Comparison between NFC/RFID and Bar Code Systems for Halal Tags Identification: Paired Sample T-Test Evaluation

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Abstract—**Malaysia is a modern Muslim country where the research on Halal product identification is at the peak. In this study, the authors have developed the mobile application which is based on Radio frequency identification near field communication RFID/NFC. The author first developed the database based on the data from Jabatan Kemajuan Islam Malaysia JAKIM, which is Malaysian Halal logo identification authority then the mobile application which uses the Near Field Communication to detect the Halal food using the Radio Frequency Identification. In this paper authors have performed the experimental analysis by comparing the Barcode system that is comprised of parallel line detected by the simple webcam for the Halal logo identification and the new developed RFID NFC mobile application. Paired sample T-Test was performed by using the SPSS 23.0 version. The results revealed that there is significantly difference between the usability, efficiency, affordability, security and satisfaction. The users are more satisfied with the newly developed mobile application as compared to old halal logo system in Malaysia.**

Keywords—Halal products; RFID/NFC; JAKIM; paired sample T-test; Malaysia

I. INTRODUCTION

Malaysia is modern Muslim country heading towards being a global Halal hub; it has been well-known as a successful halal-hub in the world since 1997. Halal is often used in reference to food and drinks, i.e. food that is allowable for Muslims to eat or drink under Islamic Shariah (law). Halal is an Islamic religious manual for how Muslims ought to experience their lives from the way their nourishment is set up to how their own and social connections are directed.

In Halal industry, keeping up halal item trustworthiness is a fundamental variable so it is necessary to present a complete and fitting Tracking and Tracing Technology to keep up halal item uprightness and build up an innovative structure that can bolster the whole Halal Product Supply Chain [1]. Information technology (IT) is supposed to be the best formula to be used to make the world a more helpful and viable place for individuals from a wide range of culture and religion. Nowadays, smart spaces and smartphones are going to lead the world of business.

Barcode system is made with the help of Matlab and they are very to detect through the webcam [2] "Near Field Communication (NFC) is short-range, low bandwidth, high frequency, and wireless communication technology built on radio frequency identification (RFID) technology" [3]. RFID refers to Radio Frequency Identification and is a term that portrays an arrangement of ID [4]. RFID depends on putting away and remotely recovering data or information as it comprises of RFID tag, RFID peruse and back-end Database [5].

The mobile RFID empowers business to give new administrations to portable clients by securing administrations and exchanges from the end-client to an organization's current online business and IT frameworks [6]. RFID innovation has been acknowledged as an execution differentiator for an assortment of business applications, yet its capacity is yet to be completely used. In future brilliant spaces, the client ought to have the capacity to utilize his own particular versatile reader gadgets to recognize the things, look for the following thing of intrigue, restrict and explore. Fig. 1 demonstrates how RFID technology works.
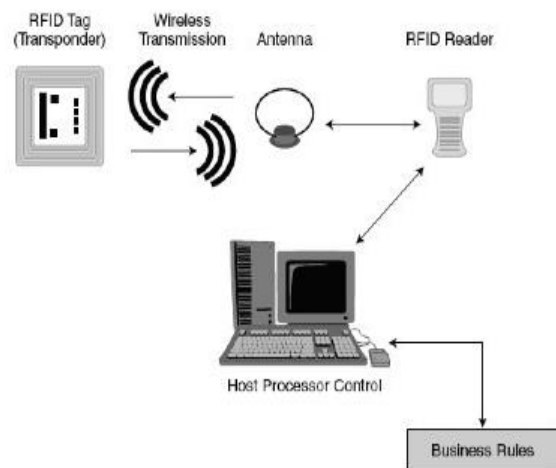

Fig. 1. RFID technology process.

II. BACKGROUND

At the 2007 world halal forum, Malaysia's former Prime Minister, Tun Abdullah Haji Ahmad Badawi stated the government's aim of establishing Malaysia as a global halal hub. Subsequently, a large number of studies were conducted in various disciplines to help pursue the goal of "Malaysia as a global halal hub" [7]. One of the controversial issues in the halal food industry is detecting fake halal products from genuine ones. Malaysian Muslim specialist on the halal item, Jabatan Kemajuan Islam Malaysia (JAKIM) has created and actualized the halal logo as the halal approval due to the demand of market broker organizations. To check the originality of halal products, customers could either browse JAKIM's website or call JAKIM's office via phone.

On the one hand, these methods are time-consuming but on the other hand, cases misrepresentation and abuse of the halal logo have progressively been accounted by purchasers [8]. To handle this issue now some researchers stated to do research on this and have implemented RFID technology while others have suggested using mobile or Smartphone gadget for validating halal products. In the Malaysian Halal industry, RFID innovation is viewed as undeveloped since standardized tags are regularly utilized as programmed identifiers regardless of the presence of web-based interfaces and cell phone applications [9]. However, Muslim consumers still face problems in validating halal products.

My MobiHalal 2.0 is a mobile-based support application for Muslims to identify the Halal status [10] so that users can send and receive MMS as answers to their queries instead of entering 13-character barcodes in the SMS. This study thus discusses the barcode conception and its functions in customer product industry.

Another study has implemented 2-D barcode halal logo detector to identify halal products and UV hologram to spot fake halal logo [11]. The scanned image is decoded and used to match a database. Prototype hardware as halal detector device has also been designed so that the customer can hold the product in front of it, then the status of the product will appear on the device screen.

Another study proposes a system that would help the consumer to validate halal products through Smartphone barcode captured straightaway on time with the applied halal product alert database system [12]. The system is called MyHalal designed to focus on a new database structure which details the company's information, Halal certificate expiry alert and new applications technique using Smartphone without accessing the network. The only operating system that customers need to have is a smartphone with a minimum Android 2.1.

Other researchers have implemented RFID technology to identify and validate halal status [13]. One study states that barcodes, reader and ingredient information by far are not adequate to validate the information claimed by the manufacturer or food producer; instead, a real-time tool is needed to feed users with genuine and validated information to assist user-buying process that is RFID technology. The perception of Malaysian customers was measured and the result indicates users agreed that a real-time system is required for the information dissemination [14].

It is imperative for specialists and makers to give redress data since buyers depend basically on item bundling, including the Halal logo, fixings and producers so as to approve Halal status [15].

III. EVALUATION

The important phase of any research is the evaluation process to determine the suitability or accuracy. The NFC enabled RFID mobile application was developed for the Halal logo recognition [16], [17]. The comparison between the Barcode system and the new RFID system was performed. To evaluate this research many qualifications attributed to this application were considered such as usability, efficiency, security, affordability and customer satisfaction. Usability referred to how easy the system interface is for the user and how easily a user can use the system [18]. The identification process might be quick for both using RFID and barcodes technology, but barcodes require special equipment and also more concentration on scanning process. The simplicity of use and inexpensive equipment in RFID identification technology increases the usability of this technology.

Efficiency can be defined as the lowest time by the system to perform the same job as compared to the old system [19]. Additionally, except for other technologies such as barcode reader which reads the codes from a printed reader, RFID does not need to read any pre-printed codes or signs. In order to identify products using barcode system, the reader must be clearly printed and without any damage to the reader. According to experience and studies, barcodes are easy to damage and sensitive to the environment. Moreover, the reader must be clean to obtain more effectiveness scan rates.

Furthermore, images for scanning the barcode, must be properly captured and need more concentration and focus on the capturing process which makes it less efficient. The RFID technology uses a wide range of radio frequency. Therefore, tags are easy to read by any customer and smartphone in any position. The third factor was very important for any system that is security [20], which referred to the process and methodologies to keep the personal data safe and secure [21]. The biggest issues in Halal product identification by consumers in Malaysia are misrepresentations of logos and product certificates. It is necessary to employ the technology which reduces fraudulent activities and increases the confidence of customers on shopping. The existing barcodes and logos are easy to reproduce and cheat the consumers. Therefore, Halal product identification methods, for example, online interface and SMS applications have been introduced to settle this issue. Using web portal has its own difficulties like consumers have to connect to the Internet and know how to search through the web portal. RFID technology offers a better security in product identification by using preregistered unique identification code for each product type. The tags are safe and protected against overwriting and altering the information which increases high security in the identification process.

The fourth factor which was evaluated was affordability it can be defined as "to bear the cost of without serious

inconvenience" [22]. Despite barcode reader which is fixed to each product, the RFID tags are reusable for any other products or the same product for a long time. Moreover, new NFC tags are inexpensive and easily available which makes them more affordable to use; also the application is free of cost for consumers. The fifth factor which was considered as very imperative is customer satisfaction. Customer satisfaction is at the core of human experience, reflecting our liking of an organization's business activities. High levels of customer satisfaction (with pleasurable experiences are strong predictors of customer retention, customer loyalty, and product repurchase. Customer satisfaction is an important factor to remain in business in this modern world of competition [23]. Customer satisfaction is also a major goal of process improvement plans. Quality characteristics which are described in the previous sections are essential elements for customer satisfaction for this application.

In this section the evaluation is compared with traditional product identification (barcode) with developed RFID. Moreover, the other evaluation characteristics to evaluate the respondents' concern in the questionnaires. Section 1 was comprised of personal behavior including the questions regarding sex, age, householder status, marital status, educational level, job status, income per month, shopping times and system awareness. Section 2 was comprised of 30 questions related to the usability, efficiency, security, affordability and customer satisfaction. It is challenging to compare traditional and developed identification technologies particularly barcodes to newly developed ones like RFID. One had wide testing in uncommercial condition and alternate had restricted business reputation

IV. METHODOLOGY

In this paper, author used the Statistics Package for Social Sciences SPSS 23.0 to perform the experimental analysis. Paired Sample T-test was performed to compare the results of the old system and new system. The self-administrative questionnaire was distributed at one of the well-known and very big shopping Mall of Kuala Lumpur. The authors distribute the questionnaire for the old system, the respondent fills them and then the authors explain the use of the new system and do the practise among the many peoples. Although it took a long time more than 3 months to self-collect the data but the data collection phase was successful. Total 300 questionnaires were distributed. 280 were received which is a good number. Out of 280, 30 were having missing data so the pair of 30 questions were removed and finally we have 250 respondent. The respondent demographic details are given in Table I.

For sex there were (n=139,55.6%) were female whereas (n=111,44.4%) were male. For age (n=109,43.6%) were between the range 31-40, followed by range 21to30 were (n=48,19.2%) after that (n=40,16.0%) were between 41to50. (n=28,11.2%) were above 50 and the lowest range were (n=25,10%) were less than 20.In the reply of Are you house holder (n=177,70.8%) were answered Yes whereas (n=73,29.2%) were answered NO. In response to marital status (n=128,51.2%) respond against married with children, followed by (n=65, 26.0%) were Single and (n=57, 22.85) were married without children.

TABLE I. DEMOGRAPHIC DETAILS OF THE RESPONDENT

Variable	Category	Frequency	Percentage (%)	Cumulative
Sex	Male	111	44.4	44.4
	Female	139	55.6	100.0
Age	Less than 20	25	10.0	10.0
	21 to 30	48	19.2	29.2
	31 to 40	109	43.6	72.8
	41 to 50	40	16.0	88.8
	Above 50	28	11.2	100.0
Are you a householder	yes	177	70.8	70.8
	No	73	29.2	100.0
Marital status	Single	65	26.0	26.0
	Married without children	57	22.8	48.8
	Married with children	128	51.2	100.0
Education	Less than High school	93	37.2	37.2
	Bachelor	132	52.8	90.0
	Master	20	8.0	98.0
	Doctoral	5	2.0	100.0
Job Status	Manager	20	8.0	8.0
	staff	30	12.0	20.0
	customer	200	80.0	100.0
Monthly Income (in Ringgit)	Under 2000 RM	74	29.6	29.6
	2000 t0 3000 RM	43	17.2	46.8
	3000 t0 4000 RM	38	15.2	62.0
	4000 t0 5000	37	14.8	76.8
	Above 5000 RM	58	23.2	100.0
How often you go for shopping	Once in a week	84	33.6	33.6
	Once in 2 weeks	67	26.8	60.4
	Once in 3 weeks	64	25.6	86.0
	Once in month	35	14.0	100.0
Did you aware of this System	No	250	100	100.0
	yes	0	.0	00

V. INSTRUMENT RELIABILITY

The reliability of items used in the questionnaire was conducted through the consistency test that is an evaluation of Cronbach's Alpha. If the value of Cronbach alpha is o.7 or above then there is a strong relationship between the items used in the questionnaire [24].

1) Reliability Test for New System (RFID)

The overall Cronbach's alpha reliability for the items in the questionnaire was revealed .936 (Table II). There were total thirty items in the questionnaire. The summary item statistics as in Table III for this construct showed the mean value of the items means was 4.945 as shown in Table III.

TABLE II.   RELIABILITY STATISTICS (RFID SYSTEM)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No. of Items
.936	.935	30

TABLE III.   SUMMARY ITEM STATISTICS (RFID SYSTEM)

	Mean	Min.	Max.	Range	Max./ Min.	Variance	No. of Items
Item Means	4.945	4.610	5.154	.543	1.118	.021	30
Item Variances	2.737	1.991	3.484	1.493	1.750	.109	30
Inter-Item Covariances	.896	-.157	2.476	2.633	-15.727	.290	30

Table IV shows individual Cronbach's alpha value for the constructs used for the questionnaire of new RFID/NFC device. There were 6 items in each construct and all having reliability > 0.7 which is considered as the acceptable [25], [26].

TABLE IV.   OVERALL RELIABILITY FOR THE RFID SYSTEM

Construct	No. of Items	Cronbach's Alpha	Reliability Result
Usability	6	0.915	Excellent
Efficiency	6	0.946	Excellent
Affordability	6	0.931	Excellent
Security	6	0.884	Good
Satisfaction	6	0.931	Excellent

2) Reliability Test for Old System (Bar Code)

The overall reliability statistics of the constructs (Table V) revealed .820 Cronbach's alpha reliability for all construct, which comprised thirty items. The summary item statistics for all construct showed the mean value of the items means was 2.895 as shown in Table VI.

TABLE V.   RELIABILITY STATISTICS (BARCODE SYSTEM)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No. of Items
.820	.820	30

TABLE VI.   SUMMARY ITEM STATISTICS (BARCODE SYSTEM)

	Mean	Min.	Max.	Range	Max. / Min.	Variance	No. of Items
Item Means	2.895	2.536	3.524	.988	1.390	.057	30
Item Variances	2.767	1.776	3.576	1.800	2.014	.255	30
Inter-Item Covariances	.364	-.287	2.744	3.030	-9.573	.499	30

Table VII shows the overall reliability of the questionnaire for old Barcode system. There were 6 items in each construct and all having reliability > 0.7 which is considered as acceptable.

TABLE VII.   OVERALL RELIABILITY OF OLD SYSTEM (BAR CODE)

Construct	No. of Items	Cronbach's Alpha	Reliability Result
Usability	6	0.814	Good
Efficiency	6	0.950	Excellent
Affordability	6	0.930	Excellent
Security	6	0.843	Good
Satisfaction	6	0.733	Acceptable

A. Descriptive Analysis New System (RFID System)

In order to perform the parametric test, such paired sample T-test which was performed to evaluate the mean difference data should be normalized [27], [1], therefore authors have performed the descriptive analysis before performing the T-test. This section presents descriptive statistics of survey for a new system that is RFID based system, descriptive analysis is mandatory to conduct in order to perform the paired sample T-test to see whether our data is normalized or not. The descriptive analysis for the new system as follows.

To measure the usability, efficiency, security affordability and customer satisfaction of RFID (NFC) system, the survey respondents were first asked to indicate their level of agreement with the usability of the new system on a seven-point Likert scale ranging from 1 (Strongly disagree) to 7 (Strongly agree). Six items survey instrument were used to measure this construct. The results of the respondents' ratings for each item of this construct are reported as follows. The data is normalized if the value of Skewness and Kurtosis fall between (less than $\pm$ 1) and the mean values should be more than Neutral value [27] i.e. 4 in this research. The mean scores for usability as shown in Table VIII was ranged between 4.99 (1.688) and 5.12(1.825),the mean values are above the neutral value (i-e 4) , that shows that the new system is easy to be used by the respondent, while data normality values i-e Skewness and Kurtosis found between the acceptable range (less than $\pm$ 1) The mean scores for efficiency as shown in Table IX was ranged between 4.95 (1.555) and 5.12(1.408), which indicates that users are satisfied with the efficiency of new system, however data normality values i.e. Skewness and Kurtosis found between the acceptable range (less than + 1). Furthermore, the mean scores values for affordability shown in Table X was ranged between 4.68 (1.609) and 4.91(1.562), while data normality values i.e. Skewness and Kurtosis found between the acceptable range (less than + 1), which indicates

that the new system can be afforded by the customers. The mean scores for security was ranged between 4.70 (1.669) and 5.11(1.594) as shown in Table XI, which indicates that users are satisfied with the security of the new system, furthermore, the data normality values i.e. Skewness and Kurtosis found between the acceptable range (less than + 1). The descriptive

analysis for the customer satisfaction was evaluated as mean scores ranged between 4.61 (1.724) and 5.12(1.555) as shown in Table XII, While data normality values i.e. Skewness and Kurtosis found between the acceptable range (less than $\pm$ 1), which shows the satisfaction of the customer with the new system.

TABLE VIII. DESCRIPTIVE STATISTICS OF MEASURED ITEMS OF USABILITY FOR RFID NFC SYSTEM NFC SYSTEM

	Mean Statistics	Std. Deviation Statistics	Variance Statistics	Skewness Statistics	Kurtosis Statistics
U1	5.01	1.864	3.474	-.858	-.346
U2	5.08	1.786	3.190	-.842	-.357
U3	5.12	1.825	3.332	-.820	-.406
U4	4.95	1.760	3.098	-.813	-.213
U5	5.08	1.688	2.850	-.772	-.328
U6	4.99	1.668	2.783	-.787	-.193

TABLE IX. DESCRIPTIVE STATISTICS OF MEASURED ITEMS OF EFFICIENCY FOR RFID NFC SYSTEM NFC SYSTEM

	Mean Statistics	Std. Deviation Statistics	Variance Statistics	Skewness Statistics	Kurtosis Statistics
EF1	4.98	1.603	2.570	-.705	-.335
EF2	5.00	1.627	2.647	-.750	-.275
EF3	4.95	1.555	2.419	-.675	-.248
EF4	4.96	1.561	2.436	-.693	-.256
EF5	5.02	1.557	2.425	-.676	-.312
EF6	5.15	1.408	1.983	-.642	-.420

TABLE X. DESCRIPTIVE STATISTICS OF MEASURED ITEMS OF AFFORDABILITY FOR RFID NFC SYSTEM

	Mean Statistics	Std. Deviation Statistics	Variance Statistics	Skewness Statistics	Kurtosis Statistics
AF1	4.72	1.713	2.935	-.675	-.514
AF2	4.91	1.562	2.441	-.745	-.096
AF3	4.72	1.687	2.846	-.517	-.676
AF4	4.80	1.751	3.067	-.614	-.708
AF5	4.81	1.683	2.834	-.526	-.706
AF6	4.68	1.609	2.590	-.408	-.727

TABLE XI. DESCRIPTIVE STATISTICS OF MEASURED ITEMS OF AFFORDABILITY FOR RFID NFC SYSTEM

	Mean Statistics	Mean Statistics	Std. Deviation Statistics	Variance Statistics	Skewness Statistics
SE1	5.11	1.594	2.541	-.733	-.245
SE2	5.01	1.532	2.347	-.721	-.099
SE3	4.70	1.669	2.784	-.522	-.657
SE4	5.03	1.574	2.479	-.684	-.285
SE5	5.03	1.585	2.511	-.800	-.081
SE6	4.95	1.695	2.872	-.774	-.313

TABLE XII. DESCRIPTIVE STATISTICS OF MEASURED ITEMS OF SATISFACTION FOR RFID NFC SYSTEM

	Mean Statistics	Std. Deviation Statistics	Variance Statistics	Skewness Statistics	Kurtosis Statistics
SAT1	5.12	1.555	2.418	-.708	-.318
SAT2	4.88	1.598	2.555	-.596	-.443
SAT3	5.02	1.629	2.653	-.558	-.646
SAT4	4.61	1.724	2.973	-.357	-.913
SAT5	4.96	1.782	3.176	-.723	-.562
SAT6	5.03	1.682	2.830	-.763	-.320

B. Descriptive Analysis for Old System (Bar Code)

This section presents descriptive statistics of survey for the old system that is Bar Code based system.

To measure the customer satisfaction towards the old system, the survey respondents were also asked to indicate their level of agreement with the usability, efficiency,

affordability, security and customer satisfaction on a seven-point Likert scale ranging from 1 (Strongly disagree) to 7 (Strongly agree). The same six items survey instrument was used to measure the construct that we used for the new system. The mean scores for the usability ranged between 2.85 (1.707) and 3.52(1.878) as shown in Table XIII, which indicates the means values lower than the neutral value (i.e. 4) it shows that

the old system is not that much user friendly and not easy to use while data normality values i.e. Skewness and Kurtosis found between the acceptable range (less than + 1).

The mean scores for the efficiency was ranged between 2.54 (1.333) and 2.61(1.554) as shown in Table XIV, which indicates the means values lower than the neutral value (i.e. 4) therefore the old system is not that much efficient to use. While data normality values i-e Skewness and Kurtosis found between the acceptable range (less than + 1). The Mean values for affordability was lower than the neutral value (i-e 4), that indicates that the old system is not affordable by the respondent. The mean scores ranged between 2.54 (1.333) and 2.61(1.554) as shown in Table XV, which indicates the means values lower than the neutral value (i.e. 4) while data normality

values i.e. Skewness and Kurtosis found between the acceptable range (less than + 1). Additionally, the mean scores ranged between 2.87 (1.693) and 3.02 (1.726) for the security construct, which indicates the means values lower than the neutral value (i.e. 4) it shows that the old system is not that much secure to use. While data normality values i.e. Skewness and Kurtosis found between the acceptable range (less than + 1) as shown in Table XVI.

The mean score for the customer satisfaction was ranged between 2.71 (1.483) and 3.41(1.891) as shown in Table XVII, which indicates the means values lower than the neutral value (i.e. 4) it shows that the old system is not that much secure to use while data normality values i.e. Skewness and Kurtosis found between the acceptable range that is (less than + 1).

TABLE XIII. DESCRIPTIVE STATISTICS OF MEASURED ITEMS OF USABILITY FOR OLD SYSTEM

	Mean Statistics	Std. Deviation Statistics	Variance Statistics	Skewness Statistics	Kurtosis Statistics
U1	2.85	1.707	2.914	.990	.010
U2	2.89	1.831	3.353	1.017	-.063
U3	2.81	1.519	2.308	1.001	.452
U4	3.07	1.657	2.746	.862	-.120
U5	2.95	1.806	3.262	1.006	.002
U6	3.52	1.878	3.528	.417	-.991

TABLE XIV. DESCRIPTIVE STATISTICS OF MEASURED ITEMS OF USABILITY FOR OLD SYSTEM

	Mean Statistics	Std. Deviation Statistics	Variance Statistics	Skewness Statistics	Kurtosis Statistics
EF1	2.61	1.554	2.415	1.035	.270
EF2	2.57	1.469	2.158	.961	.188
EF3	2.54	1.333	1.776	1.062	.576
EF4	2.56	1.455	2.118	.995	.320
EF5	2.57	1.469	2.158	.961	.188
EF6	2.54	1.333	1.776	1.062	.576

TABLE XV. DESCRIPTIVE STATISTICS OF MEASURED ITEMS OF USABILITY FOR OLD SYSTEM

	Mean Statistics	Std. Deviation Statistics	Variance Statistics	Skewness Statistics	Kurtosis Statistics
AF1	3.03	1.733	3.003	.856	-.123
AF2	2.84	1.796	3.225	.941	-.104
AF3	2.93	1.588	2.521	.944	.001
AF4	2.90	1.603	2.569	.801	-.137
AF5	2.98	1.728	2.987	.912	.001
AF6	2.97	1.781	3.172	.823	-.319

TABLE XVI. DESCRIPTIVE STATISTICS OF MEASURED ITEMS OF SECURITY FOR OLD SYSTEM

	Mean Statistics	Std,. Deviation Statistics	Variance Statistics	Skewness Statistics	Kurtosis Statistics
SE1	2.92	1.633	2.668	.938	-.004
SE2	2.87	1.693	2.867	.883	-.039
SE3	3.08	1.768	3.126	.801	-.484
SE4	2.98	1.826	3.333	.914	-.240
SE5	3.02	1.726	2.980	.896	-.186
SE6	3.20	1.741	3.031	.705	-.534

TABLE XVII. DESCRIPTIVE STATISTICS OF MEASURED ITEMS OF USABILITY FOR OLD SYSTEM

	Mean Statistics	Std. Deviation Statistics	Variance Statistics	Skewness Statistics	Kurtosis Statistics
SAT1	3.01	1.850	3.422	.902	-.274
SAT2	3.41	1.891	3.576	.501	-.928
SAT3	3.00	1.655	2.739	.820	.108
SAT4	2.75	1.658	2.749	.997	.307
SAT5	2.71	1.483	2.198	1.00	.539
SAT6	2.78	1.528	2.335	.866	.303

C. *Paired Sample T-Test*

Paired Sample T-Test can be performed when there is only one group of people and we need to collect data from them on two different occasions, and if there is sig(2 tailed) value less than 0.5 than there is significant difference between the two scores [27]. "A paired-samples T-test compares the mean of two matched groups of people or cases or compares the mean of a single group, examined at two different points in time. If the same group is tested again, on the same measure, the t-test is called a repeated measures t-test" [28]. In this section, we will perform the paired sample T-test between the average means of constructs obtain from the survey of new system data and the old system data. For this purpose, we compute the average means for all the constructs separately for the old system and new system and then we performed the Pair sample T-test between means of new system and Means of the old system as follows.

Paired sample T-test was performed between the usability construct of RFID (NFC) system and the old system. Table XVIII shows that total mean for RFID (NFC) system is 5.0373 whereas total mean for usability of the old system is 3.0147. Table XIX shows the result of paired sample T-test. The mean difference is computed as 2.0226 with standard deviation of 1.953, whereas the t statistics is 16.360, degree of freedom df is 249 with p-value that is sig(2-tailed) is .000, it means there is significant difference in the usability of new system and old system and the new system is more usable as compared to the old one t(249) = 16.369, p $\leqslant$ .05 as suggested by Julie Pallant (2011).

Paired sample T-test was also performed between the efficiency construct of RFID (NFC) system and the old system. Table XX shows that total mean for RFID (NFC) system is 5.010 whereas a total mean for usability of the old system is 2.564. Table XXI shows the result of paired sample T-test. The mean difference is computed as 2.446 with standard deviation of 1.834, whereas the t statistics is 21.080, degree of freedom df is 249 with p-value that is sig(2-tailed) is .000, it means there is significant difference in the efficiency of new system

and old system and the new system is more efficient as compared to the old one t(249) = 21.080, p $\leqslant$ .05.

Paired sample T-test between the efficiency construct of RFID (NFC) system and the old system was performed and Table XXII shows that total mean for RFID (NFC) system is 4.772 whereas total mean for affordability of old system is 2.942. Table XXIII shows the result of paired sample T-test. The difference between the mean of new system and old system was 1.8300 with standard deviation of 2.121, furthermore the t statistics is 13.637, degree of freedom df is 249 with p-value that is sig(2-tailed) is .000, it means there is significant difference in the affordability of new system and old system and the new system is more affordable as compared to the old one t(249) = 13.637, p $\leqslant$ .05.

Paired sample T-test was performed between the security construct of RFID (NFC) system and the old system. Table XXIV shows that total mean for RFID (NFC) system is 4.968 whereas total mean for the security of the old system is 3.012. Table XXV shows the result of paired sample T-test. The difference between the mean of new system and old system was 1.956 with standard deviation of 1.771, furthermore the t statistics is 17.462, degree of freedom df is 249 with p-value that is sig(2-tailed) is .000, it means there is significant difference in the security of new system and old system and the new system is more secure as compared to the old one t(249) = 17.462, p $\leqslant$ .05

Paired sample T-test was performed between the customer satisfaction construct of RFID (NFC) system and the old system. Table XXVI shows that total mean for RFID (NFC) system is 4.942 whereas total mean for the security of the old system is 2.942. Table XXVII shows the result of paired sample T-test. The difference between the mean of new system and old system was 2.000 with standard deviation of 1.633, furthermore the t statistics is 19.354, degree of freedom df is 249 with p-value that is sig(2-tailed) is .000, it means there is significant difference in the satisfaction level of new system and old system and the respondent are more satisfied with new system as compared to the old one t(249) = 19.354, p $\leqslant$ .05

TABLE XVIII. PAIRED SAMPLES STATISTICS (USABILITY)

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Usability new system	5.0373	250	1.47905	.09354
	Usability old system	3.0147	250	1.25026	.07907

TABLE XIX. PAIRED SAMPLES TEST (USABILITY)

		Paired Differences						df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Usability new system – usability old system	2.02267	1.95382	.12357	1.77929	2.26604	16.369	249	.000

TABLE XX. PAIRED SAMPLES STATISTICS (EFFICIENCY)

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Efficiency new system	5.0102	250	1.37775	.08714
	Efficiency old system	2.5640	250	1.28611	.08134

TABLE XXI. PAIRED SAMPLES TEST (EFFICIENCY)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Efficiency new system - Efficiency old system	2.44621	1.83484	.11605	2.21765	2.67476	21.080	249	.000

TABLE XXII. PAIRED SAMPLES STATISTICS (AFFORDABILITY)

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Affordability new system	4.7727	250	1.43530	.09078
	Affordability old system	2.9427	250	1.46833	.09287

TABLE XXIII. PAIRED SAMPLES TEST (AFFORDABILITY)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Affordability new system - Affordability old system	1.83007	2.12191	.13420	1.56576	2.09439	13.637	249	.000

TABLE XXIV. PAIRED SAMPLES STATISTICS(SECURITY)

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Security new system	4.9689	250	1.27688	.08076
	Security old system	3.0127	250	1.29658	.08200

TABLE XXV. PAIRED SAMPLES TEST (SECURITY)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Security new system - Security old system	1.95619	1.77126	.11202	1.73555	2.17683	17.462	249	.000

TABLE XXVI. PAIRED SAMPLES STATISTICS(SATISFACTION)

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Satisfaction new system	4.9427	250	1.18880	.07519
	Satisfaction old system	2.9427	250	1.10213	.06970

TABLE XXVII. PAIRED SAMPLES TEST (SATISFACTION)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Satisfaction new system - Satisfaction old system	2.00000	1.63395	.10334	1.79647	2.20353	19.354	249	.000

VI. Conclusion

In this paper, the evaluation of the proposed system has been performed. Results were demonstrated to compare the proposed system with the old systems which are described in the state of art section in the literature review. According to the results, the proposed system using RFID (NFC) technology for Halal food identification gained better satisfaction among all customers in any quality characteristics as compared to old Bar Code system. The usability, efficiency, security, affordability and customer satisfaction characteristics have been qualified for evaluation purpose. Moreover, the other characteristics of respondents have been evaluated to demonstrate the better results in using the RFID system for Halal food. This system will be beneficial from the commercial point of view as well as the customer point of view, as it is easy to use, efficient, and affordable. Secure and gain the customer satisfaction.

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