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

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1 INTRODUCTION

HaptoBend¹ 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 a large number of 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].

CCS CONCEPTS

• Computing methodologies → Computer graphics; Threedimensional graphics and realism; Virtual reality • Information Systems → Information interfaces and presentation; User interfaces; Haptic I/O

KEYWORDS

Virtual Reality; Shape-changing interactions; haptic feedback;

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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. A twist potentiometer connected to each rotational axis measures the

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

angle of each section, 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 *CVI* 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].

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