MOBILE APPLICATION TO COLLECT INFORMATION ABOUT ARCHITECTURE TO OBTAIN A COLLECTIVE KNOWLEDGE BASE

ar:searchbox.app

CHRISTOPH LANGENHAN [1], SAHM ALEXANDER[2], PETZOLD FRANK[3], SEIFERT ARNE[4] AND TEICHERT ASTRID[5]

Technical University of Munich
Chair for Architectural Informatics
Arcisstraße 21, 80333 Munich
[1]Email address: langenhan@tum.de
[2]Email address: sahm@in.tum.de
[3]Email address: petzold@tum.de

Technical University of Munich
TUM University Library
Arcisstraße 21, 80333 Munich
[4]Email address: arne.seifert@tum.de
[5]Email address: astrid.teichert@tum.de

Abstract. During the early stages of the architectural design process, students and architects seek information for inspiration, and to evaluate design ideas or similar solutions. An essential part of design education therefore involves building up a knowledge base of already built or designed buildings. Most students gather such information by visiting or researching building designs, for example through photos taken on design studio field trips. These photos are used for studio work or archived for later use. The "ar:searchbox.app" aims to support this in two ways. Firstly, by supporting easy mobile information acquisition and sharing, as well as the semi-automatic derivation of high quality metadata; and secondly, by employing urban environment sensitive search and similarity-based browsing strategies to support mobile education as well as a web-based access to the information. To provide long-term access and to establish an information base that is not restricted to a single design studio, the "ar:searchbox.app" builds on our previous "ar:searchbox" project which uses a central media server called "mediaTUM" that provides a handling concept for flexible metadata schemas and scalable infrastructures.

1. Introduction

The design process as an iterative process of searching for a plausible solution involves a continual back and forth between analysing and evaluating steps in which potential solutions or variants are created by various means and then reduced. For this, traditional design methods are most commonly used in the early design stages such as model making, sketches

and the use of reference examples. These methods are not just used for the purpose of presenting design ideas and solutions; they are thinking tools as well (Gänshirt, 2007) and serve to externalize and visually examine ideas or parts of it the designer has in mind. Moreover, references serve as source of information to guide or show solution to a problem at hand.

Since the mid-20th century, information technology - for example, CAD systems, 3D models and simulation techniques - has revolutionized the way we communicate and develop the design of buildings. Building on these developments, the presented approach looks at how we can store and access the information.

Digital equivalents have already been devised for several traditional design methods, however many of these do not fully translate the original strengths of the analogue methods into the digital world and fail to make maximum use of digital possibilities. The approach discussed in this paper aims to overcome these shortcomings and proposes a mobile application to collect and search for reference examples on a field trip and makes full use of current methods and technologies.

Therefore it is necessary to define requirements with regard to data structures as well as corresponding strategies for retrieving and accessing this information by using appropriate indexing strategies depending the type of information. Information regarding potential design solutions can, for example, be organized according to different visualisations relevant in early design stages like elevations or floor plans.

During the design process in the early design stages fundamental decisions based on assumption are made and influence the planning process as well as the whole lifecycle of a building. Designing means, influenced by some given and some unknown parameters like form, function, urban or historical context, material, function or construction to meet economic and temporal limits.

Hillier said about the design process “It begins as an idea for the building, then becomes an idea of the building, then a more formalised concept, then a series of more and more refined representations, then a set of instructions and finally a building.“ (Hillier, 2007, p. 43). Regarding Hillier, our aim is on design decision support for designers when they have “an idea for the building”. Exposing designers to information refers to the use of references, that can be seen as a design tool, to solve a given problem. Following Gänshirt (2007, p. 95) every design tool can be used descriptive to describe something existing, and prescriptive to describe something new. Although the descriptive part is dominating the use of references the prescriptive part will help to guide the designer through the design process. Richter (2010, p. 107) identified three categories why using approved design solutions / references: 1. Exploration: Finding an idea, 2. Evaluation of vague idea, 3. Search a specific solution.

As hand-held media devices become more widespread even in the construction industry (Anumba, 2012; Schach, 20007), many photos are now taken with the increasingly powerful cameras available on modern mobile devices. The corresponding increase in the number of photos raises problems for sorting, storing and sharing photos together with additional information among students, as well as how to deal with duplications of photos and projects. Current information systems lack sufficient depth of information, precise domain specific metadata or flexible data structures to adapt and extend existing databases.

2. Concept

The “ar:searchbox” project (Langenhan, 2012) is a cooperative initiative by the Chair for Architectural Informatics and the TUM University Library. It uses mediaTUM, an open source software developed at the TUM, to store information about architectural projects in a central repository. The repository is based on a fixed metadata scheme that enables to structure the architectural information and define relations between different projects. The current implementation offers a web based user interface to share photos and additional metadata of architectural projects. Its browsing and search functionalities allow other students to get inspiration by browsing through existing projects.
The "ar:searchbox.app" is an iOS application (Mcmeel, 2011) that uses the "ar:searchbox" as a central repository to share acquired projects among other mobile and desktop users. It focuses on the one hand on easy and fast photo taking and annotation in order to encourage users to enrich their photos with as much metadata as possible. On the other hand it leverages the capabilities of modern smart phones to let the students explore projects while being on the road.

3. Usage scenarios

In order to depict how the ar:searchbox.app will be used and how it will achieve the goals described above, we will use the technique of scenario telling like supposed by e.g. Brügge (2010). We therefore imagine Alice as a future user of the final ar:searchbox.app and describe in concrete scenarios how she may use the ar:searchbox.app.
While taking a walk through her neighborhood Alice notices a residential construction project that impresses her. She decides to document the overall project as well as the most impressive aspects of the project for her research records. Alice takes her iPhone and starts the ar:searchbox.app. She touches the large “Take photos” (see Figure 1) button on the app’s start screen to start taking photos. After every photo she takes the app asks her to specify the kind of image (perspective, floor-plan, front view) she just took and afterwards let her instantly take a further photo of the same project. Once she has taken enough photos Alice chooses “Done” in order to finish the photo session. In the next step the app asks Alice to either create a new project, or to choose an existing projects among her recent projects as well as already documented projects nearby (see Figure 1). As the project isn’t listed in the existing nearby projects Alice knows that it doesn’t exist in the ar:searchbox already. Alice chooses to create a new one and enters a (preliminary) name and chooses the type of project from a hierarchical list of architecture types. The app now notifies Alice that the new project has been created successfully on her iPhone and all photos from the session are assigned to it.

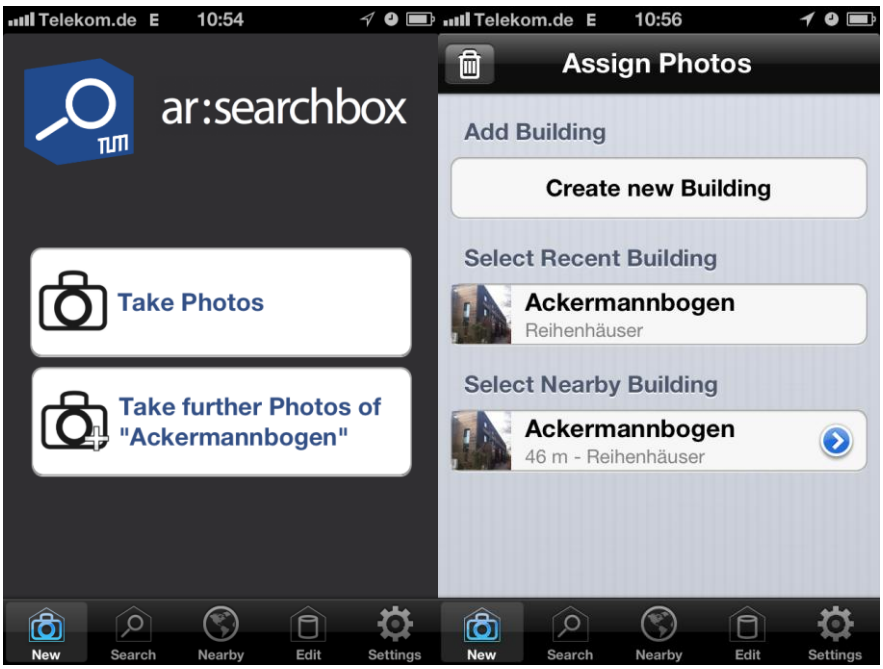

Figure 1. Left: Take Photos. Right: Assign Photos.

Using the iPhone's location features the photos are automatically tagged with the address (including street, city, and country) and orientation (south, west, etc...). Since Alice instantly after creating a photo specifies its kind, important information for future processing is gathered with minimal effort. Focusing on fast image capturing the combination of lightweight manual metadata entering and automatic metadata gathering leads to projects having rich metadata while not restraining users to capture many photos or projects.

3.1. PUBLISHING PHOTOS TO THE SHARED REPOSITORY

After a longer walk through the city Alice has captured several new projects as well as added new photos to existing projects. Back at home she now wants to research further information, like the architect about the newly captured projects. As the projects she created during her recent excursion are still only stored on her iPhone she first opens the ar:searchbox.app and navigates to her locally stored projects. By touching the "Edit" button Alice can set a selection of projects she wants to be uploaded to the ar:searchbox repository. She chooses to upload all created projects as well as the photos she added to existing projects. After successfully uploading the photos the ar:searchbox.app removes the original photos from the iPhone to save space. While the newly created projects are uploaded to her personal folder, the new photos of existing projects are directly added to the respective projects. From now on each user of the ar:searchbox can view and extend the projects Alice published using either the web interface or the ar:searchbox.app itself.

3.2. EXPLORING PROJECTS STORED IN THE SHARED REPOSITORY

Alice visits a friend and walks through the city as she notices an architectural project of interest. As she is interested in getting more information about the project, she opens the ar:searchbox.app on her iPhone. She switches to the map view that determines her location

using GPS and automatically loads the projects stored in the ar:searchbox repository that are nearby as pins on the map (see Figure 2). By clicking the pins Alice sees a photo of the project as well as its name and information about the project kind. Alice can now browse through all photos and floor-plans stored for the project, as well as get information about the architect.

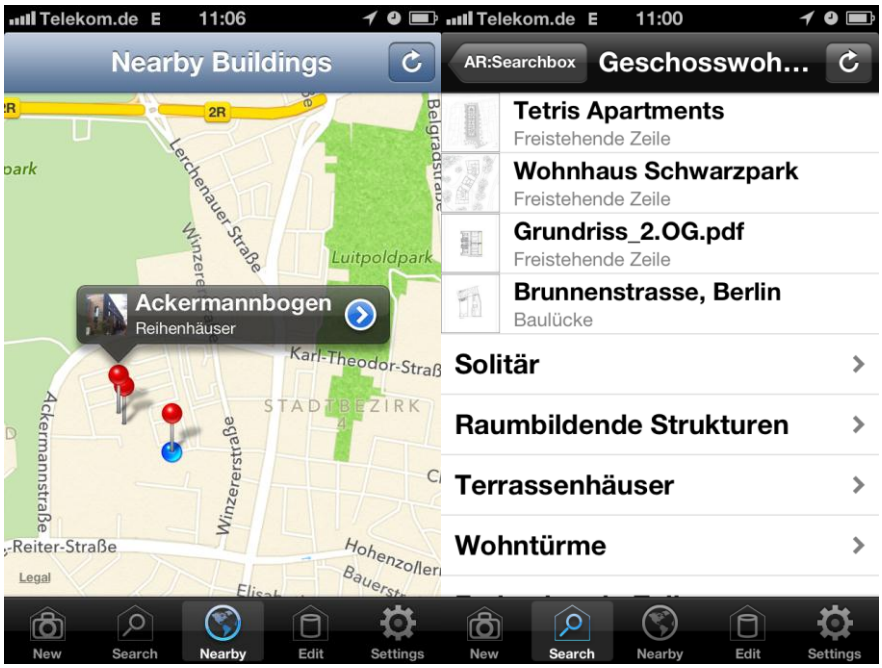

Figure 2. Left: Searching by location. Right: Searching by hierarchy.

Since the user has the ability to discover interesting architecture in the neighborhood, she can spontaneously visit those projects to have a closer look and take further photos that enrich the repository. Using the ar:searchbox.app the repository can be browsed by location using the map view, as well as by its categories in a hierarchical list view (see Figure 2).

3.3. PUBLISHING WORKFLOW

To maintain the high quality of the projects listed in the ar:searchbox we have to think about access and rights management. Different groups of users may have different restrictions when it comes to publishing projects in the shared ar:searchbox repository.
The combination of the ar:searchbox.app and the MediaTUM server enables support for various publishing workflows. Depending on the access level various actions can be implemented in different steps of the publication workflow. For example a student can publish its first project a review by a moderator can be enforced before the changes are visible for all users. Another student that already published several projects on the other hand might be able to publish a new project without a review.

4. Implementation

The technological foundation for the shared repository the ar:searchbox.app operates on is mediaTUM. MediaTUM is an Open-Source software product for large scale image, document and video archiving and retrieval (TUM University Library, 2013b). It is developed and used as central document and publication server of the Technische Universität München (TUM University Library, 2013a). It is written in Python and provides besides the web interface, REST web services for third party applications.
The overall system architecture shown in figure 3 describes what components and actors are involved in the implementation of the system and how they interact. The mediaTUM system is described simplified in four parts. The Core that handles the whole application logic and interacts with the Storage database in order to process request from either the Web-Service component or the Web-Frontend. The User can interact with mediaTUM and in a consequence with the ar:searchbox collection, either using the Web-Frontend or the ar:searchbox.app on the iPhone. The ar:searchbox.app in turn communicates with the mediaTUM system only using the Web-Service component. Hence the Web-Service component has to provide services for all features of the ar:searchbox.app.
We already had a closer look at the mediaTUM system above, we will now take a closer look at the internals of the ar:searchbox.app. Figure 3 shows a schematic drawing of the main packages the ar:searchbox.app consists of internally.

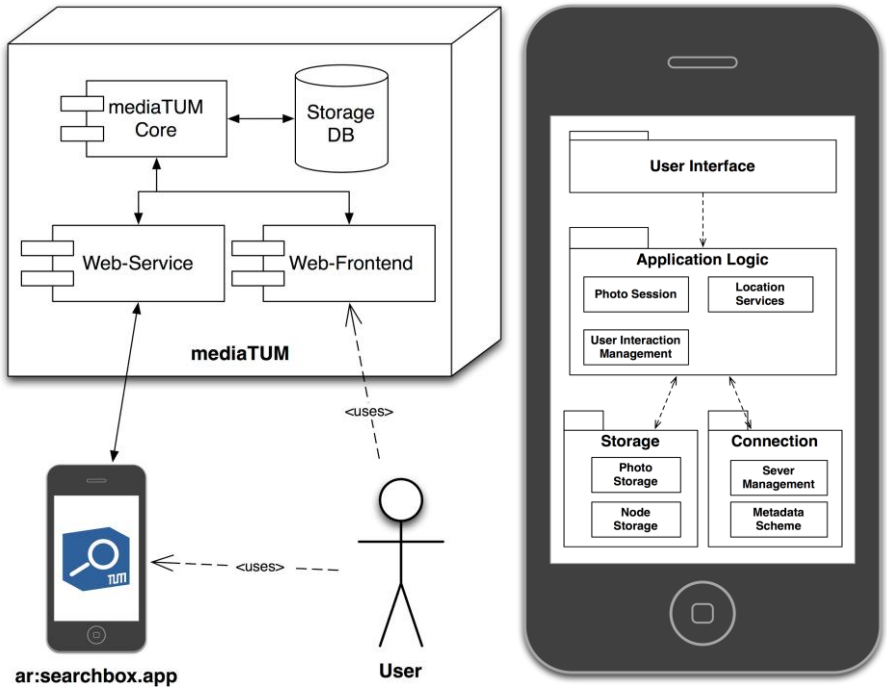

Figure 3.Left: Overall system architecture. *Right: Main components of ar:searchbox.app.*

The User Interface package contains all user interface widgets and view controllers needed to display the user interface to the user. As in most mobile applications the user interface is very important and thus is one of the largest packages in the ar:searchbox.app. The User Interface

package adheres to the user interface architecture proposed by Apple in their programming guidelines for iOS.
The Storage package handles all data that is stored in a persistent fashion on the iPhone's mass storage. It uses an Apple provided object persistence framework called Core Data to store nodes and their metadata. Nodes can either be stored locally created by the user, or be remote loaded from the mediaTUM server to be stored for caching. Furthermore the package handles the storage of all kind of images like: full resolution photo files created by the user, preview thumbnails, and cached detail images coming from mediaTUM.
The Connection package can manage multiple mediaTUM server instances, as well as the user credentials and current open sessions. It handles requests coming from the Application Logic package to query the content of a folder or metadata for a node from mediaTUM. It also handles uploads of photos and metadata changes to mediaTUM. The package furthermore manages the metadata scheme that describes the metadata fields of each node and their possible values.
The Application Logic package coordinates the whole application. It provides information about artifacts stored in the Storage component to the User Interface and interacts with the Connection package in order to initiate server connections, and handle caching of remote artifacts. It in addition handles the current state of user interaction in order to load views when they are needed by the User Interface.
The first version of "ar:searchbox.app" was successfully evaluated by architecture students at the TUM. The evaluation confirmed that the application is highly relevant, and stable enough so we are currently submitting the app to the Apple AppStore. But the first evaluation has also shown that providing a fixed set of categories from a given metadata schema isn't sufficient to categorize and interconnect a broad variety of architecture projects.
A further challenge that will arise over time is the handling of an evaluating metadata scheme. While the ar:searchbox.app itself is capable of dynamically loading updated metadata schemes from the mediaTUM server, the question arises how to migrate existing projects that were stored using older versions of the metadata scheme.

5. Future work

As soon as the app is published on the AppStore a second evaluation with a broader set of students is planned. The goal is on the one hand to evaluate the usability while on the other hand documenting more buildings for the ar:searchbox. At first a mediaTUM account will be needed in order to access the ar:searchbox, but as soon as some remaining legal issues are solved it is planned to allow access to everyone.
Future research will examine the use of social tagging or the integration of external databases with a view to revealing a common understanding of the vocabulary used among users as well as Building Information Models (Keough, 2009). Furthermore, methods to integrate user ratings and user recommendations will be examined.
Another interesting aspect for future work is a stronger focus on educational aspects. For example a future version of the mobile ar:searchbox.app could automatically recommend buildings related to the current building in respect to era, architect, or type. In combination with the location awareness, the app could prefer buildings nearby and thus allow the students to go onto an interactive city learning (Brown, 2009) tour.

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