

Networks of Smart Things

Executer:

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INTRODUCTION

The purpose of this project was to develop a portable CO2 measurement system for room air purity measurements.

TOOLS

Needed tools for this project:

- LinkitOne board
- ThingWorx platform
- Wire
- Soldering machine
- CO2 sensor- CCS811
- SIM card

STARTING POINT

Our first task was to find a low cost (<30€) CO2 sensor which can be purchased in Europe (no time for Alibaba delivery), does "sufficiently" accurate CO2 concentration measurements and can be simply interfaced with Linkit One (SPI, I2C). This task was given for everyone. After that two most suitable CO2 equivalent sensor were chosen by supervisor. We had to decide which one we want. For that we gathered information. We watched both sensors datasheets- it occurs that they are very similar.

We decided to choose CO2 sensor CCS811 because we found our project source code from Sparkfun[1]. Also, in Sparkfun there was very good explanation for this sensor beginning from soldering to source code.

FINDING SIMILAR PROJECTS

At first, we started to search similar projects [2, 3, 4, 5]. Because, in nowadays, there is lot of information available in internet. To get introduction for ourselves we just quickly watched what others have already done and how. This process gives knowledge and ideas how to do or not do our project in a more better way. For us, it helped to conduct the whole picture for this project.

DATA FLOW

In Figure 1 is drawn a simplified picture about our project. What are the main parts what are needed to build up our projects. Our goal is to find out how we should implement this data flow. The results of this project is to visualized in mashup where it is possible read measurements results.

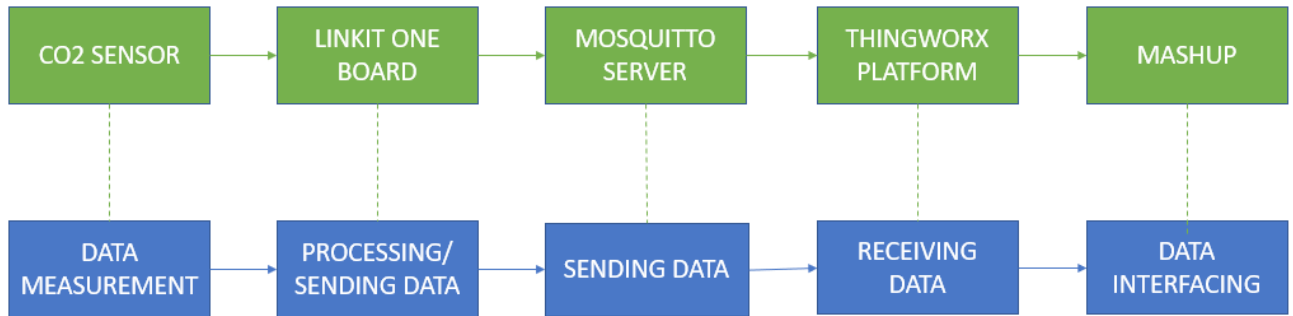


Figure 1 Data flow for project

TASKS

At this point we created table with tasks what were needed to do to implement this project. It was needed to make clear what we must do and in what order. To understand our logic behind the tasks table please see Figure 2.

Colour Scheme	
	Can be done without CO2 sensor. We should start immediately and finish within 2 weeks before sensor come to us.
	Wait till CO2 sensor are available
	Completed
	Bug

Figure 2 Tasks table color scheme

Sr No.	Task	SubTask	Required Skills
1	Interfacing CO2 sensor to LinkitOne	Understand CCS811/MICS-VZ-89TE data sheet.	Sensor data sheet understanding
		How to interface sensor to LinkitOne. LinkitOne GPIOs selection. Resistors or any other component selection in	
		From sensor data sheet, find out address from where to read sensor data	
		From sensor data sheet, find sensor data formatting formula for sensor readings	
2	I2C	Understand I2C protocol	Arduino/C programming skills
		How to use I2C in LinkitOne from Userguide	
		Write I2C protocol in Arduino	
3	QA : LinkitOne - I2C - Sensor	Run I2C protocol with sensor interfaced with LinkitOne	Arduino/C programming skills
		Resolve Bug if any	
4	ThingWorx	How to connect LinkitOne to ThingWorx	ThingWorx Cloud Understanding
		Design UI on ThingWorx	
5	QA : ThingWorx - LinkitOne	Interface LinkitOne with ThingWorx Cloud and check connection	Arduino/C programming and ThingWorx UI design skills
		Send sample data from LinkitOne to ThingWorx and display in UI	
6	QA : ThingWorx - Linkit One - I2C - Sensor	Test data sent from CO2 sensor displayed on ThingWorx or not in real time	
		Resolve Bug if any	
7	Send sensor data to Phone by SMS	Find how to send SMS from LinkitOne using GSM network (Probably by AT cmds)	AT command understand and Arduino/C programming skills
		Write code in Arduino to send SMS on specific event	
8	Report Preparation	Write a common "big" report during the project	
9	Final QA : ThingWorx - LinkitOne - I2C-	Test final project and resolve bug if any	Party skills for celebration ;)

Figure 3 Tasks table

RESULTS

We interfaced our data in mashup as shown in Figure 4.

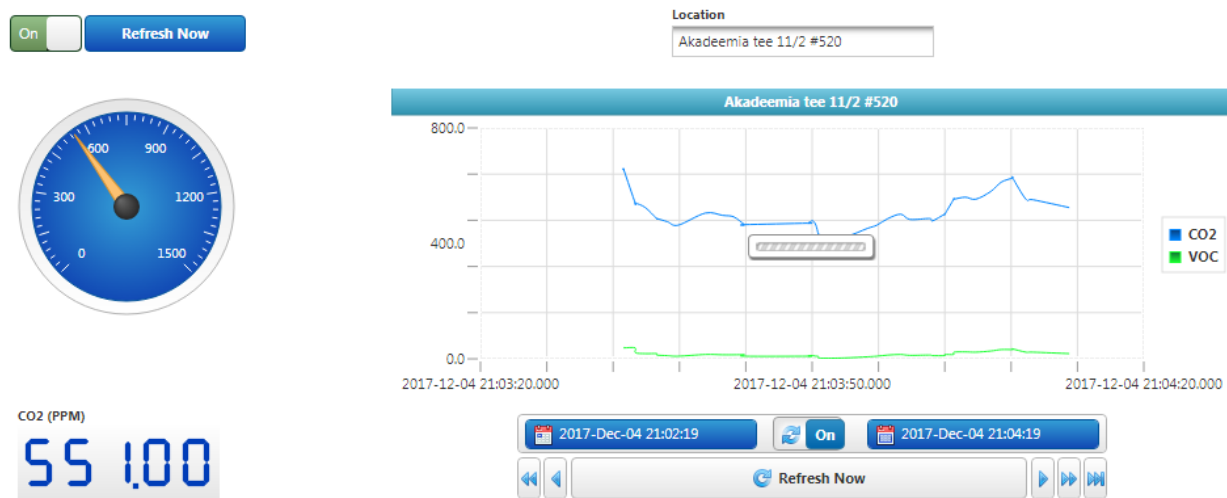


Figure 4 Mashup interface example

CONCLUSION

To conclude, the project is good enough for POC. We are able to send measured data to Thingworx platform and interface it via mashup.

Team member comments:

Name/Comments	Positive comments	Negative comments
Kertu Pikk	I liked that we organized our tasks and I am happy that I got very good team members.	It was hard to find suitable time to make meetings beacuse we all had very busy schedule. Also, in my opinion mashup was the hardest part.
Harish Singh	LinkIt One provides maximum on-board modules like BLE, WiFi, GPS, GSM, I2C, SD card slot etc compare to traditional embedded boards like RPi, Arduino, BeagleBoane etc. LinkIt One significantly speedup and	For prototyping Linkit One is a good board, but to have in-depth understanding of technology (software stacks) I suggest BeagleBone or RPi is a better option because there we can dig up to the kernel. After flashing linkitone,

	simplify the project prototyping.	sometime it stops responding or it still will be running old program. Look like flashing mechanism is not reliable.
Silver Puulmann	Info sharing and organizing projects tasks was good.	We did not archived our tasks as we planned, beacuse some tasks took more time than we expect and the others took less time.
Guillaume Olivier Pierre Ricard	Project was complex enough to make it an interesting challenge, as we had to cover several problematics and work from scratch Tasks were varied, so everybody can choose what he prefers to work on. Random teams to meet new people.	Let students know about this project sooner, so it gives the possibility to work on it at the beginning of semester (when we have less deadlines/exams) Why not give several subjects and let students decide on which one they want to work on.

FUTURE DEVELOPMENT

- 1) Integrate multiple sensors over I2C or other protocol to LinkitOne, to check its performance (battery life, accuracy, latency etc).
- 2) Ventilation control by LinkitOne
- 3) Logging data into SD card of LinkitOne for failure analysis.
- 4) Provide option for internet connection over both WiFi and GSM.
- 5) Publish data from Thingworx and subscribe by LinkitOne for ventilation control or alert.
- 6) Sending alert by SMS

REFERENCES

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- [2] <http://www.instructables.com/howto/co2+sensor+linkit+one+project/> (07.10.2017)
- [3] <https://docs.labs.mediatek.com/resource/linkit-one/en/tutorials/sensor-data-communication-using-the-i2c-protocol-on-linkit-one-development-boards> (07.10.2017)
- [4] <http://www.instructables.com/id/LinkIt-ONE-I2C-Address-Finder/> (07.10.2017)
- [5] <http://www.instructables.com/id/LinkIt-ONE-I2C-Address-Finder/> (07.10.2017)