Scatter Cube for Scatterplot Matrix Navigation in Virtual Environment

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ABSTRACT

Scatterplot Matrix is a common model of multi-dimensional data visualization at present, which can visually present the relationship between the dimensions of the data set. In the navigation of scatterplot matrix, how to better understand the transformation process of scatter in the navigation of scatterplot matrix is a great challenge. In this work, an interactive method of scatter cube is developed to navigate in the scatterplot matrix. Three-dimensional cube is used as the visual carrier of scatterplot matrix navigation. The two-dimensional scatter points are projected to three-dimensional for transportation, and projected back to two-dimensional at the end. Spatial thinking is used to enhance users' cognition of dimension transformation in the process of scatterplot matrix navigation, so that users can better explore the relationship between the dimensions of multidimensional data.

Keywords:Scatterplot matrix, Multi-dimensional data, Navigation. Virtual environment,Interaction.

1 INTRODUCTION

At present, the visualization of multi-dimensional data mainly includes methods of high-dimensional data dimensionality reduction, interactive dimension mapping, and scatterplot matrix, etc, in which the scatterplot matrix is a common method for multi-dimensional data visualization.

The scatterplot matrix enables users to see all dimensions and the combination of the two dimensions by mapping the data dimensions on rows and columns , presenting all dimensions together.

Elmqvist[1] and Fanny[2] have developed an interactive tool for structured visual exploration of multi-dimensional data in scatterplot matrix. Which uses the method of constructing volume to metaphorize the navigation between scatter plots and thus optimize queries,aiming to show the correlation and differences between dimensions in the dataset. On a two-dimensional plane, Elmqvist[1] and Fanny[2] construct three different dimensional data from two different scatter plots into a cube, and then project the data into one face of the cube to switch the adjacent scatter plot by rotating the cube.

The contribution of this work is to place the process of volume construction in a three-dimensional environment, and to construct three different dimension data from two different scatterplots into a cube in a 3D scene. Use the depth and volume cognitive advantages inherent in the three-dimensional scene to enhance the user's awareness of the process of switching between scatter plots.

2 DESIGN

This work is based on Elmqvist[1], Fanny[2] and others. This work uses Unity 3D to develop an interactive tool for scatterplot matrix diagrams in three-dimensional scenes, which is divided into 4 parts: layout, projecting to 3D ,projecting back to 2D and interaction.

2.1 Layout

The layout of this work consists of two parts: scatterplot matrix and scatter cube. The purpose of the scatterplot matrix diagram (shown in Figure 1) is to present an overview of the entire dataset, which is convenient for users to navigate. The function of a scatter cube (shown in Figure 2) is to construct the volume of the dimension mapping, presenting the dimensions of the two scatter plots in the same three-dimensional space object, and switching the scatter plot by rotating and projecting the three-dimensional object.

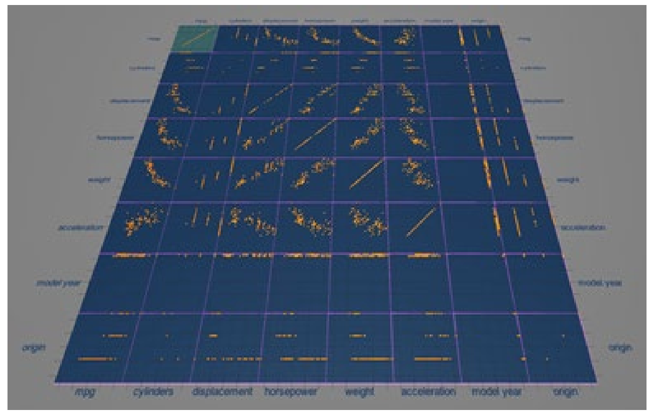

Figure 1: Scatterplot Matrix.

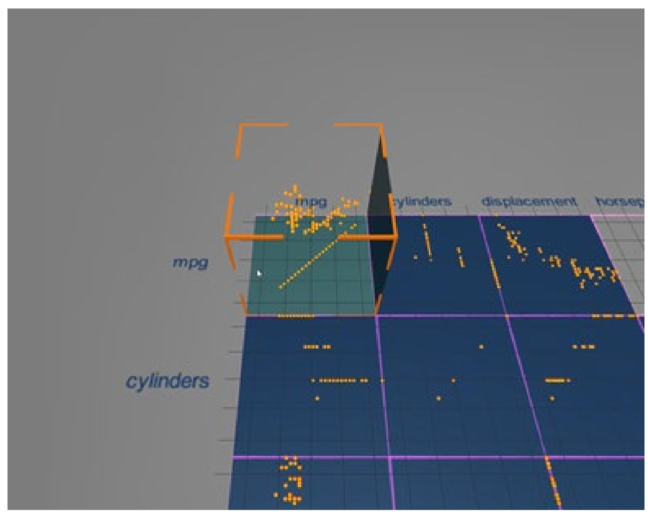

Figure 2: Scatter Cube.

2.2 Projecting to 3D

Projecting to 3D is intended to map the three dimensions associated with two scattered units into the same cube. The process of Projecting to 3D (shown in Figure 3) is divided into: scatter unit stand up, scatter cube move, scatter cube generation, scatter point mapping to the scatter cube.

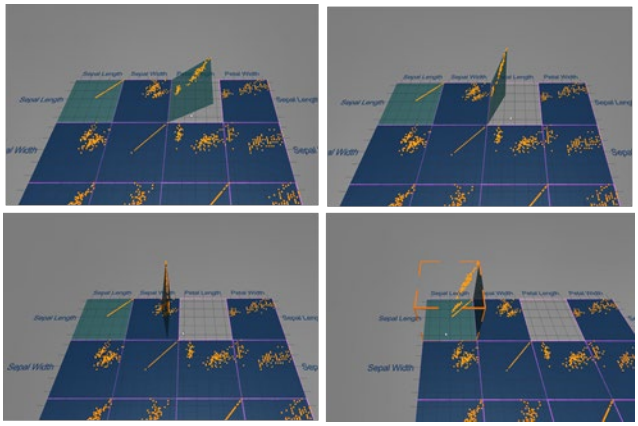

Figure 3: The process of Projecting to 3D.

2.3 Projecting Back to 2D

The purpose of projecting back to 2D is to project the scatter cube back into the scatter unit, so as to realize the transition from three-dimensional scatter to two-dimensional scatter. This process (shown in Figure 4) is mainly divided into: scatter cube generation, scatter cube movement, scatter cube flip, scattered cube projected back to a two-dimensional plane.

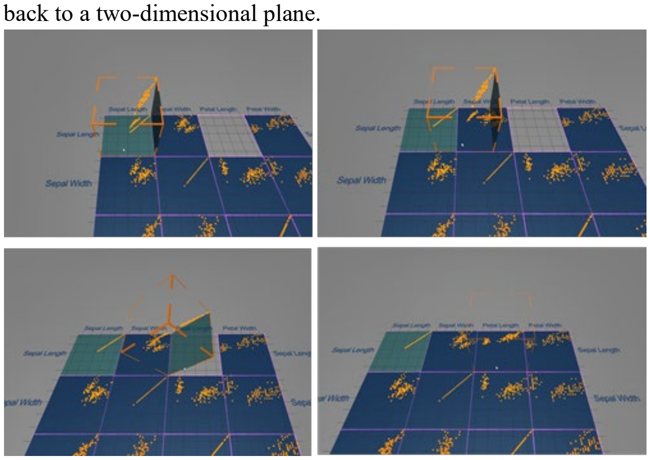

Figure 4: The Processing of Projecting Back to 2D.

2.4 Navigation Process

The default starting scatter plot for this work is the first scatter plot unit in the upper left corner of the view. Click to select the target scatter plot that needs to be switched. The system will automatically plans the transformation path of the scatter cube from the starting scatter plot unit to the target scatter plot (as shown in Figure 5). In this work, the cube is set to move the X-axis first and then the Z-axis (as shown in Figure 6).

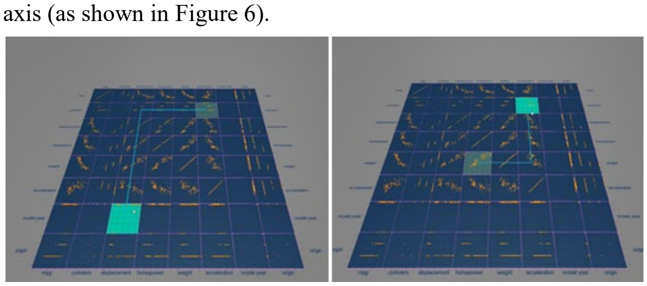

Figure 5: Path planning.

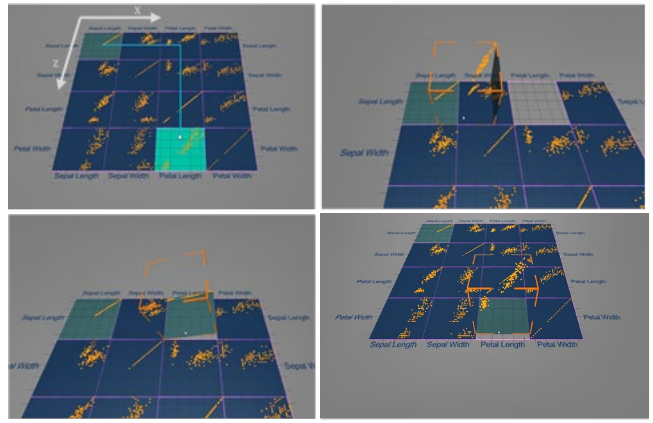

Figure 6: Path planning.

3 Conclusion and Future Work

In this work, an interactive technique of the scatter cube is developed to assist the navigation process of the Scatterplot Matrix. The navigation process is firstly mapped to a three-dimensional object, By transforming three-dimensional objects, the dimensional switching between scatterplot matrix is realized, which enables users to better understand the dimension switching process.

In this work, we use the plane display as the presentation carrier and interact with the mouse. This is not the best way to render and interact with objects in a 3D scene, and in the future we will present in a virtual environment, interacting with graphics in a more natural way. Future work will also include other visualization operations,such as graphic selection, historical queries, and more.

4 Acknowledgements

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References

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