

Project Proposal

Team: **ReflectoRay**

Team Members:

202201079	SalahDin Ahmed Salh Rezk	s-salahdin.rezk@zewailcity.edu.eg
202201293	Ahmed Muhammad Abdullah	s-ahmed.abdullah@zewailcity.edu.eg
202201517	Salah Mahmoud Gamal	s-salah.gamal@zewailcity.edu.eg

Team Contact: s-salahdin.rezk@zewailcity.edu.eg

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1 Project Overview

1.1 Background

The Ray Reflection Simulation is a Python program that simulates the reflection of rays off mirrors. The simulation uses the Turtle graphics library to visualize the behavior of rays as they interact with mirrors, allowing users to explore principles of reflection and geometric optics.

1.2 Objectives

- Create an interactive and visual simulation of ray reflection.
- Allow users to define the initial conditions of the simulation through a JSON file.
- Simulate the reflection of rays off user-defined mirrors and sources.
- Provide options to save the simulation as an image or record it as a video.

2 Technical Details

2.1 Technologies Used

- Python
- Turtle graphics library
- OpenCV (for video creation)
- PIL (Python Imaging Library)
- Rich (for progress visualization)
- TemporaryDirectory (for temporary file management)

2.2 Key Features

- **Configurability:** Users can define the initial conditions of the simulation, including mirror positions, source locations, initial angles of rays, and the number of iterations.
- **Interactive Visualization:** The simulation provides an interactive visual representation of ray reflection using the Turtle graphics library.
- **Image and Video Output:** Users can choose to save the simulation as a static image (PNG) or as a video (MP4). The video creation utilizes OpenCV.
- **Progress Visualization:** The Rich library is employed to display a progress bar during the simulation, providing feedback on the simulation's progress.

3 Implementation Plan

3.1 Milestones

1. **Basic Simulation Framework:** Implement the core functionality for ray reflection simulation using Turtle graphics.
2. **User Configuration:** Enable users to specify initial conditions through a JSON file, including mirror positions, source locations, initial angles, and simulation parameters.
3. **Visualization Enhancements:** Improve the visualization by adding features such as different colors for rays, graphical representation of mirrors, and dynamic updates.
4. **Image Output:** Implement the functionality to save the simulation as a static image (PNG).
5. **Video Output:** Integrate OpenCV to record and compile the simulation frames into a video (MP4).
6. **User Interface (Optional):** Consider adding a simple graphical user interface (GUI) for a more user-friendly experience.

3.2 Testing

- Conduct unit tests for individual functions and components.
- Perform integration testing to ensure seamless interaction between different modules.
- Conduct user acceptance testing to verify that the simulation meets user expectations.

4 Conclusion

The Ray Reflection Simulation project aims to provide an educational and interactive tool for understanding the principles of ray reflection. By allowing users to configure initial conditions and visualize the behavior of rays, the simulation promotes learning in the field of geometric optics. The implementation plan outlines key milestones to ensure a systematic and successful development process.