■ Entry Title

Lazorz

■ Executive Summary

■ Concept Overview:

What is your Project?

Our project is an educational game built with open web technologies (HTML5/JavaScript) that focuses on the physics of light, reflection, and color.

At what stage of development is the Project?

Our project is at the playable prototype stage. Our basic game mechanics and engines have been implemented, with basic art assets and sprites. The project is ready for play testing, and our team will be seeking community contributions such as levels, art, and feature improvements after the conclusion of the STEM challenge. Our game has been deployed, and is available at: http://lazorz-fossrit.rhcloud.com

■ Educational Value Proposition and Impact:

What educational need(s) does your Project aim to address?

In our research, we identified several educational needs addressed in literature and reports for our home state of New York.

Based on the New York State Education Department's Core Curriculum for Intermediate Level Science (Grades 5-8) [1], we are addressing performance indicator 4.4b--the Major Understanding that "Light passes through some materials, sometimes refracting in the process. Materials absorb and reflect light, and may transmit light."

Our game helps students to "Construct explanations independently for natural phenomena, especially by proposing preliminary visual models of phenomena" listed under Key Idea 1, in the section *Scientific Inquiry: Analysis, Inquiry, and Design* Standard 1.2.

According to the New York State Education Department's Core Curriculum for Elementary Level Sciences (Grades K-4) [2], our game helps to illustrate *"reflectiveness of light"* and *"Light, Shadow, and Color"*--listed as two Major Understandings of the Physical Setting.

The New York City K-8 Science Scope and Sequence [3] regards "lighting and shadows" within scope as early as the *Grade 1 Properties of Matter* unit.

In examining the New York City High School Science Regents Scope & Sequence [4] our game helps to

prepare intermediate students to address concepts covered in *Physics: Unit 6* on light reflection.

How have you been/will you measure educational impact?

Educational impact can be measured though quantitative results such as website traffic, source code forks, user contributions, and email feedback.

Qualitative impact will be built into the game itself by including features such as a leader-board, and timed results for each player on each level.

Outside of the game, we will conduct entrance and exit surveys for play-testers within our target demographic, as well as their parents, teachers, and mentors, to help measure the impact and engagement capabilities of our game. Social impact and classroom engagement are just as much a goal of this project as STEM education. It is our belief that children who work and play well with others tend to be more engaged in classroom and group activity.

■ Research:

What research theories or evidence are driving the development of your Project? What, if any, research has been done, and what are the outcomes?

Primarily the research done for this project was market research. We Picked the educational elements to focus on first, and found that there were multiple laser simulation games, and it was a quite popular educational game mechanic. There are several physical [6] and digital models, but we wanted to improve the playability and social aspects of these games, while adding features like color filtering and multi-player support. The outcome is we are improving on a classic concept used by other projects, based on play-testing done on other projects in the field.

■ Contribution to the field of STEM Learning:

How does your Project address the challenge of STEM curriculum through digital gaming?

Gaming is second nature for many children. Though anecdotal, we conducted an un-official survey of some of our classmates and colleagues about whey they got involved in computing and programming. When asked, "Where did your interest start?" each one of the (8) people we asked responded with either console gaming or PC Gaming when they were younglings.

By not only using Open web technologies to build our game, but leveraging them to offer our source code and game assets open source, we are encouraging users to "pop the hood" and dive into the code, to request features and report bugs, to be part of the discussion on our mailing list. These are all standard practices in many open source projects, and the sooner students engage in communities like this, the more likely they are to pursue careers in engineering and programming. This project is not just a game, but with any luck will develop into a community where students can feel comfortable asking for help, asking for specific changes, and eventually create content and puzzles for their peers and future students.

■ Playability:

How does the Project work?

Players are presented with a 10x10 grid, with a bottom row of buttons. On the grid there are tiles representing beams of light, and obstacles. The object of the game is to place reflective mirrors on the grid to direct the beam around obstacles to the end tile to solve the puzzle. Some puzzles require the beam to be filtered through a certain color.

The user interface was designed with both desktop and mobile screens taken into consideration. Both mouse and touch screen inputs were accounted for when handling user input during game play.

Levels were designed to naturally progress in difficulty while introducing players to new tools. The first level simply requires a mirror to be placed in the correct position. The second level requires the player to rotate the mirror. The third level introduces obstacles, and the fourth level introduces colored filters. This gradual increase in difficulty works well as a tutorial of the features and tools available in the current version of the game, and serves as a proof of concept of game elements and mechanics.

■ Potential for Scale:

Does your Project have potential for broad scale impact? What is the feasibility of mass production, marketing and distribution?

This game was designed to be simple, and meet the lowest common denominators in usability and technical requirements.

If we were to produce physical copies of the game, our it would only need .013% of the space on a 650MB Compact Disc. In fact, our game could fit onto a 3.5inch Floppy Disk if it had to!

As our game playable via the web, distribution is a matter of directing prospective users to a URL, where they can choose to play the game, or download a local copy.

Scaling the game is as straight forward as adding more nodes to our cloud-based deployment. Our project is deployed on Red Hat's Openshift platform (http://openshift.redhat.com), which is backed by Amazon's Elastic Compute Cloud (EC2). If we were to experience an increase in users and traffic, there are upgrade paths provided by our Platform as a Service (Paas) provider to accommodate increased traffic.

We may be biased, but we feel there is a very high potential for broad scale impact. This is based on the popularity of other physical and digital laser games and our intention to target mobile platforms and the XO Laptop of One Laptop Per Child. We feel we are targeting the broadest device penetration for developing nations, while using the most up-to-date open web technologies, and engaging the largest potential developer communities.

Please outline your thoughts around an implementation plan.

See "Next Steps" portion of the application

■ Underserved Communities:

How can your Project be made available on a platform that is accessible to underserved communities, such as to being played via a dial-up internet connection with a standard web browser or mobile phones that have limited connectivity and functionality.

The code itself is "free standing." Meaning that if have a copy of the files locally on your device, you can play the game locally without the need of an internet connection. The current version of the game requires less than 1MB of space. If someone were using a dial-up internet connection (maximum speed of 56kbps), even at 25% speeds (12kbps), it would take just over one minute (~66 seconds) to download all the files and game assets. To play the game, you need only a standard web-browser (which again, does not need access to the internet) so users won't have to download any additional software or plug-ins onto their device.

Users who want to play the game from a touch-screen mobile device or tablet experience the same interface and game play elements as on a desktop. The resolution of the game grid and interface were designed with small screens in mind. Each tile is a mere 48x48 pixels; the favicon inside your browser's address bar is usually between 12-36 pixels wide. This makes the most resource intensive game assets as manageable as possible. It is a very simple, but very effective solution.

Users who want to play the game from the internet on a desktop, need only a web-browser. Our team developed grid and beam engines that use simple 2D vector graphics that require minimal amounts of processing power and bandwidth to render. If a device can render a web page, it has all the power it needs to handle rendering our game.

2 out of our 3 team members have been involved in making games for the One Laptop Per Child Project [5]. Our longterm goal is to ensure that this game runs on this platform, of which over 1.5 million units have been deployed in developing countries world wide.

■ Next Steps:

Sketch out your plan for what you will do next if you win the Grand Prize. What is your next stage of development?

If our project was selected for the grand prize, we would use the funding to advance and promote the project in the following ways:

- Hire students to work on the existing code-base, and implement features currently outside of the scope of the prototype version.
    - Explore the feasibility of native application development for mobile devices (e.g. iOS, Android)
    - Continue developing support for Facebook authentication and integration
    - Continue to implement multi-player support
    - Explore massive-multi-player game development
    - Add additional art and sprites for different looks, feels, and experiences
    - Implement other game modes such as Time-Trial and Survival
    - Implement a leader-board and rankings system
    - Create a level editor for teachers/mentors/parents/peers to create new puzzles

        - Ensure Lazorz runs on the XO Laptop, of the One Laptop Per Child initiative.
    - Partner with entities such as the Boston Museum of Science, the Rochester Museum and Science Center, and Strong Museum of Play to engage with public sector experts in Game Design and Education.
    - Partner with entities such as Second Avenue Software and/or other companies to engage with private sector professionals who design educational games.
    - Play-test our game in local Junior High classrooms in the Rochester Area
    - Use the internet to market our game to online educational game development communities and professional associations to garner additional support and publicity for our project.

[1]: http://www.p12.nysed.gov/ciai/mst/pub/intersci.pdf [2]: http://www.emsc.nysed.gov/ciai/mst/pub/elecoresci.pdf [3]: http://schools.nyc.gov/Documents/STEM/Science/K8ScienceSS.pdf [4]: http://www.nyccsse.org/scopeandsequence/HS_science_SS_Regents.pdf [5]: http://laptop.org [6]: http://www.khet.com/