Challenges in managing Spatio-temporal Database

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Abstract
Rapid development of wireless and mobile technologies which enable the collection of large amounts of data from moving objects. Spatio-temporal databases that represent and manage changes related to the movement of objects. Such collected data contain the instant vital information of moving objects. Traditional DBMSs are not well equipped to handle data from moving objects. This poster presents the challenges in handling Spatio-temporal databases.

Keywords
Spatio-temporal, spatial, DBMS

Introduction
As a characteristic of hi-tech modern society, a considerable amount of information is generated on a daily basis from moving objects. A large part of such generated data associated with spatial or temporal information. For instance, city maps, transportation data either ferry, bus or train. Databases that deal with spatial and temporal attributes are termed as ***spatio-temporal databases***. Spatio-temporal databases are becoming a highly researched area facing the need to effectively and efficiently manage these data (Roddick, Hoel, Egenhofer, Papadias, & Salzberg, 2004; Shekhar & Chawla, 2003).

This poster paper appeared at the 2nd annual conference of Computing and Information Technology Research and Education New Zealand (CITRENZ2011) incorporating the *24th Annual Conference of the National Advisory Committee on Computing Qualifications*, Rotorua, New Zealand, July 6-8. Samuel Mann and Michael Verhaart (Eds).

In a wide range of applications, data often contain critical space and time attributes. Spatio-temporal data are obtained from numerous data acquisition devices over a period of time deployed at different locations or deployed in the moving object. Initially, research in databases handled time and space separately. It was only in the 90s that spatio-temporal databases become an area of active research.

Traditional DBMS Vs Spatio-temporal DBMS (STDBMS)

Traditional DBMSs are not well equipped to handle data related to moving objects. One of the reasons is that DBMSs assume that data is constant unless an explicit modification occurs, and this assumption is not adequate for handling continuously changing data such as the locations of moving objects. In traditional DBMS it is difficult to specify queries about spatial and temporal information.

Unlike traditional database applications, moving object applications involve the following requirements, which are a subset of spatio-temporal applications requirements (Pfoser & Tryfona, 1999; Parent, Spaccapietra, & Zimanyi, 1999):

- the need for representing objects, such as moving cars, with a position in space and an existence in time;
- the need to capture the change of position over time - continuously or discretely;
- the need for representing spatial relations among objects in time;
- the need to specify spatio-temporal integrity constraints.

Motivation:

For illustration, to store and manage GPS data of a moving object on suburban road using MS SQL Server 2008 Express.

Challenges in managing STDBMS:

1. To represent and store GPS data in MS SQL 2008 such as: longitude, latitude, direction has been well supported with new data types.

2. Query processing in spatio-temporal databases with respect of time.

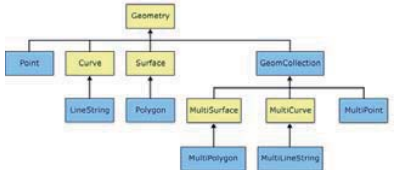

Fig 1: Spatial Data types of MSSQL 2008

In context of traditional database	In context of moving object
valid time is the time when a fact is true in a modeled reality;	the valid time of a given object is the current, past and future position that has been recorded.
transaction time is the time when an element in the database, which is not necessarily a fact, is part of the current state in the database;	The transaction time of a position refers to the current and past positions that were recorded as current in the database
existence time of an object refers to the time when the object exists in reality.	The existence time is associated only with the existence of an object and not with its position.

Table1: Time in context of moving object database

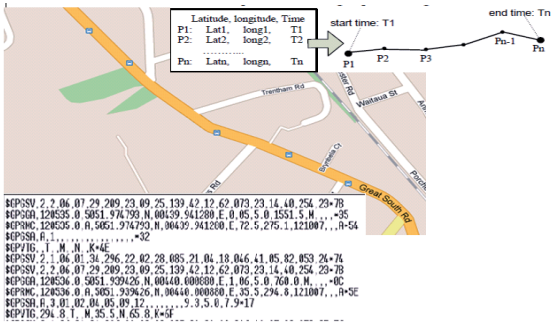

Fig 2: GPS data and path of a moving object

3. Data often contain critical space and time attributes separately. MSSQL 2008 supports spatial data, combining time attribute to answer spatiotemporal queries requires spatiotemporal joins. The approach is to extend the database to spatio-temporal features. Spatio-temporal join and query processing remains being less researched (Roddick, Hoel, Egenhofer, Papadia, & Salzberg, 2004; Shekhar & Sanjay Chawla, 2003).

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