KINISIS, a Graphical XQuery Language

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Abstract: *EXtensible Markup Language (XML) tends to become a standard way of data interchanging on the Web. XQuery is the W3C standard to retrieve information from XML documents. Moreover, graphical user interfaces are user friendly enough for naive users to use them. Thus, a graphical query language for XML documents is a very interesting research field. In this paper we introduce KINISIS a new graphical query language which is designed and implemented upon XQuery which uses metaphors extracted from the road traffic act. Moreover, we present the results of the controlled experiment that we developed in order to evaluate KINISIS usability against XQuery.*

Keywords: *Database and XML, XQuery, Metaphors, Graphical query languages.*

I. INTRODUCTION

XML (Extensible Markup Language) (XML, XML 1.0 Recommendation 2006) is a markup language developed by the World Wide Web Consortium (W3C) to deliver structured content over the web and to provide a competitive way of storing data. XML query languages were mainly designed as a solution for retrieving information from XML documents. Traditional SQL applications can evolve to deal with XML data using extensions for XML to construct XML data from relational data, as well as store, query, and retrieve XML data. These extensions form the SQL/XML (Beza et al., 2007, Funderburk et. Al., 2002) and were mostly used in DBMSs; however there was a need for purely expression languages to perform this kind of applications created that led to XML Query languages. More than twenty different query languages for XML data were introduced. In (Bekiropoulos et al. 2010) an analytical review is presented for XML Query languages.

On the other hand, the majority of computer users need only to learn how to complete simple work tasks, whereas the problems they have to solve are usually expressed in non-computing terms. Nowadays, the main type of user has changed from the skilled professional to the computer literate (unskilled or naive) user, and thus the user interface has to be simpler and friendlier. The initiation of graphical user interfaces, which utilize users cognitive skills and harness, both advances in graphics technology and increased computing power, simplified and improved the way users interface with computers and made computer systems accessibly to an even larger number of users. Currently, graphical user interfaces have become an essential part of any computer system and system designers have come to accept that in order to improve users' productivity, it is essential for a user interface to address users' skills (Dix et. al., 2004).

Thus, a number of graphical interfaces for XML query languages were developed. XML-GL (Ceri et. al., 1999, Erwig, 2000) is a graphical query language that depicts documents and their related Document Type Definition (DTD)s with the use of graphical representations. Recently, a graphical query language called XQuery By Example (XQBE) (Braga et. al., 2005) was created, based on XML-GL. In fact XQBE implements XQuery 1.0 queries (XQuery 1.0, 2007) with graphical representations. Xing (Erwig, 2003) is a graphical query language as well as visXcerpt (Fuhr and Grojohann, 2001, Bry and Berger, 2003, Berger et. al., 2004), which is an extension of Xcerpt (Bry and Berger, 2003, Berger et. al., 2004). In Bekiropoulos et al., (2010), an analytical review of graphical interfaces for XML query languages is presented. Moreover, a list of features is introduced that a graphical XQuery language should support as a result of the review.

The structure of this paper is as follows. In section II, we present KINISIS our new proposed graphical query language, which is designed and implemented upon XQuery by using metaphors extracted from the road traffic act. In section III, we briefly analyze the implementation of KINISIS by presenting some examples, and in section IV, we present the experimental evaluation of KINISIS usability vs XQuery. Finally, in section V, we draw our conclusion and our future plans regarding KINISIS.

II. KINISIS

KINISIS is a graphical query language which is designed on top of XQuery (Pliakas & Tsekos, 2010). It supports all the XQuery features and it is represented graphically by a set of "road traffic act" metaphors. XQuery is based on XPath and it "looks for" the data following a path. In a similar philosophy, we used metaphors in order to design a graphical XQuery by drawing the path to the requested information, through the respecting road traffic act signs. The metaphors we used come from road traffic. We chose this subject because the rules of the road traffic are well known so we can combine for example a sign of road traffic with a term of XQuery. Road signs are standard since 1968 when the European countries signed the Vienna Convention on Road Traffic treaty (Vienna Convention on Road Signs and Signals), with the aim of standardizing traffic regulations in participating countries in order to facilitate international road traffic and to increase road safety. Part of the treaty was the Vienna Convention on Road Signs and Signals, which defined the traffic signs and signals. As a result, in Western Europe the traffic signs are well standardized, although there are still some country-specific exceptions, mostly dating from the pre-1968 era.

III. IMPLEMENTATION

We have completed the implementation of KINISIS as an end-tool using Java and Java Swing API. The query construction using KINISIS is supported by a Graphical User Interface that has a user-friendly approach through drag and drop mechanism. We designed the GUI in order the users to work on an XQuery Flower philosophy, with the difference that we replaced all the tricky syntax of XQuery by metaphors that the user can choose from toolboxes. The results of the formal experiment that we run/conducted in order to evaluate our GUI (section IV) was quite satisfactory.

Moreover, we have developed a compiler which transforms the graphs into equivalent XQuery structures and send them to the underlying IBM DB2 in order to execute the XQuery query. In order to present the function of KINISIS the following three example queries are used.

A. Examples of KINISIS

The example queries of KINISIS based on the following running example which has been taken from (Walmsley, 2007) and includes two XML files. The “catalog.xml” is a product catalog containing product details for every department of the catalog. The “prices.xml” keeps all the prices of the products respecting particular dates.

catalog.xml

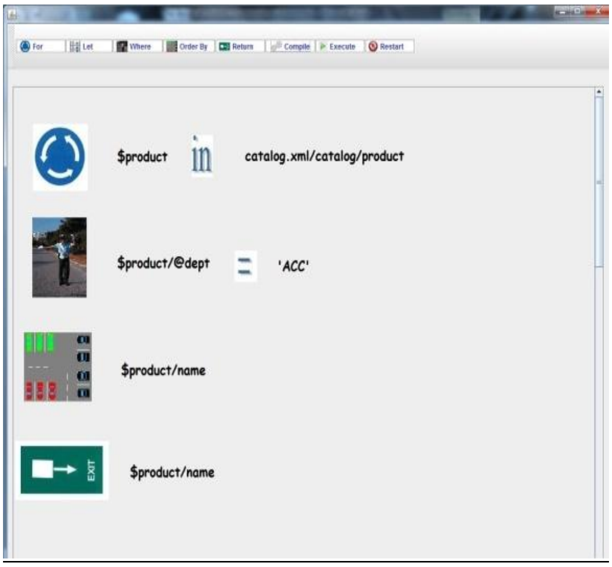
```
<catalog>
  <product dept="WMN">
    <number>557</number>
    <name language="en">Fleece Pullover</name>
    <colorChoices>navy black</colorChoices>
  </product>
  <product dept="ACC">
    <number>563</number>
    <name language="en">Floppy Sun Hat</name>
  </product>
  <product dept="ACC">
    <number>443</number>
    <name language="en">Deluxe Travel Bag</name>
  </product>
  <product dept="MEN">
    <number>784</number>
    <name language="en">Cotton Dress Shirt</name>
    <colorChoices>white gray</colorChoices>
    <desc>Our <i>favorite</i> shirt!</desc>
  </product>
</catalog>
```

prices.xml

```
<prices>
  <priceList effDate="2006-11-15">
    <prod num="557">
      <price currency="USD">29.99</price>
      <discount type="CLR">10.00</discount>
    </prod>
    <prod num="563">
      <price currency="USD">69.99</price>
    </prod>
    <prod num="443">
      <price currency="USD">39.99</price>
      <discount type="CLR">3.99</discount>
    </prod>
  </priceList>
</prices>
```

Example 1.

This query finds all the product names that can be found in Accessory (ACC) departments. The results are being sorted by the product name.



$product in catalog.xml/catalog/product

$product/@dept = 'ACC'

$product/name

$product/name

Figure 1: Example1 in KINISIS

The graphical query in fig. 1 corresponds to the following query:

```
for $product in doc("catalog.xml")/catalog/product
where $product/@dept='ACC'
order by $product/name
return $product/name
```

The first example query is developed in four steps. Every step is represented by a metaphor:

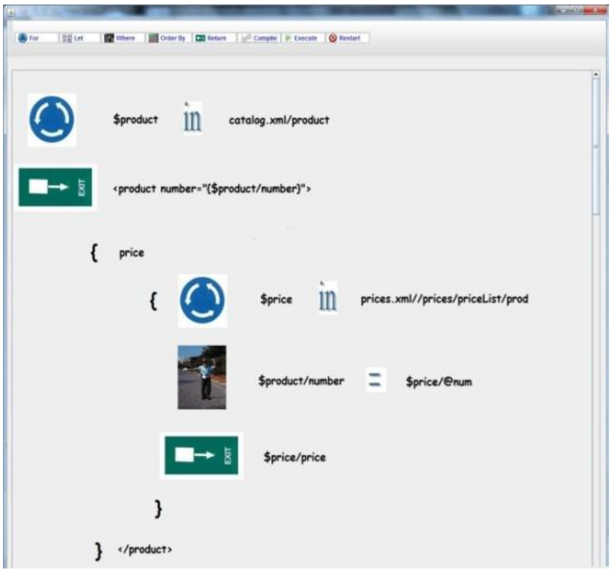
(a) At the beginning the user works on the “for” metaphor and s/he choose the xml file that the query is based (catalog.xml).

(b) Then, the user apply the query “filters” by applying the predicates as $product/@dept='ACC', in the WHERE metaphors.

(c) The next step is to apply the order criteria in the corresponding metaphor.

(d) Finally, the projection of the query is presented in the RETURN metaphor.

Example 2. This query presents the product number with its price. The two nodes are in different files, i.e. the product/number is in "catalog.xml" and the price is in “prices.xml”. Thus, in order to get the correct output the user has to join the two xml files on the clause: “$product/number = $price/@num”



```
$product   in   catalog.xml/product
<product number="{$product/number}">
  { price
    {   $price   in   prices.xml//prices/priceList/prod
        $product/number   =   $price/@num
        $price/price
    }
  } </product>
```

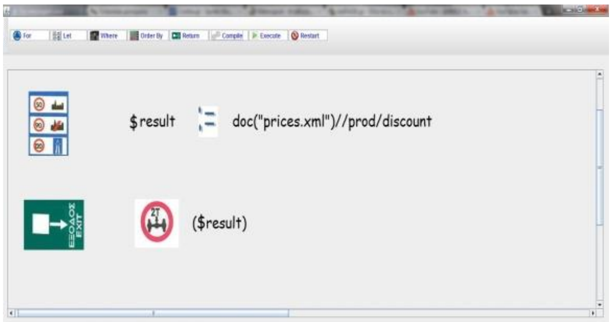
Figure 2: example2 in KINISIS

The graphical query in fig. 2 represents the following query:

for $product in doc("catalog.xml")//product
return <product number="{$product/number}">
{ attribute price
{ for $price in doc("prices.xml")//prices/priceList/prod
where $product/number = $price/@num
return $price/price}
} </product>

In KINISIS, in order to represent the *join* operation, the XQUERY structure is followed by using two FLWORs, one embedded in the return clause of the other. The outer FLWOR returns the list of products, regardless of the availability of price information. The inner FLWOR selects the price, if it is available.

Example 3 . This query returns the average discount of all products.



```
$result   :=   doc("prices.xml")//prod/discount
($result)
```

Figure 3: example3 in KINISIS

The graphical query in fig. 3 represents the following query:

let $result := doc("prices.xml")//prod/discount
return avg($result)

It is often desirable to perform calculations on the groups. For example, suppose that a user wants to know the sum or the average of the quantities for a department. This type of aggregation can be performed using the aggregation functions and KINISIS support all the aggregate function that XQuery supports.

IV. EXPERIMENTAL EVALUATION OF KINISIS USABILITY

We carried out a controlled experiment in order to evaluate the metaphors that we use in KINISIS and also the language itself. Twenty two Undergraduate students of the Department of Information Technology at Alexander Technology Educational Institute were called to compose a few queries using both IBM DB2 and the KINISIS.

The students found out that the KINISIS application is friendlier to use since they have to draw the query instead of the classic way of IBM DB2. Due to some automated parts of KINISIS application, it was easier for the students to compose the queries avoiding mistakes as wrong path expressions or other spelling mistakes. This gave the ability to the students to answer in more complex queries. As a result, there were more correct answers using KINISIS application (80.91%, 89 correct answers from 110 queries in total) than IBM DB2 (51.82% correct answers). Moreover, the time needed from students to compose the queries was much less when they use KINISIS than IBM DB2.

Finally, students filled questionnaire shown that the metaphors of traffic signs were suitable to make them understand the construction of XQuery language.

V. CONCLUSION

In this paper we presented the design, implementation and evaluation of KINISIS, a new graphical query language for XML documents supporting the XQuery FLOWR structure. KINISIS uses the road traffic act metaphor in order to represent graphically the query structure in a common picture as the one when we drive our vehicle following the traffic signs in order to arrive at our destination. KINISIS addressed to naive XQuery users. In our future plans is to alter the design of

KINISIS in order to follow a different design philosophy than XQuery FLOWR.

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