Haptic Feedback with HaptoBend: Utilizing Shape-Change to Enhance Virtual Reality

John C. McClelland
Carleton University
Ottawa, Canada
john.mcclelland@carleton.ca

Robert J. Teather
Carleton University
Ottawa, Canada
robert.teather@carleton.ca

Audrey Girouard
Carleton University
Ottawa, Canada
audrey.girouard@carleton.ca

1 INTRODUCTION

HaptoBend is an original device for providing general passive haptic feedback (PHF) in virtual reality (VR). The importance of haptic feedback in VR is apparent through improvements in presence [3] and user performance [2]. However, most general haptic systems rely on many props [1], or large, complex actuated systems [5]. As a simple shape-changing device HaptoBend addresses this gap by allowing users to manipulate it from a single plane for 2D shapes, into multi-sided objects for 3D shapes. HaptoBend is simple, yet diverse by leveraging the dominance of human vision over other senses to provide realistic PHF with physical approximations [1, 5].

2 DEVICE AND SETUP

Our prototype allows manipulation through bend by attaching four 1.5” x 5” ridged sections with hinged connections. Together they create a 6” x 5” plane when laid flat that weighs 358.8 grams. To measure the angle of each section a twist potentiometer is connected to each rotational axis, while yaw, pitch and roll are sensed by an Adafruit BNO055 IMU. An Arduino Uno sends real-time sensor data to a PC running Unity to create a 3D digital representation of HaptoBend (Figure 1) for use in VR. To demonstrate HaptoBend we use a VR ready laptop running Unity with an Oculus Rift *CV1* head-mounted display. Users will be able to deform HaptoBend into their preferred PHF shapes and manipulate a variety of virtual objects with the device. These interactions are taken from an empirical evaluation of HaptoBend examining preferred PHF shapes for a variety of virtual object, which will appear in SUI 2017 [4].

3 APPLICATIONS

The size and simplicity of HaptoBend allow for a large variety of interactions in VR. By changing its shape users can fluidly

SUI '17, October 16–17, 2017, Brighton, United Kingdom

ACM ISBN 978-1-4503-5486-8/17/10.
https://doi.org/10.1145/3131277.3134364

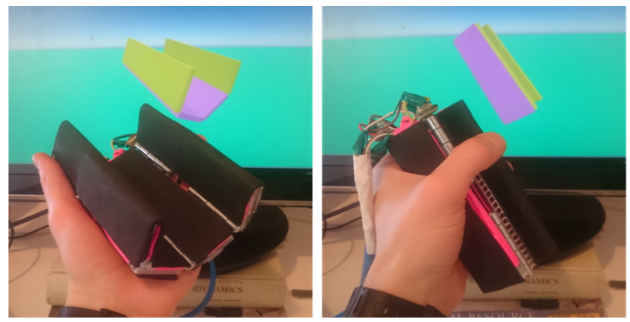

Figure 1. HaptoBend and its real-time digital reconstruction.

transition between PHF for 2D, touch-screen-like interactions to 3D interactions with a graspable tool. These affordances show potential for video games, CAD and other VR software. HaptoBend’s ability to bend also means bending interactions can be applied to normally rigid objects in VR, while maintaining realistic PHF. Future iterations of HaptoBend could easily be made wireless, enabling use with mobile augmented and virtual reality. Through our demonstration, we hope to expose more of our peers to these applications while encouraging them to share their own ideas for future uses of HaptoBend.

4 ACKNOWLEDGMENTS

This work was supported and funded by the National Sciences and Engineering Research Council of Canada (NSERC) through Discovery grants (2017-06300 & 2016-06265).

5 REFERENCES

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