Suit Up!: Enabling Eyes-Free Interactions on Jacket Buttons

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Abstract
We present a new interaction space for wearables by integrating interactive elements, in the form of buttons, into outdoor clothing, specifically jackets and coats. Interactive buttons, or “iButtons”, allow users to perform specific tasks using subtle, inconspicuous gestures. They are intended for outdoor settings, where reaching for a mobile phone or an other device may not be convenient or appropriate. Different types of buttons serve dedicated functions, and appropriate placement of these buttons make them easily accessible, without requiring visual contact. By adding context sensitivity, these buttons can also be repurposed to fit other functions. By linking multiple buttons, it is possible to create workflows for specific tasks. We provide a description of an initial iButton design space and highlight some scenarios to illustrate the envisioned usage of interactive buttons.

Author Keywords
Wearable Computing; Eyes-free input; Glance interactions.

ACM Classification Keywords
H.5.2 [Information interfaces and presentation]: Input devices and strategies.

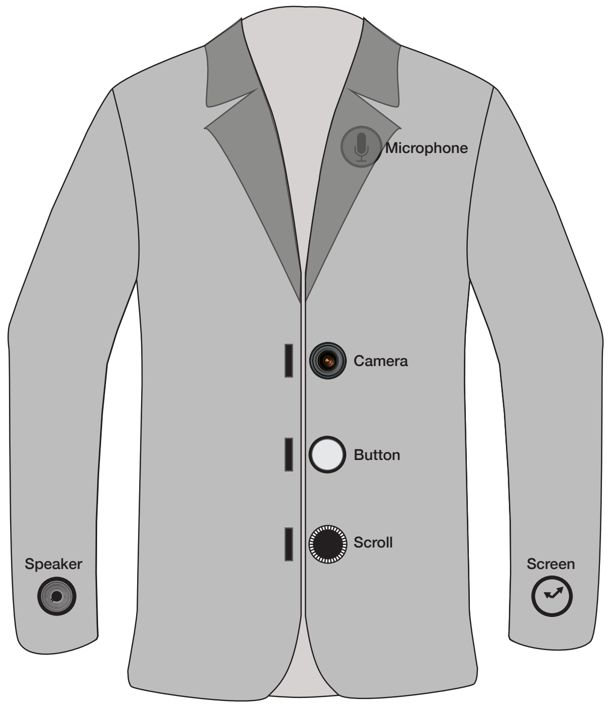

Figure 1: A jacket with interactive buttons. Different integrated sensors and actuators provide eyes-free input and glance output. Buttons on the cuffs are located towards the anterior side of the wrist.

Introduction

We often use mobile devices such as smartphones in public settings for various tasks. In certain situations, we wish to refrain from taking the device out of our pocket and explicitly interacting with it. Wearable computing tries to leverage these situations by providing users with a range of embodied interactions (with various interaction modalities), through the use of dedicated sensors and actuators, integrated networking and sufficient computing power, to achieve specific goals. An increasing number of wearable computing devices are entering the consumer market—smart watches, bracelets, pendants, glasses and headgear to name a few. Further, accessories such as rings have also been explored in the wearables research domain [8]. However, these devices are usually add-on accessories and require very explicit interactions, which might draw attention of other onlookers. There have been research works based on embedding interactions into the fabric of clothing items. [6] evaluates the performance of capacitive touch, when integrated into clothes. [7] provides a solution for eyes-free input by using pinch gestures. The interaction space of such integrated wearables is limited to touch input. Also, since the technology is embedded into the fabric, the lack of physical cues makes it necessary for the users to remember the location of the interaction region. This increases cognitive load and makes such devices harder to use in an eyes-free context.

We present a new interaction space, for wearables, in the form of interactive buttons that are embedded into clothing such as jackets and coats. Since these are rigid, physical components, users can easily locate them. Also, such buttons are inherently located at places which are easily reachable by the user. We believe the physical location of these buttons plays an important role for performing subtle, even secretive, interactions. In [5], the regions around the collar, ribcage and waist are noted for being unobtrusive for wearable objects. These are the same regions where such interactive buttons are intended to be located. Our current research is limited to buttons that are of a size suitable for jackets (rather than shirts). Although this limits the utility to when one is wearing the jacket, our focus is on interactions in an outdoor urban environment, where wearing such a jacket could be feasible. We are interested in subtle interaction techniques for mobile settings that are, for the most part, concealed from bystanders. In this paper, we explore several opportunities for using buttons to perform various functions that would otherwise require direct interaction with a mobile device. We have designed a set of buttons that support different types of interactions (both input and output) and that can be used for subtle interactions. Figure 1 shows the location of various buttons on a jacket and some of the functions they support. Figure 2 shows some of the prototype buttons we created using a 3D printer and off-the-shelf components.

In the following sections, we outline some design goals followed by a proposed interaction button space, and types of interactions supported. We also highlight some functional prototypes and outline some of our future research directions.

Design Goals

To design an effective wearable interaction technique, we have outlined some basic design goals that such a system should strive to achieve. These goals take consideration of several factors such as aesthetics, form factor and function of the physical elements.

1. The wearable device can be *integrated into existing clothing*. This prevents users from having to wear additional accessories to achieve the desired interactions.
2. The technology is *not readily visible* to the naked eye. This allows for inconspicuous interactions and does not compromise the aesthetics of the clothing.
3. Interactive elements should be *easily reachable*, and *allow for eyes-free interactions*.
4. To avoid mode-switching, each entity has its *own dedicated function*s.
5. Individual elements *can be linked together* to form automated workflows.

Interactive Button Space

A wide variety of iButtons can be created using various sensing techniques. Depending on the sensing technology used, iButtons can also combine input and output in one button. Table 1 provides an overview of the different iButtons, along with their functions and required components. Although we do not consider this to be an exhaustive enumeration of all possible buttons, we believe this overview covers some of the most important ones. When discussing the different types of interactions and setups that are supported, we will refer to this overview.

By cannily placing these iButtons at appropriate locations on a jacket, it is possible to achieve the second design goal of *invisibility*. On observing the list of some possible iButtons, it is evident that output buttons such as an OLED display should be located on the jacket cuff, on the anterior portion of the wrist. Additionally, buttons such as the microphone, which do not require any explicit physical interaction, could also be directly integrated into the jacket, and need not be visible.

Button Name	*Description*	*Input*	*Output*	*Components*
ibPush	Push	Push events	—	Push-button
ibRadial	Radial dial	Values in range	—	Rotating disk or iPod-style click-wheel
ibPad	Four-way control	Up, down, left, right	—	Four push or capacitive buttons
ibCap	Capacitive	Proximity and touch	—	Conductive surface, MP121 board (to detect events)
ibMicro	Microphone	Audio	—	Microphone
ibCam	Camera	—	Photo/Video	Auto-focussing camera lens
ibScreen	Screen	—	X$\times$Y color pixels	OLED display
ib8Seg	8-segment	—	Characters rendered using eight segments	
ibSpeaker	Speaker	—	Audible sounds	Mono Piezo-speaker
ibStatus	Status	—	Dual-state LEDs (On/Off)	Coloured LEDs

Table 1: An overview of different iButtons. The table lists the type of input/output, and the required components. A controller (e.g. Arduino) would also be required to process sensor data and to actuate output buttons.

Types of Interactions

We have classified the nature of interactions supported by iButtons into four categories:

Secretive interactions : Tasks which users might want to perform inconspicuously, because there is a need to hide them for privacy reasons or avoiding social awkwardness.

Embodied interactions : Tasks that are specific to the social settings of the user and performed by using the tangible interaction techniques and sensing embedded in an everyday object such as a jacket.

Contextual interactions : Tasks dependent on the context of usage and the environment, including situated tasks that are specific to the location of the user.

Glance Interactions : Simple tasks which require only momentary visual focus.

To elaborate, we present some example uses which highlight the role of interactive buttons in enabling each of the above types of interactions.

Secretive Interactions : Here, the user does not want to attract the attention of the people around him. A simple scenario for this would be unlocking a mobile phone. Current methods typically use four-digit passcodes or a unique sweeping pattern. These can be easily be discerned by a person casually glancing at the screen, hence compromising security. Furthermore, on-device fingerprint authentication requires the sensor to be embedded into the device (iPhone 5S). The 'Knock' app (Mac and iOS) [3] allows users to unlock their computer by tapping on their iPhone, when both devices are nearby. Similar to this, tapping on an interactive button can unlock the mobile phone of the user. Since buttons are embedded onto the user's clothing, it would be unlikely that an unauthorised person could gain access without the owner's approval.

Embodied Interactions: We try to shift focus away from mobile phone-based interactions by using embodied interactions, which provide tangible interactions in a social context [4]. The popularity of location-based social media platforms like FourSquare inspires these interactions. As a use scenario, through a simple push of a button on the jacket, a user could check-in and simultaneously trigger the camera to capture a snapshot of the location.

Contextual Interactions: The environment around the user is taken into consideration for these interactions. For example, a life-logging system similar to Autographer [1] can be realised using a combination of iButtons. Proximity sensors can detect if a person is interacting with the user, which can trigger the camera to log such a meeting. Other monitors, such as ambient light sensors, can be used to detect various different contexts and trigger new logs.

Glance Interactions: There are several tasks which only require brief visual focus. For example, the Fitbit bracelet [2] uses a series of five LEDs to show daily progress. This can be realised by integrating an iButton with LEDs and placing it on the cuff of the jacket.

Prototypes

We have developed some early-stage prototypes to demonstrate iButtons. Figure 2 shows several iButtons that support various interactions such as a button that acts as a directional pad (D-Pad) and a button that can be used as a tiny speaker, for instance to receive phone calls. We have used a 3D printer to create several types of buttons, and have taken into account the space needed to embed the hardware. Sensors and actuators are integrated manually and can be easily attached on a jacket since the wiring is only present at the back of the button. For preliminary exploratory studies, we focus on creating functional buttons rather than aesthetically pleasing ones.

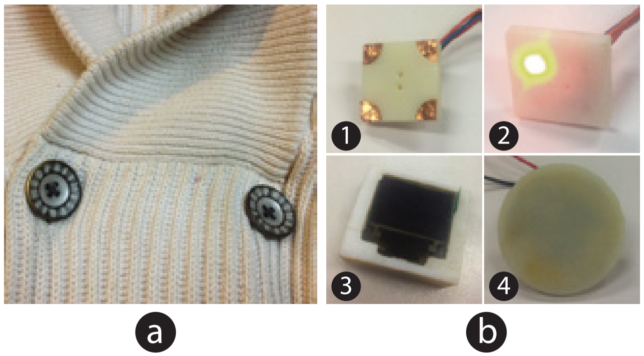

Figure 2: Prototyping interactive buttons. (a) A jacket with buttons of suitable size. (b) Some working prototypes: 1. Four-way control 2. Status LEDs 3. OLED Display 4. Piezo-electric Speaker.

Future Work

The presented work on interactive buttons is still in its initial stage. Although part of the design space is presented in this paper, we still need to explore how different ensembles of buttons work and which configurations lead to usable interactions. We plan to iterate over and extend this design space and perform a set of studies to chart preferred interactions and usages.

Our future research directions and goals for interactive buttons include the following:

1. Since buttons are not located within the direct eyesight of users, we need to determine whether they do in fact allow for efficient eyes-free interactions. Efficient usage involves factors such as locating buttons accurately, and remembering the specific function of each of the buttons aligned on a jacket.

2. User acceptance of such a technology is vital to its success, and it is important to gather qualitative feedback from users and analyse the major concerns related to such interactions.

3. One of the advantages of having an array of buttons is that they can be linked to one another, to form custom workflows. It is important to identify the most desirable workflows, and to conceptualise the design of an efficient array of buttons, which allows them to be repurposed for different workflows, to adapt to varying situations and context.

4. We also intend to design and prototype a fully-functional, interactive jacket and conduct studies in the wild to validate the enlisted design goals.

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