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Ma-Ease: An Android-Based Technology for Corn Production and Management

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ABSTRACT

Corn production is second to rice as the most important agricultural product in the country. Thus, proper information, management, and technology dissemination in corn farming are greatly needed for a good harvest. The study aims to develop a mobile application to comprehensively address the needs of corn farmers thru dissemination of proper information, management, and techniques through the cooperation of the City Agriculture Office (CAO) of Malaybalay City, Bukidnon, Philippines. It is anchored on the Unified Theory of Acceptance and the Use of Technology (UTAUT) Model, where there are core and direct determinants of user reception and usage behavior, as well as moderating factors on user's acceptance on mobile services and applications especially in the area of agriculture. The researchers use the method of "Modified Waterfall Model" or MWF Model as the process model for the development of Ma-Ease Application. The sequential structure of this approach ensures that all requirements are achieved before moving onto the next step and no important steps are left out in the development process. A presentation was conducted with the CAO Malaybalay officials and local corn farmers to introduce our technological solutions in the corn production like local and up-to-date weather updates, proper nutrient inputs and corn farming activities, efficient cost management, and control of corn pests and diseases. Effectivity tests were done during their actual interaction and engagement with the finished product and finding shows that the Ma-Ease mobile app

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has a grand mean of 4.175 for its acceptability and satisfaction rate which covers the area of functionality, reliability, usability, maintainability, efficiency and user interface. Thus, the software product was formally accepted and recommended for use and deployment by the Department of Agriculture (DA).

Keywords: Corn farming mobile application, corn farming software solution, corn management, corn production, ICT in agriculture, ICT in corn farming, technofarm, technology in corn farming

INTRODUCTION

Over the years, corn farming has been a significant source of income and food among Filipinos. Corn still remains as the most popular agricultural commodity produced by farmers within the province as a majority of the agricultural lands in the province of Bukidnon is devoted to corn especially in Malaybalay City. In fact, according to the Department of Agriculture, corn is the second most important crop in the country and about 14 million Filipinos prefer white corn staple and corn accounts for about 50% of livestock mixed feeds. Furthermore, according to Philippine Statistic Authority in "Rice and Corn Situation and Outlook Report, April 2018" (Philippine Statistics Authority, 2018) which is shown in Figure 1, the corn output of the Philippines from January to March 2018 was 2.48 million metric tons which was 4.66% higher than the 2.37 million metric tons recorded in the year 2017. The harvest area has expanded from 695.74 thousand hectares to 722.46 thousand hectares or equivalent to 3.85% increase. The yield per share has also increased from 3.40 metric tons to 3.43 metric tons, an increase by 0.79%. Table 1 also shows that the increments in these corn outputs were noted in Cagayan Valley with 2.61%,

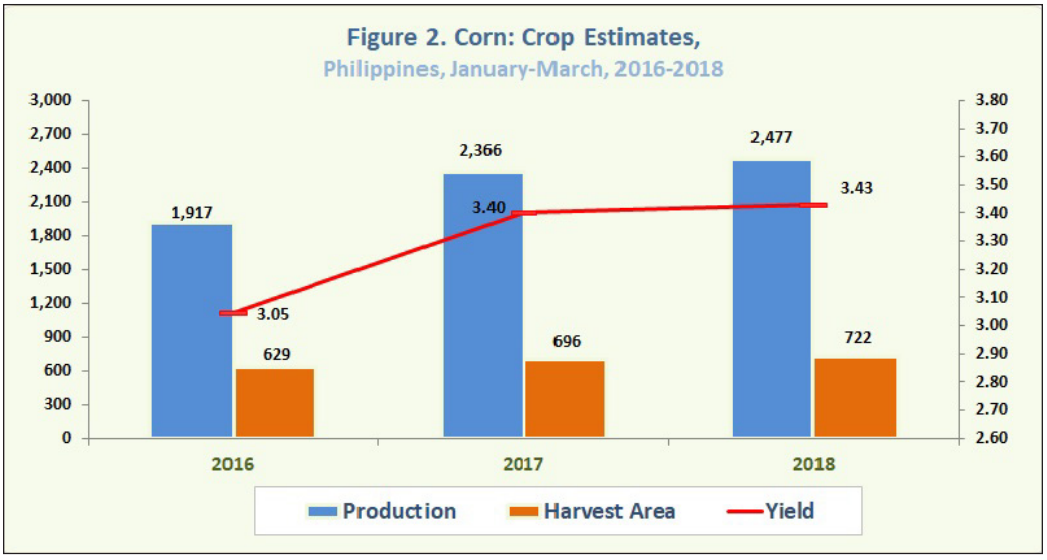

Figure 1. Corn: Crop estimates, Philippines, January-March, 2016-2018

Table 1
Corn: Crop estimates by region, Philippines, January-March, 2016-2018

Item	January-March							Percent share	% Point Contrib'n
	2016	2017	2018	2018/2017		2107/2016			
				Level	%	Level	%		
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*
PRODUCTION (MT)									
PHILIPPINES	**1,916,945**	**2,366,294**	**2,476,573**	**110,280**	**4.66**	**449,349**	**23.44**	**100.00**	**4.66**
CAR	68,719	73,185	64,900	(8,285)	(11.32)	4,466	6.50	2.62	(0.35)
Ilocos	315,992	380,415	385,287	4,872	1.28	64,423	20.39	15.56	0.21
Cagayan Valley	579,901	559,869	621,714	61,846	11.05	(20,033)	(3.45)	25.10	2.61
Central Luzon	111,607	112,240	124,654	12,414	11.06	633	0.57	5.03	0.52
CALABARZON	20,987	20,499	23,851	3,352	16.35	(488)	(2.33)	0.96	0.14
MIMAROPA	52,216	48,447	57,109	8,662	17.88	(3,769)	(7.22)	2.31	0.37
Bicol	55,225	63,114	63,847	733	1.16	7,889	14.29	2.58	0.03
Western Visayas	69,932	89,704	84,984	(4,720)	(5.26)	19,772	28.27	3.43	(0.20)
Central Visayas	17,757	21,090	22,151	1,061	5.03	3,333	18.77	0.89	0.04
Eastern Visayas	12,503	11,649	10,528	(1,121)	(9.62)	(854)	(6.83)	0.43	(0.05)
Zamboanga Peninsula	42,114	40,275	57,359	17,084	42.42	(1,839)	(4.37)	2.32	0.72
Northern Mindanao	249,121	316,675	317,762	1,087	0.34	67,554)	27.12	12.83	0.05
Davao Region	42,125	53,305	55,941	2,636	4.95	11,180	26.54	2.26	0.11
SOCCSKSARGEN	204,637	255,622	264,931	9,309	3.64	50,985	24.91	10.70	0.39
Caraga	1,518	1,079	2,144	1,065	98.70	(439)	(28.91)	0.09	0.05
ARMM	72,591	319,126	319,411	285	0.09	246,535	339.62	12.90	0.01

Zamboanga Peninsula with 0.72%, Central Luzon with 0.52%, Soccsksargen with 0.39%, Mimaropa with 0.37% and even Northern Mindanao Region with 0.05% where the City of Malaybalay belongs.

As being one of the important agricultural products in the country, the need for proper information, management, and technology dissemination in corn farming is an important tool. The researchers came up with an idea to develop a mobile application which is the Ma-Ease: An Android-Based Technology for Corn Production and Management. The aim of the researchers is to help the Department of Agriculture to disseminate information. Thus, implementation of effective production is just one of the few of the challenges corn farmers are facing. With the use of the information from the Department of Agriculture, the researchers were motivated to develop a mobile application that would help the farmers in disseminating information, awareness, knowledge, and technology in corn farming. Mobile phones offer many advantages: voice communications affordability, instant and convenient service delivery and wide ownership.

Figure 2 illustrates the conceptual view of the development of Ma-Ease: An Android-Based Technology for Corn Production and Management for corn farmers in Malaybalay City, using an Input-Process-Output (IPO) Model. This pattern is a widely approach model for conceptualizing a systems analysis and software engineering in order to identify the flow of data (input), the steps of the transformation of data (output) and the effect of transformation process (output).

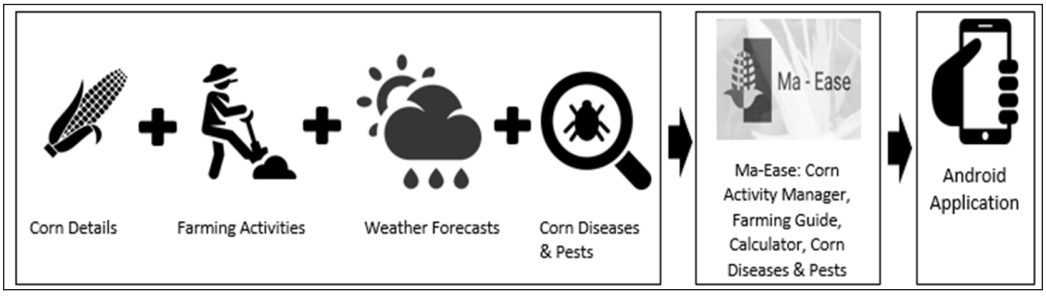

Figure 2. Conceptual framework of Ma-Ease mobile application

With the development of the mobile application, the application requires an input containing corn details which includes farm name, location, soil type, seed type, date of planting, farming activities, local-based weather forecasts, and corn diseases and pests. The application will then compute basic calculation activities for corn farmers like calculate a number of seed bags and fertilizer sacks to acquire in the field as well as the recommended inputs for the plant. The application will also give important information and solution to most common problems in the field like pests and weeds. By selecting from the list of pests and weeds in the database, the mobile application will prompt solutions.

By implementing the mobile application, the mobility of accessing important information in corn farming will be achieved, making corn farmers well informed about the corn production and for easy and accurate nutrient inputs. Moreover, using the application will help corn farmers to have a quality harvest.

Different studies have been conducted related to growth and productivity of the corn but offer limited services. In a study entitled "ICT in Agriculture", Pehu et al. (2011) only mentioned about accurate soil analyses and improved farming practices which were needed because productivity gains were highest in healthy soils. This statement was also claimed by Lee (2014), a corn specialist at The University of Georgia, who studied only on the nutrients to the corn plant. Song (2006) also cited country-specific technology dissemination strategies which proved to be successful in catering to the needs of the farmers. Some examples of these strategies include effective dissemination method in Indonesia through technology showcase or technofarm demonstration; introduction of new varieties in Malaysia through farm demonstrations, short courses, and hands-on training; participatory approaches in technology promotion and dissemination in the Philippines; and many others. A study by delos Santos et al. (2013) also mentioned about agricultural extension agents who derived their climate-related information primarily from the national meteorological agency called Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) while farmers relied only on television and radio for their advanced weather information. In fact, these extension agents were not the main source of climate-related information for farmers. Drought at any stage of crop development affects production, but the maximum damage is inflicted when it occurs around flowering (Nguyen & Blum, 2004).

Some dedicated mobile apps for agriculture exists but only offers partial features and functionalities. According to World Bank, in environments where information is scarce, leveraging existing resources will be crucial for success. First, the m-ARD (Mobile Applications for Agricultural and Rural Development) apps, for example, were developed to make publicly available accurate, granular data such as weather forecasts with integrated flood and drought information at the village or community levels. These services could increase incomes and create further opportunities for people in rural and underserved places in developing countries throughout the ecosystem for m-ARD apps (Qiang et al., 2011). Second, eWarning was created through PlanteInfo, a Danish initiative supporting decision-making in national plant production. eWarning provided farmers with real-time weather information sourced by the AgriMeteorological Information System and Danish Meteorological Institute where farmers requested information through SMS (Short Message Service) in two forms: push-type and pull-type messages. The same software was also created by Yakima software firm, customizing a weather website for specific locations to provide weather alerts to farmers in the United States. These warnings included frost alerts,

the speed of the wind with recommendations for spraying pesticide and other information on disease outbursts. Eventually, the service offered climatic information in Spanish, making it easier for native Spanish speakers to make interpretations and decisions (Lester, 2010). Third, Nutrient Manager for Rice (NMRice) Mobile was a mobile application available for farmers in agricultural countries like China, Indonesia, Nigeria and the Philippines. As Global Media Arts or GMA News Network (2011) cited, since the launch of the application, it already received a total of more than 6,000 calls from the farmers. The disadvantage of the application was that it did not offer offline support. Further, NMRice Mobile was designed only for rice farmers, which has different characteristics and environment needed for corn. Lastly, was the Farmers' Text Center (FTC), an SMS based service for answering agriculture-related queries. Philippine eExtension Service was an addition to Techno Gabay, a national extension system that provides farmers with access to best practices to improve agricultural approaches and boost agricultural productivity.

While existing studies about corn production have been clearly established, they have not been addressed holistically and comprehensively to improve farming methods and practices suggested by the Department of Agriculture. The same is true for the existing mobile applications that do not offer vast and up-to-date information and issue from agriculture professionals. Compared to the Ma-Ease Mobile application, information, and management needed in corn production are already provided. Farmers need not wait for the experts since the information provided by the app is from the Department of Agriculture. It also provides accurate and reliable weather information, a 7-day weather forecast on the different regions in the Philippines thru Philippine Atmospheric, Geophysical and Astronomical Services Administration.

The present study will help corn farmers experience the full benefits of mobile phones by the development of a mobile application with important key features that help. Likewise, the study is anchored on Unified Theory of Acceptance and Use of Technology or UTAUT (Ghazizadeh, 2012) which combined the traditional mobile technology acceptance, like Technology Acceptance Model (TAM), Theory of Reasoned Action (TRA) and Theory of Planned Behaviour (TPB) and introduces new model of user acceptance in a unified view. In the UTAUT model, four core determinants of usage and intention (social influence, effort expectancy, performance expectancy, and facilitating conditions) and four moderating variables (voluntariness of use, age, experience, and gender) acting as the key relationships were considered. The aim of formulating this theory is to provide a deeper understanding of individual and organizational acceptance of IT and mobile services and applications to researchers and managers. Figure 3 shows the connection of the core determinants as well as the moderating factor related to user behavior. The Ma-Ease application is the knowledge-based application for mobile phones which provides crop advisors, Department of Agriculture workers, and corn farmers a comprehensive guideline for their corn fields

wherever they are in the City of Malaybalay. This application can also minimize effort and time to access information at the Department of Agriculture since the information is already implemented in an android based application. With the Ma-Ease application, the corn farmers are no longer required to exert time to go to the Department of Agriculture for further explanation on how to do corn production except for soil analysis and other critical agricultural matters.

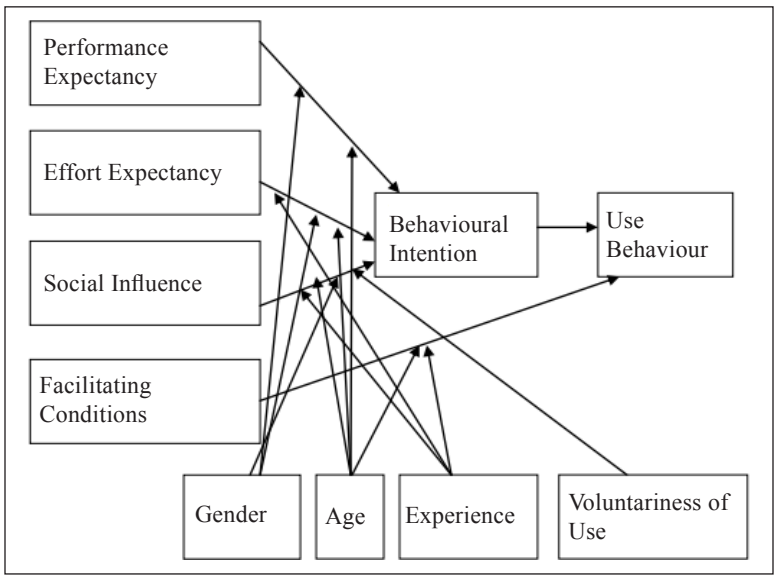

Figure 3. Unified Theory of Acceptance and Use of Technology Model (UTAUT)

METHOD

The researchers used the method of "Modified Waterfall Model" or MWF Model as the process model for the development of Ma-Ease Application. The sequential structure of this approach ensures that all requirements were achieved before moving onto the next step and no important steps were left out in the development process. Developed by Winston W. Royce on 1970, this model served as a response to the apparent problems with the "pure" waterfall model and used iteration through certain phases in the methodology to guarantee the quality of the output generated in each phase and performed improvement or necessary checking to correct or improve further the framework as a whole. The researchers used a judgment sampling method by selecting a sample based on who attended the Stakeholder's Forum on Corn Farming App last May 22, 2017, where 20 local farmers graced the invitation. These farmers resided and farmed in Barangay Laguitas, Dalwangan, Patpat, and Kalasungay in the City of Malaybalay, Province of Bukidnon, Philippines who were truly representative of the entire population of local farmers in the city per consultation with the agriculturists and officials.

Looking at the Modified Waterfall model graphic in Figure 4, the development team coordinated with the business and technical entities to define both functional and non-functional requirements of the Ma-Ease App. This was an iterative process to define, classify, and arrange all requirements according to priority prior to starting the General Systems Design (GSD) phase. The General Design phase was the first interpretation of these requirements into systems conceptual designs. During the GSD phase, the requirements gathered from the corn farmers and employees of Department of Agriculture were validated and finalized. Through the GSD and Architectural Review Board 2 or ARB 2 (composed of the development team and thesis adviser) processes, the technical team established and confirmed a mutual understanding and agreement of all the requirements as well as the solutions design and architectural approaches. Changes in requirements beyond the GSD established a change in scope typically invoking the change in the control process. Hence, all requirements were finalized before the Detailed Systems Design (DSD) phase began. The development team designed and architected the solution as outlined in the DSD. Problems and issues during this phase were encountered which required the team to undergo ARB 3. The testing phase is inclusive of the following: unit testing, module testing, systems integration testing, user acceptance testing, and performance testing. The User Acceptance Testing which was done on May 22, 2017, was the necessary checkpoint to proceed to the deployment phase. Thus, the MWF model provides an orderly arrangement of development steps with some flexible repetitive stages to streamline the adequacy of documentation and design reviews. The Modified Waterfall method is perhaps the preferred method of choice for technology-intrinsic software development initiatives.

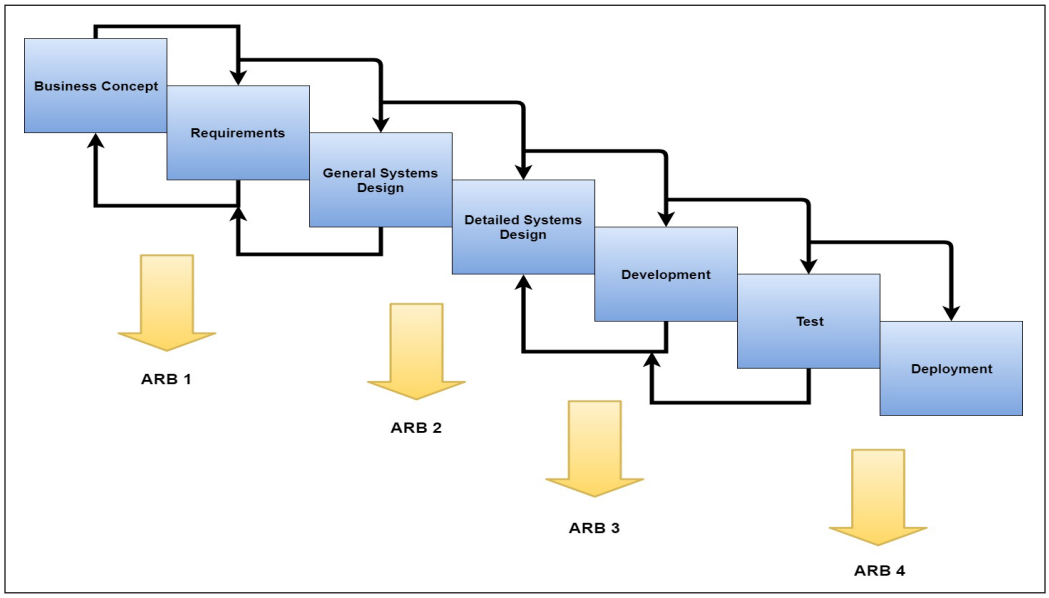

Figure 4. Modified Waterfall Model (MWF)

Requirements Gathering and Analysis of Corn Farming Related Data

Data gathering was done through surveying and interviewing local farmers in Malaybalay City. Agriculturists, thesis adviser, and officials of the Department of Agriculture were the consultants in the formulation of questions in the survey form. The partner agency initiated to call for a Stakeholder's Forum on Corn Farming App last May 22, 2017, and 20 local farmers from Barangay Laguitas, Dalwangan, Patpat, and Kalasungay responded positively to the invitation. This survey form was distributed to the invitees and the researchers conducted a follow-up interview for further information. The researchers used judgment sampling as a common nonprobability method for sampling. The researcher selected the sample based on judgment since the attendees of the forum were the truly representative of the entire population of local farmers. After requirements gathering, the data was analyzed and interpreted and the possibility of incorporating the requirements of the mobile application to be developed was also studied. Finally, a requirement description document was generated which guided the next phase of the model.

Design of Ma-Ease Application

After compiling and analyzing a list of all needed requirements by the researchers, the design phase commenced as shown in Figure 5. Based on the user requirements provided by the local farmers and employees of the Department of Agriculture and the detailed analysis of a new mobile app conducted by the analyst, the new system was designed and developed by the developer/programmer. The tester performed feature testing for the mobile app to assess its functionality. If failed, an in-development process would be repeated,

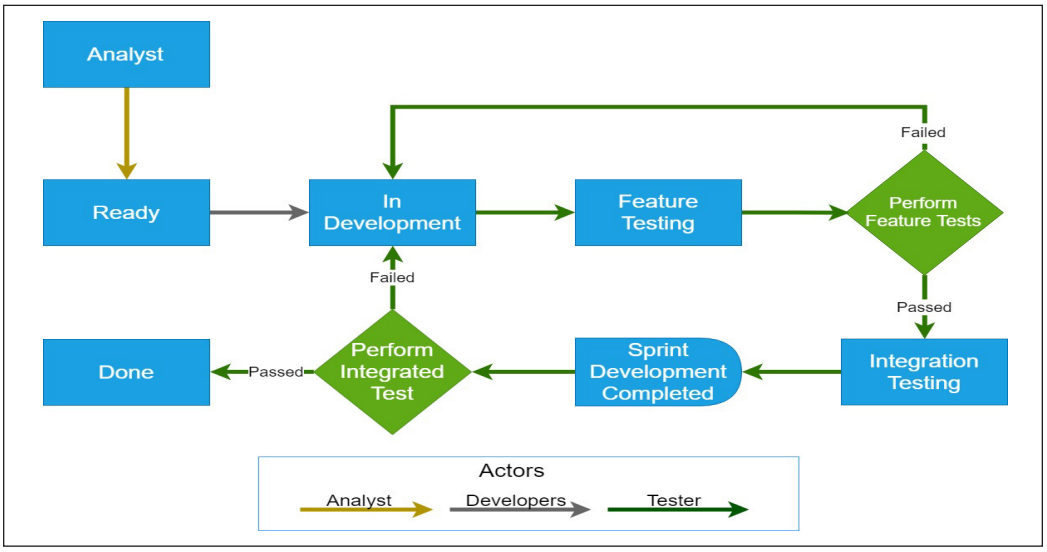

Figure 5. Design and Development Process

otherwise, integration testing and sprint development would be conducted and completed. When integration testing did not perform well, iteration went back to the in-development process in order to make necessary corrections, otherwise, Ma-Ease App was done.

Development of Ma-Ease Application

In this phase, the application design needs to be implemented to make a workable system. This phase included the specification of software and hardware requirements of the application. In order to develop Ma-Ease mobile application, the system minimum requirements were as follows:

- Microsoft® Windows® 7/8/10 (32- or 64-bit)
- 3 GB RAM minimum, 8 GB RAM (Random Access Memory) recommended; plus 1 GB for the Android Emulator.
- Minimum of 2 GB disk space (500 MB for IDE + 1.5 GB for Android SDK or Software Development Kit and emulator system image)
- 1280 x 800 minimum screen resolution.

This phase also required the coding of design into computer language using Android Studio Framework which is a Java-Based Language for mobile devices. The researchers converted the program specifications into computer instructions which they referred to as a program. The application design was referred to and changed according to the development needs when the application lacked in its functionalities. At the end of the development phase, a working prototype with the necessary functions was now operational.

Testing and Deployment of Ma-Ease Application to Local Farmers and Employees of Department of Agriculture-Malaybalay City

Before the researchers actually implement the system into operation, a test run of the system was done to remove all the bugs, if any. It is a significant phase of an effective system. After modifying the whole programs of the system, a functional test plan was developed by the researchers and testers ran the program on a given set of test data using administrator privileges – the Department of Agriculture representatives or local farmers. After testing, the application was ready to go live, which is known as the implementation phase. This was done initially by presenting our proposed mobile application to the Office of the Department of Agriculture – Malaybalay City together with the corn farmers, and finally, it was formally accepted by the DA Officials last May 22, 2017, as part of its Deployment Phase 1 as shown in Figure 6. This phase allowed the attendees to install the app on their phone via Android Application Package or APK. Phase 2 of its deployment was the integration of the app in the Google Play Store so that the app will be made available to all other corn farmers. Phase 3 involved information dissemination in partnership with Department of Agriculture – City of Malaybalay thru seminars and forums where more farmers would be invited to assess the acceptability rate of the mobile application.

Figure 6. Presentation and acceptance of Ma-Ease Project to the local corn farmers and Department of Agriculture Employees/Officials on May 22, 2017

RESULTS AND DISCUSSION

The research produced an offline Android-based application that will serve as a tool for the corn farmers in Malaybalay City, Bukidnon to improve their agricultural methods and boost agricultural productivity. Results were gathered by the researchers through thorough testing and evaluation made with the Office of Malaybalay City Agriculture and corn farmers in Malaybalay City as part of the Modified Waterfall Model.

Analysis

Table 2 shows the number of respondents who provided their satisfaction ratings and user experience with the mobile application using various criteria. On functionality, 50% of the respondents found the app very satisfactory. On reliability testing, 8 respondents agreed that the application is satisfactory. On usability and maintainability criteria, 9 or 45% of the respondents rated Ma-Ease as satisfactory. On efficiency testing, more than 50% say they are satisfied. Their user experience on the layout and design says 60% are VERY satisfied with the application program. Interestingly and unexpectedly, 2 of the respondents were not satisfied with the application in terms of reliability and usability which brought the attention of the researchers to improve the system in the specified area.

Table 3 shows the grand satisfaction ratings of the respondents using different criteria while engaging with the completed mobile application. Results reveal that the user finds the user interface VERY satisfactory with a mean of 4.6, while they were satisfied with the application in terms of functionality, reliability, usability, maintainability, and efficiency. With a grand mean of 4.175, the corn farmers and officials of the Department of Agriculture were satisfied with the software which means that they are willing to try this new technology in corn farming.

Table 2
Summary of respondents' response of its satisfaction rating with Ma-Ease mobile application on its functional and non-functional requirements

Ma-Ease Mobile Application Evaluation	Very Satisfied	Satisfied	Neutral	Un-satisfied	Very Unsatisfied
Functionality	10	7	3	0	0
Reliability	6	8	1	5	0
Usability	5	9	4	2	0
Maintainability	8	9	3	0	0
Efficiency	7	11	2	0	0
User Interface	12	8	0	0	0

Table 3
Summary of qualitative description on user's response based on their satisfaction ratings with Ma-Ease mobile application

Ma-Ease Mobile Application Evaluation	5	4	3	2	1	Average	Qualitative Description
Functionality	10	7	3	0	0	4.35	Satisfied
Reliability	6	8	1	5	0	3.75	Satisfied
Usability	5	9	4	2	0	3.85	Satisfied
Maintainability	8	9	3	0	0	4.25	Satisfied
Efficiency	7	11	2	0	0	4.25	Satisfied
User Interface	12	8	0	0	0	4.6	VERY Satisfied
GRAND MEAN						4.175	SATISFIED

This research was able to develop the Ma-Ease application in order to provide a software tool for the corn farmers in Malaybalay City which offers accessibility to practices and technology in farming's method of production. Thus, it provides workers and farmers with comprehensive site-specific farming guidelines for their corn fields.

Figure 7 shows the level 1 detailed view of activities when the farmer is engaged with the mobile application with PAGASA as the source of weather updates.

The following figures describe the use-case diagram. Figure 8 is the general use-case diagram with the end user interacting with the major processes of the application. Figure 9 shows the use-case diagram when the farmer interacts with the corn activity manager. This enables the user to add the following details: date of planting, seed type, and soil type. Figure 10 displays the different information guide related to pests, farming activities, weather, and farming history. Figure 11 illustrates how to add and calculate wages of the laborer using two methods: price per kilo and percent per kilo. Figure 12 shows how to add and view farming expense. Viewing of expenses maybe shown by total or individual. Figure 13 shows how the app notifies the user of the farming activities which includes pest termination, harvesting, and soil fertilization.

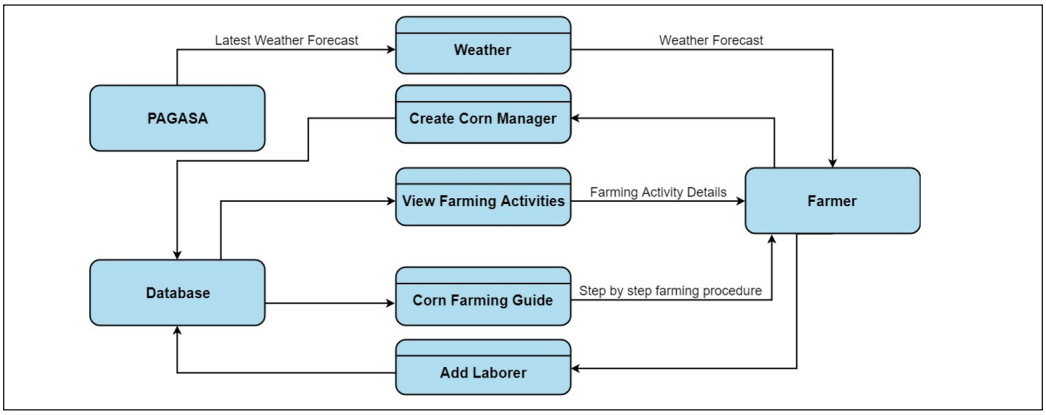

Figure 7. Detailed view of farmer's interaction of the mobile application

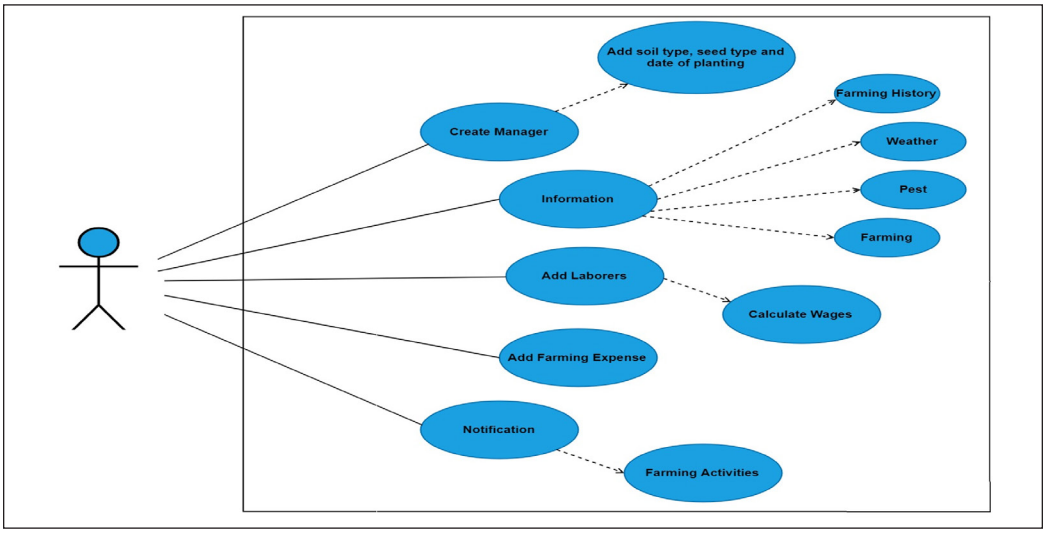

Figure 8. General use-case diagram of Ma-Ease Processes

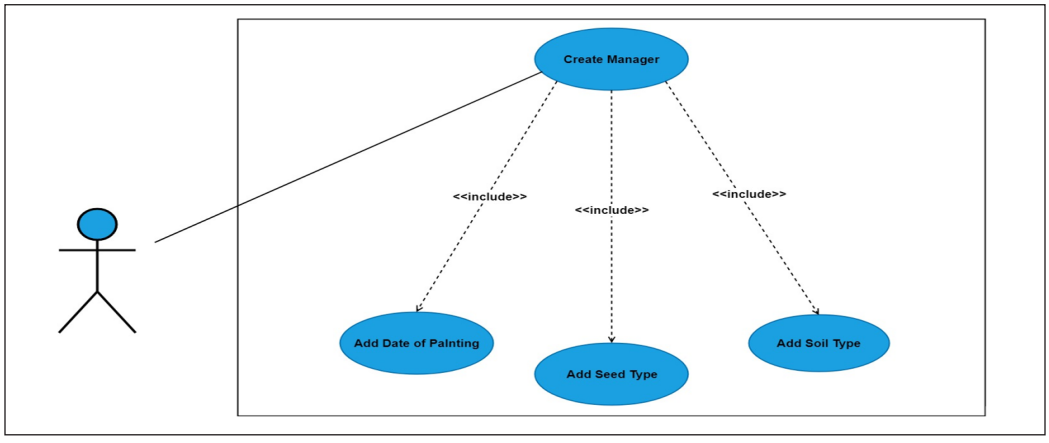

Figure 9. Use-Case diagram for creating corn activity manager

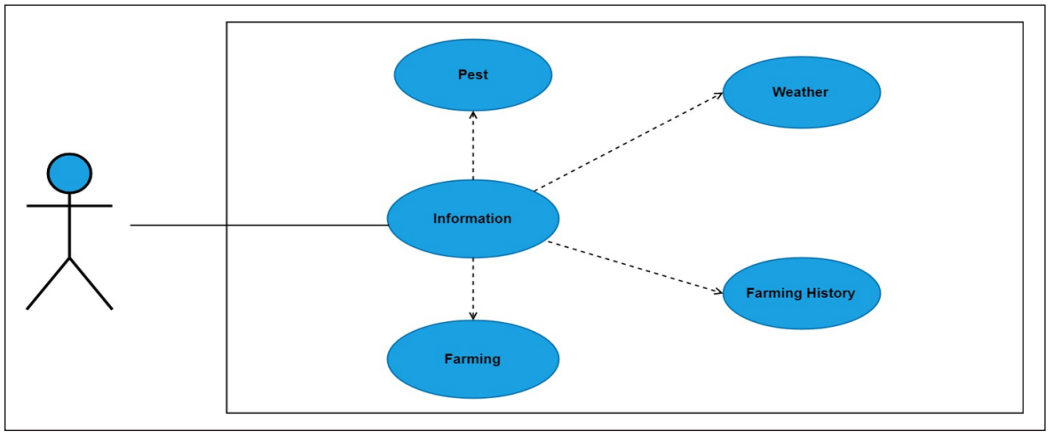

Figure 10. Use-case diagram for viewing of different information guide

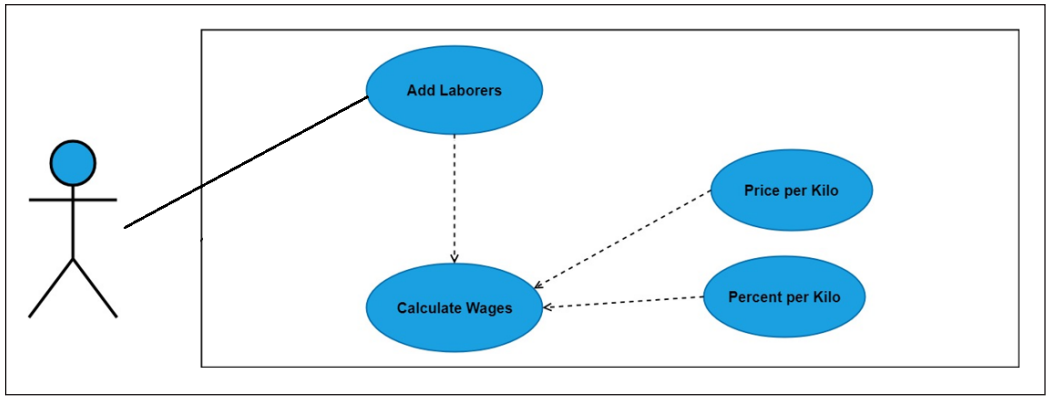

Figure 11. Use-case diagram for adding and calculating of laborer's wages

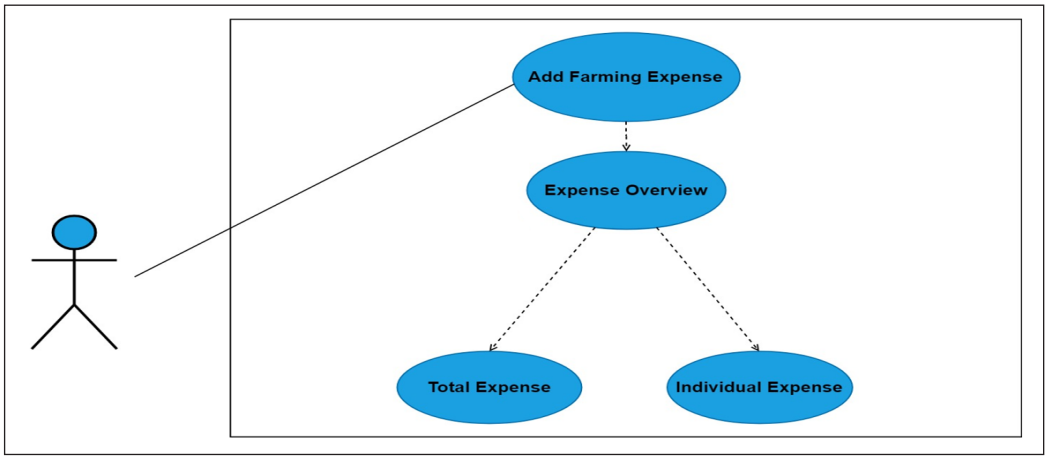

Figure 12. Use-case diagram for adding of farming expense

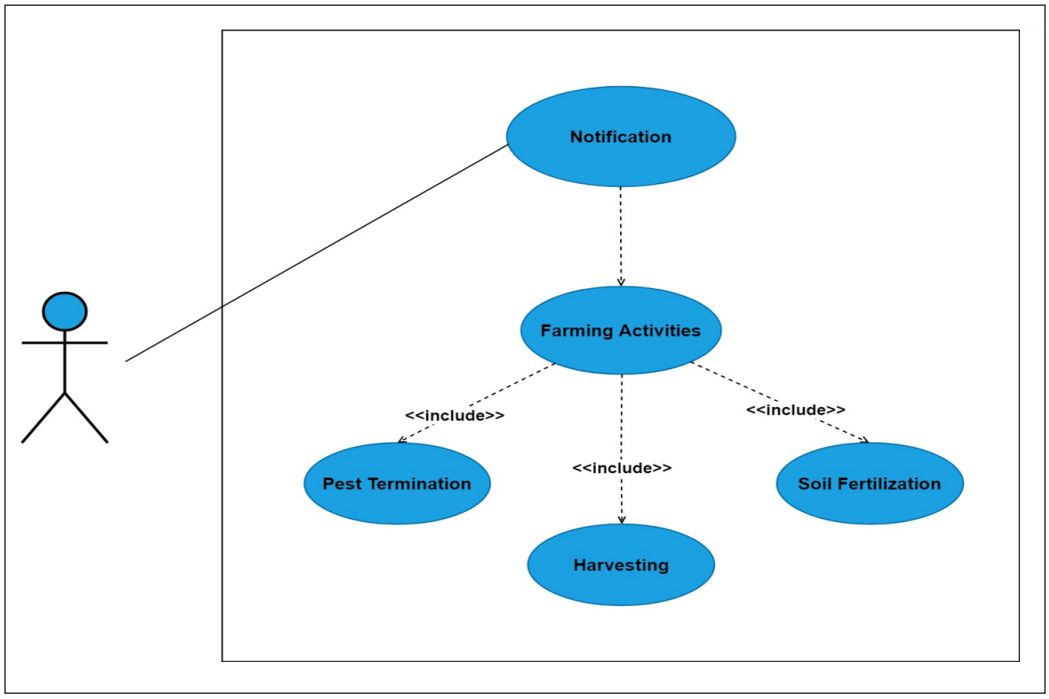

Figure 13. Use-case diagram for notification of farming activities

The following figures also shows the user interface of Ma-Ease Mobile App. Figure 14 shows a splash screen when the user opens the application on their mobile devices. Figure 15 shows the home page when the user accesses the main page of the Ma-Ease

Figure 14. Screenshot of Ma-Ease splash screen

Figure 15. Ma-Ease Home page

application which displays various menu options for corn farming such as Weather, Corn Activity Manager, Calculator, Farming Guide, and Corn Diseases and Pest Control. Figure 16 shows sample interface when the user chooses to select weather forecast option in order to check current climate condition of his/her current location. Figure 17 displays table of contents of farming guide which is translated in Filipino language so that farmer can better understand the contents. Figure 18 shows the actual contents when the user selects Topic 2 "Pagpili ng nababagay na barayti at mahusay na kalidad ng mga binhi" which in English means "Selection of suitable varieties and good quality seeds". Figure 19 also lists all types of corn diseases and Figure 20 describes in details the sample disease termed "Downy Mildew" using its scientific name, information, symptoms and recommended solutions.

Figure 16. Guide on how to use the Weather Forecast

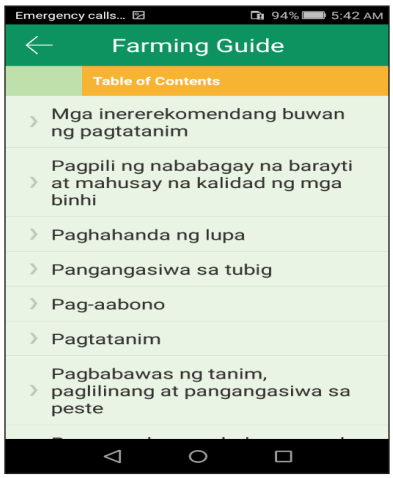

Figure 17. Farming guide table of contents

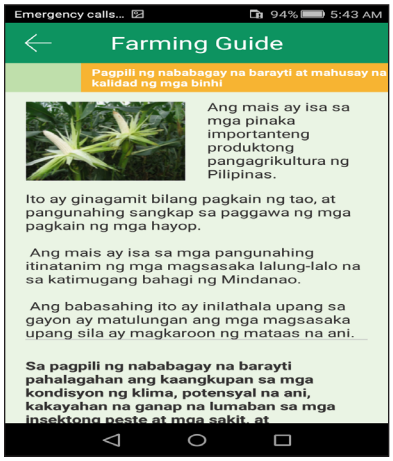

Figure 18. Farming Guide contents

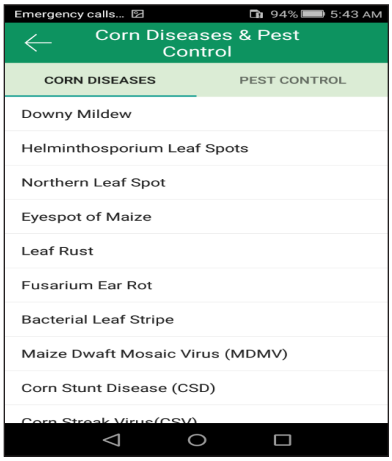

Figure 19. List of corn diseases

All of these information are provided by the Department of Agriculture. While Figure 21 lists all types of corn pests, Figure 22 also mentions "Asian Corn Borer" in specifics the scientific name, local name, damages, and the recommended solutions prescribed by DA. Figure 23 calculates number of hybrid and non-hybrid corn seed and fertilizer which requires an input data of total land area in hectares (ha). Figure 24 is a corn activity manager form which allows the user to create farm details per location. Figure 25 is a sample output when a farm details is created. It displays summary of farm using farm name and location. Lastly, Figure 26 shows additional activities once a farm is created. It includes manager, farming expense and harvest. The app provides access to best practices and latest approach to improve agricultural practices and optimize corn production.

Figure 20. Sample corn disease with the scientific name, information, symptoms, and recommended solutions

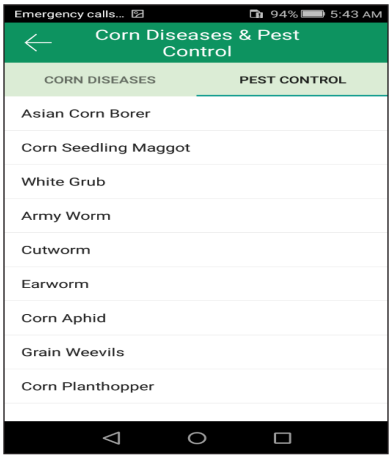

Figure 21. List of corn pests

Figure 22. Sample corn pest with the scientific name, local name, damages and recommended solutions

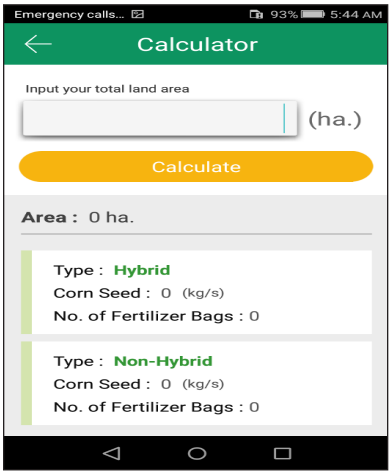

Figure 23. Corn seed and fertilizer calculator

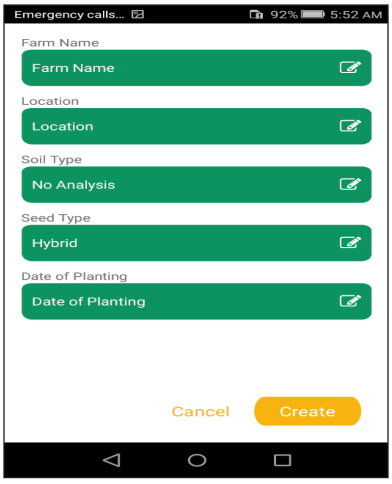

Figure 24. Corn activity manager form to create a farm

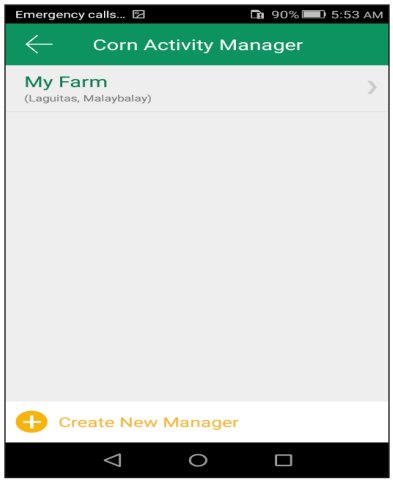

Figure 25. Creating a farm with the name and location

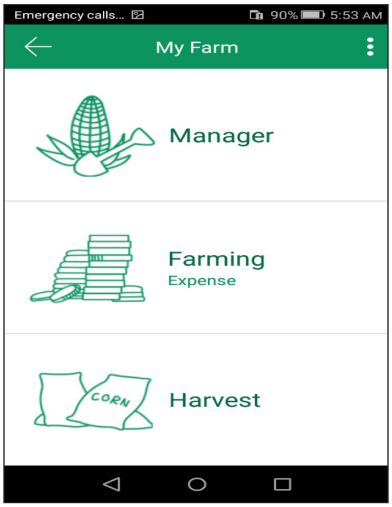

Figure 26. List of farming activities

CONCLUSION

After conducting series of tests, results show a grand mean of 4.175 which means corn farmers are satisfied with the Ma-Ease mobile app in terms of functionality, reliability, usability, maintainability, efficiency, and user interface. Furthermore, these findings show that the application was able to deliver its function to provide comprehensive information and farming guide to corn farmers, access to electronic weather information sourced by the PAGASA and other top issues and concerns confronting cities' corn growers in order to optimize farm productivity. Thus, the software product was formally accepted and recommended for use and deployment by the Department of Agriculture.

Recommendations

This study has a number of limitations which are recommended for future studies. First, the mobile application should also be available on other platforms like iOS and web. Although Android has various users especially in low socio-economic countries like the Philippines, there are already farmers which use non-android phones and own their personal computers at home.

Secondly and lastly, the mobile application should provide data about soil analysis. The current feature of the mobile application only suggests the general recommendation of fertilizer for every land. It is recommended that the future application should provide specific recommendations for the specified type of soil through the help of the Department of Agriculture in coordination with these offices: Bureau of Soils and Water Management and Fertilizer and Pesticide Authority.

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