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Enhancing the government service experience through QR codes on mobile platforms

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ABSTRACT

Digital government is universally gaining acceptance as the public becomes more technologically advanced. It is critical for the government to embrace new technology for minimizing costs and maximizing utility of services to the taxpayers. While administrative services have been easily ported to the digital world, there are still many important citizen-centric services that have not yet been effectively migrated. Quick Response codes (QR codes) provide a means to effectively distribute many different varieties of information to the public. We propose to integrate QR code systems and corresponding smartphone applications into existing government services with the goal of providing a new level of interactivity for the public. We illustrate this through two case studies, examining the National Park Services and the Mobile Environmental Information Services (MENVIS). The focus is on developing a QR code waypoint system for park navigation, as well as incentivizing park use through gamification of site attractions. The system provides increased safety for park goers, disseminates information more effectively and accurately, and improves feedback.

1. Introduction

Cell phones and smartphones continue to advance at a rapid rate—increasing in computational power and number of sensors available to the user (GPS radio, camera, gyroscope, compass, etc.). Most cell phone capabilities do not necessarily depend on the use of a network connection of some kind (cellular, 3G etc.), for example, the camera, gyroscope, and compass are physically located within the smartphone and do not require external networks to perform their functions. GPS is the notable exception, which must receive a signal from the GPS satellite network in order to function properly. Given these mobile sensors, the onboard computing power of a smartphone, and increased power capacity, there has been an explosion of mobile apps (application software and services that can be installed on the mobile devices) that benefit and entertain the public. The sensor capabilities are used to allow mobile phones to provide location based services, aid in navigation, and gather data such as images from camera. One of the newest developments is the use of Quick Response codes (QR codes) to quickly facilitate the uptake of relatively large amounts of data in a compact fashion. A Quick Response code (QR code) is a type of matrix barcode (or two-dimensional code) that is much faster than traditional UPC barcodes (see Fig. 1). It is also known as a *mobile barcode* since it can be scanned and read by a *QR-Code reader*, software that is installed on a mobile phone (Mobile Barcodes.com, 2012).

QR codes are entering the cultural zeitgeist – nowadays they are used in marketing promotions such as discount coupons, advertisements and supply chain management – areas far beyond their original imagined use cases which were tracking automobile parts in the auto manufacturing industry. QR codes provide a cheap, easy, and secure method to transmit information in a "push" format to individuals who have the ability to read the symbol. Open source libraries exist for generating QR codes from a variety of data sources, as long as the data can fit into a fixed number of characters (alphanumeric strings) depending on the revision version of the QR code. If a program can read a particular revision of QR code data, the individual programs/applications can decide how to handle the data after it is extracted from the QR code. This essentially allows the smartphone application to parse the incoming data from the tag and use it in a manner the programmer desires. Because each code revision has its own standards for data integrity, redundancy, and availability, as long as the revisions are supported by the application (being able to read the QR code itself) the codes can be used with any smartphone operating system that will support the encode/decode libraries. Also, by having users not enter in any data manually, data accuracy can be ensured.

With the growing push towards technology, digital government has gained increased adoption as a way of redefining the relationship between government and the public. Offering innovative public services builds citizen participation thus increasing trust as well as improving transparency and public understanding of government agencies and

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(a) Coordinates (b) URL (c) URI

Fig. 1. Example QR codes.

their missions. While traditional administrative services have been easily offered in digital form, many other citizen-centric services have yet to be migrated. Given the availability of mobile devices with diverse data ingestion and computing capabilities, QR codes, when appropriately used, can serve as a way of broadening the scope of government services, and improve the level of service to citizens.

QR codes make data entry and data management easy from a government perspective. A standardized database of QR codes for important information that needs to be disseminated to citizens or government agencies can be created with existing off the shelf tools and for comparatively little cost. The option to use open source tools, especially for database creation and management, is also an ancillary benefit as it keeps the costs of maintenance and/or support contracts low and prevents the government from getting locked into a service contract with a proprietary solutions vendor. This database can also be a centralized method for storing information placards that are distributed in the form of informational bulletin boards for park goers. Since this information is now available in digital format, there are many more options for making the information engaging and interactive. This also provides the ability for users to access it through the application outside of the park, as supplemental materials for education.

In this article, we explore the potential impact of QR codes used in conjunction with mobile services/applications and web services for government agencies. Specifically, we focus on the system design requirements/parameters, implementation/integration of the system, and the policy issues surrounding it. We illustrate the effectiveness of QR codes in enhancing government services through two case studies. The first is that of the National Park Services, which is a prime example of a government organization that will benefit from an accelerated transition toward this new technology. The second is the Mobile Environmental System (MENVIS) developed at Rutgers University which delivers auto-guided environmental tour information for New Jersey and New York City government agencies that take initiatives on restoring degraded environment in urban areas. MENVIS is intended not only to support staff engineers and scientists to collect data from the field using mobile devices, but also enhance the exploring, learning and discovery experience of visitors, eco-tourists and students, while moving in and around urban environmental preservation areas.

While some of the discussion is specific to these example cases, the core concepts can be extrapolated and tailored to apply to any government agency in need of a "push" style, centralized information system for interacting with the public. The following is a brief list of functionality the platform can provide in the context of the example system for the NPS and MENVIS:

- Waypointing system: While navigating the park trails, visitors may get lost not knowing where they are or where to find the next trail posts. We develop a system of QR codes and standards to deploy to U.S. National Parks that aid in navigation of park trails—helping hikers get their bearings in the events of a GPS failure or loss of cell signal. The trail markers will have QR codes that have map coordinates to a map already contained within the parks application on the device. It may even be possible to have high level code in a series of QR codes and compile it on the phone. There will also be additional "calibration" codes to ensure the correct location is being used for map navigation and to detect in case the codes used for navigation are compromised.
- Mapping data from QR code for Mobile Map Visualization: QR codes can contain thematic map data (e.g. minerals, flora, trail route and distance planning) that can then be overlaid onto the base map on the cell phone for visualization services for citizens. There is also the potential for using augmented reality via the camera function on the mobile device for visualizations based on data provided by this map and the GPS.
- Gamification using the QR codes: Hiking and park-related activities can be combined with gaming for rewards seeking activities and increased scientific exploration competition. The public can do check-ins at trail markers with QR codes that contains game-related instructions and clues to find rewards. One such example of gamification would be providing a reward to visitors who locate and contribute to tagged galleries of local park flora and fauna stored in the NPS/MENVIS database. Once approved, the user receives a reward for their contribution encouraging them to continue playing the games. By implementing this system throughout the parks and sites managed by the NPS/MENVIS, it will aid in achieving the goal of increasing visibility of the parks and the NPS/MENVIS managed site awareness, public involvement and donations.
- Facebook/Twitter integration: use existing social networks for sharing information to park goers and to receive feedback from them.

The rest of the paper is structured as follows. In Section 2, we provide an overview of QR-codes and a discussion of the related work. Section 3 discusses enhancing the National Park experience through the use of QR codes, which focuses on the framework and design of the system components. Section 4 presents an overview of the existing MENVIS system, and the integration of QR codes into the system. In Section 5, we discuss system implementation and integration ideas. The goal is to demonstrate the flexibility and utility of a QR code system used in a generalized manner for supporting e-government functions. Finally Section 6 concludes the paper and offers several recommendations for implementing a QR code system, or identifying candidate systems for expanded QR capability.

2. Preliminaries and related work

In this section, we first provide a brief overview of QR codes, including the data types and storage capacities they can support, followed by a discussion of some of the work related to this paper.

2.1. Overview of QR codes

A QR code (Quick Response code) (D.W. Inc., 2010a, 2010b) is a mobile phone readable barcode that can contain small set of data. If a