YORK UNIVERSITY

FACULTY OF SCIENCE AND ENGINEERING

# ENG 4000

# ENGINEERING PROJECT

# PROJECT PROPOSAL

# TABLE OF CONTENTS

# WIRELESS DETECTION AND RANGING

# (WIDAR)

## *TEAM MEMBERS AND AREA OF FOCUS*

MEMBERS:

Hamdi Roumani
*Team Leader*
taal@yorku.ca
Focus: *Responsible for comparing and evaluating candidate wireless sensor network kits based on a criterion stated in the "Short Project Description". Once this decision is taken this member will work along side Douglas Stamp on the communication between the wireless sensor nodes. The project leader will act as a liaison between the WIDAR team and the advisor.*

Patrick Tayao
patrick.tayao@percepta-crm.com
Focus: *Researching alternative methods of interfacing a mobile robot with wireless sensor nodes.*

Douglas Stamp
dstamp@yorku.ca
Focus: *Website design and maintenance. Researching communication methods between wireless sensor nodes.*

Tyson J Hamilton
tyson@yorku.ca
Focus: *Website design and maintenance. Researching communication between wireless sensor nodes and the mobile robot (Working along side Patrick Tayao).*

## *FACULTY ADVISOR*

Professor Natalija Vlajic
Department of Computer Science and Engineering
vlajic@cse.yorku.ca
416-736-2100 x 77878

## *Project Description*

Wireless Sensor Networks are a fast growing technology for developing systems to monitor a variety of constrained environments. These environments can be vastly different, from a manufacturing plant to a remote location in the rainforest. Wireless sensor networks consist of two major components: nodes and a base station. Nodes are low power consuming devices that are integrated with different data feeds to monitor a situation. These feeds may contain environment sensors or, for example, video feed from different nodes. The information gathered by different nodes is then transmitted from one node to another using peer to peer protocols. The responsibility of the base station is to provide a powerful communication device to relay information from different nodes to the end user.

A problem arises when a node or group of nodes fail and break the communication within a sub network of the wireless sensor nodes, producing two fully operational groups of nodes that cannot establish a communication link between one another. Since the base station has a connection to only one of the groups, the other will not be able to establish any communication with it, thus hindering any data transfer.

A viable solution to this problem is to introduce into the network a mobile node which will act a communicational bridge between the two independent groups of nodes. A challenging task in the implementation of this solution is the localization of nodes to ensure proper placement of the mobile robot. Since nodes are scattered in different geographical locations the localization process is difficult.

To simulate the stated problem, the project will implement two groups of nodes. A video feed will be recorded by a camera attached to a node in one group and transmit the video feed to the other group where the base station exists, hence allowing communication to an end user application. Without any information on the location of the nodes, the mobile robot will run a positioning algorithm that will search for the communicational gap. It will then find the optimal position within the network to bridge this gap so to resume transmission from one group to the other. To ensure the correctness of the positioning algorithm, different gap scenarios will be implemented.

Implementing the solution to the problem stated above will be the defining goal of this project. There are many possible expansions that will be considered as the project progresses. Although there is an abundant amount of theoretical material available in this research field, there is a lack of experimental / empirical data. Therefore, there will be different testing phases that will provide useful data for analysis in the design of our project. Possible expansions to the project include the implementation of mobile nodes opposed to static ones. To further elaborate, the gap between the groups of nodes will still exist, the nodes themselves, however, will be able to move apart implying an algorithm to bridge the gap will need to dynamically execute.

## *MILESTONES*

Project phases include the Project Definition, Research, Implementation, Testing, Integration, Finalization and Presentation. The organization of these phases is displayed graphically in the Gantt chart on our project website online for easy viewing:

**http://www.cse.yorku.ca/~cs232039/eng4000/ToDoList/milestones.htm**

Project Definition

- Development of contract proposal

MOBILE ROBOT

Research

- Search for feasibility of acquiring or building mobile robot.
- Determine Hardware Requirements.
- Determine Interfacing Options.
- Determine Algorithm requirements.
- Determine Mobility control.
- Determine Energy Requirements.
- Selection of Mobile Robot

Implementation

- Robot Construction
- Algorithms development:
    - Robot Localization.
    - Movement.
    - Connection Strength Management.
    - Power Management.
    - Signal processing.
- Interface support.

Testing

- Algorithm Testing
- Bug Fixing

## WIRELESS SENSOR NETWORK MOTE

Research

- Research and selection of WSN kit.
- Acquisition of WSN kit.
- Determination of Communication between nodes.
- Acquire online docs and materials for developing WSN.
- Determination of sensor devices to attach to nodes.
- Determination of sensors to attach to nodes.
- Determination of specifications of sensor devices and sensor nodes.

Implementation

- Develop code for WSN communication.
- Develop code for transfer of information between nodes.

Testing

- Test communication within several WSN.
- Fix any bugs determined.

## INTEGRATED SYSTEM (MOBILE ROBOT AND WIRELESS SENSOR NETWORK MOTE)

Integration

- Develop code for synchronization between mobile robot and WSN.
- Develop code in the mobile robot to communicate with wireless sensor nodes.
- Develop code in the mobile robot for gap determination.
- Develop code in the mobile robot for localization.

Testing 2

- Test integrated system with different gap scenarios.
- Fix any bugs determined.

Finalization

- Onsite testing and ensure system is implemented in area of presentation.

Presentation

- Produce posters for final presentation.
- Develop a video presentation.

## *BUDGET*

The budget outlined in Table 1 shows our initial intentions of dividing our funds. The headings in the table are described below:

Price

- This is the hypothetical value of the respective item.

Variance

- The possible difference in the quoted price and the actual price.

Cost

- The dollar amount that will be subtracted from the total allowance.

| *Item* | *Price ($)* | *Variance ($)* | *Cost ($)* |
|---|---|---|---|
| Robot | 500.00 | 100.00 | 500.00 |
| Sensor Nodes | 5,000.00 | 3,000.00 | - |
| Camera | 100.00 | 30.00 | - |
| Lab Fees | 150.00 | 150.00 | - |
| Licenses | 100.00 | 100.00 | - |
| Presentation | 300.00 | 50.00 | 300.00 |
| **Total** | | | **$800.00** |

**Table 1**

TABLE SUMMARY:

Robot

*The mobile robot will be developed either through purchasing a kit, purchasing the hardware separately or using York University's system.*

Sensor Nodes

*The communication devices in the project will be funded through our advisor.*

Camera

*A web-cam will be donated from a group member, or purchased through another means.*

Lab Fees

*These fees will encompass any electronic testing or software development that may be needed.*

Licenses

*Acquiring licenses for software development suite that may be used.*

Presentation

*This will cover the presentation fees such as a professional poster, media etc.*

## *Deliverables*

The project will deliver two systems, a wireless sensor network and a mobile robot. The sensor network will be configured to communicate and transfer information from one end of the network to the other. A mobile robot will be equipped with a wireless sensor communication device to communicate with other sensor nodes and will be configured to determine gaps within the sensor network. When a gap is determined, the mobile robot will be configured to move to an optimal position to bridge this gap and ensure communication between the independent groups of nodes.

## *Names and Signatures*

Hamdi Roumani

Patrick Tayao

Douglas Stamp

Tyson Hamilton