Design and Implementation of an NFC Food Labeler for Smart Healthcare

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Abstract. This paper presents the design of a smart food labeler mobile application that utilizes Near Field Communication (NFC) technology. The system aims to increase nutrition awareness and encourage food sellers to provide information about their food products in an efficient and interactive way.

Keywords: Nutrition education · Food label · NFC technology · Smart healthcare · Mobile application

1 Introduction

Human body health depends on what someone eats. Most of diseases such as Diabetes, High Blood Pressure and Digestive Diseases are caused by bad nutrition [1–3]. It is important for people to be more conscious about the food they are going to eat. One approach that helps people know about the food nutrition is food labels.

Food labels play an important role in communicating nutrition facts and health related issues where people can be aware of the food they are consuming and can make healthier choices. Food labels provide vital information about any food such as food content, ingredients, calories and fats. Knowing food ingredients help people who have food allergy to avoid the ones that are not suitable for them. Also, knowing food calories and fats help them to know how much energy and fats that their body will gain after consuming that food.

Smartphone devices with advanced features are the most growing technology in the market today. Their usage is increasing and they even become an aid in various fields of life using different apps. One of the recently emerging technologies that are integrated in smartphones is Near Field Communication (NFC). NFC is built inside more than 500 million smartphones and it is expected to be increasing for the next years [13]. In contrast to other available technology such as Quick Response (QR) codes that require additional apps installed in smartphones to read them, NFC is built inside the smartphone and does not require any additional apps to read its tags. Therefore using NFC as a medium for information storing will give the developed application a high user experience in an interactive and smart way.

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2 Background

2.1 NFC Technology

Near Field Communication (NFC) is a technology that allows devices to communicate wirelessly over a short distance of few centimeters. NFC technology devices have various communication ways. One of the ways, which is for passive devices, is communicating with a reader and storing information on them but not actively reading other devices [4]. Another way is peer-to-peer communication between active devices such as smartphones, which both can send and receive information [4]. The NFC technology is widely used in payment domain such as Google wallet and Apple pay. Also in exchanging information between smartphones i.e. read and write information to NFC tags.

2.2 NFC Tags

NFC tags are chips that use NFC technology and have different forms such as stickers, labels or hangs. They are considered passive devices and can store information that can be read and written by other NFC devices like smartphones [5]. The stored information could be normal data such as text, photos or videos or it could be specific action such as turning on Wi-Fi, opening certain app, etc.

Technically speaking, there are five different types of NFC Tags defined by NFC Forum. Table 1 shows major features of the first four types. However, Type 5 has been defined recently by NFC Forum, it follows ISO/IEC 15693 standard and it is configured to store NFC Data Exchange Format (NDEF) messages [8].

Table 1. NFC forum NFC tag types [6, 7]

Features	Type 1	Type 2	Type 3	Type 4
Standard	ISO14443A	ISO14443A	Japanese Industrial Standard (JIS) X 6319-4, known as (FeliCa)	ISO/IEC14443
Memory size	96 bytes and can be expand up to 2 Kbytes	48 bytes and can be expand up to 2 Kbytes	Variable (limit 1 Mbyte per service)	Up to 32 Kbytes per service
Communication speed	106 Kbit/s	106 Kbit/s	212 Kbit/s	Between 106 Kbit/s and 424 Kbit/s
Read and write capability	Both and can be configured to become read only	Both and can be configured to become read only	Pre- configured to become both or read only	Pre-configured to become both or read only

3 Related Work

There are many available websites and mobile apps in different platforms such as iPhone and Android, which have some common features with our proposed app. We selected the most three popular from them to be compared with our app. Table 2 shows the comparison between our app and the selected apps.

Table 2. Comparison between smart food labeler app and other selected apps

Major features	ReciPal	Fooducate	Calorie counter	Smart food labeler
Diet tracking	×	✓	✓	×
Barcode reader	×	✓	✓	×
Provide huge food database	✓	✓	✓	✓
Allows to add new food	✓	✓	✓	×
Allows to add recipes	✓	✓	✓	✓
Storing recipes in the cloud	✓	✓	✓	✓
Calculate calories	✓	✓	✓	✓
Allows to view nutrition information	✓	✓	✓	✓
Generate nutrition information	✓	×	×	✓
Support NFC	×	×	×	✓

3.1 ReciPal [9]

ReciPal is a website that enables creating nutrition facts labels with FDA format. The website allows creating recipes by adding ingredients from their database or adding new ingredients by the user. All nutrition facts for the recipes are calculated when adding the ingredients. The recipes are stored in the cloud and the user can edit them or delete them any time. It provides options to hide ingredients, allergens list and business info. It provides various label styles, which the user can choose from them then save the label and print it. The website offers a free trial for three free recipes.

3.2 Fooducate [10]

Fooducate is a free mobile application available on Android and iPhone platforms. Also it has a website version. The application allows scanning food product barcode then shows whether it is healthy or not based on their grading system that grade product from A down to D. It provides food, calories and exercise tracking. Also it allows searching and adding food from their database and allows adding user recipes and food, which is stored in the cloud.

3.3 Calorie Counter [11]

Calories Counter is a free mobile application available on Android, iPhone, iPad and Windows Phone platforms. Also it has a website version. The application provides tracking of food, exercise and major nutrients such as calories, fat, protein, sugar, fiber and cholesterol. It allows scanning food product barcode. Also it allows searching and adding food from their database and allows adding user recipes and food, which all stored in the cloud.

4 System Design

Our Smart Food Labeler system is designed to help food sellers provide their customers with information about their food products efficiently. The system consists of three essential components which are NFC food labels, smart food labeler app and cloud backend, as shown in Fig. 1.

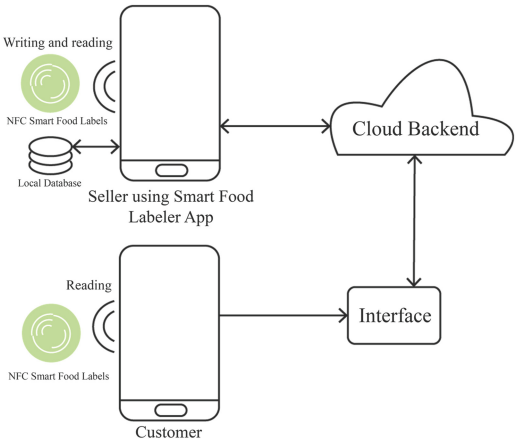

Fig. 1. System architecture

The system works as follows: a seller uses the App to add her/his food products information and retrieve the ingredients from cloud backend database. The added food product information will be stored in the cloud backend associated with a seller ID. Then (s)he writes one of the added food products to the smart Food Label after entering activation ID which is provided to seller with smart Food Labels. The seller will place the smart Food Label on her/his food package and sell it to the customer. Then the customer taps her/his NFC smartphone to the smart Food Label and all information of that food product will be retrieved from the cloud backend through the interface to the customer.

4.1 NFC Food Labels

NFC Food label is an NFC tag that can be read and written by NFC smartphones. The label is small and suitable for all kind of food packaging. The tag type that will be used for the labels is Type 2 with ISO 14443A standard.

4.2 Smart Food Labeler App and Cloud Backend

Smart Food labeler app is an Android mobile application that enables sellers to write their food content to the NFC food labels. It allows them to add their food ingredients from comprehensive food database and automatically calculates food calories. Also it enables reading from the smart food labels.

The cloud backend is used for storing seller recipes, ingredients and contact information along with seller ID. Also, it is used for retrieving recipes and ingredients of sellers and for retrieving nutrition information of the food product to the customer.

5 Implementation

The Smart Food Labeler App is developed for Android platform using Android Studio and Android NFC library package [12] to provide NFC functionality. The cloud backend is implemented using PHP and SQL for database storage. The mobile database is implemented using SQLite to store seller's products and information and uncompleted backend processes. The interface is developed using HTML5 and JavaScript in a form compatible with mobile devices.

The application provides three main options: Write to tag, Read from tag and View all user food products, as shown in Fig. 2.

The View all user food products option allows a seller to view all his/her food products and add new one or edit/delete existing one. When a seller adds new food product, it will be provided with a user friendly form which includes the name of the

Fig. 2. Main interface in Arabic: (1) write to tag (2) read from tag (3) view all user food products and (4) add new food product interface.

product, ingredients and total of calories, as shown in Fig. 2(4). The calories will be calculated after the seller adds the ingredients using the comprehensive database that enables him to search and add the ingredients (s)he wants. For the seller property rights, the application provides hide ingredients, which hide all ingredients of the food product recipe. The write to tag option allows the seller to write food product information to the Smart Food Label. It allows seller to select one of the food products that (s)he adds in his/her list, then it will ask him/her to tap the mobile device to write on the Smart Food label. For read from tag option it will ask the user to tap his/her device to the Smart Food Label to view the information of the food product inside the Smart Food Labeler App.

6 Conclusion

This paper presented the design and development of a smart food labeler mobile app using Near Field Communication (NFC) technology. The need for such an app came from the perspective of nutrition awareness and its importance in the healthcare field; the awareness can be achieved through food labeling of homemade food.

We presented our Smart Food Labeler App in an exhibition to conduct user acceptance testing. We asked 12 persons using a questionnaire and the reviews ware very satisfactory, where 92 % said that the app was excellent and 8 % said that the app was very good.

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