# Project Requirements Document

CSE 481v AR/VR Capstone

Fall 2018

**Rockit Physics**

**Hi 5**

Candice Miao

Jeff Ranhao Xu

Phoenix Meadowlark

Ryan Smith

## Summary

Rockit Physics is a VR physics playground to help users with little knowledge of the concepts learned in PHYS122 Electromagnetism, have a stress free and immersive environment to get acquainted with these physics concepts. Our aim is to give a real-time connection to the concepts of Electromagnetism. Rockit Physics will focus on the high-level understanding of concepts, opting to familiarize users with concepts and relationships rather than focus on low-level computation and equations. We are narrowing onto a Statics demo.

## Deliverables

- VR application
  - VR physics playground controlled with Acer Motion Controller featuring a demo helpful for honors 122 students studying Electromagnetism
  - Close collaboration with the Physics department to create a demo that will be useful for their instruction purposes
  - Demo user should have a basic understanding of a core concept from Electromagnetism
- Kickstarter style website tracking progress and demoing the current product
- Kickstarter style hype demo video

## Critical Features

**Minimum Viable Product**

- Demo a Electromagnetism concept, such as magnetic fields generated from current moving through a wire
- Head-Up Display showing real-time change or electric or magnetic field based on environmental changes
- Head-Up Display showing current demo properties to tie visuals into data
- Ability to pause and continue time to see properties at a freeze-frame

**Final Product**

- Expandable Head-Up Display which gives more information for each property, describing the physics concepts behind the property and relationships with other properties
- Adjustable settings allowing users to change properties of the demo

**Stretch Goals**

- Allow more user interaction with the demo, possible allowing user to change currents, or shape of surface to show flux changes, etc
- Add richer visuals

## Performance Metrics

- Functionality - Is the user able to complete the following tasks
  - Control the objects in the scene
  - See the properties of the objects at any time and position
  - Pause and unpause the scene
  - Set the physics variables of the environment
- Enjoyability - Is the user able to enjoy interacting in the playground?
- Teaching Moment - Is a user with no concept of electromagnetism able to gain any high-level understanding of the demo concept? Does the user understand more about electricity or magnetism after the demo?
- Ease of Use - Do the controls feel natural? Is the user able to interact with the environment and Head-Up Display effectively?

# Milestones

### Week 1 (Oct 1 - Oct 5)

Team interaction, scheduling, initial brainstorming

- Full Team

### Week 2 (Oct 8 - Oct 12)

Project proposal and presentation, set up DevOps and UW-Gitlab repo

- Full Team

### Week 3 (Oct 15 - Oct 19)

Initial Kickstarter style website, Project Requirements Document, build bare bones Unity project on Acer Headset

- Candice Miao - project management, assist Unity build
- Jeff Ranhao Xu - building project to Acer Headset with controllers API's downloaded
- Phoenix Youngman - website creation and design
- Ryan Smith - first draft PRD, assist website creation

### Week 4 (Oct 22 - Oct 26)

Explore Unity 3D Physics, Colliders, Rigidbodies, and Physics Forces. Demo - Working block interaction with Dell VR Controllers. First meet with physics department to adjust direction to fit departmental needs.

- Candice Miao - Explore SteamVR SDK, Unity Text for HUD
- Jeff Ranhao Xu - Explore SteamVR SDK for working with Dell VR Controllers
- Phoenix Youngman - Blog update, conceptual drawings and ideas for EM demos
- Ryan Smith - GPE demo in Unity/SteamVR with live text update, GPE and KE calculations

### Week 5 (Oct 29 - Nov 2)

Meet with Physics Department on Tuesday to brainstorm a EM demo and see what their department is working on in VR internally.

- Candice Miao - Gather resources for vector visualizations, practice with physics-not-included
- Jeff Ranhao Xu - Begin working on an EM demo, practice with physics-not-included
- Phoenix Youngman - Gather resources for vector visualizations, practice with physics-not-included
- Ryan Smith - Begin working on an EM demo, practice with physics-not-included

### Week 6 (Nov 5 - Nov 9)

Settle on Demo concept, begin work towards MVP, continue meeting with Physics department weekly for updates

- Candice Miao - Adding HUD elements related to demo and real-time updating vector fields
- Jeff Ranhao Xu - Calculations in C# scripts to resolve what vectors should be displayed
- Phoenix Youngman - Calculations in C# scripts to resolve what vectors should be displayed
- Ryan Smith - Adding HUD elements related to Demo and real-time updating vector fields

### Week 7 (Nov 12 - Nov 16)

Gather feedback from PEG, iterated on MVP demo to clean up and work through PEG feedback

- Candice Miao - Iteration based on PEG feedback

- Jeff Ranhao Xu - Iteration based on PEG feedback
- Phoenix Youngman - Iteration based on PEG feedback
- Ryan Smith - Iteration based on PEG feedback

**Week 8 (Nov 19 - Nov 23)**

Expandable HUD elements with more information and concepts, User can pause time. This seems to be a valuable feature for EM, so we might retain this feature

- Candice Miao - User can pause and rewind demo
- Jeff Ranhao Xu - Implementation of additional HUD experience in the demo
- Phoenix Youngman - User can pause and rewind demo
- Ryan Smith - Implementation of additional HUD experience in the demo

**Week 9 (Nov 26 - Nov 30)**

Add ability to adjust constants/starting parameters, in depth testing

- Candice Miao - Edit scripts to allow different parameter inputs, demo testing
- Jeff Ranhao Xu - In-depth demo testing and iteration
- Phoenix Youngman - In-depth demo testing and iteration
- Ryan Smith - Edit 3D scripts to allow and responds to different friction values, demo testing

**Week 10 (Dec 3 - Dec 7)**

Finalizing Demo, attempting to make styling and experience more professional

- Candice Miao - Testing, debugging, and design tweaks
- Jeff Ranhao Xu - Testing, debugging, and design tweaks
- Phoenix Youngman - Testing, debugging, and design tweaks
- Ryan Smith - Testing, debugging, and design tweaks

## Materials and External Help

- Extensive use of Unity's physics scripts
- Extensive use of SteamVR SDK for controller interaction
- Reserve our budget for potentially adding more professional graphics, 3D models, or background textures to the demo

# Risks

- **We can't properly visualize a 3D vector field because it is too computationally expensive or too difficult to figure out.**
  We can have some fixed, non interactive demos with 3D vector field animations that mock a field instead of resolving one from actual computations
- **Difficulty working with Physics-Not-Limited project and coming up with a shared demo vision with PEG**
  We need to develop a simple back-up demo that can be done completely removed from the PEG in case we have difficulties coming up with a concrete shared project. One idea is to show electromagnetic field generated by a moving current in a wire. The demo could allow the user to switch the current direction, turn the current off, or increase the voltage difference between the wire ends to see the changing effects.
- **The user isn't engaging with physics and just playing without learning**
  We need to take care to direct user attention to the physics aspect of the playground and not just give them the impression that they are playing with a block aimlessly. This may require adding story elements that introduce the user to the experience or walk them through an intended interaction
- **The user is unable to relate the changes in the properties of the object to the physical concepts**
  Add a function to change the time scale so that the user is able to watch the changes in slow motion. Displaying the relationships between each property could also help the user to understand the relationships between the variables.
- **The user feels sick or dizzy using our experience**
  We need to take care to limit the speed of acceleration of objects in the playground and keep in mind that a static reference can help users not feel motion sickness with other elements are in motion