RFID Localization for Tangible and Embodied Multi-User Interaction with Museum Exhibits

Francesco Cafaro
Computer Science
University of Illinois at Chicago

Leilah Lyons
Computer Science / Learning Science
University of Illinois at Chicago

Joshua Radinsky
Curriculum Studies / Learning Science
University of Illinois at Chicago

Jessica Roberts
Learning Science
University of Illinois at Chicago

SCENARIO

Over the past two decades, there has been an increased interest in how ***museum exhibits*** might promote interactive learning and sociability, spawning new forms of interactive experiences like large shared ***ambient displays***.

RESEARCH GOAL

Use RFID to provide both *identification* and *localization*, to encourage the collaborative investigation of a rich information space presented on an Ambient Display in a museum exhibit.

Keep technology costs down (one reader, inexpensive tags).

Use proximity not as a lure to encourage users to approach, but to control interaction with the display's data.

The PROTOTYPE SYSTEM

Our system is a combination of a ***shared projected display***, a single ***RFID reader*** and individual ***passive RFID tags***.

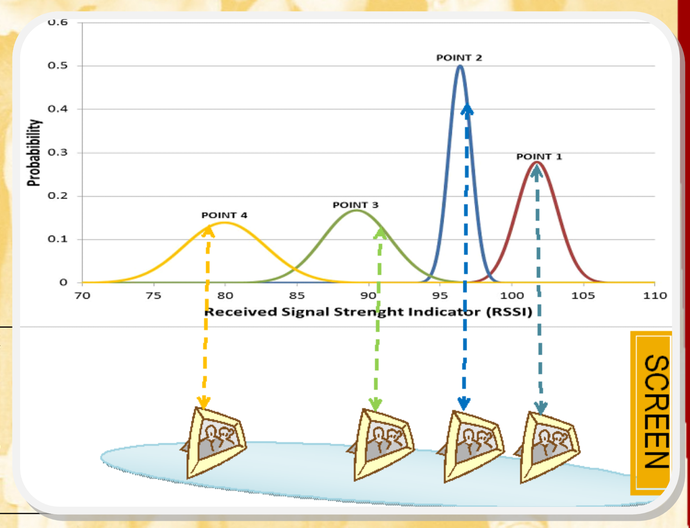
The shared display shows historical maps about immigration flows to the United States during various eras.

The system can:

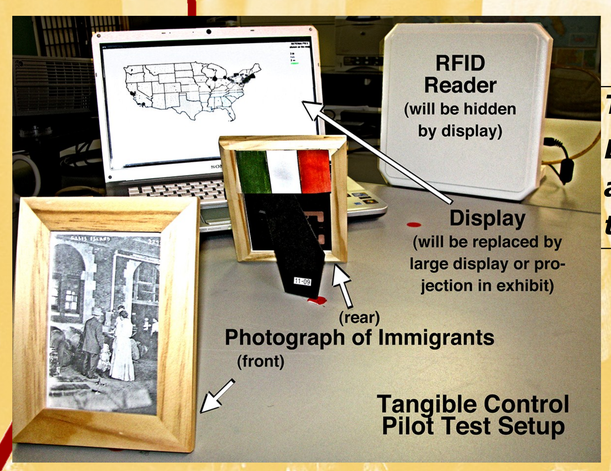
IDENTIFY the tags, using the Electronic Product Code (EPC);

LOCALIZE the transponders, with a location fingerprinting method based on the Received Signal Strengt Indicator (RSSI).

Four Gaussian probability density functions corresponding to 4 points (25cm, 50cm, 75cm and 135cm) given the signal strength returned from a tag (x-axis).

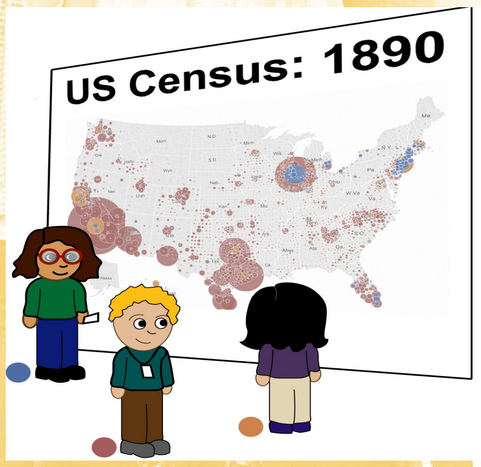


TANGIBLE CONTROL



Tangible Control set-up.
Each frame is tagged with an ISO 18000-6C transponder.

Multiple users can interact with the screen by moving one frame to be closer to or farther from the shared display.



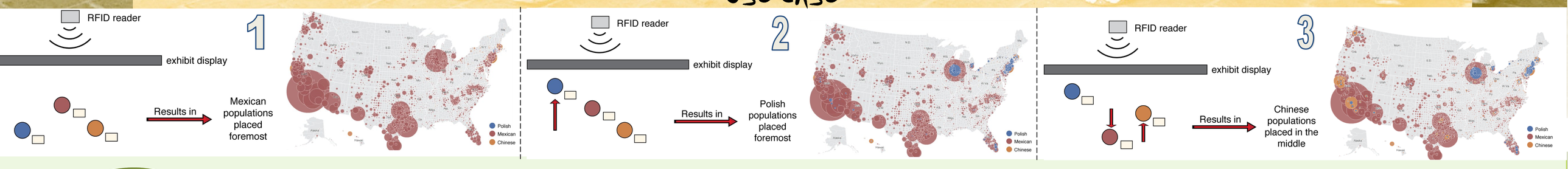
EMBODIED CONTROL

Embodied Control set-up.
Each person receives a tag, which can be linked with one (or more) country of origin.

Each person *becomes the object* of her/his own interaction, as the screen is directly controlled by people's movements within the simulation space.

Courtesy National Archives, photo no. 90-G-125-29

USE CASE



SYSTEM SET-UP

Thingmagic Astra Reader
Reader power: 30dBm
One read operation every 50ms
Alien 9634 tags (ISO 18000-6C)

PRELIMINARY RESULTS

REFRESH RATE (static conditions)

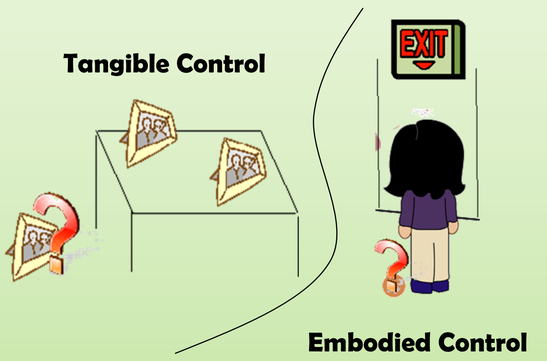
Time between two consecutive successful reads of a tag (i.e. the tag is both identified and localized)
Min 1.62s Max 2.43s Avg 2.00s (SD=0.05)

RESPONSE TIME (dynamic conditions)

Time elapsed before the system interprets that a tag has been moved from one zone to another
Min1s Max 10s Avg 2s (SD=1.47)

DESIGN RECOMMENDATIONS

Persistence of Data

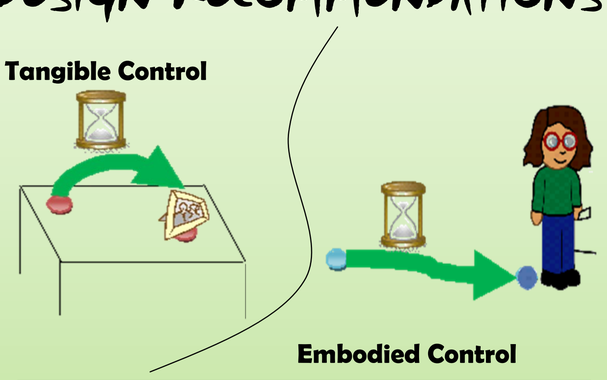


The system cannot be instantaneously aware when a tag exits the reader area

*** The time-out (that we can use to determine if a tag exits the reader area) should be greater than the average REFRESH RATE.**

**** A USER STUDY should be performed: which is the greatest time-out that conforms to the user's expectations?**

Responsiveness of the System

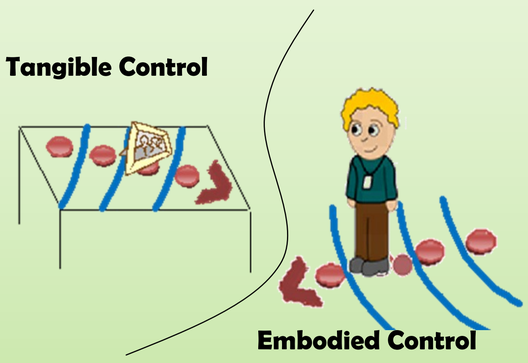


The system is not immediately stable after a tag is moved

*** We recommend not to update the display before the average RESPONSE TIME.**

**** Scenarios that require smoother system responses may demand the adoption of TRAJECTORY-SENSITIVE ALGORITHMS for driving the display.**

User Schema of Technology



We observed a user tendency to line tags up perpendicular to the display (but the RSSI changes within a radial pattern)

*** We recommend incorporating VISUAL CUES (like painted lines) in the physical interaction space.**

FUTURE WORK

We are currently evaluating the adoption of ***semi-passive tags*** to achieve a smoother level of interaction and to extend the scope of the reader interrogation area.

We are planning an ***experimental user study*** under both Tangible and Embodied Control. We expect that visitors will respond differently to these two different interaction strategies and will show different interaction patterns both when exploring the data and with each others.

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