YushanNet: A Real-World WSN Deployment for Hiker Tracking in Yushan National Park

Yi-Chao Chen[1], Yu-Te Huang[1], Jyh-How Huang[2], Ling-Jyh Chen[1], Polly Huang[3], Shivakant Mishra[2]

[1]Institute of Information Science, Academia Sinica

{yichao, ytls, ccljj}@iis.sinica.edu.tw

[2]Department of Computer Science, University of Colorado

{huangjh, mishras}@cs.colorado.edu

[3]Department of Electrical Engineering, National Taiwan University

phuang@cc.ee.ntu.edu.tw

Abstract

The objective of this work is to develop a reliable and robust system for hiker tracking in a national park. Knowing tourists' hiking traces is important for the administration and operation of a national park. For instance, the aggregated information can help administrators to provide necessary services for tourists (e.g., map information, sightseeing spot information, toilets, pavillions, etc.) based on the collected spectral and temperal tourist distributions in the national park. Moreover, the collected hiking traces can provide important clues for mountain rescuing if there are hikers lost in the mountains. However, since the full wireless coverage is impossible in wilderness environments, network communication in the proposed system is inevitable intermittent and thus very challenging.

The basic ideas of our work are based on [1,2], which apply a delay/disruption tolerant network technique and make use of opportunistic, ad hoc, and short-range wireless communications to dissemination data in a network. As funded by Yushan National Park Headquarters[1], we are now deploying a WSN-based system, called YushanNet, for hiker tracking in Yushan National Park. The Yushan Mountain (3952m) is the highest mountain in East Asia, and there are about 50,000 tourists in the national park every year. The *Yushan Peak Trail* is a 10.9km long trail from the entrance to the summit with a 1302m altitudinal shift. In the proposed YushanNet system, each tourist is asked to bear a small device called *Taroko* mote (about 160 grams weight) when he/she passes the entrance. The *Taroko* mote has a GPS receiver, Zigbee radio, and 10 KB memory. When one tourist encounter another tourist in the park, their carried *Taroko* motes will automatically exchange their IDs and locations, and store the received information in their memory. When a tourist reaches one base-station, which is installed on some hot spots in the park, it will upload all stored information to the Internet servier through the base station via GPRS or Wi-Fi (the free WiFi service is provided in Paiyun Lodge, which is the main overnight resting place for those climbing to the summit of Yushan). Our contributions, comparing to [1,2] are the followings. First, in the YushanNet system, the GPS receiver operates with a low duty cycle (it will be turned on and off periodically), and therefore the system can save about 95% power. Second, the *Taroko mote* records the tourist's location information periodically even if it does not meet any other motes. By doing this, the YushanNet system not only can have finer grain on each tourist's walking trace, but it can also provide clues indicating that there are no appearences of other tourists in that region in that period. Third, we provide a Super Node (SN) function for rangers, which can download the most up-to-date information directly from the encountered hikers. The Super Node has been implemented on a Asus EEE PC[2] and will soon be ported to handheld devices (e.g., PDA or Mobile Phones) for easier carry.

In the near future, we plan to incorporate biosensors with our system for monitoring the health condition of the hiker. The carried mote will alarm signals while detecting abnormal conditions, and it will automaticall dial out for help if there is GSM coverage and the mote could be connected to the mobile phone (via USB or Bluetooth). Moreover, since the mote architecture is small, robust, and flexible, aditional sensors and/or solar cells could be easily connected to the motes, the proposed YushanNet system is also promising in wildlife tracking and other applications. For more detailed information about this work, please visit http://nrl.iis.sinica.edu.tw/YushanNet/.

Reference

[1] J.H. Huang, S. Amjad, and S. Mishra. "CenWits: a sensor-based loosely coupled search and rescue system using witnesses," in *SenSys'05: Proceedings of the 3rd International Cnference on Embedded Networked Sensor Systems*, pages 180-191, New York, NY, USA, 2005. ACM Press.

[2] J. Huang, L. Jiang, A. Kamthe, J. Ledbetter, S. Mishra, A. Cerpa and R. Han, "SenSearch: GPS and Witness Assisted Tracking for Delay Tolerant Sensor Networks," in *Technical Report TR-2006-001*, School of Engineering, University of California, Merced, December 2006.

1 The project is funded by the Yushan National Park Headquarters under grant number 097301020200G1004 from 2008/3/15 to 2008/12/31.

2 http://usa.asus.com/products.aspx?l1=24&l2=0&l3=0&l4=0&model=2005&modelmenu=1