Study on Usability Interface in Mobility Device for Precision Farming

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Abstract: Precision farming is an emerging technology that allows farmers to manage their farm by giving them the information about their farms' condition to help them to optimize profit, sustainability and also protection of the land resource. The current practice is quite ineffective as for instance, the farmers had to manually measure the temperature of a greenhouse using a thermometer. The aim for this work is to study mobile devices application that can help farmers to get the current mushroom house temperature and also the humidity to ensure the mushroom house environment are suitable for their mushroom production. The application is designed using an interactive user interface and usability approach and is evaluated using a scenario in a typical mushroom cultivation environment. The result from this paper is the mushroom farmers prefer an application that are simple and not complicate them to use it. This work gives a description of the precision farming monitoring application that provides meaningful services to farmers.

Keywords: Usability, precision farming, user experience, human– computer interaction, user interface

1. Introduction

Precision farming is a system or software that is widely used in agriculture at this time because it can help and facilitate the work of the farmers. In addition, the term precision farming can be described as a variety of management and research to help the farmers to learn new developments in their field and it directly would positively affect the outcome. Many benefits can be provided by precision farming, especially to the ecosystem of the environment as the use of chemicals is consumed in the place and time when it is only needed.

This study suggests the design of an interface of the application that is suitable for the farmer to get the humidity and temperatures for the mushroom room. This study is inspired by exploring and understanding human–computer interaction that can help and support people to understand the application and assist the activities to become easier. This study aims to increase the understanding about the usability interface in mobility device and also the heuristic for user interface design for precision farming.

The next section of this paper will discuss the related work to this study, followed by some descriptions of cultivation of mushroom as our case study in section 3. Analysis and design is presented in the section 4 and followed by implementation in section 5. Section 6 presents the usability testing. This paper ends with discussion and conclusion and future work.

2. Related Work

Mobile computing has generally been built on the concept of being able to connect anytime and anywhere [1]. For instance, Jens Ziegler [2] presents a mobile assistance system for help and preservation personnel in industrial services which is an interactive handheld or body-worn system supporting maintenance personnel in their routine. The system known as MSS has a visual output and variable means for user input. The main objective of MSS is to provide a workflow management and sophisticated information management. The system is evaluated using advanced scenario in typical industry surroundings.

Besides that, a comparison with the conventional paper and pencil-based maintenance workflow also includes in the evaluation. That paper also presents the result that the proposed system allows for successful and satisfactory service and maintenance text.

According to Rikin et al. [3] agriculture in India has witnessed a revolution by mobile phone as one of the new approach to develop their agricultural sector. The approach that they use is Digital Green which is uses to form videos that help farmers become more productive by improving the impact of agriculture extension workers. Digital Green produced videos that can improve their livelihoods. When farmer see the video, they will featuring people similar to themselves and its look like they viewer a reality television and farmer made snap judgments of a person's work, learning, and station, apparently based on language, outfit, and mannerism cues.

3. Cultivation of Mushroom

Precision farming for mushroom cultivation covers two important aspects, which are the characteristics of mobile devices suitable for farmers and mushroom cultivation process or activity itself. Two aspects are very important to note because the farmers do not have sufficienttime to read and observe all the changes in the field conditions because of their hustle activities.

It is also important to facilitate the farmers obtaining real time and latest information about their farm or cultivation room so they can maximize their agricultural produce. In addition, application design for mobile devices must be able to display all information for each activity and the cultivation of mushrooms, such as the temperature and humidity for each process because each process requires different temperature and humidity. Mushroom cultivation process involves several stages, such as the preparation of mushroom bags, steaming bag of mushrooms, mushroom seed selection, seed injection mold, fermentation media bag of mushrooms, the collection of the mushrooms as well as post harvest handling (see Figure 1 and Figure 2). Each process requires a great care research to produce quality mushroom.
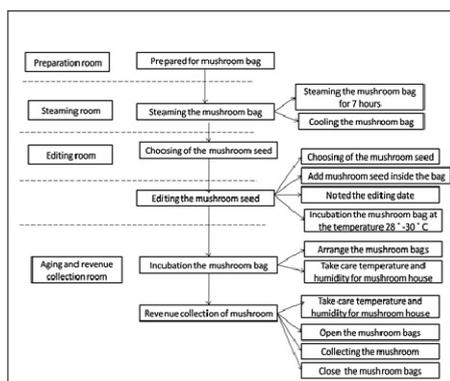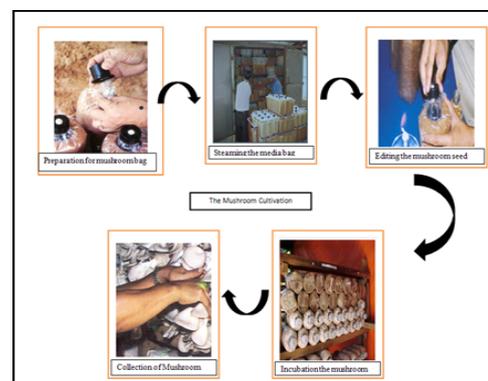

Figure 1: Mushroom Cultivation Process

Figure 2: Step by step for mushroom cultivation process

For the mushrooms, things to note are the temperature and humidity. The most suitable temperature is between 28 to 32 degree Celsius. While moisture must be retained in between 65 and 70 percent, the formation of fruit body requires between 80 and 90 per cent and at low temperatures. Mushrooms are perishable and will not last long if exposed to water mold. Rack is used to place media and drainage bags used at the rack on the floor for process temperature control.

4. Analysis and Design

Hierarchical model for mushroom cultivation process in Figure 3 is designed to show the process of mushroom cultivation as reflected in section 3. By doing so, we would be able to identify which of the many processes would be benefited the most by applying the technology.

It is identified that processes reflected in 4.4, 5.2, and 6.1 from Figure 3, would be the most suitable processes for the use of technology to help the farmers to monitor temperature and humidity condition of the house. In addition, the entire process of mushroom cultivation can also use precision farming applications so they can monitor the activities of mushroom that as all activities are recorded.

Process 4.4 in Figure 3 is the fermentation process bags mushroom during the editing of mushroom seeds at a temperature of 28-30 degree Celcius, the process 5.2 is the care home temperature and humidity during the curing mold fungus and the process 6.1 also includes monitoring temperature and humidity of the mushroom house revenue collection process. We will concentrate on these three processes by proceeding with the suitable interface design. Based on studies that have been implemented, interface design of mobile device applications to help farmers cover two aspects, namely the characteristics of mobile devices as well as information to be communicated to the farmers for each process of mushroom cultivation. To the characteristics of mobile devices suitable for a farmer, several aspects need to be addressed. This is because the farmers need a device that can be taken at any time due to congestion and constraints of farmers. However, in the other aspect, if the device is placed in the mold itself is not a problem if the event can be attached and pulled back with a docking station and laptop concept and this concept allows the device is not limited to one place only.
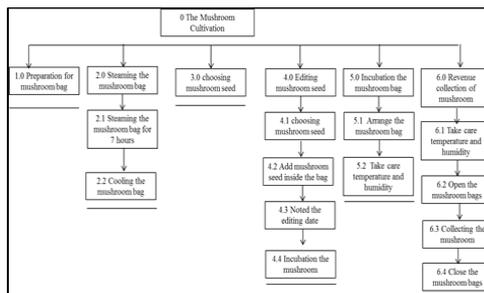

Figure 3: Hierarchical model for Mushroom Cultivation Process

Following are suggestions of appropriate type of mobile devices. First, the type of the device itself, either it is a PDA's, personal computer or a tablet PC that could facilitate the farmers to take it anywhere by considering its size and weight. This is aligned with of Mobile Design Principles by Dale Zak [4]. This feature will help the farmers to bring the device anytime and anywhere and they can simply keep it in their pocket. Second, mobile devices of the type of smart phones such as an iPhone, a mobile phone using the Android operating system, BlackBerry phones and the like can be used as a smart phone; the farmers can use the internet for precision farming and it follows the mobile design principle which is used to access the internet. Finally, the choice of either using the buttons, touch screen, voice recognition and body gesture as a way to control the precision farming applications for mobile devices. These types of features will make the user more interested with the application.

The main concept of precision farming is to assist the farmers to manage their agricultural activities in an orderly and systematic. This requires monitoring and scrutiny of each mushroom to mushroom cultivation process quality can be produced and to maximize the total production of mushrooms. To help the farmers, applications of mobile device must be constructed to closely monitoring the important aspects of mushroom cultivation, which are the temperature and humidity for mushroom production quality as identified in Figure 3.

Based on the identified three processes, the following are the proposed functions of mobile device applications for mushroom cultivation: (i) farmers can control the mushroom house temperature by using the menu Check mushroom house temperature so that the temperature is in the situation under control. This application can be used in the processes indicated in 5.2 and 6.2 in Figure 3 which relate to the 4.2 the process of care mushroom house temperature during the fermentation process of the bag during the collection of mushrooms, (ii) farmers can control the humidity of the mushroom house in home menu so that humidity mushroom house in a controlled situation. This application can be used in the 5.2 and 6.2 processes in Figure 3, which is the process of curing the mushroom bag during the collection of mushrooms, and (iii) farmers can record and monitor the activities carried out in this application by using the logbook menu.

5. Implementation

Precision farming applications are designed to facilitate the farmers to get the latest information about the temperature and the humidity of the mushroom house. This information is very important for mushroom farmers because of these two aspects have great influence on the quality of the mushrooms. In addition, the

emphasis on these aspects is also important for facilitating the farmers to get real time and latest information so they can maximize their agricultural produce. Monitoring the activities of mushroom cultivation is also important to ensure that the process is done in a systematic mushroom cultivation. For this study, two types of design are proposed to choose which one more suitable for the farmers is. Besides that, the graphical interface is also quite different. The design of prototype one uses grey as a background colour, while prototype two uses purple as a background colour. These two types of background colour will give different effect to user when they use it. Grey colour is considered as a soft colour, while purple is brighter. Besides that, the icons for the main menu are also different. For the prototype one, it uses graphical icons while prototype two uses text only. Precision farming applications are designed to facilitate the farmers get the latest information about the temperature and the humidity of the mushroom house. This information is very important for mushroom farmers because of these two aspects have great influence on the quality of the mushrooms. The following describes the two prototypes by illustrating the flow charts of both prototypes screenshots.

Prototype One

i. Figure 4a below shows a flow chart for checking humidity in the mushroom monitoring center application.
ii. Flow chart for checking temperature in the mushroom monitoring center application is shown below in Figure 4b
iii. Flow chart for logbook activity of prototype one is shown below in Figure 4c.
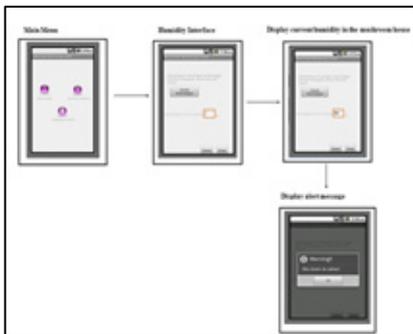
Figure 4a: Flow Chart for Checking Humidity in the Mushroom Monitoring Centre of prototype one
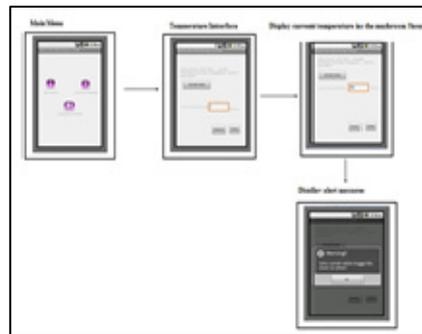
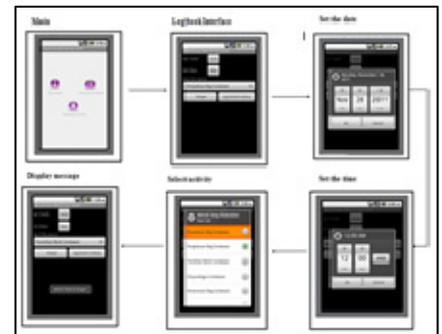Figure 4b: Flow Chart for Checking Temperature in the Mushroom Monitoring Centre of prototype one

Figure 4c: Flow Chart for Logbook activity of prototype one

Prototype Two
i. Flow chart for checking the humidity in the mushroom monitoring center application for prototype one is shown in Figure 5a.
ii. Figure 5b shows a flow chart for check temperature in the mushroom monitoring center application of prototype two.
iii. Flow chart for logbook menu of prototype two is shown in Figure 5c.

Figure 5a: Flow Chart for Checking Humidity in the Mushroom Monitoring Centre of prototype two.
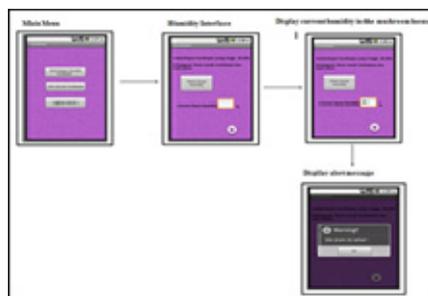
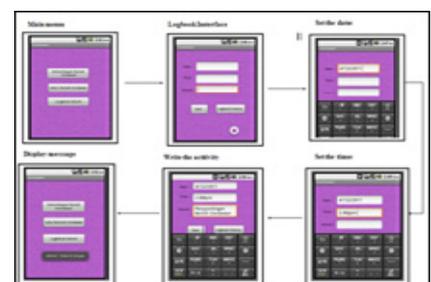Figure 5b: Flow Chart for Checking Temperature in the Mushroom Monitoring Centre of prototype two

Figure 5c: Flow Chart for Logbook activity of prototype two

6. Usability Testing

One of the methods to measure (questionnaire) usability is based on customer satisfaction, which is known as QUIS (Questionnaire for User Interface Satisfaction) [5]. This method can be used for any form of user interface and the measurement is based on the extent to which users are satisfied with the prototype tested. In the QUIS, the level of customer satisfaction expressed is in the form of a Likert scale. Each item uses a 5-point scale and at both ends of the scale (1 and 5) will be given the evidence, for instance, whether the farmer found the interface as blurry or clear. Point one is the lowest and point five is the highest value of usability.. QUIS was conducted among 10 mushroom farmers and QUIS forms were distributed to enable them to answer the questionnaire. Figure 6 illustrates the results in a graph format.
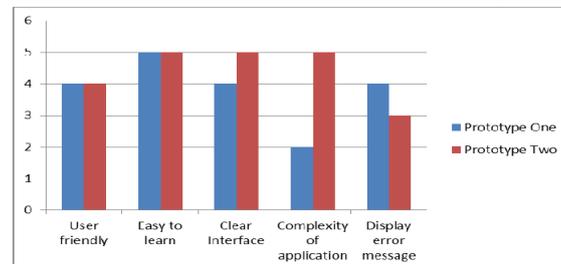

Figure 6: The graph for the test results

7. Discussion

Based on the test presented in the previous section, the results obtained indicate that the application of prototype two is able to satisfy users more than prototype one as it is found that the application's interfaces are easier to use. It was observed that the difficulties experienced by the farmers are very low. Application complexity arises when users have to press the button many times while performing tasks in precision farming applications. The interface of prototype two applications did not deliver any error in the event of an error. This has caused the user to perform an error without realizing. Things like this happen on the date and time format of the information entered by the farmers during the recording of mushroom cultivation activities. However, for mushroom farmers, the proposed prototype one interface is more satisfying on several aspects such as background colour and also the complexity of the application interface is found to be less than prototype two. In addition, mushroom farmers are also more comfortable using the proposed prototype one because of its non-complicated and easy to understand. For the farmers, an application must be simple and not complicate them to use it.

8. Conclusions and Future Work

The aim of our work is to design anapplication that could support and help farmers to manage their farming via mobile devices. We have investigated technology that already in use for precision faming and the pattern of user interface that have been designed so that the other application can be improved to give a better support to other types of crop. The participants of the user are most important because they are the person that give the requirement and use the application and also give the feedback about the application. The focus of our future work is the implementation of the wireless system in the actual mushroom room.

9. Acknowledgement

10. References

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