SHORTEST PATH DETECTION IN ONLINE REPOSITTORIES

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Abstract: The online shortest path problem aims at computing the shortest path based on live traffic circumstances. This is very important in modern car navigation systems as it helps drivers to make sensible decisions. To our best knowledge, there is no efficient system/solution that can offer affordable costs at both client and server sides for online shortest path computation. Unfortunately, the conventional client-server architecture scales poorly with the number of clients. A promising approach is to let the server collect live traffic information and then broadcast them over radio or wireless network. This approach has excellent scalability with the number of clients. Thus, we develop a new framework called live traffic index (LTI) which enables drivers to quickly and effectively collect the live traffic information on the broadcasting channel. An impressive result is that the driver can compute/update their shortest path result by receiving only a small fraction of the index. Our experimental study shows that LTI is robust to various parameters and it offers relatively short tune-in cost (at client side), fast query response time (at client side), small broadcast size (at server side), and light maintenance time (at server side) for online shortest path problem.

***IndexTerms*—Spatial databases; Vehicle driving; Broadcasting**

1. INTRODUCTION

What is Data Mining?

Generally, data mining (sometimes called data or knowledge discovery) is the process of analyzing data from different perspectives and summarizing it into useful information - information that can be used to increase revenue, cuts costs, or both. Data mining software is one of a number of analytical tools for analyzing data. It allows users to analyze data from many different dimensions or angles, categorize it, and summarize the relationships identified. Technically, data mining is the process of finding correlations or patterns among dozens of fields in large relational databases.

How Data Mining Works?

While large-scale information technology has been evolving separate transaction and analytical systems, data mining provides the link between the two. Data mining software analyzes relationships and patterns in stored transaction data based on open-ended user queries. Several types of analytical software are available: statistical, machine learning, and neural networks. **Generally, any of four types of relationships are sought:**

- **Classes**: Stored data is used to locate data in predetermined groups. For example, a restaurant chain could mine customer purchase data to determine when customers visit and what they typically order. This information could be used to increase traffic by having daily specials.

- **Clusters**: Data items are grouped according to logical relationships or consumer preferences. For example, data can be mined to identify market segments or consumer affinities.

- **Associations**: Data can be mined to identify associations. The beer-diaper example is an example of associative mining.

- **Sequential patterns**: Data is mined to anticipate behavior patterns and trends. For example, an outdoor equipment retailer could predict the likelihood of a backpack being purchased based on a consumer's purchase of sleeping bags and hiking shoes.

Data mining consists of five major elements:

1) Extract, transform, and load transaction data onto the data warehouse system.
2) Store and manage the data in a multidimensional database system.
3) Provide data access to business analysts and information technology professionals.
4) Analyze the data by application software.
5) Present the data in a useful format, such as a graph or table.

Different levels of analysis are available:

- **Artificial neural networks**: Non-linear predictive models that learn through training and resemble biological neural networks in structure.

- **Genetic algorithms**: Optimization techniques that use process such as genetic combination, mutation,

and natural selection in a design based on the concepts of natural evolution.

- **Decision trees**: Tree-shaped structures that represent sets of decisions. These decisions generate rules for the classification of a dataset. Specific decision tree methods include Classification and Regression Trees (CART) and Chi Square Automatic Interaction Detection (CHAID). CART and CHAID are decision tree techniques used for classification of a dataset. They provide a set of rules that you can apply to a new (unclassified) dataset to predict which records will have a given outcome. CART segments a dataset by creating 2-way splits while CHAID segments using chi square tests to create multi-way splits. CART typically requires less data preparation than CHAID.

- **Nearest neighbor method**: A technique that classifies each record in a dataset based on a combination of the classes of the *k* record(s) most similar to it in a historical dataset (where *k*=1). Sometimes called the *k*-nearest neighbor technique.

- **Rule induction**: The extraction of useful if-then rules from data based on statistical significance.

- **Data visualization**: The visual interpretation of complex relationships in multidimensional data. Graphics tools are used to illustrate data relationships.

Characteristics of Data Mining:

- **Large quantities of data**: The volume of data so great it has to be analyzed by automated techniques e.g. satellite information, credit card transactions etc.
- **Noisy, incomplete data**: Imprecise data is the characteristic of all data collection.
- **Complex data structure**: conventional statistical analysis not possible
- **Heterogeneous data stored in legacy systems**

Benefits of Data Mining:

1) It's one of the most effective services that are available today. With the help of data mining, one can discover precious information about the customers and their behavior for a specific set of products and evaluate and analyze, store, mine and load data related to them
2) An analytical CRM model and strategic business related decisions can be made with the help of data mining as it helps in providing a complete synopsis of customers
3) An endless number of organizations have installed data mining projects and it has helped them see their own companies make an unprecedented improvement in their marketing strategies (Campaigns)
4) Data mining is generally used by organizations with a solid customer focus. For its flexible nature as far as applicability is concerned is being used vehemently in applications to foresee crucial data including industry analysis and consumer buying behaviors
5) Fast paced and prompt access to data along with economic processing techniques have made data mining one of the most suitable services that a company seek

Advantages of Data Mining:

1. Marketing / Retail:

Data mining helps marketing companies build models based on historical data to predict who will respond to the new marketing campaigns such as direct mail, online marketing campaign…etc. Through the results, marketers will have appropriate approach to sell profitable products to targeted customers.

Data mining brings a lot of benefits to retail companies in the same way as marketing. Through market basket analysis, a store can have an appropriate production arrangement in a way that customers can buy frequent buying products together with pleasant. In addition, it also helps the retail companies offer certain discounts for particular products that will attract more customers.

2. Finance / Banking

Data mining gives financial institutions information about loan information and credit reporting. By building a model from historical customer's data, the bank and financial institution can determine good and bad loans. In addition, data mining helps banks detect fraudulent credit card transactions to protect credit card's owner.

3. Manufacturing

By applying data mining in operational engineering data, manufacturers can detect faulty equipments and determine optimal control parameters. For example semi-conductor manufacturers has a challenge that even the conditions of manufacturing environments at different wafer production plants are similar, the quality of wafer are lot the same and some for unknown reasons even has defects. Data mining has been applying to determine the ranges of control parameters that lead to the production of golden wafer. Then those optimal control parameters are used to manufacture wafers with desired quality.

4. Governments

Data mining helps government agency by digging and analyzing records of financial transaction to build patterns that can detect money laundering or criminal activities.

5. Law enforcement:

Data mining can aid law enforcers in identifying criminal suspects as well as apprehending these criminals by examining trends in location, crime type, habit, and other patterns of behaviors.

6. Researchers:

Data mining can assist researchers by speeding up their data analyzing process; thus, allowing those more time to work on other projects.

2.Problem Statement:

Nowadays, several online services provide live traffic data (by analyzing collected data from road sensors, traffic cameras, and crowdsourcing techniques), such as Google-Map , Navteq , INRIX Traffic Information Provider , and TomTom NV , etc. These systems can calculate the snapshot shortest path queries based on current live raffic data; however, they do not report routes to drivers continuously due to high operating costs. Answering the shortest paths on the live traffic data can be viewed as a continuous monitoring problem in spatial databases, which is termed online shortest paths computation (OSP) in this work. To the best of our knowledge, this problem has not received much attention and the costs of answering such continuous queries vary hugely in different system architectures. Typical client-server architecture can be used to answer shortest path queries on live traffic data.

Disadvantages of existing system:

1. Scalability limitations in terms of network bandwidth and server loading.

2. Online Shortest Paths computation is not much attention.

3. Proposed system:

Motivated by the lack of off-the-shelf solution for OSP, in this paper we present a new solution based on the index transmission model by introducing live traffic index (LTI) as the core technique. LTI is expected to provide relatively short tune-in cost (at client side), fast query response time (at client side), small broadcast size (at server side), and light maintenance time (at server side) for OSP.

The index structure of LTI is optimized by two novel techniques, graph partitioning and stochastic-based construction, after conducting a thorough analysis on the hierarchical index techniques.

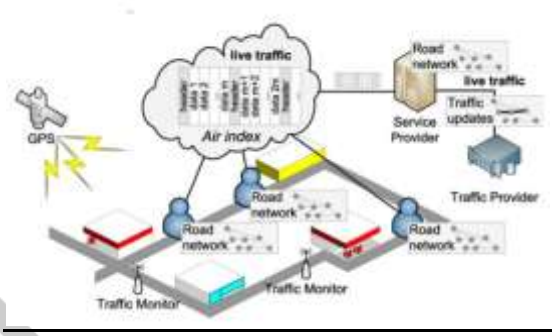
Advantages of proposed system:

1. The server periodically updates the travel times on these paths based on the latest traffic, and reports the current best path to the corresponding user.

2. Efficiently maintains the index for live traffic circumstances.

3. To the best of our knowledge, this is the first work to give a thorough cost analysis on the hierarchical index techniques and apply stochastic process to optimize the index hierarchical structure.

4.System Architecture:



5.Modules:

1. Tune-in Cost (Client Side)
2. Broadcast Size(Server Side)
3. Maintenance Time(Server Side)
4. Query Response Time(Client Side)

MODULES DESCRIPTION:

Tune-in Cost (Client Side):

We prioritize the tune-in cost as the main optimized factor since it affects the duration of client receivers into active mode and power consumption is essentially determined by the tuning cost (i.e., number of packets received). In addition, shortening the duration of active mode enables the clients to receive more services simultaneously by selective tuning. These services may include providing live weather information, delivering latest promotions in surrounding area, and monitoring avail-ability of parking slots at destination. If we minimize the tune-in cost of one service, then we reserve more resources for other services.

Broadcast Size and Maintenance Time (Server Side):

The index maintenance time and broadcast size relate to the freshness of the live traffic information. The maintenance time is the time required to update the index according to live traffic information. The broadcast size is relevant to the latency of receiving the latest index information. As the freshness is one of our main design criteria, we must provide reasonable costs for these two factors.

Query Response Time (Client Side):

The last factor is the response time at client side. Given a proper index structure, the response time of shortest path computation can be very fast (i.e., few milliseconds on large road maps) which is negligible compared to access latency for current wireless network speed. The computational so consumes power but their effect is

outweighed by communication. It remains, however, an evaluated factor for OSP.

6. CONCLUSION

The shortest path computation; the shortest path result is computed/updated based on the live traffic circumstances. We carefully analyze the existing work and discuss their inapplicability to the problem (due to their prohibitive maintenance time and large transmission overhead). To address the problem, we suggest a promising architecture that broadcasts the index on the air. We first identify an important feature of the hierarchical index structure which enables us to compute shortest path on a small portion of index. This important feature is thoroughly used in our solution, LTI. Our experiments confirm that LTI is a Pareto optimal solution in terms of four performance factors for online shortest path computation. In the future, we will extend our solution on time dependent networks. This is a very interesting topic since the decision of a shortest path depends not only on current traffic data but also based on the predicted traffic circumstances.

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