A Proposal for Semantic Recommender for Outdoor Audio Tour Guides

Alexey Koren *
Natalia Stash **
Alexander Andreev *

* Excursia Inc., USA
** Eindhoven University of Technology, The Netherlands

I am going to present our project proposal for building a semantic recommender for outdoor audio tour guides. This is a joint work between Excursia Inc and Eindhoven University of Technology.

Project Proposal

- **Implementation of a personalized outdoor tour guide:**

  - **Utilize knowledge about:**
    - user preferences, interests,
    - statistics,
    - context - location, visited places, time, date, day of week, weather

  - **Dynamic recommendations based on semantic information model**

- **Basis: the current implementation of the adaptable (customizable) Excursia Audio Guide**

- **Building a semantic recommender engine based on CHIP project ideas**

The aim of the proposed project is the implementation of a personalized outdoor tour guide which will utilize knowledge about a particular user, statistics and current context (e.g. location, visited places, time, date, day of week, weather, etc.) for dynamic creation of personalized routes through the most interesting points in an area.

The core will be the semantic recommender based on semantic information model.
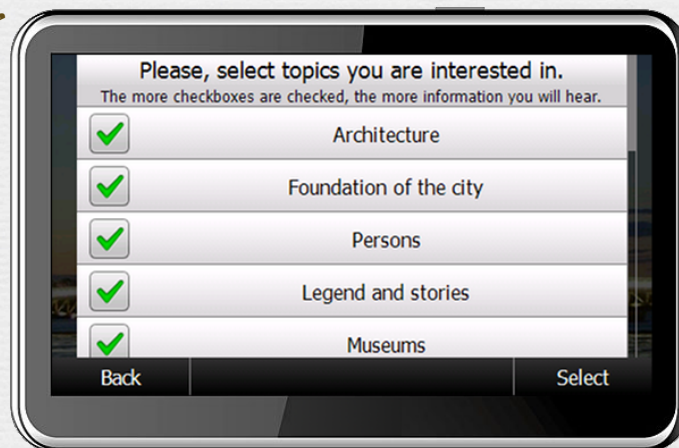
This project is a collaboration between Excursia Audio Guide project and CHIP project that are going to be briefly presented in the next slides.

The proposed personalized outdoor audio guide will be based on the existing implementation of an adaptable (customizable) audio guide, a result of the Excursia Audio Guide project. A user model is not involved yet.

In order to make it adaptive, in the proposed project we plan to build a semantic recommender engine system that can offer many routes for a user based on her/his past experience and strict or fuzzy dependencies amongst interest topics. With this aim we look at some CHIP ideas for providing personalized museum tours, such as the use of semantically enriched data, mapping the data to common vocabularies, user model description, dynamic tour adaptation and discuss how this ideas in indoor environments can be applied for outdoor tours as well.

Excursia Audio Guide Project: Mobile Audio Guide Application

- **Tourist-oriented customizable location-based audio guide**

  - **Selection of Points of Interest (POI) based on user preferences**
  - **Story about the same POI adapted to the user**

Please, select topics you are interested in.
The more checkboxes are checked, the more information you will hear.

- ☑ Architecture
- ☑ Foundation of the city
- ☑ Persons
- ☑ Legend and stories
- ☑ Museums

Back   Select

Excursia is a tourist-oriented customizable location-based audio guide.

Points of interest are selected based on the preferences set up by the user.

After setting up initial preferences in Excursia audio guide the tourist does not need to interact with the device anymore during the walking tour.

When the visitor approaches a point of interest (POI) the audio guide automatically starts telling a story about it based on the current visitor's geographical location.

Not only can the POIs be selected based on the visitor's preferences, also the story about the same POI can be adapted to specific visitor's interests.

The audio guide is under testing in Saint-Petersburg, Russia and Helsinki, Finland.

The guide does not provide adaptation to what user is actually doing while following the tour (adaptable guide).

In CHIP there is this feedback.

CHIP Project

- Cultural Heritage Information Personalization

- Cultural partner Rijksmuseum Amsterdam

- Focuses on techniques for providing personalized access to the museum collection both online and while in the museum

- Uses semantic metadata of the museum collection for generating personalized tours
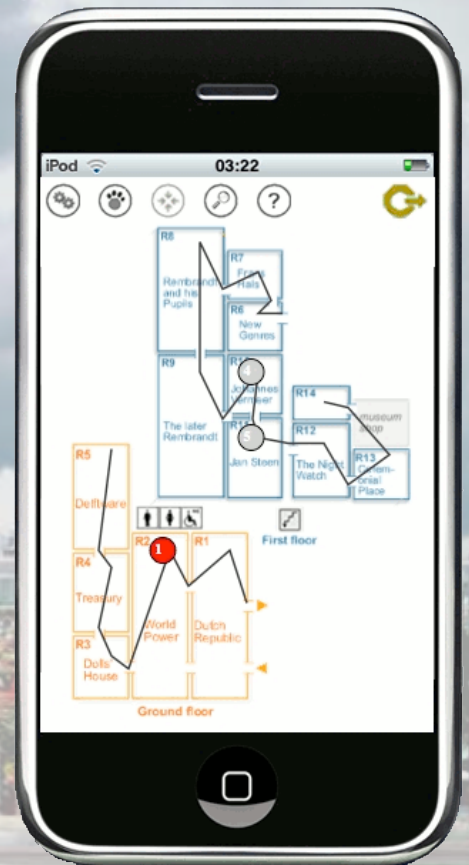
CHIP stands for Cultural Heritage Information Personalization. This project was done in collaboration with the Rijksmuseum in Amsterdam. CHIP focuses on techniques for providing personalized access to the museum collection both online and inside the museum.

It uses semantic metadata of the museum for generating personalized tours.

This means that various semantic relationships between the collection topics are being used,

e.g. if the visitor likes Rembrandt, the famous Dutch painter, the system recommends the visitor to see not only artworks created by Rembrandt himself but also artworks created by painter related to Rembrandt, e.g. his teacher or students.

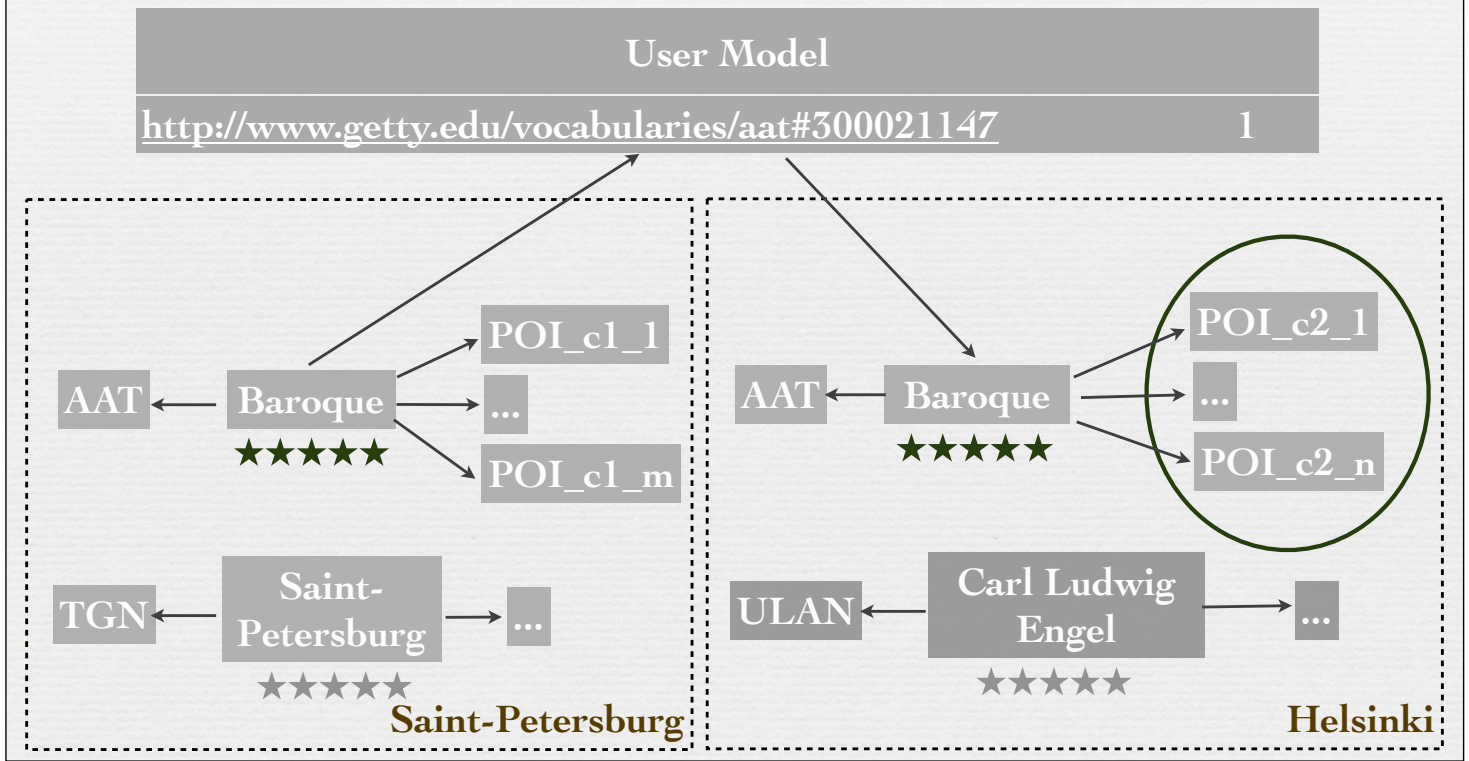Through these relationships in the data we can provide very rich recommendations.

The Mobile Museum Guide tool was developed to help the user navigate through the physical museum by following the tours presented on a mobile device.

The idea is that it can use a wireless connection inside the museum. In this way the user can access the tours that were prepared in advance before visiting the museum. While following the tour inside the museum the user can give ratings to artworks/art topics which results in user model updates and in the adaptation of the tour on the fly based on changing user interests, seen artworks, current position inside the museum and spacial constraints so that the walking distance to view all artworks in the tour is minimized.

On the slide we can see the route that the user has to follow and in the circles we see the number of artworks from the tour that are present in a particular room.

Semantic Recommender

❧ **Recommendations based on user model information from standard vocabularies**

User Model	
http://www.getty.edu/vocabularies/aat#300021147	1

Saint-Petersburg

AAT ← Baroque ★★★★★ → POI_c1_1, ..., POI_c1_m

TGN ← Saint-Petersburg ★★★★★ → ...

Helsinki

AAT ← Baroque ★★★★★ → POI_c2_1, ..., POI_c2_n

ULAN ← Carl Ludwig Engel ★★★★★ → ...

Semantic description of the data is the main idea that we are going to reuse from CHIP.

We also need to implement the user model that should be shared between different city tours.

In given circumstances we should expect requests from user like "more places like this one" or "something similar or related to places I have visited in Paris last week".

First of all data about each city has to be mapped to standard vocabularies.

When topics are mapped to standard vocabularies different cities know they are talking about the same topic, this can help them exchange information, and use information about the previous user visits to other cities.

The use of a common id rather than a name is important to make sure we are talking about the same topic. There are several cities in the world with the same name.

Saint-Petersburg is my home town in Russia, however there is a city called Saint-Petersburg in Florida as well. TGN gives every city a unique id.

As in CHIP we can provide mappings to 3 Getty vocabularies: ULAN, AAT and TGN and store user's ratings of topics and POIs in the user model.

If the user visits one city and indicates that he likes Baroque style (ID: 300021147 from Art and Architecture Thesauri) this information can be used during his visit to another city for recommending buildings in Baroque style as well. Or we can recommend the user seeing the building by the same architect (ULAN).

Semantic Recommender

❧ **Recommendations based on semantically described information model**
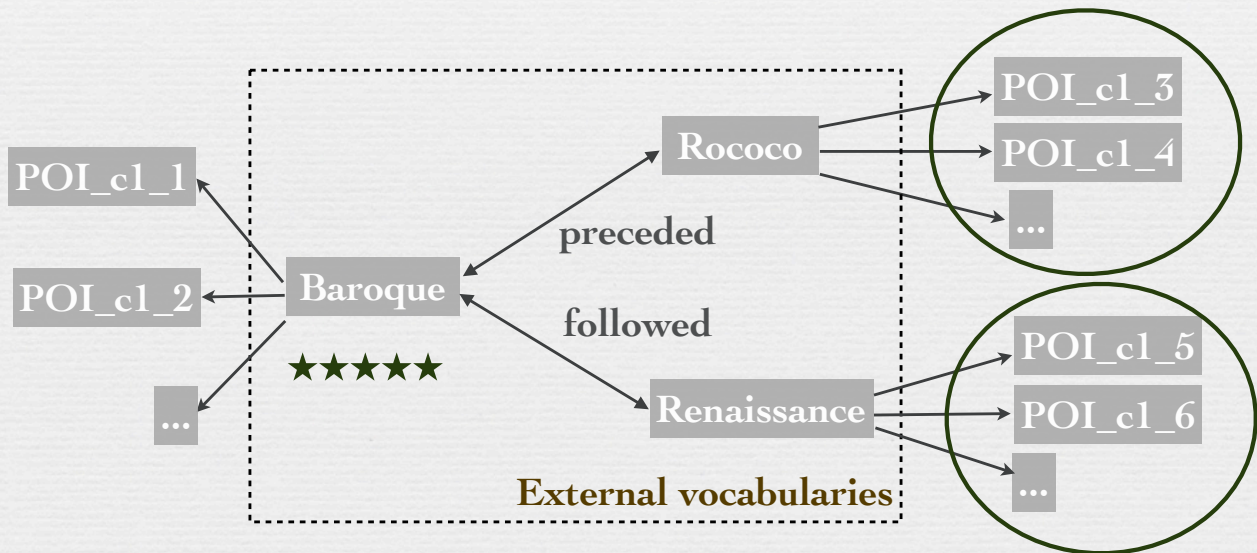
Another idea from CHIP is the use of various semantic relationships based on the semantically described information model for generating recommendations.

In this way if the user likes Baroque style, based on the information gathered from external vocabularies - AAT in this example - we can recommend the user the POIs in styles that are somehow related to Baroque.

Lots of information may be extracted from plain text describing POI to an easy-to-analyze form of RDF triples. Or information may be added implicitly by the user or content creator with semantic tagging.

The ontology describing the information model that is going to be built in the scope of this project is supposed to be a set of existing tourism, art and heritage ontologies carefully mapped to each other.

Discovering Relationships

- Association rules analysis methods

    - 98% of visitors that visit POI1 visit POI2 as well

- Quantitative association rules

    - 100% of visitors between age 16 and 25 visit POIi

Some interesting relationships may be not present in the system knowledge base.
But these can be discovered e.g. through the use of association rules analysis methods like market basket analysis:
98% of visitors that visit POI1 visit POI2 as well.
We plan to use quantitative association rules (when in our data we have quantitative and categorial attributes) e.g.
100% of visitors between age 16 and 25 visit POIi.

Discovering Relationships

- Generalized association rules

  - people visiting POIs from Subcategory1 visit POI4

Category1

Subcategory1 **Subcategory2**

POI1 **POI2**

Category2

POI3 **POI4**
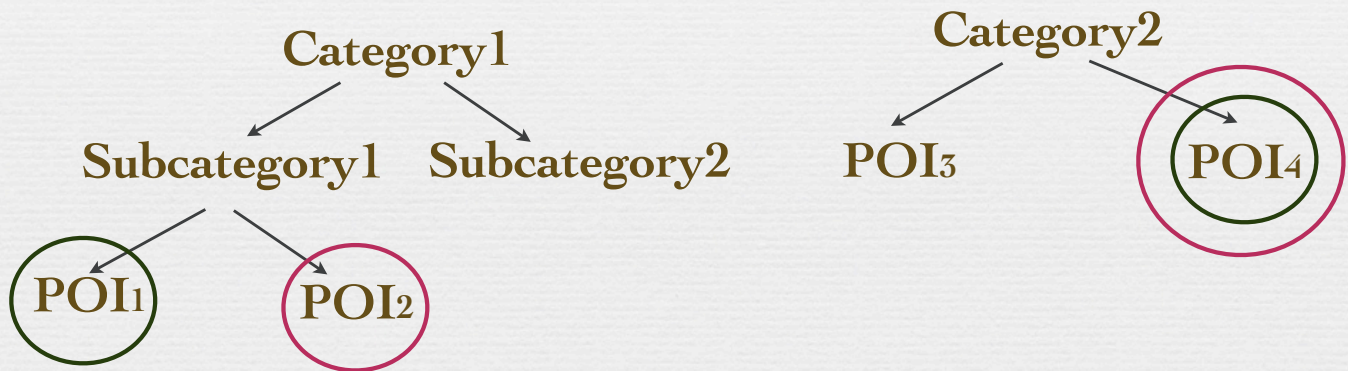
Through hierarchical structure of ontology we are also able to use generalized association rules,
also tracking the objects' places in the hierarchy in addition to direct associations.
For example, we may infer a rule that people who visit POIs from subcategory1 tend to visit POI4 from the fact that
people visiting POI1 visit POI4 and people visiting POI2 visit POI4.
This example is taken from shopping transactions, where instead of POIs we talk about shopping items.
Support for the rule subcategory1 -> POI4 may not be the sum of the supports for rules POI1 -> POI4 and POI2 -> POI4 since the visitor might have visited all 3 POIs in one visit (or bought the shopping items in the same transaction).

Dynamic Tour Adaptation

- **Hard-coded recommendations**

    - **links between POIs and categories**

- **Dynamically built recommendations**

    - **take into account location, visited places, time, date, day of week, weather**

- **Tour creation**

    - **Input: user model information, walking time estimation, area of walk**

    - **Output: POIs in given area**

Following types of recommendations are suggested to be included in the prototype:

 a. Hard-coded recommendations – links between POIs and categories that were set once by content creator or were generated by semantic reasoning software, e.g. category monuments or churches and a respective list of points of interest.

 b. Dynamically built recommendations – links that are generated at the time of the recommendation request. They take into account: location, already visited places, time, date, day of week, weather and other forms of context. Prototype architecture should be flexible and support of potentially any kind of context to be used in calculations.

 c. Tour creation - The user may request a tailored tour which should be built once based on the user's interests model based on implicit input and information gathered from service usage history. Other types of input are expected to be the walking time estimation and suggested area of walk. Output is a route including main POIs in given area for given user. Route may be a linked story or just summary of main POIs. In any case, it should meet location criteria such as maximum distance between two consequent POIs in an excursion and route geometry constraints (e.g. absence of cycles and minimal number of edges intersections).

Conclusions

- **Hard-coded (*stable*) recommendations are already available. Next:**

- **Development of dynamic semantic recommender**

- **Proposal of metrics for algorithms estimation**

- **Tests on focus groups**

- **Gathering both explicit and implicit data**

- **Gathering information about users from social Web sites**

- **In the future, see how both systems (outdoor and indoor guide) can work together**

Hard-coded recommendations are already available. In every area (city), the user may choose preferred topics from a list. Based on this selection, location and links amongst POIs defined by content creator, this software can give personal recommendations on where to go next.

Still all these recommendations are static. A user model and semantic technologies are not yet involved. The roadmap includes:
- development of dynamic semantic recommender providing the features as discussed in the previous slides,
- proposal of metrics (evaluation methods) for algorithms estimation and
- tests on focus group.
- On one hand we want to use user's explicit feedback revealing his likings/dislikings, etc. but users do not like to interact with the mobile device a lot so it is practically impossible to make him or her analyze and check/uncheck 50 or more options in good verbose taxonomy of possible excursion topics. Moreover, sometimes user may not know whether he or she likes some category or not before visiting some related POIs.

Gathering implicit feedback is really hard when we are talking about outdoor systems. Does the user like this square or (s)he is here just for a while because (s)he is lost? What exactly does the user like about this bridge? Is it the bridge itself, sea view or tent with souvenirs?

If the user is revisiting the same place - does this mean that he got lost?

A lot of similar questions should be answered during a collection of user data and structuring feedback model.
- It would be interesting to investigate how we could make both systems work together and reuse each other's information, e.g. how information gathered about the user when (s)he was following a city tour can be used for recommending a visit to a particular museum and providing recommendations inside the museum and vice versa - how the user's (dis)likings inside the museum can affect her/his city tour.

E.g. person shows interest in Baroque style buildings, the guide guides you to the museum that offers a lot in Baroque style and vice versa.