

Weather-in-a-Box: Exploring Physical Representations of Internet Information

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ABSTRACT

The authors have been interested in research through design and rapid prototyping for decades. In this position paper, we use the case of Weather-in-a-Box, a physical manifestation of internet-based weather information, that sought to recreate the award-winning Yahoo Weather app as a physical box, with all of the whimsical “graphics” and animations from the app. Through building the device and using it on our desks, we learned much more about the physical Internet than we could have through paper-based design exercises or ruminating over “implications for design.” We have seen, through decades of building, the power of rapidly constructing a concept and what can be learned by putting it into people’s lives for weeks or months at a time.

Author Keywords

Physical prototyping; Design; Internet of Things; Ubicomp; Weather.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

INTRODUCTION

The authors have been interested in research through design and rapid prototyping for decades. We strongly believe in the power of artifacts to articulate ideas in a much deeper way than sketches, textual descriptions, or “implications for design.” And we have seen through decades of experience what can be learned from an in-the-wild study of technology prototypes to advance design as well as theory in particular domains. The first author has been teaching these methods for over 10 years at MIT and through an online MOOC on the EdX platform.

In the past, we have built and studied systems for Ambient Social Television [5], Location-Based video experiences to

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Figure 1: The Weather In-a-Box prototype. The wheel in the back can display two different cities, and shows iconic Flickr photos of these locations. The sun shows the current position in the sky for the city that is being displayed. The windmill spins proportionally to the wind, and the thermometer in the front lights up 1 LED for each 10F in temperature. The cities are changed via a mobile application, which is used to receive weather data and connects to the device over Bluetooth.

connect grandparents to grandchildren [2], time-away location-based information in mobile messaging [4], mobile health systems [3], and mobile video experiences for sporting events [1] – among others.

In this position paper, we will discuss the design and construction of Weather-in-a-Box, a physical instantiation of the popular Yahoo Weather application. This device was intended as an initial exploration into the design space of physical information devices for the home, as a part of a research initiative within Yahoo Labs. Through designing and building this prototype, we wanted to explore:

- 1) How we could capture the whimsical graphical interactions of the application in physical form – such as the windmills that spun proportionally to the wind, the rising and falling sun, and the rich Flickr photos that made the app popular.
- 2) How a physical weather box could fit into the built environment of the home or office.

- 3) How receiving weather information in this format could change people's awareness of their own city or other cities, and what people would do with this new awareness.
- 4) Insights for creating new physical devices that conveyed other types of data from the Internet in the home.

THE PROTOTYPE

Weather-in-a Box is implemented using an Arduino with a Bluetooth shield. A mobile application written on Android receives weather data through the Yahoo Weather APIs. It then periodically connects to the device over Bluetooth to send the latest weather data. The mobile application also allows for switching cities, which rotates the Flickr photo in the background and resets the sun and weather conditions.

The device itself receives data and controls a variety of servos, LEDs, and motors to convey the current weather conditions. A motor drives a 3D-printed windmill to show the current wind speed. A servo drives the sun across the sky as the day progresses. Other servos control sticks with graphical icons for various weather conditions including clouds, rain, and snow. Consistent with the digital Weather app, a Flickr photo of the city creates a background for these components. The background images are mounted on a servo driven disk and change when the mobile application alternates the city on display. The electromechanical system is enclosed in a small box. A thermometer made of a strip of color-changing LEDs sits on the front of the box and lights up one LED for each 10F in temperature change as well as sets the color of all lit LEDs to match the color of that temperature on a traditional newspaper weather map.

The device seeks to capture some of the more whimsical features of the mobile application while creating a device that is attractive and could fit in to a variety of home or office settings. The entire device was engineered and constructed in 24 hours and is fully functional, showing the rapidity of physical prototyping that is possible with current materials and devices.

DISCUSSION

For us, building has always been a way to learn rapidly – not only about what is technically possible to create and current constraints of that technology, but to learn what it is like to live with a concept.

Creating the Weather-in-a-Box allowed us to learn first hand the differences between an application that is checked periodically on a phone vs. an always-on ambient awareness device on the desk. We also learned about the joy that can be created through simple mechanical interactions, such as watching the “sun” set in another city, or seeing the wind pick up on a wintry Chicago day from the warmth and comfort of San Francisco.

When using the Weather-in-a-Box, we observed that the physicality of the weather display can cause a shift in people's awareness of and connection to the weather.

Instead of residing multiple clicks deep on a phone screen, the weather information now occupies a physical space in the living or working environment. The types of ambient awareness seen in previous work (e.g. [5]), are now applied to a new type of information. Could this prompt new habits and help people to dress more appropriately for the weather or bring umbrellas (e.g. [6]) when needed? Could it help people to feel connected to the weather in their hometowns? Or since changes in weather drive the motors to move, could the slight noise 'notify' a nearby user to look at it, instead of needing to inquire current weather condition from an app? How can an app complement a physical device and allow people to dig deeper or control the device itself? This device has allowed us to think more deeply about all of these questions.

Building physical devices has become exponentially simpler with the introduction of rapid prototyping platforms such as Arduino. In addition to physical prototypes, we have also had great success in creating rapid mobile applications within the constraints of a 24-hour period – applications that were robust enough to give to strangers to use in their lives for weeks at a time. Through these field studies, we have learned much more than we could have from other types of investigations such as in-lab usability studies or surveys/focus groups to gather feedback on designs. People were able to live with our technology and we learned how it did (or did not in some cases) fit into their daily lives.

We find it unfortunate that so little of the published work in HCI constitutes application/device development. Each year a handful of apps or physical devices are created, while almost every paper includes textual “implications for design” that are rarely acted on by the authors. We would love to see this balance change, and demonstrate how design and understanding of users can be advanced through building and testing the use of new concepts in the wild.

VIDEO

A video of the functional device in action is available at: <https://youtu.be/B0Q-ULEiILU>

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Frank is a Principal Researcher at Yahoo, leading research for communications applications. For the past ten years, he has taught the class Building Mobile Experiences at MIT and as a MOOC on EdX, focusing on rapidly constructing working prototypes of design ideas and studying how people use them. After studying at MIT, Frank worked in the Experiences Research team at Motorola Labs in Chicago for 12 years before heading to Yahoo Labs and then the Yahoo User Experience Research team in California. Frank is the author of the MIT Press book Building Mobile Experiences as well as an upcoming self-published book on making vegan donuts.

Cheng Xu

Cheng is Concept Prototyper that conceptualizes and builds with all media from software to hardware, across the fields of user experience design, digital fabrication, and mechatronics. She has designed and shipped consumer products at Motorola, published research on wearables and design tools at Disney Research and Yahoo Labs, and exhibited art installations to global audiences.