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MyHalal: an interactive application

Wong Xin Ying, Zarul Fitri Zaaba
School of Computer Sciences, Universiti Sains Malaysia, Pulau Pinang, Malaysia

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ABSTRACT

According to the Halal industry development corporation (HDC). Malaysia's Halal industry market value is expected to achieve approximately RM614.36 billion by 2025. It indicates that the Halal industry has great potential in covering local and international markets. In Malaysia, the department of islamic development malaysia (JAKIM) is the official agency responsible for Islamic affairs. In most circumstances, the public can check the Halal status of products by accessing the official website. The searching via the website is quite tedious and complex. Therefore, this work bridges the gap by proposing a mobile application namely MyHalal (MH) as a proof of concept which significantly improved the current method. This application will assist users in verifying the Halal status of food products and premises. In this context, MH also introduces a barcode scanner to check the product listing in JAKIM with camera access. Besides that, users also can report an issue when they found any misconduct regarding Halal certification. This mobile application is developed together with the web-based application as the backbone for the administrator to manage technical matters. It is expected to be a user-friendly platform for the users and a channel for JAKIM to manage information and spread awareness about Halal.

Corresponding Author:

Zarul Fitri Zaaba
School of Computer Sciences, Universiti Sains Malaysia
11800 Pulau Pinang, Malaysia
Email: zarulfitri@usm.my

1. INTRODUCTION

Malaysia is a country whose most professed religion is Islam. According to the statistic of the Population of the World, there are approximately 18.9 million Muslim adherents or 61.3% of the population in Malaysia. As we know, the term Halal is particularly associated with the Islamic dietary laws which must be followed by every Muslim [1]. In addition, the Halal principle is beyond the understanding of religious values alone but appeals to hygiene, health, and quality of products [2], [3]. The rising concern on health among non-Muslims has increased the demand for Halal products especially Halal foods [4], [5]. According to the result from part B of a questionnaire that studies the behaviour beliefs of people towards Halal foods and food premises, we can conclude that most people have positive perceptions toward Halal topics [6], [7]. This phenomenon indicates that Halal industries are highly accepted by the public regardless of religion. However, some issues have arisen and caused consumers to find difficulties in verifying the Halal status of foods and premises [8], [9] either local or international. Therefore, it is significant to provide a proper guideline for consuming Halal foods.

JAKIM is the only authorized Halal certification body that handles Halal affairs. It provides a website for users to access Islamic information including the Halal directory which is less user-friendly for users to search and verify Halal products. There is an incomplete platform for users to report any misconduct to JAKIM [10]. Apart from access to the official website, the development of mobile applications is proposed

to ease the users in verifying the Halal status of products, especially at the moment shopping in the retails. This application will improve the flexibility of search functions in different involved search engines and barcode scanner [11], [12]. At the same time, providing users with an enhanced Halal directory to identify domestic and international food at their fingertips. This proposed solution also aims to contribute effort to solving Halal issues by supporting users with the report misconduct platforms.

2. RELATED STUDIES

Tables 1 and 2 show the feature comparison of domestic and international Halal-related applications respectively. From the comparison, only a few of them provide user registration. A sign-in feature usually offers more engagement such as comments and sharing opinions. Besides, some of the applications allow users to search E-Numbers while most of the applications offer users food products or premises searching. Besides, only verify Halal allows users to search the foreign certified Halal products. In short, none of them integrates three search engines in an application. Moreover, 60% of the domestic and international applications featured barcode scanners. Finally, some applications enable users to report misconduct if any issues. However, most of them only redirect users to the mail system or ask for users' feedback without providing pieces of evidence. In a nutshell, the existing applications, either domestic or international only contain a few functionalities within a single application which is not enough for users in checking all Halal status of products or premises.

Table 1. Feature comparison of local Halal-related applications

Features	App scan Halal	Verify Halal	Halal E-numbers	Smart Halal apps	Halal Jakim barcode scanner
User registration	×	√	×	×	×
E-numbers search engine	√	×	√	×	×
Domestic food products and premises search engine	×	√	×	√	×
International food search engine	×	√	×	×	×
Barcode scanner	×	√	×	√	√
Report misconduct	√	×	×	√	×

Table 2. Feature comparison of international Halal-related applications

Features	HALA eat	Halal advisor	Halal OuPas	Halal check	Halal io
User registration	×	√	×	×	√
E-numbers search engine	×	×	√	√	×
Domestic food products and premises search engine	√	√	×	√	√
International food search engine	×	×	×	×	×
Barcode scanner	×	×	√	√	√
Report misconduct	×	√	×	×	√

In this paper, the MH application is equipped with multiple Halal food search engines which include local and international food products, domestic premises, and e-numbers, together with domestic food products barcode scanner and enhanced report misconduct feature. An Android mobile application is developed for the client side and connected with a web-based application for administrators to dynamically handle technical and management issues of the mobile applications.

3. METHOD

3.1. Preliminary study

A questionnaire was conducted approximately for 1 week from 13th November 2021 until 19th November 2021 (i.e., 38 respondents). This survey had been created by using google forms and distributed online to gather participants' responses. This method is a cost-efficient and faster way of obtaining feedback from a large sample of people [13]. It provides statistical evidence for an assumption which is useful for further evaluation. Table 3 shows the summary of respondents' demographics in characteristics of age, gender, nationality, race, and religion. The result shows that this survey comprises 34.2% male and 65.8% female responses (i.e., the majority are 18-25 years old and all of them are Malaysian). More than half of the participants are Malay which is 52.6%, followed by 42.1% Chinese and 5.3% Indian. 52.6% of the

respondents are Muslim whereas 31.6% of them are Buddhism. Christianity has 13.2% while only 2.6% of Hinduism responded to this survey.

Table 3. Survey respondent information

	Frequency	Percentage (%)
Age		
18-25	33	86
26-33	3	7.9
34-40	2	5.3
41-55	0	0
Above 55	0	0
Gender		
Male	13	34.2
Female	25	65.8
Nationality		
Malaysian	38	100
Non-Malaysian	0	0
Race		
Malay	20	52.6
Chinese	16	42.1
Indian	2	5.3
Religion		
Muslim	20	52.6
Buddhism	12	31.6
Hinduism	1	2.6
Christianity	5	13.2

Part B is aimed to investigate respondents' behaviour and beliefs on the Halal food industry according to different backgrounds. 79% of them have a positive perception of nutrients provided by Halal food industries while 76.3% strongly believe that foods and premises labelled with Halal certification provide Halal food. Besides, 39.5% of participants agree that Halal food does not contain any harmful substances. 47.4% of the respondents agree that Halal principles give them a healthy diet. More than half of them realize that Halal food industries contribute good effort to humans, animals, and the environment. In short, most people show positive behaviours and beliefs toward the Halal food industry. It implies the demand for a platform to verify the Halal status of foods.

Part C will elicit users' requirements for the mobile application. More than half of them consider using the mobile application in verifying Halal status while few of them might use or not use it. For the E-numbers search feature, not many "strongly agree" responses but still, respondents find this feature useful at around 68%. Half of them state that they strongly prefer to check the Halal status of international food products. Notably, only 5.3% of respondents have a neutral stand on the statement of the usefulness of barcode scanners in the application. Other respondents look forward to the feature of the barcode scanner in the application. There are 39.5% of them that report misconduct platform as an important feature for this application.

Figure 1 exemplifies the mapping of the feature comparison in existing applications. Only three of them provide user registration for more user engagement. None of them integrates three search engines in a single application. Furthermore, only verify Halal allows users to search for foreign certified Halal products. 60% of the domestic and international applications featured barcode scanners. Besides, applications that featured report misconduct only redirect users to the installed mail system or ask for users' feedback without providing evidence.

Part C shows a result that most of the users are glad to have different useful functionalities in the mobile application. Therefore, MH will be featured with user registration, three search engines, a barcode scanner, and an enhanced report misconduct platform to fulfil users' requirements in identifying the Halal status of foods.

3.2. System requirements

This survey has gathered respondents' opinions on five of the main proposed solutions. One of them is verifying the Halal status of food products and food premises. This function will be embedded as one of the submodules which are named Halal food and food premises search engine. The second function will be the E-numbers search function which will be implemented in the submodule of the E-numbers search engine. The third function is to check the Halal status of international food products. This function will be classified as the international food products search engine submodule. Three of the submodules are under the Halal information management module. Barcode management module will include barcode scanner submodule and barcode information submodule to implement the barcode scanner in the mobile application. Admin will

handle all the required information on the website. To provide a report misconduct platform, users will be able to register and log in to their accounts and report misconduct by providing relevant information and evidence. These features require a user account management module which includes account registration, manage account, and report misconduct submodules. Admin will be able to update the status of reported misconduct by users on the website.

Domestic					Features	International				
App ScanHalal	Verify Halal	Halal E-numbers	Smart Halal Apps	Halal Jakim Barcode Scanner		HALAeat	Halal Advisor	Halal Ou Pas	Halal Check	Halalio
×	✓	×	×	×	User registration	×	✓	×	×	✓
✓	×	✓	×	×	E-number search engine	×	×	✓	✓	×
×	✓	×	✓	×	Domestic food products and premises search engine	✓	✓	×	✓	✓
×	✓	×	×	×	International food products search engine	×	×	×	×	×
×	✓	×	✓	✓	Barcode scanner	×	×	✓	✓	✓
✓	×	×	✓	×	Report misconduct	×	✓	×	×	✓

My proposed solutions:

1. Provide user registration
2. Combine three search engines
3. Integrate barcode scanner
4. Enhance report misconduct feature

Figure 1. Mapping of comparison of features available in existing application to survey

3.3. Proposed solution

Figure 2 shows that MH consists of four (4) main modules: (i) user account management module, (ii) Halal information management module, (iii) barcode management module, and (iv) admin management module. This proposed solution is a proof of concept where it can be useful by the JAKIM agency to improve the delivery of Halal information. In the user account management module, users can create accounts in the mobile application. Users can view and update information such as gender, phone, email, state, race, and religion. Users' details are useful for user analysis as well so that the admin can analyze the web application. MH also integrates an in-app email system to allow users to report any misconduct to JAKIM regarding any Halal issues. Users can capture or upload a relevant picture as well as share the location of premises as evidence.

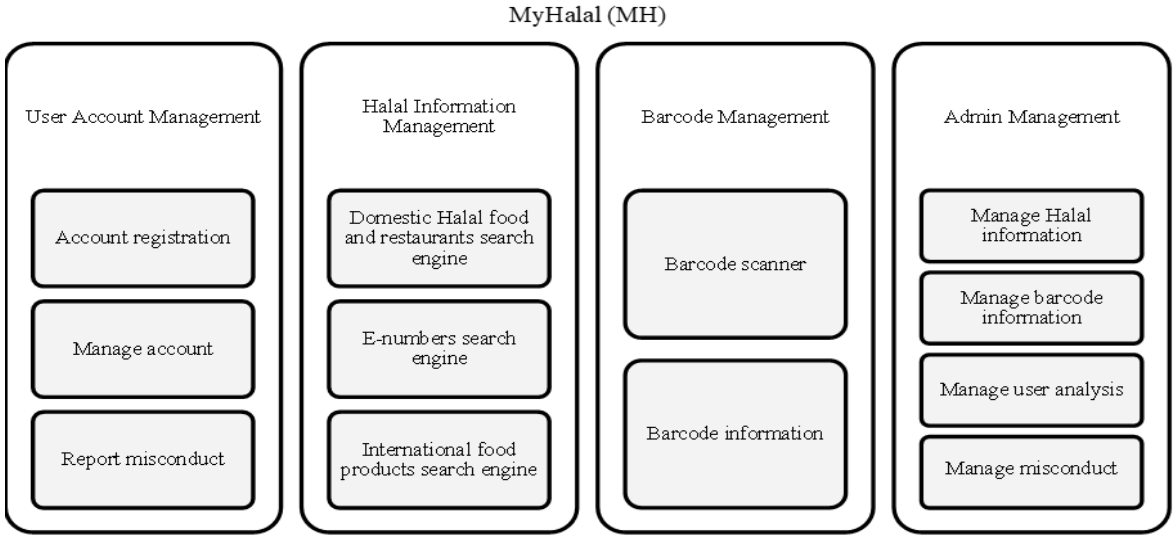

Figure 2. MH modules

Halal information management module includes domestic Halal foods and restaurants search engine, e-numbers search engine, and international food products search engine for users to verify the Halal status of foods and premises. Barcode management module allows users to scan the barcodes on the packaging of the food products by accessing the phone camera. It provides users with the result of the Halal status of the food products. In the admin management module, the admin can add, edit, delete and view the Halal and barcode information in the web application. Different roles of admin will be assigned different responsibilities to verify the information and handle misconduct. Besides, the admin should be able to do analysis and generate a report based on users' profiles and activities in the mobile application.

3.4. MH architecture diagram

Figure 3 shows the architecture diagram of the MH app. The target users of MH are the customers of Halal foods and restaurants. The data coverage will be the category of domestic and international foods and domestic food premises. Roadside stalls and street-food stalls are not covered in this project. However, users can report misconduct if they find the stalls make them confused with the Halal status of selling food. For mobile application development, Android Studio IDE will be the choice to develop this application. Figure 1 shows the architecture diagram of MH. For the client side, users can access the MH which is an Android application by using their own mobile devices. For the admin side, they will access the website through a desktop or laptop. Both mobile and web applications must be connected to the internet. Both of them refer to the same database for data saving and retrieval.

Figure 3. MH architecture diagram

3.4.1. MH mobile application architecture

Figure 4 illustrates the MH mobile application architecture. The presentation layer includes mobile interfaces which are accessible by android users on their smartphones. Information interface will present the information Halal foods, premises and E-numbers; scanner interface shows the screen for barcode scanning; In-app mail interface is adopted for composing Halal-related issues to authority; user profile interface presents users' profile details. The application layer consists of multiple features, i.e., an information search engine, barcode scanner, report form, and reported case details. The data service layer establishes the database which is MySQL to store application data.

3.4.2. MH web application architecture

Figure 5 displays the MH web application architecture where the presentation layer is only accessible by the admin. Presentation layers consist of a form interface for managing reported misconduct; an analysis interface for chart and report display; data presentation interfaces for information display. The application layer defines main functionalities, i.e., manage information, barcode, user analysis, and reported case. Data service outlines the connected database for data storage and retrieval.

3.5. Pre-process of Halal information

All the Halal information is scraped from the official JAKIM website by using ParseHub as a scraping tool [14], [15]. The data that is directly scraped from the website is usually unnormalized which causes data redundancy. Therefore, pre-processing is required to normalize those data. After web scraping,

the first step is downloading it as an Excel file. Then, all the scraped data have to be consolidated in Excel. For instance, the first scraped webpage is only containing the company name, address, and expiry date of food products. The company details such as state, phone number, email, reference number, etc. are hidden inside a detail button. The details need to be scraped separately and then compiled with the first scraped result in Excel to produce a full company detail. After the data is well prepared, normalization is applied to all the tables in the third normal form (3NF) which does not consist of partial dependency and transitive dependency [16]. Each row of data is assigned with the primary key to identify the specific relationship between tables. Figure 6 shows the sample result of displaying information on the user's mobile screen. Whereas Figure 7 illustrates the details and image of food products.

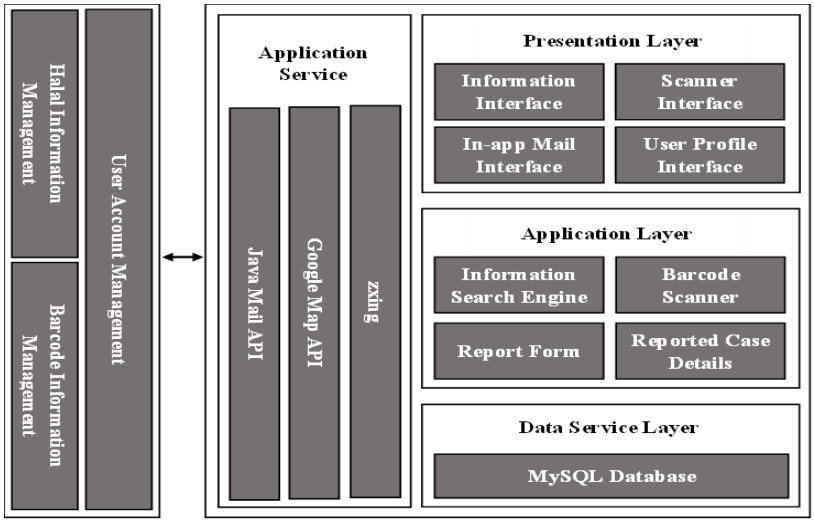

Figure 4. Mobile application architecture

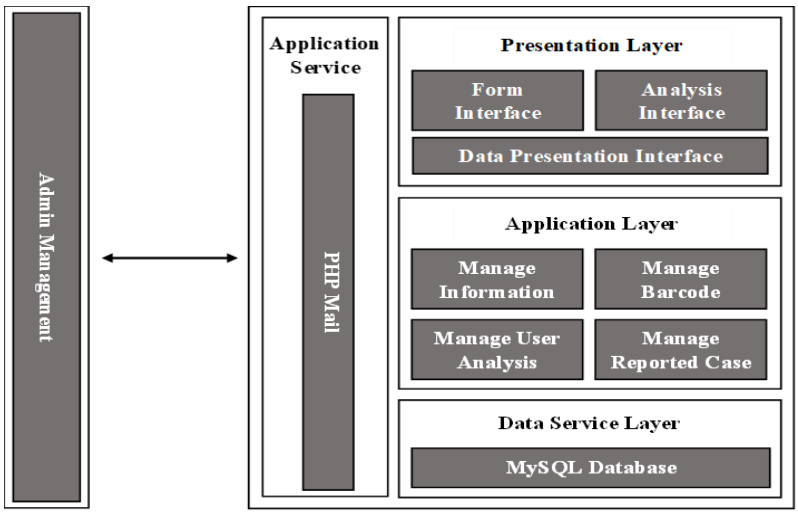

Figure 5. Web application architecture

3.6. Implementation

3.6.1. Implementation of mobile barcode scanner

In [17], [18] focuses on decoding most codes directly on the built-in camera of smartphones without server communication [17], [18]. In this development, we are going to implement EAN13 and UPC barcodes which are used by food products in Malaysia [19]. Barcode types have to be set with the IntentIntegrator embedded in this library. The ZXing library is used where it uses the onPreviewFrame() call back method from the camera. Therefore, the camera of the device can be accessed. The system will only read the contrast of the red colour to get and decode the encoded data. The encoded data here will be the barcode that can be

found on the packaging. After we get decoded data, we can compare it with the barcode stored in the database. If the value is matched, then the information of the product will be shown on the screen [20].

3.6.2. Implementation of in-app mail system with google map

To allow users to pin locations in MH, google map API is used for searching the current location of the device [21]. Then, the system can get the location with the location name, latitude, longitude, and address. The user is allowed to input text to search for a specific location with a location name. On the other hand, JavaMail API is used for in-app mail systems in Android applications [22], [23]. User input such as subject, message, location, image, and datetime will be accepted as parameters and then saved in the database. At the same time, the system will send email confirmation to the user once a case is reported. The case number will be shown in the email for confirmation. Figure 8 shows the in-app mail system design with form and buttons which allow users to provide issue details, images, and location. Figure 9 shows the in-app google map for users to pin location.

Figure 6. List of Halal food products

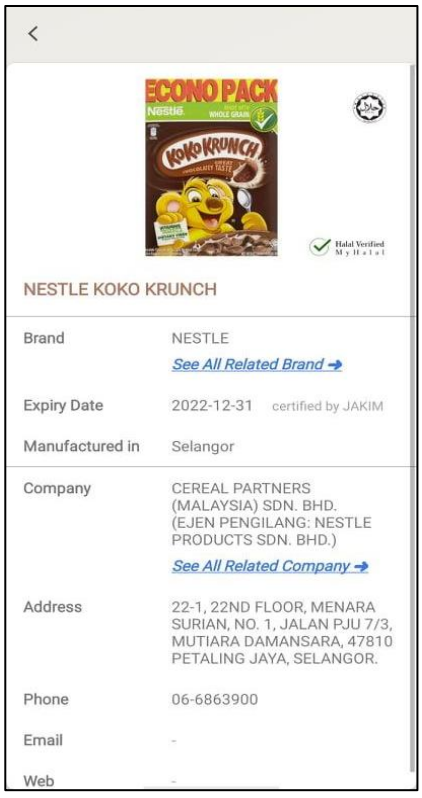

Figure 7. Details of food products

3.6.3. Implementation of layered responsibilities of administrators

This layered process as Figure 10 is applied to both features of verifying information and managing misconduct. JAKIM officers will take responsibility for verifying the Halal status of information before updating it to the mobile application. The officer will approve or reject the request for information verification. It is a double check for Halal information verification to ensure all the information displayed in mobile applications is verified before the admin adds new information into the system. Besides, in the context of reporting misconduct, the JAKIM officer is assigned to generate an investigation form and then pending the officer's approval or rejection. Only if the head of the JAKIM officer approves the investigation form, then the officer can proceed to investigate the case reported by users. After the investigation is completed, the admin will play a role to close the case by sending the result of the investigation to the user's email [24]. PHP Mail is used for admins directly sending an email about the result of the investigation to the user [25]. It is a built-in PHP function that uses simple mail transmission protocol (SMTP) to send mail. The SMTP setting is done in php.ini and sendMail.ini of XAMPP [26]. Required parameters such as the result of the investigation will be posted to PHP API and sent an email via the API.

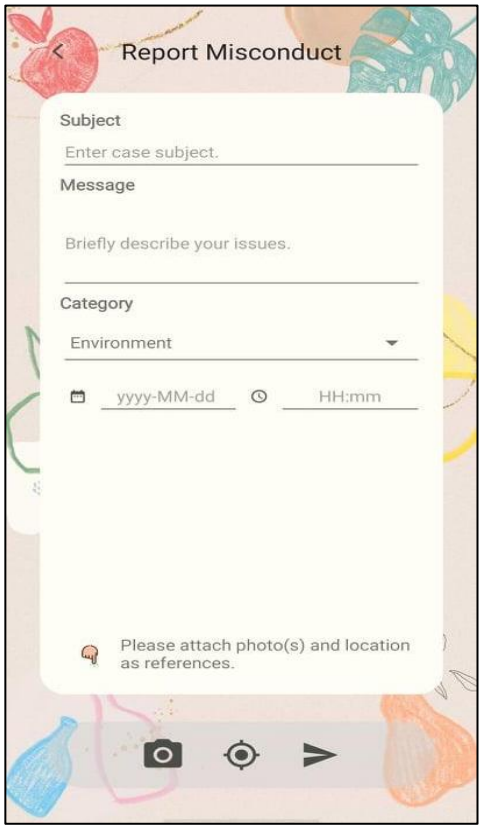

Figure 8. In-app mail system

Figure 9. In-app google map

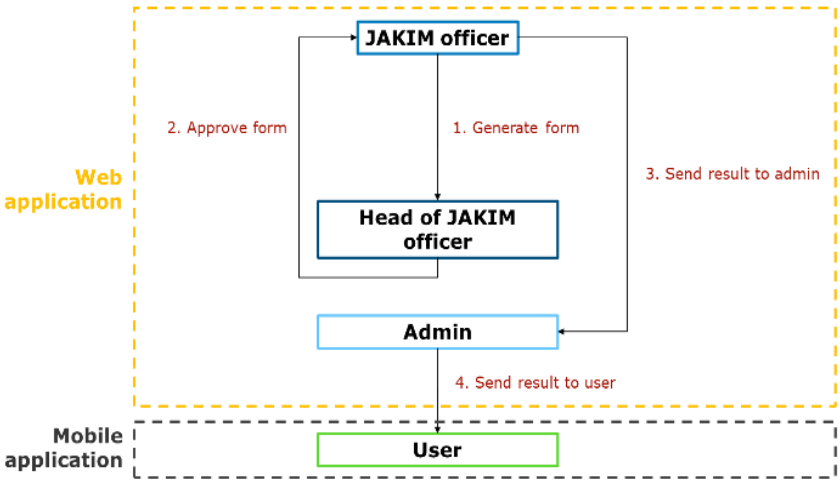

Figure 10. Layered responsibilities of different roles of administrators

4. RESULTS AND DISCUSSION

4.1. User acceptance test result

Table 4 shows 20 respondents' feedback gathered from conducted UAT on mobile-based and web-based MH applications. From the Table 4, we can observe that 55% of them strongly agree that this system helps them in Halal status verification. Only 45% of the respondents were strongly satisfied with the usability of the manual searching process. On the other hand, 12 respondents strongly agree that this system is clean and simple to use as well as assists in reporting misconduct. In the context of managing user analysis, more than half of the participants (i.e., 55% of them) strongly agree that this system contributes a lot. Moreover, 100% of them are willing to use the website to handle management and technical issues of mobile applications in case they are

the admin of this system. In this study, 45% of the respondents choose the feature of reporting misconduct as the most useful functionality in the webpage, followed by verifying Halal information, managing user analysis and managing admin. In a nutshell, users are generally satisfied with the MH application. With this UAT, we can evaluate user requirements and future enhancement in advance as well.

Table 5 (in appendix) shows the survey questions and result. In Part B, there are five questions are prepared to understand public's behavior belief toward Halal food industries. This part is useful for targeting users for this project. Part C consists of five questions to elicit users' requirement for the mobile application.

4.2. Discussion

This assessment makes a systematic basis for determining whether this system fulfils both functional and non-functional requirements. It assists in identifying potential or existing bugs and errors in the software before delivering it to the end-user. During this phase, we can evaluate whether the MH system meets the user's requirements as well. The overall level of user satisfaction is considered high based on the evaluation of test results throughout this process. Users believe that the MH system can help them to verify the Halal status of food products. Moreover, more than half of the respondents like the barcode scanner feature the most. It means people are always looking for new features with the latest technology which can ease the process of verification. There are some important findings during software development. The findings including solving technical problems and managing the mobile application with web application make the whole system more dynamic. Moreover, users' strong interest in barcode scanning implies that people always seek the latest and most convenient features to verify the Halal status of food products. On the other hand, users' low interest in manually searching items implies that they expect a more convenient way of searching features.

Table 4. User acceptance test result

	Frequency	Percentage (%)
Q1. This system helps me to verify the Halal status of food products and premise		
Strongly disagree	0	0
Disagree	0	0
Neutral	2	10
Agree	7	35
Strongly agree	11	55
Q2. This system eases the process of searching for food products and premises		
Strongly disagree	0	0
Disagree	0	0
Neutral	0	0
Agree	11	55
Strongly agree	9	45
Q3. This system helps me to report misconduct		
Strongly disagree	0	0
Disagree	0	0
Neutral	1	5
Agree	7	35
Strongly agree	12	60
Q4. This system helps me in managing user analysis		
Strongly disagree	0	0
Disagree	0	0
Neutral	2	10
Agree	7	35
Strongly agree	11	55
Q5. This system is clean and simple to use		
Strongly disagree	0	0
Disagree	0	0
Neutral	0	0
Agree	8	40
Strongly agree	12	60
Q6. If you are the admin or officer of this system, are you willing to use the website to handle the management and technical issues of a mobile application?		
Yes	20	100
No	0	0
Q7. Please choose ONE feature implemented in the MH webpage that you feel is useful the most		
Verify Halal information	6	30
Manage user analysis	3	15
Manage misconduct	9	45
Manage admin	2	10

5. CONCLUSION

MH is expected to assist consumers in verifying the Halal status of food products, food additives, and food premises. By using a barcode scanner, the proposed system aims to facilitate the checking process. In addition, a platform is available for users to report misconduct when they observe Halal-related issues in their daily lives. Besides, users no longer have to install multiple applications for the same purpose. The MH application can thus be considered as a supporting digital Halal verification tool by JAKIM and its users. Moreover, we provide an admin website for handling all the technical issues and management of mobile applications. Administration web application is developed to solve technical problems and manage the mobile application. For a better user experience in mobile applications, mobile and web applications are fundamentally connected. Having a web application as the backbone of the MH system allows us to process data and requests dynamically. This proof of concept will enable JAKIM to deliver information conveniently and in an easy-to-understand manner to the end-users.

APPENDIX

Table 5. Survey questions result

	Frequency	Percentage (%)
Part B: Behaviour beliefs toward halal foods and food premises		
Halal foods and premises provide a satisfactory level of nutrition.		
1	0	0
2	1	2.6
3	7	18.4
4	13	34.2
5	17	44.7
Halal foods and premises provide food that is free of ingredients that are against Islamic Shari'ah.		
1	0	0
2	0	0
3	2	5.3
4	7	18.4
5	29	76.3
Halal foods and premises provide foods that are free from harmful substances.		
1	0	0
2	2	5.3
3	10	26.3
4	15	39.5
5	11	28.9
The Halal principle is a good practice in having a healthy diet.		
1	1	2.6
2	0	0
3	5	13.2
4	18	47.4
5	14	36.8
Halal foods and premises are good for humans, animals, and the environment.		
1	0	0
2	1	2.6
3	6	15.8
4	19	50
5	12	31.6
Part C: Perception of halal food and premises application		
Do you think a mobile application is useful to verify the Halal status of food products and food premises?		
1	2	5.3
2	2	5.3
3	8	21.1
4	12	31.6
5	14	36.8
Do you think an E-numbers search engine is helpful to identify the safety assessment of food additives?		
1	0	0
2	1	2.6
3	11	28.9
4	17	44.7
5	9	23.7
Would you prefer to check the Halal status of international food products?		
1	0	0
2	0	0
3	8	21.1
4	11	28.9
5	19	50

Table 5. Survey questions result (continue)

	Frequency	Percentage (%)
Do you find it helpful if it is featured with a barcode scanner to check the Halal status of food products?		
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
Do you think a proper platform to report Halal-related misconduct to authority is significant?		
1	0	0
2	4	10.5
3	9	23.7
4	10	26.3
5	15	39.5

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BIOGRAPHIES OF AUTHORS

Wong Xin Ying received a Bachelor of Computer Science (first class hons) from Universiti Sains Malaysia in 2021. She is majoring in software engineering and minoring in management. Currently, she is working as an IT engineer who is mainly responsible for data analytics in her company. Her interests are application development as well as data analysis. She can be contacted at email: xinying97@student.usm.my.

Zarul Fitri Zaaba was born in Kuala Lumpur, Malaysia in 1981. He received his BSc in Information Technology from the Universiti Utara Malaysia in 2003, MSc in Information Security from the Royal Holloway University of London in 2007, and Ph.D. from the University of Plymouth, the United Kingdom in 2014. He is currently a Senior Lecturer at the School of Computer Sciences, Universiti Sains Malaysia (USM). Prior to joining USM, he had worked for a few years with the government and semi-government sectors. He specializes in security management, web security, and the human aspects of security. He is also actively involved in science, technology, engineering & mathematics (STEM) education and is appointed as Master Trainer in computational thinking. He can be contacted at email: zarulfitri@usm.my.