Project Overview

CptS 322—Software Engineering
5 February 2005

Objective:

A key software engineering task is requirements analysis. During this analysis software engineers refine an initial concept into a rigorous set of requirements that precisely constrain the software project that is to be developed. In order to facilitate this process, the following overviews of the two project options are given. Neither overview is complete. Each student will be required to write a comprehensive Software Requirements Specification (SRS) that describes one of these two projects.

Sensor Network Application:

Wireless Sensor Networks (WSN) are the focus of current research and were recently featured on the cover of IEEE Computer (Aug. 2004). For this project a student must develop a simulated vehicle-tracking WSN. (This is a CptS class and therefore we will simulate hardware rather than actually use hardware.)

Sensor Capabilities:

Each sensor broadcasts its location and sensor values at a user-configurable fixed time intervals (e.g., every second, minute, hour). A supervisory system receives these broadcasts. It is assumed that messages are not corrupted during transit and that the supervisory system is capable of receiving all broadcasted messages. However, the life-span of a sensor is limited! Eventually the sensor's battery power will fail. And in a few cases, a sensor may be destroyed before its battery fails (e.g., malicious activity, acts of nature).

Option 1—Location is reported as a pair of floating-point x, y coordinate values. One sensor value is reported. It is based upon the formula $Value_{sensor} = Value_{vehicle} / distance^2$. If two vehicles are present, then the formula is $Value_{sensor} = Value_{vehicleA} / distanceA^2 + Value_{vehicleB} / distanceB^2$.

Option 2—Location is reported as a pair of floating-point x, y coordinate values. One sensor value is reported (see Option 1 for details). Two floating-point distance values are reported. If two vehicles are present, the smaller distance is reported first. A negative distance value is reported in the second distance position when a second vehicle is not present.

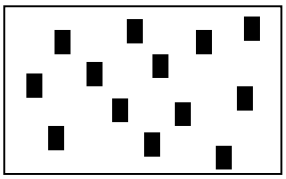
Supervisory System:

The supervisory system records and processes all of the data gathered from the individual sensors. It reports vehicle-tracking events to its user. These events consist of a vehicle's classification (e.g., small, medium, large), location, and speed and direction of travel (if known).

Border Control Configuration:

A configurable number of sensors will be deployed along a (straight-line) border at uniform distances. In addition to the standard classification, location, and direction data, the supervisory system must also identify when and where a vehicle crossed the border.

Area Monitoring Configuration:



A configurable number of sensors are randomly deployed across an area of interest. (Image the sensors being air-dropped from a cargo plane). Once initialized, the sensor network must identify stationary

vehicles and report their classification and location. In addition to the standard classification, location, and direction data, the supervisory system must also report the entry and exit of moving vehicles in to and out of the monitored area.

Simplifying Assumptions:
- Vehicles move in straight lines and at constant speeds.
- There will be at most one stationary vehicle and at most one moving vehicle at any time.
- Sensors do not move. If they do, then they have been tampered with and their data should be discarded as unreliable.

Smart Home Application:

Embedded sensors are being deployed into homes in ever increasing numbers. For this project students must develop a smart home application that controls the heating and cooling of a smart home. (As with the other project option, all hardware components will be simulated in software).

Smart Home Capabilities:

Each room within the smart home contains both a thermostat and an occupancy sensor. The data from these two components are used by the home's temperature control system to determine when the home should be heated or cooled. The furnace is capable of heating the home uniformly (i.e., for a given time period, the temperature within all rooms of the home will rise by a constant value). The air conditioning system cools each room in a similar manner.

Configuration Options:

Depending upon the time of year (e.g., winter vs. summer) the home should be set in either its heating or cooling configuration. Both of these configuration modes also have an energy savings setting that allows the home owner to select a second temperature setting to be used during the night-time hours.

The home-owner will configure the following values:
- Configuration mode (either heating or cooling)
- Temperature set point value (target temperature value for the home)
- Temperature tolerance value (determines the acceptable range temperature values)
- Energy Savings start and stop times

Temperature Control:

The temperature of each room will vary depending upon the time of year (e.g., winter or summer). Unfortunately, the temperature gain/loss in each room is not uniform, due to such things as non-uniform insulation (or the number of exterior walls) and the use of each room (e.g., cooking dinner in the kitchen).

In order to maximize the perceived comfort of the homes occupants, the occupied rooms will be given a double weighting when computing the home's overall temperature value. If this value is not within current acceptable temperature value range, then either the heater or air condition will be turned on. Once on, either the heater or air conditioner will remain on until the desired set point temperature value is reached.

Simplifying Assumptions:
- When in the heating mode, the home temperature will naturally drop.
- When in the cooling mode, the home temperature will naturally rise.
- Home occupants may instantaneously move from one room to any other room.