Team Project Proposal

Program Development in a Graphical Environment

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Interactive Wave Physics Simulator

Vanier College

420-SF3-RE

Prof.: Nagat Drawel

I. Task Description

Our project, the Interactive Wave Physics Simulator, is an application which aims to develop an interactive application that demonstrates various types of waves. The purpose is to provide an educational tool for students to understand better the concept of waves as it is also one of our program course for this semester.

The application will allow users to modify parameters (frequency, amplitude, wavelength, etc.) in real time and visualize waves equations ($A * \cos(kx - \omega t + \delta)$) and their mathematical relationships (for example its frequency λ would be $\lambda = \frac{2\pi}{k}$). Thus, the application is centered in the domain of physics simulations.

Functionality
- Simulate and display different types of waves (e.g. non-damped, damped, standing, traveling).
- Allow users to adjust wave parameters and instantly observe effects.
- Display equation and graphs relating to the simulation.
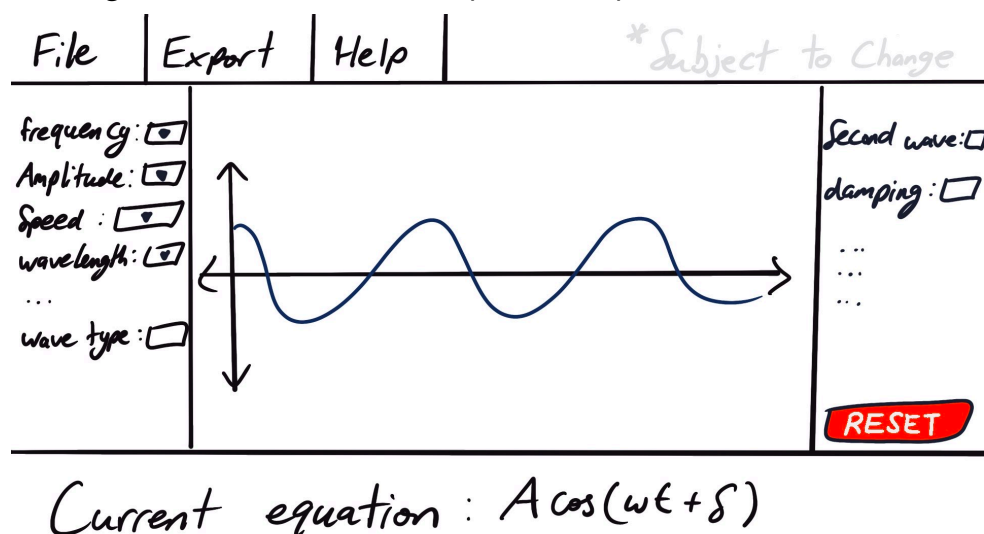- Export visuals for reports or presentations.

II. Interface Visualization

Main Window:
- Top: Menu bar (File, Export, Help)
- Left Panel: Controls for wave parameters (frequency / amplitude / speed / wavelength / etc.) and wave type.
- Center: Animated wave visualization (2D graph for displacement to position or time).
- Right Panel: Additional controls (second wave / damping / etc.)
- Bottom: Real-time equation display.

Visualization (Sample, might have differences with the final product):

Figure 1 — (Hand-drawn Sample) Mockup of the main interface

III. Proposed Implementation Approach

Technical overview:
- Programming language: Java 22
- Framework: JavaFX22 for GUI / Visualization

Project Structure:
- `Main.java` : Main program to run / Application entry point.
- `WaveSimulator.java` : (Model) Core logic for wave calculations.
- `WaveDisplay.java` : (View) JavaFX scene for drawing waves animation and parameter controls.
- `WaveController.java` : (Controller) Event handling for user interactions.
- `Utils.java` : Utility functions / tools for calculations, including import and export of the file and exporting the graph as image.

Libraries and Tools:
- JavaFX22 - GUI and visualization - https://openjfx.io/
- ChartFX - Chart Animation Library - https://github.com/fair-acc/chart-fx

IV. Trello

We will be using Trello to plan and track our tasks during the development process. Team members will be assigned to specific tasks and will update the status on Trello as members progress.

Trello Board Link
https://trello.com/b/QBSKjbH8/project

V. Version Control (GitHub)

We will be using GitHub for version control and each team member will review the work before merging. The repository owner does not mean to be the one who does the most work.

GitHub Repository Link
https://github.com/Cloumy074/Vanier_420-SF3-RE_F25_Team-Project.git

VI. References

- OpenStax, University Physics Volume 1
- Macmillan Learning, Physics for Scientists and Engineers 6e
- Document Template by hzkonor on Typst