Display Stickers: Enhance Your Environment with Tiny Interactive Stickers

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Abstract

We propose a novel form factor of displays that integrates visual output, sensing and interaction seamlessly with the physical environment. Display Stickers have a similar shape and size as traditional paper-based stickers. Users can freely attach them anywhere in the environment. Once attached, a Display Sticker enhances its environment with sensing, information display and interactive functionalities. This creates a lightweight platform for seamlessly integrating the physical with the digital realms. This includes enhancing physical objects with new functionality and making digital information available anywhere in architectural space.

Author Keywords

Flexible Displays; Sensors; Small Displays;

ACM Classification Keywords

H5.2. [Information Interfaces and Presentation]: User Interfaces - Interaction styles

General Terms

Human Factors; Interactions.

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Introduction

It is common to attach post-its on top of books, add magnets to the fridge or the whiteboard, pin post-cards on a corkboard or stick a note on the entrance door to notify others. Sticky objects allow us to easily place information in our living spaces, to augment objects or to fixate them at a specific location. However, an increasing amount of information is becoming digital and cannot be attached to a meaningful location. At the same time, the functionality that everyday devices are offering is dramatically increasing.

In this work we present the vision of Display Stickers. These are cheap, lightweight and flexible displays that fuse the capability of sensing the environment with the ability to display information. Their form factor allows to be attached to a wide variety of objects. The sensors allow for reasoning about the environment using realtime data. The display allows for offering interactive functionality that depends on the object the sticker is attached to. This extends Fitzmaurice's notion of a situated display [2]. Display Stickers is also inspired by Weiser's Vision [1] of populating rooms with inch-scale, interconnected displays by allowing the entire architectural space to be augmented with digital information.

In this work we aim to provide a first device concept along with a vision of interaction that makes use of the specifics of such a future Display Sticker.

Display Sticker Device Concept

Similar to attachable objects such as fridge magnets, Display Stickers can come in a wide variety of sizes and shapes. We envision them to be small, paper-thin and lightweight.

A Display Sticker features a full color active-matrix display for output and touch sensing for input. Embedded sensors can measure a wide variety of environmental data, such as temperature, movement of the device, sound, ambient light, or even pictures of its environment. The sticker is wirelessly connected to the internet. To be attachable to surfaces and objects, Display Stickers feature a magnetic or a permanently adhesive backside (see Fig. 1).

We envision that Display Stickers will become very cheap and will ultimately be available in high quantity in each household and at every workplace. To avoid the need for manually recharging batteries of such a large number of displays, the device features a highly energy efficient display (e.g. e-ink). Moreover, it actively harvests energy from its environment [3], by e.g. using transparent printed solar cells [4] or by harvesting ambient EM fields.

Sticky Interactions

This section outlines interactions that are enabled by Display Stickers.

Enhancing Physical Objects



Figure 1. (a) Concept of a flexible Display Sticker. (b) Concept of a round Display Sticker.



Figure 2. A Display Sticker enhances the heater by automatically providing a thermostat as soon as it is attached. Rotating the Display Sticker adjusts the temperature.

Display Stickers can enhance objects by adding new functionality to them, using the display and the built-in sensors. Consider the example in Fig. 2. A magnetic Display Sticker is attached to a heater. Using its built-in camera, the sticker recognizes the object that it is attached to and wirelessly connects to its digital control interface. Using its built-in sensor, it permanently senses the temperature and shows it on the display. By rotating the device, the user can adjust the temperature.

Affixing Objects and Sealing Packages

A traditional sticker is often used to affix objects and documents at specific locations as well as to seal boxes and packages. Using a Display Sticker to do so will allow for additional functionality, for the sticker is aware whether it is removed or torn into two pieces.

Consider for instance a product package that is sealed with a Display Sticker (Fig. 3). As soon as the Sticker is removed or cut, it can indicate first steps to do with the product.



Figure 3. (a) The display is turned off, when the box is closed. (b) As soon as the user lifts up the display, the Display Sticker shows further instructions such as registering the product or to watch a product video.



Figure 4: At-a-glance awareness of digital information. Display Stickers can be easily attached to meaningful locations to keep the user aware of digital information, such as the status of contacts, shared documents and task lists

Highly Flexible and Reconfigurable Physical Information Spaces

The flexibility of how many Display Stickers are used, handed over and attached in space creates a highly versatile platform for awareness and communication.

Spatial anchoring effectively supports reminding, getting an overview and staying aware of information. Building upon Mark Weiser's Vision [1], Display Stickers can be attached anywhere in architectural space. Once attached, a Display Sticker can support the user in staying aware of digital information, such as changes in a friend's online status or changes in a shared document.

Many people collect documents and post-its they need to be aware in the kitchen on their fridge. Similarly, Display Stickers can be attached to the fridge for creating awareness about what is going on in the digital realm, e.g. on Facebook. So, the user just needs to glance at the displays at his fridge while passing by in order to be up-to-date (see Fig. 4). As another example, the Display Sticker can be attached to the office door. The user can update the information on the display while she is on the go. For instance, she can set the text to "Running 5 minutes late" or "Will be back at 4pm" to provide a well visible status update right at the place where coworkers are interested in getting this information.

In addition to bringing information to meaningful locations, users can also use Display Stickers as a lightweight means for communication. The user can hand over a Display Sticker to another person, similarly to how we hand over a document. Alternatively, she can leave a Display Sticker as a reminder at a specific well-visible location; for instance it can be placed on a coworker's desk. We envision that future Display Stickers can also be torn apart like paper, so that information can be physically duplicated before one part is handed over to another person.

Conclusions And Future Work

We presented the vision of an interactive Display Sticker. These are small flexible and interactive displays equipped with sensors and wireless communication. We presented a device concept along with first interactions that instantiate our vision.

To realize working prototypes, we are currently approaching our vision from two opposing ends. The first one focuses on the paper-like and flexible form factor as well as on the sticky interactions. To do so, we are developing printable sensors and printable displays that are inexpensive, thin, flexible and lightweight. The second one focuses on applications of Display Stickers and visualizations on distributed micro displays. We are developing a platform that uses tiny high resolution and full color displays to support users in staying aware of cloud-based information and communicating with others.

Acknowledgments

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References

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