ECE4011/ECE 4012 Project Summary

Project Title	hapticAR
Team Members (names and majors)	Adwait Lele - EE Varun Nambiar - EE Samir Vedantham - CmpE Abraham Kancherla - EE
Advisor / Section	Mick West, Whit Smith
Semester	2017/Spring Circle: Either Intermediate (ECE4011) or Final (ECE4012)
Project Abstract (250-300 words)	Our project aims to re-envision how users interface with augmented reality headsets. Using haptic feedback enabled finger sleeves our project provides users with a better experience when working in the augmented reality space. Current state of the art standards provide no feedback but just track the fingers or hands in the environment. This project will entail making the glasses, a haptic finger sleeve and applying computer vision algorithms to capture the relevant information about the environment and finger orientation. This project targets development of the haptic feedback enabled finger sleeves, the enclosure to hold the processing and Bluetooth hardware, and Android demo applications to showcase the utility of this technology. The AR glasses used for the project are the Google Cardboard visor. To fetch the orientation of the finger, an Android application reads markers that are on the index finger sleeve. The middle finger sleeve has a button which acts like a mouse for the user to interact with virtual objects projected into the augmented world. The finger sleeve uses an Arduino Uno to interface with the haptic motors, the button, and a Bluetooth module to receive and send information to the phone. To give sample use cases for our project we have created three demos: Block Stack, Paint, and Drag & Drop. Some conditions that our team kept in mind when developing this project was the size of the device, specifically the enclosure and the finger sleeves. We also aim to have a device with low power consumption and with the user's comfort in mind. Because the demos are Android applications, they will work with peoples' phones and there won't be a need for extra hardware.

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List **codes** and **standards** that significantly affect your project. Briefly describe how they influenced your design.	Bluetooth – to communicate from the Arduino to the Android phone USB -B – needed to port code onto Arduino from a computer I2C – used to get information from the Arduino to haptic motors module. Serial Standard (Asynchronous) – used to get information from the Arduino to HC-06 Bluetooth module.
List at least two significant **realistic design constraints** that applied to your project. Briefly describe how they affected your design.	Finger Size – material that finger sleeve must be made with has to be flexible so that it can accommodate multiple sizes. Environment – there are many variables outdoors (wind, light changing, etc.) that can change how the computer vision algorithms perceive the markers. Enclosure size – enclosure must be big enough to fit the Arduino and the peripherals but small and light enough to be comfortable for a person's arm.
Briefly explain two **significant trade-offs** considered in your design, including options considered and the solution chosen.	OpenCV vs Unity/Vuforia – OpenCV is free software but a lot of low-level math and graphics development would need to be done by the team. Unity/Vuforia requires the purchase of a plugin for Bluetooth and also leaves a watermark on the application, but graphics and marker tracking are easier. **Unity/Vuforia was the chosen software.** Raspberry Pi vs Android Phone – Raspberry Pi makes sense when using OpenCV but requires peripherals, specifically a camera and a screen. Android phone has a built-in processor, camera, and screen but would easily work only with Unity/Vuforia and not OpenCV. **Android phone was chosen.**
Briefly describe the **computing aspects** of your projects, specifically identifying **hardware-software** tradeoffs, interfaces, and/or interactions. *Complete if applicable; required if team includes CmpE majors.*	Unity is used as the overall graphics, augmented reality, and Bluetooth connectivity software. Vuforia is used as the primary AR software that tracks markers and is a package imported into Unity. Unity demos are built as Android applications – Android phone will be used as the AR processor, screen, and camera for the project. Haptic motors/drivers and a capactive touch button are used in conjuction with an Arduino and an HC-06 Bluetooth module to send and receive information from the Android applications. Google Cardboard used to create an augmented reality in real space for the user.

ECE4011/ECE 4012: International Program

(Only groups with one or more International Program participants need to complete this page)

Project Title	
Global Issues (Less than one page)	(10 point font, single spaced)