SkinUI: Using Skin Interface as Quick Access to the Specific Functionality on AR Glasses

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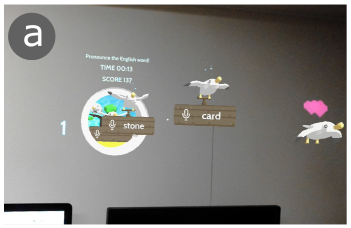
Abstract
AR glasses have a great potential to be the next generation computing platform due to the prevalence of AR technology in many domains. However, using head gaze and mid-air gestures to perform some tasks on AR glasses is still cumbersome. E.g., checking the battery level in a game application. Hence, we present *SkinUI*, an on-skin interface that offers quick access to system and app-specific functionality according to the current context. In addition, we present two scenarios of using *SkinUI* on AR glasses and the challenges in creating such skin interfaces which are seamless and dynamic.

Author Keywords
Skin surface, AR glasses, Quick access

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous.

Introduction
AR applications have been ubiquitous on mobile devices since Louis Rosenberg developed the first immersive AR system Virtual Fixture [1] in 1992. Recently, AR glasses become increasingly significant in global AR market due

[1]To improve human performance in direct and remotely manipulated tasks.



An AR game -*English bird*

Move the arm to FOV during the game

System status and notification shown in the game

Figure 1: Using *SkinUI* to look system status and notifications in a game.

to its immersive experience and hands-free interaction. Technavio predicts global AR glasses market will grow tremendously during next four years.

In order to enhance the interaction capability, most of existing AR glasses have been featured with voice interaction. However, sometimes the effectiveness of voice interaction will be affected by the working environment [1]. Ease of access and affordance are two main advantages of on-skin interaction [8], which inspires us to consider using the skin to augment the interactions on AR glasses. In specific, the context-specific content will be displayed on a detected skin surface. We list the design goals of *SkinUI* as follows,

1. *SkinUI* is **natural**: its appearance fits the skin surface and it tracks the position of skin surface in real-time.
2. *SkinUI* is **context-aware**: it shows UI for the relevant functionality according to the context of use.
3. *SkinUI* is **intuitive**: it does not require the extra efforts of understanding and learning.

After prototyping this concept, we ran a test with three users to collect preliminary feedback. Overall, the results show that the design goals have been met. *SkinUI* tends to increases the efficiency of performing certain tasks such as quick look and quick configuration.

The contributions of our work are two fold: (1) an approach using the skin to provide quick access to the context-specific functionality on AR glasses. (2) an insight into the use of the skin interfaces for AR glasses.

Related work

Despite of many latent technical challenges, skin has been regarded as the next user interface in mobile computing [7]. Numerous researchers have designed and implemented the systems using the skin as interaction surface. They focus on employing emerging sensing technologies to enable the user to interact with the skin. A part of these systems use skin as an input surface but have no visual user interface. E.g., *PalmGesture* [9] is a gesture interface that leverages an infrared camera to recognize the gesture drawn on the palm. *Imaginary Phone* [2] employs a depth sensing camera to capture user touch events on the palm without visual feedback. While some systems can render a visual user interface on the skin. *Skinput* [4] appropriates the arm as input surface by using acoustic sensors to recognize the finger tap on the arm and display the UIs on the arm by an equipped pico-projector. *OmniTouch* [3] is a wearable system that uses a depth sensing camera and a projector to allow the multi-touch interaction on the skin. Since a visual user interface can be rendered on AR glasses directly, our system does not need a projector. By detecting the position of the targeted skin, a UI will be rendered and overlaid on the skin. Comparing to the aforementioned approaches, our design only requires light-weight implementation for rendering.

In addition, the skin surface has been employed to expand the interactive region for some wearable devices while having the limited display size. E.g., *SkinWatch* [6] enhances the input interaction of smart watches by sensing the deformation of the skin under the watch. *Skin Buttons* [5] uses a projector to render touch sensitive icons on the skin, which also expands the touch region of smart watches. However, to our best knowledge, the skin interface for AR glasses has not been investigated yet.

Move the palm to FOV while using camera

Image filters shown in shooting mode

Options for photo editing shown in view mode

Figure 2: Using *SkinUI* to configure the camera application in different modes quickly.

Scenarios

We present two likely scenarios of using *SkinUI* on AR glasses.

Scenario 1: Quick look of system status and notifications in a game.

Figure 1a shows a user is playing an AR game *English bird*. Later, he intends to look the time and the battery level (see Figure 1b). Usually he has to pause the game and return to the system launcher, which is tedious. However, *SkinUI* simplifies the process and does not interrupt the running game. When the system detects his arm, the corresponding content will be displayed on his arm (Figure 1c). Furthermore, the notification bar shows the number of unread messages. When the gaze focuses on the bar, it will be highlighted and shows the message content.

Scenario 2: Quick settings for the camera

It is common to use AR glasses to shoot a photo. Usually the camera setting involves several steps. Using the gaze and mid-air gestures to complete these steps takes more time than using finger touch and mouse. While after detecting the targeted skin, *SkinUI* shows the settings which are most likely to be configured. E.g., the user palm has been used to trigger the camera settings (see Figure 2a). In shooting mode, a setting for image filters will be shown, and each filter is bound to a finger. A filter can be selected by bending the corresponding finger (Figure 2b). While in view mode, *SkinUI* shows the photo edit options such as deleting, saving as favorite, and sharing (see Figure 2c).

System Design

To achieve our design goals, *SkinUI* consists of three modules:

1. A module that tracks the real-time position of the targeted skin and indicates where and how the UIs should be rendered. By leveraging the depth sensor and camera on the glasses, the position of skin can be tracked.
2. A module that is aware of the temporal context of use. By detecting the running application and environment such as illumination. Then the system knows what and how the content should be rendered on the glasses.
3. A module that renders the selected content at the indicated position.

Interaction design

We employ head gaze and mid-air gestures as main interaction methods for *SkinUI*, which does not require extra efforts to learn new interaction methods. We categorize the tasks by the need of user interaction and recommend interaction methods for each category of tasks.

Quick look: It does not require the user to interact with the content actively. It shows the context-specific content upon the user intention, e.g., move the arm to the field of view (FOV) of AR glasses.

Quick look and exploration: On top of quick look, the user could explore more content by head gaze selection, e.g., focus on a message title to check its content.

Quick configuration: Sometimes, the user may need to configure a setting in an application quickly. An configuration UI will be shown on the skin. Combing head gaze and mid-air gestures allows the users to point and select an object.

Although we have reviewed various novel interactions used on the skin, *SkinUI* does not include these interactions so far. It uses the skin as a medium to facilitate the efficiency of performing certain tasks on AR glasses rather than using the skin as an input for novel interaction. Nevertheless, integrating some of the aforementioned interaction technologies to *SkinUI* should be feasible, because AR glasses has been equipped with some sensors required by these technologies.

Discussion and conclusion

The preliminary feedback show that *SkinUI* is a light-weight solution for offering natural and intuitive quick access to the specific content on AR glasses. It is possible to implement novel input interactions such as the direct touch interaction on the skin by using the depth camera equipped on glasses. However, to fully meet the proposed design goals, it may require more sophisticated computer vision algorithm. E.g., it is challenging to render a UI fitting the arm surface perfectly and distinguish the skins having similar visual features.

In this paper, we presented how the skin surface could facilitate some common tasks to be performed on the AR glasses such as quick look and quick configuration. By leveraging the utility of AR glasses and the unique affordance of the skin for interaction, we design *SkinUI* that enables the user to access to the context-specific more easily without heavy implementation and additional hardware. We present two scenarios as an example of this vision. In addition, towards the category of tasks on AR glasses, we recommend the proper interactions for each of them. We hope this work will stimulate future explorations of using skin interface on wearable AR devices especially for glasses. Next, we will evaluate the *SkinUI* in terms of efficiency and effectiveness comparing to the current solution for quick look and configuration on AR glasses.

References

[1] Bongartz, S., Jin, Y., Paternò, F., Rett, J., Santoro, C., and Spano, L. D. Adaptive user interfaces for smart environments with the support of model-based languages. In *Proc. of the AmI'12*, Springer (2012), 33–48.

[2] Gustafson, S., Holz, C., and Baudisch, P. Imaginary phone: learning imaginary interfaces by transferring spatial memory from a familiar device. In *Proc. of the UIST'11*, ACM (2011), 283–292.

[3] Harrison, C., Benko, H., and Wilson, A. D. Omnitouch: wearable multitouch interaction everywhere. In *Proc. of the UIST'11*, ACM (2011), 441–450.

[4] Harrison, C., Tan, D., and Morris, D. Skinput: appropriating the body as an input surface. In *Proc. of the CHI'10*, ACM (2010), 453–462.

[5] Laput, G., Xiao, R., Chen, X., Hudson, S. E., and Harrison, C. Skin buttons: cheap, small, low-powered and clickable fixed-icon laser projectors. In *Proc. of CHI'15*, ACM (2014), 389–394.

[6] Ogata, M., and Imai, M. Skinwatch: skin gesture interaction for smart watch. In *Proc. of AH'15*, ACM (2015), 21–24.

[7] Steimle, J. Skin–the next user interface. *Computer 49*, 4 (2016), 83–87.

[8] Strohmeier, P., Carrascal, J. P., and Hornbæk, K. What can doodles on the arm teach us about on-body interaction? In *Proc. of EA on CHI'16*, ACM (2016), 2726–2735.

[9] Wang, C.-Y., Hsiu, M.-C., Chiu, P.-T., Chang, C.-H., Chan, L., Chen, B.-Y., and Chen, M. Y. Palmgesture: Using palms as gesture interfaces for eyes-free input. In *Proc. of the MobileHCI'15*, ACM (2015), 217–226.