Abstract—The demonstration will provide the simulation of intelligent multi-hop techniques to maximize network lifetime. Different routing techniques would be compared using data visualization. Moreover, telos-based motes will be used to demonstrate the implementation of proposed techniques in a realtime embedded operating system such as TinyOS. The motes will be used to assess the environment condition.

I. INTRODUCTION

This section describes a brief introduction of wireless sensor network (WSN) components that will be used in the demonstration. The top most element of the WSN is the Base Station (BS). The BS is the ultimate storage and processor of all sensed data. It is assumed to have sufficient energy source to ignore its energy consumption. All other elements are powered locally with limited energy source which may not be replenishable.

An element of the WSN that resides within the deployment field is called a node. A node can be either a sensor or a proter. A sensor is a device that can sense its vicinity. A sensor sends its sensed data to the BS if queried. The sensed data is sent as part of a data packet. All nodes including the BS can receive and transmit data packets using wireless radio channel. A proter, unlike a sensor, cannot sense. However, it can have additional features such as caching, extra energy, and more processing power.

How a data packet will travel from a sensor to the BS is determined by a pre-specified data routing path. At any round, all data routing paths resemble a data routing tree that is rooted at the BS and spans all active sensors and zero or more active prosters. The BS constructs sufficient data routing trees for the WSN’s expected lifetime and disseminates them to all nodes before the first round. The BS uses the initial energy and location information of the nodes to construct these trees. It also uses a sensor model and a radio model to estimate nodes’ energy consumption due to sensing and data routing, respectively. The expected lifetime is valid only if all sensors are queried at every round.

A query is a request from the BS to a sensor to send its sensed data. There are three types of queries: continuous, manual, and self-generated. A continuous query specifies all or a group of sensors to send their data to the BS for some consecutive rounds. A manual query asks one or more sensor to send their sensed data at an arbitrary round. In a self-generated query, a sensor itself sends its sensed data to the BS whenever the sensed data validates some condition. This paper will only consider a default continuous query where all active sensors will send their sensed data to the BS at every round until they are all inactive.

A data packet has two parts: (i) preamble, and (ii) data. The preamble contains sender-receiver authentication information. The data contains either a sensor’s sensed data or a query or maintenance information from the BS. A WSN’s lifetime is divided into equal rounds. The duration of each round is same and the activities within a round are similar. At the beginning of a round, all active nodes turn on their radios and wait a fixed amount of time to receive any packet from the BS. If received, the packet will contain a query or maintenance information. Next, all active sensors send their previous round’s sensed data to the BS. This is the time when all in-network data routing occurs according to the data routing tree preset for the corresponding round. After that, all nodes turn off their radios and the prosters transition to their low power state. This is the time when sensors’ starts sensing. The sensors also transition to their low energy state once they finish sensing. All nodes remain in their low power state until the next round begins.

The BS requires all nodes’ location information to build the data routing trees. Therefore, whenever a node is deployed in the WSN, an entry must be added at the BS describing the node’s authentication and location information. The easiest way of locating a node is to
locate it relative to another node whose location is known. We will assume all nodes including the BS remain in one place throughout the WSN’s expected lifetime. The BS constructs the data routing trees that minimize all active sensors’ total energy consumption at every round. The trees also ensure that sensed data from all active sensors are received by the BS at every round.

II. DEMONSTRATION

The demonstration will show the simulation and implementation of our techniques proposed in [1], [2], [3], [4]. The demonstration software will provide a web-based management and monitoring of a sensor application. The users would be able to run the simulation experiments to validate the results and to understand the protocols. The data visualization tools would demonstrate the design of WSNs. Moreover, the proof-of-concept implementation in TinyOS environment will reinforce the confidence in the proposed techniques.

For instance, using the web application, the humidex ratings for a sensor can be generated. Humidex is a combination of the temperature and humidity that represents how hot it feels. It is similar to how the temperature in the winter works when it is calculated in respect to the windchill. Figure 1 shows the humidex readings for a room in summer, where 45 degrees were observed; this is considered as a dangerous category.

Depending on the location of the sensors, the readings can vary significantly. For instance, Figure 2 shows that the sensor located at position (4, 5) has a higher temperature than any other sensor. It is because this sensor is located near the ceiling on a fire exit sign. The height plays a role in the temperature difference as well as the sign is lighted and generates some heat, which also plays a role in the difference in temperature. The situation is similar for the sensors at positions (8, 1) and (9, 1) as they are on a fire exit sign near the ceiling as well. This sign however is not as hot as the first sign.

III. EQUIPMENT AND RESOURCES

For demonstration we would need a table and a power outlet. We would bring the following: a) laptop, b) 30-40 sensor nodes (tmotes), and c) 2 TmoteConnect gateway nodes.

REFERENCES


