ECE4011/ECE 4012 Project Summary

Project Title	Light Emitting Navigation System (LENS) – Headgear for the Visually Impaired
Team Members (names and majors)	Malavika Bindhi, EE David Clyde, EE Anushri Dixit, EE Daniel Fulford, EE/BME minor James Fulford, EE Muhammad Islam, BME
Advisor / Section	Dr. James Hamblen / L5B
Semester	Year/Semester: Fall 2016 Circle: **Intermediate (ECE4011)**
Project Abstract (250-300 words)	The Light Emitting Navigation System(LENS), is so named for its critical use of LIDAR sensing technology. The project is sponsored by Dr. Brian Gay who originally approached brothers James Fulford and Daniel Fulford with the idea. Essentially, he envisions a head gear that can be comfortably worn by a visually impaired user that uses object detection and alerting to allow the user to safely navigate their environment. Currently, there are no major and commercially practical accessory devices such as this being produced. There are major advancements in the area of Ophthalmology, including neuroprosthetics, but not all can afford or are willing to use this as an option. Our hope in this project is to design and develop a device that is non-invasive and affordable outside of health insurance. Estimated at around $500 per unit, the device is to be worn around the head either as glasses or in a hat-like construction. Low hanging obstacles are a huge concern for the blind population and implementing preventative measures for this is also a critical concern. Furthermore, we would like the system to be as robust as possible, so using more than one sensor and possibly ultrasonic for peripheral use is under consideration. Obstacle detection is made aware through the use of haptic feedback. The sensors will detect an object and alert the user via vibration feedback. The vibration pattern/intensity changes with distance of object detection. Additionally, this project will explore the use of audio feedback to incorporate cross-modal feedback. Musical tones, based off of location, will trigger with varying volume similar to the vibration feedback response. Two prototypes are set to be produced with one used to fulfill the project requirements and the other for Dr. Brian Gay. If the prototype is a success, commercial considerations are likely to occur.

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List **codes** and **standards** that significantly affect your project. Briefly describe how they influenced your design.	1. LIDAR sensor standards: LIDAR sensor will be used for gathering data for real-time navigation and haptic feedback. These sensors have data exchange format standards which will relevant to determine how the data can be used in the device. 2. I2C bus specification: To integrate sensors and other peripheral devices, with the microcontroller, I2C interface would be needed. I2C bus specification details the connections, protocols, formats, addresses, and procedures that define the rules on the bus. 3. USB: To interface the microcontroller with a PC 4. IEEE Standard Dictionary of Electrical and Electronic Terms: To facilitate communication with other designers and engineers in the field. SPI bus interface: If we decide to use an LCD display module, then SPI would be required to interface the LCD with the microcontroller.
List at least two significant **realistic design constraints** that applied to your project. Briefly describe how they affected your design.	1. Durability: Must be able to handle slight abuse, such as being dropped from a height of at least four to six feet, being stepped on or hopefully much less likely being hit against a wall. 2. Simplistic and ergonomic design: Must be simple to use, the user must remember where each button is and what they do since the user won't be able to see or read them. Must also be very comfortable for long periods of use. 3. For the design to be comfortable to wear it must also be very light which will also affect its durability. The two constraints work against each other. The design must find a balance between the two constraints.
Briefly explain two **significant trade-offs** considered in your design, including options considered and the solution chosen.	1. LIDAR vs. Ultrasonic/Infrared Sensors: LIDARs are far more expensive than ultrasonic/IR sensors. However, they are also more accurate. The need for accuracy is more important than the price because the LIDAR still falls within our budget. This is why the LIDAR was chosen. 2. Weight and convenience: It is crucial that the weight of the headgear be minimized in order to improve usability and convenience. However, the weight tends to increase as soon as we have to increase functionality by adding more sensors. Usability is more important so we tried to find sensors that could be used for multiple functions.
Briefly describe the **computing aspects** of your projects, specifically identifying **hardware-software** tradeoffs, interfaces, and/or interactions.	- **Inputs:** ›› Distance measurements from LIDAR ›› Time taken for ping to return after being sent from Ultrasonic sensors - **Outputs:** ›› Using distances measurements from sensors and microcontroller to handle varying distances, produce a haptic feedback using vibrations motors ›› Environmental awareness for the user - Mbed Vs Arduino: Mbed has a quicker processing speed but Arduino is cheaper and more user friendly. Also, some versions of Mbed lack USB 3.3 volts which is useful for various circuit modules. We may use a combination of both.