Enabling Interactive Bathroom Entertainment Using Embedded Touch Sensors in the Bathtub

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Abstract. We propose a new entertaining bathroom environment with applications controlled via capacitive touch sensors embedded in the bathtub. The bathtub touch sensor system, called TubTouch, provides a new touch user interface near to the edge of the bathtub for persons who are bathing. TubTouch can be used to control both existing bathroom equipment, such as water heaters, jacuzzis, TVs, audio, and lighting, and a variety of new applications. In this paper, we give an overview of the TubTouch system and discuss its entertainment applications used in daily life.

Keywords: Capacitive Touch Sensor, Bathroom, Bathtub, Everyday Life.

1 Introduction

With network-enabled household appliances now a reality, ubiquitous computing research to enhance the convenience and comfort of everyday life in the home has become very active. To date, most of the research has been focused on the living room and kitchen, where electrical appliances are easily installed. The focus of our research is to bring various ubiquitous computing technologies into bathrooms and to enhance the everyday act of bathing so that it is more entertaining. In this paper, we present a number of entertainment applications for the bathroom that are controlled via embedded touch sensors in the bathtub.

2 TubTouch System Overview and Design

TubTouch provides an integrated user interface and several interaction features in the bathtub for the control of various equipment and applications. As illustrated in Fig. 1, capacitive touch-sensors are attached on the inside edge of the bathtub to enable a bather to interact by touching the bathtub. A video projector installed above the bathtub projects virtual buttons and/or a screen for applications over the touch sensors, shown in the picture on the right side of Fig. 1. In Japan, standardized bathroom systems are widespread in homes, including houses, condominiums, and apartments. The bathrooms are constructed from

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unit elements, for instance wall, floor, ceiling, bathtub, and are relatively easy to assemble and remove. The space on the inside of the side of the bathtub can be accessed by removing a side panel; resulting in easy installation of capacitive touch-sensors, shown in the picture on the left side of Fig. 1. This space in the side of the bathtub was designed specifically for additional equipment such as a Jacuzzi. The picture on the left side of Fig. 1 also shows several electrodes on the upper inside edge of the bathtub, and a sensor box containing a touch sensor controller board. This arrangement means that TubTouch can be installed as an additional system in any such existing bathroom. In addition, electrodes can be freely installed on the rear side of surfaces, including curved surfaces. Another advantage is the flexibility of the interactive display and its compatibility with conventional household environments.

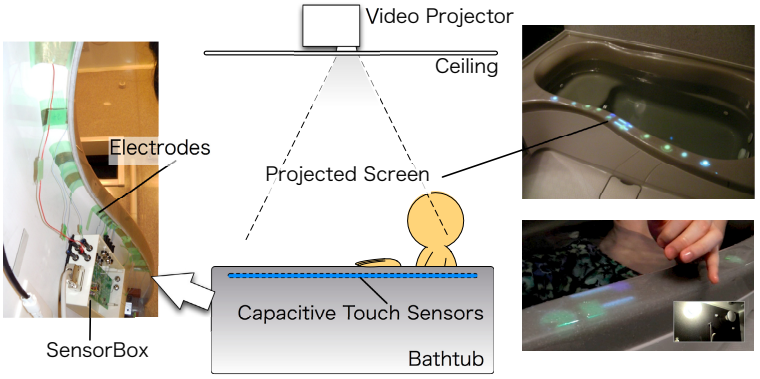


Fig. 1. TubTouch System Overview

Capacitive sensors usually respond to contact with water and are therefore used to measure water levels in tanks. Hence, recent multi-touch input devices tend to be incompatible with wet environments. However, the basic function of a capacitive sensor is to react to the presence of dielectric objects. Since water and the human body have different relative permittivities, TubTouch can indeed be used to detect human touch, even when wet, in response to each sensor signal.

Japanese bathroom systems also have space in the ceiling to install equipment such as ventilators, dryers, mist generators, loudspeakers, and audio units. In the bathroom ceiling, an access hatch is provided for easy access to this space; thus, a projector can very easily be installed there.

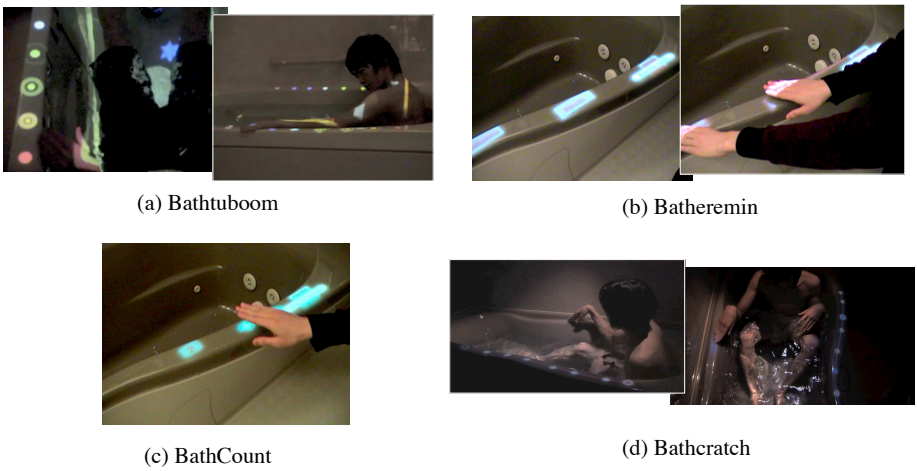
There are three ways to interact with TubTouch: touching, sliding, and proximity to the edge of the bathtub.[1, 2] As mentioned above, the proximity value is measured by reaction to the presence of dielectric objects, such as fingers and hands in this case. Touch detection is a proximity state that can be determined

[1] TubTouch Example 1: `http://www.youtube.com/watch?v=lDKR6rTwobM`
[2] TubTouch Example 2: `http://www.youtube.com/watch?v=oiKocZ1IORw`

quite simply using a threshold. Sliding motions can be detected by transitions of proximity values from multiple electrodes.

3 TubTouch Entertainment Applications

TubTouch has several entertainment applications, including control of some bath equipment such as lighting, audio, and TV. In this section, we introduce four entertainment applications that, in particular, provide new experiences during baths.



(a) Bathtuboom

(b) Batheremin

(c) BathCount

(d) Bathcratch

Fig. 2. TubTouch Entertainment Applications

3.1 Bathtuboom

Bathtuboom, shown in Fig. 2(a), is a kind of interactive art system. Each colored ball projected on the edge of the bathtub is a button that is able to activate sound phrases and move light shapes on the top of the bathtub. When a bather touches these buttons simultaneously, the overlapped sound phrases generate music that can be listened to. Bathers, especially kids who dislike bathing, can experience some amount of pleasure by touching these balls and listening to the resulting music.

3.2 Batheremin

Batheremin, shown in Fig. 2(b), is a theremin application. The theremin is a very famous electronic musical instrument that is controlled by the proximity of the two hands via capacitive sensors. We designed a bathtub embedded touch sensor system as a theremin that can be played using two hands.

3.3 BathCount

When taking a bath, many Japanese children play a game, while in the tub of water, in which they count from one to a few tens until the end of the bath. Children learn numbers and counting through these experiences with their parent(s) in the bathroom. BathCount, shown in Fig. 2(c), is a kind of support system for this counting experience. When a button is touched, BathCount displays the number on the bathtub, and speaks the number or plays some sounds. Children using this system can count numbers with/without a parent, resulting in more fun at bathtime.

3.4 Bathcratch

Bathcratch[1], shown in Fig. 2(d), is a DJ scratching entertainment system that partially utilizes TubTouch. Using this application, a bather can scratch like a DJ by rubbing the edge of the bathtub with a hand, and touching TubTouch buttons to select rhythm tracks, scratching sounds, and phrases.

4 Conclusion

In this paper, we presented the TubTouch bathroom system, which enables a bathtub to become an interactive controller using embedded capacitive touch-sensors, and a number of new entertainment applications associated with it. We described four of these applications in detail. The TubTouch system and these applications have been exhibited and demonstrated at several exhibitions and conferences. The general feedback from people who experimented with the applications has been very positive; they usually state a desire to have the TubTouch system and its applications in their own homes.

As a future work, we plan to develop middleware for TubTouch in order to make applications easier to develop. The middleware will use the TUIO protocol [2] to divide TubTouch into hardware and software platforms. We hope to spread this technology, and also hope that more and varied entertainment applications will be developed for both kids and adults to enhance bathing activities and make the act of bathing more fun.

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