CHI 2008 – Engineering Magic

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Abstract
The expectation of the supernatural can be an affordance for tangible user interfaces, and result in playful technologies that fit in a cultural context. In this paper we describe a series of objects that are inspired by and derived from traditional magical objects used for divination: a divining rod, a pendulum scry, and a scrying pool. For each object, we consider its traditional use in divination and then propose an engineered corollary using modern technology.

Keywords
Magic, divination, Wi-Fi, book review, sea conditions, pendulum scry, water scry

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
Arthur C. Clarke wrote that "Any sufficiently advanced technology is indistinguishable from magic," [3] and indeed, many commonplace technologies of today might seem magical to a time-traveler from the past. How would you explain a cell phone to Thomas Jefferson? Or a light bulb to Socrates? One could even argue that if it were not for the post-Enlightenment dominance of philosophical naturalism, we would all be inclined to believe that such artifacts operated by

supernatural means. Do you really know how a cell phone works? Could you explain it to someone who was unaware of electricity?

At the same time, there exists a yearning for the supernatural in the popular consciousness. Palm-readers and ghost-hunters aside, many people enjoy dreaming of a world like our own imbued with supernatural properties. If the popularity of fictional works like the *Harry Potter* and the *Lord of the Rings* series are not convincing, then surely the reader must once have looked upon an open flame and, if only for an instant, imagined it was more than simple combustion. Supernatural imagery and expectations like this suffuse almost every culture on Earth. At least in the West, sentient trees, flying broomsticks, and voodoo dolls are such conventional magical objects that it can be difficult to see their physical representations and to avoid expecting or wanting some magical properties from these objects.

The expectation of the supernatural can be an affordance for tangible user interfaces, and can result in playful technologies that fit in a cultural context. For example, a broom provides a physical affordance for gripping in the form of firm shaft that fits simultaneously in two human hands. By the same token, the broom exposes a cultural affordance as a personal transportation device, because most Westerners are familiar with stories in which witches and other magical people use brooms to fly.

Here we examine several objects related to the magical practice of divination, and explore ways of utilizing our expectations of magical properties to create natural, culturally embedded, or amusing technologies.

Divination

Divination is "the practice of attempting to foretell future events or discover hidden knowledge by occult or supernatural means." [7] Divination has been practiced by nearly all cultures and civilizations for thousands of years, and divination methods vary widely. Most divination methods involve the observation of natural phenomena and interpretation by a gifted diviner. Some examples of divination methods include:

- Wind scrying - The ancient Greeks practiced wind scrying in a grove of oak trees dedicated to Zeus. Wands and brass basins were hung from the tree branches in such a way that when the wind blew the wands struck the basins. Diviners interpreted the sounds and predicted future events. [12]
- Oomancy - The Chinese used eggs for divination by breaking the egg into a glass of water, and then interpreting the forms of the egg white in the water. [11]
- Tasseomancy - The reading of tea leaves is associated with the Gypsies and the English. During a tasseomancy reading, the person seeking information drinks a cup of tea but leaves a small amount at the bottom of the cup. The diviner empties the cup onto a saucer and then interprets the patterns formed by the tea leaves. [12]

All of our objects - the divining rod, pendulum scry and sea scry - are inspired by and rooted in traditional divination methods. Using these traditions, we suspend our knowledge of technology, and design objects that really seem to be answering our questions in a magical way.

Wi-Fi Divining Rod

Traditionally, a divining rod is a Y-shaped branch of willow or hazel that points its operator toward hidden objects of value, like underground water or precious minerals. The practice of finding resources with a divining rod is known as "dowsing," and records of its practice date back to at least the 16th century [8]. In addition to widespread knowledge of their historical usage and supposed powers, divining rods remain in use today by small groups of believers [1,10]. The divining rod was the first magical object we considered for this project, after learning of Eva Hornecker's work using a divining rod as a "physical sketch" of a digital tour guide device [9]. While Hornecker's students used the rod as a placeholder for an actual technological artifact, we thought the rod itself could support some technological properties, taking advantage of the cultural expectation of its ability to find things.

There are many things an electronic device could be designed to find, but we were particularly intrigued by the possibility of using a natural object of magical significance to find seemingly-magical resources of natural significance, like Wi-Fi access points or areas of strong cell phone reception. Electromagnetic (EM) radiation outside the visible spectrum is a natural phenomenon that we cannot detect without specialized tools. Simply the awareness of EM radiation requires specialized knowledge, placing it well within the bounds of Clarke's magic/technology gray area. However, despite the magical appearance of EM radiation, cell phone and Wi-Fi reception have very real, natural significance to those of us who need them to work and communicate. We believe that the magical qualities of such invisible resources make them natural targets for technologically enabled dowsing.

Design

A radio antenna installed inside an actual Y-shaped stick detected the strength of a wireless resource, and on-board circuitry transduced the signal, activating a DC motor that vibrated the stick in proportion to the radio signal strength. The stronger the signal, the more violently the stick vibrated. We specifically designed our divining rod with Wi-Fi access points in mind, so the vibration would always be relative to the strongest nearby signal.

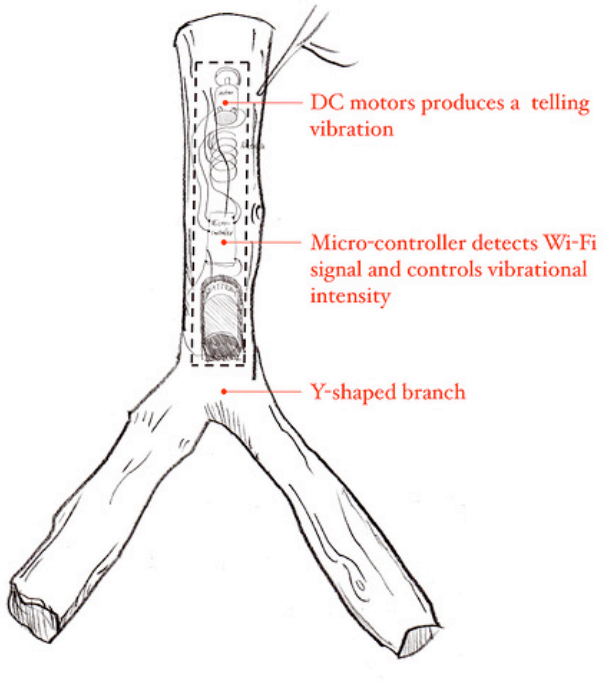

figure 1. Sketch of Y-shaped stick with embedded motor and microcontroller

We also considered ways to provide more control and feedback. For example, the handle segments of the branch could rotate to control radio frequency, or, in the case of Wi-Fi, toggle between wireless networks, or an attached LCD could display the ID of the strongest nearby Wi-Fi network. However, we felt that while such additions might be useful, they would detract from the rod's significance as a magical artifact by affixing clearly technological cues.

Implementation

We built a prototype of the Wi-Fi Divining Rod with all the sensing and actuation we designed by placing a DC motor within the tip of a large Y-shaped branch, and running wires out to an Arduino microcontroller, which in turn was attached to a laptop over a USB serial connection. A script on the laptop used the laptop's Wi-Fi card to detect local signal strength, and transmitted that value to the microcontroller, which changed the vibrational intensity of the motor accordingly.

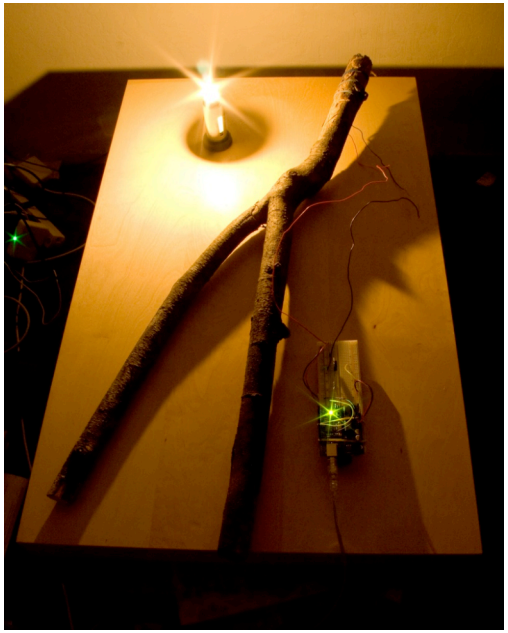

figure 2. Photo of implemented divining rod with Arduino board

Interestingly, the distance between the obviously technological components and the stick provided by the wires seemed to be enough for users to engage the stick alone as a novel device, and possibly even as a semi-magical artifact. Even after we explained to them that the device detected Wi-Fi signal strength and that the laptop, not the stick, was the sensor, users still moved around and pointed the stick in different directions while the person holding the laptop stood still. We were prone to the same behaviors when holding the stick, and found that exploring the Wi-Fi signal strength of an area to be both amusing and a

more spatial way of considering radio signals. It is unclear whether the willingness to believe in the rod's sensing powers despite its obvious attachment to another device was due to its physical affordance as a pointing device or its cultural affordance as a magical detector, but the way its form intrigued and engaged users suggests it is a good starting point for future design.

Book Review Pendulum Scry

Traditionally, the simplest use of a pendulum scry was for answering "Yes" or "No", or binary questions. Materials used for scrying included pendants, rings, and stones. The diviner held the pendulum in her hand, and asked a question. The direction of the swing of the pendulum indicated the answer to the question, swinging toward and away from the body to indicate "Yes," and across the body to idicate "No." One traditional use of the pendulum scry was to determine the gender of an unborn baby. In this case, the woman's wedding ring was suspended on a string over her pregnant belly. A circular pendulum swing meant the baby was a girl, while a back and forth direction indicated a boy. [5]

There are many possible binary questions we can answer using information available from a computer. Just a few examples include:

- Whether or not one has received a new email
- Whether or not a particular contact is available for
- Whether or not a computer has a virus

Ultimately, we decided on designing the pendulum scry as a book rating detector, to answer the question "Is this a good book?" There are many online book ratings available for use in determining whether or not a book was good. We felt this use would be compelling to many users, and enjoyed imagining our users bringing pendulum scrys to their local bookstores.

Design

A barcode reader and microcontroller are placed in a hollowed-out stone. The stone (with reader and microcontroller) is then used as a pendulum weight and attached with a ribbon to two Servo motors. One Servo motor controlled direction, while the other controlled swing. When the barcode reader detected a book's barcode, the microcontroller used data from the barcode and looked for book rating information from Amazon, The New York Times, bookreview.com, etc. It then averaged the ratings to determine if the book was good or bad. A side-to-side swing of the pendulum, corresponding to a shaking of the head for "no", indicated the book is bad. A front-to-back swing, corresponding to a nodding of the head for "yes", indicated the book wass good. Intensity of swing indicated the extent of the book's positive or negative ratings.

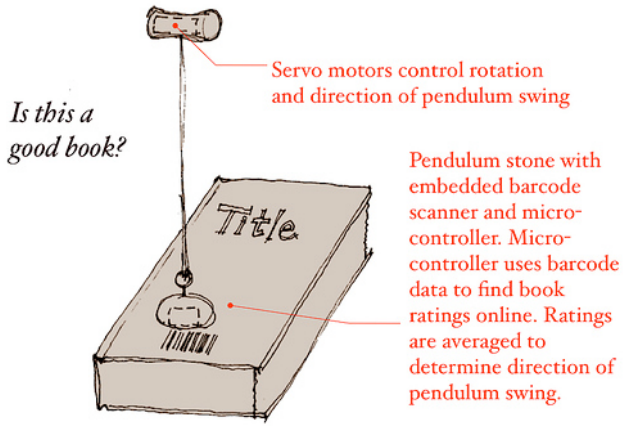

figure 3. Sketch of pendulum weight with barcode scanner and micro-controller, attached to servo motors

Implementation

We built a prototype of the book review pendulum scry without the barcode reader and without the ability to search for book ratings online. Our prototype consisted only of a stone attached with a ribbon to two concealed Servo motors. Keyboard input controlled the direction of the pendulum's swing. While the prototype did not completely function as designed, it successfully demonstrated the actuation we had in mind.

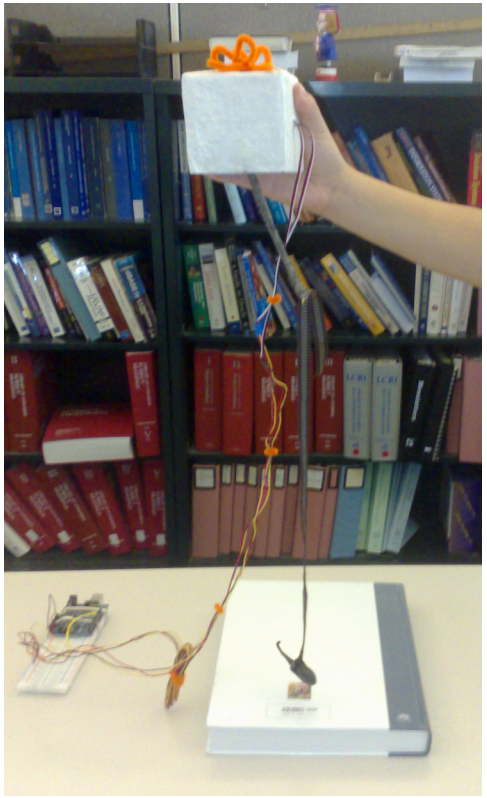

figure 4. Photo of pendulum scry held over barcode on a book (barcode reader and micro-controller not implemented)

When we demonstrated our prototype to users, we did not tell them that the barcode reader was missing. Instead, we explained the desired functionality as if it had been implemented, and asked users to hold the pendulum over a book. When the pendulum swung, some users were "surprised it was working" and asked if it would work for any book. Other users were

suspicious because the small size of the stone was unlikely to fit a barcode scanner.

Surf Scrying Pool

Water scrying is the magical practice of divining the future by interpreting the reflections and ripples in water, and is related to the use of crystal balls for the same purpose. A scrying pool is a pool or bowl of water dedicated to this purpose, and can be purchased from vendors dealing in occult artifacts [7]. While we did not find the scrying pool particularly compelling as an active interface demanding the operator's full attention. Instead, we were drawn to the potential of moving water as a source of ambient feedback.

We considered various sources of information the movement of water within a pool or bowl might communicate, but ultimately a direct mapping seemed to be the most meaningful: moving water in the bowl should reveal the condition of a remote body of water, perhaps the wave height at a favorite surfing spot, or the stillness of a lake where you were planning an afternoon canoe trip. Ambient awareness of water conditions could provide motivation for unplanned excursions outside, or warn of hostile conditions before arrival, or even before checking more precise sources of data.

Design

We arrived at two related designs for the Surf Scrying Pool. In the first, a stone or glass weight displayed a large-scale map on its surface, perhaps etched there permanently, with different stones representing different places. Thermistors embedded just beneath the surface detected a sustained press of a finger, thereby setting the coordinates to which the pool would respond. The stone acknowledged the action with light emitted at the selected region, using sub-surface fiber optic cable or LEDs. With coordinates set, the user placed the stone in a bowl of water. The stone connected to the house Wi-Fi network and queried for publicly available data on water conditions at the selected region from the National Weather Service or other sources. Pumps within the stone then agitated the water relative to the wind speed or surf height at the selected location.

In our second and more feasible design, the stone was smaller, and contained a magnetic bar. A similar rotating bar beneath the base of the bowl spun back and forth, moving the stone within the bowl and agitating the water. In the simplest case, a user set the location via software over the household network, but a etched heat-sensitive map like the one described for the first design could also be employed on the side of the bowl, or perhaps even at the bottom of the bowl, assuming the input electronics and the magnets did not interfere with each other.

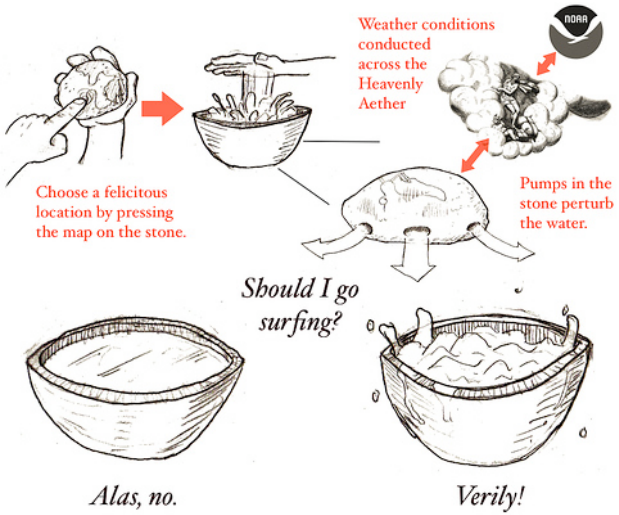

figure 5. Sketch of pendulum weight with barcode scanner and micro-controller, attached to servo motors

Implementation

We were unable to build a prototype of the Surf Scrying Pool in time, but we believe a prototype and a fully functional product are feasible. The magnetic stone design is based on magnetic stirrer technology used in chemistry and biology labs for decades, and the only materials required to construct one are a PC cooling fan and a few strong magnets [4]. Input is more difficult, as imbedding thermistors and fiber optics in glass or stone would require extensive experience in working with those materials, but a prototype might simply use a software interface, as described above.

Evaluating the Surf Scrying Pool might involve a diary study in which we select recreational surfers and sailors who live at least several miles away from their favorite bodies of water, provide them with Surf Scrying Pools, and instruct them to record every time they thought about going surfing or sailing, and whether the Scrying Pool played a role. Since we intend the Pool to enhance ambient awareness and enable impromptu excursions, a more controlled study would not provide us with the kind of contextualized, in situ results of a diary study, even if they would be more precise and generalizable.

Conclusion

In this paper we have described some initial attempts to repurpose traditional magical objects for technological uses. We believe that knowledge of the myth and folklore surrounding certain supernatural artifacts is an affordance for interacting with technology, and have shown examples of how such interactions might work.

Fully working prototypes and thorough evaluation were beyond the scope of this work, but the divining rod and pendulum scry we implemented revealed intriguing responses from those who tried them. As mentioned above, many people believed the pendulum actually worked as designed. Some found it amusing but impractical, others said they preferred asking friends for recommendations, while others found the thought of using a pendulum in a public setting amusing, and recommended that bookstores should hand them out to customers.

The divining rod generated considerable response and unexpected behaviors, like pointing the rod into nooks and crannies, or at other people. People were especially intrigued by the material of the rod, and several commented on the appeal of using natural

materials to house electronics. However, while some immediately identified the object as a divining rod (one person even claimed her husband frequently hired dowsers to find water on their property), most required an explanation of its history, and everyone required an explanation of its reengineered function as a Wi-Fi detector. This suggests that designers seeking to use cultural knowledge about magical interactions should be sure that their target audience has that knowledge, in order to maximize the "magical" impact on the audience. However, part of the allure of magic is its mystery and exclusivity. Perhaps knowing the secret of what the divining rod detects actually adds to its appeal as a tool, granting the user a sense of secret knowledge to which only a select few are privy.

In the future, we would like to build more robust artifacts with fewer obvious technological cues like visible wires, and use them in public settings to determine how people might use and perceive them. We would also like to explore different magical artifacts and interactions, and perhaps assess how the magical interactions from one culture might work in another.

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