

Approach to Learning Research with Wireless Sensor Networks in an Outdoor Setting

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Abstract: Automated collection of environmental data may be accomplished with wireless sensor networks (WSNs). In this paper, a general discussion of WSNs is given for the gathering of data for educational research. WSNs enhance the scope of a researcher to include multiple streams of data: environmental, cyberdata, video, and RFID. A brief overview of the technology prepares the exploration of a setting used for outdoor learning.

Keywords: Wireless sensor networks, education research, ecology, RFID, ethnography

Introduction

Wireless sensor networks (WSNs) are a pervasive information-gathering technology. RFID and WSNs enable wireless identification and location, with recent research applications including education: language learning [5], kindergarten objects responsive to stimulus [7], and more [1]. This paper aims at a data-gathering system for outdoor learning.

Human behaviors are similar to the setting, which includes locations, physical and temporal attributes and other participants [6]. In an outdoor mobile learning activity, researchers use field techniques such as participant observation, interviews, and handheld video recording to investigate learners in the field. Recent studies, bird watching [2] and learning about flowers [9], revealed emergent patterns in mobile learning activities. In our own learning activities, unobtrusive observation allows researchers a new way to study the educational value of visits to a nature area (Fig. 1).

1. Wireless sensor network design

The feasibility of constructing a wireless multimedia sensor network [1] for outdoor research is primarily constrained by system cost, battery lifetime, and bandwidth considerations, but allows the automated collection and tagging of the following data types:

- Environmental factors – Temperature, ambient audio, and population density.
- Cyberdata – Data from devices used in learning activities.
- Video sensor network – 360-degree video sensors as introduced by [4].
- RFID – Collects identification and location of tagged people and objects.

The primary goal of sensor deployment is the maximum coverage of the area of interest within constraints of sensor life and transmission radius. Accordingly, sensor nodes will be placed so as to provide maximum coverage of the area of interest. Post-deployment, WSN



Figure 1. Learner activity monitored by three wireless sensors.

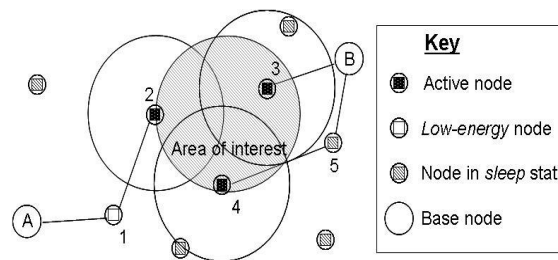


Figure 2. Sensor nodes capture data and route to base nodes.

communications are self-configured; sensor node data is aggregated and forwarded via location-based routing to the gateway, (Fig. 2). Query-based, negotiation-based, QoS-based routings are adopted, allowing data to be obtained interactively in real-time, enabled by wireless communications techniques addressed in [1] [3] [8].

Due to energy considerations, communications between wireless sensors are connected by low-powered frequencies, and higher bandwidth video is sent over 802.11a/b/g. Adjustments to sensors and cameras are centrally controlled interactively according to application, relieving researchers of constant reconfiguring. Audio, video and cyberdata is identified via RFID for future analysis. Data mining and database theory allow researchers to determine patterns in existing data, from which theories can be developed.

2. Conclusion

The contribution of this paper is to provide a basic overview of a WNS system designed for automated data gathering in an outdoor learning setting, so as to determine relationships between environmental features and observable behaviors of learners. The current work is to gather data that influences educational theory; develop concepts of how educational researchers can use WSNs to enhance data gathering abilities; and expand knowledge of wireless multimedia sensor networks, such as battery life, routing and topology. In the long term, we seek to develop environments that actively react to events.

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