Using QR Codes to Improve Mobile Wellness Applications

Mabel Vazquez-Briseno, Juan-Ivan Nieto-Hipolito and Elitania Jimenez-Garcia,

Autonomous University of Baja California, Ensenada, Mexico

Abstract

In recent years several mobile applications for wellness and weight management have been developed. These applications can promote healthier lifestyles by helping people to track food and calorie intake. A major drawback of mobile wellness applications is that they rely on manual data entries to capture the required information. This is still complicated for many people due to the miniature keyboards used in most mobile devices. In this paper we propose the use of QR codes to capture nutritional information instead of doing manual entries. We also describe a prototype application called *calReader* developed using the Android Platform.

Key words:
mHealth, Android, QR codes, mobile computing

1. Introduction

Wellness can be defined as the quality or state of being in good health [1]. According to [2] sustained healthy behaviors, such as a balanced diet, regular physical activity, non-smoking, and moderate alcohol consumption, are essential to maintaining health and preventing diseases. Unfortunately, it is well known that our society is suffering of many health problems and most of them are related with overweight and eating disorders. In many cases these problems are caused by sedentary lifestyles and fast food culture. According to a recent study by the World Health Organization (WHO) more than 1.6 billion people in the world are either overweight or obese [3]. The Organization for Economic Co-operation and Development (OECD) has recently published that the country with the highest percentage of overweight adults is Mexico (70%) followed by the United States with 68% [4]. Childhood obesity is also a big problem in these countries. The WHO has established that an important cause of obesity and overweight is the imbalance between calories consumed and calories expended, other factors include the fact that now people is consuming foods that are high in fat and sugars but low in vitamins, minerals and other micronutrients [3]. In this way obesity is a serious problem that could be prevented by limiting the number of calories consumed a day as well as controlling fat consumption and sugar intake. To achieve an optimal Body Mass Index (BMI) the WHO also suggest increasing physical activity by doing at least 30 minutes of regular exercise.

In Mexico the government is seriously concern about obesity, especially in children and adolescents, and has taken several measures to reduce the problem. In 2010 the Lower House of Congress approved two reform measures banning the sale of junk food in schools and making physical education classes mandatory, according to the National Agreement for Nutrition [5]. In the same way, in order to provide clearly information to consumers, from January 2011 several food products will include a new label highlighting the levels of four key nutrients: energy (calories), saturated fat, sugars and sodium [6].

Tracking food intake for keeping records and statistics of calories and key nutrients consumed has proven to be very useful to achieve an optimal weight. Mobile devices can be excellent tools to do these tasks, however doing manual entries of nutritional information in these devices is still a tedious and error prone task. This fact may discourage people from using mobile wellness applications because of the extra time and effort required. To ease this problem in this paper we propose using QR codes tags to store food's nutritional information in order to facilitate capturing this data on mobile wellness applications.

The rest of this paper is structured as follows: Section 2 describes QR Codes; Section 3 briefly discusses mobile wellness applications. Section 4 presents the developed mobile application. Finally, concluding remarks are given in Section 5.

2. QR Codes

Quick Response Codes or QR Codes are two-dimensional bar codes developed in 1994 by Denso Wave Corporation. The main characteristic of a QR code compared with a traditional bar code is that it contains information in both the vertical and horizontal directions, while a bar code contains data in one direction only. For this reason QR codes hold a considerably greater volume of information. The typical bar code holds a maximum of 20 digits, while

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a QR code can hold up to 4,296 alphanumeric characters [7].

Fig. 1. QR Code [Source: http://www.qrcode.com/aboutqr-e.html]

Fig. 1 shows a QR code compared with a traditional bar code. As it can be observed a QR code contains three large square patterns (four in version 2) that are used for position detection. The rest of the code consists of several small blocks where the information is encoded.

QR codes can be decoded using mobile phones equipped with a camera and an appropriate scanner or reader. Some recent mobile phones include pre-installed QR code readers, for example Nokia Barcode Reader is pre-installed on the N82, N93, N93i, N95, E66, E71 and E90 mobile phones. Most Android mobile phones also include a pre-installed QR code scanner. In addition, there are several readers available for different mobile platforms like: BeeTagg (www.beetagg.com), QuickMark (www.quickmark.cn), Kaywa (reader.kaywa.com), Zxing (code.google.com/p/zxing/), among others. Once the appropriate QR code reader is installed on the mobile device, users only require taking a snapshot of the code to decode it.

QR codes can be easily generated using free generators available as web-based or stand alone applications. They can be printed on paper using an ordinary printer and attached to any object. Until now QR codes have been mainly used as a way to link online content to mobile devices. This is because in most applications these codes are used to store URLs or other small identifiers like e-mails and phone numbers. Once the information stored in the QR code is decoded the appropriate content is retrieved from a remote server facilitating mobile navigation.

3. Mobile Wellness Applications

In recent years several mobile wellness applications have been developed. Most of these applications include diaries that help people to track food intake and physical activity to reach the ideal weight or healthy nutrition goals. Several studies like [8], [9], [10] and [11], just to name a few, have proved that mobile applications can be excellent tools to achieve wellness. This is due to the fact that mobile devices are kept along almost all the time, allowing timely inputs and providing appropriate persuasions. In this way these applications can help to motivate people to exercise and avoid excessive eating. In order to track food intake most of these applications require capturing data from food nutrition facts labels like the one shown in figure 2. This task however can be discouraging for some persons especially for elder people or for people that are not well familiarized with mobile devices since one of the main disadvantages of these devices is that they have insufficient input capabilities providing tiny keyboards to do manual entries.

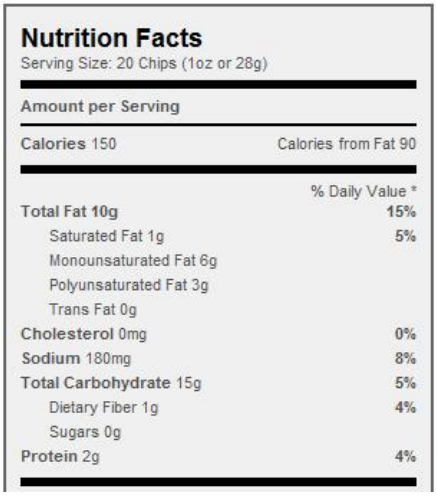

Fig. 2. Nutrition facts label

Some efforts have been done to facilitate inputs in food journals. Applications like Calorie Tracker by Livestrong [12] and Calorie Counter by FatSecret [13], include large databases. The first one for example claims to contain 625,000 food and fitness items in its database. However searching large databases can be cumbersome sometimes since localizing the appropriate food item may need several keyboard inputs. This approach also requires continues application's updates in order to maintain an up to date database. Others applications like My-Calorie-Counter [14], offer an online database to retrieve the information using a mobile web browser. These entries are however limited to the information contained in the database and do not offer a standard format to include new food items adapted to different cultures.

We consider that mobile wellness applications' adoption could be accelerated by using a standard food's information format that can be used worldwide as well as an appropriate automatic data capture technique that

Fig. 3. Screenshots from the CalReader mobile application.

facilitates inputs. We propose using QR Codes as we describe in the next section.

4. Prototype Application Description

We have implemented a prototype application called *CalReader*. It was developed using the Android development Platform and tested on an HTC Magic Mobile Phone. The application is intended to get nutritional information of food products by scanning a QR code. Figure 3 shows the process flow and some screenshots of the application. In order to store the nutritional information in the QR code it is necessary to use a common data structure. We propose using JSON as the data representation. **JSON** (JavaScript Object Notation) is a lightweight data-interchange format that has been used as an alternative data interchange format to XML [15]. This is because JSON provides smaller messages and simpler syntax. An average JSON string is about two thirds of the size of the same data in XML [16]. In addition, we consider that JSON is an ideal format since it is easier to read and understand than XML. We think that this characteristic could facilitate its adoption in the food industry.

To test the prototype application we generated several QR codes for various food products, containing the four key nutriments as stated in [6]: Calories, saturated fat, sodium and sugar using a JSON schema. For example the information contained in the nutrition facts label shown in figure 2 can be represented as follows:

```
{"info":{"cal":"150","fat":"1",
  "sodium":"180","sugar":"0"}}
```

We use the web-based ZXing QR Code Generator to create the QR codes and printed them using an ordinary printer. Figure 4 shows a QR code containing nutritional information as a JSON data format.

Fig. 4. QR Code containing nutritional information as a JSON structure.

Figure 5 shows the *CalReader* application structure. As it can be observed the prototype application requires using ZXing QR-Reader to scan and decode QR codes. This task can also be achieved by using any QR Code reader pre-installed on the mobile device. Once the information is retrieved it is parsed using the classes and objects from the `org.jason` package, including the `JSONTokener` public class provided in the Android development platform. Finally the information is interpreted and displayed to the final user.

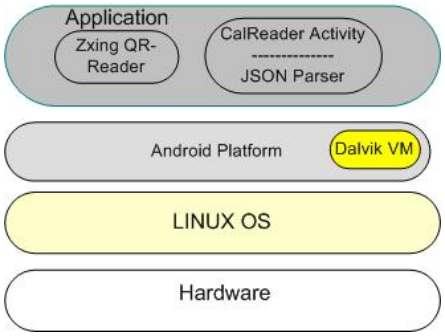

Fig. 5 CalReader structure

The nutritional information is presented as a list including the key nutriments' names and values. A progress bar is also included in the output to indicate the percent daily value for each element. This information is calculated based on a 2,000-calorie diet for healthy adults as provided by the FDA (U.S. Food and Drug Administration) [17] and shown in table 1. There is no daily reference value for sugar but no more than 40 grams are recommended.

The *CalReader* application tracks calorie and key nutriments intake, once the recommended daily allowance for one element is reached it notifies to the user by sending an android's Alert.

Table 1. Daily Values (DV) recommended by the FDA

DV based on a 2,000 calorie diet	
Nutrient	**DV**
Total Fat	65 g
Sat Fat	20 g
Sodium	2400 mg

5. Conclusions

Mobile wellness applications can be excellent tools for helping people reaching their ideal weight or keeping a healthy diet. We believe that these applications can be considerably improved by using automatic identification and data capture (AIDC) techniques. AIDC techniques can be used to capture nutritional information instead of using manual entries that can be complicated for some people. In this paper we have proposed QR codes as the choice of tags to contain this information, and JSON structure to represent the data. As a proof of the concept we have implemented a prototype application using the Android development platform. We consider that QR Codes are the ideal choice at the moment since they are easy to use, offer high decoding speed and many state-of-the-art smartphones provide pre-installed decoders. As a future work we are planning to explore other AIDC techniques including RFID and NCF that could help to enhance wellness and mobile health applications.

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Mabel Vazquez-Briseno received her Ph.D in Computer Science from Telecom SudParis (ex INT) and Pierre et Marie Curie University, France in 2008. She received the M.Sc degree in Electronics and Telecommunications from CICESE Research Center, Mexico, in 2001. She is now researcher-professor at the Autonomous University of Baja California (UABC), where she is a member of the Telematics research group. Her research interests include computer networks, mobile computing and protocols.

Juan-Ivan Nieto-Hipolito got his Ph.D. in Computer Architecture and Technology at Technical University of Catalonia, Spain in 2005. He is now researcher-professor at the Autonomous University of Baja California campus Ensenada where he is Coordinator of Post Graduate Studies and leads the Telematics research group.

Elitania Jimenez-Garcia received her master degree in Computer Sciences from CICESE research center, Mexico in 2001. She is now professor at the Autonomous University of Baja California, Ensenada, Mexico where she is a member of the Telematics research group