Augmented Edge: Haptic Augmentation of Visual Representation of a Smartphone by Electro-Tactile Sensation Through the Edges*

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***Abstract*—We present Augmented Edge, a design and method for augmenting the visual representation of a smartphone using electro-tactile stimulation. Augmented Edge presents spatial tactile sensations through electrical stimulations from electrode arrays mounted on both edges of the smartphone. We demonstrate two application scenarios, haptic feedback from a virtual character on screen, the skin sensation of rainfall.**

***Index Terms*—Mobile Haptics, Electro-Tactile Interface**

I. Introduction

Current smartphones employ bezel-less to enlarge visual presentation, and stereophonic devices to enrich auditory presentation. They convey rich spatial (2D and 3D) cues and achieve immersive experiences, even with handheld devices. However, tactile presentation on current smartphones continue to rely heavily on vibrations that only convey temporal signals

One of ways to solve this issue is using electro-tactile stimulation. Electrical stimulation is a promising candidate for tactile presentation in smartphones because it can realize high spatial resolution easily with low energy consumption.

Although most of these attempts present tactile feedback primarily on the screen or back of the smartphone, we focused on the edges of the smartphone.

As a prior study, Tactlets [1], which installed electro-tactile I/O on interactive objects using electrodes printed with conductive ink, were primarily intended to be used as an I/O device, our main focus was on how the visual representation on the screen could be augmented by the spatial tactile sensation at the edges, thus showing that haptic edge presentation can enhance the immersive experience with handheld devices.

II. Augmented Edge

We designed Augmented Edge as a novel tactile presentation method for smartphones; this provides tactile feedback to fingers or a thenar eminence in contact with a smartphone through electrical stimulation from 1-D electrode arrays mounted on both edges of the smartphone (Figure1 (a)). Specifically, Augmented Edge can selectively stimulate each electrode, thereby presenting a spatial tactile sensation. The device that is embedded in a smartphone consists of a control unit of the electrical stimulation device [2], a switching circuit board, and a flexible printed circuit board on which the electrodes are wired.

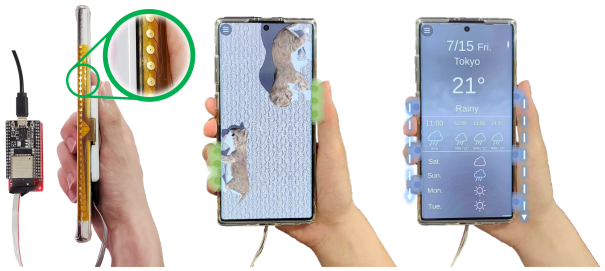

Fig. 1. Augmented Edge: (a) Electrical stimulation device, (b) Play with Cats, and (c) Rain Forecast.

Augmented Edge is particularly good at spatial tactile presentation; it can supplement use cases where a single tactile presentation, such as the vibration of the entire device, is not effective. For example, it can be used to interact with characters at the edges of the screen using the ability to present tactile sensations for each grasped finger individually. In addition, if the point of stimulation is programmed to move along the edge, a clear stream of stimulation can be felt, even within a single finger. This can be used to present flow patterns inside and outside the screen. To realize this use case, we created two applications: one that interacts with cats on the screen (Figure1 (b)) and the other that presents the intensity of rainfall predicted in a rain forecast (Figure1 (c)).

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References

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