Beacons in the Museum: Findings from a Pilot Study using iBeacons within a Mobile AR Game in a Natural History Museum

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Abstract: Mobile augmented reality (AR) games can be engaging learning experiences, leveraging real-world artifacts and locations with a digital overlay of information, narrative, and interactivity. By integrating iBeacons, AR game platforms create a viable means for informal learning organizations (e.g., museums) to create indoor, location-based mobile games. A pilot implementation targeting youth ages 6-12 paired with adults visiting a natural history museum demonstrated that participants were able to locate specific items in galleries densely crowded with artifacts. Participants also found the experience highly engaging, felt that the game provided a lens for closely observing and comparing artifacts, and fostered synthetic thinking across exhibit spaces.

Background

Mobile experiences can promote the types of visitor engagement valued by informal learning organizations (Cahill et al., 2011; Hsi & Fait, 2005; Klopfer, Squire, Perry & Jan, 2005). Played on mobile devices, located-based augmented reality (AR) games provide information based on the player's current location linking gameplay to the physical world. In this way, AR games leverage the physical environment by providing a layer of narrative, information, or other digital interactivity. In informal learning venues (such as zoos, nature centers, and museums), AR games can potentially engage visitors in a number of ways: guiding visitors to locations and artifacts they might not otherwise visit, encouraging visitors to look closely at specific artifacts, prompting visitors to access prior knowledge, offering visitors behind the scenes information, and highlighting the research agenda, broader goals, and values of the host venue.

However, implementing location-based AR games in indoor locations can be challenging. Over the past several years, visual tags (e.g., QR codes) allowed visitors to scan or input information enabling their device to presume the player's current location (Ceipidor et al., 2009). However, this approach has three potential drawbacks: First, the visual codes need to be within line of sight of the visitors, often cluttering the visual landscape. Second, players needed to pause from gameplay to actively enter their location, which can disrupt gameplay and eliminates the possibility of a surprise experience. Third, unless signage is pronounced, these visual cues do little in and of themselves to guide the player to a novel location.

iBeacons

The recent development of iBeacons allows mobile devices to connect to a point-of-interest (POI) via Bluetooth. The mobile device senses the beacon's unique identifying code, allowing the mobile software to estimate the device's current location within the indoor space. While not invisible, these devices (small plastic units the size of a walnut) can be mounted out of visual line of sight, requiring only proximity detection. As the player approaches the beacon, the mobile device can react automatically, giving the player clues, information, or feedback, and ultimately giving the player a potentially more natural, flowing experience.

Pilot

Researchers at MIT conducted a study to investigate whether integration of beacons into TaleBlazer (a platform for making and playing mobile location-based games) could: (1) guide visitors to specific POIs, (2) promote observation and discussion, and (3) provide an enjoyable, engaging experience. In Spring 2015, a pilot game using beacons was developed at the Harvard Museum of Natural History (HMNH) in collaboration with the MIT STEP Lab. This pilot sought to offer *youth visitors* role-playing activities that playfully engage them in STEM practices within indoor exhibit spaces. In parallel, the authors sought to provide *informal learning organizations* with a proof of concept pilot demonstrating the capacity of indoor AR tools and practices that thoughtfully utilize existing exhibits in indoor learning spaces.

The pilot game "Super Survivor", aimed at tweens and their families, aimed to promote observation of animal physiology and discussion of bodily adaptations. Gameplay took place within three adjacent museum galleries (Africa, New England Forests, and the Great Mammal Hall) all of which feature densely exhibited mounted specimens located inside glass cases. The player is assigned a specific biome (desert, tundra, or rainforest) and is tasked with customizing a fictional creature to best survive in that biome. Upon entering a room, beacons sense their location and provide instructions and clues to find each of four specific "landmark" specimen, large and generally recognizable organisms. The player is then prompted to closely observe three nearby specimen and to select their preferred feature (e.g., teeth from the honey badger). The player ultimately obtains feedback indicating how the assembled traits helped or hindered their fictional creature's survival in their assigned biome.

Sample and Methods

During the roughly 45-minute pilot, nine groups (adults and children ages 6-12) played the game on borrowed iOS smartphones/tablets. Researchers closely shadowed participants, recording at 30 second intervals their location and level of engagement (with adults categorized as "actively involved," "observing," or "off task," and youth categorized as "actively involved," "related task" or "off task"). Observers also noted any particular areas of confusion or frustration (e.g., locating specific target POIs). Additionally, players completed a written post-survey and participated in a 20-minute post-game focus group to probe players' feelings about the experience.

Findings and Discussion

Participants averaged 20 minutes of gameplay, though duration was highly variable across groups ranging from 11 to 31 minutes. Children were generally highly engaged by the game (83% on task), with only two children observed to be off-task, one of whom was visibly not feeling well during the game. Adults frequently (86% of the time) took an active role in playing the game, reading the text to the children and discussing the choices with them. Researchers observed players looking closely at the exhibits; when deciding between teeth options, for example, many players bent down to the ground so that they could look more closely at the honey badger's teeth. Some challenges included groups with multiple kids sharing a single device, in which the adult felt as if she needed to guide youth in sharing the device and collaborating. Despite these challenges, post-survey findings demonstrate that the game was very well received. Using a five-point Likert scale, participants said the "technology was intuitive" (4) and the "game was easy to start" (4.25). Adults found the experience "meaningful" (4.38) and felt it helped them "think in new ways" (4.63), enjoyed finding the objects (4.88), and agreed it was a "fun way to spend time together" (4.75), saying they would play it again (4.88). Children liked the story/quest (4.63), agreed it was a fun way to visit a museum (4.81), enjoyed finding the real-world objects (4.63) *("It was cool when things popped up to say you're near"*) and would like to play a similar game again (4.75). Participants felt the game added to their visit, commenting, *"[the game] made me look closer at things"* and gave them something to do– *"instead of just watching the animals, we're discussing [them]."*

Data from this pilot demonstrate the viability of using iBeacon technology as a means to foster youth/family engagement within a museum setting. Future work includes additional game mechanics to engage players in tasks other than observation, as well as wayfinding support from the technology, which will be particularly useful in games that utilize a larger physical space.

References

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