

# 3cixty: An Innovative Way to Explore Cities

Catalin-Mihai Barbu, Kai-Dominik Kuhn, Adrian Spirescu  
German Research Center for Artificial Intelligence (DFKI)  
Intelligent User Interfaces  
Saarbrücken, Germany  
Email: {firstname.lastname}@dfki.de

Luca Lamorte, Christian Scanu  
Telecom Italia S.p.A.  
Strategy & Innovation, Joint Open Lab S-Cube  
Milan, Italy  
Email: {firstname.lastname}@telecomitalia.it

**Abstract**—3CIXTY is a flexible and modular platform that integrates heterogeneous data in a semantic knowledge base and provides a full API ecosystem that affords the rapid development of web and mobile apps. It allows answering complex queries that combine different types of information about events, places, and means of transportation in a city. We describe EXPLORMI 360, the first large-scale solution based on 3CIXTY, which has been developed to support visitors to Milan and Expo 2015. By leveraging services already deployed in smart cities, the application aims to support tourists arriving in a new city in planning their visit, exploring their surroundings, and moving around efficiently.

## I. INTRODUCTION

We are living in a world in which we have access to many online technologies and services designed to make our cities smarter—and our daily lives easier to manage. Indeed, you are quite unlikely to find yourself in a situation in which technology cannot support you [1]. Let us consider a person who is planning a visit to Milan and Expo 2015. Like most people, either residents or tourists, she will presumably turn to the internet to figure out what to do and where to go during her stay. Suppose she wants to find a restaurant that her friends have liked and that is easily reachable within 5 minutes by metro from the hotel in which she will be staying. Or maybe she is interested in finding out which is the best week to visit Expo if she wishes to attend events on the theme “sustainability”. Many websites and mobile applications are available to assist with such tasks (e.g. GOOGLE MAPS, CITYMAPPER, TRIPADVISOR, or CITY1TAP); but putting all this information together is not easy—it usually requires users to open several tabs in their browser or to switch among several apps on their smartphones. We propose a solution that facilitates an efficient search process, transforming complex user requests, constraints and desired services into places and events that reflect the idea of discovering a city without having any prior knowledge of it.

## II. INNOVATIVE PLATFORM FOR DEVELOPERS AND USERS

At its core, the 3CIXTY platform consists of a semantically integrated knowledge base (KB) and a set of services (APIs) that enable developers of city-related applications to offer especially comprehensive views of the city, which complement those supported by other services (such as the GOOGLE MAPS API) [2]. In order to achieve this goal, it collects and aggregates information from 18 data sources, half of

which are accessed through the E015 digital ecosystem (<http://www.expo2015.org/en/projects/e015>). This workflow has resulted in the creation of a comprehensive KB that contains information about various types of events, points of interest, transportation modalities (e.g., public transport, bike rental, and car sharing stations), and user reviews related to the city of Milan and Expo 2015. Ensuring that the various entities are recognized and linked properly, while at the same time minimizing the number of duplicate objects, is an ongoing effort [3]. Developers can leverage the 3CIXTY platform to build applications that help users compare and combine these data in novel ways. The services offered include a) a powerful query mechanism for executing mixed-domain queries, b) a “parallel exploration” graphical user interface, c) a social network mining service, d) a “Wish List” service, e) a query augmentation service, f) generic crowdsourcing mechanisms, and g) a mobility profiling service.

To make it easier and more efficient to develop mobile applications that run on the 3CIXTY platform, a tool has been implemented that allows rapid, cross-platform generation of 3CIXTY applications. Using a simple drag and drop interface, developers are able to integrate data sources and services into their own applications quickly.

## III. DEPLOYMENT IN MILAN DURING EXPO 2015

In preparation for the launch of Expo 2015, a showcase app (consisting of a web-based and a mobile part) was developed to highlight the potential of the 3CIXTY platform: EXPLORMI 360.

The web-based part (<https://www.3cixty.com/webApp>) depicted in Figure 1 employs a novel user interface that extends the “parallel faceted browsing” paradigm introduced in [4], which allows users to construct and view the results of multiple interrelated queries in parallel. Intermediate results can be successively winnowed using a rich set of filters that range from common (e.g., “date range”, “rating”, “category”) to more advanced (e.g., which make use of particular relationships between items such as “reachable within 5 minutes by metro”). Result sets can be either displayed as lists or overlaid on a map. Through a system of “bookmarks”, the current exploration state can be saved and resumed at a later point in time or shared with others via email or social media channels. The most promising items found during exploration can be saved in a “wish list” that can be accessed by different 3CIXTY apps

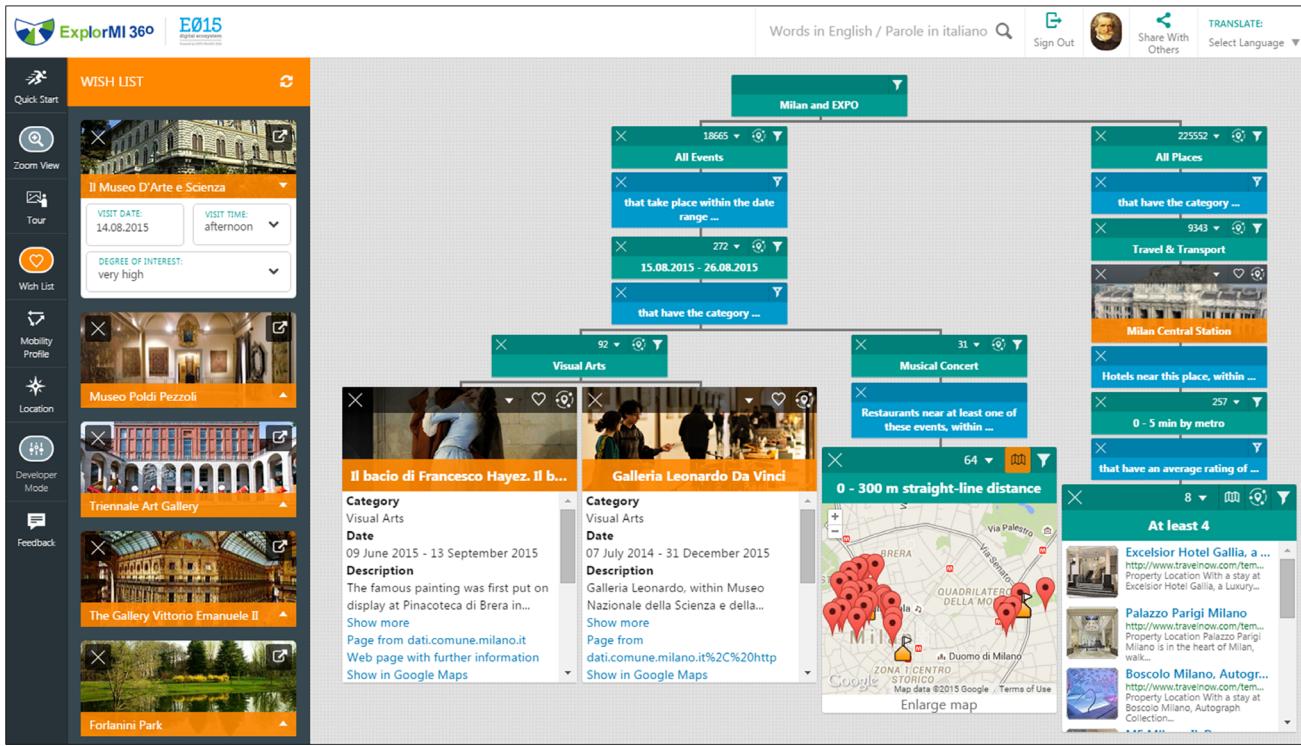


Fig. 1. Snapshot of the web-based part of EXPLORMI 360 showing some of the queries and filters that a tourist planning her visit in Milan might employ. The “wish list”, which keeps track of the most interesting items found during exploration, is open on the left-hand side.

(e.g., the web-based and mobile parts of EXPLORMI 360). For each item on the wish list, users can set additional attributes such as the date and time of day when they would like to go to that particular event or place as well as their degree of interest in it. Other 3CIXTY apps can read this information to make decisions such as how prominently an item should be displayed in the list or how often the user should be proactively reminded about it.

A number of features have been implemented that are intended to reduce the initial perceived complexity of the app and to support tourists. Quick Start Apps embedded within the web-based part (Figure 2) allow novice users to formulate complex queries by simply selecting from a list of predefined natural-language questions. Results are presented as if the user had constructed the query tree herself. The “Zoom View” feature hides all but the final query results, thereby allowing the user to focus on comparing items without seeing each intermediate step. Non-English-speaking visitors can benefit from the integration with GOOGLE TRANSLATE, which provides on-the-fly translation into more than 90 languages. The latter feature required a novel adaptation of the user interface to help ensure that the automatic translation retains the original meaning as much as possible: All of the labels, tooltips, and descriptions in the interface have been changed from the usual terse phrasing (e.g., “Filter by Rating”) to more natural-sounding sentences that have a better chance of being translated accurately (e.g., “Show only places that have an average rating of . . .”).

Fig. 2. Overview of the “Quick Start Apps” functionality in the web-based part of EXPLORMI 360: 1) available Quick Start Apps; 2) questions that can be answered by the user-selected app; 3) presentation of the results with tooltips that explain how the query tree can be explored and modified.



Fig. 3. A user’s mobility profile displayed as a heat map in the mobile part of EXPLORMI 360 mobile part. Also displayed are nearby events and places (green icons) as well as items on the user’s wish list (orange icons).

The mobile part of EXPLORMI 360, which is currently available for Android and iOS (see <https://www.3cixty.com/>), helps users throughout their visit in the city by presenting relevant information and media items on their smartphone or tablet concerning events, points of interest, and mobility. It allows the user to find nearby places and events and to synchronize and modify the wish list that she has created beforehand in the web-based part of EXPLORMI 360. While walking around the city, users receive notifications about wish list items near them as well as directions to these places or events. Users can also authorize the application to track their movements around the city so that the 3CIXTY platform can understand their preferred places and modes of transportation and recommend places or events to see. The “mobility profile” can be displayed as a heat map (Figure 3), thereby allowing users to review the places they have visited and also to discover areas where they have not yet been. A long press on any point on the map brings up more details about a specific area. A link to GOOGLE MAPS enables the user to find the best mode(s) of transportation to get to a given place or event. An integrated crowdsourcing mechanism (provided by the 3CIXTY platform but currently not included in EXPLORMI 360) lets users look at the current situation reported by others (e.g., how crowded a metro station is) or share their own experiences.

Tourists who wish to make the most out of their time at Expo 2015 can benefit from the “Thematic Tours” feature, which—given a starting point, a set of tags (e.g., “family”, “sustainable world”, “art and craft”), and temporal constraints (e.g., “half day”)—suggests one or more ordered lists of things to visit (Figure 4). Each proposed tour takes into account the walking time between pavilions and the average visit duration at each location.

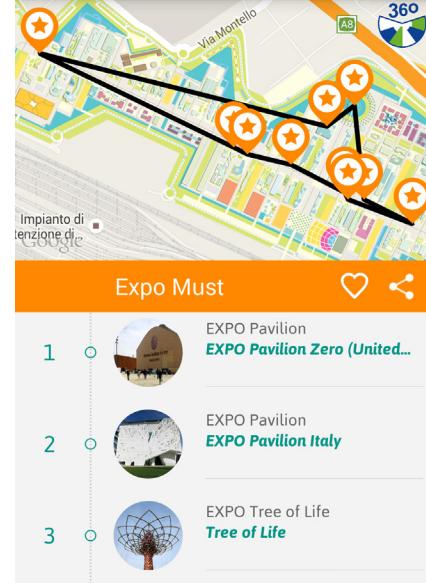


Fig. 4. Example of a suggested Expo 2015 tour in the mobile part of EXPLORMI 360. Tour objectives are overlaid on a map of the Expo site. Users may choose to remove items that they are not interested in visiting.

#### IV. CONCLUSION AND FUTURE WORK

The 3CIXTY platform and the associated showcase app are being further tested and strengthened during real-world use by visitors to Expo 2015 (May–October) and other Milan visitors through a coordinated combination of technical strengthening and several forms of user testing. The lessons learned during the initial deployment will be taken into account for the planned future transfer of 3CIXTY to other cities and venues.

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