

[0035] A data element is the graphical representation of a row resulting from a query. It is always associated with a layout and data source, and it is constructed much like a scene. It may contain any combination of objects, including layouts and wormholes to other scenes. Properties for objects making up a data element may not only reference scene parameters, but may also reference column names in the associated data source.

[0036] Scenes and data elements may be represented differently as a function of the user's zoom level. Each representation is called a level of detail (LOD), and is visually mutually exclusive from other LODs. For example, an object that starts off represented by a single dot may change into an icon as the user zooms closer, and then into a chart as the user zooms even closer.

[0037] Transition points between levels of detail are defined manually by the user in terms of zoom factors. A scene or data element may have N-1 transition points for N levels of detail.

[0038] Visibility can also be controlled on a per-object basis by setting a "Visibility" property to a conditional expression such as

[0039] `If(UserZoom>2, true, false)`

[0040] Thus, transition regions may be created where alternate representations overlap for certain ranges of zoom levels rather than being mutually exclusive. Overlapping may be particularly important in the creation of layered maps containing multiple data elements. Furthermore, more complicated expressions can be used to control visibility to achieve other effects.

[0041] Data sources can be named SQL queries that may be parameterized by one or more identifiers that are set at runtime. As data sources are defined, they are named and added to a world and displayed in the data sources category of the World Manager. They are then available for execution. The results can be browsed in a data sheet or used in a layout. When used in a layout, each row resulting from the query is transformed into a graphical representation represented by a data element. Columns in the resulting data source may be linked to attributes of objects contained in the data element. Parameters present in the data source query may be associated with a global program variable, with a local scene parameter, or with a column in a data source higher in the world tree hierarchy.

[0042] FIG. 1 shows a multiple-document interface for editing one or more worlds simultaneously. The principal portions of the user interface are a World Manager window 10, project workspace and editor window 20 and 22, an Object Inspector 30, a control bar 40, and an output window 24.

[0043] The world workspace is a background area that contains the editor windows. Four types of editor windows are provided. A graphical drawing editor called a scene editor is provided for composing a top-level scene. A graphical drawing editor called a data element editor is provided for defining the representation of each data point in a layout. A tool called a query editor is provided for defining SQL queries, either by constructing a graphical block diagram of the query or by directly entering the SQL manually. The query editor also provides a datasheet for viewing the results

of a query. Additionally, a world editor is provided which shows two views of a complete virtual world: the first is the world structure view showing the navigational hierarchy of the world along with parameter linkages, and the second is a read-only pseudocode view providing documentation and search capabilities for the complete world.

[0044] The World Manager window 10 is the principal interface for editing and managing a user's open world(s). It has a dockable control bar with tabs 12, 14 and 16 and corresponding panels of information. When the user clicks on a tab, the tab is moved to the top and an underlying panel is shown. Each panel in turn presents a set of buttons, for displaying categories of information. The clicking of a button displays the category of information associated with the button. The Graphics tab 16 presents a categorized palette of all graphical objects that can be added to a scene or data element.

[0045] The World Manager 10 may be docked to either the right or left of the workspace 20. In its docked state, it may be stretched horizontally to enlarge or reduce the dimensions of the panels. In its floating state, it may be stretched both horizontally and vertically.

[0046] In the example of FIG. 1, one tab called a Worlds tab 12 displays three separate views of the structure and hierarchy of the worlds currently open. Each open world is displayed underneath the main workspace item in a tree control 18. A context menu is available for each item displayed in a tree control and provides a list of common menu commands for the selected item when a right mouse button is clicked.

[0047] In this example, a scenes category displays global parameters and scenes contained within each open world. Global parameters are identifiers which may be referenced anywhere within the hierarchy of any scene in both object properties and event actions. Underneath each scene is a list of its local parameters (if any) and viewpoints, along with the levels of detail for the scene and a hierarchical list of the objects that comprise each level of detail. Each level of detail is mutually exclusive from the others when viewed. In other words, only one level of detail is visible at a time. The order of the objects in the tree beneath a level of detail determines their drawing order. Objects displayed underneath other objects are called child objects, and their owners are called parent or composite objects. Certain items in the tree may reference other items in the tree such as a wormhole (discussed below) which references another scene, or a data element which references a data source in the tree for the data sources category.

[0048] The data sources category displays a list of queries contained by each open world. Each data source in turn contains a list of query parameters, column names or aliases, and a diagram if the query diagram editor was used to construct the query. When present, query diagrams contain the list of blocks and connections used in their construction. The resources category displays a list of execution resources that may be used in the computation of property values for scenes and their graphical content (nodes). The basic resource types may include colormaps, color sequences, stock images, and user classes.

[0049] The data tab 14 contains two categories of information: Query Design, which provides a palette of elements