**UCF Senior Design 1**



*Department of Electrical Engineering and Computer Science*

*&*

*Center for Research and Education in Optics and Lasers*

*University of Central Florida*

*Dr. Lei Wei*

*Initial Project and Group Identification Document*

*Divide and Conquer*

Group 29

Sandy Cline Photonics sandygcline@knights.ucf.edu

Ryan Heitz Computer Engineering rdheitz@knights.ucf.edu

Shane Zweibach Computer Engineering shanez1215@knights.ucf.edu

PROJECT NARRATIVE

In the modern era, where the pace of technical progress has been increasing exponentially, the radio spectrum that we depend on for communication is becoming increasingly crowded. AM/FM radio waves, cell phone antenna, TV, Wi-Fi, and Bluetooth signals all crowd the limited spectrum of radio frequencies that we have access to, and eventually we will run out of space (both in radio waves and physical space) for newer technologies. We see this in the cell phones. As 4G LTE has expanded to the point of becoming ubiquitous in most urban areas by 2018, carriers have been deprioritizing 3G, to the point where it is barely usable with modern website design and trends. We are becoming analogous to a child accidently driving two different remote-control cars at once because there are a limited number of channels available.

In addition, these technologies are highly energy inefficient, and example being how Wi-Fi, Bluetooth, and cellular connectivity can quickly drain the modern smartphone battery, especially if the signal is weak or the user is jumping between multiple towers. This factor cripples battery life of LTE devices in areas with weaker reception.

Thus, there is a need for a communication protocol that can be used for smaller, more single purpose devices with smaller batteries that does not use this spectrum. We believe that there is a possibility of using either light itself or a directed laser to solve this problem, with either choice having different tradeoffs. The advantages and disadvantages of each strategy are shown below.

|  |  |  |
| --- | --- | --- |
|  | Light | Directed Laser |
| Advantages | * No need to direct it * Easier to capture | * Huge range * Very precise |
| Disadvantages | * Less precise (distortion) * Limited range | * Laser must be aimed directly at sensor. No communication if it misses |

REQUIREMENT SPECIFICATIONS

* The receiver shall be less than 10 lbs as it will be mounted on a glider.
* The receiver must be aerodynamic so as not to interfere with the flight path of the glider.
* Receiver must be less than 8 inches in height, 8 inches in width, and 8 inches in length
* The receiver must be somewhat durable as it may meet inclement weather.
* The receiver must be efficient in terms of power consumption as the glider will be untethered from the “light house”.
* The sender must communicate with the receiver by using lasers instead of RF communications.
* The electronics onboard the receiver must have a printed PCB.
* The sender/lighthouse must only use a single cord.
* The glider must be able to communicate if there is a clear line of sight.
* Efficiency must be at least 35%.
* Receiver must be able to be installed and running within 20 minutes.
* The receiver must be less than $150 to assemble.
* If a light is used, range for an undistorted message must be at least 15 feet.
* If a directed laser is used, range for an undistorted message must be at least 150 feet.

HOUSE OF QUALITY

When building the product and meeting the requirements, we must decide what requirements go with each other and against each other. Listed below is a graph where we measure each of these values with respect to each other.

↑

↑

↑

↑

↑↑

↑

↑

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | Dimensions | Accuracy | Range | Install time | Cost |
|  |  | - | + | + | - | - |
| Portability | + | ↑ |  |  | ↑ | ↑ |
| Power | - | ↓ | ↓ | ↑ |  | ↓ |
| Installation | + | ↑ |  |  | ↑ ↑ |  |
| Cost | - | ↑ | ↓↓ | ↓ |  | ↑ ↑ |
| Tasks for Engineering Requirements | | < 8\*8\*8 inches | >95% | Light: 15 feet  Laser: 150 feet | < 20 minutes | < $150 |

LEGEND

= no correlation

↑ = positive correlation

↑↑ = strong positive correlation

↓ = negative correlation

↓↓ = strong negative correlation

+ = high value

- = low value

PROJECT BLOCK DIAGRAM

Tower

Moving Object

Simplified diagram of system

More specific diagram of system

Power

Light/laser

Receiver

**Optics and Sensors**

Reads and digitizes data

Sandy

To be acquired

**Electronics and Circuits**

Interprets data and generates response

Ryan and Shane

To be acquired

**On-board hardware**

Carry’s out response generated by electronics and circuits

Ryan and Shane

To be acquired

Sender

**Electronics and Circuits**

Allocates power and translates message into an optical signal

Ryan and Shane

To be acquired

**Optics**

Produces signal

Sandy

To be acquired

ESTIMATE PROJECT BUDGET AND FINANCING

In the chart below, we created a list of the possible parts we may need for this project, the amount of each part we may need, and the price of each individual part.

|  |  |  |
| --- | --- | --- |
| Project Budget | | |
| Component | **Quantity** | **Price** |
| Microcontroller | 1 | $40 |
| PCB | 2 | $80 |
| Sensor | 2 | $40 |
| Battery | 1 | $50 |
| Light Sources | 3 | $15 |
| Cables | 1 | $30 |
| Analog to Digital Converter | 1 | $20 |
| Total: $275 | | |

INITIAL PROJECT MILESTONE FOR BOTH SEMESTERS

|  |  |  |
| --- | --- | --- |
| Task | Time needed | Dates |
| Senior Design 1 | | |
| Develop Project Idea | 2 weeks | 8/20-9/2 |
| Submit Proposal | 1 week | 9/7-9/14 |
| Review Existing Projects | 2 weeks | 9/2-9/14 |
| Update Proposal | 1 week | 9/20-9/28 |
| First Draft | 7 weeks | 9/14-11/2 |
| Final Draft | 12 weeks | 9/14-12/3 |
| Research PCB | 1 weeks | 9/28-10/5 |
| Research Microcontrollers | 1 weeks | 10/5-10/12 |
| Research SolidWorks | 1 week | 10/12-10/19 |
| Research Wi-Fi | 1 week | 10/19-10/26 |
| Research Sensors | 1 week | 10/26-11/2 |
| Research Lasers | 1 week | 11/2-11/9 |
| Research Optics | 1 week | 11/9-11/16 |
| Research Light Sources | 1 week | 11/16-11/23 |
| Order Parts | 3 weeks | 12/3-12/24 |
| Build Prototype | TBD | TBD |
| Senior Design 2 | | |
| Test Prototype | TBD | TBD |
| Finalize Report | TBD | TBD |
| Finalize Presentation | TBD | TBD |
| Finalize Project | TBD | TBD |