(All In) One Jar

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Abstract

We have designed a collection jar that records the movements and presence of collected nature items (such as insects, spiders, marine invertebrates, mushrooms, and flowers) and replays these recordings for later viewing. This design also includes a terrarium to collect, replay, and store these recordings over time. The goal of our design is to create a permanent memory of and prevent harm to observed nature findings. Our collection jar is augmented with motion and touch sensors to detect particular movements from the collector, a video camera to record the collected item, and an LCD screen to provide digital feedback of these recordings. We have created a functional prototype of the collection jar and have determined future directions for our work.

Keywords

Tangible User Interface, Bug Jar, Digital Imaging, iSchool, Nature, TUI

ACM Classification Keywords

B.4.2 [Input/Output and Data Communications]: Input/Output Devices---Image Display; H.5.2 [Information Interfaces and Presentation (e.g., HCI)]: User Interfaces---Prototyping

Introduction

Collecting bugs and other nature items is a fun way to learn about the natural world. Touching and seeing these nature items not only promotes learning but also creates an appreciation for nature. Existing tools such as bug jars and nature kits feature nets and magnifying glasses to facilitate collection and observation. Unfortunately, these tools do not retain memory of these collected items. These tools are also not designed to provide an appropriate living environment, and can thereby cause harm to living observations.

Therefore, the goal of our design is to create a permanent memory of and prevent harm to observed nature findings. We have designed a collection jar that records the movements and presence of collected nature items (such as insects, spiders, marine invertebrates, mushrooms, and flowers) and replays these recordings for later viewing. This design also includes a terrarium to collect, replay, and store these recordings over time.The following paper introduces related work, illustrates and discusses our design and prototype, describes potential use cases, and determines directions for future work.

Related Work

Two examples of nature-related tangible interfaces include the Eco-Pods tangible user interface and the Electronic Field Guide augmented reality user interface. The Eco-Pods interface features several pods that represent nature elements (such as wind, water, and sunlight) and a display screen that simulates the growth of a flower. Moving and interacting with these pods in certain ways affects the flower's growth. For example, cupping the sun pod increases sunlight and can help the flower grow with adequate water [1]. The Electronic Field Guide interface is used to identify species while in the field. It captures images of the unknown species and presents representations of potential matches. These representations can then be manipulated through hand gestures and other movements [2]. These interfaces remind us that tangible user interfaces can help users understand elements of the natural world.

One Jar Design

Interaction Loop

The One Jar interaction loop begins with the collector placing a nature object in the collection jar and recording this object by pressing the button on the jar's lid. Its location on top of the lid prevents any obstruction of the collector's view and allows the collector to record and observe the nature item at the same time. This video will record as long as the collector continues to press this button. Once the recording finishes, the complete recording will replay on the side of the jar. After the collector is done observing the item, it can place the bug or mushroom or other object back into its environment. When the collector wants to view past recordings, he or she can shake the empty jar and a past recording will replay at random on the side of the jar. These recordings will continue to be stored within the jar until the collector tilts the jar over the terrarium. Tilting the jar in this manner will transfer these recordings from the jar to the terrarium.
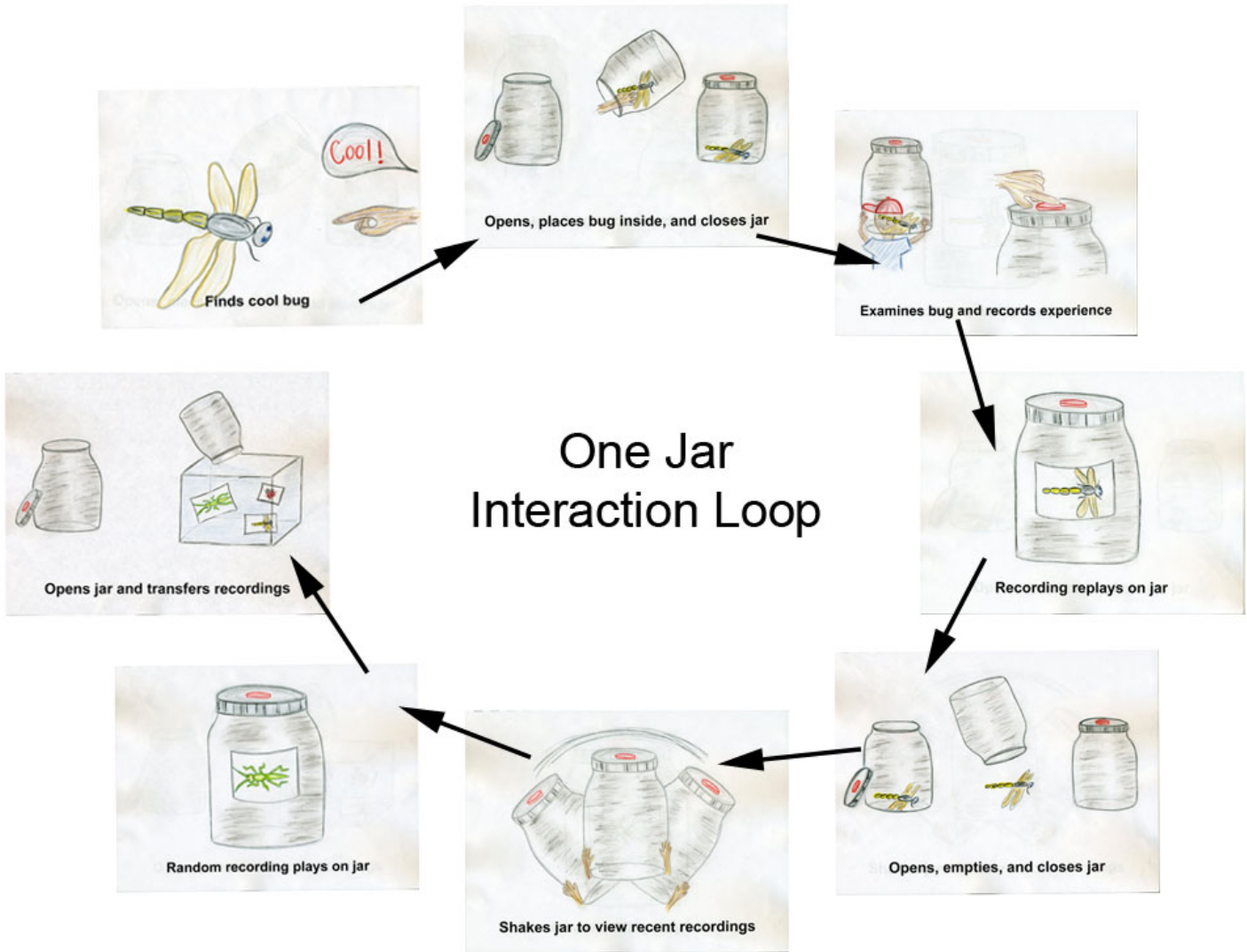
Figure 1: One Jar Interaction Loop

Use Case One: Capturing Bugs

Polly loves to catch all sorts of bugs, especially fireflies. While her parents are not interested in having bugs in their house, they don't want to discourage their daughter's curiosity. For the past few months they've let Polly store her bugs in jars for a day or two, always noticing that the bugs quickly die. For her seventh birthday Polly's parents bought her a collection jar (the One Jar) capable of capturing and storing her collections indefinitely and its accompanying terrarium, a device that allows Polly to display the things she has collected from her One Jar. The first time using the One Jar Polly captures five fireflies and watches them fly about inside of the jar, observing them from all angles. After several moments of inspecting them, Polly decides to record their movements by pressing down on the top of the jar's lid. A small camera, discreetly attached to the underside of the lid, records the fireflies as they glow and flitter about. After about an hour, Polly's parents request that she come back inside and go to bed. Knowing that she has already captured a recording of the fireflies, she releases them from her One Jar and heads back inside. Back in her room, Polly pours out the digital recordings of the fireflies into the terrarium. Suddenly, as the terrarium begins to play back her recordings, these fireflies come back to life. Polly hops into bed and watches her newly captured fireflies glow softly as she falls asleep.

Use Case Two: Identify this slug!

Tom the naturalist is out tide pooling, but isn't having much luck finding anything interesting. Even though there is a significant low tide, the strong storm that recently moved through the area may have stirred things up a bit too much. All of a sudden he sees a glint of florescent purple and orange from underneath a coral head. Tom immediately jumps into the tide pool and finds a beautiful nudibranch, or sea slug. Not knowing what type of nudibranch he has found, Tom collects it in his One Jar to take a closer look. He inspects the nudibranch while simultaneously recording the nudibranch's bizarre swimming activity. After several minutes Tom decides it would be best to put the creature back where he found it. He is so excited that he runs back to his friends (who are on the beach flying a kite) with his One Jar in tow. He explains what he saw and his friends' jaws drop in astonishment. Based on Tom's description he may have seen a very rare sea slug, only spotted several times in this park. Without hesitating, Tom shakes the One Jar, activating the jar's playback feature. A side of the jar which is normally clear springs to life displaying the nudibranch for several seconds. Now able to see it with their own eyes, Tom's friends confirm that he has spotted this very rare nudibranch and beg him to add his finding to iNaturalist.org (a community for naturalists that allows you to record nature observations, share and explore this data, and meet other naturalists).

Discussion

Some of the functionality of the One Jar can be achieved using items that are already commercially available, such as a digital camera and computer screen. However, the interactions inherent in these traditional tools do not encourage the kind of detailed inspection of natural findings that we hope to encourage. Snapping a photograph with a camera tends to lead to a much more detached observation of natural objects. The act of finding something, carefully capturing it, placing it inside a container, and moving it around to best capture it digitally is a more engaging and participatory experience. It also provides the user
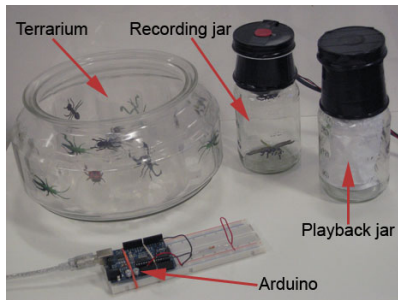
with the opportunity, while recording, to manipulate and examine the item inside the container. Such interactions can encourage an interest in the natural world, particularly in children. Additionally, the means of storing and replaying images from a standard camera generally lead the user to lump together memories from a wide variety of other activities. A recording of "fireflies", for instance, may sit in a folder adjacent to "Fran's birthday". The One Jar produces a distinct artifact, separate from artifacts of all other domains. By providing a different means of storing and displaying items captured in the One Jar, the container is given a special and unique place in the owner's collection.

Prototypes

Tangible Artifacts
We implemented a functional prototype of the collection jar using two clear mason jars and a mockup of the terrarium using a small aquarium. One mason jar contains a web camera, allowing it to capture videos of the objects placed inside of the jar. The camera captures video through a Processing script, actuated by a force-sensitive resistor (FSR) mounted to the lid of the jar, and displays the recording on a connected computer screen. In an attempt to simulate the playback of videos through a shaking interaction, the same Processing script records and captures feedback from a Wiimote placed in the second mason jar. When shaken, the script analyzes this feedback from the Wiimote and replays a random recording on the same computer screen. The terrarium mockup consists of a round glass bowl that displays images of bugs captured by the collection jar on several layers of mylar transparencies to simulating the effect of multiply layered screens.
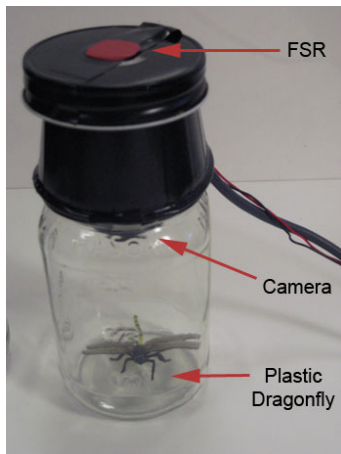

Figure 2: Prototypes

Figure 3: One Jar recording prototype

Digital Artifacts
We used Processing's native video libraries to implement the video capture, recording, and playback, the program DarwinMote to pre-process the Wiimote's raw output (it sends a special class used by Processing to further manipulate the Wiimote's input), and Arduino's normal development environment to write a simple script that captures the FSR's input and transmits it through a serial port connection to Processing.

Implementation

Video Capture
Processing's video capture libraries are not very robust and over time consume large amounts of memory, ultimately rendering the application unusable. An actual implementation of the device would require using well designed capture software, along with a much smaller capture and storage platform. Small cameras are commonly available from hobbyist stores, as well as more economically from large industrial suppliers.[1] Small, high capacity flash memory cards would also be necessary components of a production quality implementation.

Video Display on One Jar
Our prototype displayed video using an attached computer screen. Rendering a video from a saved archive proved to be too difficult for Processing to handle while simultaneously managing other computations. A more adept set of video playback software would need to be developed and incorporated into the system for it to work more seamlessly. Our design also calls for a flexible, translucent screen for

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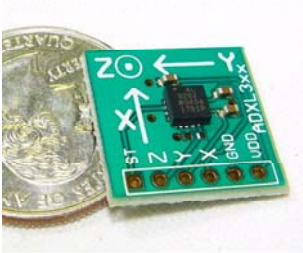[1] http://www.helihobby.com/html/micro_video_camera.html

Figure 4: Three Axis Accelerometer

Figure 5: Bendable LCD

Figure 6: Heliodisplay

displaying captured movies on the side of the glass jar. Fujitsu is currently developing just such a flexible LCD.[2] Alternatives might be to use a form of projection or opaque screens placed intelligently around the perimeter of the jar.

Accelerometer
Capturing output from the Wiimote worked well, however implementing an algorithm that handled shaking proved somewhat difficult. It was difficult to capture a shaking movement intelligently when the controller was held in different orientations. This may be due to superfluous design considerations on the Wiimote that would be overcome by using a simple, standalone accelerometer. These have recently become extremely small and affordable, and are widely available.[3]

Video Display in Terrarium
In order to play back the images captured by the jar, the terrarium must have some sort of display interface. The interface we have chosen is not yet available widely, but has indeed been shown to work well in applications such as this. Heliodisplay shows an image that appears to "float" midair by projecting light onto disturbed air.[4]

Communications

In order to transfer images from the jar to the terrarium, a wireless communication path must be established. Bluetooth communications modules are common products today[5]; in fact, many people already own an item incorporating this technology. They are small and very reliable, perfect for the One Jar.

Future Work
Evaluation
The goal of the One Jar is to support and encourage interest in the natural world by enabling users (especially children) to digitally capture observations of objects and life in the world around them. In order to evaluate how well the One Jar meets this goal, our team would like to distribute several highly functional prototypes to elementary school science class groups. Additionally, it would be valuable to observe new or creative ways that children find to make use of the One Jar.
1.   When given the choice, do students prefer to use traditional methods of capture (photography, specimen jars) or the One Jar?
2.   Do students primarily use the jar to capture images of living creatures or inert objects?
3.   Should the terrarium support other modes of playback? (for instance, would a display mode including only the items from one or two specific jars be useful in a setting with groups of users?)

Other Interactions
We have developed a fairly simple interaction loop. Collectors can record their findings by pressing on the

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[2] http://www.fujitsu.com/global/news/pr/archives/month/2005/20050713-01.html

[3] http://www.sparkfun.com/commerce/product_info.php?products_id=847

[4] http://www.io2technology.com/salesinquiry

[5] http://www.sparkfun.com/commerce/product_info.php?products_id=8494

record button, replay past recordings by shaking an empty collection jar, and transfer recordings to the terrarium by tilting the collection jar over the terrarium. However, we have not developed meaningful interactions for deleting and finding past recordings. And in future work we will explore interactions such as deleting recordings by dragging them to the bottom of the terrarium or the bottom of the collection jar. We will also explore interactions such as finding past recordings within the terrarium by displaying recordings in order of date and enabling scrolling.

Conclusions

Our design overcomes a container's primary limitation of space: multiple jars are required to capture multiple things. However, this does not exclude the possibility that many interesting interactions could come from using several One Jars in concert. As an organizational interface, each One Jar could be used to store a certain type of observation. Perhaps a single jar stores all of a collector's ants, another stores the collector's favorite leaves, and a last stores interesting aquatic life. A future version of the One Jar might use its Bluetooth connection to allow multiple jars to communicate, along with screens that are not only translucent but also touch sensitive. Using these different forms of interaction a user might "pickup" captures with touch interactions such as a pinching gesture allowing them to place it into a different jar. This same interaction could be used in the accompanying terrarium, providing a way for captures to be distributed onto one of the multiple displays in the terrarium. A range of creative possibilities becomes available by providing a method for allowing users to distinctly layer each capture. For example, users could use this added functionality to create interesting terrarium-scapes comprised of a

layer of leaf movies, below a layer of interesting bugs they saw in the same forest. In this way, the One Jar and terrarium ceases to be a simple display of random captures and instead becomes a highly manipulable showcase.

Project Participants

Nathan Agrin, Jessica Kline and Alana Pechon, graduate students at the UC Berkeley School of Information, carried out all phases of this project.

Acknowledgements

Citations

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