"Persistent Interoperable GIS"-An Ontological Solution

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Abstract

Interoperability is an ancient problem. Basically it is now a crucial issue in geographical information systems (GIS). Many researchers tried to solve it by different techniques such as semantic translator, mediators, integrators and ontologies. But persistent interoperability has added a new dimension in interoperability problem. This research is trying to build a persistent interoperable GIS using ontologies as a tool. To describe entities, classes, properties and functions related to a certain view of the world ontologies are used, which are theories and use a specific vocabulary. The first step is to specify ontologies specified in a formal language. The ontology editor can generate a set of classes from the specified ontologies that are available to be browsed by the end user and provide metadata about the available geographic information and thus satisfy a persistent interoperable GIS.

Keyword : *Persistent; Interoperability; Ontology.*

I. INTRODUCTION

Interoperability would seem to be a straightforward concept. It is simply a measure of the degree to which various organizations or individuals are able to operate together to achieve a common goal. According to IEEE, Interoperability is the ability of two or more systems or components to exchange information and to use the information that has been exchange [8]. However it requires full exchange of data between the systems heterogeneous data models [3].

Interoperability problem arises when different heterogeneous nature of geo-data poses disagreement amongst information sharing. There are several types of heterogeneity such as structural, syntactic and semantic heterogeneity. Structural heterogeneity means that different information systems store their data in different structures. For example, same data is stored in different structure or format such as .mdb (Microsoft access format) .ora (Oracle format), .dbf (dBase format) etc. Syntactic heterogeneity means that different database systems use different query languages [SQL (Structured Query Language), OQL (Object Query Language), QBE (Query By Example) etc]. Semantic heterogeneity considers the content of an information item and its meaning [2]. In this paper designing of a persistent Interoperable GIS (PIGIS) taking ontologies as a tool discussed since PIGIS satisfies Interoperability problem after banishing heterogeneity of different data model and also persist the information system.

The following sections organized as follows, section 2 gives an overview of persistency and significance of Interoperability in GIS, section 3 gives Solution attempts taken to address the interoperability issue in GIS section 4 emphasizes an architecture of PIGIS, and section 5 conclude the paper.

II. PERSISTENCY

Non-computer expert users can access and direct the processing of large scale datasets utilizing distributed high performance computing and storage resources. The implementation of this system can benefit from many of the attributes of persistence, however the wide variety of target system, target languages and the need to support legacy codes make a truly persistent system infeasible.

The two basic principles [1] behind persistence are:
i) that any spatial object such as point, line and area may persist for as long, or as short, a period as that object is required, and also
ii) may be manipulated in the same manner regardless of this longevity.

Persistent Interoperable GIS is a vital issue while widespread use of spatial data in information systems. Some heterogeneity problem as stated before could overcome by using interoperable GIS. But this can't satisfy proper longevity of spatial objects. This paper is trying to introduce an ontological solution that satisfies persistency. Here description of ontology introduce as engineers point of view. There two types of ontology in the real world, R-Ontology and E-Ontology. [6] suggests a terminological distinction between the referent-based or reality-based ontology (R-ontology) and elicited or epistemological ontology (E-ontology)[11]. R-ontology is a theory about how the whole universe is organized and corresponds to the philosopher's point of view. An E-ontology fits the purposes of software engineers and information

scientists and can be defined as a theory about how a given individual (or group or language or science) conceptualizes a particular domain. It can be observed that the ontology of a particular domain is different to various Geographical Information Communities (GIC). Consequently, this causes an issue of interoperability, in various organizations.

A. Significance of Persistent Interoperability in GIS

The traditional paradigm for the development of databases and applications using their data is based on the cycle modeling-design-implementation, and considers a single database framework under one data model and with one schema. The advent of heterogeneous systems and, more recently, the Web, is changing this picture. Large amounts of data are available in distinct formats and systems, varying from structured DBMS repositories to unstructured files and home pages. Some data are structured according to well-established data modeling techniques, such as the relational or object-oriented data models. Other data, such as data maintained in various information systems, spreadsheets, or Internet repositories, are in proprietary formats, semi-structured or unstructured. This situation of multiple models and schemas, combined with the intrinsic difficulties for communication and establishment of agreement for data representation in the application domains, makes the interoperability problem very complex.

To integrate data the problem can be decomposed into that of extracting data from the sources to feed the warehouse, and integrating these multiple source data into the warehouse. The emphasis of this work is on the second step. This decomposition allows us to focus on representational and semantic issues, and the fundamental data integration problems. Afterwards, results from the research on data integration in warehouses may be useful to achieve persistent interoperability in a wider sense.

III. SOLUTION ATTEMPTS TAKEN TO ADDRESS THE INTEROPERABILITY ISSUE IN GIS

The first attempts to obtain persistent GIS interoperability involved the direct translation of geographic data from one vendor format into another using persistent glue such s java. The motivation of this practice turned to use a standard file format. These formats can lead to information loss, as is often the case with the popular CAD-based format DXF. This problem can be avoided by using an alternative solution like the spatial data Transfer Standard (SDTS) and Spatial Archive and Interchange Format (SAIF). A modernization proposal for SDTS using and object profile that integrates a dynamic schema structure, an OpenGIS interface, and the Common Object Request Broker Architecture Interface Definition Language (CORBA IDL) is presented in [2] One important initiative to achieve GIS interoperability is OpenGIS Consortium.

Since widespread use of heterogeneous data not accepted initiatives like SDTS, SAIF and OpenGIS and thus cannot banish interoperability [2,3,4,5,6,7,10]. Moreover existing solution cannot satisfy persistency. It is mentioning that Persistence means continue to existence [8]. However there is a similar concept in information system. [6] quoted two basic principles behind persistent information system [8]: that any object may persist for as long, or as short, a period as the object is required, and that objects may be manipulated in the same manner regardless of this longevity.

IV. ARCHITECTURE OF PIGIS

This architecture consists of a Global Community (GC)- and a number of Geographical Information Communities (GIC) as illustrated in Figure 1. Each GIC (for example, WASA, T & T, PDB, BGS) contains a GIS application constitutes a persistent glue here in java and corresponding spatial database (DB). GIS application is used to retrieve, share, manipulate spatial database (DB) through local schemas or data definitions as shown in Figure 1.

Global Community (GC) contains an integrator, a global schema and a common ontology. The role of integrator is to develop the global schema by taking similar attributes from the local schemas. For example, national highway and regional highway are a kind of highway and hence they inherit the attribute of the highway. Therefore, the role of integrator is to find the commonality from the local schemas, which in turn becomes global schema. Common ontology consists of global schema, which is called global data definition, along with methods/rules, necessary to retrieve the information in an efficient way. For example, T&T requires information from WASA but the constraint is that both can't communicate with each other directly. In this case common ontology, consisting of global data definition and rules, is used to retrieve the requested information of T&T from WASA. In this way, each GIC (WASA, T&T) can share information through GC. In addition, GC maintains all shared/common geo-spatial data, which are publicly available and could be used by all GIC. Thus the architecture, presented, enabling an intelligent integration of information from multiple heterogeneous GIC data sources.

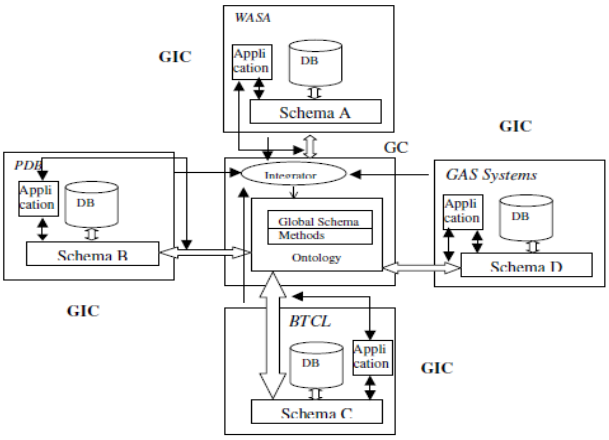

Figure 1: An Ontological Architecture for PIGIS

It is interesting to note that when GIS application of a GIC is looking for a data, which is different from local spatial database, in that case, the request is directly sent to the common ontology. Common ontology contains necessary rules for data retrieval purpose but it needs classes and objects definition from global schema. Now common ontology gathered all resources of information including location of data and rules for how and what data should be retrieved.

V. DISCUSSIONS AND CONCLUSION

One of the crucial issues in GIS, particularly in the study of spatial databases is the sharing of knowledge. In this context persistent interoperability is considered as the vital issue. This paper presented an ontology-based architecture, which can be used to assist persistency, enabling the tackling of interoperability issue, faced by the various local communities. When different community uses different local ontologies, the architecture translates it into a common ontology. Therefore, for each query related to the local ontology it sdoes not need to process every time. Finally, the proposed architecture has been applied taking a case study area into account. This in turn could play an important role to address the interoperability problem, faced by these communities of Chittagong city.

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