Demo: A Versatile Controller Concept for Mobile Gaming†

John Helmes
Stuart Taylor
Steve Hodges
Microsoft Research
Cambridge, UK
jhelmes@microsoft.com
stuart@microsoft.com
shodges@microsoft.com

Chris Lovett
Microsoft Research
Redmond, WA, US
clovett@microsoft.com

† This work was carried out between 2012 and 2014.

UbiComp/ISWC'18 Adjunct, October 8–12, 2018, Singapore, Singapore

ACM ISBN 978-1-4503-5966-5/18/10.
https://doi.org/10.1145/3267305.3267676

Abstract
Popular games for smartphones and tablets focus on touchscreen-based interaction. Here we describe a speculative research exploration motivated by the desire to enable traditional gaming experiences on mobile devices by incorporating tactile input controls. The design and ergonomics of our prototype accessory concept were informed by anecdotal feedback from a variety of gamers.

ACM Classification Keywords
H.5.2 User Interfaces; K.8.2 Personal Computing Hardware.

Introduction and Related Work
As smartphones and tablets have become pervasive, so has mobile gaming. Not surprisingly, popular games for these platforms are focused on touchscreen-based interaction. However, many types of game are less well-suited to mobile devices [2]. Despite systems like AdaptControl [7] which can adapt to the 'drift' typically occurring when using virtual on-screen controls, touch-based emulations of traditional gaming controls like D-pads, buttons & joysticks are often unsatisfactory [1].

Mobile gaming devices like the Sony PlayStation Portable and Nintendo's DS and Switch are dedicated mobile gaming platforms which overcome these limitations via physical controls. The success of the

A versatile mobile gaming controller

Figure 1: Our prototype mobile gaming controller can take the form of a traditional controller, particularly useful for charging.

Figure 2: The two wireless units may be removed from the charging dock and clipped to a mobile device such as a smartphone to support mobile gaming.

Switch [6] is testament to the value of mobile gaming with physical controls. A number of cheaper products allow a smartphone to be clipped into or onto a modified handheld gaming controller; these include the ION iCade mobile, the GameCase, the GameVice and products from Moga. However, the fixed form of these accessories means they are bulky and inflexible.

As [2] points out, there is little research into mobile gaming controllers in the literature. Yu et al. [8] and Kratz et al. [5] present passive tangible controllers which use conductive materials to map user input to touch points on the display edges, while MagGetz [4] uses a similar approach based on magnetic field sensing. These solutions are battery-free, low-cost and lightweight, but they lack the flexibility of being freely-positioned on any device to support a variety of existing games. Here we overview our prototype mobile gaming controller [3] which builds on related research and previous products to address this limitation.

Ergonomic Design

Guiding Principles

The key design goal for our mobile controller, shown in Figure 1, was to combine a compact and convenient-to-carry form factor with the ease-of-use, control and comfort of a traditional physical controller. Key to our design are two hinged 'clip-on' modules which attach to the bezel of a mobile device, see Figure 2.

Informal evaluation of early prototypes revealed a clear trade-off between size and comfort. Simply put, small controllers are more portable but larger controllers feel better. Our final design was a compromise, using the same sized controls (buttons, D-pad and joysticks) as a regular controller but arranging them more closely together to reduce overall size, see Figure 1.

Adapting to user preference and device form-factor

The controller modules can be placed anywhere along the left and right edges of a mobile device, supporting both landscape and portrait orientations. We found this gave a lot of flexibility for accommodating a wide variety of devices along with the personal preferences of a particular user.

With tablet-sized devices, users typically fitted the controls towards the top of the display and used palms to grasp the device. However, with phones this was not practical; users tended to hold the controllers only. This felt 'cramped' to many so we developed slide-in grips which can extend the controllers' contact area with the hand, more closely resembling a traditional controller. To accommodate different hand sizes, including children, we developed three different sized sets of these slide-in grips, see Figure 3.

Triggers and bumpers

To support a wide range of existing games we accommodated the full set of controls present on a traditional full-size gaming controller. Most challenging were the bumper controls which are typically top-mounted, since our controllers straddle the screen they are attached to. Following users' feedback, we opted to rear-mount these, above the triggers, see Figure 4.

Implementation

Following initial hand-cut foam models, we used a 3D printer for mechanical fabrication. A 3D-printed flexible TangoBlack insert was used in conjunction with a custom-wound spring for gripping the mobile device.

Ergonomic Design

Figure 3: We developed three sizes of slide-in grips which make the mobile controllers feel more comfortable when used with a smaller device like a smartphone. Users can select the size which suits them best, or simply use the controllers with no grips inserted.

Figure 4: Trigger and bumper controls are located on the underside of the controllers.

The Research Vision: A Versatile Controller for Mobile Gaming

Our vision is a mobile gaming controller which can be used standalone and across a variety of devices.

Figure 5: Near right, the controller pieces have medium-sized slide-in grips fitted and are attached to the charging dock for traditional use.

Far right, one controller piece with a large slide-in grip has been removed from the dock for single-handed use – e.g. for virtual or augmented reality.

Figure 6: The two halves of the controller have been removed from the charging dock and attached to a smartphone.

Figure 7: Left, the USB charging dock with exposed contacts for delivering power to each half of the controller. Right shows the controllers attached to a tablet

The left- and right-hand parts of the mobile controller are independent Bluetooth low-energy (BLE) devices, each with their own BLE microcontroller and battery. A docking station which connects to exposed contacts inside each clasp mechanism allows for recharging. The triggers are based on force-sensing resistive (FSR) material and are auto-calibrated.

We experimented with two different BLE profiles: the gaming controller profile allows direct generation of HID game control inputs whilst a keyboard profile allows control of games which are compatible with traditional keyboard input. We built a "key injector" application which runs under the Windows operating system and can be used to automatically map the controls to game-dependent key combinations.

Anecdotal Results and Conclusions

Anecdotal evidence from early evaluations of our mobile gaming controllers indicated that users found them better than touch-based controls for non-touch mobile gaming. However, since this work was primarily a speculative exploration we have not performed any formal evaluation or comparisons.

We expect that mobile gaming will continue to grow as handheld devices become more powerful and with the adoption of streamed gaming. We believe that compact, ergonomic, affordable, versatile and tactile controls have the potential to fill a gap in the design space of current products. Our vision for a versatile clip-on mobile gaming controller which supports a variety of gaming scenarios is illustrated in Figures 5-7.

Acknowledgements

The authors would like to thank Artem Dementyev for his help with an early prototype and Shabnam Erfani and Scott Stacey for their steadfast support between 2012 and 2014 when this work was carried out.

References

1. M. Baldauf et al. Investigating On-Screen Gamepad Designs for Smartphone-Controlled Video Games, ACM Trans. Multimedia Comput. Commun. Appl., Vol. 12, No. 1s, Article 22, October 2015.
2. H. Been-Lirn Duh et al. Playing Different Games on Different Phones: An Empirical Study on Mobile Gaming, Mobile HCI 2008, pp 391-394.
3. J. Helmes et al. Reconfigurable clip-on modules for mobile computing devices, US Patent 8,858,335, filed 18 January 2013, granted 14 Oct 2014.
4. S. Hwang et al. MagGetz: Customizable passive tangible controllers on and around conventional mobile devices. In Proceedings of the 26th annual ACM symposium on User interface software and technology (UIST '13). pp 411-416.
5. S. Kratz et al. 2011. CapWidgets: Tangible widgets versus multi-touch controls on mobile devices. In CHI '11 Extended Abstracts on Human Factors in Computing Systems (CHI EA '11). pp 1351-1356.
6. Nintendo Co. Ltd., Japan. Consolidated Results for the Years Ended March 31, 2016 and 2017, https://www.nintendo.co.jp/ir/pdf/2017/170427e.pdf, accessed 12 August 2018.
7. L. Torok et al. AdaptControl: An adaptive mobile touch control for games. In SIGGRAPH Asia 2014 Mobile Graphics and Interactive Applications.
8. N.-H. Yu et al. 2011. Clip-on gadgets: expanding multi-touch interaction area with unpowered tactile controls. In Proceedings of the 24th annual ACM symposium on User interface software and technology (UIST '11). pp 367-372.