will be used for the precise measurement of the water level. A heat plate will be used for temperature adjustments. External Temperature and humidity sensors will be used to verify the result that our sensor module has obtained through ADC. All equipment excluding transparent enclosure will be obtained from Civil Lab.

III. MAVRK/uMAVRK programming

Compatibility issue of MAVRK & uMAVRK with code composer was resolved. The developers of the MAVRK module agreed to work on software programming with our team to avoid any hold ups caused by their product.

IV. TINA Simulation

TINA simulation program learned. Team is able to run simulation of simple circuitry within parts provided in library of TINA. This simulation program will not be able to simulate the final circuit design due to incompatibility of non-Texas Instruments devices being chosen.

V. PCB fabrication

Grabber file of break board for 40-pin male analog adapter was created. Due to time constraint and steep learning curve of Allegro, dip trace was utilized. After some of the files were created and ready for fabrication, TI expressed that they would be unable to help us with this process due to the incompatibility between software. We switched back to Allegro. We are making substantial progress in Allegro now.

Problems

I. Sensor Board

Need more research and understanding on picking suitable OP AMP for sensor signal amplification. Currently we are planning to use the LM741 General purpose OP AMP, but need more research on different parameter of OP AMP to choose best fit for our overall performance. Text book from Engineering Library was rented out due to limited information obtained from web research.

II. MAVRK/uMAVRK programming

Having issues with actual programming of uMAVRK. Demo application provided by supplier does not function. In progress of resolving problem by working with supplier directly. PIC will be used as ADC converter till the issue is resolved.

III. TINA Simulation

Unable to run simulation when parts are not provided in library of TINA. Figuring out ways to build custom library for parts not given in TINA.

IV. PCB fabrication

Problems with parts that is not in allegro library. Also trying to build custom library.

Work Scheduled

I. Sensor Module

Oct 28. Build full circuitry on to proto board. Two 1.5V battery will be used at this point for power source. If uMAVRK software issue is resolved, ADC feature of uMAVRK will also be tested.

Oct 31. Suitable OP amp will be chosen to replace LM741.

II. Test Environment / Enclosure

Oct 26. Thermocouple & hot plate obtained from CE lab which can be used until Design day.

Oct 28. Two types of enclosure order. One assuming that we will use two 1.5V battery(dimention 3cm x 6.5cm x 1.5cm) and other assuming that we will use battery module provided by TI(dimention 2.5cm x 10.5cm x 2.5cm). Order will be processed through Digikey and manufacturer will be

Oct 29. Transparent container & Sand obtained from local store (Home Depo).

Nov 28. Test final design on chamber which we can adjust temperature and humidity precisely. Structural lab is located off campus and Civil Engineering professor has permitted the usage.

III. PCB fabrication

Nov 3. First PCB fabrication order placed. Estimated delivery time is 7 business (2 days for our surface mount parts sent to manufacturer) days with rush processing fee.

Nov 15. Second PCB fabrication order placed. If first PCB fabrication were successful, PCB containing uMAVRK, Power module, and sensor module will be fabricated. If not, second sensor board with modification will be fabricated.

Nov 24. Third PCB fabrication. Not necessary if first PCB fabrication was successful.

IV. MAVRK / uMAVRK programming

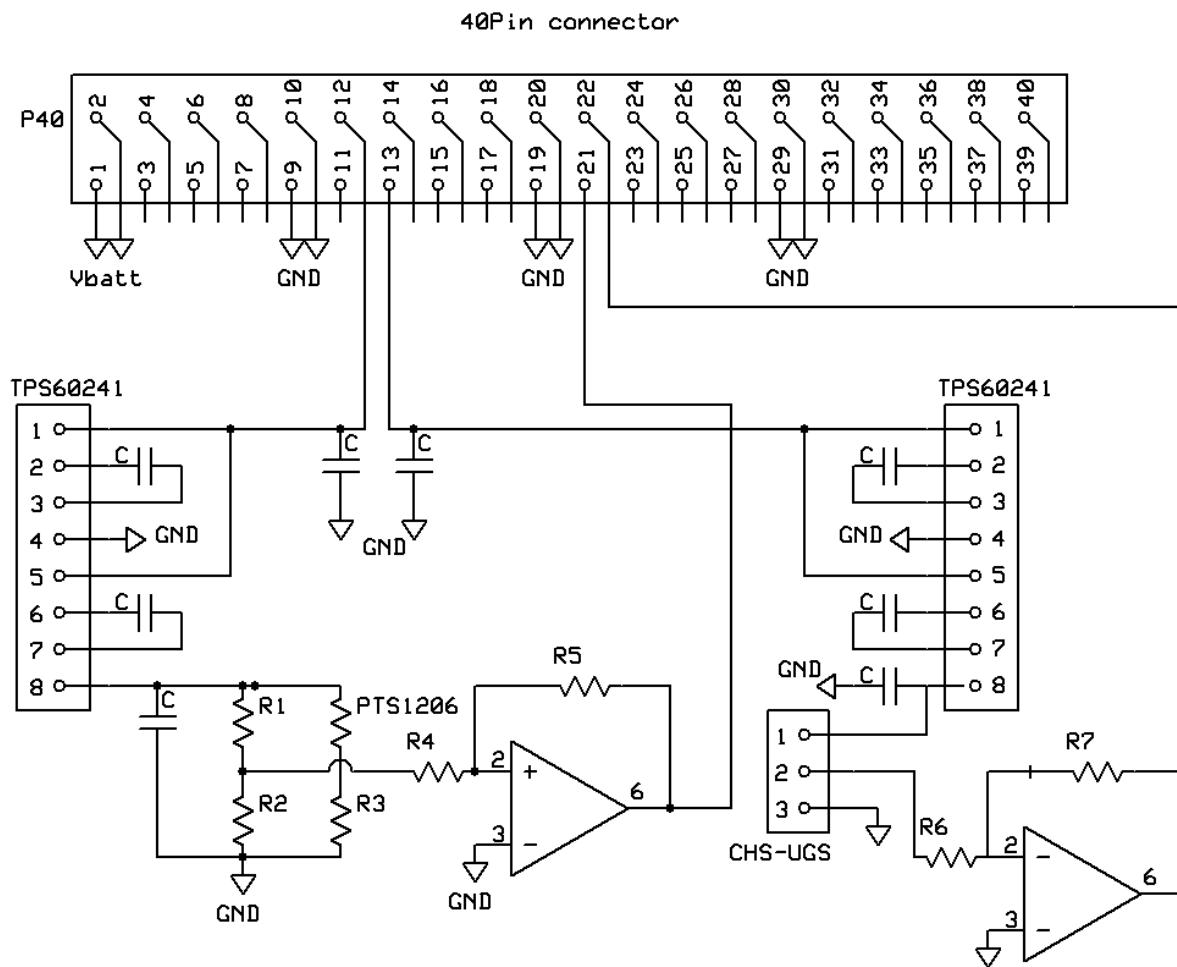
Nov 2. uMAVRK programmed to be used for ADC conversion.

Nov 11. uMAVRK programmed to control temperature and humidity sensor. RF communication with MAVRK established.

Nov 28. MAVRK Communication with PC and GUI completed.

Reference

i. Circuit Diagram



ii. Information on specific parts selected.

Temperature Sensor

Part Number	PTS1206
Manufacturer	VISHAY
Thermal response time	$t \leq 0.1s$
Operating Temperature Range	-55 to 150°C
R min(0°C)	100Ω
R max(60°C)	123.24Ω

Humidity Sensor

Part Number	CHS-UGS
Manufacturer	TDK
Operating Voltage	4.75V to 5.25V
Output Voltage	10mV per %RH

DC-DC Step up Booster

Part Number	TPS60241
Manufacturer	Texas Instrument
Supply Voltage	2.7 to 5.5V
Output Voltage	5V(fixed)
Current Output	25mA

40-Pin μEVM connector interface

Part Number	DF-40C-40DS-0.4V
Manufacturer	Hirose Electronics

Operation Amplifier

Part Number	LM4250CN
Manufacturer	National Semiconductor
Type	Programmable Gain Amplifier

Miscellaneous Circuit components

Name	Quantity	Value
Capacitor(C)	8	10uF
Resistor (R1, R2, R3)	3	100Ω ± 5%
Resistor (R4, R6)	2	68Ω ± 5%
Resistor (R5)	1	680Ω ± 5%
Resistor (R7)	1	220Ω ± 5%