rainBottles: gathering raindrops of data from the cloud

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Abstract
This paper introduces a design for a new way of managing the flow of information in the age of overflow. The device, rainBottles, collects virtual data and converts it into a virtual liquid that fills up specially designed glass bottles. The bottles then serve as an ambient interface displaying the quantity of information in a queue as well as a tangible controller for opening the applications associated with the data in the bottles. With customizable data relevance metrics, the bottles can also serve as filters by letting less relevant data overflow out of the bottle.

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Tangible User Interfaces, Ambient Media

ACM Classification Keywords
H5.2. Information interfaces and presentation: User Interfaces.

Introduction
Water has always, in one form or another, been one of the more illustrative metaphors used to describe the flow of information around the Internet. Embedded in our understanding of information, the ideas of bandwidth and capacity, the phrase "surfing the web", and the idea of overflow itself all invoke the image of water and its natural affordances[1]. Recently, there

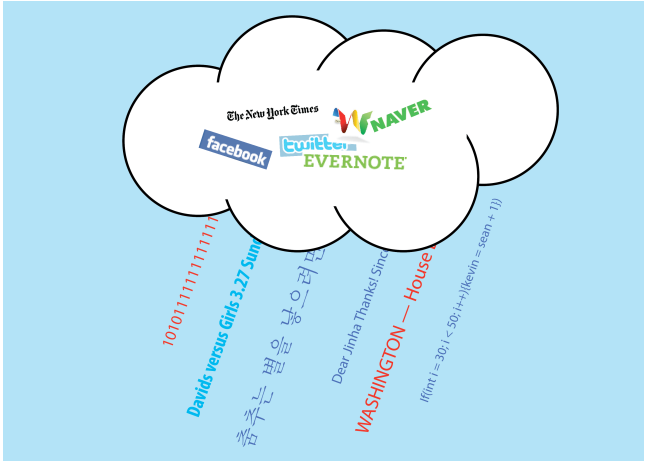

Figure 1. The metaphor of cloud and rain illustrates how users consume and retrieve information from the web. Some is more relevant (blue) than others (red).

has been an increasing emphasis on information that, rather than being contained in one hard drive or one computer, resides in a more intangible form: in the rainBottles: gathering raindrops of data from the cloud.

This data does not exist as a resource to be navigated, like how the web is traditionally understood, but as a stream of information that rains down on users in forms ranging from simple e-mails to Twitter updates to RSS feeds.

What happens when a user is overwhelmed by the rain? What if a user could capture the rain falling from the cloud in a set of bottles, storing the information away to be dealt with later? These questions led us to design rainBottles, an ambient, tangible interface that allows users to easily collect, filter, prioritize and later access the information raining down from the cloud.

rainBottles

The rainBottles themselves are glass bottles with a frosted, translucent coating on them. Inside is a vertical array of multi-color LEDs, an Arduino board, an accelerometer and a wireless transmitter. The Arduino handles events sent from a computer indicating when new information is filtered into the bottle. The Arduino takes these events and lights up the LEDs to indicate how much "fluid" is in the bottle. To access the information in the bottle, the bottle can be turned over to simulate pouring, which will be detected by an accelerometer.

To indicate the relevance of the information in each bottle, one of two representations can be chosen. The first is a binary representation, where the liquid in the bottle is split by color. For example, more relevant information takes the form of blue liquid and fills the

Figure 2. rainBottle gathers 'raindrops' of cloud data.

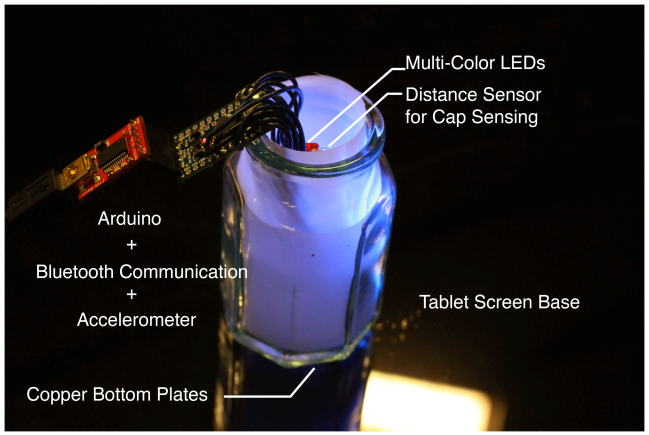

Figure 3. rainBottles are composed of simple electronic modules and are recognized by a tablet device underneath.

bottom of the bottle, while less relevant information takes the form of red liquid and fills the top. Another way of representing relevance is for each bottle to have liquid of a set hue, and to vary the saturation based on the relevance, which provides a more continuous visualization of the relevance with the multi-color LEDs.

Interactions

With the dual metaphors of the bottles themselves and the fluids they contain, we strove to design natural interactions that users could easily understand from the affordances inherent to a real bottle full of liquid.

Filling up

In the absence of user input, the bottles function as ambient information displays. Over time, the bottles *collect* information as they are accumulated. This is represented using LEDs to light up the bottles from the bottom up, with the light representing the "fluid" inside of each bottle.

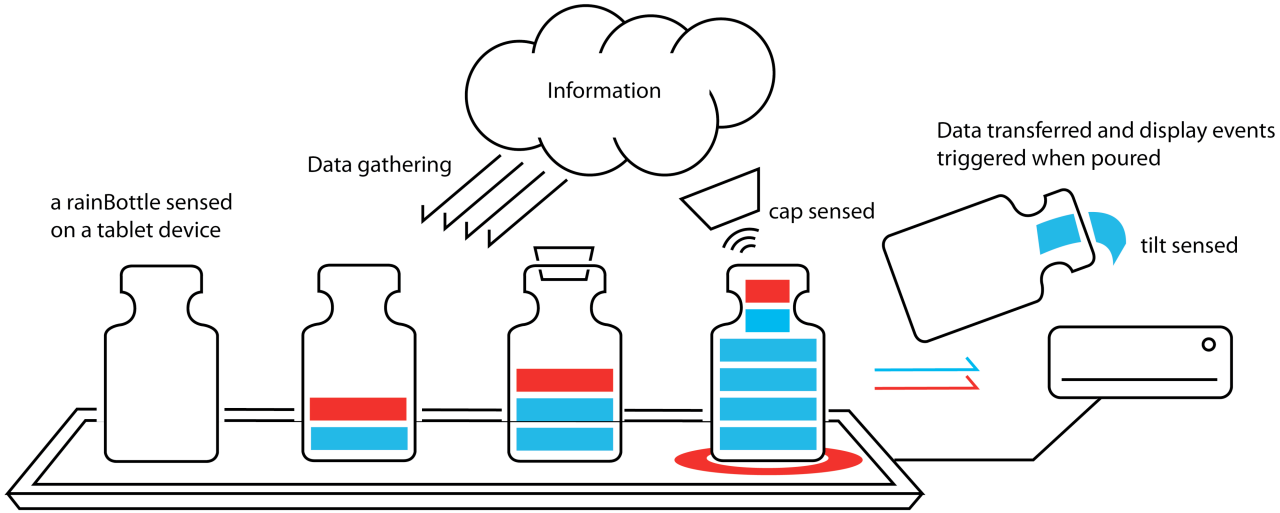

Figure 4. Interactions with the rainBottles

Prioritizing and Sorting Information
As the bottles fill, they perform two types of filtering implicitly: separating different types of information into different bottles, and separating information of differing relevance into different density fluids. The first form of filtering simply means that, for example, new e-mails go into a bottle specifically for e-mail and new Facebook updates go into a bottle for Facebook. The second form means that in any given bottle, highly relevant information is represented as high-density fluid, sinking to the bottom, and less relevant information is represented as low-density fluid, floating to the top.

Overflowing
When a bottle reaches its maximum capacity (representing the user's maximum cognitive capacity), any additional information that reaches it will cause the bottle to *overflow.* The interesting aspect of this interaction is the idea that the first information to overflow out of the bottle is the lowest density (lowest relevance) information floating at the top of the bottle. By doing so, the bottle can gather only the most relevant information to the user while discarding less relevant information beyond the user's cognitive capacity.

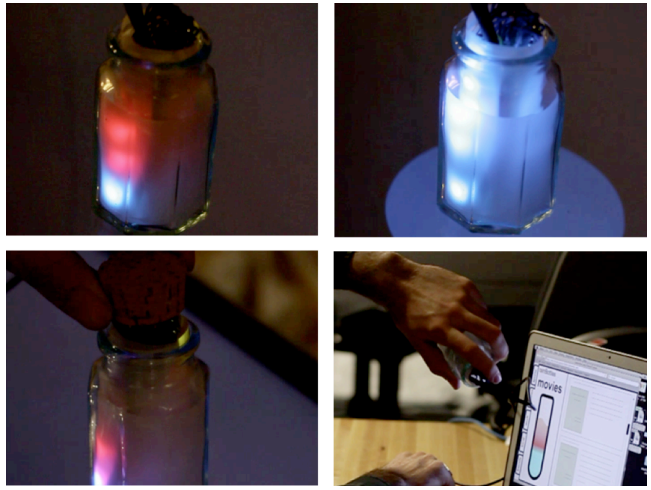

Figure 5. rainBottles in use.

Plugging
If the user decides that he no longer wishes a specific bottle to capture any more information, he can also choose to *plug* the top of the bottle with a cork, effectively preventing any more information from falling into the bottle. One can imagine this being useful when the user wants to prevent the information currently in a bottle from overflowing, such as when there is a specific piece of information in a bottle that the user wishes to preserve.

Pouring
Finally, when a user wishes to view the information stored in a bottle, she can choose to *pour* the contents of the bottle into another device, such as a laptop or smartphone. This triggers the software component of rainBottles, and causes the bottle to empty its contents into the display of the device. This could be as simple as opening the user's e-mail program of choice, or opening Google Reader to display the appropriate RSS feeds.

User Scenarios
Users can take advantage of ambient and tangible nature of the interface around the rainBottles and use them for different purposes. Users looking to keep on top of their incoming news sources may use rainBottles

as a way to monitor them for when they might be overflowing. When they see one bottle start to fill up and overflow, they can make time to read the incoming stories from that bottle to keep it from overflowing. Users looking to take advantage of the filtering and prioritizing mechanisms may instead choose to wait for the bottles to overflow until they are filled with only blue "liquid." This allows them to focus on the stories that their filters decide to be most relevant.

Software Implementation

The primary functions the software for rainBottles performs are pulling information in from the cloud, determining relevance and launching applications. Pulling information from the cloud is accomplished by adding support for RSS feeds and popular web application APIs. We also provide an interface for adding custom APIs not bundled with the release and for customizing options like data source, liquid color and data relevance metrics as shown in Figure 6. Determining relevance can be accomplished manually

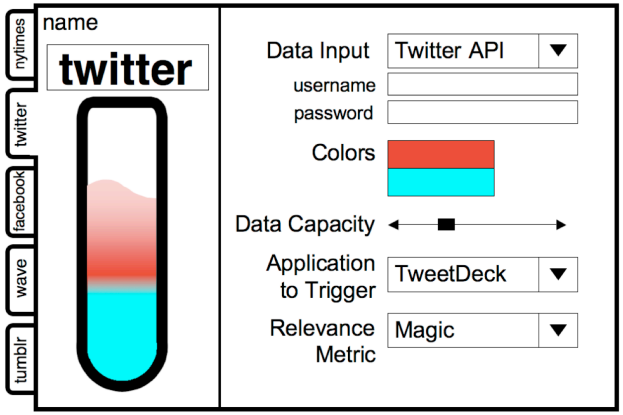

Figure 6. Software interface for configuring the bottles.

by providing support for filters similar to the filters supported by many email applications. The software accesses user data and uses machine learning techniques similar to Like/Thumbs-up systems to automatically provide suggestions for the relevance of each data item. The possibilities for relevance metrics are configurable, leaving options for customizing.

Related Works

Weiser envisioned 21st century computation to be weaved into everyday environments such that users can interact with digital information without noticing the computer interfaces [1]. Tangible Interfaces were explored to lay out guidelines for designing such "calm computing environments" through a tight coupling of bits and atoms [2]. As another guiding principle, Jacob et al. explores and proposes designing interfaces based on reality that occur in the physical environment [5]. Among many tangible and reality-based interfaces, the most direct inspiration of this project comes from musicBottles by Ishii and et.al.[4].

In the quest for deploying architectural space as a medium for digital interfaces, Wisneski et al. explores various types of ambient devices. They attempt to employ peripheral awareness in information retrieval [3]. rainBottles inherits dual spirits of tangible interfaces and ambient media, serving as an unobtrusive interface which allows users to control and perceive digital data seamlessly situated in their everyday environments.

Future Work

The idea of using bottles is not only limited to the few types of interactions that we have implemented here, nor is it limited to the materials and physical form

factor available to us. One could imagine bottles where, instead of simple LEDs glowing to represent the information contained, there were LCDs that displayed small snippets of data, e.g. headlines, subject lines, tweets, "floating" inside of each bottle. Or, one could also imagine using sound as an output method to playback the sound of raindrops falling as data fills the bottles, providing a soothing ambient indication of the rate of data flowing in. RFID chips or a Bluetooth connection could be used to allow the bottles to be identified and used by multiple computing devices.

Beyond additional output methods, one could also envision physical "filters" that users could place on top of the bottles to provide even finer-grained filtering. These filters could be stacked on top of each other to provide logical conjunction ("and"), or perhaps placed side-by-side to provide logical disjunction ("or"). This is just one extension of the tangible interface side of rainBottles; undoubtedly there are many others waiting to be explored.

Conclusion

The goal of rainBottles is to design an interface that could function as both an ambient information display of cognitive capacity and as a tangible tool for prioritizing information based on relevance, helping users deal with information overflow. Our solution, light-filled glass bottles that appear to fill with "fluid" of varying densities as data rains down from the "cloud" above, effectively serves both of these purposes. The metaphors of data as a liquid and bottles as cognitive capacity, together with the natural affordances of a bottle, provide a natural and immediately understandable set of interactions: collecting, overflowing, plugging, and pouring. rainBottles, by combining aspects of both ambient and tangible interfaces, effectively allows users to visualize and manage their information overflow.

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