Group 6: 3D Web about Solar system

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Instructions:

1. Please open the file named `Group6-3DWEB` in the Visual Studio Code.
2. Before you compile code, you need to install an extension in Visual Studio Code. The steps of installation is following:
   a. On the left side, click `Extensions`.
   b. Search `**Live Server**`(with identifier Ritwick Dey) and install it.
3. Go back to `Explorer`, you will see three folders(respectively scene1, scene2, scene3). In each of folder, you could run its .html file. Here, we really recommend that you firstly run `main.html` in the scene1 folder.
4. Please right click on `main.html`, then choose `**Open with Live Server**`.

Notes: Although you can open .html files in the default browser, you probably cannot see any of 3d objects because of issues about browser setting. So, please use Live Server Extension to compile and run the code.

Operating Instructions:

- PAN: dragging while left click / 3 fingers swipe (rotate the scene, checking on different angles of view)
- ZOOM: 2 fingers swipe forward or backward / scroll (scale up and down)
- CLICK: left click (checking on information, switch among scenes by clicking the navigation bar on the right)

Functionality:

Scene1 functions:

The initial scene displays the solar system, which contain the sun, 9 planets and its orbits, (And also the moon associated with the earth). The background of scene consists of the skybox that imitates the universal space, and the animated stars that stimulates galaxy. Additionally, the planets are randomly placed on the orbits every time the user enter or refresh the page. By default, the planets are rotating and revolving just like reality. The revolution only stoped when the user clicked on the target planet, which is for a better visual effect. At the same time, the rotation will remain dynamic until the user starts to take control. Moreover, there will be certain animation shown while clicking on the planet, which meant to perform an effect of camera approaching for improving interactive purpose.

1. Hover: brighting effect when moving mouse on target planet & animation when moving mouse on buttons.

2. Check details of planet: left click on any of target planet (except for moon).
3. Check another planet: left click on next target planet. Or left click current planet again and then click on next target planet.
4. Back to initial: left click on sun / left click again on current planet

Scene2 functions:

The main body of the scene consists of three planets: the sun, the earth, and the moon. The earth revolves around the sun, while the moon revolves around the earth, both at a certain speed. In some special cases, the three planets are on the same line, which will lead to solar and lunar eclipses. These two common natural phenomena are the theme of this scene.

To give users a better experience, we have specially added three buttons in the upper left corner. They correspond to the initial scene, solar eclipse, and lunar eclipse. When they click "Solar Eclipse", the three planets will rotate faster until they show a state of "solar eclipse". The same is true for the "Lunar Eclipse" button. At the same time, the text box and graphic introducing either eclipse both will be displayed on the left to tell the user the principle of these two natural phenomena. When the user clicks "Initial Scene", it will go to the first scene — the three planets rotate freely.

Sence3 Functions:

There is a rotating earth on this scene.

1. Earth can be zoomed in/out and rotated.
2. Users can click any of circle points on the earth, and then a pin will be on it.
3. The relevant 3D model of iconic landmarks or special local product can be shown on the left top after clicking on a circle point. Users also can use mouse/trackpad to zoom and rotate 3D model. Meanwhile, the text information about country and 3D model is shown on the left bottom.
4. Users can click on `close` button to close both 3D model and text box in order to continue to check next circle point.

Experiment Preparation

Research question: We want to investigate whether interactions through the 3D Web can help people better understand the solar system.

Experiment goal:

Using the interaction with 3D web, we hope that users can experience the charm of astronomy from different perspectives. Meanwhile, it increases interest, promotes independent exploration, enhances understanding of knowledge, and establishes a connection between geographic knowledge and physical objects. Especially for some complex and abstract content, 3D-web interactive technology can enhance users'

cognition and feelings. However, the different 3d-web interactions will affect the degree of help to users. This experiment aims to find out which interactions are more or less helpful to users. Therefore, we need to make an experiment to see which interaction mode is less helpful, and then further improve our 3D web through data analysis.

Experiment process:

We decided to complete the experimental goal in the form of a questionnaire. The specific experimental process is as follows:

1. Confirm the experimental variables. There are three types of variables, which are listed below:
   - Independent variable: 3D interaction(the levels based on interaction ways).
   - Dependent variable: degree of help to users(five levels).
   - Control variables: Quiet room, stationary temperature, healthy participants, specific experiment time.
2. Design the questionnaire contents based on these variables. The link of questionnaire is shown below: https://docs.google.com/forms/d/e/1FAIpQLSfPeM_15pSGcD_AoJu4Y_V-4OkSVryM5SjMr2jx4aBxDt63Vg/viewform, which has two parts: close-ended & open ended questions.
3. Identify participants: Since our web pages can only run locally, we can't let people to experience 3D web through web link. The serious covid-19 situation is also one of the factors to be considered. Therefore, we decided to invite our relatives and friends to become participants, and invite at least 2 participants for each group member(totally at least 10 participants). They will experience our website on the computer and then fill out the questionnaire after the process.
4. Determine the experimental time: We plan to set up a minimum experience time of 5 minutes to ensure users have used all the functions of our website. In this way, the feedback they give in the questionnaire will be more valuable.
5. Collect & analyze experimental data: In our close-ended survey questions, the Likert-scale data with five levels for degree of help will be collected(very much, much, neutral, little and very little). In this way, we are able to understand how much the different interactions with 3D web help us know about the solar system. And then, in the process of analyzing the data, we are able to implement descriptive statistics analysis methods to explore the results of our data. To get an overview of data, creating a frequency distribution table is a good way to know the frequency for different degrees of help in each of the interactions and which interaction could help users know about the solar system. At the same time, plotting pie-charts also gives us an intuitive idea of what percentage of people think the 3D interactions in the web are helpful or not for their comprehension of the solar system. In addition, we can implement an ordinal logistic regression model to further study the relationships between 3D interactions and the levels of understanding about the solar system.

Differences with the implementation and project plan

Because there are many objects in three scenes, it could be slow to load pages. So, we add a pre-loader effect while web is loading. In addition, the navigation bar enables users to flexibly switch among scenes, and also making whole pages to be consistent.

- Scene1: We planned to create simple plane geometry for orbits. In order to build a more realistic environment, we now use particle motion create orbits in the scene1. And also, we add hover effect on each of planets, giving users a better interactive experience.
- Scene2: On the top left, the design of three buttons provides users a way to flexibly check various happens of eclipses.
- Scene3: The original plan for this scene only has text information after users click any of points on the earth. Now, we add one more 3D space that emended in the scene3, which means users are able to control over 3D objects and better know the country information and its iconic landmarks.