Abstract

We describe the development process of Jobim Botanic, an app for those who wish to explore Rio de Janeiro’s Botanical Garden, one of the most visited attractions in the "Wonder City".


Keywords: Tom Jobim, Botanical Garden, Rio de Janeiro

1 Introduction

Jobim Botanic is part of a project that focuses on exploring the impacts and potentialities of the interactive multimedia technology applied to mobile devices. In short words, it is a mobile application for iOS that aims at three main points:

1. Providing information (both practical and recreational) about Rio de Janeiro’s Botanical Garden;
2. Supplying a navigational tool to allow users to explore the garden;
3. Allowing users to produce, record and share contextual data with peers.

The motivation to develop it came with the desire of experimenting new mobile technologies that would serve real users and have a clear and practical purpose. We perceive the Botanic project as a ground for experimentation and research on new technologies and tools, but we also believe that the outcome of this project can transcend the academic field and become a product supported by institutions or companies, being thus part of an R&D innovation cycle.

The choice of the theme for the app came after an extensive research, from which we realized that, when it comes to mobile applications that focus on places in general, there are basically two types:

- Those which deals with navigation in a macro way (i.e., it takes into consideration large areas, such as cities and even countries) and has solely practical purposes (it is a tool that helps users to get from point A to point B); and
- Those that privilege content (be they recreational or informative) and deal with smaller, indoor areas. Such would be the case of a museum app that shows the ongoing exhibitions and activities, but does not provide interactive navigational tools (probably because roofed areas are difficult to be reached through GPS, and because the area does not justify the need for a more complex navigational system).

We wanted to mix these two different categories in an app that would deal with navigation by making use of all the resources available and to provide interesting and relevant content that would be recreational (and not just utilitarian). We wished to enable macro and micro exploration of a specific/controlled area that would not only be rich in information but also have a diameter large enough to require navigational tools.

Rio de Janeiro’s Botanical Garden is the place of our choice for having all the desired qualities: It is one of the most visited attractions in the city, receiving annually over 600 thousand people (and nevertheless, the place so far lacks its own mobile application); it is also a prominent center of study and research; it has many cultural attractions that go beyond the botanical field and distinguish it from other parks and gardens, such as the Tom Jobim Space and the Environment Museum. Finally, the geographical proximity to IMPA, making it easy for us to do tests in loco, and the close relationship...
between the VISGRAF Lab and the Tom Jobim Institute were also
determining factors.

The number of mobile applications for botanical gardens has been
growing rapidly since 2013, when we started our project. During
the conception phase, our research on similar apps resulted in only
two relevant applications (Kew Gardens and Chicago’s Botanical
Garden), and both at a very incipient stage. At the time of writing
there are already more than ten similar apps available on the App
Store. This shows that our initiative is consonant with what can be
considered a global tendency.

However, there are many features that differentiate the Botanic
project from all others. While most of them tend towards one ap-
proach or another in regard to the content (i.e., there are those which
privilege the presentation of a closed and edited content to users,
opposed to those that focus solely on the creation and sharing of
content by users, such as Instagram), Jobim Botanic has both. We
decided to put together features that combine information with navi-
gational tools and also the possibility for the user to produce and
share data and all these associated with state-of-the-art technolo-
gies applied to the fields of Augmented Reality, digital panoramas
and interactive media, just to name a few.

2 App Overview

The genesis of the Jobim Botanic app was the result of a combina-
tion of two distinct forces: i) the desire to transform a printed book
into a mobile multimedia app; ii) the impulse to exploit mobile plat-
forms in the development of new tools for personal exploration of
a rich ecological environment.

The musician Antonio Carlos Jobim always adored nature. His
name has become strongly associated with the preservation of
Brazil’s ecological and cultural heritage. He also had a special rela-
tionship with the Rio de Janeiro Botanical Garden (JBRJ), a place
he used to visit very often. This motivated the creation of a cul-
tural and environmental center in the JBRJ with his name (the Tom
Jobim Institute [IACJ 2012]).

In 1987, Tom Jobim joined forces with the photographer Zeka
Araujo to poetically record the beauty of the Botanical Garden in
the form of a book called “Meu Querido Jardim Botanico” (My
Beloved Botanical Garden), containing poems and pictures of the
park. Figure 1 shows two pages of the book.

Figure 1: Pages of the book My Beloved Botanical Garden,
containing handwritten poems of Tom Jobim and photos of Zeka
Araujo.

The rich and evocative content of the book prompted the Tom Jobim
Institute to make it available in the form of an interactive multime-
dia app.

However, the Institute is physically located inside the Rio de Janeiro
Botanical Garden and promotes several cultural activities within the
park. Figure 2 shows a map of the JBRJ and the Institute location.

Figure 2: Map of the Rio de Janeiro Botanical Garden and loca-
tion of Tom Jobim Institute.

The facts reported above naturally lead us to the idea of exploit-
ing the relationship of the book’s audio-visual content with the real
environment it depicts, though a mobile augmented reality app. In
this way, Jobim Botanic was born. The App logo, shown in Figure 3
combines graphics and type integrating the royal palms, which have
become the JBRJ emblem, with textual elements.

Figure 3: The Jobim Botanic App signature.

The Jobim Botanic app can be defined by a single sentence:
“Get inspired, explore, and share!”.

This phrase reveals both the spirit and structure of the application. It
summarizes the app’s functionality and what users will experience.
It also enumerates the app’s main modes.

In this context, Jobim Botanic is: an information tool – a visitor’s
guide of JBRJ; a navigation tool – a map of the park; and a data
collection tool – an instrument for taking notes and photos of the
visit. Each of these aspects comprises one of the three main modes
of the app: Info, Visit and Data.

The Info mode aggregates the functionality that the user will need
before a visit to the Botanical Garden. In this mode, users have
access to all the information related to the park, such as directions,
parking, opening hours, etc, as well as activities of JBRJ’s asso-
ciated organizations, i.e., the Environment Museum, Tom Jobim
Space and Society of Friends of Botanical Garden. In addition, the
user can enjoy in this mode multimedia content from the book My
Beloved Botanical Garden, such as poems and photographs to get
inspired and visit the park. App documentation and configuration
is also located in this mode.

The visit mode is the core of the app and integrates the various tools
required for exploring the park. It contains a catalog of curated
tours with selected spots in the Garden that reveal different aspects
of the park’s flora, fauna and architecture. When taking a tour, the
visitor may rely on the map navigation tool to get directions and
The visit experience is complemented by search tools, so that the user can quickly find places on site. In order to capture data during the visit the user has also available in this mode, resources to take photos and make notes with geolocation.

The data mode allows the user to manage the data collected during his/her visit to the park and share specific content with friends. Photos, notes, and visits, as well as the user’s personal information and contacts are stored in a database for easy access. Communication and sharing tools make the link between the app and a networked environment. This mode typically will be used after a visit, but can also serve for live communication purposes while visiting.

According to this basic structure, the app was designed in such a way to minimize mode changes. Nonetheless, it is very simple and intuitive to change modes in the application. The app’s initial screen, shown in Figure 4, allows the user to select a mode to enter at launch time, and once the app is within a particular mode, other modes can be accessed with a single command.

![Figure 4: Jobim Botanic initial screen with mode selection menu.](image)

### 3 Development Process

With the main concept of the application defined as presented in Section 2, we initiated the development of Jobim Botanic. The development process included the following phases: Brainstorming; Strategy planning; Work on functionality; and Content generation.

During the first phase, we collected data and references about existing mobile platforms, applications and tools. This research lead us to decide to develop for Apple’s mobile operating system – the iOS – and, more specifically, to iPhone devices. The reason is because that platform family had all the features required for the experience we wanted to provide (such as a GPS locator, access to internet, camera and so forth) allied with the convenience of being lighter and easier to carry than the iPad (although an iPad Mini could also fit the purpose).

The second phase consisted of determining the development strategy of the app. After having chosen iOS, a research on the system’s existing tools and resources was carried out. The survey indicated which functionalities would have to be developed from scratch, and which ones were part of the default features. That prevented us from being redundant and wasting our efforts on things that might already have been done. Nonetheless, it is important to mention that our contributions still had to be synchronized with Apple’s product strategies. The company itself is constantly adding features to each version of iOS, which means that it is possible that we develop the same kind of tools simultaneously. This reflected also on the way we dealt with the interface, as will be explained next.

### 4 User Interface

The development of the user interface followed a top-down approach. This was accomplished in two successive moments. A general description was first made of what would be present in each screen, using basic drafts to visualize a first conception. Next, a second draft was made with more details in each view and already presenting a navigation structure for the screens, as well as ideating some animations for the opening screen. This process is depicted in Figure 5, which shows the evolution of the design of one particular view, i.e., the main map.

![Figure 5: Evolution of the design of the Map view.](image)

The desired navigation in the app, particularly in the visit mode, would have a progressive presence of the content as the user drilled down the hierarchy, using less interface objects at each step taken. It was necessary to devote a special attention to the navigation tool. In order to achieve this goal, we combined at the top level, a Tab View Controller, with a Navigation Controller which “peels off” widgets at lower levels. Figure 6 shows the interaction flow for the Map view, as the user selects a spot and interacts with media content (in this case a poem).

![Figure 6: Example of interaction flow with Map view.](image)

For the user interface design, it was decided at the beginning of the process that the styling would follow a line of visual simplicity and that many default iOS resources would be used in the final product. With that in mind, the first versions of the UI concentrated on usability. After the basic structure was developed and tested, the team resumed with the visual styling per se. That decision was instrumental, because during the development of Jobim Botanic, Apple introduced iOS 7, which implied in a radical change of the overall user interface philosophy for the company’s mobile platform. In this context, our option for simplicity and adoption of standard UI elements was key for a smooth transition from iOS 6 to iOS 7. Figure 7 shows part of the top level views for the two versions of the app.
5 Functionality

After designing the basic user interface structure, we started to devise how each function would work, incorporating many iOS functionalities that were cogent to our objectives. We wanted to take advantage of the powerful capabilities of the iOS platform. In particular, we exploited extensively the multimedia frameworks for imaging, audio and video. Nonetheless, it was necessary to enhance and complement the core functionality in various ways to accomplish our goals. This work is mostly related to map generation; augmented reality; panoramas; and animation.

Because of the emphasis on navigation aspects of Jobim Botanic, we needed a detailed map of the Botanical Garden for the users to explore. However, after analyzing the digital maps provided by Apple, Google and Open Street Maps, it was clear to us that we would have to add many features to whatever map system we chose to use. Figure 8 shows the official map of Botanical Garden with main alleys and sites, side by side with the information available in Google Maps at the time.

Figure 8: (a) Official map of Botanical Garden and (b) Google Maps view of the corresponding area.

When we compared the official map of the Botanical Garden with the digital information available in the above options we realized that it was necessary to remap all the regions, paths and sites on our own vectorial map, and associate it with a geographic database.

In the end, we decided to use Apple’s mapping tools with the Map Kit resource for that purpose. But we had to create the digital geographical database ourselves using in-house tools. Figure 9 shows some stages of the process. We created a layered database structure, with the main alleys at the top level, different zones with secondary alleys at a second level, and also the main buildings, sites and points of interest at the lowest level.

The sites and mapping information were generated based on Botanical Garden’s official maps and its website.

Figure 9: Structure of the geographic database for the Botanical Garden: (a) main alleys; (b) zones; (c) buildings and points of interest.

The geographical information is experienced in the app through the Map view, which is essentially a 2D projection of the park area where the user can be situated based on his/her current position using the Location framework. (See Figures 5 and 6.)

The Augmented Reality (AR) view is yet another navigation functionality besides the one provided by the Map view. It gives an immersive perspective of the user’s surroundings through the device camera, enhanced with geolocated information of sites and landmarks. Additionally, the AR view provides turn-by-turn navigation instructions to a target site on the currently selected tour of the park. Figure 10 shows the AR view with the camera image annotated with the location of two sites (top area) and the turn-to-turn instructions for reaching the target site in the center area.

Figure 10: Augmented Reality view with turn-by-turn navigation.

The implementation of the AR view is based on several built-in iOS frameworks with in-house software and a custom designed interface. Figure 11 shows an schematic diagram of the AR view module architecture. Data for the sensors are collected and combined with the camera image to produce a picture annotated with site labels from the current tour. In order to place the site labels on screen clearly and without overlapping we resort to 2D buckets. This information is then displayed using the OpenGL ES framework.
The AR view works very well for providing a sense of the surrounds to the user and for turn-to-turn navigation. On the other hand, this tool has some limitations in the context of interactive augmented reality when the user wants to explore content associated with particular sites. This problem is mainly because of two reasons: 1) it is very difficult to locate precisely elements of the 3D scene in the camera image and register synthetic objects onto these elements in the picture; 2) it is not possible to generally modify the appearance of existing elements of interest in the scene from the camera image. The source of the above problem is due to the live feed from the camera. The traditional way to tackle the problem is using Computer Vision techniques.

We propose to solve the problem using an alternative strategy: i.e., replace the live camera image by a 360 degrees photographic panorama of the scene. The panorama provides a view of the scene that is very similar to the one generated by the camera, assuming that the user is located at the same spot as the center of the panorama. By taking advantage of the sensors of the device for location and orientation, it is possible to select the correct panoramic image, that allows the user to do pan and zoom in a natural way.

This approach gives various benefits: 1) makes it possible to precisely annotate and register synthetic objects and interaction links in a pre-processing step; 2) the panoramic image may be edited to modify and enhance objects in the scene. Figure 12 shows a scene for the Central Fountain of the Botanical Garden highlighting a hyperlink handle for interaction with the Tom Jobim Monument. Also the fountain has been enhanced with animation based on a local cyclic motion and 3D sound effects using sampled sound output from the OpenAL framework.

In the app, interactive panoramas are used to view special sites of the Botanical Garden. When the user comes near to the site location, a link becomes active in the Map view such that exploration of its content is enabled.

The representation of the panorama employs an equirectangular image that is texture-mapped on a sphere and rendered with OpenGL ES. Figure 13 shows this scheme.

Another important functionality that we needed in the Jobim Botanic app is related to providing the user with a unique experience of multimedia content. We envisioned that during a tour of the Botanical Garden, the user would visit sites where he/she could enjoy the artistic work of Tom Jobim and Zeka Araujo while being immersed in the same environment that inspired the artists. In other words, in a particular spot the user would be able to listen to a poem of Tom Jobim and see photographs of Zeka Araujo related to that place.

This kind of functionality demands a “general” multimedia engine that supports simple and effective authoring of pieces based on sound, text and images, while at the same time taking advantage of Apple’s media frameworks built into iOS.

Having the above goal in mind, we designed an Uber Media Engine. This module generates a sequence of image-based animations, with transitions between animations and synchronized audio. The animations exploit the so called “Ken Burns Effect”, that allows panning and zooming from still imagery, such as photos.

The authoring framework for the Uber Media Engine employs a simple animation language and a key-frame based animation editing program. Figure 14 shows a visual representation of an authored piece consisting of a sequence of three animations with two transitions, where the first animation has two keyframes.
6 Media Content

Parallel to the development of the app itself, we worked on organizing the content that would be provided by the application. This included the visiting information, as well as the media content extracted from the book.

The visiting information was assessed from the official websites of each institution, with links to the original pages. We designed several customized views for that purpose, combining Table views, PDF and HTML views.

The content that was extracted from the book ‘Meu Querido Jardim Botanico’ involved a curatorship of the book designers, as part of the partnership with the Tom Jobim Institute. The selected poems were assembled and digitalized, both in Portuguese and in English, and, for the images, a structure of galleries was created to display Zeka Araujo’s pictures. Figure 15 shows a view of a poem and a view of a photograph from one of the galleries.

![Figure 15: Content from the book “My beloved Botanical Garden”. Poem view (a) and Picture view (b).](image)

In addition to the content for the Info mode, the content for the Visit mode was created based on tours for visiting the Botanical Garden with curatorship of the Tom Jobim Institute. The multimedia pieces were produced using 360 panoramas, and the Uber Media framework, among other resources.

7 Testing and Deployment

As soon as a first version of the App was ready, an heuristic evaluation of the interface and functionality was made by the team. The points made in this process were discussed and the necessary changes were incorporated in the product, also having an influence on future developments.

Subsequently, an ad-hoc distribution of the improved version was then made. Since the product was still at a very incipient stage, it was decided that the distribution would be made to a selected public, that would be more involved in basic stages of conception. A small group of designers, frequent visitors of the Botanical Garden and its employees were selected for this evaluation. A questionnaire was then presented to these users, which gave us some first valuable user responses.

After all the alterations were finalized, a first official version was released on the App Store.

In order to publicize and introduce the Jobim Botanic app to the world, some marketing actions were taken. The first channel created was the website [IMPA 2013], alongside the presentation video, which explained the functionalities and set the theme for the app’s user experience. With a central information point established, other media were employed. The first action was an e-vite to a selected group of people, which generated newspaper articles and an insert on a design newsletter. Finally, a flyer and a poster were created for distribution at the Tom Jobim Institute, IMPA and other interesting sites. Figure 16 shows a display with the poster and flyers.

![Figure 16: Poster and flyers to advertise the App in the Tom Jobim Institute.](image)

8 Conclusion and Future Work

Even though Jobim Botanic has implemented many of the desired resources and functionalities, there are still some functions that can be developed in order to improve the user experience, especially those concerning content sharing.

Although the visual styling has already been defined, there will be some adjustments to make in order to incorporate user preferences. This kind of continuous feedback from the user community is essential for an effective evolution of the project. The app will also be complemented with new interactive and artistic content, strengthening our relationship with Tom Jobim Institute and other partners.

The project is a work in progress, with many improvements and perspectives even after several months of development. The possibilities go beyond the iPhone application, reaching actions on social networks, data and map sharing and perhaps inspiring the creation of novel associated applications.

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References