Progress Report #1

October 13th, 2019

Smart Chemical Sensor/Alarm System

404!

Asif Iqbal, Roni Das

Faculty Advisor: Leon Shterengas

Executive Summary

1.1 Overview

The goal of this project is to make a smart sensor system to detect CH4(Methane gas). This system is a combination of hardware and software and should be optimized for least amount of processing time. The application of this device lies in home appliance. Many house fires are caused by a gas leak. This system will detect the leak and notify the user about it. This project has the potential to save property from being burnt and save lives.

Product:

The smart chemical sensor/alarm system includes a vapor sensor, temperature sensor, methane gas sensor, a microcontroller and an LED. It is fast since the computing is done in a microcontroller. The microcontroller is programmed in assembly language to make the runtime as fast as possible. The sensors will be interfaced with the microcontroller. When it senses the methane gas leaking, or an unattended stove, the system will immediate ring an alarm. The system is small, portable. It is recommended that it is implemented on a gas stove for the utmost performance. When gas leakage occurs, the system will send a signal to turn off the gas.

1.2 Competition

For the final working version of the system, there is no competition. In the market, currently there is not gas detector system for stove. However, a system does exist for electric stove. Given that gas stoves popular in terms of usage, the system has little competition.

1.3 Challenges

The challenge the team faces is communication between the sensors and microcontroller. It is very crucial the interfacing is done in perfection. Then comes the challenge of programming the microcontroller with assembly. To make the code as simple as possible for faster runtime.

1.4 Team Experience

The team is made with two seniors in Stony Brook University majoring in Computer Engineering. Both members have taken coursework on Embedded Systems and currently taking a graduate course on Modern Sensors. Both teammates have experience in programming microcontroller using assembly. The team have the knowledge required for the completion of the project and the team will apply the knowledge to complete the project.

Introduction:

Specific parts for the project have been picked out. Parts like, breadboard, sensors, microcontroller, etc. Due to over-sea shipping, it will take about a month for all of the parts to arrive. The way our project is layed out, we need every single part available to assemble the circuit board. Once that is done, then comes the coding part of the project. Assembly language will be used to program the microcontroller to process the data sent by the sensors. Due to not having parts, we could not approach the any tasks yet. We have used the time we had so far to plan out what exactly is to be done by each person in the group when the parts comes. Both team members will work on assembling the circuit. Asif will do the interfacing between the sensor and the microcontroller. Roni will be designing a PCB board for the final prototype model. Both of the members will work together on writing the software for the microcontroller.

Parts:

Materials	Purpose	Cost	Source
ATxmega 4809	CPU/ Data processing	10 @ 23.70	Mouser Electronics
Winsen MC105	Combustible Gas Sensor	10 @ 22.70	Ebay
WPAH01	Pressure Sensor	10 @ 22.00	Ebay
BME 280	Humidity Sensor	2 @ 11.96	Ebay
JTAG Header	Interface JATG w/ MC	1 @ 3.00	Ebay
RGB LEDS	Output/ Debugging	25 @ 6.05	Ebay
Resistors	Circuit Elements	Free	Lab
	Total :	$ 89.41	

Detailed Descriptions:

As scheduled, research phase of this senior design project has been undertaken. While we wait for the parts to arrive, we are in process of researching data sheets for respective parts. Using tool like Active HDL we are in process of completing top level Schematic of the system. This will allow us in connecting parts onto breadboard efficiently. The reference schematic below highlights common connection between different parts of the system.

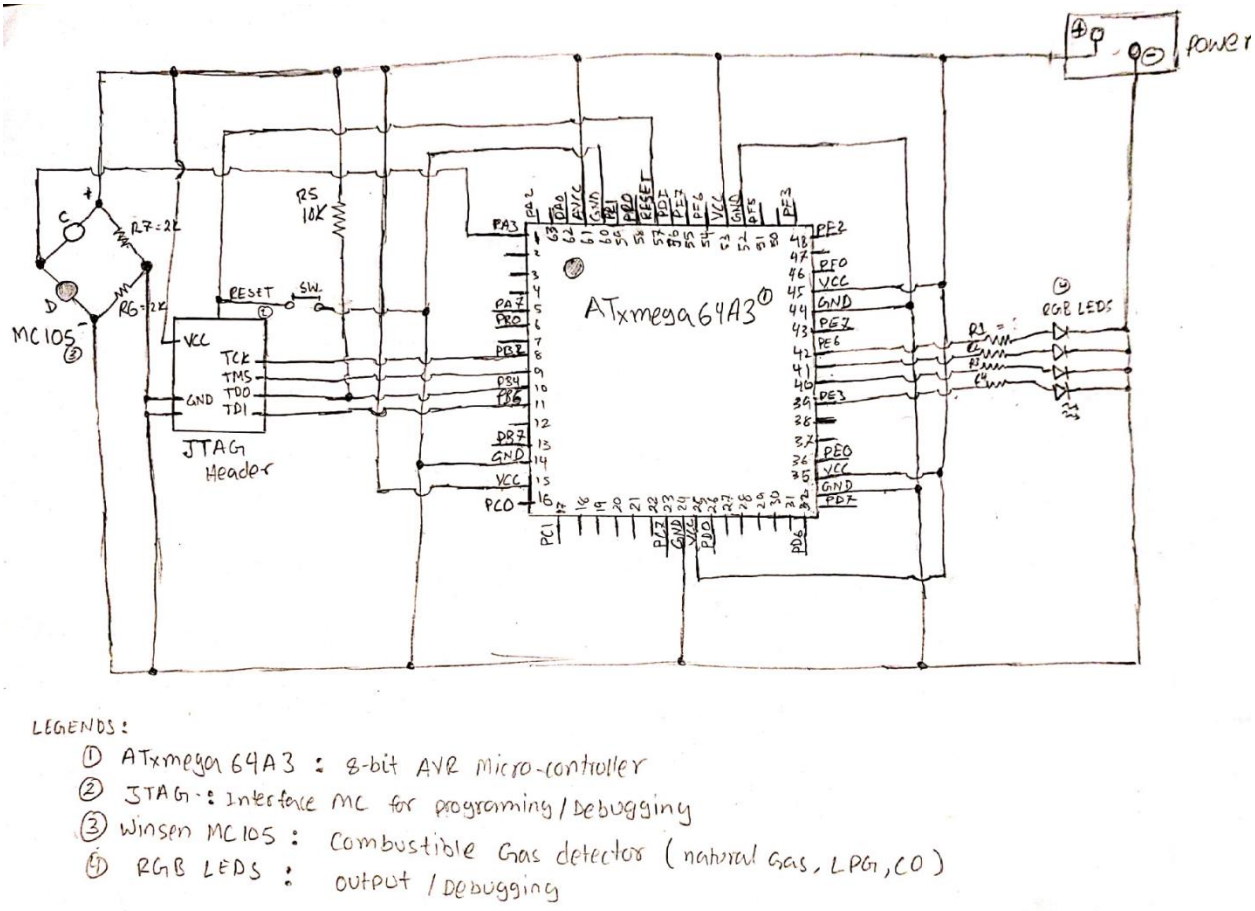

Figure 1: Top level Schematic of the system.

Above figure describes, typical connection between sensors and MCU. At prototyping stage, each sensor will be interfaced with a 8bit AVR MCU in a similar fashion shown above. MC105 is combustible gas sensor capable of detecting many gaseous forms including CH4(methane). This four-prong device generates a voltage across C and D terminal in direct response to levels of natural gas in air. Reference circuit of the system is gathered from the data sheet and shown below.

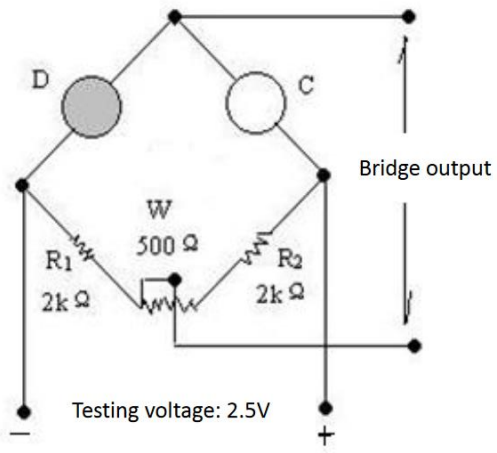

Fig2. Basic Test Circuit

Figure 2 describes general test circuit of Combustible gas detector from Winsen Sensors. The bridge output is connected to a pin of AVR microcontroller. The CPU continuously samples from this pin to give an accurate reading on present gas level in atmosphere. With help of a 12-bit ADC a digital signal is generated on output Port of the MCU. Debugging LEDs can be utilized to indicate change in concentration of gas detected. The research phase will continue to accommodate better understanding in resolving fallacies and pitfalls arrives from design project.

Gannt Chart:

Below described a list version of Gantt chart. Figure describes which tasks are completed as well as which tasks are still pending. This chart was made to encompass all details of this senior design project including tasks to be completed in ESE 441. There is a progress meter associated with a task which is updated every week to reflect amount of work done. As scheduled, we have completed design descriptions, order parts, achieved top level design methodologies along with 50% of researched about these parts are completed. Some of these tasks are time sensitive and dependent on previous tasks such as prototyping the circuit on a breadboard. Therefore, we have started working on coding in assembly to maximize our effort in completing senior design.

Senior Design

Project Specifications	**100%**	**Start**	**Due**	**Assigned**
What will this project DO?	100%	Sep 1, 2019	Sep 15, 2019	
Paperworks	**26%**	**Start**	**Due**	**Assigned**
Proposal	100%	Sep 1, 2019	Sep 15, 2019	
Progress Report I	100%	Oct 7, 2019	Oct 18, 2019	
Progress Report II	0%	Feb 1, 2020	Feb 14, 2020	
Presentation I	0%	Monday	Nov 4, 2019	
Presentation II	0%	Apr 1, 2020	Apr 17, 2020	
Poster Day	0%	May 11, 2020	May 22, 2020	
End of 440 Report	0%	Dec 2, 2019	Dec 13, 2019	
End of 441 Report	0%	May 1, 2020	May 15, 2020	
Research	**50%**	**Start**	**Due**	**Assigned**
Sensors	50%	Sep 14, 2019	Thursday	
Gas/Electric Stoves	50%	Sep 14, 2019	Thursday	
Existing Technology	50%	Sep 14, 2019	Thursday	
Smoke Detectors	50%	Sep 14, 2019	Thursday	
Required Parts (Order)	**92%**	**Start**	**Due**	**Assigned**
Natural Gas Sensor	100%	Oct 4, 2019	Nov 1, 2019	
Water Vapor Sensor	100%	Oct 4, 2019	Nov 1, 2019	
Micro-controller	100%	Oct 4, 2019	Nov 1, 2019	
Pressure Sensor	100%	Oct 4, 2019	Nov 1, 2019	
Temperature Sensor	100%	Oct 4, 2019	Nov 1, 2019	
Breadboard	100%	Oct 7, 2019	Oct 9, 2019	
Custom PCB	0%	Nov 18, 2019	Nov 30, 2019	Roni Das
Prototype W/ Micro-controller	**0%**	**Start**	**Due**	**Assigned**
Natural Gas Detection	0%	Nov 4, 2019	Nov 8, 2019	
Pressure sensing	0%	Nov 11, 2019	Nov 15, 2019	
Water Vapor Sensing	0%	Nov 18, 2019	Nov 22, 2019	
Interface PCB	0%	Dec 2, 2019	Dec 6, 2019	
Software	**37%**	**Start**	**Due**	**Assigned**
Micro-controller OS (assembly)	10%	Oct 14, 2019	Nov 22, 2019	
Phone App (JAVA)	0%	Feb 3, 2020	Feb 29, 2020	
Top Level Schematic	100%	Oct 14, 2019	Nov 15, 2019	
Verifications	**0%**	**Start**	**Due**	**Assigned**

Phase I (LED)	0%	Nov 25, 2019	Nov 29, 2019	
Phase II (Sound)	0%	Dec 2, 2019	Dec 6, 2019	
Phase III (autonomous)	0%	Apr 13, 2020	May 15, 2020	

Figure 3 : A list version of Gantt Chart.

Conclusion and Discussion:

As with any long project it is necessary to follow intermediate steps precisely to achieve final goal. This progress report serves as recording and acknowledgment of these intermediate tasks. We as a group are on schedule and progressing according to Gannt Chart developed earlier in the project. All the parts required for this project has been bought and top-level design is achieved. The software in currently in process of development and will be tested once hardware is available for prototyping. Researching for this project is an ongoing project which will extend into ESE 441 for providing more clarity of our system. Overall, our project is on schedule.

Reference:

1. Ahrens, Marty. “Home Cooking Fires.” *Nfpa.org*, 2018, www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/US-Fire-Problem/Fire-causes/2018-Home-Cooking-FIres--Report_FINAL.ashx. Date Accessed : 9/10/2019

2. Based, Online. “Ionization vs Photoelectric.” *Ionization vs Photoelectric*, 2017, www.nfpa.org/Public-Education/Staying-safe/Safety-equipment/Smoke-alarms/Ionization-vs-photoelectric.Date Accessed : 9/10/2019

3. “ESP32-DevKitC ESP32 Module Development Kit.” *Grid Connect*, www.gridconnect.com/products/esp-devkitc-esp32-module-development-kit?gclid=CjwKCAjwwvfrBRBIEiwA2nFiPSPkU8oijmgaZ-rEyin4uhir3fMao3TCTfFCh5WkcI2c5wluNH_fKxoCfj4QAvD_BwE.

Appendix A:

Team meeting is held with professor Leon every Friday at noon in the fall semester. There will be weekly meeting held in the spring semester too. Time and days for that will be determined in the beginning of Spring semester.