Senior Design I

Smartphone-integrated Heads Up Display for GPS Navigation in Automobiles

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Initial Project and Group Identification Document:
Divide and Conquer

Group 6
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Project Narrative:

In today's world where mobile technology has become an essential part of our lives, it is often difficult to disconnect and put these mobile devices away for much longer than a few minutes. This becomes a major hazard when getting behind the wheel of a vehicle. There is a myriad of distractions to take into account when driving a vehicle. According to the National Highway Traffic Safety Administration, "distracted driving is dangerous, claiming 3,166 lives in 2017 alone". Distracted driving not only puts the driver's life in danger, but also the lives of the other drivers and passengers on the road, creating dangers such as speeding.

With our Senior Design project, we will design a device that provides a driver with enhanced situational awareness by displaying pertinent information in the driver's field of view.
To accomplish this, we want to create our own device using knowledge of hardware and software gained throughout our college careers. This device will contain a Bluetooth module for wireless connectivity, a display module, a power delivery system, an LED array, and a speaker. The device will read information sent by the phone and use a display module to project an image onto the windshield of the vehicle, containing information such as speed limit data or navigational aids. Apart from the display module, we have also discussed adding an LED array to turn on when certain conditions are met. For example, if a driver begins to drive over the speed limit, a red LED will turn on and a speeding announcement will be played over the speaker.

There are vehicle manufacturers that have special packages that contain integrated heads-up displays, but these packages are often associated with premium prices. Additionally, these heads-up displays are not always integrated with advanced navigational awareness features such as speed limit awareness. We want to create a low-cost solution that contains advanced functionality beyond what is provided with pre-existing heads-up display systems. To differentiate our device from other products, our device will have low power consumption, with a reduced footprint on the dashboard, and an easily readable and functional display.

We believe that this project will push us to learn more about the advanced systems required to make this device a reality. As seniors in Computer Engineering, Electrical Engineering, and Optics and Photonics Engineering, we will combine our fields of study to effectively and efficiently produce a product that can be used to reduce the amount of distractions and increase situational awareness while driving a vehicle.

Goals and Objectives:

One of the great things about having a Senior Design lecture is that it exposes us to a lot of strategies to making a successful design team. Events such as the Senior Design Bootcamp allowed us to come together and determine how each member of the group can contribute to the project as a whole. Referenced further in this document is a list of project milestones that we have determined to be important to the success of this project. We are going to do our best to stick to these milestones to promote timely and efficient work.

Another goal for this project is to make it as cost efficient as possible. We have not obtained any sponsorships, and as such we will be self-funding everything. As college students, bearing the cost of additional materials can be a burden. We will be sourcing materials to make the most effective product at the lowest price possible, reducing the financial strain on each member of the team.

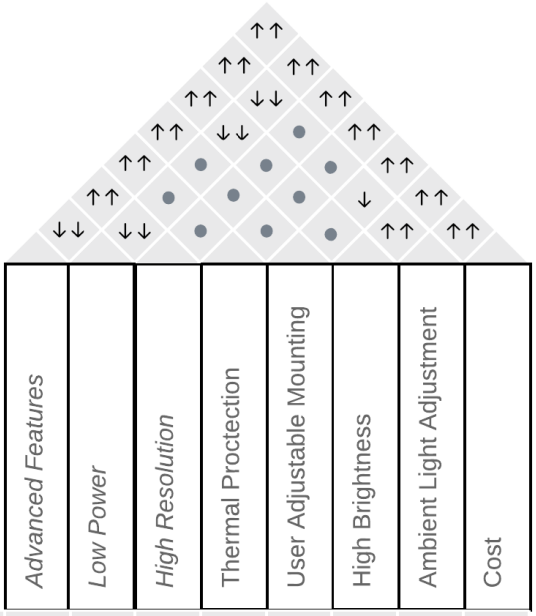
Requirement Specifications:

- To keep a reasonable size device it should be lightweight, 1 pound or under
- For space management the device should not exceed maximum of a 5x3x2 inch rectangular prism
- The HUD must run off the 12-volt cigarette lighter port
    - From this port there must be a voltage step down to run about 5 volts or lower for low power consumption
- The HUD will have a Bluetooth receiver to connect to a phone for easy connectivity
    - This will be compatible with android devices
- Once connected the device should be able to pull and display data onto a screen near the windshield or on the windshield itself.
    - The display should have good resolution for easy viewing
    - The integration of software will be done using API provided by either Google Maps or OpenStreetMap to help display speed control, navigation, and route specific directions
- If the data displayed, such as google maps, requires sound, there will be a speaker on the side of the device
- The HUD must be able to withstand temperature extremes and direct sunlight during continuous use and storage
- The HUD must be user-adjustable to be visible with various windshield designs
- The HUD image must be visible through polarized sunglasses
- The HUD must be able to adjust its brightness based on ambient light
- The idea is to keep it low cost, around $300, to be able to market the HUD

House of Quality:

There are many factors that need to be analyzed and discussed when designing our Heads-Up Display Device. Each of these factors has an impact on the implementation of our project. Below is a House of Quality chart to weigh the tradeoffs and effects of each factor on the outcome of our project.

Legend	
+	Positive Polarity
-	Negative Polarity
↑↑	Strong Positive Correlation
↑	Positive Correlation
↓	Negative Correlation
↓↓	Strong Negative Correlation
●	No Correlation



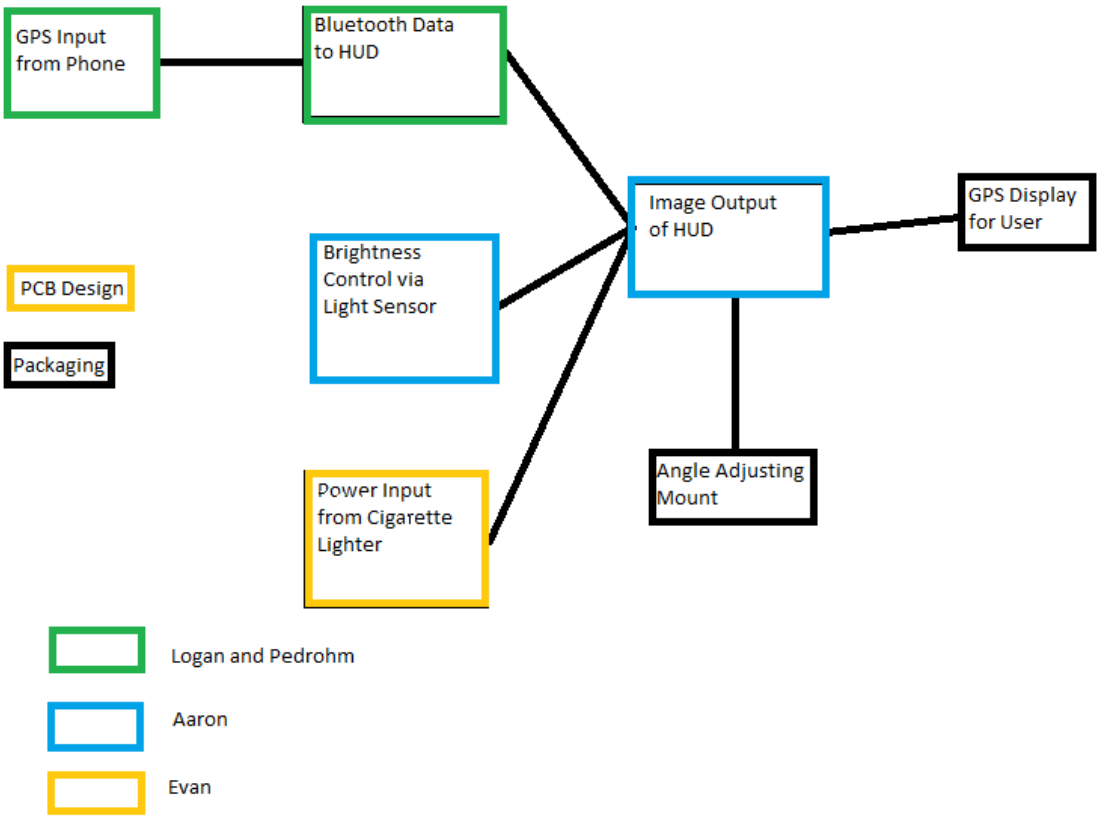
		Advanced Features	*Low Power*	*High Resolution*	Thermal Proctection	User Adjustable Mounting	High Brightness	Ambient Light Adjustment	Cost
		-	-	+	+	+	+	+	-
Durable	-	●	●	●	↑↑	●	●	↑↑	↓↓
Low Cost	+	↓↓	↑	↓	↓	↓	↓↓	↓↓	↑↑
Easy to Use	-	↓	↓	↑↑	●	↑↑	↑↑	↑↑	↓
Advanced Functionality	+	↑↑	●	↑↑	●	↑↑	↑↑	↑↑	↓↓
Increased Situational Awareness	+	↑↑	●	↑↑	●	↑↑	↑↑	↑↑	●
Compact	+	↓↓	↑	↓	●	↓↓	↓↓	●	↑

Initial Project Milestones:

Task	**Start Date**	**End Date**	**Status**
Senior Design I			
Create Groups	8/30/19	8/30/19	Completed
Project Ideas	8/31/19	9/6/19	Completed
Role Designation	9/7/19	9/8/19	Completed
Initial Project Documentation - Divide and Conquer	9/13/19	9/20/19	Completed
Start Design Documentation	9/23/19	9/23/19	In Progress
Table of Contents	9/23/19	12/2/19	In Progress
Research Individual Parts	9/23/19	12/2/19	In Progress
Schematic Design	9/23/19	12/2/19	In Progress
60 Page Rough Draft	9/23/19	11/1/19	In Progress
100 Page Submission	11/1/19	12/2/19	In Progress
Parts Acquisition	11/30/19	1/1/19	In Progress
Senior Design II			
All Parts Must Have Arrived	1/1/19	1/15/19	In Progress
Schematic Implementation/ Prototyping	1/16/19	2/28/19	In Progress
Testing Design	3/1/19	3/30/19	In Progress
Final Prototype	4/1/19	4/15/19	In Progress
Miscellaneous Time for Further Troubleshooting	4/15/19	4/20/19	In Progress
Panel Presentation	TBA	TBA	In Progress

Block Diagram:

The following is a block diagram for the Heads-Up Display Device, detailing each component required to implement its design, as well as each team member assigned to the implementation of the component.



Notes:

- All materials have yet to be acquired
- All block approaches are being researched
- All blocks are still being designed
- No block has been prototyped yet
- No block is complete

Budget:

To implement this project, we will need to research and obtain materials that will meet our specifications in order to produce an effective heads-up display device. We will need a PCB, a power delivery system, microprocessors, LEDs, soldering equipment, a Bluetooth module, and a speaker. At this point, we have not obtained funding or sponsorships for anything involved with this project. As such, the group will be self-funded and will split the cost required to complete the device. To implement navigational aids, we may have to acquire a license to access the Google Maps APIs. This is something that will be researched to determine if this cost is realistic. We have determined that a rough estimate of $300 will be enough to completely implement the project.

Constraints:

Engineering students are known for having busy schedules and our group is no different. We will schedule meetings around our educational and personal commitments and use our Project Milestone Chart to keep us on track. Time management is critical when working on projects that require in depth research and implementation. We will try our best to maintain the previously noted milestones schedule by working diligently at every point in the project.

Other constraints such as technical difficulties and limitations are often unplannable. We will do our best to mitigate these constraints if they were ever to arise.

Conclusion:

Our end goal in Senior Design is to design and implement a device by leveraging all of our obtained learnings throughout college. Our device will project a GPS image onto an automobile windshield so that the driver will not have to take their eyes off the road to see directions. By using Bluetooth input from a mobile phone, the heads-up display (HUD) will be able to display a GPS image with a minimum amount of computing power. The HUD will be a stand-alone unit that can be adjusted to work with different windshield shapes and will be able to withstand the harsh environment of a vehicle dashboard. We hope to learn many things throughout the next 2 semesters and are excited to begin our final journey as engineering students at the University of Central Florida.

References:

"Digital Micromirror Device." *Wikipedia*, Wikimedia Foundation, 29 July 2019, https://en.wikipedia.org/wiki/Digital_micromirror_device

"DLP Products – Getting Started." *DLP Getting Started | DLP Products | TI.com*, http://www.ti.com/dlp-chip/getting-started.html.

"U Drive. U Text. U Pay." *NHTSA*, 8 May 2019, https://www.nhtsa.gov/risky-driving/distracted-driving.