

# eXspot: A Wireless RFID Transceiver for Recording and Extending Museum Visits

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## ABSTRACT

Science museum visitors are often pressed to attend scheduled events and to see as many exhibits as possible in a single visit, leaving little time to experiment, learn, and reflect upon deeper ideas and science concepts behind an exhibit. We have developed a museum-based application that uses a low-powered, wireless RFID transceiver called ‘eXspot’ that is intended to support, record, and extend exhibit-based, informal science learning at the Exploratorium, an interactive hands-on museum of art, science, and perception located in San Francisco. In this demonstration we will show a typical exhibit and how a visitor would interact with it to extend his/her museum experience.

## Keywords

Museum application, RFID, low-powered radio, informal science learning

## INTRODUCTION

The Exploratorium is an interactive, hands-on science museum with several hundred exhibits about science, art and perception on display at a time. In the spirit of the Exploratorium’s vision of informal science learning, the exhibits are designed to promote playful exploration and discovery of scientific phenomena. Some exhibits involve one-handed manipulation to move a disc, knob or lever, while others involve two-handed manipulation or a group of visitors to operate an exhibit. Many of the exhibits are powered and noisy, involving sand, water, electricity, magnetism, heat and soap, and some exhibits are on the open floor without easy access to power.

Learning in these informal educational settings is unstructured, unsystematic, highly motivating, and often takes place within a family group with multiple, competing interests, and agendas. The resulting interaction with any single exhibit is fleeting and typically lasts about 30 seconds in length [1]. An adult in a family group may want to know more about the scientific phenomena the exhibit highlights and its history, or may want to interact with it longer, but is pulled away by children to the next event or exhibit.

Our technical design challenge is to create a wireless solution that both preserves the hallmark of the Exploratorium experience that is learning by conversations with others and hands-on activity with exhibits, yet also enable deeper reflection and conceptual understanding about the scientific phenomena being demonstrated in an exhibit. Our pedagogical goal is to promote science learning through nomadic inquiry: visitors experience a phenomena in context, test out their ideas with exhibits, ask more questions, and continue their inquiry over multiple visits to a museum, and between visits to a museum via online records, additional resources, and activities for later reflection to foster lifelong curiosity.

At the conference we will demonstrate the eXspot prototype for extending museum experiences [Figure 1]. We will show how visitors interact with the eXspot and how the information gathered from eXspots can dynamically generate post-museum content for the user to further their education. The eXspot was created through a collaboration between the University of Washington, Intel Research Seattle, and the Exploratorium.

## PRIOR RESEARCH ON RECORDING VISITS

Our prior research with electronic guidebooks has established that visitors have difficulty carrying handheld devices while operating the museum exhibits [2,3] and prefer that their hands be free to manipulate highly interactive exhibits. Thus, to get deeper information about an exhibit required an unobtrusive solution. Tags and tagging appeared to be the most promising low-cost, lightweight technology for this purpose [4]. A token could support recording, capturing a memorable photo on the spot, or tracking one’s conceptual pathway through the museum. After a museum trip, the visitor can later review additional science materials via a personal web page.

The first implementation of a visitor ‘remembering’ system at the Exploratorium made use of custom designed ‘PI stations’ which mounted on to a stand an RFID reader, infrared HP Cooltown beacon, and digital camera [2]. These studies carried out by researchers at HP Labs found that capture was useful and that majority of users opted to login after their museum visit, even when provided with only a personalized photo and links to- more information on their personal web page [2]. This feasibility study validated that users wanted this functionality and thus prompted and motivated further research and design

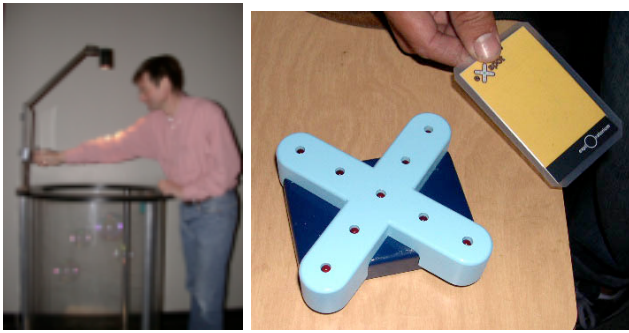


Figure 1. Swiping the eXspot with RFID card at an exhibit; A working prototype of eXspot package that houses the transceiver.

### SYSTEM DESIGN COMPONENTS

The eXspot system consists of a registration kiosk, the transceiver/radio package mounted on a museum exhibit, an RFID tag carried by the visitor, and a personal webpage. On selected exhibits, a camera is mounted on exhibits and/or contains camera video output within the exhibit itself (e.g., the heat camera) that is captured into a personal webpage when a visitor swipes the eXspot package. The visitor can later view personal photos or learn more about the exhibit from a web page.

#### The RFID tag

Each museum visitor can obtain a laminated card that has Texas Instruments' Tag-Its RFID tag enclosed. The cards are designed with one side of graphics that contain optical illusions and the other side with a clear view of the RFID antenna and chip to promote visitor curiosity. Visitors who receive an RFID card can register it by swiping an eXspot reader at registration kiosks located near the front of the museum entrance. Although the card has a unique ID, visitors must enter in their email address at the registration kiosk screen as a measure of security in case cards are lost at the museum or on the way home.

#### eXspot Transceiver Packaging

eXspot is a plastic molded package that contains LEDs for visual feedback to the visitor, and a low-power RFID reader with a range of a few inches (for 13.56 MHz tags). The package also contains a Crossbow Mica2Dot mote for radio connectivity. The eXspot continually attempts to read RFID tags. When an RFID card is swiped in the vicinity of the reader (within a few inches) the tag is read and its ID is sent to the laptop-based station over the 433MHz mote radio. This package provided similar functionality to the earlier PI stations, but this smaller design utilizes only RFID, was easier to mount on exhibits, and is rechargeable requiring no power outlets.

#### Post-museum Online Experience

After a museum visit, the visitor can review his/her visit on the World Wide Web via a web address entering in their ID (from their card) and email address. While at this personal Web page, the visitor can view the dates he/she visited the museum, those exhibits that have been swiped on a given day and time, and personal photos taken at the exhibit. The Web page also provides online content (e.g.,

online exhibits, science articles, explanations, home-based construction kits, teaching resources) related to the exhibits [Figure 2].



Figure 2: Working prototype of post-museum visit webpage with personal photo capture and online activities

### ON-GOING USER STUDIES

Two sets of experiments are underway. Five exhibits selected from each of two sets of exhibits 'energy and matter world' and the 'seeing' collection will have eXspot packages mounted on exhibits. Visitors will be given a card and asked to visit all five exhibits in any order at their leisure. Afterwards, visitors will be asked to take a survey and answer a small number of interview questions by the researcher. This portion of the visitor evaluation is ongoing.

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