Development of Mobile Search Applications over Structured Web Data through Domain-Specific Modeling Languages

M.Sc. Thesis
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• Article 2.1
  – (...) They shall produce a final thesis in English with summaries in Italian or Turkish, which shall be presented at both Institutions. Thereafter they shall be awarded the titles of "Laurea Magistrale in Ingegneria" at PM and "Master of Science" at ITU. (...)
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• under supervision of Asst. Prof. Marco BRAMBILLA

• within the scope of the Search Computing Project (SeCo)
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• SeCo aims to build the answers to complex search queries
  – by interacting with a constellation of cooperating search services
  – using **ranking** and **joining** of results as the dominant factors for service composition

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Problem Definition

• Web search applications are primarily designed for access through PC’s
  – Most widespread usage scenario
• Adoption of web-enabled smartphones, tablets and embedded devices
  – Different application goals and user expectations
  – Limitations and opportunities
  – Different interaction methods
Problem Definition

• Basic text-based search had been acceptable until recently, but…

• Technological advances
  – Broadband internet connectivity
  – Device mobility

• New trends
  – Web 2.0
  – Semantic web

• Higher expectations
We aim to propose a novel search paradigm focusing:

- Mobile devices
  - Utility information on concepts and on geolocated entities, rather than web pages
  - Less complicated interaction and minimal textual input
- Multi-Domain search
- Exploratory search
- Enhanced presentation of results
Our claim is that:

‘New search paradigms may let users conduct the search on small devices without being hampered by the limitations of the devices themselves.’

‘Appropriate solutions may also exploit the advantages of such devices for further improving the overall search experience.’
Background Information

• Multi-Domain Search
  – ‘Queries that are over more than one semantic field of interest’
  – Automatically combine the results of domain-specific searches
  – Provide answers originating from various domains
  – Exhausting and time-consuming job without multi-domain search
‘Find a good database conference in October 2012 in Milan, Italy, with accommodation in a 5-star hotel with reasonable price’

‘Find a Cinema in Paris that has Titanic movie on display with a good, nearby Chinese restaurant’
• A multi-domain search application may include:
  – Identifying semantic fields
  – Identifying input parameters
  – Invoking domain-specific search services
  – Associating and combining results
  – Ranking and sorting combinations
  – Presenting combinations
Background Information

• **Exploratory Search**
  – ‘Blends **querying** and **browsing** strategies from retrieval that is best served by analytical strategies.’

• **Motivation**
  – User may not be an expert in the area
  – User may be unsure on how to conduct the search due to technology or process
  – User may be unsure about the goal of the search
• Increasing human interaction in search
• Supporting the user in every step of the search process
  – Identification and formulation of the query
  – Exploration of most relevant and credited information sources
  – Presentation of results
  – Possible improvement of the query
    • Specify
    • Broaden
Background Information

- Search Computing Framework
  - Mart Repository ReST API
  - Query Processor ReST API
• Connection Patterns in SeCo
Background Information

- Mobile Search Interfaces
  - Smaller **screen size and resolution**
  - Ability to use in different **orientations** like landscape and portrait
  - Responds to **hand gestures** instead of clicks
  - User can interact with a single application and a **single screen** of it at the same time
  - Less computational capacity
Presentation of Results

- Result set for multi-domain query can be highly dimensional
- Multiple visualization methods should be provided
  - map view for geo-referenced objects
  - timeline view for time-located objects
  - other methods when suitable interval dimensions are not available
Proposed Solution

• Initial formulation of the query
  – Top-down approach, predefined items

Service Mart
  - Movie

Access Pattern
  - Title
  - Genre

Service Interface
  - IMDb
  - Yahoo! Movies
  - IMDb
Proposed Solution

- Collection of input parameters
  - Predefined input list
  - Specialized form elements for different data types
- Coordinates, date, time etc.
Proposed Solution

• Presentation of results
Proposed Solution

• Improvement of the query
  – Predefined connections
  – Possibility to add another domain after a domain-specific search is complete
  – ‘Potentially unlimited loop of connected domain-specific searches’
  – History list/map to review previous selections and add new domains
Proposed Solution

- Service Mart
- Access Pattern
- Connection Pattern
- History
- Service Interface
- Results
- Input Form
• Web search is conventionally carried out in web pages through a browser instead of standalone applications.
• The application is developed as a web application optimized for mobile devices and browsers.
• A domain specific language for developing mobile web applications called mobl is used.
Implementation

• Integrates all aspects of a mobile web application into a single language: data modeling, user interfaces, application logic, styling and web services.

• Compiler generates HTML5 / Javascript / CSS mobile web applications that run on modern Webkit-based browsers
  – iOS (iPhone, iPad), Android (2.0+), WebOS, Safari and Chrome
Implementation

• Statically-typed language with type inference
• Lets specify ReSTful web service interfaces declaratively
• Integrated Development Environment
  – Eclipse based
‘A real estate for sale around here with an open IT position nearby’
Index of walkability for a location
Doctors and Medical Specialists
Jobs and open positions
Sale and Rent of Real Estate
Hotel, B&B, inn etc
University and College
Car Rental Services
Information about Mexico
state: NY
zipcode: 11201
city: Brooklyn
street: 57 Montague St APT 2F
longitude: -73.99723815917969
latitude: 40.69566345214844
type: makeMeMove
useCode: Cooperative
details:
price: 360000.0
bathrooms: 1.0
Zipcode: 11201

city: Brooklyn

street: 57 Montague St APT 2F

longitude: 73.99723815917969

latitude: 40.69566345214844

type: makeMeMove

useCode: Cooperative

details:


price: 3600000.0

bathrooms: 1.0

bedrooms: null

lotSize SqFt: null

country: USA

Choose
Sale and Rent of Real Est...

tupleScore: 0.64

state: NY
city: Brooklyn
street: 57 Montague St APT 2F
longitude: -73.99723815917969
latitude: 40.69566345214844
type: makeMeMove
useCode: Cooperative
details:
http://www.zillow.com/homedetails/57-

Search History Map Reset
bathrooms: 1.0
bedrooms: null
lotSizeSqFt: null
country: USA

Car rental near Home
Walkscore indexes of Neighbourhood
School near Home by Zip
Events near Home
Transit index of Neighbourhood
Job near Home
This service searches jobs with California.

Keywords

Longitude
-73.99723815917969

Latitude
40.69566345214844
Conclusion

• We propose a solution for multi-domain search and exploratory search performed on mobile devices
• Our main focus is on non-functional requirements
• Proposed solution is also implemented as a mobile web application.
Conclusion

• The proposed application paradigm
  – helps the user to develop complex multi-domain queries
  – with the aim of exploring the results from credited sources with ease
  – and possibly associate them with one another
Conclusion

• It increases the usability of exploratory search in mobile devices w.r.t. the desktop computers

• It exploits the strengths of the mobile devices interaction paradigms by channeling them to the search process.
Thank you for your time
Appendix