ZenithAngles

Project Overview: Interactive 3D Visualization of Plane and Normal Vector Angles

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Client: Centre for Development of Advanced Computing, India

Project Goal: To create an interactive educational tool that helps students understand the mathematical relationships between planes and their normal vectors in 3D space.

Project Description:

We developed a highly interactive and user-friendly React website designed to visually demonstrate the mathematical proofs of angle relations between planes and normal vectors. The primary features of the website include:

1. 3D Visualization of Planes:

- Users can input the coordinates of the planes.
- The website dynamically generates and visualizes these planes in a 3D space.

2. Angle Calculation:

- The application calculates the angles between the planes and their normal vectors.
- A draggable protractor is provided to measure these angles, offering an intuitive understanding of the geometric relationships.

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3. Educational Focus:

- The primary users of this website are students.
- The platform is designed to be engaging and easy to use, ensuring that students can explore and learn without frustration.

4. Comprehensive Tutorial:

- A step-by-step tutorial is available to guide users through the functionalities of the website.
- This tutorial ensures that even users with minimal prior experience with such tools can navigate and utilize the features effectively.
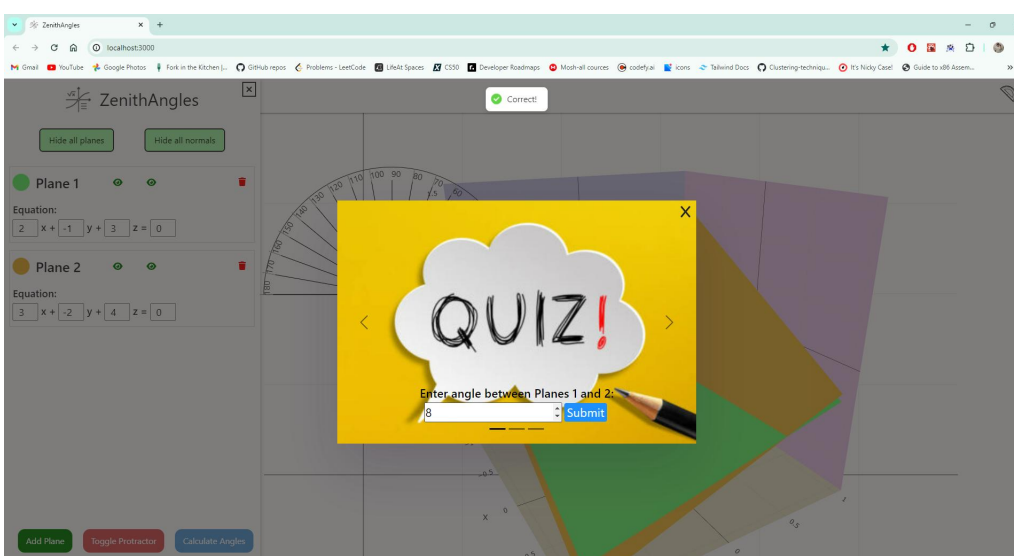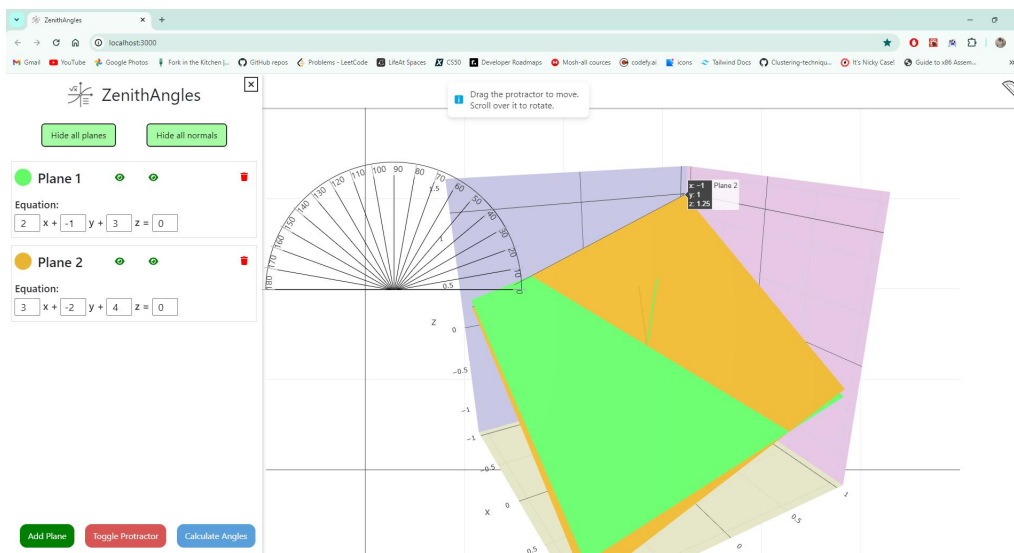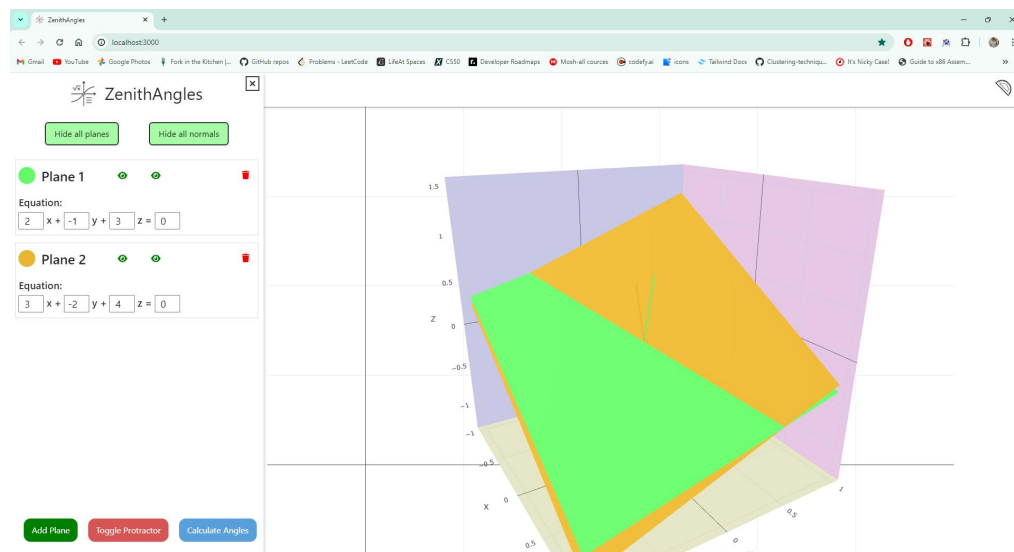
Technical Stack:

- **Frontend:** React
- **3D Rendering:** ChartJs, ReactPlotlyJs
- **Interactivity Tools:** Custom draggable protractor for angle measurement

Educational Impact: This project serves as an innovative educational resource, making complex mathematical concepts more accessible and understandable for young students. By integrating interactive 3D visualization and user-friendly tools, it fosters a deeper engagement with the subject matter and encourages self-paced learning.

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App Screenshots:

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Angle List

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- Angle between Plane 1 and Plane 2: 6.982 deg

The angle θ between two planes, n_1 & n_2, can then be calculated as:

$$\theta = \cos^{-1}\left(\frac{n_1 \cdot n_2}{\|n_1\| \, \|n_2\|}\right)$$

Where:
- $n_1 \cdot n_2$ is the dot product of the two normal vectors.
- $\|n_1\|$ and $\|n_2\|$ are the magnitudes of the normal vectors n_1 & n_2