Wireless Sensor Network Simulator

Project Proposal

by

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As Part of the Requirements for the Degree of
Master of Science in Computer Science
University of Colorado at Colorado Springs

Committee Members and Signatures

Approved by

Date

Project Advisor:  Dr. Edward Chow

Committee Member:  Dr. Jugal Kalita

Committee Member:  Dr. Roy Lewis
I. MASTERS PROJECT GOAL:

To create a Wireless Sensor Network Simulator that will be used as a teaching aid to further a computer science student's understanding of a Wireless Sensor Network’s capabilities and limitations.

To quantify the effectiveness of the project I will create a “FCQ like” survey so that UCCS Computer Science students who use the application can rate its educational value.

II. INTRODUCTION

The project being proposed will create a Wireless Sensor Network Simulator which will function as an educational tool by clearly demonstrating the unique considerations of this type of network and presenting current approaches to address those considerations.

Wireless Sensor networks have recently become a topic of great interest to Computer Science researchers. This interest has largely been sparked by the dramatic drop in cost, size, and an increase in range and sensing capability of wireless sensor devices. These developments allow for a world where numerous, large, distributed networks of wireless sensors are a reality[3]. With this new reality comes a series of interesting computing challenges that will engage Computer Scientists in both the academic and commercial realms for years if not decades to come.

III. BACKGROUND

A wireless sensor network is composed of many individual sensor “nodes”, sometimes referred to as “motes”, each with their own individual power, computing, environment sensing, and wireless communication hardware. The sensors are often scattered at random around a geographically diverse terrain and will then activate and begin to form communication networks with the intent of transmitting a complete “picture” of the environment back to a central location for analysis[3].

A wireless sensor network has much in common with a traditional mobile ad-hoc network, in that networks consisting of N nodes are formed organically and both involve multi-hop communications. It is the significant differences, however, which make wireless sensor networks such an interesting problem to study. Wireless sensor networks must deal with global considerations that arise from the limitations of the individual sensors. Since each sensor is completely wireless, it depends heavily on its personal power source. Once key nodes in the network begin to run out of power and die, then the entire network can be compromised. This power limitation leads to the conclusion that data transmission needs to be kept to a minimum (fewer packets sent means less power consumed). The pressure to minimize data in order to maximize the life span of the network leads to a desire to form the network in an intelligent way such that redundant data transmissions are minimized [3].

A “best” solution to these and many other interesting problems are not to be addressed within this project. My goal is simply to create a tool that will reflect and demonstrate these constraints and concerns in a tangible way, therefore educating and stimulating the user to consider how they would approach such solving problems.

IV. NEED

Because of this emerging area of computing, many educators in computer science wish to introduce the concepts of wireless sensor networks and the challenges they present to their
students. As is often the case, software can aid us in this endeavor. A wireless network simulator that is interactive, intuitive, and easy to use can be a wonderful teaching tool for both beginner and advanced students. Unfortunately, most wireless sensor network simulators that exist today are intended for advanced and in-depth research and are therefore complex, cumbersome, and likely intimidating to a novice student [4][1][2].

My goal is to create an approachable and user-friendly teaching tool that will allow students to discover and learn independently with minimal intervention from the educator. To accomplish this, the application will be written in Silverlight and accessible via the web with very little, if any setup required on the part of the user. Since the application will be web-based, users will be able to run it from any machine with web access—even without administrative privileges. The application will allow users to select one of several algorithms for forming a network and also allow users to modify many variables affecting the network such as, but not limited to, node count, GPS capability, sensor range, and sensor power levels.

V. PROJECT OVERVIEW

This project will be a thoughtfully designed, well-commented, and object-oriented application. It will consist of a GUI front end written using Microsoft Silverlight. The “back-end” code that will be doing most of the non-GUI oriented work will be written in C#. The application will allow the user to select one of three (at minimum) methodologies for forming wireless sensor networks. The application will also allow the user to quickly and easily change key variables pertaining to the network such as node count and power level—more detail is presented below. Once the algorithm is selected and the parameters are chosen, then the application will demonstrate the random scattering of nodes, followed by the formation and subsequent lifespan of the network the user has configured. The application will be modular and will allow future developers to add additional network formation algorithms with minimal effort. The application will be web based and simple to install and configure.

The application will allow the user to modify via the GUI (at minimum):
- The Network Formation Algorithm
- Node count
- Node power level
- Node communication range
- Whether the nodes have GPS capability
- Volume of data collected by each node

In addition to researching Silverlight and C# technology, I will be conducting research into the various proposed algorithms for forming wireless sensor networks. I will select at least three algorithms to implement and demonstrate in a step-by-step graphical manner within the proposed application.

VI. PROJECT DELIVERABLES

a) Proposal – This document which is an initial description of the proposed project, its deliverables, and its development schedule.

b) Software Requirements Specification – A document that describes the applications required components and capabilities.
c) **Design Documentation** – A document which describes the internal design of the software and explains how to modify and extend the source code for the project.

d) **User Documentation** – A document that describes how to deploy, run, and interact with the software.

e) **Software** – The source code as well as the compiled files used to run the completed application.

f) **Survey Results** – Summary graphs and raw data results of the effectiveness survey.

g) **Presentation/Defense** – Presentation of my work and a demonstration of the project.

h) **Final Document** – This document will contain the background and research done to complete the project as well as possible future work.

i) **Presentation Viewgraphs** – The slides that make up the defense presentation.

VII. **PROPOSED SCHEDULE**

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<thead>
<tr>
<th>Task/Deliverable</th>
<th>Date</th>
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<tbody>
<tr>
<td>Initial Research/Software Development</td>
<td>5 April – 15 June</td>
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<tr>
<td>Project Proposal</td>
<td>16 June</td>
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<tr>
<td>Software Requirements Specification</td>
<td>18 June</td>
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<tr>
<td>Software Development/Testing</td>
<td>18 June – 7 July</td>
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<tr>
<td>Design Documentation</td>
<td>8 July</td>
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<tr>
<td>User Documentation</td>
<td>9 July</td>
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<tr>
<td>Final Report/Viewgraphs</td>
<td>11 July</td>
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<td>Defense</td>
<td>TBD</td>
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</tbody>
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VIII. REFERENCES


