Introducing Spatial Context in Comparative Pricing and Product Search

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Outline

- Introduction
- Related Work
- The Proposed System
- Case Study
- Conclusion and Further Work
Motivation: Big Data

The growing interactivity among services offered over the web and their users generate a huge amount of information.

The Web 2.0 brought new challenges and opportunities in the searching and retrieval of information.
Motivation: E-commerce Context

- On-line product evaluation services;
- On-line price comparison services;
- Shared goal: Better benefit-cost (save money!)
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Motivation: E-commerce Context

Shopbots ⇒ offer/price comparison agents
Motivation: E-commerce Context

Shopbots...

- facilitate consumers potentially interested in buying a new product online;
- carry out the task of searching for prices and payment forms;
- increase competition between suppliers.

Consumers become **better informed** about best prices and suppliers.
Issues: Spatial aspects

- **Price** of a product offered in a certain online store is **not just the total cost** price.
- **Spatial location** of supplier and consumer **are not** taken into account.
- Consumers are interested in products’ total prices.

Spatial context needs to be considered!
Issues: Historical Prices

- Dispersion of prices is still **substantial** (Big Data problem);
- **The maintenance** of a price information history is **challenging** (Scalability);
- Historical charts with dispersion of product prices allow temporal analysis about prices variation.
The Proposal

A system for historic and real-time price comparison considering the spatial context in products search by using Geographic Information Systems (GIS).

- To provide consumers with location-based information about products available on the Internet.

- An architecture that encourages shopbots to offer a wider historical prices database than the ones presently found.
Related Work

Issues like shipping costs, modes and delivery deadline are among the first reasons for abandoning shopping carts in online stores, according to Kukar-Kinney and Close (2010). Why not keeping consumers previously informed about this costs?

Lim et al. (2011) proposed to provide shopbots with information about shipping costs, but they don’t use GIS.

Hinzand and Frischmann (2008) analyzed several shopbots and addressed issues concerning price dispersion.
A system for **introducing the spatial context in comparative price searches** for products in e-commerce.
The Proposed System: Goals

- To extend the functionality of shopbots **adding location-based capabilities**;
- To **improve user experience** in making product comparison based on accurate information about geographic location;
- To provide **users’ saving**!
The Proposed System: Involved Technologies

The Proposed System in Comparative Pricing and Product Search

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Java
Apache HBase
Hadoop
The MVC-based System Architecture.
System Architecture: The Control Layer

 Responsible for **processing requests** from the visualization layer;

 Composed of **four modules**: controller, interpreter request, executor query and result formatter.

### The Controller Module

Controls all internal modules and manages communication with other layers.
Introduction

System Architecture: The Control Layer

The other modules are:

**Interpreter Request:** interprets the requests received by the web service and submits them to be processed in the *Query Executor* module;

**Query Executor:** receives the query requests from the *Interpreter Request* and processes them. Also implements traditional and spatial queries (HBase does not yet offer native spatial operations);

**Result formatter:** receives the results from the *Query Executor* and puts them into the format expected by the web service, sending the results to the visualization layer.
Comprises a distributed NoSQL database using HBase in a Hadoop distributed infrastructure;

Stores a large volume of product offers and spatiotemporal data about prices;

Aims to provide scalability in read and write operations.
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System Architecture: Persistence Layer

- Comprises a wrapper module;
- Periodically communicates with several shopbots or virtual stores;
- Updates the product offers database (*new offers, locations and prices*);
- Builds a historical database of location-based product prices.

Wrapper captured data

\[ \text{Offer} = \{ \text{product, timestamp, price, seller} \} \]
System Architecture: Visualization Layer

- Comprises a graphical user interface and web services;

- **GUI** → very intuitive interactive interface;

- **Web Services** → data can be used by other systems;
System Architecture: Visualization Layer

An example of a spatial search of products
The lowest and the highest prices showed in the interactive map.
System Architecture: Visualization Layer

Implemented Web Services:

✓ **searchOffer**: Executes queries for offers.

✓ **getProduct**: Returns up-to-date details of a specific product.

✓ **getHistoryPrices**: Returns the price history of a specific product.

✓ **getPrice Location**: Returns the location of a price registered for a specific product.

✓ **getExtreme PriceLocation**: Returns the location of the maximum and minimum prices registered for a specific product.
Case Studies

To evaluate the approach proposed in this work concerning functionality, scalability and usability.

A case study applied to a Brazilian shopbot will be presented;

Aims to demonstrate an usage of system and evaluate them.
The case study: Setup

- Product offers of the Brazilian shopbot Buscapé;
- The wrapper have been capturing continuously during two and half months (75 days);
- Four different periods of a day: dawn (0-6h), morning (6-12h), afternoon (12-18h) and night (18-0h);
- Data volume: 54 GB/day (average) - total of approx. 4 TB;
The case study: Setup

Generated data

- Aims to **simulate** the price dispersion for **long temporal series** (more than 75 days);
- Allowed to **carry out performance tests** of queries posed to large volumes of data stored;
- **Volume**: two years capturing prices four times a day and spatially limited to the geometry of Brazil.
Search for “Galaxy Grand Duos” in a radius of 30 km from the center of São Paulo city (-23.53125, -46.65482).

- **Product**: a mobile phone (smartphone);
- **Spatial range**: Circle area formed near 30 km from São Paulo city;
- **Temporal range**: the last checked price (default);
- **Seller**: ordered by distance and better price (default).
The spatial query ready to be submitted by the system interface (search terms and geographic region).
The case study: Results - Functionality

Search results (product offers list + points on a map)
Some **details** of a selected product offer, buttons to show the price chart or to be redirected to the on-line store.
The case study: Results - Functionality

The historical price chart for a selected product offer.
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The case study: Results - Scalability

Processing costs versus volume of historical data.
The implementation of an infrastructure for Big Data enhanced with spatial capabilities have demonstrated a suitable solution to improve the usability/functionality of shopbots;

Interactive user interfaces based on maps enables to define searches on product prices and historical prices more precisely;

Performance of the distributed queries proved to be satisfactory in our experiments.
There are **several directions**, like:

- The replacement of HBase with a NoSQL database which offers support to spatial data management;

- To provide the execution of spatial queries based on spatial geometries, such as political division (Countries, States, Cities, etc).
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