Designing Devices for Context-aware Sound Recordings

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Abstract. The *Special Moments* project investigates the design of highly contextualized devices for recording and reproducing sound. Such devices are intended for a casual user to capture and store their experiences in a form of a "sound album" – a collection of sound recordings that are related to a specific context. We present two working prototypes, illustrating the uses of such sound recording devices. A *candle recorder* allows for capturing the general atmosphere and conversations at a party, and the *children's book recorder* records the interactions between parents and children while reading a book together.

Keywords: Sound recording, Context-aware, Tangible UI, Life-logging.

1 Introduction

Since the invention of the mechanical cylinder phonograph by Thomas Edison in 1877, sound recording has become one of the most important means for recording, storing, and reproducing people memories. There is a wide variety of users and uses: a student recording a lecture, a hobbyist taking a portable recording device to a concert, a sound artist capturing environmental sound for an art installation, a blogger recording a podcast among others. However, all these examples are cases of either professional or enthusiastic hobbyist use. Sound recording devices are rarely used *casually* for "capturing a moment" just for the sake of creating a memento, as we often do when we take quick snapshots with a digital camera.

We present a *Special Moments* project that focuses on designing, experimenting with, and evaluating recording devices for casual sound recording and playback. We envision small handheld sound recording devices that can be used by anyone to record sound snapshots in the same way we use a camera to record visual snapshots. The device itself would form a *sound album*, providing an easy way for reproducing a recording without using a computer, home sound system, or any other external devices. We present the design rationale and implementation of the prototype devices we have developed.

2 Related Work

The majority of personal recording devices, such as voice recorders, are general-purpose devices designed for use by professionals, i.e. news reporters, or sound enthusiasts. The value of recording sound in everyday lives is not yet clearly understood by casual users. Indeed, when Apple Inc. researchers conducted a study on recording habits in 1992, they intentionally chose only those subjects that are comfortable with the use of audio data, so that researchers could avoid "getting caught in the question of why one might want to use audio" [1]. Therefore, the purpose and usefulness of recording devices for casual use have to be immediately evident to the user.

General-purpose recording devices also tend to make people uncomfortable and restrict their speaking behaviour [2]. The awareness of being recorded may change intonation and speech patterns similar to the way people's facial expressions and postures change when their picture is being taken. Therefore, the design of casual recording devices should be unobtrusive, and fit in the particular context of where a recording is being made.

Several research projects were attempted to integrate sound recording into everyday life. For example, life-logging devices continuously record audio-visual information [3]. The shortcoming of this approach is that it's difficult to browse the large volumes of recorded audio to find parts that are worth listening to. Usually, this would require separate software techniques. To overcome this problem, we limited the recording to very specific *contexts* and indexed the sound recordings by recognizing the changes in the context.

A related Audio Notebook project records sound and links it to the notes written on a computationally enhanced notebook [4]. The user however, has to explicitly press buttons to start and stop the sound recording. We aimed at designing our recording devices so that they do not have to be explicitly controlled and can be used without significant conscious effort, in line with research in tangible user interfaces [5].

3 Special Moments: Context-aware Recording Devices

Our Special Moments project is based on a number of basic principles. First, the sound recording devices are *context-dependent* and *context-aware*. Audio data by its nature has a narrow information bandwidth, especially when compared to visual data, and there are only a few situations where recorded sound is valuable to the end-user. However, we can identify contexts when a casual sound recording does present significant value. Therefore, the sound recording devices need a specialized and optimized design to be used in these very specific contexts.

Second, recognition of the user context is a complex problem. We found that the context and changes in it are often well represented by the objects that the users are using. We can recognize the context and trigger recording when the desired context change occurs by embedding sensors into these objects.

Third, the operation of the device must be unobtrusive; the physical and interaction design of the device must fit in the specific context where the device is to be used.

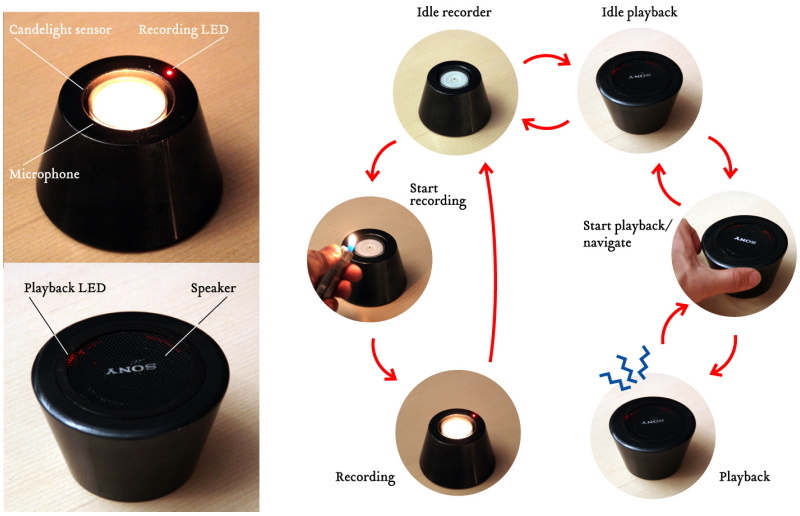

Fig. 1. *Left*: Candlelight recorder has recording and playback modes that are defined by device orientation. *Right*: State-transition diagram of candlelight recorder.

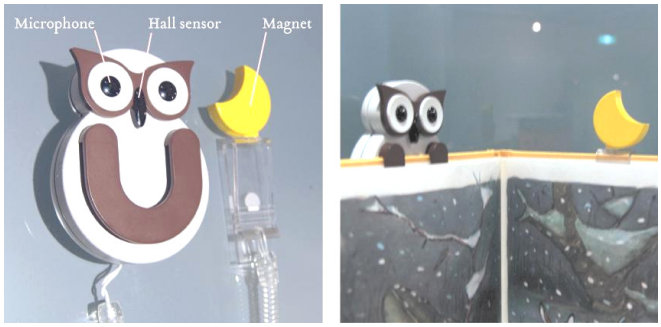

Fig. 2. Children book recorder uses Hall sensor to detect opening and closing of book.

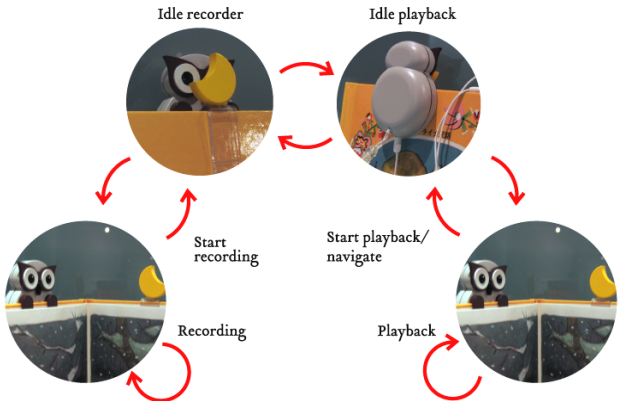

Fig. 3. State-transition diagram of book recorder.

Fourth, the device should have both recording and playback functionality. The device itself is a *sound album* that can be enjoyed without using any other external devices. We envision users having multiple sound recording devices, and therefore, do not provide tools for deleting recordings. We developed the following two recording devices based on these principles: the *candlelight* and the *children-book* recorders.

The *candlelight recorder* can be used in the context of a party, dinner, or other similar occasion. The recorder is designed as a candle stand (Fig. 1) and the recording starts when the user lights the candle. The candlelight is sensed and tracked by an inexpensive infrared light sensor and an LED is lit to indicate that a recording is taking place. When the user extinguishes the flame, the recording stops. To play back the recording, the user simply flips the candle stand over and the device becomes a small speaker (Fig. 1). The orientation is measured using a built-in tilt sensor. To start the play back the user twists the device, twisting it again will fast forward to the next recording and twisting it in the opposite direction will stop the play back.

The second case study is a *children's-book recording device* (Fig. 2). The device is attached to a children's book and can detect when the book is opened, triggering the start of the recording (Fig. 3). As parents interact with their child while reading the book, the recording device records both the parents and child's voices. Closing the book stops the recording. To listen to the recording, the user can attach headphones to the back of the device, which switches the device in to playback mode. The reader, e.g. a grown-up child, can re-experience reading this book with his or her parents.

4 Conclusions

We have not conducted formal user studies, but have conducted extensive demonstrations of our prototypes to approximately 200 people that have attended our research exhibitions. The general reaction was very positive and many suggested they would like to use such devices themselves. We are currently planning to conduct a more detailed study on such context-based recording devices.

The main contribution of Special Moments project is our investigation into design issues of developing highly context-dependent media capture devices. As ubiquitous computing proliferates into the real world, more elements of our environment will be augmented with sensors. This will allow for the creation of new context-aware recording devices for capturing and preserving peoples' experiences.

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