Food Code Breaker (FCB) – Developing the Multi-Lingual Food Code Translation Android Application Using Multi-Options Code Reader System

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Abstract. This paper researches a food code and food ingredient translator mobile application based on Android called Food Code Breaker (FCB). FCB functions to decipher food based chemicals or food additives which are represented by unique barcode numbers called E-numbers. FCB incorporates an easy to use and multi-option code reader food code translation platform with an Optical Character Recognition (OCR) system integrated within the application. The aim of this research is to be able to provide an affordable, accessibl and easy to use system that helps consumers to identify and verify the halal, vegan and allergy status of the ingredients listed in food wrappings or packaging via its multi-option code reader and OCR technology. The outcome of this research is an android mobile application that reads food ingredients in either textual or image formats and is able to provide a customizable languages translation feature to help consumers with foreign languages translation. FCB will be particularly useful for travellers with dietary restrictions, whether religious, ethical, or allergy related.

Keywords. Hand-held multimedia device, Text Translation, Text to Speech, Android Application, Optical Character Recognition (OCR) system, E-Codes, Food Code Translator, Multi–Lingual
1. Introduction
Travellers visiting countries which do not speak the same language often face problems in translating the ingredients of the food they buy. Any random food wrappings or packaging be it local or imported would often list their food ingredients either in its native language, foreign language or in E-codes. Therefore, would often have trouble verifying the halal, vegan and allergy status of these E-codes or ingredients listed in a foreign language. The lack of available translation can be more than just an inconvenience, especially if travellers had allergies to specific food ingredients which could cause dangerous after-effects. These travellers or visitors are unable to use online translation services or pocket translators to translate the food ingredients mainly because they are unable to write the foreign text they see on to these hand-held devices. This particular paper proposes an Android application called Food Code Breaker (FCB) via mobile technology to solve the aforementioned problem by enabling users to take a quick scan of the QR code from the food packaging or wrappings. Travellers can scroll through the various options and have all the food ingredients displayed in their own language, with several options available including English, Malay, Chinese, Japanese, Thai, and Dutch. FCB provides an easy to use and multi-option code reader food code translation platform. FCB reads the food ingredients in either textual or image formats and is able to provide a customizable languages translation feature by which visitors to the country can quickly scan and translate the ingredients of the food they buy. FCB will be particularly useful for travellers with dietary restrictions, whether religious, ethical, or allergy related.

2. Related Work
Available studies relating to mobile application translation systems mostly use OCR technology to recognize images, text translation and text to speech mainly to overcome language barriers during travels to foreign countries. Titus, A. et al (2015) discussed an Android Application ATMA. ATMA stands for Android Travel Mate Application with a built in OCR suite as well as Image Processing suite both installed in the Android device which enables Travellers and Tourists to easily capture the native country language Books pages, signboards, banners and hotel menus etc. The built-in OCR converts the text embedded in the captured image into Unicode text format. It also provides translation facility so that Tourists can translate the Native Language Unicode text into their own country language.

Panchal et al (2015) designed an Android-platform based text detection and translation application that is able to recognize text present in digital image, translate the text from English to various other languages like Arabic, German, French, Russian, Spanish etc. The app was also able to convert the text into speech and allows the audio file to be stored locally for later use. He and his team of researchers experimented with a set of 100 random business card pictures, captured using a smartphone camera. Findings revealed a maximum accuracy-rate that is greater than 90%, more efficient and consumes less memory rendering it a suitable app for smartphones.

J. Yang et al (2001) propose a system for translating signs written in Chinese to English. Their prototype automatically extracts sign regions from images applying an adaptive search algorithm that uses color information and performs edge detection at different scales. The sign regions detected are segmented using Gaussian mixture models before being fed to a commercial OCR software. Their system uses Example-Based Machine Translation (EBMT) to translate the signs. This particular research above justifies the need to conduct such studies as present studies mainly focused on text recognition and translation application for smartphone targeted towards overcoming language barriers during travelling. Findings from this study will not only fill the gap in the literature, provide an insight on further enhancing existing food ingredient translator apps but also disclose the latest trends in text detection and translation system for camera based smartphone specifically in the scanning a plethora of food packaging and wrappings.
3. Methodology

3.1 Application Design

FCB application design comprises of four stages or processes which are as follows – Stage 1: Initialization, Stage 2: Data acquisition, Stage 3: Data processing and Stage 4: Data presentation. These stages are further divided into these three steps: (1) Language selection, (2) Data input and process, and (3) E-Code Extraction and presentation. These stages or processes are demonstrated via dashed blocks as illustrated in Figures 1 and 2 below. The following subsection details out these stages or processes.

![Figure 1: Language Selection](image)

3.1.1 Language Selection

Language selection is critical to identify input and output data whereby users select the language of the food code which are printed on the food packaging or wrappings, and the preferred output language (user’s mother tongue or spoken language). This stage is deemed essential for processing the code and for displaying the E-code translation in the user’s preferred language. Nonetheless, a default language is set to English for the purposes of handling cases involving unexpected language selections. The present version of FCB supports the following language selections - English, Malay, Chinese, Japanese, Thai, and Dutch. A GUI based feature is also designed and integrated to prompt the user for languages selection as illustrated in Figure 1 above.

3.1.2 Data Input

Data input refers to the data acquisition process. FCB implements two options for data acquisition namely textual and graphical. With these two options, the user is able to select the desired method in order to increase the flexibility of the application. The graphical option is triggered by scanning the food wrappings or packaging using the image capture resources located in the smart device in this case the camera. The process is then subsequently proceeded by two image preparation steps. First, the image should be cropped specifically to the segment where the food ingredients and E-Code are presented in the image. Secondly, the captured image is processed by an android image library to extract the image features. Then, the extracted features of the image are used as an input for an Optical Character Recognition (OCR) module of the input language.
3.1.3 E-Code Extraction and Presentation.

The E-Code extraction and presentation step is the final step which displays the obtained text for further modification by the user. The textual data acquisition dictates the user to enter the text manually. The final output of this process is the E-Code extraction and its translation in a textual format or version. Figure 2 below sums up the Application Processes of the FCB Design Application in a pictorial format.

Figure 2: FCB Application Design
4. Results

4.1 FCB Application Work Process Screenshots

Figure 3 and 4 below illustrates the two versions of the FCB (formerly termed as Food Ingredient Translator [F.I.T]) work process screenshots.

![Figure 3: Screenshots of FCB First Trial Version (Text Output)](image)

![Figure 4: Screenshots of FCB's Upgraded Version (Text and Audio Output)](image)

Figure 4 below presents the upgraded version of the FCB that is able to automatically analyze the list of words (ingredients & food codes) collectively and translate them via **AUDIO OUTPUT (Say it)** or **TEXT OUTPUT (Snap it)**.
Figure 5 below depicts the ‘SAY IT’ feature of the FCB whereby users can directly speak into the microphone icon when it appears on the screen. The app will analyse users’ voice input and translate the food codes and ingredients into the selected target language.

![FCB App Work Process: Say it](image)

Figure 5: The ‘SAY IT’ Application Design of FCB

### 4.2 Application Evaluation Based on Similar Application Comparison

The similar application compared to the Food Code Breaker (FCB) application is the ipiit – Scan Food Ingredients application. Table 1 below displays a similar application comparison of FCB and ipiit. As illustrated in Table 1, ipiit application does not have several features provided in FCB such as ‘audio output’ which allows users to speak or articulate the food ingredients, ‘translates food ingredients and E-Codes into other languages’ which also acts as a translating device and ‘multi lingual medium of instruction’ which provides a multi lingual option for the user.
Table 1: Similar Application Comparison of FCB and ipiit

| Feature                                      | Food Code Breaker (FCB) | ipiit – Scan Food Ingredients |
|----------------------------------------------|-------------------------|-------------------------------|
| Based on Android OS                          | √                       | √                             |
| Scans bar codes of food products             | √                       | √                             |
| Text output                                  | √                       | √                             |
| Audio output                                 | √                       |                               |
| Translates Food ingredients and E-Codes into other languages | √                       |                               |
| Multi lingual Medium of Instruction         | √                       |                               |
| Monolingual Medium of instruction            |                         | √                             |
| Checks for allergy triggers                 | √                       | √                             |
| Checks for kosher or ‘halal’ status          | √                       |                               |
| Checks for vegetarian or non-vegetarian origins | √                       |                               |
| Checks for Nutrition Facts                   |                         | √                             |
| Provides information on food ingredients     | √                       | √                             |
| Creates personalized preferences            |                         | √                             |
| Product comparison feature                   |                         | √                             |
| Rate food product feature                    |                         | √                             |
| Online mode                                  | √                       | √                             |
| Offline mode                                 |                         | √                             |
4.3 Application Evaluation

Section 4.3 presents the FCB application user interface evaluation based on eight rules as proposed by Shneiderman B, Plaisant C, Cohen M, dan Jacobs S. (2010) – (1) Consistency, (2) Provide Universal Usability, (3) Provide Information Feedback, (4) Design Final Dialog, (5) Simple Error Handling, (6) Internal Locus of Control, (7) Reversal Action Allowance, (8) Reduce the Information Capacity for Short-Term Memory. Analysis revealed FCB only employed 50% of the proposed eight rules:

1. Consistency
FCB keeps its consistency by using the same font type, colour, layout, menu, and menu icon in each pages. It applies to website application and mobile application.

2. Provide Universal Usability
FCB is user friendly. Its feature eases users to use the application. The ‘audio output’ for instance enables users with literacy or physical disabilities to use the app while the multi-lingual option caters to a wider range of users. The ‘Back’ button utilizes a universal icon which relates to users globally.

3. Reversal Action Allowance
FCB application integrates a simple reversal action. There is a Back button in almost all interfaces of the application.

4. Reduce the Information Capacity for Short-Term Memory
FCB integrates the reduction of information capacity for short-term memory. The menu icons use universally recognized icons.

5. Conclusions and Recommendations

5.1 Conclusions
Based on the result of this research, it can be concluded that FCB has many benefits; particularly useful for travelers with dietary restrictions, whether religious, ethical, or allergy related. FCB provides an easy to use and multi-option code reader food code translation platform. FCB reads the food ingredients in either textual or image formats and is able to provide a customizable languages translation feature by which visitors to the country can quickly scan and translate the ingredients of the food they buy. It’s audio output is especially appealing and user friendly as it specifically caters to users with either literacy or physical disabilities.

5.2 Recommendations
For further efficiency, this application will incorporate the remaining 50% of the eight rules in feature improvement as discussed in section 4.3 earlier. FCB can be further technological advanced to other platforms such as Blackberry and iOS and into offline mode. With this, users who use Blackberry operating system and iOS can also use FCB. Therefore, widen the target user segmentation. FCB could also be integrated with social media such as Facebook, Instagram, and Snapchat to facilitate users’ in obtaining FCB application information. Further research is also strongly recommended towards further improvement of the FCB as the present accuracy rate is directly dependant on quality of input image and FCB has demonstrated difficulty to recognize cursive characters and symbols.
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