Spherical Layout
Layout for 3D Graph Visualization

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Information Visualization is a field of research that has less than ten years of history, but has growing very fast as a reach and interdisciplinary research field. The last advances in Visualization and, particularly in Information Visualization, also highlights fundamental research issues. Nowadays, it is currently a challenging task for designers to find out the strategies and tools available to visualize a particular type of information.

The data characteristics and their organization are essentials aspects when an adequate visual representation must be selected. The creation of adequate visual representations is a big challenge. A visual representation is able to convey relationships among many elements in parallel and provides the user with a tool to explore the data in an effective way. Visual representations are essential aids to human cognitive tasks to the extent that they provide stable and external reference points upon which dynamic activities and thought processes may be calibrated and upon which models and theories can be tested and confirmed. The interaction with visual representations makes many complex and intensive cognitive tasks feasible. Visual representations and interaction techniques must allow the users to see, explore and understand large amounts of information at once and are essential to the analytical reasoning process, in order to gain insight in the data.

Computer networks, business processes, database schemas, software systems, social networks, the Web, … have in common that they can be modeled as graphs and that visualization is crucial. A graph is a discrete structure consisting of vertices and edges, where the vertices correspond to the objects and the edges to the relations of the structure to be modeled.

The first step to obtain a visual representation of a graph is to determine where to place the vertices and edges, in the 2 or 3 dimensional space. The space solutions for this problem is huge and only very few representations can be considered acceptable from the effectivity/usability point of view.

The 3D graph visualization faces multiples challenges: the election of an appropriate layout, the use of the interactions that make it easier the data exploration and a metaphor that helps the information understanding. A good combination of these three elements (layout, interactions and metaphor) will result in a visualization that effectively convey the key features of a complex structure or system to a wide range of users and permits the analytical reasoning process.

The goal of this work was centered in the graph visualization. The hope is that the extra dimension would give, literally, more *space*, and that this would ease the problem of displaying large structures. In spite of their apparent simplicity, the displaying of graphs in 3D can also introduce new problems that can be overcome with the appropriate interactions. So, we have developed a new visualization technique for 3D graph visualization; this includes the design of a new graph layout that we called spherical layout and the set of interactions that can be applied on this representation. This technique allows representing structures to different levels of detail and also can be used as a visualization technique that allows more information to be visualized; based on the universe metaphor, the visualization technique was extended keeping all the time the consistency between the visual representation and the metaphor.

We propose a new 3D graph layout, the Spherical Layout. This layout is a 3D extension of the 2D radial layout. The radial layout positions the nodes on concentric circles according to their depth in the spanning tree generated from the graph. A sub tree is then laid out over a sector of the circle and the algorithm ensures that two adjacent sectors do not overlap. In order to generalize the 2D radial layout algorithm for 3D, we map the concentric circles to concentric spheres and place the nodes on the sphere surface. To do this, we have developed two different alternative algorithms.

With respect to the interactions, we can say that virtually all 3D displays of graphs allow the user to interactively change the view by *moving around in space*. Besides the classical interactions of 3D visualizations we defined a set of interactions to fly through in the visualization. This does exist in other 3D visualizations; however, in this case we differentiate between two types of navigation, the directed and the free one. It is also allowed for the user to have four different visualization views of the same object.

We also developed a metaphor in order to enriches the visualization and allow the user and the designer of the visualization to have additional elements to work with. In this case, we can say that many systems have used the

planets and stars metaphor before; but in all those cases the relationship between the visualization and the metaphor was too much flexible. We present a new metaphor for information visualization using graphs along with the concepts of planets and stars.

In short, spatial layout and graph drawing algorithms play a fundamental role en Information Visualization. A good layout effectively conveys the key features of a complex structure or system to a wide range of users, whereas a poor layout may obscure the nature of an underlying structure. We have developed a new 3D graph layout, the spherical layout, a set of interactions on this representation and a metaphor that can enriches the visualization of the graph; that is an interactive graph visualization technique based on the planet metaphor.

As future work we plan to design new algorithms that present alternative distributions of the nodes on the sphere in order to do a better sphere surface use optimization. With respect to the interactions we will continue searching for new ways to enhance the communication and interaction between the user and the visualization. We also plan to use usability tests to evaluate how the metaphor influences in the perception of the visualized information.

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