

Smartphone App For Disease Identification And Its Management For Maize Crop Targeting Rural Women In Nilphamari District Of Bangladesh.

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ABSTRACT: Mobile phone have become a useful tool in agriculture because of the portability, cost effective and visual interface. Android based smartphone is an essential part of the people's entertainment and daily life. Several application of smartphone makes people life more easy and affordable. A Most popular smartphone application is games followed by listening music, watching videos, communicating with social media, exploring photos, taking a selfie etc. Mobile apps also become popular than the desktop computer based software. The mobile phone is used for different purpose activities from simple communication to video conferencing, from play games to the utilization of apps for day to day life. Since mobile network reaches to every corner in Bangladesh, it is now potential time to use the mobile phone for providing need based information to the farming communities for their benefit. The research area had selected Nilphamari district of Bangladesh and we developed crop management and disease identification app for maize because maize is one of the common crops in that region of the country. This paper mainly discussed in two sections; 1. the application interface in local (Bengali) language with multimodal function; text, voice with local language, and images; 2. Feedback from the users about the app.

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I. INTRODUCTION

The android operating system is becoming more and more popular in the current communication era especially in the smartphone environment. Most popular smartphone application is games followed by listening music, watching videos, communicating with social media, exploring photos, taking selfie, etc. (M. Butler, 2011). Mobile apps also become popular than the desktop computer based software. And multimodal conversation becomes daily activities for mobile phone users. These advances have extended the initial application domains of conversational interfaces to complex information retrieval and question answering applications (Metze et al., 2014), e-commerce systems (Tsai, 2005), surveys applications (Stent et al., 2006), in-car systems (Hofmann et al., 2014), remote control of devices and robots in smart environments (Minker et al., 2010), e-learning and tutoring systems (Kopp et al., 2012), communication within vehicles (Misu et al., 2015), Ambient Assisted Living systems (Bickmore et al., 2010), recommendation systems (Reschke et al., 2013), or virtual companions (Horchak et al., 2014). Griol et al. (2016) proposed two techniques for developing conversational agents using well-known standards and operative systems, VoiceXML or Android and found Android is the best solution.

After critically analyze from the above statistics from World Bank Report (2017), it can easily be remarked the usability and availability of mobile communication to the mass people in South Asian region. Traditional crop varieties and cultivation practices have been sufficient to feed the population from the expansion. With the blast of population increase, the extend of land utilization expanded and after few centuries, now we have run out of free lands to expand our cultivation on them. Timely supply of crop and location specific information is a must to recommend appropriate and precise management, where mobile app can come

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as a savior. The Government of Bangladesh is (GOB) passed the ICT policy in 2009 updated as ICT policy 2015 and aims to build digital Bangladesh, an ICT driven nation comprising knowledge-based society by the year 2021. The GOB also passed set 7th five year plan in 2015 for FY2016-2020 toknowledge into economy (GED 2015). Crop specific mobile apps can ensure desired information supply to the farmer to take actions against the encountered problem. Technology is not a fancy thing now a days. Almost everybody owns a smartphone running on Android OS. It is found Nilphamari (Northern district of Bangladesh) suitable area for providing benefit to the farming communities by developing an mobile app. We choose the diseases identification and its' management of Maize crop as Maize is the 3rd most common of that area and rising crop in Bangladesh.

II. METHOD

The research work was conducted at the department of Computer Science and Information Technology in Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur and the selected study area was at Dakshin Kharibari, Dimla, Nilphamari district, Bangladesh from June 2015 to November 2016. The research had conducted a survey among 46 respondents for beta testing and compatibility analysis. According to the study, we have found that out of 46 respondents, 26 were female and 20 other were male. The main research instruments were i) Primary Information of Principle Respondent ii) Experience of mobile app usage.

III. RESULT AND DISCUSSION

The mobile phone uses and users in South Asian counties increasing very fast. According to the world bank report (2017), the subscription of mobile cellular increased from 0 per 100 people in 1969 to 78 per 100 people in 2015. BuddeComm (2016) published their report for 2016 on mobile communication in title of the report "Mobile subscriber growth in Bangladesh continues" stated that the mobile subscriber growth rate in Bangladesh has been strong between 2011 and 2016. The report also found, the mobile market penetration increased from 55% in 2011 to 80% in 2014, 84% in 2015 and 87% in 2016. From the same report it was found that the mobile subscription rate is increasing in Bangladesh and International voice traffic minutes per person through mobile phones dramatically increased to 236 per 100 people (stated in fig 1).

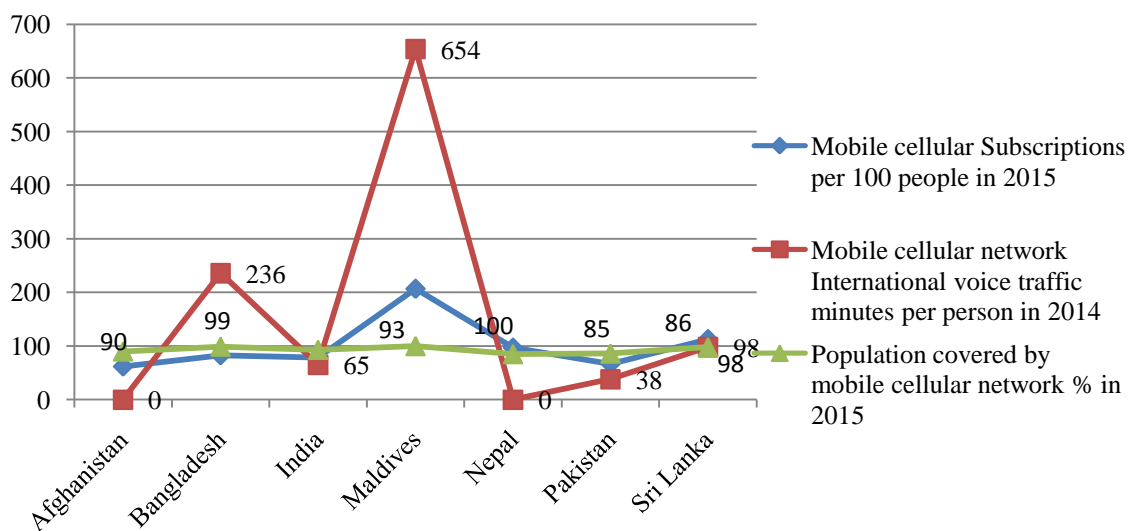


Fig 1: Development flow of mobile subscribers and it network cover over population

User interface and user experience

The visual architecture of the app was aiming at letting farmers detect the crop diseases in a user friendly systematic manner. The detection system was guided through visual aid comprising identical image of original plant growth stage, plant parts and disease symptom. For classification of maize growth stages, we have divided the growth stage into four class (CIMMYT, 2015) viz. 1. Seedling Growth Stage, 2. Vegetative Growth Stage, 3. Flowering and fertilization Stage, and 4. Grain filling and maturity Stage. We later used representative real photo of the plant growth stages as text classification may not be understandable for the farmers. Fig. 2 shows the representative plant parts of the different growth stages in the app. After growth stage selection, there comes the choice of navigating the exact location of infestation in the plant. Disease and insect infestation type varies based on the growth stage and part of the plant. For better detection, we have divided the plant diagram

into three parts, viz. upper part consisting young leaf, and cob during later stages, middle part where mature leaf, stem, and tassel during flowering stage, and lower part which consists of root and part of the stem in touch of the soil. Fig. 2 illustrates the plant parts in the application which are used for selection of the disease.



Fig. 2: Selecting plant growth stage and plant part from the app for better filtering of the diseases

The later step involves display of probable disease symptoms for this part of the plant at the selected growth stage of maize plant. Fig. 2 shows the probable disease symptoms of a maize plant in the upper part of the plant can occur during the maturity stage of the plant. This collection consists of both disease and pest infestations altogether, so that the farmers can easily select the disease properly visually. The thumbnail collection helps the farmer visually identify the disease which matches the symptom he observed on the field.

ভুট্টা গাছের রোগ বালাই এর লক্ষণ



Fig.3: Probable disease symptoms for maize plant

কীটনাশকের ছবি



Fig. 4: Preview of the solution of a disease in

at upper part during its maturity growth stage the app

Following the development of the app, user experience was evaluated by surveying among 46 respondents. Among the 46 respondents, everybody had smartphone, and 42 of them were using android based smartphone, 3 users using windows phone and one using iPhone. The study consisted on analyzing different aspect of use of the app, and the response of the farmers were very positive towards to problem solving of maize crop using this on their smartphones. Table 1 contains the information regarding the farmers response on their experience of using the app.

Table 1. User usability, experience and effectiveness of the app while using the on their smartphone

Operating System	Successfully Run		Found Suitable Disease		How Effective		Total
	Yes	No	Yes	No	Very Effective	Effective	
Android	24	18	40	2	20	22	42
iOS	0	1	1	0	1	0	1
Windows	0	3	3	0	1	2	3
Total	24	22	44	2	22	24	46

According to the study, 4 respondents didn't have smartphone run on Android OS, and among the other users, among the other respondents, 4 of them were using smartphone other than android, and all of them were female. As our app is compatible with android OS, they were not able to install our app on their phone. Among the other respondents having android OS phones, everybody were able to install our app, however 15 of them could not run the app on their phone. Later we have investigated the issue and found that their Android version was Jelly Bean or older, which was very old to run the app. Hence, we have noted the finding as a bug to conduct improvement operation.

In case of studying the suitability of the app among its respondents, it is encouraging that 44 respondents out of the 46 respondents opined positively. All the iOS and Windows OS phone users, and 44 Android smartphone users found the app suitable for solving their maize disease related problems.

The feedback on the effectiveness of the app for the farmers were very much satisfactory, as nobody mentioned the app as ineffective. According to Table 1, 22 respondents reported it as effective, while other 24 respondent reported it as very much effective.

Mobile app for problem solving

On the other hand in case of using smartphone apps for problem solving on other issues, both male and female respondents were reluctant to this practice, though the number was higher for female than male. However, according to fig. 5, the number of male respondents use smartphone app for problem solving than female was higher in this study.

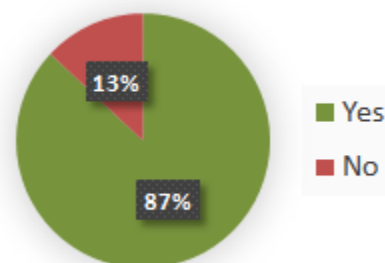
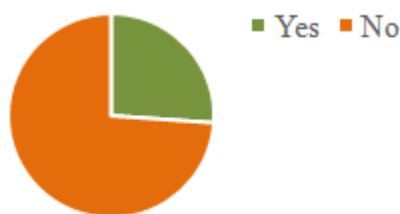


Fig. 5: Problem solving practice through mobile apps Fig. 6: Respondent's ability to navigate through the options of the app

User experience of navigation through app

The respondents were however comfortable using the app. According to the illustration in fig. 6, 87% of them were able to navigate through the different filtering options to get the solution of a disease. Among them female responds were having more trouble navigating, that means women need extra training for adopting this kind of mobile app.

Suitability of using the app

Respondents found the app very handy to browse through the option, check different parameters and extract results. From the Table 2, it is evident that, among the whole respondents, almost 96% of them were able to navigate through the different selection criteria to find the solution of a maize disease. Rest 4% were having issues navigating through the options, though few of them mentioned their lack of understanding the criteria as they are not maize crop grower.

Table 2: Users able to find solution of disease through app

Response	No. of respondent	Percentage
Yes	44	95.7
No	2	4.3
Total	46	100.0

So it indicates the suitability of usage for the maize crop growers.

Understanding disease solutions through app

As it was for the case of navigation, respondents were also able to find solution of the disease they were looking for and number was similar the successful user to navigate properly (fig. 7).

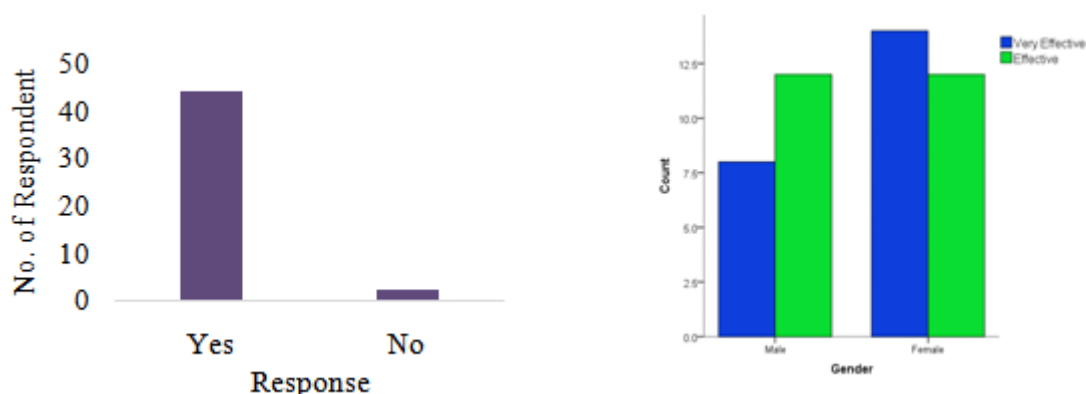


Fig. 7: Illustration of the understandability Fig. 8: Effectiveness response regarding the app

Respondents were quite able to understand the solution mentioned in the app against each disease. Only a few respondent had hard time understanding, though majority found the solutions quite easy to understand.

Effectiveness of the app

The feedback on the effectiveness of the app for the farmers were very much satisfactory, as nobody mentioned the app as ineffective. According to fig. 8, around 52% respondents reported it as effective, while other 48% respondent reported it as very much effective.

Suitability to find solution to diseases

In regard of the suitability of the app for the farmers, it was a fantastic record as everybody reported the app is very much applicable to the farmers for getting the solution of the problems they encounter in their field. The richness of the collection of the disease and corresponding solution was not covering all the possible diseases, and respondents opined accordingly.

Table 3: Suitability of the app to find disease solutions

Response	No. of respondent	Percentage
Yes	40	87
No	6	13
Total	46	100

As it had most of the commonly encountered disease, that is why 87% of the total respondents mentioned the collection as sufficient to find solution of diseases (Table 3). The rest 13% respondent however wanted to have all the disease information and reported alike.

IV. CONCLUSION

The 3rd most common crop of the Northern part of Bangladesh is Maize and also rising crop in the country. The interface of the developed mobile app in Bengali language found very user friendly and understanding by the end users. The app focused on disease identification and its management. It included text, image and voice with local accent. The result of the study found most suitable (87%) app for the farming communities of Maize cultivation. The total 52% respondents reported it as effective, while other 48% respondent reported it as very much effective.

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