Development of a Web-based Decision Support System on the Cultural Management of Oyster Mushroom (*Pleurotus ostreatus var florida*)

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Abstract

This study developed a web-based data-driven decision support system on the cultural management of oyster mushroom. The system provides a platform in disseminating best practices and a facility for managing the knowledge base on oyster mushroom's cultural management. The designed database was effective and efficient which was then implemented on MySQL relational database. The system has an easy-to-use graphical user interface developed using PHP and Bootstrap (i.e. Cascading Style Sheets (CSS), JavaScript and Hypertext markup language (HTML) framework). The knowledge base came from the Department of Agriculture–Regional Field Office 08 (DA-RFO 08) Research Division along with its community-based oyster mushroom enterprise in Eastern Visayas. A mean acceptability rating of 4.24 from ten (10) guest users reveal a very satisfactory descriptive score (i.e. based on a 5 point Likert scale). Moreover, ten (10) administrator users recorded a mean rating of 4.68 which entails to an outstanding acceptability rating.

Keywords: Data-driven; Decision support system; Knowledge base

Introduction

The management of agricultural operations is complex and daunting due to many biological, chemical, and physical processes and information involved (Heinemann, 2009). So to alleviate these difficulties, a decision support system (DSS) is necessary since it enables users to sift through and analyze massive reams of compiled data that can be used to solve problems, and support complex decision making (Turban, 1990). Moreover, it is an interactive, flexible, and adaptable computer-based information system that utilizes decision rules, models, and a model base coupled with a comprehensive database. The decision maker’s own insights is also included leading to specific, implementable decisions in solving problems that would not be amenable to management science models (Power, 2008).

Recently, the Department of Agriculture–Regional Field Office 08 (DA-RFO 08) Research Division established a station-based and community-based oyster mushroom laboratories within the region. This project would serve as a source of mother and sub-culture intended for interested individuals, assisted farmers and community-based mushroom enterprise. This variety of mushroom was chosen since it is suitable to the climate and resources within the region. Moreover, it can contribute to livelihoods of rural and semi-urban residents through income generation (Marshall & Nair, 2009).

However disseminating technical information using the assigned researchers are limited to both the number of researchers and their availability. So a web-based decision support system provides better access to relevant information that will help farmers or interested parties in identifying problems and solving the challenges regarding the cultural management of oyster mushroom. Moreover, researchers and specialists could easily disseminate updated technical information.

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Methodology

This study followed the spiral model of software development in software engineering (Sommerville, 2010). Knowledge elicitation would establish the needed objectives and bounds of the study. An Entity Relationship (ER) diagram for the database was then designed out of the gathered information. Since the system was web-based, it typically followed the three-tier architecture followed by the appropriate user interface design. After completing the design, implementation proceeded using the appropriate web technologies. Finally the system was evaluated that would provide a feedback mechanism to improve the system’s functionality. Figure 1 provides for the graphical view of the development model.

A. Knowledge Elicitation

Knowledge elicitation is used to obtain the information required to solve problems (Burge, 2001). For this particular study, the research specialists at DA-RFO 08 were interviewed regarding the cultural management of oyster mushroom with guide question as follows:
- What is an oyster mushroom?
- How did you get a spawn?
- What temperature should your cultivation room be?
- How do you maintain a high level of cleanliness?
- Where do you sell oyster mushrooms?
- How much growing area do the cultivators need?
- Why is oyster mushroom important in our region?

B. Database Design

The gathered information was carefully analyzed to construct an efficient and effective database. The normalization process was applied in designing the database to reduce data redundancy and update anomalies. Figure 2 shows the normalized database design of the system.

C. System Architecture Design

A three-tier client-server architecture was used to meet the system requirements (Helal, Hammer, Zhang, & Khushra, 2001). The first tier (i.e. client tier) holds the presentation and broadcast all of its specific request to the middle tier. The middle tier runs on the application server. The last tier is the data stage that helps optimize the overall application access and development management.

D. User Interface Design

The user interface of the system was designed to be user-friendly and easy to navigate. Buttons, icons, modal boxes, menus, tables and frames were used for user interaction and system output.

There were two (2) type of users, namely, guest users and administrator (i.e. experts) as shown in Figure 3. The guest users were only allowed to view the available information which consists of images, tables, and printable data. However, they can participate in forums given that they would sign up (refer to Figure 4). On the other hand, administrators can perform data management such as adding, editing and deleting information given that they are logged on.

E. System Implementation

The system was implemented using XAMPP, which includes Apache (Bowen & Coar, 2007) as the web server, MySQL (Tahaghoghi & Williams, 2007) as database server and PHP (Tatroe, MacIntyre, & Lerdorf, 2004) as the server-scripting language. Bootstrap (Shenoy & Sossou, 2014) which is a CSS, JavaScript and HTML framework was used for better presentation of web pages.

F. System Testing and Evaluation

The system was evaluated by the Research Division personnel at the Department of...
Results and Discussion

Website Map

Agriculture–Regional Field Office 08. The respondents were asked to answer an evaluation form with regards to the functionality of the system using a 5 point Likert scale for scoring. Feedbacks and recommendations were also noted so that the system would all the more fit the user’s preference.
Figure 5: Use case diagram of forum members

Homepage

Figure 7 shows the various screen shots of pages whenever any of the four (4) visible hyperlinks from the left navigation pane is clicked.

- Home (Figure 7a) - which contains the homepage itself;
- Contents (Figure 7b) - provides information for the cultural management of oyster mushroom that will guide the guest users in decision making;
- About (Figure 7c) - which describes the functionality of the system and how to make use of the acquired data;
- Forum (Figure 7d) - where the guest users can ask questions or start a discussion with the administrators or other users.

Forum Page

Since the forum page of the system would serve as a tool for the users to gain more knowledge, it is necessary to prevent it from being spammed. So, the guest users are obliged to sign up before they can start a discussion. Each entity of the Signup form (Figure 8) must be filled and a Completely Automated Public Turing test to tell Computers and Humans Apart (CAPTCHA) is also included to prevent automated scripts from spamming the forum database (Ahn, Blum, Hopper, & Langford, 2003).

Administrator Page

Scrolling down from the navigation pane of the homepage would show the login hyperlink. Clicking this hyperlink would display the administrator’s login page (Figure 8).

Once the administrator is logged in, he will be directed to a welcome page shown in Figure 10. Clicking the Proceed button will continue to a page wherein the administrator is allowed to manage the information stored in the knowledge database. On the other hand, clicking the Manage Experts button permits to add a new administrator.

The administrator page contains an Add Factor button which enables an administrator to add a new knowledge (Figure 11a). Once the Save button is clicked, the new knowledge will be stored in the system’s database. Clicking the Edit icon on the left pane directs the edit page that permits the administrator to update the existing information from the system’s database. Manage Forum menu contains the response of the administrator to a particular topic. It allows the administrator to reply and delete forums. Figure 11b shows the Manage forums page.

Uploading, updating and deleting of image(s) is done if the administrator clicks the Edit icon. Figure 11c illustrates the ability of an administrator to upload a new image for a particular knowledge of oyster mushroom management. The omission of knowledge stored in the system’s database takes effect when the administrator clicks the Delete icon. Information from factors up to image(s) will be displayed together with the prompt that would ask for confirmation if the user would continue the deleting process or not (Figure 11d).

Evaluation Results

The developed system was presented to the Research Division personnel at the Department of Agriculture–Regional Field Office 08, Kanhuraw Hill, Tacloban City, to verify whether the developed system is
acceptable. Ten (10) respondents for guest and another ten (10) for administrator were taken into account. A 5 point Likert scale with descriptive rating shown below was used to score the individual survey question.
Table 1 presents the guest user’s acceptability rating of the system. A grand mean of 4.24 from five different survey questions indicate that the system is very satisfactory.

On the other hand, Table 2 tallies the acceptability score from the administrator’s point of view. A mean acceptability rating of 4.68 stipulates an outstanding assessment.
Table 1: Evaluation results from the guest user’s perspective

<table>
<thead>
<tr>
<th>System Testing (n=10)</th>
<th>Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to guide in decision making.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>User-friendliness of the system.</td>
<td>8 2 4 5 4.2</td>
</tr>
<tr>
<td>Design and appearance of the system.</td>
<td>1 4 5 4.4</td>
</tr>
<tr>
<td>Ease of access.</td>
<td>2 7 1 3.9</td>
</tr>
<tr>
<td>Information acquisition.</td>
<td>2 4 4 4.2</td>
</tr>
<tr>
<td>Grand Mean</td>
<td>5 5 4.5</td>
</tr>
<tr>
<td><strong>Descriptive Rating</strong></td>
<td>Very Satisfactory</td>
</tr>
<tr>
<td><strong>Grand Mean</strong></td>
<td>4.24</td>
</tr>
</tbody>
</table>
Table 2: Evaluation results from the administrator’s perspective

<table>
<thead>
<tr>
<th>System Testing (n=10)</th>
<th>Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  5</td>
</tr>
<tr>
<td>Ability to log-in</td>
<td>10</td>
</tr>
<tr>
<td>Ability to perform data management (add, edit and delete information)</td>
<td>3  7  4.7</td>
</tr>
<tr>
<td>User friendliness of the system.</td>
<td>5  5  4.5</td>
</tr>
<tr>
<td>Design and appearance of the system.</td>
<td>5  5  4.5</td>
</tr>
<tr>
<td>Restriction on returning using the back button once log-out.</td>
<td>3  7  4.7</td>
</tr>
<tr>
<td>Grand Mean</td>
<td>4.68</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Descriptive Rating</th>
<th>Outstanding</th>
</tr>
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</table>

Summary, Conclusion, and Recommendation

This study developed a Web-Based Decision Support System (DSS) on Cultural Management of oyster mushroom. The system development platform used was XAMPP, Apache as the web server, MySQL for the database management system and PHP as the scripting language for the server-side. JavaScript and jQuery were used for the client-side functionalities. HTML, CSS, and Bootstrap were used in the creation of the forms, designs, menus and other elements of the user interface. Evaluation results for acceptability are 4.24 (very satisfactory) for guest and 4.68 (outstanding) for administrator concludes that the system is indeed very useful. Moreover, since the system is web-based, once it is deployed on a public web server, its services can be available to anyone, any time given that there’s Internet connection. Thus, it provides oyster mushroom producers the ease and convenience to acquire the necessary data that would lead to increased production.

For the most part, the study focused on system development, so it is necessary that a more comprehensive evaluation must be done to improve the user interface as well as the functionality of the system. Moreover, web security experts can make certain security breaches on the system to expose its vulnerabilities. This, in turn, would be used to improve the system’s security ensuring data privacy. Finally, it is recommended that the system will be deployed on a public server so that its services would be made available to the target clientele.

References


