Contour Tracking: A Comprehensive Student Project for Sensor Network Education

Damon Tyman, Akshay Dua
Portland State University
Portland, Oregon USA
damont@pdx.edu,
dakshay@gmail.com

Jens Mache
Lewis & Clark College
Portland, Oregon USA
jmache@lclark.edu

Nirupama Bulusu
Portland State University
Portland, Oregon USA
nbulusu@cs.pdx.edu

ABSTRACT

Wireless sensor networks are poised to become an ubiquitous part of the computing landscape. We are developing and class-testing sensor network lab exercises. The goal is to enable undergraduate students to learn sensor network concepts in a hands-on manner, and build sensor networking applications. This demonstration of tracking a light contour using a network of SunSPOT devices showcases a project completed by students in less than two weeks at the end of our sensor network course.

Categories and Subject Descriptors

C.2.4 [**Computer-Communication Networks**]: Distributed Systems – *distributed applications.*

General Terms

Algorithms, Design, Experimentation.

Keywords

Wireless Sensor Networks, Contour Tracking, Laboratory Exercises, Activity-Based Learning.

1. MOTIVATION AND DETAILS

Are wireless sensor networks ready for the undergraduate classroom? This demonstration showcases a project completed by students in less than two weeks at the end of the first iteration of an activity-driven sensor networks course which included weekly lab activities [1]. We chose contour tracking as the project, since it is a canonical task common to many different kinds of distributed sensing applications. For instance, atmospheric scientists may be interested in tracking the plume fronts of air pollution, while first responders may be interested in tracking the boundary of a chemical spill or a forest fire.

2.CONTOUR TRACKING

A portable flashlight is used to create a moving light field over a network of nine sensor nodes (SunSPOTs [2]), see Fig. 1. Tracking refers to the identification of boundary nodes on either side of the edge of the light field. As the light field moves, the current boundary nodes light up their LEDs while the old ones turn theirs off. As a result, one can see the nodes adapt to the moving light field.

The implementation is simple, completely distributed, and relies solely on local (one-hop neighbor) information. The neighbors and links for each sensor node are hard-coded to form a planar mesh as required by the algorithm.

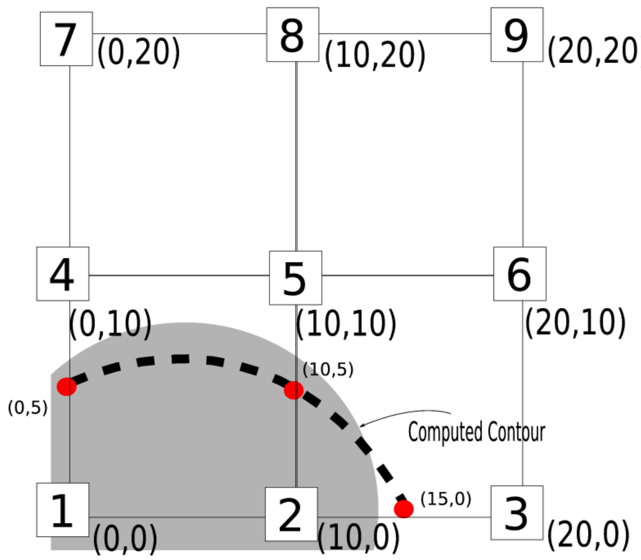

Figure 1: Sensor nodes 1,2,4,5 and 3 are boundary nodes.

Each node stores its own id, its contour value (1 or 0, indicating presence in the light field), a set of contour values for all one-hop neighbors, and its color. Nodes communicate with their neighbors as a result of periodic flooding of announcements. Once a node has heard from all its neighbors, it uses their contour values and its own to determine its color. The color indicates the state of the node and can have the following values: white if the node as well as its 1-hop neighbors are in the light field, black if the node as well as its 1-hop neighbors are not in the light field, or gray if the node is neither black nor white and is thus a boundary node. As soon as a node determines its color to be grey, it lights up an LED. If it has any other color, it turns all its LEDs off.

ACKNOWLEDGMENTS

This work is supported by NSF grants CNS-0720914 and CNS-0720545.

REFERENCES

[1] Jens Mache, Damon Tyman and Nirupama Bulusu, "Making Sensor Networks Accessible to Undergraduates Through Activity-Based Laboratory Materials", In Proceedings of SECON, 2008.

[2] SunSPOT devices, http://sunspotworld.com

SIGCOMM'08, August 17–22, 2008, Seattle, Washington, USA.
ACM 978-1-60558-175-0/08/08.