

City 'R Us: A City Reporting application used for improving Urban Services

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Abstract

"City 'R Us" is a project that aims to reinforce citizens' participation to the city decisions by establishing a transparent mechanism for collecting information from citizens' smartphones. It takes advantage of the widespread use of smartphones and their sensing and processing capabilities and builds on a prototype application that gathers sensory data, processes it on the mobile device and uploads them to a centralized repository. The analysis of the collected information is expected to highlight the use and usability of city facilities and infrastructure and increase citizens' awareness and participation in city matters. The application can also serve as the platform where more participatory applications can be developed in the future. The project builds upon the new shift in smartphones' usage - from communication tool to a networked mobile measurement instrument, thus creating a perfect paradigm of Participatory Urbanism.

Keywords : smartphones, smart mobility, crowdsourcing, crowdsensing, urban design.

Introduction

Many solutions have been developed in the field of smart cities during the last decades, but they all have several technological and social constraints. The main limitation of such approaches is that citizens are considered as service consumers and do not contribute to the decision making process. For example, cities provide smart parking applications to assist citizens find a parking place, but do not use their feedback on deciding where to build the next public parking lot. A second limitation is that smart cities applications are based on low-powered sensor networks, in which sensors simply gather data and transfer them to the processing nodes. Processing nodes either use data locally, through local actuators (e.g. traffic lights) or forward data to other networks for further analysis. When sensors with more processing capabilities are used (e.g. traffic flow detectors) this increases the cost for infrastructure and eventually inflates the city's expenses. A final limitation is that the existing sensor networks are mainly targeted to public transport and cars and fail to track pedestrians. Consequently, they can hardly respond to an emergent increase in the number of public transport passengers, which may happen because of external factors (e.g. a concert, a strike etc.).

All these limitations systematically affect the effectiveness of smart mobility solutions and consequently restrict the gains for citizens and cities. In addition to this, groups of people that need special attention or citizens that support eco-friendly mobility schemes are not able to affect the decision making process and improve quality of life in their cities. The proposed solution aims to overcome these limitations and transform citizens from service consumers to information producers and key-players in decision making.

City 'R Us takes advantage of the widespread use of smartphones and their sensing and processing capabilities and delivers a prototype application, to gather sensory data and process it on the mobile device, thus leveraging the process load of any centralized decision making process. Then it forwards this information to a centralized repository using cellular network technology (Tragopoulou et al, 2014). As a result, it can run in the background and collect a daily log of user activities, which the user can subsequently upload to the central repository. The aim of the application is not egocentric but collaborating and participatory: citizens contribute their daily activities in order to allow the local government to have better insight of the city services usage. It is also possible for users to tag their locations, or actions using predefined sets of tags that relate to the usage of a facility (e.g. walk with pet, walk or run with kids, moving with wheelchair, place of art/history/sports), thus creating a crowdsourcing solution for cities that wish to have a better understanding of the usage of their facilities or wish to enhance their POI (point of interest) database.

The processed information is sent to a central data collection facility using cellular network technology. There, information from social networks, other open data resources (e.g. POI databases) and sensor networks can be used to enhance the crowdsourced information. For example, information concerning the type of each area in the city (e.g. parks, squares, pedestrian areas, bike lanes etc) can be used to better organize collected data. As a result local government can listen to citizens' mobility needs and preferences combine it with advanced analytics and deliver smart city solutions and better infrastructures.

The information flow within City 'R Us platform is summarized in Figure 1.

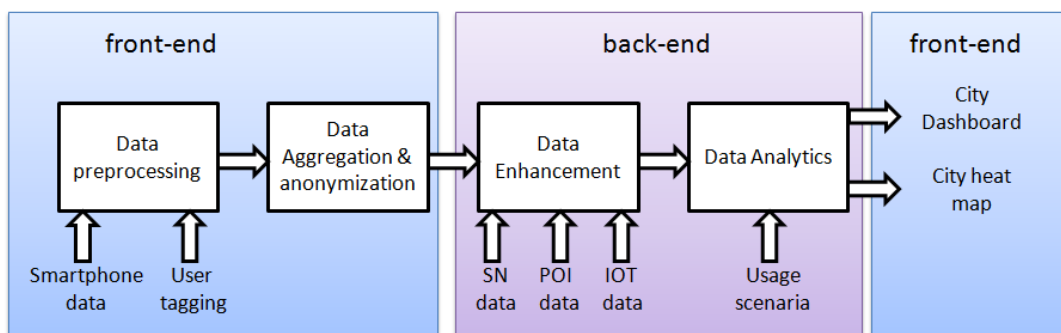


Figure 1. The information flow

Overcoming technological restrictions is an issue but making citizens to actively participate is the key issue for delivering a successful city-sensing crowd sourcing application. Even when the technology is able to solve all other issues, users intention to collaborate and share data with the city, is achieved

when they are offered incentives or services that overcome the possible costs in money, time, or privacy. In order to engage citizens, City 'R Us supports gamification features, virtual and real rewards. Citizens can have their profile in the City 'R Us platform and are awarded virtual credits based on the amount of information they contribute to the community. Information is contributed on the basis of different thematic 'Missions' that collect route or position information for a specific cause. Additional credits can be given to citizens that recruit more active citizens to the platform and form communities of specific purpose (e.g. cyclists groups, car-pooling communities, citizens with mobility restrictions etc). The rewards for the most highly ranked citizens or groups can be the participation to city's council meetings, an appointment with the city mayor, or even discounts at city's transportation tickets. Thus, local government can think forward and act proactively and citizens can be actual reporters of their city needs.

The mobile application for Android phones is already available at Google Play¹ and all the application code is available as open source at GitHub². The publicly accessible city map that presents all the data collected so far by citizens of Athens is available³. The sections that follow present the architecture of City 'R Us platform, explain how the technical issues concerning energy consumption, connectivity costs, privacy and security have been treated and how the provided services have been evaluated. Finally, the first results from the usage of City 'R Us in the city of Athens are reported and discussed.

Background

The use of smartphones for crowdsensing is an emerging solution that is currently driving many real-world smart-city applications (Chatzimilioudis et al, 2012), such as traffic navigation systems (waze⁴, VTrack by Thiagarajan et al, 2009 etc), city issues reporting apps (e.g. seeclickfix⁵, PotHole by Strutu et al, 2013), urban noise mapping systems (NoiseTube by D'Hondt et al, 2013 and Ear-Phone by Rana et al, 2015). All the aforementioned applications use technology, especially smartphones and their sensors, to support the citizen participatory model. Smartphones' portability, the abundance and variety of sensors they carry, and their ability to connect in many ways with other smartphones and the internet (Bluetooth, WiFi, NFC, 4G) can allow ubiquitous participation of citizens. However, everything comes at a price and the price for ubiquitous participation through smartphones refers to energy consumption, connectivity and connectivity costs, privacy and security.

¹ <https://play.google.com/store/apps/details?id=gr.scify.cityrus>

² <https://github.com/scify/city-r-us-web>

³ <http://city-r-us.scify.org/web/public/>

⁴ www.waze.com

⁵ <http://seeclickfix.com/>

A typical urban sensor example that uses a smartphone app as its front-end and collects data from embedded sensors (GPS, wifi, accelerometer, magnetometer, etc) and external Bluetooth sensors has been presented in Rodriguez et al, 2014. The SenseMyCity⁶ app connects to a service in the back-end for storing all the collected information. An **energy consumption** analysis shows that the energy consumption of sensors does not scale proportionally to the sampling rate and it is suggested to use collect samples at large time intervals (60 seconds). If data collection is energy consuming, data transfer requires communication with the back-end, which is bandwidth consuming. The **data transmission costs** can be restrictive when using a paid data connection. The use of public or free wi-fi can reduce costs, but may lead to sporadic data transfers. **Data privacy** can be achieved if the application gives users the control of when their devices are gathering possibly sensitive data, whether these data will be transferred to a central repository and who can access that data and for what reason. Last but not least, **security** of data that is transmitted to the back-end and stored in the repository is necessary, and protection from various risks (data loss or stealing, unauthorized access and transfer, fraudulent data etc.) must be established (Welbourne et al, 2014).

In City 'R Us the energy consumption is reduced as much as possible by enabling background tracking and using large sampling intervals, whereas data transmission cost can be zero if users asynchronously upload their data via Wi-Fi. Data privacy is protected by anonymizing any contributed data that goes public and allowing to the user only to view his/her own contributions and in terms of data security all the data that is uploaded to the centralized repository is deleted from the mobile device in order to minimize the risk from data loss and data stealing from the device itself. However, many more security risks still remain, e.g. when uploading data using a public Wi-Fi spot, and this is a subject of future work.

As far as it concerns citizens' engagement, smartphones prove to be an ideal platform (Salim and Haque, 2015) due to their frequent use, the many sensors they carry and the multitude of available applications. Based on the suggestions of Lehner et al (2014) we promoted the collaboration and the sense of belonging to the same group, to the participating civilians, instead of the sense of competition with other groups. We set up missions of interest to specific groups – e.g. missions for recording easy accessible areas, safe bike route collection missions etc, which have been proven very effective for data collection (Salim and Haque, 2015; Nov et al, 2011). The approach we follow, where players collaborate (teamwork), discover new places (discovering & exploring places) and participate in joint challenges (participate in challenges) are based on the three most important criteria of pervasive gaming (Lehner et al, 2014) upon which City 'R US builds its gamification approach.

The use of 'Missions' allows to configure the level of detail of the work citizens are invited to do and thus enables each municipality to optimize the use of the tool and citizens' participation, without any programming intervention

⁶ <https://sensemycity.up.pt/>

(Nov et al, 2011). City 'R Us is an in-situ application that enhances e-participation and activates citizens, but leaves the final design of this interaction to the citizen and the state (through missions and their outcomes), which differentiates it from efforts such as the eGov+ case (Bohøj et al, 2011). From a technical point of view, City 'R Us is a solution, where missions slightly remind the authoring environments of Sensr (Kim et al, 2013), but by extending the open access code, more specialized applications can be developed. As a conclusion, City 'R Us provides the technology and appropriate mechanisms for supporting crowd-based city reporting and for improving city design, and if combined with political will and concrete action from the state, can yield significant improvements.

System implementation

Functional Specifications

In order to better design the functionality of City 'R Us and prioritize the development of features that are of greater interest to the citizens, we followed a methodology that consisted of three stages:

- The first stage referred to the refinement and iterative development of the concept to a) quickly define weak spots of the initial approach, b) develop the directions of an appealing concept and c) re-test the developing concept, through unofficial personal interviews and brainstorming sessions.
- The next stage was a qualitative research with key players to a) pinpoint key areas that need to be taken into consideration, b) help to better understand needs and c) give insights that will allow better explanation of the findings of the quantitative research. Since City 'R Us is primarily targeted to groups of special interest in Athens, but also to the city administrators themselves, a series of interviews was performed with citizens with disabilities, with a cyclists' group and with two Vice Mayors and the General Secretary.
- In the final stage a quantitative research allowed to get an initial quantification of the findings of the first two stages and quickly reach a wider audience. The research comprised a questionnaire that summarize the main functionalities and restrictions of the solution and evaluate their importance for the end user.

The main findings of this process are summarized in the following paragraphs.

Smartphone devices' ability to track users' activity in the background is becoming very popular, especially through fitness applications but also through Google Now background tracking services which is inherent in Android phones. However, users seem to not like the concept that the application will be always active (running in the background) and automatically track their movement because of one of the following reasons: a) it introduces a sense of loss of privacy, b) they are worried about increased data usage that will result to high

mobile phone bills and c) about quick depletion of battery life. It seemed more reasonable to them to start and stop the recording of a route manually and upload the information at any future time (e.g. when they have access to a wifi hotspot).

The ability of the system to automatically detect the type of movement of the smartphone's user is not interesting in itself, since users could not easily understand the benefit. If the application could present an added value that stems from this, it would be a very interesting feature to consider. The idea of "Missions", that the municipality can define and citizens can undertake to address challenges, was very attractive for both the citizens and the city administrators.

Both citizens and the municipality found it interesting that City 'R Us is not yet another problem reporting application. The main perceived value of City 'R Us stands in that a citizen/visitor can share beautiful spots/routes with fellow citizens/visitors/members of the same group. However, citizens considered very important that the city wants to listen to their suggestion and respond to them by improving city services.

Public sharing of uploaded information on a heat map is very interesting; in most cases it solves the problem of lack of structured information sharing around their interests, something both cyclists groups and people with disabilities underlined. Social sharing of the information the users upload (through, for example, Facebook), seems a "nice to have" feature.

Users' opinions are divided as to how important the ability to use the application using a nickname to protect anonymity is. It is important to some, whereas not important to others. Therefore, neglecting this feature can lead to a great loss of users.

The ability to suggest missions to MoA is quite important (90% of the users consider it important) and the ability to get mission-related notifications is an interesting "nice-to-have" feature.

Based on the key findings presented above, we concluded with the functional specifications of City 'R Us platform, which are divided into two different groups of functionalities: a) those that refer to the mobile application (login, register, view profile, choose mission, record a contribution, tag a contribution, upload a contribution, suggest mission, invite users, see rewards), b) those that refer to the municipality dashboard (view city map, filter city map, login, manage missions, view top contributors, message mission contributors, manage contributions, manage POIs from social network applications). The public part of the municipality dashboard is accessible to any user without login and provides the ability to view the city map for a selected mission, zoom in a region and filter contributions for a specific time period.

System architecture

City 'R Us has emerged from the combination of a research prototype smartphone application⁷ (Tragopoulou et al, 2014; Varlamis 2015), which has been tested against its ability to understand the type of user movement based on features collected by the smartphone sensors (location, speed, altitude, distance from POIs etc) and a platform for easy and fast creation of interoperable and socially-aware services. The latter is RADICAL platform⁸, which allows data from Internet of things (IoT) devices, social network data and any other data gathered in real time to be integrated and used to support new services. The RADICAL platform facilitates the access from a single API to different sources of information (social networks, IoT infrastructures, city application), performing data analysis and combining data by using the appropriate platform tools. As part of the RADICAL architecture, City 'R Us had to integrate with the platform components but also had the chance to use existing components via simple APIs.

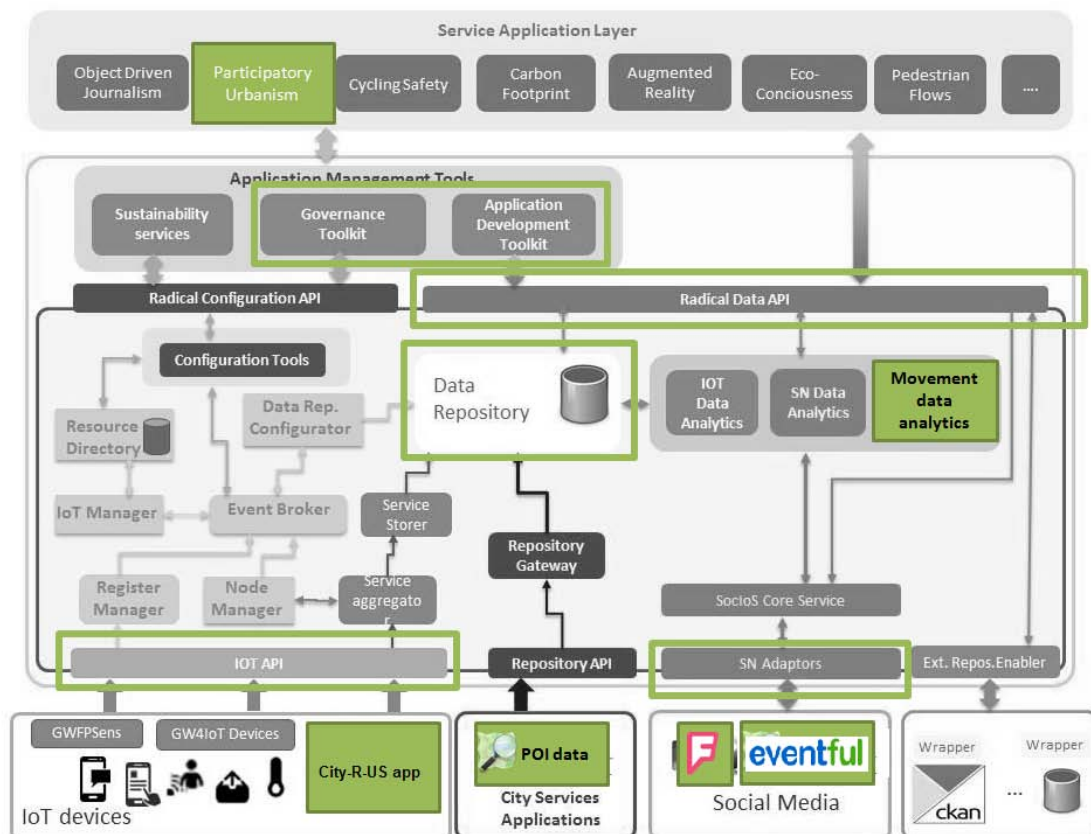


Figure 2. Bindings to the RADICAL platform

RADICAL components are deployed in dedicated virtual machines at the BonFIRE infrastructure (Kavoussanakis et al, 2013) but can also be deployed on private machines, for increased privacy. Figure 2 presents an overview of

⁷ GPS Tracker. <http://galaxy.hua.gr/~it20934/>

⁸ <http://www.radical-project.eu/platformandservices/radicalplatform/>

the RADICAL platform, in which the City ‘R Us components are marked with green colour.

Since the case city for City ‘R Us is Athens, information from social media and other repositories (FourSquare POIs and Eventfull events) has been collected for the city of Athens, taking advantage of RADICAL Data API. All the data collected from the smartphone application are forwarded to a Local Database using a private installation of the RADICAL Repository API. The Movement data analytics component processes the aggregated data in the database and feeds the Municipality Dashboard. The Municipality Dashboard is a web application, implemented using latest web-technologies (Laravel MVC, Html 5, CSS 3 and JavaScript frameworks such as JQuery, React.JS and Google-maps. Figure 3 that follows, presents a high-level architecture of the City ‘R Us platform.

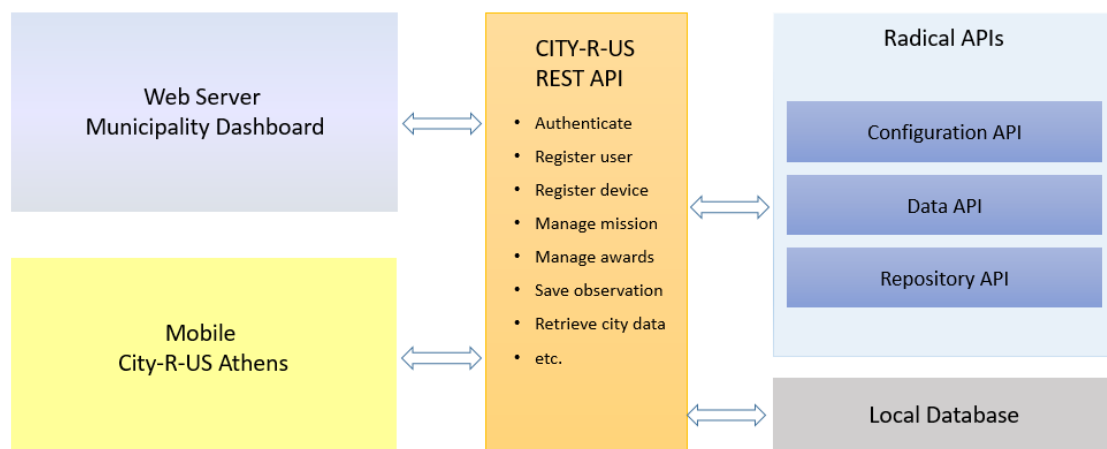


Figure 3. High level architecture of City ‘R Us platform

The core component of the City ‘R Us platform, which is responsible for connecting the Municipality Dashboard and the mobile application, is the City ‘R Us REST API. The services are built on top of the RADICAL platform and communicate either directly with RADICAL or with the local database. The Configuration API allows remote configuration of the various parameters of the platform. For example, in terms of gamification, several missions have been designed in order to motivate users’ participation. The number of credits assigned for a contribution to the mission, as well as other parameters are fully configurable for the city administrative and this configuration is done via calls to the Configuration API.

Gamification features

Gamification is a way to engage users, and increase user participation and is usually achieved through goal setting and rewards (Lea et al, 2015). In this direction, City ‘R Us capitalizes on the concepts of “Missions” and “Rewards” and combines them with ‘User Profile’ and “User Invitations” in order to strengthen the social (community) aspect of the approach.

Missions can be described as small data contribution (collection) challenges which can be defined by the municipality and carried out by citizens. They can run for a predefined limited period, or they can remain open for a long time. The data contributed by citizens during a mission, can be either about a location or a route and is collected when the citizen is in the location or moves along the route. Each mission has a special cause/interest, for example citizens are requested to share beautiful spots to relax, dangerous spots for cyclists, accessible routes for disabled people etc, therefore citizens choose missions based on their interests (internal motives) and get a number of credits for each contribution. A virtual crediting system is used as a motivation (external motives) for users to participate and contribute.

Citizens have a **user profile** in the platform and are awarded virtual credits based on the amount of information they contribute to the community. Since City 'R Us aims in fostering user communities and increasing citizen's base, it awards additional credits to citizens that recruit more active citizens to the platform and form citizens' communities of specific purpose (e.g. cyclists groups, car-pooling communities, citizens with mobility restrictions etc) and citizens that propose new missions for the city.

The **rewards** for the most highly ranked citizens or citizens groups can be the participation to city's council meetings, or an appointment with the city mayor. Smaller rewards can be used to promote public transportation schemes, e.g. free tickets to the citizens that decide to leave their car and use public transport.

Through the smartphone app citizens can see all the open missions, as depicted in Figure 4, can get information about the mission aim and the credits they can get by contributing, and can make and tag a contribution.

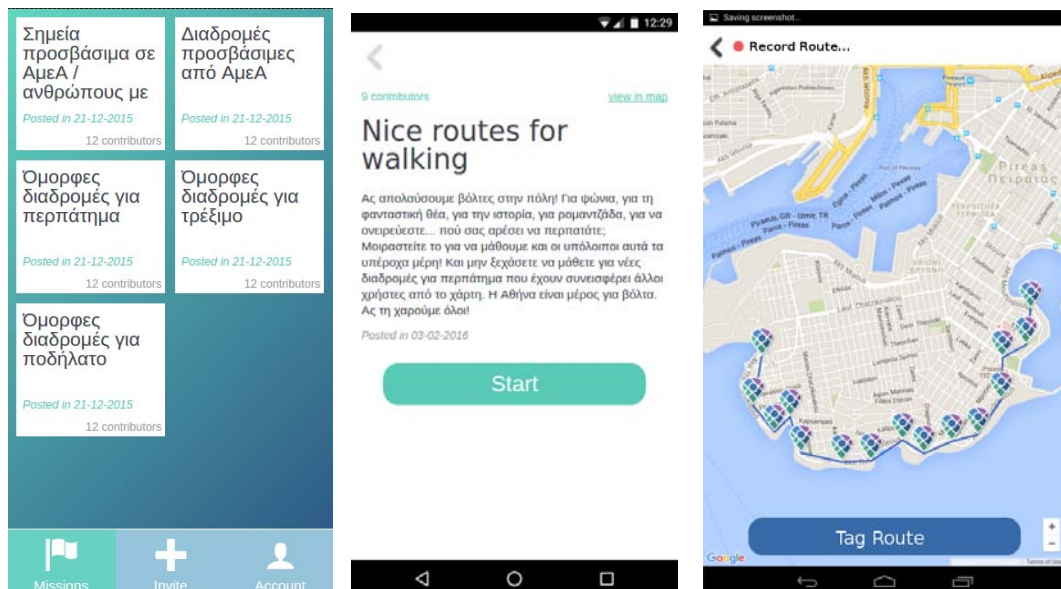


Figure 4. Screenshots from the mobile application (all missions, mission description, view a contribution)

Missions are managed through the administration platform by authorized users, who are usually the city administrators, and are a means for collectively

highlighting parts of the city (locations or routes) of special interest or around a purpose. At this initial phase of City 'R Us, missions follow a top-bottom logic, and are aimed for the city authorities, that want to collect information for improving city planning and services. For example, a city can start a mission for recording all the public playgrounds and collect real information about their usage, depending on how many users actually contribute information when they are in the playground, whether they visit the place more in the morning than in the afternoon and can possibly collect citizens ratings about the place. Based on this information city administrators can decide where to create a new playground depending on the load in the neighbour, which playground to repair or renovate depending on the frequency of usage etc. Of course, all this information is available to the citizens, through the city heat-map which is available in the City 'R Us web site. They can see what other citizens have contributed and discover new places within their city.

The crowdsourcing model is mainly based on the volunteer contribution of information from citizens and the long term benefits for citizens that highlight interesting spots or routes in the city can be multiple. Missions can be supported by one or more groups of citizens with a special interest, for example a mission for collecting 'Biking routes' can be supported from cyclist groups, whereas a mission for 'Bike repair shops' can be of interest both to them but also to the shop owners. Similarly, highlighting open spaces for leisure and relax can be useful for the citizens but also for the local market.

Although the initial implementation follows a top-down logic, a bottom-up approach is also supported. Citizens can suggest a mission through the smartphone app, and so can do the members of a group of special interest. When many citizens ask for a mission, the city administrators can set the mission to the public and start collecting information about places or routes. Users are self-motivated to contribute to a mission, or are invited to participate by fellow members of the same group of interest in the real world. As a result a new group of interest is formed around the mission within the app.

Even in a bottom-up approach the final call for City 'R Us success remains to city administrators, who decide which suggested missions to adopt, what to prioritize and what not. As a next step, the city administrators must take account of the collected information and change the city design based on what citizens suggested. It is also important to inform citizens and primarily mission contributors about any actions related to the mission.

In order for the crediting system to work, every contribution is associated with a user account. The account that invites other users to a mission, the account that contributes to a mission or suggests a mission that is accepted by the city, gets the respective credits, which are visible in the user profile. The crediting system, in combination with contributor ranks (top-contributor, or golden/silver contributor for a mission or overall) is another gamification feature, which is typical in social networks and motivates users active participation. No other personal information is revealed in the user profile and all information that appears in the Mission Heat Map is anonymous, so that the citizens cannot know who contributed what.

Response to citizens contributions

Citizens like the idea of sharing their experience and knowledge about good and bad stuff about their city and have access to such information shared by others. Collectivity is important for most citizens, and moreover the idea that they can help the authorities in their work to make things better for everyone. However, most citizens are concerned with the role and the actions taken from the city's authorities initiated by their suggestions. They also find it great that the city's authorities will initiate calls through the application, for good or bad places/routes, as well as the ability to share what they think is good and to report what they think is bad. It is also great that all the information will be available in a shared map. This transparency also increases the trust of citizens to city administration.

Based on these findings from user evaluation process, we describe in the following, how citizens can have an overview of all contributions for a mission, and what the city provided rewards can be.

Mission heat map

Citizens can have an overview of all contributions through City 'R Us web site as depicted in Figure 5. They can choose a specific mission and zoom in a certain region of the city and they can filter contributions by selecting a specific period. This last feature is also very useful for city administrators, in problem reporting missions that run for a long period, since they can filter out older reports for issues that have already been handled.

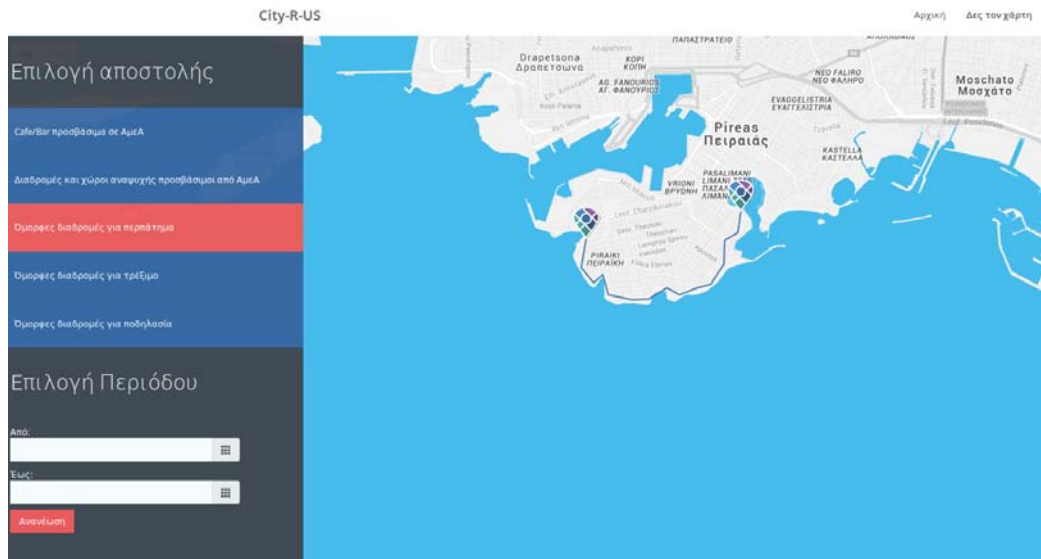


Figure 5. The city heat map for a mission. Controls on the left allow to switch missions and filter contributions by time.

City-provided rewards

Several missions have been suggested for inclusion to City 'R Us and most of them were of interest to the Municipality of Athens (MoA). However, there was a preference to include missions for cyclists and disabled people. The municipality also found it interesting to be able to include local businesses in missions, thus strengthening local commerce.

Among the various real-life rewards that were suggested to the MoA, the most promising ones seemed to be: a) the ability to meet a vice mayor and discuss issues about the mission, b) the ability to select a specific vice mayor to discuss problems (although this would need communication of other Vice Mayors), c) send a reward of recognition to the citizen in the form of a paper certificate. Among the rewards that are not very appealing are: a) the ability to take part in a Municipality Board meeting, b) free tickets on events organized by the MoA. Such events happen only during summer, and are usually for free. Yet, there is some potential to this idea, for example providing a discount to events that require a fee or ticket, or to give a priority when the number of tickets is limited.

In addition to these real-life rewards which can be increased if additional sponsorships are found, the municipality is willing to respond to what citizens suggest by considering them when improving city services. If safe/nice bike routes are reported, then MoA could add signs on the road to assist citizens in locating them. Also for people with disabilities, MoA could respond to problematic points by easing access (e.g. adding ramps). Although problem reporting is not a priority of City 'R Us, the interest of MoA to integrate data collected from a related mission to the existing city CRM was expressed. Such a mission will need citizens to tag problematic points and potentially add a picture and a description so it will need extra functionalities to be added. Information would be directed to the city's Citizen Relationship Management System (CRM) and then assigned to the appropriate person within the municipality.

From the citizens' perspective, most citizens find interesting the ability to collect points and badges based on their activity or the validity of content provided. They also think that some real rewards would be good as well, e.g. citizens that collect most points in a mission must be called by the municipality authorities in meetings regarding the mission, could receive free-tickets for concerts or other occasions, could take composting bins as a reward, or maybe even having the right for voting over collective decisions. The identification and validation of the user through his/her email is very important regarding the rewards.

System assessment

The methodology followed for assessing City 'R Us software infrastructure and the related web and mobile applications included: a) the collection and evaluation of user feedback concerning the quality of service and b) the technological evaluation of the system in terms of compliance with the initial objectives.

Through four pilot missions, we assessed a) User acquisition in terms of the number of new users, b) User acceptance (usage) measured as the ratio of active users over total users, c) User loyalty based on the average use duration and the number of points collected by a user in the application (by contributions and invitations), d) User experience, both for the citizens using the application, and for the municipality that uses it to engage citizens. Information was

collected using two questionnaires distributed to MoA⁹ and app users¹⁰. The metrics of the two questionnaires involved assessment of ease of use and perceived usefulness of City 'R Us.

The above subjective measures (perceived ease of use and potential), that describe user experience, need to be cross-referenced with objective metrics that stem from Google Analytics. Although the time for the pilots was very short, we can come to some first conclusions. In brief, 38 new users participated in the pilots in a two weeks period and they were all active. Their average use duration of the application exceeds 7 minutes. As far as it concerns the user experience, 77% of the respondents find the application very useful and 70% of the respondents believe it can improve the everyday life of citizens and visitors of Athens very much. Finally, among the desired new features suggested by citizens, we must highlight, the ability to add comments and upload photos and the ability to share routes and points of interest on social networks.

The evaluation of the technical and technological aspects of City 'R Us and the compliance to the initial objectives, was mainly focused on the integration with the larger platform (RADICAL platform). The initial goal of contributing two new components to the platform was achieved by adding the two components that collect information from social networks, the Social Enablers that have included information regarding point of interests (venues) from Foursquare and events from Eventful. The project also incorporated existing components for storing data and configuring its services, as designed. Finally, concerning multiple platform support, our aim was to support all popular smartphone OS and thus increasing market reach. This was achieved by developing a cross platform application with PhoneGap (<http://phonegap.com/>), an open source solution for building cross-platform mobile apps with standards-based Web technologies. The usage of this technology allows to easily expand City 'R Us to platforms like Windows Phone, BlackBerry 10 etc.

Conclusions and future extensions

City 'R Us has been initially envisioned as a tool for local administrators, which search for a crowd-sourcing solution that can be easily used by citizens to highlight city spots and routes. Gamification and social networking features, such as missions, rewards and invitations, have been used to engage citizens and activate participants. The mission heat map is used as an immediate recognition of user's contribution and the real-life rewards are expected to motivate users and increase participation. The ability of citizens to suggest new missions increases the extensibility of the approach and can assist bottom-up approaches to foster. In this pilot operation phase the solution has been tested

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<https://docs.google.com/forms/d/1diKa283eTAV1qsbXHQawQKEx5lRpsX5koGYFdlabhhw/viewform>

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https://docs.google.com/forms/d/1GrV0KxJmrBSKtuqMmtiWpAfyBna4_w9deZ2PUsDCDEM/viewform

on a large municipality but have also been presented to several organizations / unions / groups of special interest (mainly running teams and people with disabilities). Several of these groups of citizens have expressed their willingness to participate in this crowd-sourcing model and a few of them have already contributed to the pilot missions.

The adoption of the platform from a Municipality may have several advantages and bring new solutions, but also introduces operational and maintenance costs. Depending on the number of active participants and the frequency of use, a solution used tens of thousands citizens may scale-up to a real-time big data analytics platform and the cost for a backend infrastructure that guarantees accessibility to the service and efficient analytics of the data collected may increase, making it hard for the Municipality to afford. The cost for guaranteeing the quality of the contributed content will increase too, since there will be an increased need for content curators. However, if the service is used only by municipality employees or by specific citizen unions that are related to each mission it would be easier to control and operate.

Another option for City 'R Us is its use by Non for Profit Organizations (NPO) or other unions that want to use it as a spot-recording tool used by their members only. For example NPOs that support homeless people or families that need help can use City 'R Us as administrators for setting up small scale missions and have their members use the mobile application for recording homeless positions or any other spot of interest on the map. This will move the administration from municipality to citizens' groups and will probably change the business model behind City 'R Us. Instead of a centralized, municipality-hosted and operated model, there will be a City-Reporting-as-a-Service model, where citizens' groups can join for a fee, can create missions and collect data of their interest by motivating their own members and can have access and analytics to these data.

In both models the ability of citizens to actively participate to the formation of city services and city design is supported. It then remains to the city administrators or citizens' formations to use the provided solutions and motivate citizens to participate and seriously considering their contribution during the decision formation process.

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