

Multispace Information Visualization Framework for the Intercomparison of Data Sets Retrieved from Web Services

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ABSTRACT

We introduce a new visualization framework for the intercomparison of more than one data set retrieved from Web services. In our framework, we use more than one visualization space simultaneously, each of which visualizes a single data set retrieved from the Web service. For this purpose, we provide a new 3D component for accessing Web services, and provide a 3D space component, in which data set retrieved from the Web service is visualized. Moreover, our framework provides users with various operations applicable to these space components, i.e., union, intersection, set-difference, cross-product, selection, projection, and joins.

Categories and Subject Descriptors: H.5.2 [User Interfaces]: Graphical User Interfaces (GUI), Interaction Styles

General Terms: Design, Human Factors

Keywords: Visualization, Web service, IntelligentBox, WorldBottle

1. INTRODUCTION

Recently, we can obtain lots of information through various Web services, especially, in the fields of product information and bioinformatics. Web services are software components invoked remotely through an XML interface. In this paper, we define Web services as the enabling technologies satisfying the following three requirements: (1) Web services are software components made available as services over the Internet. (2) The interface of these software components are described using the WSDL. (3) Web services use the SOAP protocol for exchanging messages.

The motivation for this work arises from the following consideration. First, users may need to compare the visualization of more than one data set, which requires their simultaneous visualization instead of their sequential visualization. Second, programmers can use various Web services to access data resources, and they can combine Web services with each other. However, it is difficult for endusers to interactively use and/or combine Web services through graphical user interface.

Such consideration has led us to introduce a new framework. Our framework has the following three functions; (1) one for using Web services in a 3D environment, (2) one for visualizing more than one data set retrieved from Web services in more than one visualization space, and (3) one for

applying operations to visualization spaces. Our framework exploits a 3D meme media system IntelligentBox[1] as its platform.

2. ACCESS TO WEB SERVICES

We introduce a 3D proxy component for accessing Web services. This component works as a proxy of Web services. We also introduce 3D component mechanisms for creating requests to Web services. Figure 1 shows our architecture for accessing Web services. (1)(2) For a desired Web service, the user first inputs the URL of its WSDL into the Web-ServiceProxyBox(WSPBox), and selects an operation from the function list in the WSDL. (3) The WSPBox creates QueryBoxes automatically to create a request to the selected operation. The selected operation may require various parameters that are constructed by various types, i.e., string, integer, and a compound type “struct”. Each parameter is treated as a slot. If the parameter has a compound type, the QueryBox has a child QueryBox to create a compound type value (e.g. para3 in Fig.1). (4) User adds boxes as user interfaces in order to input values to QueryBoxes (e.g. StringBox for para1). User inputs values into the added boxes to create a request. (5)(6) The WSPBox retrieves information about the created request from the selected Web service. (7) WSPBox extracts the data set portion from the data retrieved from the Web service. (8) The extracted data set is visualized by our framework for the virtual reification of database records[2]. By introducing user-defined visualization components, any types of data sets can be visualized in arbitrary manners.

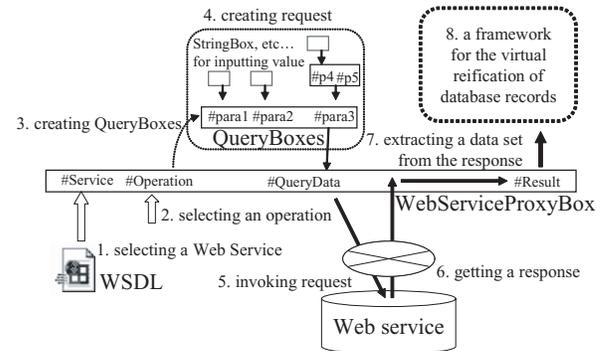


Figure 1: The architecture for accessing Web service.

3. VISUALIZATION IN WORLDBOTTLES

To visualize more than one data set in a single visualization environment, we use a 3D space component called WorldBottle[3]. The WorldBottle displays a relevant information space in its inside, and works as a portal to this visualization space. We introduce mechanisms for combining WSPBoxes and WorldBottles. Data sets created by WSPBoxes are sent to the spaces displayed in WorldBottles through their #I/O-Port slots. To connect one Web service to another, we provide a special component called Mapping-Box. The MappingBox gets a value of an attribute in one record, and sets this value to a parameter of the selected operation.

Consider the following example of Fig.2 and Fig.3. First, the user inputs a keyword, and obtains a PDB (Protein Data Bank) id list from SRS service. The result id list is visualized in space B by sending the data through the #I/O-Port of WorldBottle. Next, the user can get 3D structure data of the protein retrieved from GetEntry service for each pdb id. The pdb id in one record in space B is set to the parameter of GetEntry service through a MappingBox. Data sets retrieved from GetEntry service are visualized in space C, D, and E. The user can simultaneously observe more than one protein 3D structure related to the same keyword. Figure 3 shows that the user can easily change representations, among “Spacefill”, “Ball and Stick” and “Wire Frame”, using other WorldBottles.

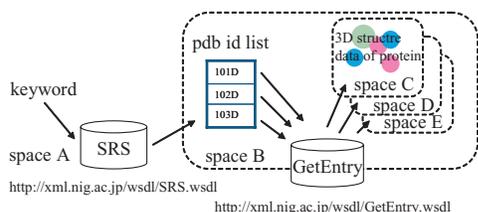


Figure 2: An example of connecting Web services using multiple spaces.

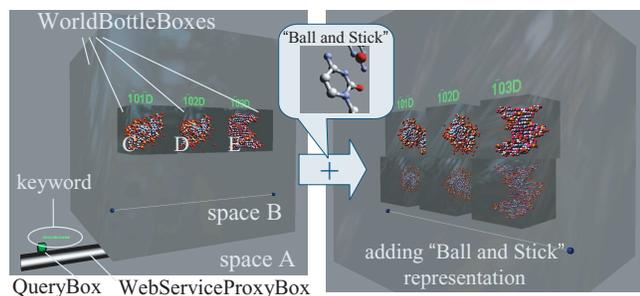


Figure 3: Snapshots of an example Fig.2 and adding another representation.

To compare different data sets visualized in different WorldBottles, we provide mechanisms for simultaneously manipulating scenes displayed in more than one WorldBottle, such operations include panning, rotating, zooming, and mechanisms for manipulating objects visualized in each WorldBottle, i.e., rotating, translating, scaling. Each manipulation is applied to more than one WorldBottle in parallel. In Figure 3, the user is simultaneously manipulating scenes and data sets in the WorldBottles C, D, and E, which are children spaces of the space B.

4. OPERATIONS

Now, we introduce operations applied to each WorldBottle. Operations applied to a WorldBottle are applied to the data sets in this WorldBottle. Using this framework, the user can compare data sets and recognize the differences between data sets. We use database relational operation as operators, i.e., union, intersection, set-difference, cross-product, selection, projection, and joins. To use relational operation as operators, each space is treated as a database view. Every operation to spaces is treated as a view modification. Figure 4 shows that the operation to select a data set with the condition “ $\sigma_{chainID="A"}(R1)$ ” allows us to create a new view $R2$. Figure 5 shows that the space $R1$ can be dropped into $R2$ to make the view $R2$ modified to a new view $R3$ which is the union of view $R1$ and $R2$.

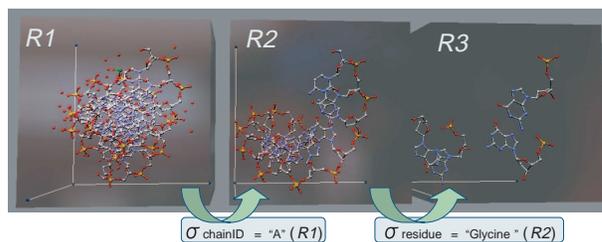


Figure 4: An example of selection.

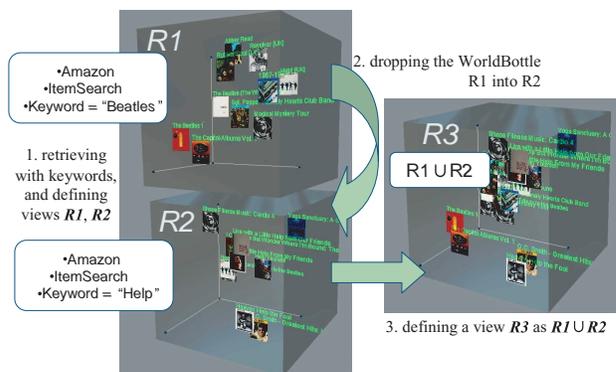


Figure 5: An example of union.

5. CONCLUSION AND FUTURE WORK

Our framework provides basic mechanisms for the inter-comparison of more than one data set retrieved from various Web services. Moreover, we can easily create integrated 3D visualization systems for Web services and Databases, using our framework. We are considering some improvement to our framework, i.e., other types of operators applicable to representations in order to compare data set more effectively, and mechanisms for carrying out operations on a set of spaces all at once, and more effective interaction techniques for all operations.

6. REFERENCES

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