



How to Handle Big Traffic Video Data

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Introduction

Some earlier transportation-related applications, such as urban planning, required only static spatial databases or *geographic information systems (GISs)*. In addition, various *intelligent transportation systems (ITS)* often use static GIS map databases for location referencing and frequently exchange spatial information with other map databases. However, more interesting transportation applications need to consider the values of traffic parameters that vary continuously over time. Spatial database systems deal with these data sets in an inefficient way via discrete time points or intervals. Given traffic data's multiform and multidimensional nature, more efficient traffic data archiving is needed to add a temporal dimension to GIS-based transportation management systems.

Today, video cameras are widely used for traffic monitoring and data collection. The combination of space and time is a defining feature of digital video. However, considering the large space and expensive cost in traffic video storage, traffic video data are usually saved into video segments, scenes, shots, or frames. In addition, it is very difficult to extract key spatio-temporal data, such as individual vehicle trajectories and traffic aggregate data, from the physical storage medium. Ideally, this would be done automatically, but typically this information is obtained using manual methods. Therefore, it is difficult for current video database systems to quickly scan traffic video data and find the desired transportation-related spatio-temporal query results.

There are two main ideas for storing video data. First, once the video cameras collect discrete vehicular trajectory data (some number of frames per second), the trajectory data is interpolated into continuous traffic data. The continuous traffic data is described by some functions of a temporal parameter t and the spatial parameters. Second, the continuous traffic data is stored in spatio-temporal databases.

Development Method

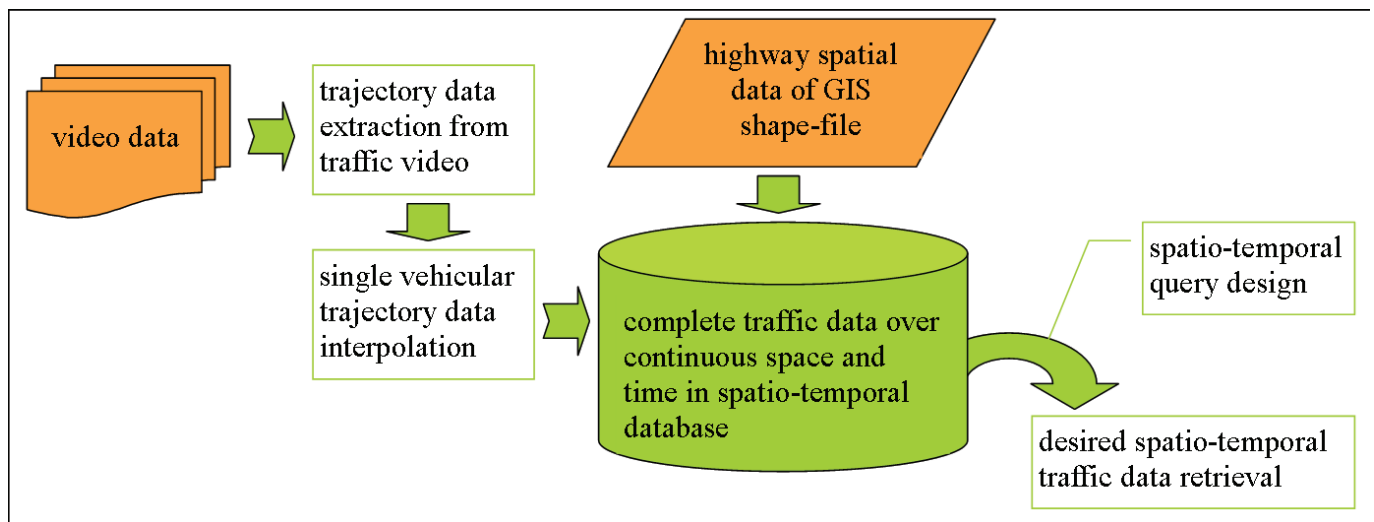
The transportation spatio-temporal system can optimize traffic data completeness and offer high-level spatio-temporal queries of transportation data. The design and development of the transportation spatio-temporal system consists of the following four main parts:

Data extraction: Through video-capture methods, traffic video data extraction provides vehicular trajectory data (i.e., vehicular instantaneous location, time, and speed data points).

Data interpolation: Discrete individual and average vehicular velocity points with different time intervals are interpolated into continuous velocity by the linear and nonlinear data models.

Data integration: Both of the highway spatial data of GIS shape-files and the continuous vehicular trajectory data are transformed and integrated into spatio-temporal databases.

Data retrieval: A high level traffic information query interface guides the users in performing spatio-temporal queries of the integrated dynamic transportation information.



Overview of the Transportation Spatio-temporal System

Advantages

Data completeness

Data completeness requires that data sources in databases should cover all information (i.e., all data types and the complete information of each data type) to meet the current and future demands of various data users. Traffic stream is observed at each spatial point within some distance interval over time, not just at one spatial point.

Existing transportation software systems store discrete traffic aggregate data, such as volume, density, headway, queue length, spacing etc., in relational databases. Aggregate data incompleteness in space and time causes the insufficient performance of traffic engineering models in transportation software systems. For example, due to the lack of volume over continuous time and space, not all travelers can gain desired travel time query information from volume-based travel time estimation models in *advanced traveler information systems (ATIS)*.

The transportation spatio-temporal system can offer complete individual vehicle trajectory and traffic aggregate data over continuous space and time. Complete traffic data sources are useful for the description of traffic flow phenomena and for the calculation of various transportation engineering models. Such spatio-temporal system can be particularly advantageous in understanding highway flow breakdown (i.e., incident detection), and dynamical

traffic congestion, because a detailed picture of traffic parameters over both time and space is better than these parameters in time alone.

Besides individual vehicular and traffic aggregate parameters, the transportation spatio-temporal system can offer other traffic data over continuous time and space. These specific traffic data involve the speed difference among moving cars at an intersection at any time, the identification of cars that drive in excess of the speed limit during any period, the number of trips during any period in a city, and so on.

Data redundancy

Discrete traffic aggregate data archives cause not only the loss of a large amount of aggregate traffic data, but also the increase of data redundancy in databases. Aggregate data are a typical data redundancy in databases, and it means that some data are stored for multiple times. Efficient data operations require data consistency and data synchronization in databases by minimizing or avoiding data redundancy.

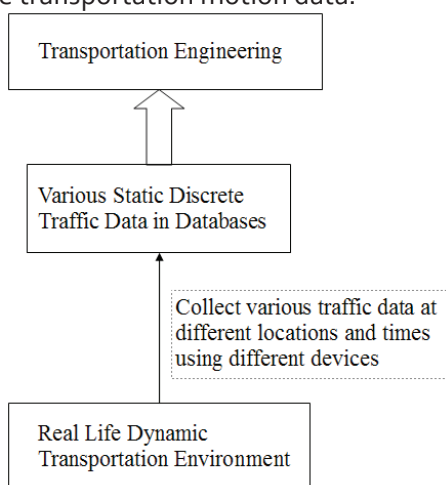
In relational databases traffic data redundancy often causes data anomalies, data corruption, and data retrieval errors. It is difficult for existing transportation management systems to keep data synchronization between volume values and the above four traffic parameters. The frequent operations of traffic data in databases easily cause data inconsistency or anomalies and data retrieval errors.

By using new traffic data models, spatio-temporal

databases just request the collection and storage of individual vehicular time, location, and instantaneous velocity. Traffic aggregate data can be retrieved from the transportation spatio-temporal system by database query designs. Therefore, the transportation spatio-temporal system provides traffic data archiving methods that can solve the above problems concerning traffic data redundancy. In addition, traffic devices for aggregate data collection could be removed from highways.

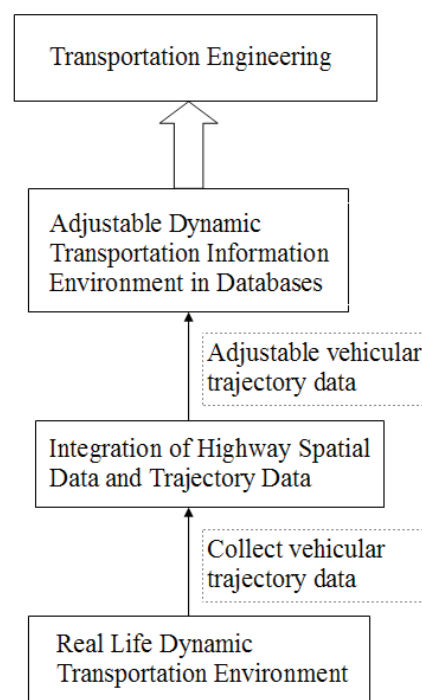
Data operation

In contrast to existing static traffic data sources, the transportation spatio-temporal system offers an adjustable dynamic transportation information environment. It means that the data collection of individual vehicular trajectory would be more important than traffic aggregate data for data collection and storage for transportation applications. The integration of highway spatial data and vehicular trajectory data create the spatio-temporal logical relationships among the entire transportation motion data.



Existing static traffic data sources

Based on the above data integration, vehicular trajectory data not only control the accuracy of all aggregate data, but also determine data synchronous operations among traffic aggregate data. This synchronicity of adjustable traffic information is an immense advantage for the analysis and verification of dynamic traffic phenomena. In addition, the dynamic information environment provides potential opportunities for the development of dynamic or multi-dimensional transportation engineering theory and the optimization of transportation software systems.



Adjustable dynamic transportation information

Conclusions

Video cameras can easily collect traffic information, but storing the raw video data generally requires a huge storage space. More importantly, it is difficult to retrieve the values of traffic parameters from video data for the calculations of transportation engineering models or the development of transportation software, not to mention traffic data operation or adjustability. The transportation spatio-temporal system is recommended to overcome the storage problem by converting traffic videos into a spatio-temporal database.

The transportation spatio-temporal system converts traffic video data into vehicular motion information in spatio-temporal databases. The transportation spatio-temporal system interpolates the vehicular trajectory data (time, location, and velocity), which are extracted from video, and integrates them with spatial road information for the storage of dynamic transportation environments. The transportation spatio-temporal system can avoid data storage and retrieval issues caused by traffic videos. Moreover, users can manage and operate multiform and multidimensional traffic data in a spatio-temporal transportation environment.

ABOUT CHARTER GLOBAL



Murlidhar Reddy – Chief Executive Officer & Co-founder
Devender Reddy – Chief Business Officer & Co-founder



Charter Global is an Atlanta-based, global technology consulting and outsourcing company. With over 20 years in the business, CGI has a long history of proven success for their clients in the areas of project staffing and management, application development and support, business intelligence and data warehousing, ERP solutions, SharePoint and cloud computing, and now big data. Founded in 1994, CGI has grown to over 750 IT professionals located in the US and India and has been rated one of the fastest growing companies in Georgia as well as garnering the distinction of a top workplace for 2014.

Leadership can be credited to hold a lion's share in the phenomenal success story of this organization that kicked off steadily and has been ascending greater heights venturing into newer horizons by adopting novel and ethical methodologies constantly updating with the needs of increasingly globalized world. The leadership team has been instrumental in effectively organizing and coordinating with the teams both onshore and offshore. The support extended ensures that the staff is always equipped with the adequate resources eventually attributing to the performance improvement of the employees. Leadership imparted further momentum by consistently inspiring the teams and motivating them in order to bring out the best possible results.

As a professional services company who offers specialty resource staffing, Charter Global's recruiters and salespeople keep two fingers on the vein pumping

out candidates from colleges, specialty schools and masters programs at all times. When the Big Data rumor began buzzing, the demand for data scientists went up without enough resources to match. Charter Global's on-site training facility ensured they have enough resources to assess, design, and execute a big data implementation for their clients.

The company's recent developments include innovative Big Data know-how. Charter Global has introduced their own Big Data program to help their customers make a smooth transition into the latest technology trend. Whether a company is just starting out or halfway down the road, Charter Global has developed pre-packaged, ready-to-go deliverables ranging from seminars and workshops, to current state assessments, talent sourcing and training programs.

Of the company's recent technology advancements into a Big Data Accelerator, CGI has positioned itself as a front runner in the emerging trend. Data Scientists are premium assets much too expensive to keep on staff without a fully scoped budgeted project. The problem is, to many companies, Big Data is still in the experimental phase and managers are having trouble getting the funding for a Big Data Project without clearly defined goals. With Charter Global's Big Data Accelerator Program, they offer a full assessment which entails on-site visits, weeks of crucial business process examination to tailor make a solution to utilize big data to meet the client's goals, and ultimately, implementation of that solution.

OFFSHORE DEVELOPMENT



Pradeep Kumar – Offshore Business Operations Head

Offshore outsourcing has been one of the salient features of this organization from its beginning in 2001 in Hyderabad, India as the base. India operations gradually expanded with the number of delivery centers increasing to 3, Pune and Noida being the other

two centers. The consulting solutions provided and the recruiting services offered pertaining to the field of Information Technology extend to offshore delivery. Our successful projects and future growth opportunities help CGI build a strong client base and the teams work in fulfilling the needs of our clients. The impetus of Offshore IT development is not just monetary benefit, it is about leadership and strong management leading to a better relationship with the client. The data security and privacy issues are the prime point of concern. The PCI Certification for data security since the year 2009 is the benchmark CGI attained for proving authentic practices to clients. Building long lasting customer relationship is the key to company's success.

The fraternity of Charter Global works with a motive

of minimizing uncertainties in the businesses of clients with the aid of core competencies and technologies designed by the collective intelligence and collaboration amongst the teams thereby making CGI a sustainable high performance organization. The members of the organization are responsible for the growth of the organization which in turn is fueled by continuous learning and leverage its team work efficiently. Though global, the teams operating in various regions work closely to bring out the best results. The depth of CGI's technology and activity expertise has been built through effective investment in people. The performance driven ambiance in which innovation is welcomed would always be the best one for any employee to foster. The company nurtures new talent and enables continuous knowledge transfer.
