EE 491 Senior Project Proposal
WWU Wind Feed

Ted Fernau

Summary

The WWU Wind Feed is a tool to deliver wind information to users of the WWU boathouse on Lake Whatcom. The system will collect wind speed (and possibly other) data and upload it to the Internet at regular intervals. The device utilizes an off the shelf marine anemometer, and does information processing and communication with an embedded microcontroller and a Wifi module. The system will be powered by the grid.

1 Detailed Description

The goal of this project is to provide wind speed data for the users of the WWU boathouse on Lake Whatcom. The wind conditions on the lake in front of the facility are unpredictable and are not accurately represented by the weather forecast for Bellingham. For this reason members of the WWU wind sport community frequently call Lakewood for a wind update. I propose a device to measure wind speed periodically and publish the data online for user consumption. Providing current wind conditions makes it easier for users to decide when to go boating. This device utilizes the fact that most WWU students and alumni have smart phones, and can access the web conveniently.

Wind speed is the focus of this project because this is vital information for those who participate in wind sports. Wind sports equipment represents the bulk of the available rentals at the WWU boathouse. Other local information is important for the users of the WWU boathouse such as air temperature, water temperature, hours of operation, wind direction, etc. This other data is reported by the Bellingham weather forecast.

The goal described above leads to the following product features, listed in order of priority:

Make current wind speed available to WWU boaters. This is the key feature of the project. This feature is necessary due to the reasons described above, that wind speed is not accurately represented by weather reports, wind speed is the most important information for those who enjoy wind sports, and wind sports represent most of the resources available to the WWU community.

Provide historical wind data to indicate trends. Besides the current wind speed, an important determinant of sailing conditions is the wind speed trend. This allows users to determine whether the wind speed is increasing or decreasing, and thus better choose when to sail. Ideally, publishing the information would include a graphical output, providing context for the current wind speed.

Publish wind data in the optimal format for user consumption. Some formats are more convenient for users than others. The easiest way to accomplish the goal of making information available to all is to publish data on a web page. Users can be assumed to have internet access. Mobile internet access is also ubiquitous and represents an important and growing proportion of information services. In addition to a simple web page, social media may be an efficient way to deliver to those interested. It has been proposed that using the Lakewood Twitter feed may increase visibility.

Provide other relevant data besides such as wind direction, temperature, and barometric pressure. There is other information that could be useful to users. It would be ideal to publish as much relevant data as possible, in order to provide the

most benefit to the most people. Some possible additions are wind direction, temperature, and barometric pressure data.

2 Constraints and Standards

There is limited space available at the Lakewood facility, and still less space that is exposed to wind conditions similar to those at the middle of the lake. The space occupied must be suitable to accomplishing the goal of the project, while being suitable to Lakewood users and management.

In order to meet the goal, and provide for the features listed above and the benefits below, the product must be reliable. The device must withstand outdoor conditions with little or no maintenance over the lifecycle.

The cost must be on par with other low end solutions on the market, which is roughly under $200. This is a fixed device that would be installed for long term use. This is also a custom solution, which allows for some deviation in price for the purpose of reliability and key features. The budget for developing a prototype is subject to the limitations of the personal finance of the creator.

The product must operate without affecting boathouse operations. This is not a project Lakewood management is seeking out, thus there is little accommodation for any imposition on the facility and operations, thus product must be retrofitted to the boathouse as it presently exists. This means the product must communicate with the existing network using standard protocols.

The product must be designed, with a working prototype, by early June. This limits the likelihood of added features. The features will be developed in order of importance. There will be no added features until the initial goal is satisfied, and it is cost and time effective to add them.

3 Benefits

This product is meant to demonstrate a possible application for the 'Internet of Things' (IoT), and represents a template for a broad range of possible products. In the process of developing this solution I will become familiar with the relevant issues for IoT design. The product is also an exploration of the so-called information economy. One of the largest roles for technology in today's world is to provide relevant information to economic participants in order to reduce transaction costs, thus leading to more efficient market outcomes. I see the end point of this progression as a more informed society that is better able to understand and react to our changing world.

This product benefits the user by providing the necessary information to utilize a small segment of the WWU recreational resources. If the solution is properly implemented, it will make the Lakewood Boathouse a more efficient organization by reducing the cost associated with providing redundant information.

Most of the solutions that currently exist come in two forms: boat mounted instrument systems that provide wind data for a vessel, and remote weather stations for home or commercial use. The products for boats differ from my design since they are not generally broadcast oriented, instead displaying information to the vessel crew to be used in the moment.

Remote weather stations are more similar to this design, since they monitor conditions at a remote location and display at a base station. These products come with various features, some that are accessible with a smart phone or tablet. These are largely integrated systems that vary largely in features and cost. My solution is a scaled back version of a remote weather station, with the focus on making the data ubiquitous by putting in on the web. Another difference is this product is meant to represent many one off designs that could be fitted to any application.

The broader benefits of this product is reduced cost of Lakewood usage for the users, WWU, and society. The cost of usage is saving a phone call or a trip out to the Boathouse. The benefit to Lakewood management is a decrease in inquiries about wind conditions, thus freeing resources for more efficient operation. Society benefits from the decreased energy consumption from fewer wasted trips.

4 Preliminary Development Plan

The preliminary block diagram and system sketch are displayed in Figure 1 and Figure 2 below.

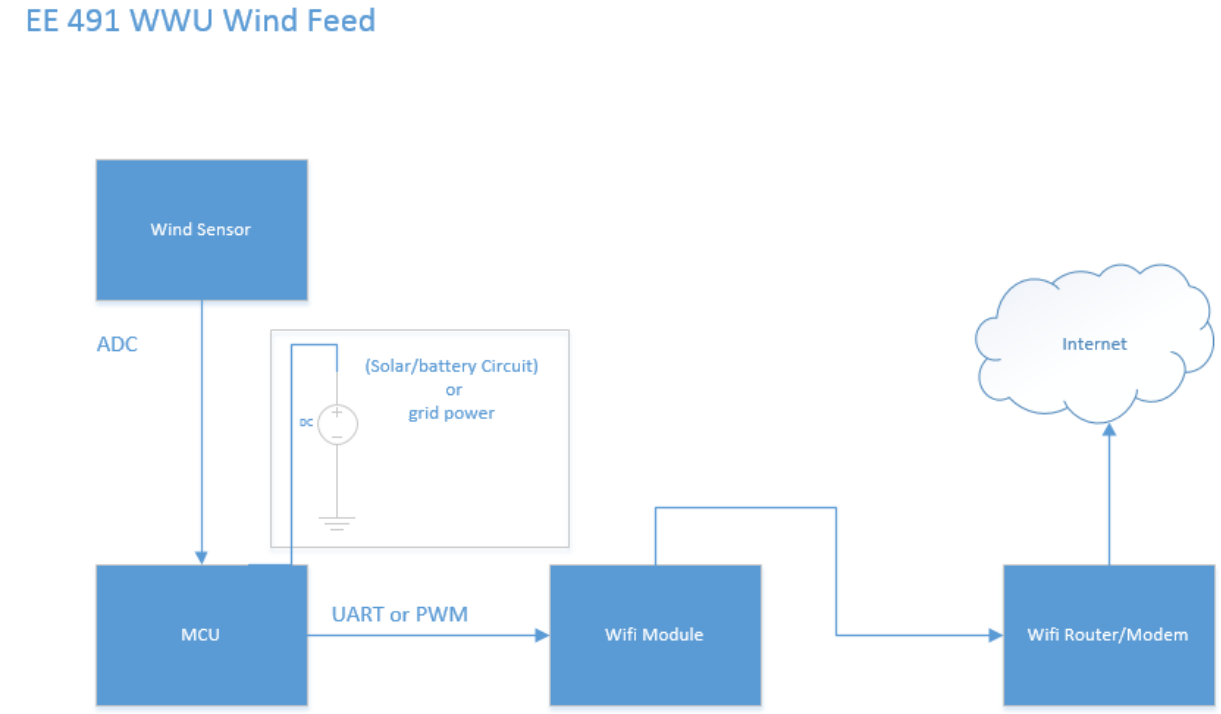

Figure 1: Preliminary System Block Diagram

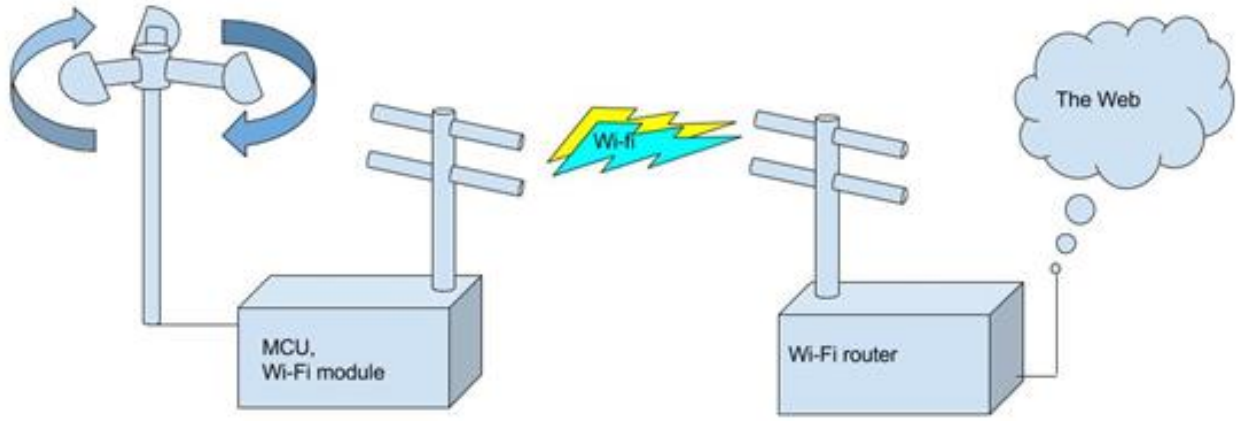

Figure 2: Preliminary System Sketch

In order to design and implement this product, I will first need to answer a couple initial questions: Where is the optimal location to accurately monitor wind speed on the Lakewood campus? In order to answer these questions, I will consult with Lakewood management and WWU EE faculty for relevant constraints and guidance.

Once I have decided these details, the next step is to source parts that will be optimum for a prototype. I plan on purchasing the anemometer early to build a rough prototype of the sensor circuit, and to optimize the instrument location. This sourcing of parts will be done online, or possibly at local marine supply stores.

I will be designing an IC for the prototyping and implementation, so I will next decide which micro controller will be optimum for my design, as well as necessary peripherals including the Wi-Fi module. This will be done by finding the relevant constraints, and searching online for components that achieve the maximum required performance, without extra cost or complexity.

Once the hardware design is complete, I will move to software design and implementation. For this I will utilize the resources that exist in the WWU EE labs.

Once the design is complete, I will move to implementing a prototype using the WWU EE lab resources as much as possible.

Depending on the quality of the prototype, I will work to implement a version of the system at the Boathouse. I would like to have a prototype to demonstrate in the lab, as well as the stream of actual weather data from the lake.

5 Bibliography

Possible parts:

Wind Sensor:

http://www.ebay.com/itm/Climatronics-Wind-Speed-Sensor-100075-/331589368095?hash=item4d3444391f:g:8r0AAOSw3ydViYsR#viTabs_0

http://www.ebay.com/itm/Wind-Speed-Sensor-Anemometer-Three-Cups-Aluminium-Alloyed-Voltage-Output-0-5V-/322206596553?hash=item4b05027dc9:g:FCsAAOSweXhXmFCu

https://www.adafruit.com/product/1733

Wi-Fi Module:

http://gridconnect.com/tiny-wifi-module-802-11-b-g-n-industrial-grade-temperature.html

Relevant Academic Papers:

M. Popa and C. Iapa, "Embedded weather station with remote wireless control," Telecommunications Forum (TELFOR), 2011 19th, Belgrade, 2011, pp. 297-300.

URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6143549&isnumber=6143488

A. Shaout, Yulong Li, M. Zhou and S. Awad, "Low cost embedded weather station with intelligent system," Computer Engineering Conference (ICENCO), 2014 10th International, Giza, 2014, pp. 100-106.

URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7050439&isnumber=7050418

B. C. Mishra, A. S. Panda, N. K. Rout and S. K. Mohapatra, "A Novel Efficient Design of Intelligent Street Lighting Monitoring System Using ZigBee Network of Devices and Sensors on Embedded Internet Technology," 2015 International Conference on Information Technology (ICIT), Bhubaneswar, 2015, pp. 200-205.

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Xiaoneng Gao and Pengtong Fan, "Internet access technology based on the embedded devices," *Multimedia Technology (ICMT), 2011 International Conference on*, Hangzhou, 2011, pp. 391-394.
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Relevant Datasheets:

http://www.climatronics.com/pdf_pn/Wind_Speed_Direction/100075,100076,101994.pdf