ToolShaker: Presentation Technique for "as-is" Display of Daily Commodities

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ABSTRACT

Recently, various research projects have proposed presentation techniques for displaying products in our day-to-day environments. These techniques involve embedding sensors and actuators in the commonly used commodities. However, such methods have difficulty in maintain the usability of these everyday objects because of their effect on the product size and weight. In this study, we propose a presentation technique, namely, the TookShaker, which can physically control the daily used items "as-is" without attaching specific devices. We develop a prototype to control ferromagnetic objects (e.g., tools) placed on a wall surface by using electromagnets.

CCS CONCEPTS

• **Human-centered computing → Ubiquitous and mobile computing**; *Ubiquitous and mobile computing theory, concepts and paradigms*; Ambient intelligence;

KEYWORDS

Display technique, daily commodities, electromagnet, and ambient display

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1 INTRODUCTION

Recently, various research projects have proposed presentation techniques for displaying commodities in our day-to-day environments [1, 2]. These techniques involve embedding sensors and actuators in these everyday products and then using them as robots or displays. This allows a presentation that is notable and with an easy recall value of the object. However, in particular, in case of small objects, such techniques have difficulty in maintain the product usability because they have significant effect on the size and weight of the merchandise. Furthermore, with such methods, it is problematic to embed sensors and computers in the small sized commodities while maintain an appropriate size and weight.

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To solve this problem, we propose a technique for presenting everyday commodities "as-is" by attaching devices to our day-to-day settings. Specifically, we focus on (1) ferromagnetic products (e,g,. tools and tableware displayed on wall/table) an (2) physically controlling these objects using electromagnets. We propose a new display system, namely, the ToolShaker, to physically control the ferromagnetic items placed on a wall surface by using the magnetic force originating from external electromagnets.

2 RELATED WORK

We introduce related works in two categories: "Presentation techniques for daily commodities" and "Interaction techniques using electromagnets".

PotPet [1] is a flowerpot type robot that has sensors and wheels, and it displays the state of a garden plant through the flowerpot movement. SyncDecor [2] is a system that shares daily activities by synchronizing the behaviour of two everyday products located in remote places. These approaches embed sensors and computers in the day-to-day objects of the user, whereas we focus on a display technique to physically control commonly used products without attaching devices directly to them.

Actuated Workbench [3] can physically control objects on a table using electromagnetic arrays fixed under the table. ZeroN [4] can physically control a ferromagnetic object in the air using electromagnetic arrays. FluxPaper [5] is a paper-based medium that has an extremely thin patterned magnetic layer pasted behind the paper. It can control movement on a wall surface by using electromagnetic arrays. These tools are examples of various interaction techniques that employ numerous electromagnets. We focus on a presentation technique to physically control everyday products using a magnetic force.

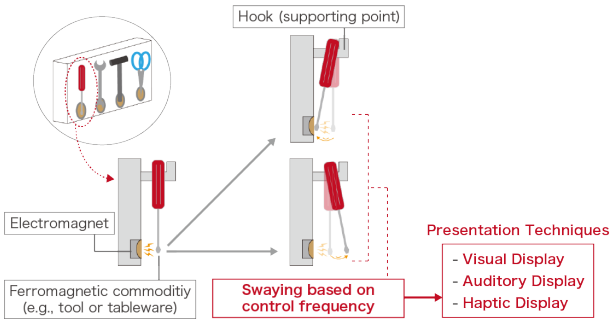

Figure 1: Configuration of ToolShaker

3 TOOLSHAKER

The basic concept of ToolShaker is shown in Figure 1. We assumed that the ferromagnetic object (e.g., a tool) is displayed on a wall with a hook. We attach an electromagnet under the hook. When the system turns the electromagnet on/off, the tool is pulled in/off the wall.

We expect to realize three types of display by adjusting the control frequency of the electromagnet, namely, visual display, auditory display, and haptic display. As a basic function, the ToolShaker can sway a tool using an electromagnet, and control the swaying speed and interval by varying the on/off frequency of the electromagnet. We assume that such physical movements of the products are useful in a visual display. For example, if we apply the visual display function to tools on a workbench,the system can present visually the tool that should be used in the next process of fabrication. Next, we utilize the function that the tool generates a sound when it contacts the wall while swaying. These sounds can be possibly used for auditory display to present information without visual attention. The toolShaker could present the information using sounds such as those of an alarm or a timer for providing an auditory display.

We also emphasize on the force-feedback technique to control the accessibility of the tools. For example, when a tool is set on a hook and the electromagnet is continuously activated, a user has difficulty in removing the tool. Conversely, the ToolShaker may assist the user to place the tools at their appropriate locations through the magnetic force.

4 IMPLEMENTATION

The ToolShaker mainly consists of "tool-hanger devices" that actuate the everyday items on display and a "host program" and "external applications" that together control the tool-hanger devices. In addition, there is a host PC that integrally controls the microcomputers and electromagnets embedded in the tool-hanger devices. Figure 2 shows its system architecture.

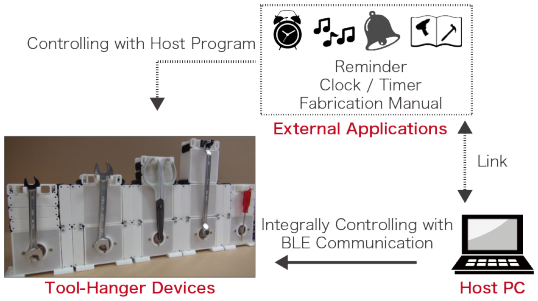

Figure 2: System architecture

Each tool-hanger device mainly consists of two parts: the electromagnet part that includes the electromagnets and a microcomputer, and the hook part that hooks the daily used tools for display.

The electromagnet part contains an electromagnet and original circuit board (Figure 3). As the figure shows, the electromagnet is placed on the surface of the case, whereas the circuit board is located inside the case. We employed TMN-2613S (26 × 15mm, 60N-175N) as the electromagnet. The circuit board has a microcomputer, a motor driver, and connectors for the electromagnets and power supply. We selected BlendMicro as the microcomputer to communicate with the host PC via BLE (Bluetooth Low Energy). We selected NJM2670D2 as the motor driver. The system can control a maximum of two electromagnets via the motor driver. The size of the case was approximately 70mm/70 mm/25 mm (width/height/depth). In addition, we designed the case to have holes to pass through the cables on the side surface. The housings of the electromagnet part were fabricated by a 3D printer using the ABS resin.

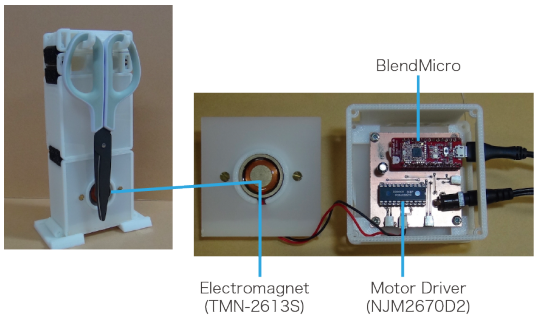

Figure 3: Architecture of the electromagnet part.

The hook part places a tool on the wall surface with a hook. The hooks are designed in consideration of the shapes of the tools. We have developed five types of hook parts for the tools: small-spanner, large-spanner, screwdriver, scissor, and screw wrench.

Also, we implemented the host program as a single-page web application in JavaScript. We can set the on/off frequency of each electromagnet using sliders or numeric control widgets.

5 APPLICATION

We consider two application, entertainment and utility, of the ToolShaker. The entertainment application is based on the concept of "having fun" while presenting the necessary information when actuating the daily used commodities "as-is". For example, we assume that when the application is a clock or timer, the time is presented using three products, each expressing the hour, minutes, and seconds.

Through the utility application, we will present information by utilizing the easy recall of the objects by actuating "as-is" the daily commodity. For example, the application can be a fabrication support system. The system can present the tool that should be used by the user in next step of the fabrication process, by linking it with an external manual service.

6 SUMMARY AND FUTURE PROSPECTS

In this study, we proposed a new display system, namely, the "ToolShaker", which physically controls the ferromagnetic commodities placed on a wall surface using the magnetic force from external electromagnets. Also, we developed prototypes of the tool-hanger devices for five type of tools and a host program.

In the future, we will connect our prototype to external applications, and implement tool-hanger devices for various daily commodities. We also plan to evaluate the concepts and performances of the system.

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