Internet of Things Weather Station

IEEE Northern Virginia Section

Hands-On Professional Development Series

October 29, 2016 Montgomery College

IEEE
Advancing Technology for Humanity

Sketch 04 – IoT Weather Station

What are we going to do

- Define Barometric Tendency
  - Create graphic characters to display trend
- Add a simple Real Time Operating System (RTOS)
- Activate the ESP8266 WiFi transceiver
- Open a ThingSpeak account
- Post data to the Internet
- Visualize and analyze the data

Barometric Tendency

- The trend is measured over a three-hour period:

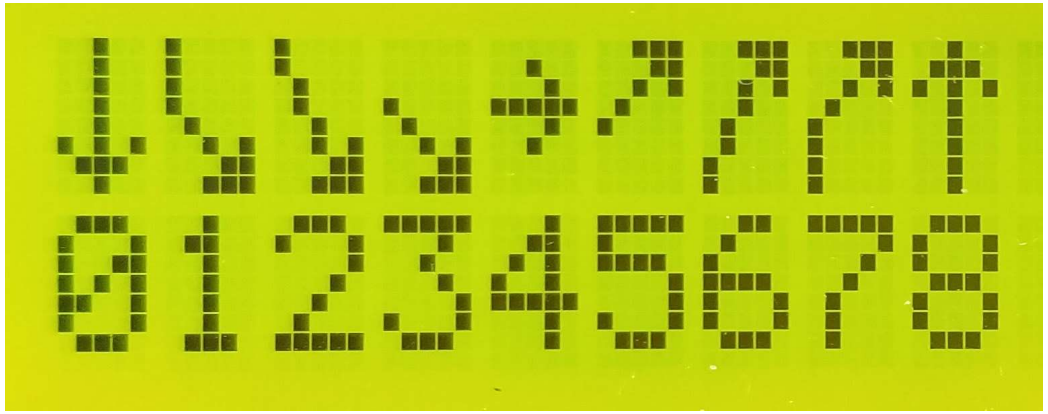
Trend	Lower	Upper
Steady	0 mb	< 0.1 mb
Falling or rising slowly	0.1 mb	1.5 mb
Falling or rising	1.6 mb	3.5 mb
Falling or rising quickly	3.6 mb	6.0 mb
Falling or rising very rapidly	> 6 mb	

"On-Board Weather Handbook" by Chris Tibbs

- http://www.islandnet.com/~see/weather/eyes/barometer3.htm

“Graphic” Display

- We need 9 graphics to illustrate barometric trend
- The LCD allows the definition of 8 5x8 characters
- Fortunately, there is one suitable built-in character suitable the indicate “Steady”



Weather Prediction

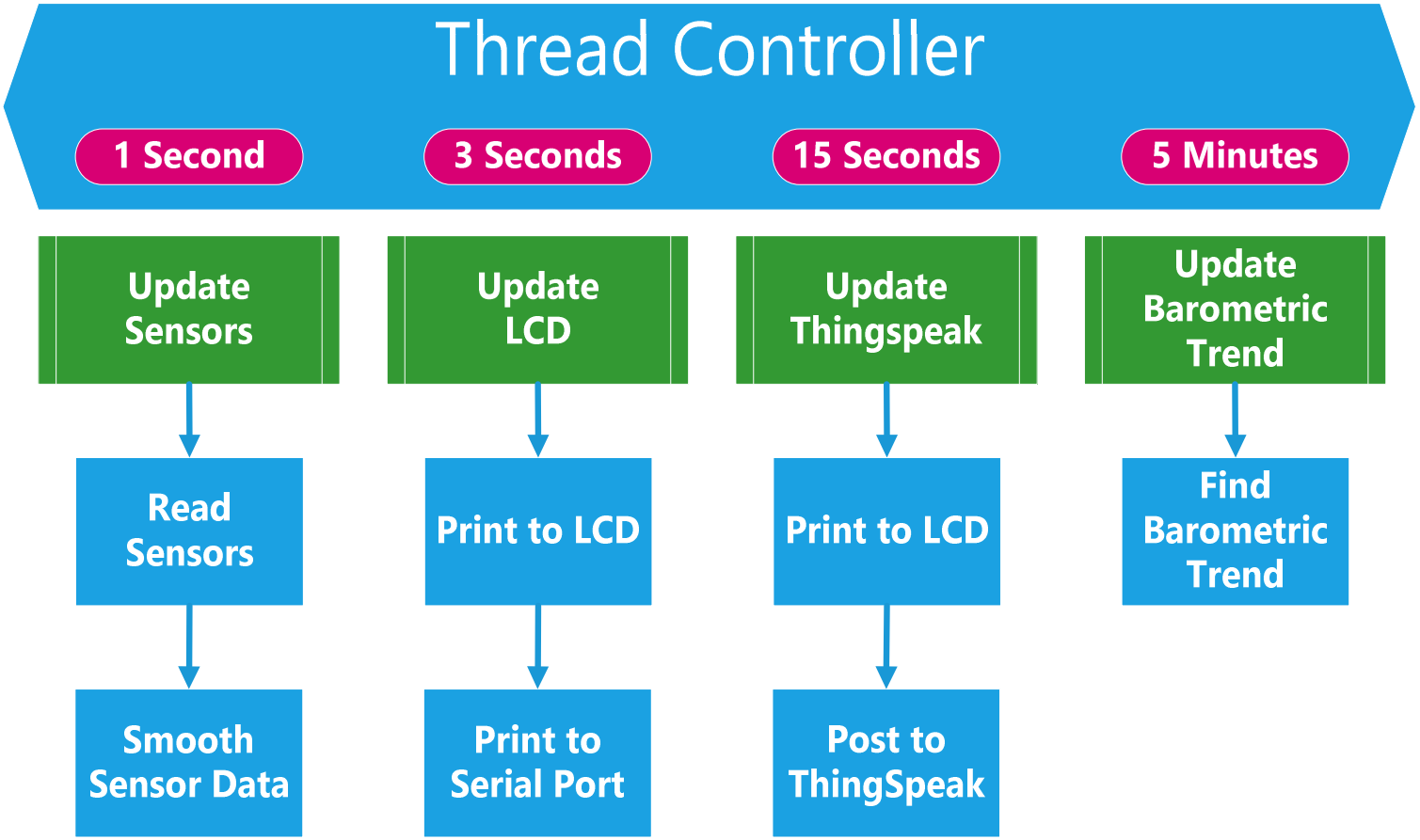
Sea Level Pressure

kPa	< 1009	1009 - 1027	> 1027
inHg	<29.8	29.8 - 30.2	>30.20
Rapidly falling	Storm	Precipitation likely	Cloudy, Warmer
Slowly falling	Precipitation	Little change	Fair
Steady	Clearing, cooler	Same as present	Continued fair
Rising	Clearing, cooler	Same as present	Continued fair

Source: http://www.sciencecompany.com/-W135.aspx

A Simpler Approach

Real Time Operating System



ThingSpeak Account

- In browser open **www.thingspeak.com**
- Click “Sign Up”
- Select & Record your UserID
- Change Time Zone to GMT-5:00 Eastern Time
- Select & record your Password
- Agree to Terms
- Click Create Account
- On next screen click “New Channel”

ThingSpeak Channel Definition

- Choose & record channel name
- Field Definitions
  - 1 = Temperature
  - 2 = Humidity
  - 3 = Station Pressure
  - 4 = Sea Level Pressure
  - 5 = Light Intensity
  - 8 = Voltage
- Make Public
- Elevation = 170
- Show Location
- Latitude = 39.1863
- Longitude = -77.2466
- Save Channel
- Record API Keys

Sketch 04 - ThingSpeak

- Use Arduino IDE Library Manager to install **ArduinoThread**
- Open **IEEE_IoT_Sketch04_Thingspeak_V02**
- Edit the sketch:
  - Line 50: change ssid to “MCPA”
  - Line 51: change password to “”
  - Line 54: enter your ThingSpeak API Write Key
- Upload it and observe LCD screen

ThingSpeak Built-in Visualizations

- Select Public or Private View – it should be populated with charts.
- Watch charts update every 15 seconds.
- Float mouse over a chart line to see time & value.
- Click on edit icon (pencil) in upper right of a chart.
  - Note Timescale, Data Min & Max, Y-Axis Min & Max
  - Charts are autoscaling. Out of bounds data messes up axis. Use Data Min & Max to ignore bad data.
  - Use Y-Axis Min & Max to force reasonable axis values.
  - Use Timescale to avoid data overload

MATLAB Visualizations

1. While in Private or Public View
    1. Click on MATLAB Visualization
    2. Select Custom Template – click Create
2. Change Name to IEEE IoT Network
3. Open **Display_Multiple_Channels** in ThingSpeak_Scripts folder
4. Select all text (Control A) and Copy (Control C)
5. Paste (Control V) in MATLAB Code window.
6. Modify script to add other sensors (See next slide)
7. Under "Add this Visualization…" check Private View and Public View
8. Click "Save and Run"
9. Return to Public View, Click on Add Visualizations, select IEEE IoT Network

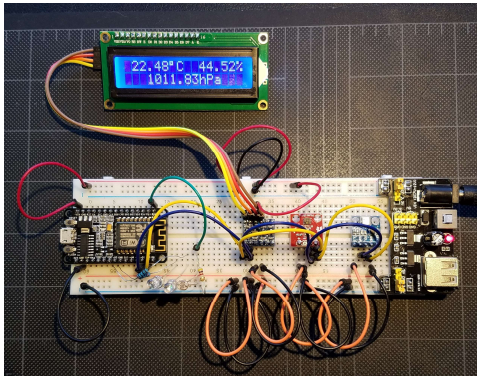
IEEE IoT Weather Station Network

Channel	ChannelID	FieldID	Name
1	123792	1	Karl
2		1	
3		1	
4		1	

Personal Computer

ThingSpeak Server

Cloud



Weather Station

Local Wi-Fi

Personal Computer

IEEE Advancing Technology for Humanity

Next Steps & Enhancements

- Follow project on www.w4krl.com
- Create a Smartphone app
- Add Over-the-Air update
- Printed Circuit Board
- Enclosures: circuit & sensors
- Solar power and battery backup
- Lightning detection
- Add local Real Time Clock routine
- Add local SD storage
- Wind speed & direction

Questions?

Thank You!

Karl Berger
Marty Schulman
Monica Mallini
Barry Douglass

Please fill out Course Evaluation and Survey Sheets.