# ECE4007 Project Summary

| | |
|---|---|
| **Project Title** | Augmented Communication Device |
| **Team Members** (names and majors) | Roberto Pereira - Computer Engineering<br>Seth Stewart - Computer Engineering<br>Jarius Tillman - Computer Engineering<br>Sarvagya Vaish - Computer Engineering |
| **Advisor / Section** | Arthur Koblasz / L04 |
| **Semester** | 2013 Spring Final |
| **Project Abstract** (250-300 words) | Currently, most computer input devices like keyboards and mice require the user to be able to use their hands. The Augmented Communication Device team has developed a portable, inexpensive, human interface device called the HeadWay. It enables persons with spinal cord injuries or other impairments that cause limited hand movement to control a computer cursor with head movements, and facial gestures. The main device is worn as a Bluetooth headset and all other electronics are in another small box which can be placed around the neck. The Bluetooth headset shell houses the Inertial Measurement Unit (IMU) component. It is connected through a 4-wire cord to a PCB which communicates with an Arduino Pro Mini. This microcontroller receives the IMU data and sends it to a computer via an FTDI cable. A 2.5 mm audio jack also in the PCB is used to interface with a bite switch. For the purposes of hygiene during the demo, we have wired up a push button which would simulate the bite switch. The Arduino receives this data through a digital pin to interpret cursor clicks. The IMU tracks head movements to guide the cursor. The bite switch is used for clicking. The IMU also detects head shakes to automatically trigger a re-center command. The final prototype product cost $160.20 to develop and we demonstrate the capabilities by playing a simple computer game. |

| | |
|---|---|
| **Project Title** | Augmented Communication Device |
| List **codes** and **standards** that significantly affect your project. Briefly describe how they influenced your design. | The Augmented Communication Device will make use of the following standards for general electrical safely:<br>1. With the ground wire disconnected, the chassis leakage is limited to 100 uA and the patient lead leakage must not exceed 50 uA<br><br>The Augmented Communication Device will make use of the following standards for intra and inter device communication:<br>2. Inter-Integrated Circuit (I2C) protocol between the Inertial Momentum Unit and the ARM microprocessor<br>3. USB hardware protocol to receive the data sent by the Arduino Pro Mini<br>4. Future Technology Devices International (FTDI) software driver to convert TTL Serial Transmissions to USB Signals<br><br>ARM microprocessor and between the ARM processor and the USB controller<br>The following programming languages will be used for data processing and communication:<br>1. Python to interpret the received data into cursor commands and to interact with the Graphical User Interface. |
| List at least two significant **realistic design constraints** that applied to your project. Briefly describe how they affected your design. | **Cost:** Limited budget of $160.20 to design a prototype of the system.<br><br>**Time:** There is an optional temporal constraint on the initial use setup time of the device. The default settings of the device interpret bite switch actions as clicks; however, the user must fine tune the sensitivity and do Head Shake calibration. The GUI will run the user through the necessary programs to gather the needed data for this functionality. The training time might be as long as 5 minutes. |
| Briefly explain two **significant trade-offs** considered in your design, including options considered and the solution chosen. | **Processing:** The Augmented Communication Device needs to have a small response time for a seamless experience for the user. The response time is based on the processing of the bite switch and IMU data and the speed of communication between the device and the computer. By offloading the communication to the host computer, we have decreased the total response time of the system.<br><br>**Wired vs. Wireless:** Initially we proposed that we would like to implement wireless communication between the device and the host computer. We however spent our time fine tuning the IMU head movement recognition software. The wireless implementation can be taken up by a future Senior Design group. |

| | |
|---|---|
| Briefly describe the **computing aspects** of your projects, specifically identifying **hardware-software** tradeoffs, interfaces, and/or interactions.<br><br>*Complete if applicable; required if team includes CmpE majors.* | The inputs are:<br>• Head movement data using the IMU<br>• Digital switch inputs via a bite switch or push button<br><br>The output is:<br>• Cursor commands to a Linux OS through a Python software interface<br>• Cursor Clicks to a Linux OS through a Python software interface<br><br>**Onboard vs. Offboard Processing:** The device uses data from both an IMU and a bite switch (or push button) interfacing through an Arduino Pro Mini. The data is then sent to the host computer via using the FTDI protocol. The data is interpreted by the Python program running on the on the host processor. Python handles sending the commands to the Linux OS kernel in order to interpret cursor movement and clicks. The user interacts with the device through a GUI written in Python. |