Augmented Reality Simulator

Purdue University

Cornell Cup 2014

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# Challenge Definition

# Project Solution

## Customer Value Proposition

## Changes From Original Proposal

## Key Technical Elements

# Product Performance Evaluation

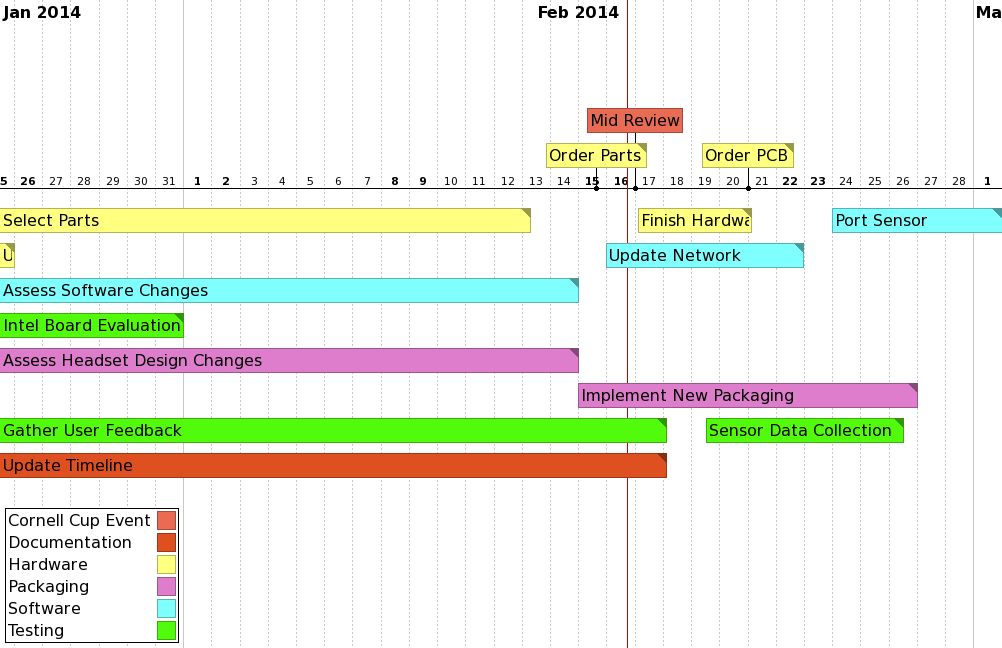
## Performance Metrics

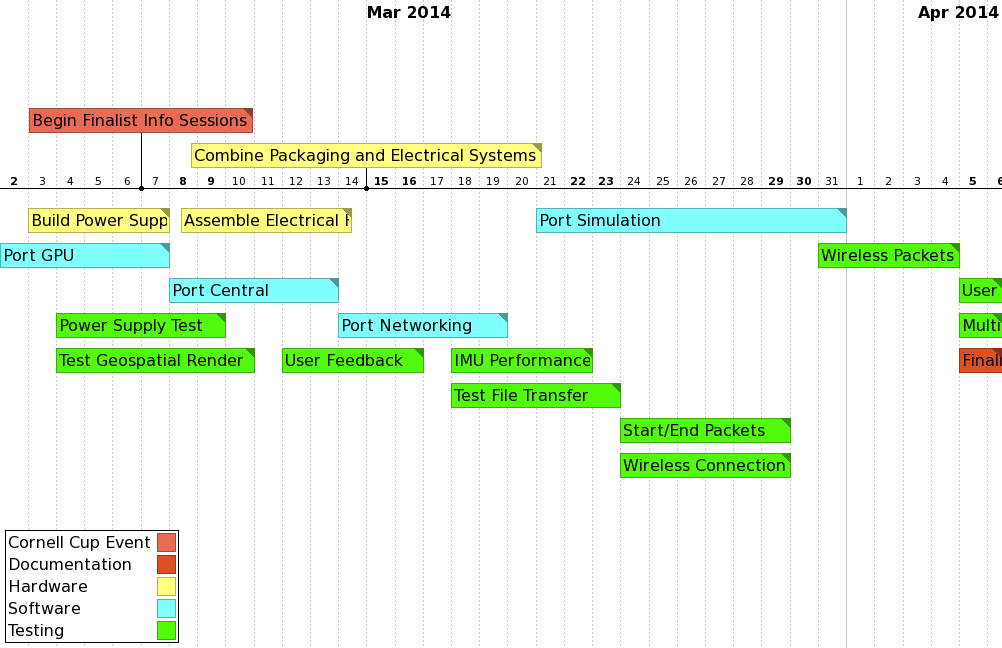
## Failure Analysis

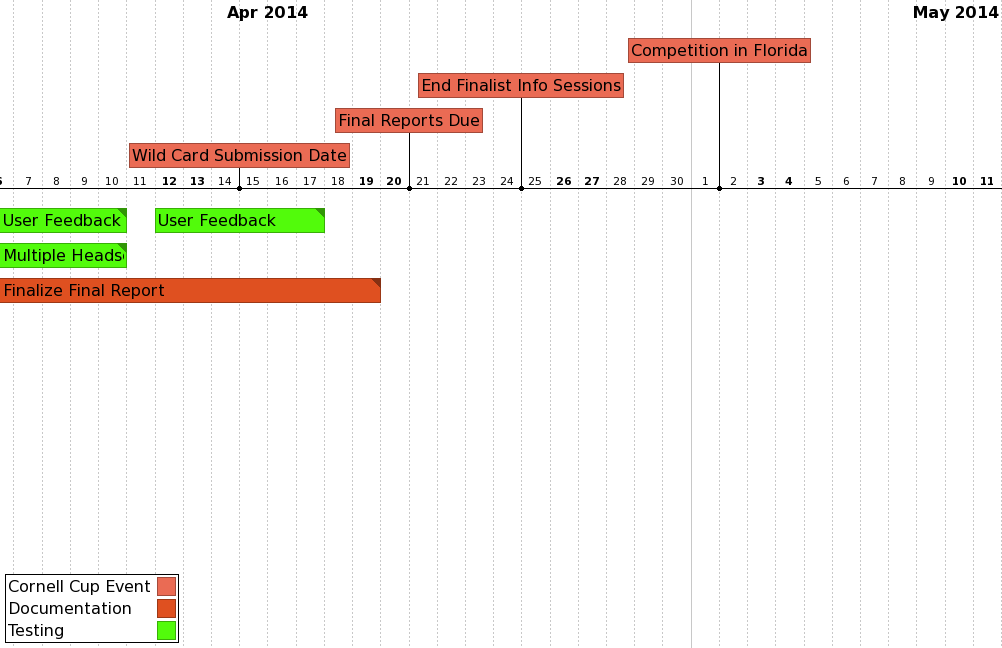
# Technical Documentation

# Project Execution

## Timeline







### Adjustments

## Budget

### Bill of Materials

Table 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Digi-Key PN | Description | Footprint | Qty | Unit Price | Cost |
| LVK12R010DERCT-ND | Resistor 0.5W 10mOhm | 1206 | 1 | $0.50 | $0.50 |
| 490-6521-1-ND | Cap 4.7uF 50V Ceramic | 1206 | 3 | $0.76 | $2.29 |
| P16460CT-ND | Cap 180uF 16V Low ESR | Panasonic E | 1 | $2.32 | $2.32 |
| 490-3367-1-ND | Cap 2.2uF 50V Ceramic | 1206 | 2 | $0.39 | $0.78 |
| CTX406-ND | Crystal 8MHz 20pF | HC-49US | 2 | $0.36 | $0.72 |
| 160-1889-1-ND | LED Blue | 1206 | 1 | $0.38 | $0.38 |
| 475-1407-1-ND | LED Green | 1206 | 2 | $0.11 | $0.22 |
| P68.1KBCCT-ND | Res 68.1K 0.1% | 1206 | 1 | $0.79 | $0.79 |
| P5.76KBCCT-ND | Res 5.76K 0.1% | 1206 | 1 | $0.79 | $0.79 |
| P100KBCCT-ND | Res 100K 0.1% | 1206 | 1 | $0.79 | $0.79 |
| P34KBCCT-ND | Res 34K 0.1% | 1206 | 1 | $0.79 | $0.79 |
| P499KBCCT-ND | Res 499K 0.1% | 1206 | 1 | $0.79 | $0.79 |
| P215KBCCT-ND | Res 215K 0.1% | 1206 | 1 | $0.79 | $0.79 |
| P2.43KBCCT-ND | Res 2.43K 0.1% | 1206 | 1 | $0.79 | $0.79 |
| ED2992CT-ND | Mini USB Connector | Special | 2 | $0.87 | $1.74 |
| 497-11767-ND | STM32F405RGT6 | TQFP 64 | 1 | $11.45 | $11.45 |
| 497-13631-ND | STM32L100RBT6 | TQFP 64 | 1 | $4.37 | $4.37 |
| 576-1827-5-ND | Regulator 3.3V 500mA | MSOP 8 | 1 | $2.35 | $2.35 |
| 576-1281-1-ND | Regulator 3.3V 150mA | SOT-23-5 | 1 | $2.01 | $2.01 |
| LM2936MP-3.3/NOPBCT-ND | Regulator 3.3V Low-Iq | SOT-223-4 | 1 | $1.78 | $1.78 |
| DS2782E+-ND | Fuel Gauge IC | TSSOP 8 | 1 | $7.46 | $7.46 |
| 296-20523-ND | Power Module 12V 3A | Special | 1 | $17.70 | $17.70 |
| 497-12918-ND | 9-DOF IMU Breakout | DIP 24 W | 1 | $27.60 | $27.60 |
|  |  |  |  |  | $89.20 |
| Items from Senior Design include: | | |  |  |  |
|  | Cap 0.1uF Ceramic | 1206 |  |  |  |
|  | Cap 1uF Ceramic | 1206 |  |  |  |
|  | Header Breakaway Female | 0.1 |  |  |  |
|  | Header Breakaway Male | 0.1 |  |  |  |
|  | Res 4.7K 5% | 1206 |  |  |  |
|  | Res 10K 5% | 1206 |  |  |  |
|  | Res 6.8K 5% | 1206 |  |  |  |
|  | Res 22 5% | 1206 |  |  |  |
|  | Res 1.5K 5% | 1206 |  |  |  |
|  | Cap 39pF Ceramic | 1206 |  |  |  |
|  | Cap 470pF Ceramic | 1206 |  |  |  |
|  | Cap 10uF 16V | Panasonic D |  |  |  |
|  | Cap 22uF 16V | Panasonic D |  |  |  |
|  | PCB Button | Special |  |  |  |

### Expenditures

### Funding Sources

Table 2

|  |  |
| --- | --- |
| Cornell Cup | $1500 |
| Purdue University | $300 |

## Mid-Review

## Process Understanding

# Recommendations and Next Steps

# Glossary

Augmented Reality: a system which overlays a computer generated image on top of real world objects

Virtual Reality: a system which fills the user’s entire field of view with a computer generated image

# References

**There are no sources in the current document.**

# Acknowledgements

# Survey Responses

# Appendix

## Performance Measures

**Table 3**

|  |  |  |  |
| --- | --- | --- | --- |
| Metric | Phase 1 (Measured) | Phase 2 Target | Phase 2 (Estimate) |
| Mass | Headset: 1.3kg | Headset: 1 kg  Backpack: 3 kg | Headset: ~1kg  Backpack: ~2.5kg |
| Power | ~3 hours | 3 hours runtime | ~4 hours |
| Location Precision\* | ~1.5 m | 2 meters | ~1.5m |
| Wireless Range | 200 m | 80 m, line of sight | 200 m |
| Display Refresh | 10 FPS | 20 FPS | 60 FPS |
| Network Refresh | Unimplemented | 20 FPS | 60 FPS |
| Usability | Turnkey startup | User can start and use without a technician | Turnkey startup |
| Simultaneous Device Limit | 5-6 | 16 | 32+ |
| Head Tracking Latency | ~100ms | 50ms\* | >=16ms |

## Test Plans

### Range Test

### Latency Test

## Assembly and Construction

Constructing a headset for this project is a fairly simple but quite laborius process. At a high level, the basic steps are to mount a screen and reflector to a suitable enclosure, construct and mount to the helmet a set of aluminum mounting rails, mounting the display assembly to the mounting rails, and then constructing and mounting a sensor enclosure to the rails.

### Rail Assembly

Due to the difficult of mounting hardware directly to a hard hat, a system of rails must first be mounted to facilitate the rest of construction. The material used will be aluminum angle bar with 1/8” thickness and ½” length.

### Display Assembly

This part will vary quite a lot depending on the type of display being used and how it will need to be mounted. We have created headsets using two different displays and the procedures for earch were drastically different.

#### Reflector

To achieve the desired augmented reality effect, a sheet of semi-transparent, semi-reflective material is required. In this case it will be a sheet of polycarbonate with a reflective film applied on one side, and a tint film applied to the other side to mitigate brightness issues. A sheet of approximately 6”x4”x1/8” must be cut out. Several holes must be drilled for mounting purposes. Two will be near the bottom corners, which will be used for wire loops to hold the reflector at the correct angle. Four more will be along the top edge, for hinges which secure the reflector to the front of the headset. After the sheet has been cut to the correct size and the holes drilled, a sheet of reflective film the same size as the plastic needs to be cut out and applied as per the directions supplied with film. Then the tint film is to be applied to the other side in the same way. Be mindful that the reflective side needs to be facing the user once everything is assembled.

### Sensor Assembly

The sensors used to measure the user’s location and head orientation reside on their own circuit board which must be mounted to the headset. This is accomplished by mounting the PCB inside of its own enclosure and mounting that enclosure to the rear portion of the rail assembly on the headset. The enclosure used will be a 5”x2.5”x2” ABS project box.

#### Mounting the PCB to the enclosure

In order to mount the PCB to the enclosure, sevearal holes will first need to be drilled..

#### Mounting the enclosure to the rail

### Materials required

|  |  |
| --- | --- |
| Material | Quantity |
| Hard Hat | 1 |
| Angle aluminum, 1/8” thickness, ½” leg | 3’ |
| Project Box, 4”x6”x2” | 1 |
| Project Box, 5”x2.5”x2” | 1 |
| Zip ties | Many |
| Screws | Many |