Microflow
Systems Inc.

January 18, 2010

Dr. Andrew Rawicz
School of Engineering Science
Simon Fraser University
Burnaby, British Columbia
V5A 1S6

Re: ENSC 440 Project Proposal for a Networked Water Faucet System

Dear Dr. Rawicz:

The attached document, ***Proposal for a Networked Water Faucet System***, outlines our capstone project for ENSC 440W (Engineering Science Project).

The attached document is intended as a project proposal that includes the following information: scope of the project, a high level system overview, a cost breakdown, and the projected timeline of the project milestones.

The objectives of this project are to design, program and model a functioning networked water faucet system. Upon completion of our objectives the system model will be manufactured for installation into any building where standard water faucets can be installed.

Microflow Systems Incorporated is a start up Technology Company made up of the following four founding members: Kwang-young Lee (CFO), Sonca Teng (CEO), Micheal Hou (COO) and Aaron Marcano (CTO). All four of the company's founding members are currently attending Simon Fraser University's Burnaby Mountain Campus.

Sincerely,

Sonca Teng
Chief Executive Officer
Microflow Systems, Inc.

Enclosure: ***Proposal for a Networked Water Faucet System***

Microflow Systems Inc.

Proposal for a Networked Water Faucet System

Submitted to: Dr. Andrew Rawicz – ENSC 440
Steve Whitmore – ENSC 305
School of Engineering Science
Simon Fraser University

Capstone Engineering Project
Team Members: Kwang-young Lee
Sonca Teng
Aaron Marcano
Micheal Hou

Contact Person: Aaron Marcano
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January 18th 2010

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Executive Summary

Advanced and developing economies demand vast resources to satisfy the needs of their citizens, many renewable resources are proving to be insufficient to satisfy these growing needs. For a resource such as fresh water there are many efforts in place to conserve it; some conservation efforts are purely voluntary and some are mandatory. Microflow Systems is proposing a system that will be marketable to either of these voluntary or mandatory water conservation efforts. Our proposed system will satisfy the social and ethical needs to conserve fresh water for today and for future generations.

The water faucet system proposed herein is intended to immediately and accurately track water consumption from multiple water faucets within a networked system. This type of monitoring and feedback will raise awareness as to how much of this resource is being used. Consumers are unable to optimize their water use because faucets don't display the volume of water that flows through them. Our system will measure and display the volume of water used by all of the faucets connected to the system. In addition, each faucet will act as an accurate dispenser of water; this feature will allow the user to dispense any volume of water from a faucet.

The total cost of all product development stages is estimated at $774, this amount will be funded primarily by the four founders' seed capital. It should be noted that alternative sources of investment capital will be pursued and negotiated while the project is underway. Proprietary investments for this system are already in discussion and if patented these intellectual properties will add financial security for Microflow's investors.

Future market potential for our faucet systems include but are not limited to: homes, office buildings, hotels, and industrial facilities where regular water faucets are used. For example, our systems can be used in integrated circuit fabrication clean rooms to monitor and control the use of deionized water, which is a high cost resource.

Microflow Systems Inc. is operated by a team of engineering students with skill sets in the following areas: microelectronics, digital and analogue circuit design, integrated circuit fabrication, computer aided design, programming, and wireless communications. The team at Microflow is a very motivated group looking to succeed based on its proprietary technologies and hard work ethics. We began planning this project in December of 2009 and our newly formed company plans to demonstrate a product that will transform the way people use fresh water resources. Microflow will execute a 13 week plan to bring our first product to completion in order to help societies' members track their use of this increasingly precious and limited resource.

Introduction

Today, water resources in the world are in limited supply, and the problem is worse in certain areas around the world, such as China and Los Angeles, California. In order to monitor any facility's water usage, buildings are equipped with water meters. However, these meters only display the total consumption. This total consumption includes use of water due to toilets being flushed and clothes being washed, usage that is not under by choice or under control of the user. Water use through bathroom faucets, kitchen sinks, and showers are however under the control of the user, and so these areas are where our technology can be effective on water use.

In order to track water use, a faucet may include a built-in LCD display that shows how much water is being used. However, the effectiveness of this solution alone is limited because each faucet displays only its own information. This fault is remedied by our networked solution.

Our new product measures and displays the amount of water being used by each faucet as it runs, in real time. If the user were to wash their hands at the sink, they could watch the readout from the faucet display, and use water accordingly. If the user wanted to measure out a 500mL cup of hot water to use in a baking recipe, he or she would be able to do so as well. Once the water is shut off, the total water usage for the day is displayed. At all times, the total water usage across the network is also shown on the LCD display.

This new product measures the amount of water used from the faucet by way of a flow sensor. It takes the sensor output and processes it, then displays to the LCD locally, and also broadcasts its usage data to the network using a built in wireless networking capability. It is by this process that all faucets in the network may display total network usage in real time.

These features will be enabled using a system that incorporates the MicroChip PIC24F series microprocessor. It is not ultra conservative in its power draw, but has a powerful integrated processor, memory, and (ADC) analog-to-digital converters. This system will be used to integrate the flow sensor, the LCD display, and the wireless transceiver, to accomplish the desired functions.

Budget

For this project, both mechanical and electronic parts are required to assemble the functional models. The project requires only a number of mechanical parts, while it requires more number of parts in electronic parts. The cost breakdown is shown in the Table 1.

Table 1: Project Cost Breakdown

Part Name	Number of Units	Individual Cost	Total Cost
Mechanical Parts			
Flow Sensor FTB2004	3	95.00	285.00
RONA Faucets	3	50.00	150.00
Various Fittings	1	40.00	40.00
Electronic Parts			
MicroChip PIC24 Series	3	3.00	9.00
MicroChip RF Module	3	10.00	30.00
New Haven LCD Display	3	10.00	30.00
MicroChip PIC Programmer	1	200.00	200.00
Various Connectors and Elements	1	30.00	30.00
TOTAL			**$774.00**

It should be noted that some minor components have been grouped into a functional equivalent. For example, the power regulating circuit, including transistors, resistors, and other such elements are grouped together under 'Various Connectors and Elements'.

It should be also noted that the prices for all items have been over-estimated by 10~15%, in consideration of cost over-run, shipping fees, and other unforeseen costs during the project development. This should provide this group with enough safety margin in project cost. This is the reason why the project might seem more costly than it should be ideally.

Funding

Due to the high projected cost for this project, the group has been actively seeking funding and other various opportunities to reduce cost in development. The group has applied to Engineering Science Student Endowment Fund, and has gotten in contact with previous project classes' members for compatible parts. The effort has enabled us to rent the MicroChip PIC programmer, we also borrowed a few parts enabling us to eliminate lead order time on these items and save cost of the development.

Although the group has been able to find some funding relief for the project, the remainder of the cost still needs to be incurred by the group members. Accurate accounting of the project cost will enable the group members to divide the total cost equally and fairly.

System Overview

Overview

The demonstration models we are seeking to build for our project is a direct replacement for any regular household faucet. As such, we have specified our system to operate in exactly the same fashion as any user would be accustomed to. The user interface is identical to that of a traditional faucet save for a backlit LCD display which would show both water usage for the current session, and total water usage throughout the day across the faucet network.

A conceptual model of our faucet is shown below in Figure 1.

Figure 1 – Conceptual Model

The Flow Sensor is what drives the technology behind our water usage tracking. It sends a data signal representing the flow of water through the tap, to the PIC24F-Based Control Module. This unit processes the signal, and displays to the LCD.

Further enhancing our technology is the wireless capability made possible by our RF transceiver. A wireless network automatically forms between faucets installed into the home, and an illustration of this is shown below in Figure 2.

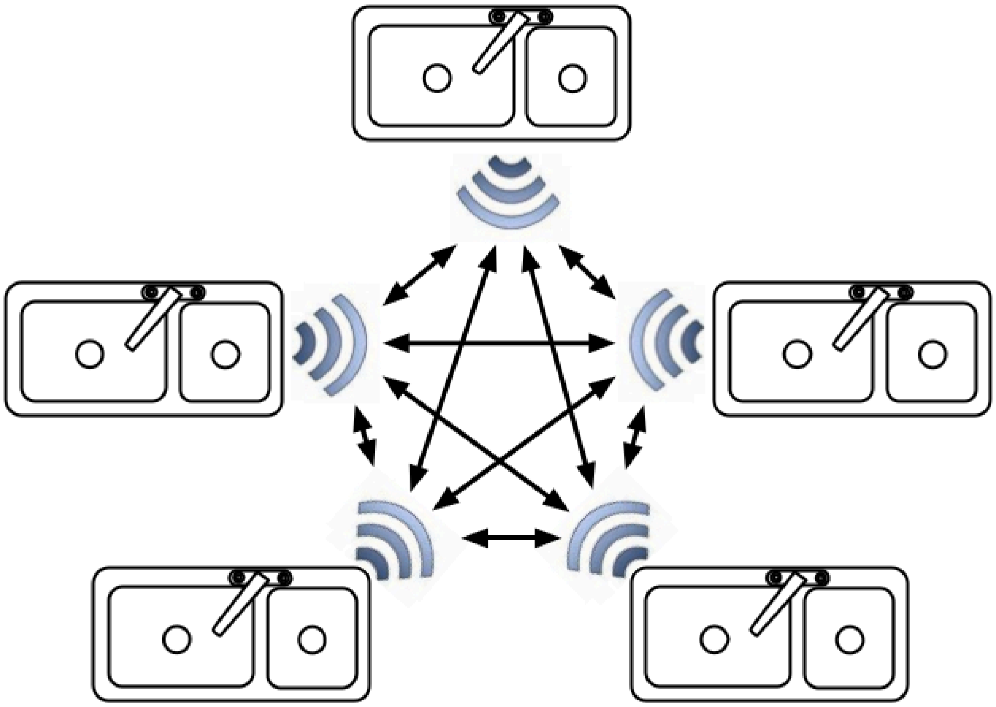

Figure 2 – Network Model

Once two or more Microflow faucets are present in the network, the individual Control Modules of each faucet process the total water usage on the network, and the LCDs of every faucet are able to display this information to the user.

One of the greatest appeals of our system is that the consumer may purchase just one faucet to try, and upon realizing the merit of such a unit, purchase another. With two in the building, the units network automatically, and the user is able to keep track of the total usage between the two. Realizing that there is usefulness in being able to more comprehensively keep track of all water usage around the house that is under their control, the user would purchase more units to replace current existing ones. All of these additional units would automatically add themselves to the network, with no intervention from the user. The user simply uses the faucets as they normally would any existing one – there is but one simple addition to the traditional faucet as far as the User Interface is concerned, and that is the water usage readout in the form of an attractive backlit LCD screen.

While the water is running, the LCD Display on our faucet would give a readout as shown in Figure 3, updating both figures in real time as the water runs. Current Usage reflects usage as currently being used by the faucet in use, and Network Usage denoting the total water used on the network of Microflow faucets in the building.

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Current Usage:   0.2 L
Network Usage:  17.2 L
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Figure 3 – LCD Display – Water Running

When the water is off, the LCD Display reverts to showing Total Usage by the faucet in question, while the Network Usage display shows the water use across the entire network, which updates in real time. This is shown as follows in Figure 4.

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Total Usage:     2.8 L
Network Usage:  17.2 L
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Figure 4 – LCD Display – Faucet Not in Use

System Block Diagram

A simplified block diagram of our Networked Faucet System is shown below in Figure 5.

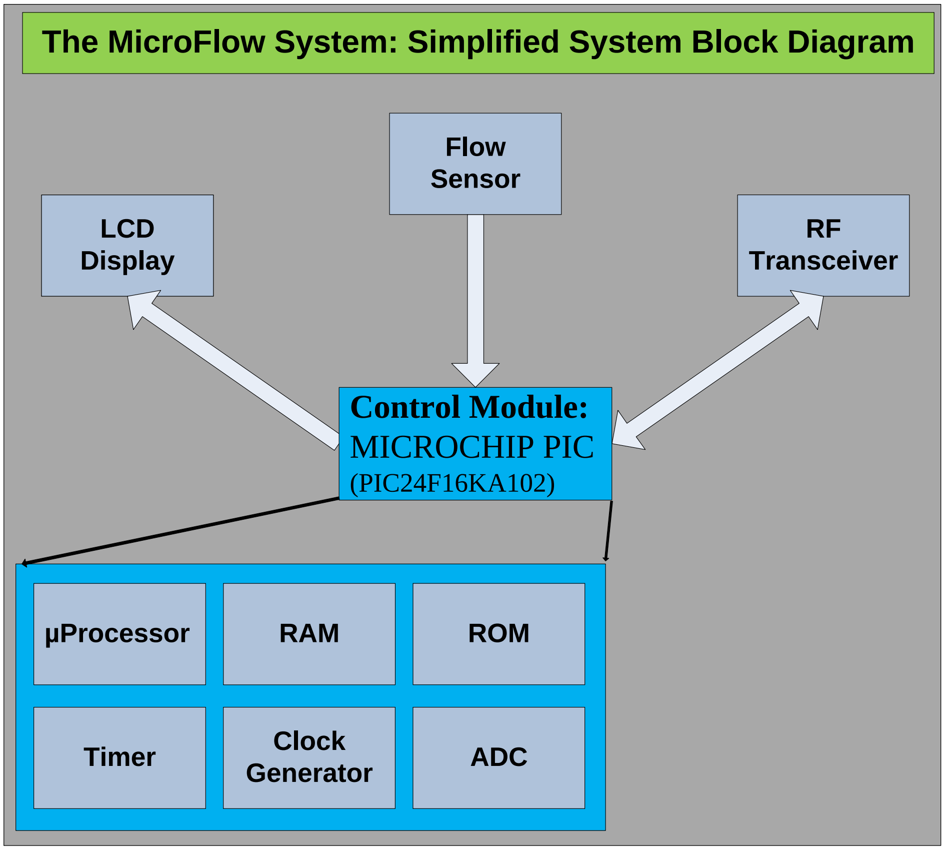


Figure 5 – System Block Diagram

As had previously been mentioned in the system overview, the main peripherals in our system are the LCD display, the Flow Sensor, the RF Transceiver, and the Control Module. The Control Module is primarily made up of the RoHS (Reduction of Hazardous Substances) certified Microchip PIC24F, which contains a processor, RAM, ROM, timer, clock generator, and ADC (analog to digital converter). The integrated microprocessor is both powerful in function and low in power consumption, which represents the perfect solution for our innovative new device.

Schedule

Figure 6 below shows the project Gantt char. It shows that our software development and optimization will take the longest time to complete and remind us that we need to document our progress throughout the project. The bars are shaded from heavy to light to indicate time is running out, and it is also colored red to show the urgency as deadline approaches, where red means the deadline is within days.

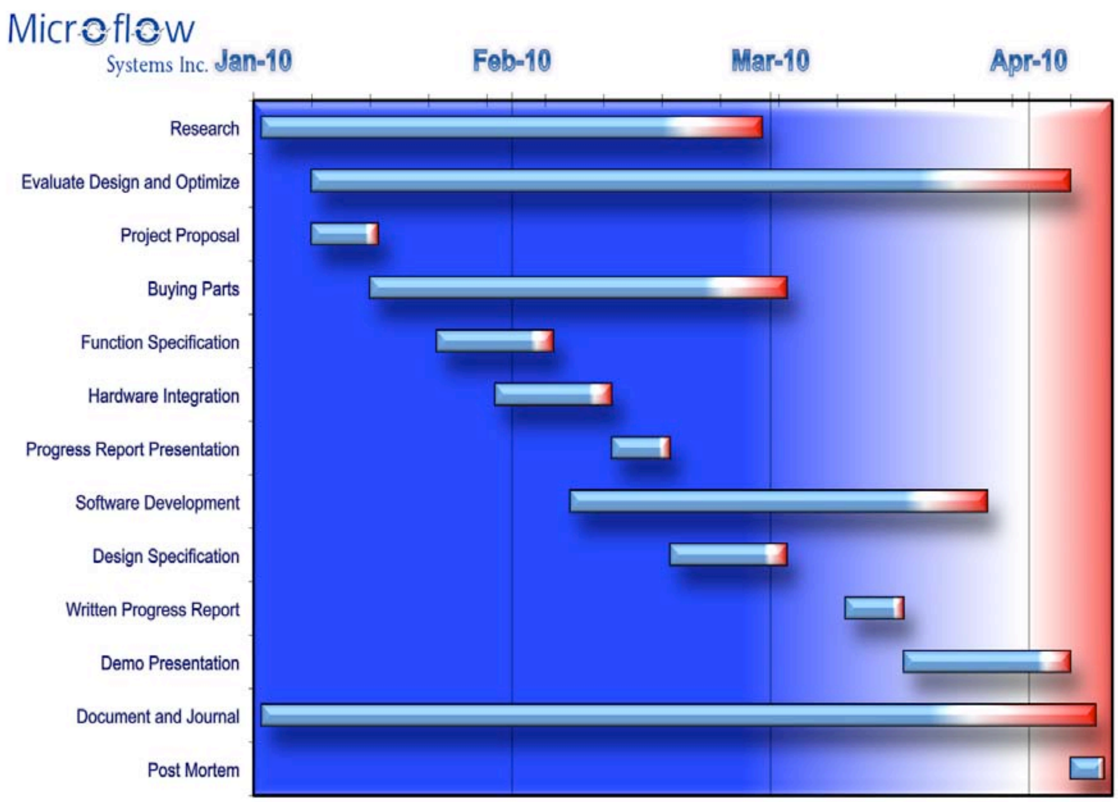


Figure 6 – Gantt chart

Shown in Figure 7 below, the project milestone chart which points out when each major portion of the project will be completed.

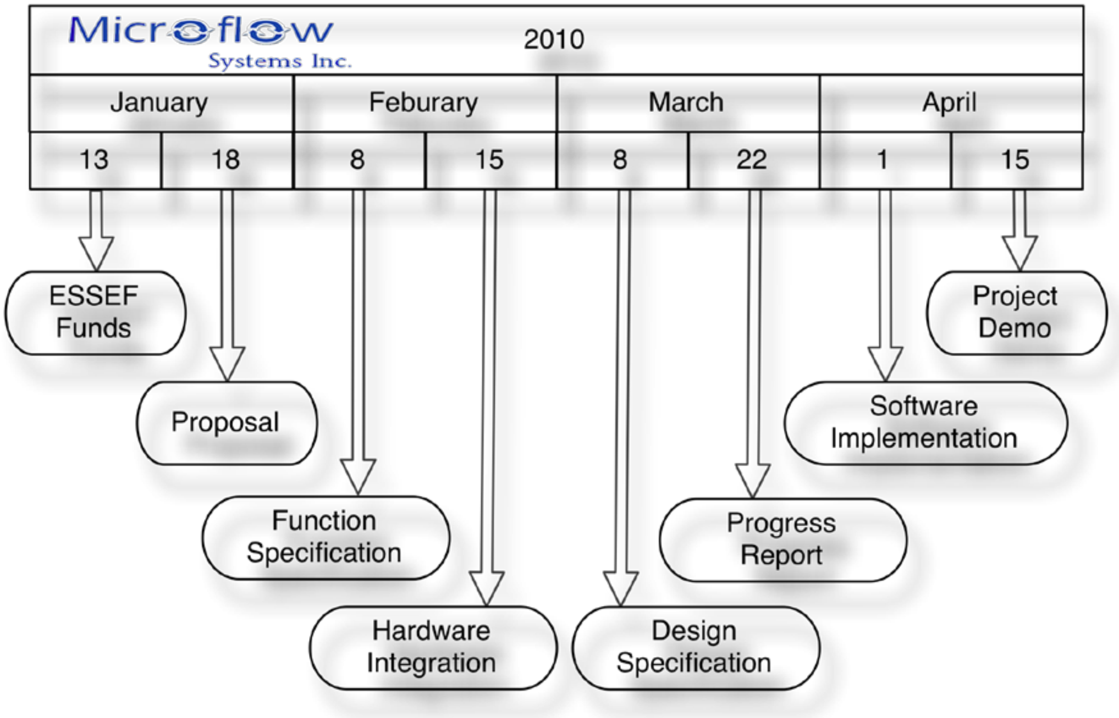


Figure 7 – Milestone Chart

Organizational of Duties

Out of a realization that completing a project of this scope in a time as short as this would be no small feat, we first settled on an informal, then formal segregation of responsibilities for our project. Michael is responsible for specifying a timeline, defining of a series of milestones marking progress on our project, and keeping us on schedule in general. Kwang-young is to keep track of our hardware design and component list, and expenses. Aaron is to look after the big picture when it comes to the technology we use and the way we implement this. Sonca looks out for what problems – both technical and interpersonal – we may run into as a team, and how we can solve them before they become serious problems.

We are careful not to designate one person for software design, one person for hardware design, etc. This comes from an agreement from day one of our team's existence: we would all like to experience every aspect of design on this project. We are all here to learn, to take from this experience all that we can. An added advantage of this organizational scheme is that if one person falls ill or encounters some other unforeseen circumstances, one or more of us can immediately jump in and help cover their responsibilities.

It has been recognized that our team members are taking other courses this semester. We are allotting slack time for emergency occurrences such as the need to study for exams or to provide for unplanned need to spend more time on other projects or labs. Again, we are also prepared to pool time from other team members to fill in for absences because of our distributed-specialization scheme.

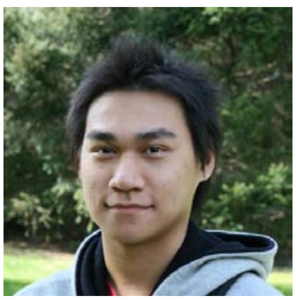
Finally, to keep the team cohesive, we have been (and plan to continue) getting closer and more familiar with each other, learning each others' likes and dislikes, our habits and personalities. We fully recognize that in order to succeed, we must function as one.

Company Profile

Sonca Teng – Chief Executive Officer

Sonca is in his final year of studies in Electronics Engineering at Simon Fraser University. His senior electives in advanced digital and analog electronics design, as well as in communication systems, communication networks, and embedded systems design make him well suited to the design and implementation of Microflow's premier line of networked faucets. His past roles as team lead in previous engineering projects makes him the ideal candidate for coordinator of Microflow's R&D efforts toward success with its first commercial offering.

Michael Hou – Chief Operations Officer



Michael is a fifth year System Engineering student at Simon Fraser University. His specialties are in reliable mechanical design and sustainability. His technical background includes electronic design with low and high level programming (HC11, FPGA, C++, JAVA, PERL), and system analysis. He has also gained communication and teamwork skills from previous work experience.

Aaron Marcano – Chief Technology Officer

Aaron is studying Systems Engineering in his final year at Simon Fraser University. His interests include programming, computer aided design (CAD), wireless communications, and integrated circuit fabrication. He has been part of many project teams in which robotic designs were made using SolidWorks CAD software. In his role with Microflow Aaron will be involved with the design, programming, and testing stages of the Networked Faucet System Project. Aaron enjoys leisure activities such as biking, snowboarding and cooking.

Kwang-young Lee – Chief Financial Officer

Kwang-young is in fifth year of Systems Engineering at Simon Fraser University. His interests are in mechanical design, computer aided design, and fabrication of mechanical and robotic systems. His previous work experience as a support engineer at Greenlight Innovation Corp, a hydrogen fuel-cell test equipment development company, gives him knowledge of billing and materials tracking, mechanical design processes, and computer aided design. It also gives him great teamwork and communication skills.

Conclusion

Microflow is a green-centric company and our goal is to provide solutions to raise awareness of resource preservation. With that in mind, we dedicate this project to helping society to save their hard earned money while conserving their communities' water supplies with the aid of our system. Given the technical and financial break-down of the project, we have a clear goal to achieve. Furthermore, the Gantt chart provides a clear timeline for our project and with our group dynamic it will be an enjoyable challenge and learning experience.

Our device is self-sustainable, simple to operate, and easy to install. The working models we seek to produce for this project will demonstrate the water flow measurement, water usage display, and incremental networkability of Microflow faucet units.

Into the future, we will continue to develop our system with a never-ending resolve to better address the need for our world community to co-exist with the environment. Armed with the knowledge that our cause is just and that our technology is sound, there is no doubt that we will succeed.

References

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[2]Catalog No. FTB-2000, Economical Flow Rate Sensors, OMEGA Engineering, INC., One Omega Drive, Stamford, Connecticut.