OpenPOI – Location-Based Applications to Collect Free Point-of-Interest Data for Secondary School Students

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Abstract

This paper discusses the development of location-based applications, which were designed and implemented by a collaboration of secondary school students and the Department of Geoinformation at Carinthia University of Applied Sciences (CUAS). A web-based portal for collecting and sharing Points-of-Interest (POI), representing the interests of young people, was successfully realized (www.openpoi.at). This POI data repository is accessible through free and open-source Web-based interfaces. Such web-based interfaces form the basis for the implementation of mobile location-based applications providing a sustainable developed environment for future collaboration projects. Two groups of secondary school students have generated mobile and location-based applications to utilize POI in the course of their A-level projects.

1 Introduction and Motivation

OpenPOI is an ongoing research project at CUAS, which focuses on the development of location-based applications for collecting and sharing POI. This is accomplished in collaboration with teachers and students of the secondary school HAK1-International in Klagenfurt. The target group of these applications consists of young people between 14 and 18 years. The concept and organisational framework of the project were introduced at the GI-Forum 2011 (ANDRAE et al. 2011a).

POI, i.e. places of interest such as sights, restaurants, landmarks as well as the current position of users with handheld devices, serve as an important data source of location-based applications like car navigation systems, routing planers for transportation reasons, location allocation planning for companies or tour planning for tourists (ERLACHER et al. 2010). Generally, POI can be seen as spatial information that represents the interest of certain users on a specific topic. Nowadays, there are several communities such as OpenStreetMap or OpenAddresses that follow the principle to collect free and open geodata using the crowd-sourcing paradigm (RAMM 2008). Despite the availability of free and open-source platforms, which provide geodata such as POI too, there is a lack of satisfying definitions and standards for POI (HAID et al. 2005).

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This paper shows the collaborative development of a spatial data model according to the needs of young people and the resulting location-based applications.

2 Project Overview and Collaboration

The project *OpenPOI* is initiated and financially supported by the Sparkling Science research program. This research program is a founding source supported by the Austrian Federal Ministry of Science and Research to combine research and educational institutions through joint projects. The overall goal of the program is the creation of a strong linkage between research and education with the aim to work side by side with young people in scientific research projects. Throughout the last years the Department of Geoinformation at Carinthia University of Applied Sciences (CUAS) has cooperated with several secondary schools in Carinthia and Styria in terms of lectures, presentations, workshops, secondary school theses and projects such as the Sparkling Science *Applications on the Move* (ANDERS et al. 2009, PAULUS et al. 2007). The Department of Geoinformation and the Commercial College HAK1-International Klagenfurt have been cooperating in the *OpenPOI* project since autumn 2010. This school partner provides the branch Digital Business that has a special focus on sound commercial education and incorporates an intensive Information Technology (IT) training such as *Software Development*, *Operating Systems* and *Network Technologies*, *Applied Programming*, *Business Information Technology* and *Internet and Multimedia*. These subjects, respectively lectures represent an important basis for the development of location based applications.

As stated in ANDRAE et al. (2011a) the OpenPOI project is divided into the three phases *OpenPOI Portal Development*, *Mobile Location-Based Applications Implementation* and *Road Show Realization*. The following chapters illustrate the collaboration and teaching methodology for each phase of the OpenPOI project.

2.1 OpenPOI Portal

This phase covers the conceptual modelling of POI, the design and implementation of a database model for POI and the development of a web-based portal to capture, edit, visualize and query POI. During this phase 26 students of the third form of the Digital Business branch were involved. A kick-off workshop that incorporated introductory lectures and presentations in the domains of Geoinformation (GI), Location Based Services & Games (LBS & LBG) and Internet Technologies & Applications was organized in order to provide a theoretical background for pupils and professors of the HAK1-Internationl. Furthermore, the secondary school students had the opportunity to test applications such as Geocaching and the Location Based Game (LBG) VestiGO (ERLACHER et al. 2010; see Figure 1, left image) in practical hands-on labs. These examples of location based applications facilitate the comprehension of LBS. The first major milestone in this collaboration was a joint and detailed analysis to develop the OpenPOI data model that is satisfying the needs of the target group. For this reason literature reviews, creative workshops (see Figure 1), questionnaires, use-cases, requirement analysis and paper mock-ups of the web-based portal results were analyzed, which made it possible to create the conceptual model.

During the workshops some web-based portals for the collection of POI, e.g. OpenStreetMap, PoiFriend, POIbase, TagIT, were reviewed by the pupils in respect to supported features such as POI Download, provided categories, accessibility via a defined interface. The interests of the target group were determined via creative workshops in a playful atmosphere and questionnaires, which were prepared and analyzed by the pupils. More than 400 questionnaires were evaluated in order to identify the interests of the young generation and the requirements for the spatial data model and Web-based portal. Additionally, topics such as the creation, modification and erasing of POI were discussed in class. *Who is allowed to edit and modify available POI?* Different opinions were discussed intensively. Not all involved pupils agreed that every OpenPOI user could modify or delete existing POI and their descriptive attributes. Another issue of the discussion was the quality assurance of data collection. In this context the various roles of data collectors and community were covered. The quality of the collected POI strongly depends on the local spatial knowledge of the users and the OpenPOI community that verifies the content. In order to ensure a certain quality of the collected POI methods for saving historic perspectives of the OpenPOI information were discussed in class, too.

Fig. 1: Impressions from the practical GI hands-on labs (location-based game VestiGO (left)) and the creative data model design workshop

The analysis and the available conceptual model enabled the implementation of the OpenPOI database model which has been improved through several development cycles. In parallel the CUAS research team developed the Web-based portal according to the requirements and implemented finally the database model that incorporates the resulting Web Services. In summer 2011, during an internship, four secondary school students tested and analyzed the Web-based portal prototype according to the ten usability heuristics by Jakob Nielsen. This incorporated terms of references such as the visibility of the system, consistency, efficiency, user control and freedom, error prevention, recognition, aesthetic and minimalist design, help and documentation. Additionally, new features like the integration of social media networks such as *Facebook* and the online translation and localization tool *dakwak* were added by the pupils. Furthermore, POI for selected regions in southern Austria, namely Klagenfurt, Villach, Lienz and St. Veit were collected and integrated during the internships.

2.2 Mobile Location-Based Applications

One major goal of the OpenPOI project is the development of Web- and mobile location based applications utilizing the freely accessible POI data. *The term Location-Based Services (LBS) is a concept that denotes applications integrating geographic location (i.e., spatial coordinates) with the general notion of services (*SCHILLER *et al. 2004,* p. 1*)*.

In this project phase the demonstration of the advantages and benefits of applying interoperability and standardization concepts is a key issue in the learning process. During the summer holidays in 2011 a bachelor student of the School of Geoinformation generated in the course of an internship an Android tablet application to display and create new POI via the available OpenPOI interfaces. This application represents an important basis for the A-level projects of eight secondary school students, because it illustrates basic handling of the OpenPOI interfaces. These eight secondary school students formed two groups and defined their project ideas in cooperation with teachers and researchers. Each team is guided by one responsible professor of the HAK1-International and a researcher who is responsible for the scientific guidance and the development progress. The first group was interested in developing an Android application that provides planned tours for selected POI, whereas the second group was keen on the implementation of an Augmented Reality (AR) based pub finder application. At the beginning of the A-level projects technologies, existing location based examples (e.g. the OpenPOI Android app) and procedures for solving the tasks were presented and discussed during workshops. Milestones such as required specifications, mock-ups for the graphical user interface, prototypes and a documentation were defined at the project beginning too. Throughout the A-level projects periodical meetings and workshops were held in order to support the secondary school students and the teachers during the development process. Each month the pupils presented the progress of the implementations respectively their intermediate results and documented the progress as well as problems on the OpenPOI Wiki (http://geoweb05.cti.ac.at/openpoi/index.php?title=Main_Page). A good portion of the development was realised during the lecture *Software-Development, Project-Work and Project-Management* (SPP) that were leaded by the professors of the HAK1-International.

2.3 Road Show

The Road Show represents the third phase and covers the integration of the OpenPOI project into secondary school lessons, mainly geography, biology and history. POI concerning these fields, e.g. historical- or natural POI, will enrich the OpenPOI database and can be shared with the community. Young people with heterogeneous background in terms of age or geographical location will be encouraged to collect POI using their spatial knowledge and discuss their perception with students, teachers and researches who are involved in the project. Furthermore, pupils of the A-level project obtain the opportunity to present their location based applications. *The dissemination of results in the respective communities, e.g. papers/poster at scientific conferences, a Road Show at schools, is the main aim of this phase* (ANDRAE et al. 2011a).

3 Implementation

3.1 Spatial Data Structure

Figure 2 represents the conceptual data model for the OpenPOI project. This model illustrates the spatial entity POI that could incorporate a set of additional information like images, web-links, images or alternative names. Each POI entity belongs to a specific user who captured his local knowledge respectively interests in terms of POI. POI entities could be rated by the community and belong to a certain category. The temporal availability of the POI entity is integrated too. The below displayed conceptual data model was finally implemented as PostgreSQL/PostGIS database scheme. Additionally, temporal data management procedures were generated in order to provide the ability to remember historic perspectives of the OpenPOI information.

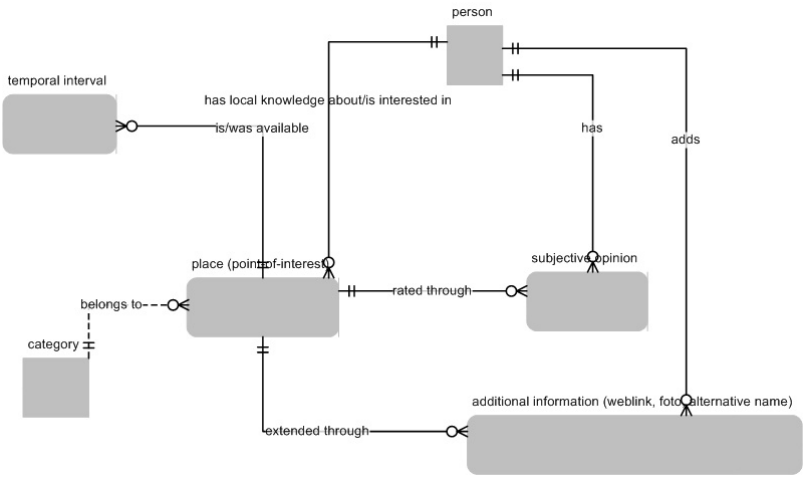

Fig. 2: Overview about the OpenPOI conceptual model

3.2 OpenPOI Portal

The requirements for the implementation of the Web-based portal are the integration respectively combination of open-source components and the provision of free and open interfaces to access the spatial- and non-spatial POI data. In order to identify State-of-the-Art technologies and architectural principles within the scope of community driven platforms, existing platforms (e.g. OpenStreetMap, OpenAddresses) were analyzed. Throughout the participation in the development of the OpenAddresses platform, the underlying system architecture and the MapFish framework (see figure 3) was identified, to meet the defined specifications. The MapFish framework is a free and open-source project for rich web mapping applications that is based on Pylons and comprises the Model View Controller (MVC) design pattern (GAMMA et al. 1994). As stated in ANDRAE et al. 2011b this framework incorporates the open-source libraries Ext JS, GeoExt, OpenLayers and a Map-

Fish library for the screen representation and the MapFish server that includes several modules which can be implemented as Python, Java, Ruby or PHP. Furthermore, the MapFish server implies the UMN Map Server, a web mapping server to provide Web Mapping Services (WMS) and Web Feature Services (WFS) and the Python SQL (Structured Query Language) toolkit and mapper SQLAlechemy that allows to access object relational database management systems such as PostgreSQL/PostGIS. For retrieving the data the MapFish server provides a RESTful protocol, too.

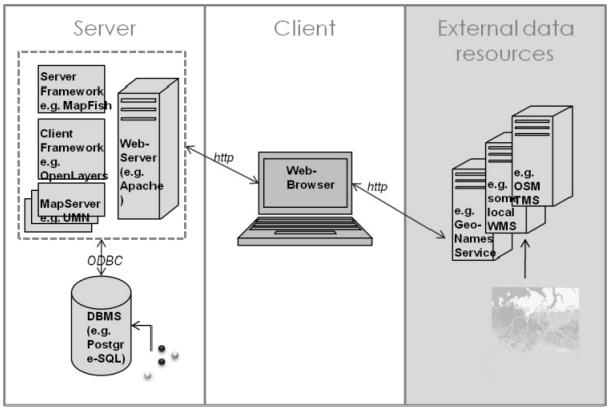

Fig. 3: System architecture of the OpenPOI web-portal based on the MapFish framework

3.3 Mobile Location Based Applications

The second project phase incorporated the implementation of two Location-Based Services (LBS), respectively applications that avail the collected POI data and the corresponding interfaces. The first LBS example was implemented as Android application (version 2.2) that provides functionality to compute a round trip for selected POIs. Android is an open-source mobile operating system as well as software platform for Tablets (Motorola Xoom, Samsung Galaxy Tab) and Smartphones (e.g. HTC Desire, Samsung Galaxy). For the computation of routes the Google Directions API (Application Programming Interface) was chosen. The second LBS example is implemented as Layar application that provides functionality to find pubs within a certain distance of the current position and to display the results on the mobile screen. Layar offers a mobile browser for Smartphones (e.g. Android, iPhone), which allows users to find POI based upon Augmented Reality (AR) technology. Many mobile devices are equipped with a built-in camera, which makes it possible to add further information or virtual objects to the camera view. Both applications incorporate the Global Positioning System (GPS) technology to determine the position of a mobile device. Detailed information concerning the GPS technology can be found in HOFMANN et al. (2001).

4 Results

4.1 OpenPOI Portal

At the end of the summer 2011 the first prototype was implemented and made available via a test server. Currently, the OpenPOI portal can be accessed via the following link www.openpoi.at. Figure 4 illustrates the latest version of the OpenPOI portal, which allows to capture, edit, visualize and query POIs. The Graphical User Interface (GUI) consists of the following components: The search and information component, which allows a detailed search for POI (e.g. OpenPOI database or GeoNames – free of cost place names), the map component that displays the OpenPOI data in respect to the categories and the base maps (e.g. OpenStreetMap or Bing Maps), the navigation components such as zoom and pan and the download component (KML – Keyhole Markup Language format). Furthermore, the OpenPOI users have the opportunity to change the portal languages or to share and rate their POIs via the integrated Facebook features.

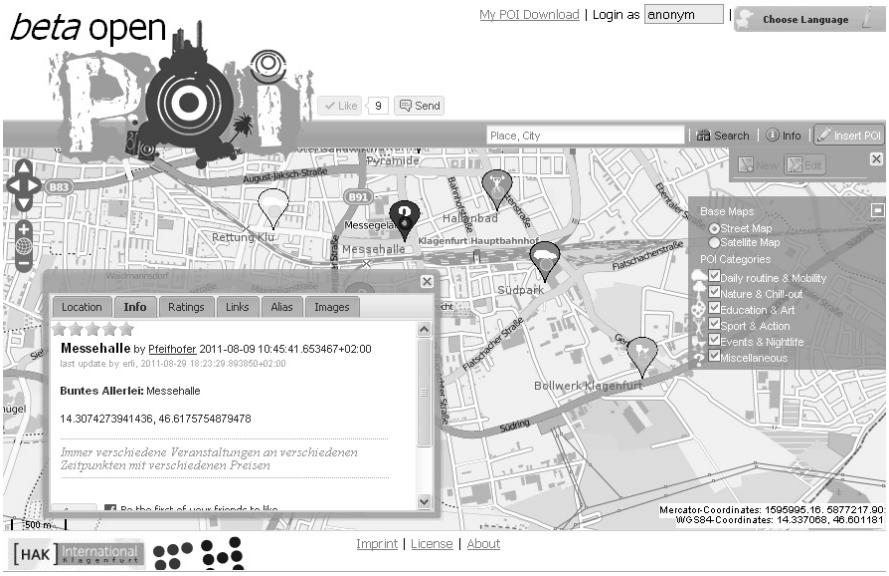

Fig. 4: Graphical user interface of the OpenPOI web-portal (www.openpoi.at)

4.2 OpenPOI Tour Planner

The POI routing application is based on the Android framework and supports a tour planning tool for selected POI. This prototype stores POI with the help of a SQLLite database, which will be automatically synchronized with the OpenPOI PostgreSQL database during loading the application. Users of the implementation have the possibility to filter locations in respect to their interests (see Figure 5, image a). The selected locations, respectively POIs are displayed on Google maps and provide additional information like a detailed description or rating values. Interesting POIs can be directly selected on the digital map in

order to calculate the route. This prototype supports route settings such as travel mode (e.g. driving, walking or bicycling) or multi-part directions using a series of waypoints. Furthermore, round trips are offered by the application, which connotes that the starting position represents the final position too. Computed routes are displayed with a colour gradient from light green (starting direction) to dark blue, which expresses the course of the journey (see Figure 5, image c). The information for the travel duration and length for each segment is displayed on the mobile screen, too. Additionally, users of this application have the opportunity to enter new POIs with the help of the GPS sensors. Added POIs are again synchronized with the OpenPOI PostgreSQL database.

(a) (b) (c)

Fig. 5: Illustrations of: (a) the setting view for the round trip, (b) selected POI and (c) display of the computed shortest route on the Google map view

4.3 OpenPOI Pub Finder

The pub finder implementation is based on the Layar framework, which offers AR functionality to display POI like bars, clubs or pubs in terms of virtual objects to the camera view. Users of this application have the opportunity to choose POI sub-categories and a specific detection range in order to limit the amount of displayed data. The developed application supports both the augmented reality mode and the map view mode (see Figure 6). For visualizing virtual objects the combination of GPS, compass, handheld camera and a 3G/Wifi connection is required. POIs which are very close to the user are represented with bigger symbols and can be selected by the user to obtain additional information such as opening hours, types of music, events as well as the distance to the POI. Additionally, it is possible to compute and display the route of a chosen POI for pedestrians or vehicle drivers. The map view mode represents the current position of the user in the centre of the Google map. Furthermore, the chosen bars, clubs and pubs for the given detection range are displayed in the map too.

Fig. 6: Map view mode (left) and the augmented reality mode (right) incorporating the current position of the user and the pubs (symbolized by beer glasses) within a distance of ten kilometres

4 Conclusion, Discussion and Future Prospects

The final result of this project is more than a Web-based portal for POI focusing on the interests of young people. It also incorporates a spatial data module, collected POI of the cities Klagenfurt, Villach, Lienz and St. Veit in Carinthia as well as mobile location-based applications that use open interfaces. POI users have the possibility to capture, edit, visualize, query, share and rate POIs either via the OpenPOI portal or via the implemented location-based applications. Additionally, the developed location-based applications provide functionality for planning a round trip of selected POIs and to augment the reality for finding pubs in the surroundings.

Unfortunately, not all requirements of the Web-based Portal were implemented, not only due to lack of time. For example, at the beginning of the project it was planned to integrate functionality for spatial-temporal queries, but it turned out that the majority of the target group is not interested anymore in such tools, because it would afford too many complex settings. To integrate the temporal aspect for POI in a detailed manner causes a lot of presetting for POI creation. For example, the temporal availability for a specific event can be linked to an event that occurs only once, twice, or monthly during a certain period of time or the opening hours of shops, restaurants or museums can differ during the year, season or month. Therefore, the first prototype only supports a limited functionality to express the temporal availability of different types of POI. For the upcoming road show an enhancement of the data model in context of the temporal POI availability should be considered. The aspect of temporal POI availability could be integrated in school history lessons, in order to display the historical changes through the time. In this context more detailed spatial-temporal data models and –queries have to be integrated (ERLACHER 2006).

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