

Acoustruments: Passive, Acoustically-Driven, Interactive Controls for Handheld Devices

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1. INTRODUCTION

Smartphones and handheld devices are increasingly being used in interactive applications beyond their conventional touchscreens. For example, tangibles allow users to interact with mobile devices using physical objects both on screen and around the device. Similarly, there is a growing class of auxiliary devices that require a smartphone to be docked, transforming an otherwise simple object into something with rich interactivity. However, these auxiliary devices still require numerous components, including mechanical mechanisms, PCBs, and sometimes batteries. This increases manufacturing costs, and reduces physical robustness.

2. ACOUSTRUMENTS

Acoustruments are low-cost, passive, and powerless mechanisms, made from plastic, that can bring rich, tangible functionality to handheld devices [Laput et. al 2015]. The operational principles were inspired by wind instruments, which can produce expressive musical output despite their simple physical design. In the same manner, we can create an “instrument” that attaches to a smartphone. One end of an enclosed tube is connected to the speaker, which emits a continuous ultrasonic sweep (Figure 1 Top). The other end is directed into the microphone, which monitors the output. Like musical instruments, we can introduce structural elements along this pathway that can characteristically alter the acoustic output, which in our case, we use for interactive control.

By combining design primitives, familiar physical controls, such as knobs, rotary encoders, and sliders, can all be constructed from passive elements. On top of these, we can create end-user applications. Using technologies like 3D printing, rich physical controls can be rapidly prototyped. In addition, through mass production techniques (e.g., injection molding), Acoustruments introduces a cheap and passive method for the construction of consumer “pluggables.”

3. SIGGRAPH DEMONSTRATION

Example applications include 1) a modular setup for attaching different control mechanisms, 2) a toy character that responds to various physical configurations, and 3) an interactive car mount with no electronics.



Figure 1. Physical controls manipulate the traversing ultrasonic signal from the speaker to the microphone (top). Using design primitives, familiar physical controls can be constructed (A). Branching and modular insertions enable attachable interactive controls (B). On top of these, we can create end-user applications, such as an alarm clock (middle), or an interactive doll (bottom).

REFERENCES

Laput, G., Brockmeyer, E., Hudson, S.E., Harrison, C. Acoustruments: Passive, Acoustically-Driven, Interactive Controls for Handheld Devices. In *Proc. CHI'15*.