m-Naslada: A mobile application for black pepper crop disease information

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Abstract This paper presented a mobile application to be used for agricultural advancement. The criteria needed for the development of a mobile application are described. A mobile application known as m-Naslada was also proposed and highlighted. m-Naslada is a mobile application prototype developed for agricultural purposes. m-Naslada is specifically aimed at providing information concerning black pepper crop diseases. m-Naslada is expected to effectively support black pepper crop farmers by meeting their requirements and providing necessary information in relation to diseases that may affect their crops. Feedback received from the evaluation conducted towards m-Naslada was positive. The work projected herein might be used as a baseline to aid in the continuation of various research scopes within the agricultural sector.

Keywords: Agriculture; Mobile Applications; Mobility; Simplicity

1. Introduction
Agriculture practitioners, especially farmers are often confronted with the issue of obtaining agricultural information and advice rapidly from agriculture extension officers. A study conducted amongst black pepper farmers in 2013 revealed that 40% of respondents had the opportunity to meet with their agriculture extension officers at least once in one (1) year. Additionally, 36% respondents are able to gain agricultural information from agriculture extension officers at least once a year, while 17% respondents never had the opportunity to obtain advice from agriculture extension officers [1]. This situation occurs due to inadequate human resources and leads to inefficient crop management.
Rapid access to all possible information is required to help farmers manage their crops effectively [2].

Electronic agriculture (e-Agriculture) is among the information and communication technology (ICT) that was introduced to provide better services to agricultural practitioners [3], e-Agriculture is defined as a particular domain which gives focal attention to agricultural and rural area development by means of improving information and communication accessibility. e-Agriculture can be referred to as an intersection of agricultural informatics, agricultural development, and entrepreneurship delivered or enhanced via the Internet and other applicable technology [4]. e-Agriculture is a systematic propagation of ICT in agriculture and is proficient in maximising ICT as an instrument to exploit and sustain agricultural quality and quantity [4]. e-Agriculture provides agricultural services in addition to the dissemination of information and presentation of technology through the usage of computers, Internet, or other associated devices or gadgets [4, 5].

Introduction to mobile agriculture (m-Agriculture) began in 2010 parallel to the vast evolution of mobile technology [6, 7]. m-Agriculture is an expansion of e-Agriculture where the concept is piloted at embracing agriculture-related services through mobile technology [5]. The rudiments behind m-Agriculture is to provide support and improve information accessibility services for agricultural extension as well as increase awareness and knowledge among agricultural practitioners on the available ways to obtain agricultural information [5, 8]. The following are several advantages of m-Agriculture [9, 10]:

i. to provide agricultural information,
ii. to improve accessibility to financial services,
iii. to improve data visibility for supply chain efficiency, and
iv. to provide marketing information.

Mobile applications (m-apps) have thrived rapidly in the global mobile market [10]. m-apps specific to the agricultural sector are expected to be beneficial especially to agricultural practitioners in terms of retrieving related agricultural information. Hence, m-apps are considered part of m-Agriculture.

In a preliminary study conducted in Malaysia, farmers cultivating black pepper crops remain confronted with the lack of access to agricultural information due to limitations in the number of agriculture extension officers and domain experts [1]. This example among others translate to the urgent need to put forth and pursue matters linked to accessing agricultural information where substantial work has yet to be established.

Considering the ample benefits anticipated for m-apps particularly in terms of agricultural development, this paper attempts to propose an m-app known as m-Naslada. m-Naslada functions to provide agricultural information exclusively for farmers cultivating black pepper crops. The background and criteria for developing an m-app will be elaborated on the following section, together with the user evaluation carried out on m-Naslada.

2. General Review
The development of m-apps was pioneered in 1988 through a mobile phone known as Candy bar. m-apps during this era were quite basic in their configuration due to constraints in the ability of available mobile devices, for instance lack in user interface and data servicing issues. Wireless application protocol (WAP) was then introduced in 1998 to support wireless markup language (WML). This language is a subset of hypertext markup language (HTML). Subsequently, m-apps’ development became fairly complicated because the main focus of WAP was to access websites through mobile devices. In 2002, m-apps’ development purportedly intensified due to the rise of smartphones. Nonetheless, smartphone capability back then was restricted because mobile developers merely focused on messaging and personal information management. The touch screen feature was later added into smartphones in 2009, paving the way for mobile developers to expand their competency and develop more m-apps [11, 12].

An m-app is defined as ‘a software program developed for small low-powered handheld devices such as mobile phones and tablets’ [6, 13]. m-apps can either be pre-installed during manufacture or
downloaded from application stores and other mobile distribution platforms [6, 13]. Table 1 shows three (3) strategies used in the development of m-apps [14-16].

m-apps for agriculture can be divided into nine (9) categories namely agriculture information apps, business apps, conference apps, disease and pests apps, farm management apps, learning and reference apps, location-based apps, market data apps, and weather apps [7]. Existing examples of m-apps for the agricultural sector include Yara CheckIT, Pesticide Recordkeeping (PeRK), Soybean Diseases, Plant Doctor and Cereal Disease ID Application [7, 17, 18].

| Strategy    | Description                                                                 |
|-------------|-----------------------------------------------------------------------------|
| Native app  | • Requires a specific design for each specific operating system.             |
|             | • Mobile application can be downloaded and installed into a mobile device   |
|             |   directly.                                                                 |
|             | • Provides full accessibility, high performance and high interactivity.      |
|             | • Requires a user to download the m-app and update to the latest version    |
|             |   manually.                                                                 |
| Web app     | • Is not a real application; instead it is a website.                        |
|             | • Requires the use of a browser.                                            |
|             | • Commonly written in HTML5, CSS and JavaScript.                            |
|             | • Uses web technology and is not limited to the underlying platform.        |
|             | • Can be run and supports the distribution of Web apps.                     |
| Hybrid app  | • Combines both native and web strategies.                                  |
|             | • Allows cross-platform development.                                        |
|             | • Can be reused on different mobile OS.                                     |
|             | • Reduces development cost.                                                 |

3. Criteria for Development of Mobile Applications

Much effort has been made by local governments in subsidising the development of ICT infrastructure in rural areas as reported in the literature. However, implementation of these ICT infrastructure are usually concentrated at public venues like libraries or community centres [19]. This warrants farmers into believing that ICT technology is not compatible for them as undermined by their persistent working hours at planting sites [20].

Criteria such as compatibility and mobility are deemed important during the designing of a mobile application. Compatibility may determine if users will adopt a mobile application or otherwise. It is a factor which postulates that an innovation must be consistent with potential users’ existing values, experiences, and needs [21].

Mobility is the ability to use technology to access information while having the liberty to move without the usage of any cable, or by using any mobile devices [22]. This permits users to accomplish various computing activities anytime and anywhere [22, 23]. Mobility is defined as the degree to which an individual believes in receiving benefits based on time and place, service and usage [24].

4. m-Naslada Overview

m-Naslada is a mobile application proposed as a platform providing information related to black pepper crop diseases. m-Naslada can thus be categorised under the disease and pest apps’ category. The compatibility and mobility criteria for m-Naslada were developed according to requirements for native apps instead of Web apps. As such, internet access is not required when accessing content in m-Naslada.

To fulfil the simplicity criterion, the design for m-Naslada’s user interface was made to be small and light to suit mobile devices. Less complex features were applied to m-Naslada’s user interface.
where it only narrates the presentation of information along with features for performing tasks. The m-app’s aesthetic value was also taken into account during m-Naslada’s development process.

m-Naslada was intended to be developed as an Android operating system (OS). This was instigated by the notion that mobile phones using Android OS have the highest level of ownership compared to mobiles using other OS like iOS (Apple), Windows (Microsoft), RIM Bada and Symbian [28]. In addition, Android OS offers a platform for the development of native mobile applications.

The Eclipse platform was used in the development of m-Naslada because the platform is an open-source software suitable for developing m-apps for Android OS [29, 30]. Additionally, Java, XML and HTML programming languages were used in the coding activity of m-Naslada. The hardware specification employed consisted of a notebook with Intel (R) Core™ i7 processor. Windows 7 Home Premium with 64-bit system was used as the OS to develop m-Naslada.

m-Naslada is comprised of five modules known as Taxonomy, Variety, Disease Information, Disease Diagnosis and Directory (Table 2). Fig. 1 shows the flowchart for m-Naslada. Fig. 2 depicts an actual screenshot of m-Naslada’s main menu.

| Module                  | Description                                                                 |
|-------------------------|-----------------------------------------------------------------------------|
| Taxonomy (Taksonomi)    | Contains basic information on black pepper crops.                           |
| Variety (Varieti)       | Contains information on three varieties of black pepper crops.              |
| Disease Information     | Shows information such as disease status, symptoms and control for a specific disease. Information provided can be used as guideline for controlling diseases. |
| Disease Diagnosis       | Provides user with the ability to diagnose diseases based on symptoms.       |
| Directory (Direktori)   | Contains information of agencies involved with black pepper crop cultivations as well as the mobile application developers. |

Figure 1. Overall flowchart of m-Naslada
5. m-Naslada Evaluation
Compatibility, mobility and simplicity were emphasised on during the evaluation phase of m-Naslada. Questionnaires were constructed and prepared for data collection. A five point Likert Scale (1=strongly disagree to 5=strongly agree) was adopted to indicate the level of agreement based on the three aforementioned criteria. The evaluation was carried out among actual black pepper crop farmers. For the evaluation, m-Naslada was pre-installed into a smartphone since it was still at the prototype stage.

Before initiating the evaluation, a brief overview of m-Naslada was explained to target respondents. The appropriate use of m-Naslada was also demonstrated. Respondents were then given a chance to use m-Naslada. Finally, respondents were requested to answer the evaluation questions relevant to the three (3) criteria via the use of questionnaires. The descriptive analysis method was used to analyse data obtained from the evaluations.

6. Results and Discussion
The evaluations of m-Naslada transpired within the month of December 2014. Thirty (30) individual respondents comprising of local farmers (11 males, 19 females) from the Asap-Koyan Resettlement Area, Belaga in the state of Sarawak, Malaysia had voluntarily participated in this evaluation. Farmers who took part in the evaluation were ascertained of their active involvement in the cultivation of black pepper crops. Moreover, 70 percent of these respondents had more than four (4) years of cultivation experience of the crop.

Table 3 shows the results obtained from evaluation on the three criteria: (1) compatibility, (2) mobility and (3) simplicity. The mobility criterion for m-Naslada achieved the highest score compared to the other two criteria. The mean score for the mobility criterion was found to range from 4.40 to 4.07. This result indicated that the native app strategy was suitable for integration when developing the m-apps where it is mainly used to overcome issues of internet access and ICT infrastructure amongst farmers.

Meanwhile, the mean score for compatibility criterion was found to range from 3.60 to 3.90. The lowest score for the compatibility criterion was attained for question SER2 which is related to the
compatibility of conducting early diagnosis on crop diseases. In view of this finding, the Disease Diagnosis module is recommended for improvements in potential further works.

The simplicity criterion achieved the lowest score in comparison to other criteria. The mean scores for questions SED1, SED2 and SED3 were found to be 3.97, 3.77 and 3.27, respectively. These results indicated that the simplicity criterion should be given the utmost priority for improvements to m-Naslada.

Table 3. Results of m-Naslada evaluation

| Criterion | Question                                                                 | Mean  | S.D. |
|-----------|--------------------------------------------------------------------------|-------|------|
| Compatibility | I intend to use m-Naslada if it is compatible with my way of gaining information on crop diseases. | 3.90  | 1.06 |
| SER2 | it is compatible with my way of doing early diagnosis on crop diseases. | 3.60  | 0.77 |
| SER3 | it is compatible with my way of gaining information on disease treatment procedures. | 3.87  | 0.90 |
| Mobility | it can be used in any location. | 4.40  | 0.67 |
| MOB2 | it can be used any time. | 4.20  | 0.71 |
| MOB3 | it can save time used to gain advice. | 4.07  | 0.78 |
| Simplicity | the user interface is well organised. | 3.97  | 1.09 |
| SED2 | the user interface is simple. | 3.77  | 0.90 |
| SED3 | the user interface design is pleasant. | 3.27  | 1.11 |

*S.D. Standard Deviation

The overall average mean score for all criteria was found to be 3.89 (S.D.= 0.89). This result signified that m-Naslada had a positive perception emanating from these three criteria. Then again, improvements on compatibility and simplicity criteria were of notable concern and should dully be considered for rectification in future works.

7. Conclusion

The m-Naslada had in principle provided black pepper crop farmers with the opportunity to gain disease information concerning their crops boundless to time and locality (anytime and anywhere). m-Naslada was developed using the native type strategy that seeks to resolve internet access and ICT infrastructure issues. An evaluation on the access criteria of compatibility, simplicity and mobility for m-Naslada was initiated based on users’ perspective. From the evaluation findings, the compatibility and simplicity criteria were suggested for enhancement in order to make m-Naslada more intriguing for users to adopt. Overall, m-Naslada was developed in motivation to diversifying the benefits of mobile technology to support development in the agricultural sector.

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