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Implementation of User Centered Design Method on CarbonArea Website User Experience Meilani Jesica Tiodora

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Abstract

This study aims to evaluate the application of the User-Centered Design (UCD) approach in designing the user interface (UI) and user experience (UX) of the CarbonArea website, which provides information on the impact of carbon dioxide (CO_2) on food security. The research methodology included interviews with potential users, a literature review, as well as iterative stages of UCD, including understanding the context of use, identifying user needs, designing a solution, and conducting a design evaluation. The interview results revealed that users wanted interactive features such as maps and graphs for real-time monitoring of CO_2 levels. The application of UCD proved effective in creating a design that meets user needs, while improving user experience and website attractiveness.

Keywords: design, user centered design, user experience, user interface, website.

INTRODUCTION

In this modern digital age, the use of online communication tools has become one of the most effective and easy ways to get information directly or indirectly. With this technological advancement, all forms of information can be disseminated using social media from various platforms, it is not uncommon to find out that some digital platforms are devoted only to publishing various kinds of information on a special application or website. That way, it makes it easier for people from various circles to get all the information they want to find (Afifah et al., 2024).

Optimizing the appearance and workings of the website through a User Centered Design (UCD) approach is very important to increase user attractiveness and comfort. In the User Interface (UI) aspect, an interactive and visually appealing design plays an important role in creating a positive impression on the final website product. Meanwhile, User Experience (UX) is an important part of ensuring the comfort and convenience of users in exploring the platform, so that they are encouraged to continue using the website in the long run.

The CarbonArea website is a website designed to present information on the impact of carbon dioxide (CO_2) levels on food security. It aims to collect, record and disseminate important information on how climate change, especially rising CO_2 levels, affects global food production. Through this website, the general public, academics, researchers, policy makers, and practitioners in agriculture can

access accurate data on CO_2 availability in various regions and understand its impact on food security. Websites and social media are effective and efficient means of supporting information dissemination in this digital era. By harnessing their potential, platforms like CarbonArea can provide solutions to help people understand the important issues affecting their lives, while encouraging action to address these problems.

The existence of a website like CarbonArea is very important in this modern era, especially in efforts to increase public awareness and understanding of environmental issues, especially climate change. With the features available on the website, visitors can easily find out the CO_2 levels in a particular area as well as other related information. This is certainly very useful for those who want to monitor environmental changes around them and take the necessary steps to address any negative impacts that may be caused. Overall, the use of social media and websites in information dissemination in this digital era is an inevitable development (Rohim et al., 2024). With more and more people relying on the internet as their main source of information, it is important for website owners to continue to innovate in delivering engaging and relevant content. Social media, with its interactive nature, provides an opportunity for users to not only receive information, but also to actively participate in the discussion and dissemination of that information.

METHODS

In the implementation of User-Centered Design (UCD) on the CarbonArea website, user feedback was systematically integrated into the final design through a structured iterative process. Initially, potential users were engaged through interviews to gather insights into their needs, preferences and challenges when using similar platforms. This qualitative data was carefully analyzed to identify common themes and issues, such as navigation difficulties or unclear design elements. By prioritizing these user-reported issues, the development team can create targeted design solutions that directly address the identified needs, ensuring that the final product is user-centered and effective in improving user experience.

The iterative nature of UCD allows for continuous refinement of the design based on ongoing user feedback. Once the initial framework and prototype are developed, usability testing sessions are conducted where users interact with the design and provide real-time feedback. This feedback is very important; it not only highlights areas that need improvement but also validates the design decisions made at earlier stages. For example, if a user expresses confusion regarding a particular feature during testing, adjustments are immediately made to simplify that aspect of the interface. Next, an interactive prototype was created for users to try out the website's features. Testing was conducted through direct observation of users as they completed specific tasks, such as making a purchase or searching for information on the FAQ page. These observations recorded any difficulties, confusion, or satisfaction that users experienced and were analyzed using qualitative descriptive methods. This analysis provides deep insight into the effectiveness of the design and identifies areas that need improvement but also validates the design decisions made at earlier stages. For example, if a user expresses confusion regarding a particular feature during testing, adjustments are immediately made to simplify that aspect of the interface.

Ultimately, by incorporating user feedback into the entire design process-from initial interviews to final usability testing-the CarbonArea team was able to create a website that not only met but exceeded user needs. The systematic incorporation of this feedback resulted in better navigation, improved visual elements, and a more intuitive overall experience.

RESULTS AND DISCUSSION

In the results section of the "Implementation of User Centered Design Method on CarbonArea Website User Experience," the evaluation of the CO2 level distribution map and other features was conducted using a combination of quantitative and qualitative methods to ensure they met user expectations in terms of usability and interactivity. Usability testing was performed through direct observation of users interacting with the website, focusing on their ability to navigate and utilize the features effectively. Metrics such as task completion rates, time taken to complete tasks, and error rates were recorded to quantify usability. Additionally, user feedback was gathered through surveys and interviews post-interaction, allowing for insights into user satisfaction and areas for improvement. This mixed-methods approach enabled a comprehensive assessment of user experience, ensuring that the design not only functioned as intended but also resonated well with users' needs and preferences, ultimately enhancing the overall usability and interactivity of the website. (Fauzi *et al.* 2024).

In research, using the User Centered Design approach method which has a flow to process data to be more in-depth and accurate (Cahyani1 & Dwi, n.d.).

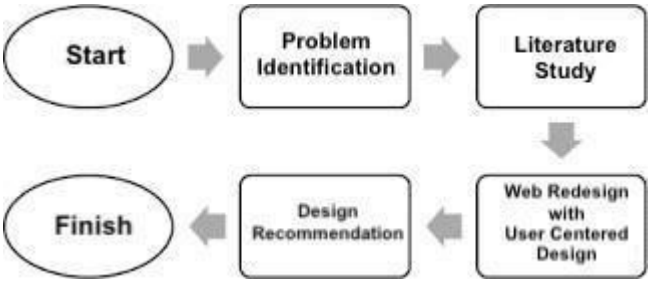


Figure 1. User Centered Design Research Flow

1. Start

   The initial process in the flow begins with the identification of user needs through information gathering, where data is collected from users on their needs for the system. This information becomes the beginning of designing features and workflows accordingly.

2. Problem Identification

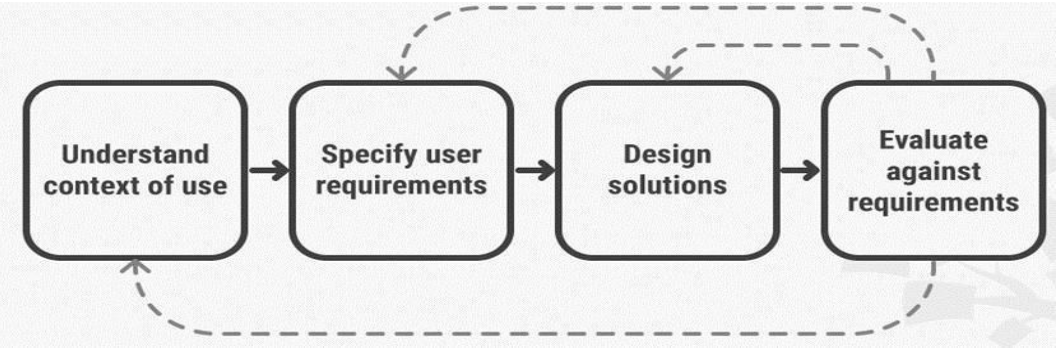
   Problem identification is one of the beginnings to proceed to other stages of the flow. At this stage aims to find out what problems exist in a project in order to get the appropriate results.

3. Literature Study

   This flow is needed to explore sources of knowledge that support research. Sources of information can come from previous research, books, and national and international journals.

4. Web Redesign with User Centered Design

   This method has 4 stages, namely:



Source : https://www.interaction-design.org/literature/topics/user-centered-design

Figure 2. User-Centered Design Process

- Understand context of use

  Understand the context of the system user, including who the application user is, the purpose of its use and the situation when the application is used. This understanding is an important stage to ensure that the application is in accordance with the needs and conditions of the user.
  Used to determine potential users, interviews and user personas.

Table 1. Potential User

Category	
Demographics	1. Male and Female 2. Age >18 years old 3. All ages.

Geographic	Jabodetabek domicile
Behavior	- Opening a plant business - Want to know the development of CO_2 levels

User Persona
Identity of Interviewee (Prospective User)
Name: Hendrawan Syahputra
Age : 18 years old
Occupation : Private Employee
Domicile : Depok

Background

Hendrawan is a private worker who lives in Sawangan, Depok. In addition, he is busy doing side jobs every day. Hendrawan often spends his time on his plant business.

Interview Question:

1. How important is information about carbon dioxide levels in your area for your daily activities or work?
   Answer: Very important, especially for monitoring air quality and its impact on the plants I grow.
2. What features or information do you wish were available on the website to monitor carbon dioxide levels in a particular region?
   Answer: I wish there were interactive maps and graphs showing the current CO_2 data in my area.
3. How would you prefer to receive or see updates on changes in CO_2 levels in your area? For example, through interactive maps, graphs, or periodic reports?
   Answer: I prefer to use interactive maps and graphs because they are easier to understand and quick to access.

From the results of these interview questions, it can be stated that information about carbon dioxide levels in each region is very important for potential users, especially those related to activities that affect air quality, such as agriculture. Potential users expect features that provide interactive maps and graphs as a tool to monitor CO_2 data in real-time. They also prefer visual data presentation formats, such as maps and graphs, because they are easier to understand and access quickly.

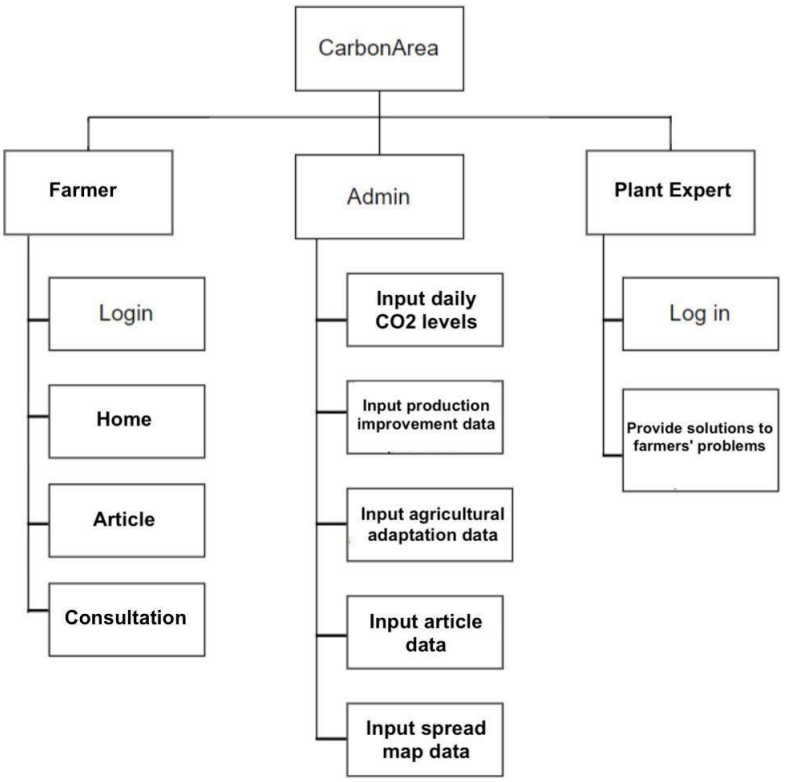


Figure 3. User Program Structure

- Specify user requirements

The next stage after understanding the context to be used then proceeds to the stage of determining user requirements. At this stage, it is required to identify user needs.
Used for problem solutions, user flow and wireframes.

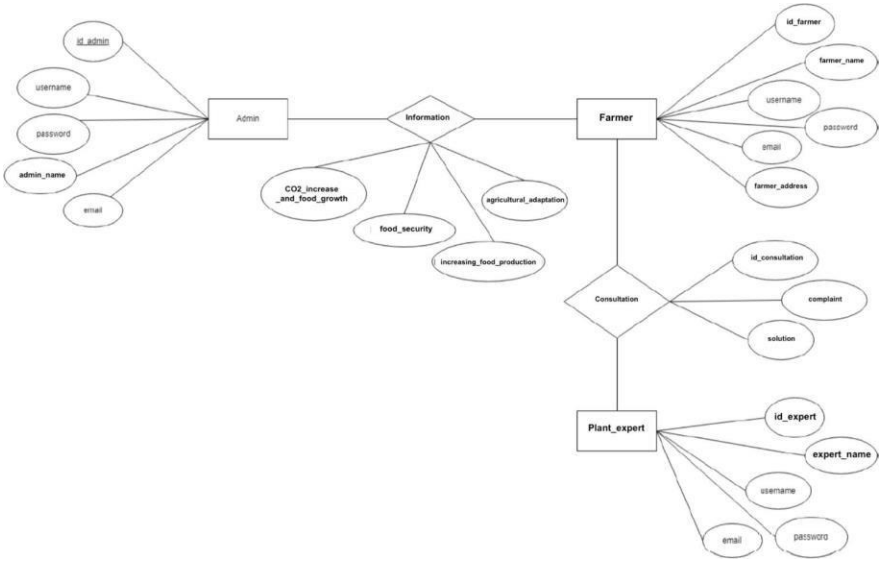


Figure 4. Relationship Scheme

This stage also requires a wireframe structure display on the website.

1. Wireframe Display Login / Register Website

Figure 5. Register / Sign Up

Figure 6. Login / Sign In Wireframe

2. Website Home Wireframe Display

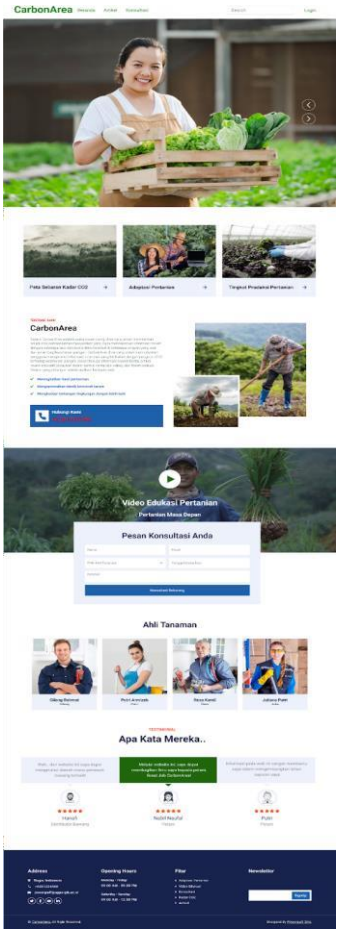


Figure 7. Homepage View

3. Website Article Wireframe Display

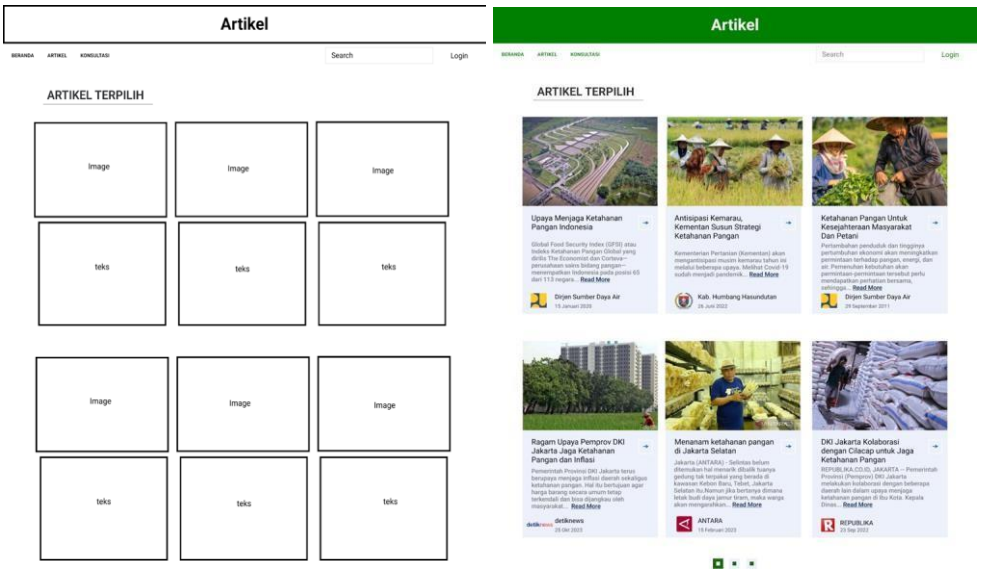


Figure 8. Article View

4. Consultation Screen Wireframe Display

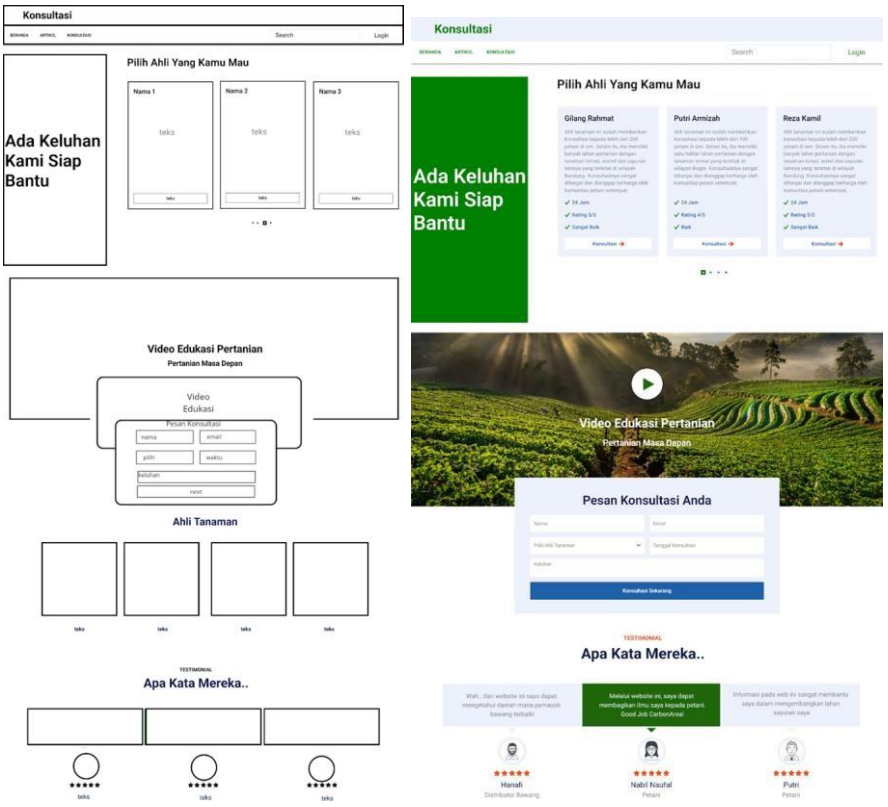


Figure 9. Consultation Screen View

- Design solutions

Designing solutions based on user needs that have been identified in the previous stage. This process includes several stages, ranging from the development of initial concepts, prototyping, to the preparation of a complete final design. This stage aims to produce a solution that fits the user's needs as a whole.

Used for interface display and prototyping.

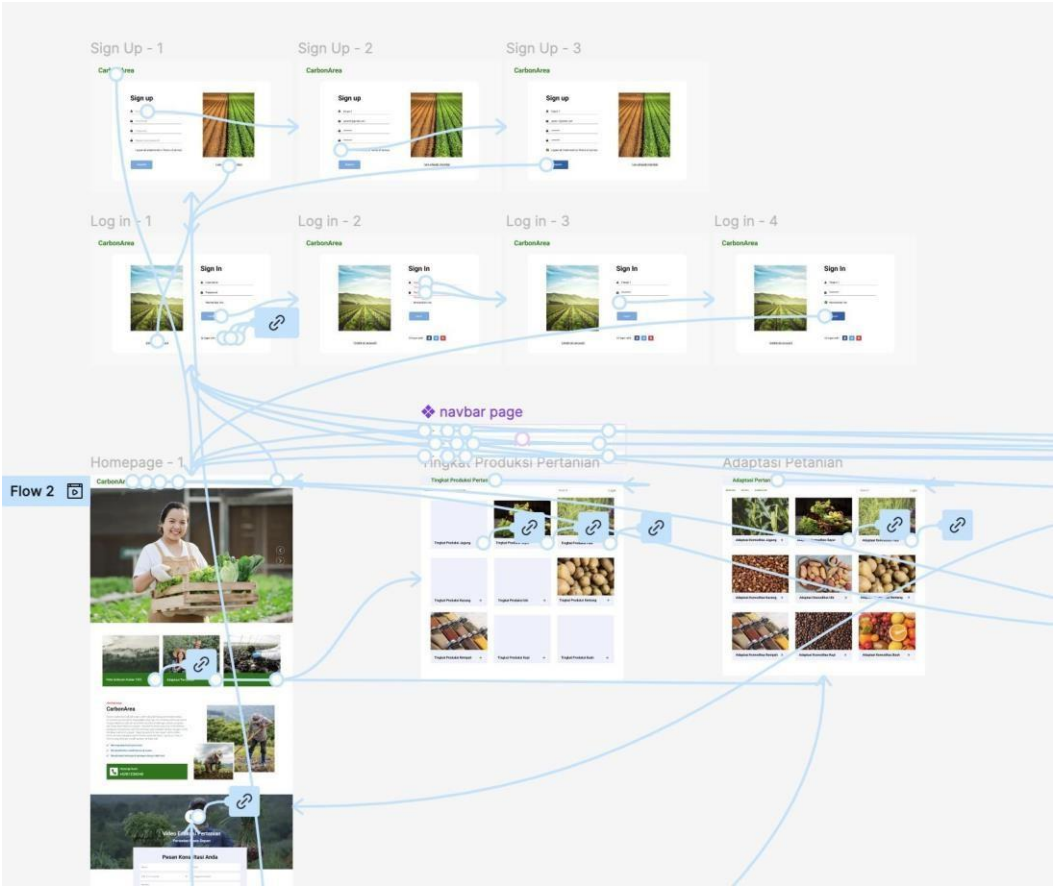


Figure 10. CarbonArea Prototype

- Evaluate against requirement

  There will be evaluation or testing at this stage and will ask for user assessment in this stage. This stage aims to assess the design directly to the user so that the level of conformity with user needs can be known.

Farmer Registration Function Test Results

The Farmer Registration Function Test Results table displays the results of testing the farmer registration function in a system or application. This table includes data on the performance, accuracy, and validity of the function based on various test scenarios.

Table 2. Farmer Registration Function Test Results Table

Test Case Name	Case Description	Initial Conditions	Tester
Farmer Registration Function	Sign up function - Normal conditions, incomplete fields	Registration view with empty fields.	Salman Al-farisi, Ika Septia Anggraeni, Annisa Aulia Rohim
Scenario			
Test procedure steps for test case [DUPL.CARBONAREA.001] 1. The homepage will be displayed with the Register button and the fields name, email, password, and repeat password. 2. After filling in all fields, the user must check the approval checkbox located above the Register button. 3. If the user presses the Register button but has not filled in the fields completely, a notification will appear. 4. There is an im already member button to sign in			
Results			

Which are expected	Observation	Results
1. After registering, users will be directed directly to the homepage	1. After registering, the account is directed to the homepage, but because there is no database, the register data that we input is not stored. therefore, when entering any data, it will still go to the homepage.	Succeed

Farmer Login Function Test Results

Farmer Login Function Test Results table records the results of farmer login function testing in the system. This table shows the performance, security, and accuracy of the login process based on the test scenarios that have been carried out.

Table 3. Farmer Login Function Test Results Table

Test Case Name	Case Description	Initial Conditions	Tester
Farmer Login Function	Login view with empty fields	Farmer Login Function	Salman Al-farisi, Ika Septia Anggraeni, Annisa Aulia Rohim
Scenario			
Test procedure steps for test case [DUPL.CARBONAREA.002] 1. The username and password fields will be displayed 2. The sign in button will be displayed 3. There is a remember me checkbox above the sign in button 4. If the data is correct → homepage 5. If the data is incomplete → notification to complete the field 6. Can login using Facebook, Twitter and Google. If you log in using the social media account, it will continue to the social media.			
Results			
Which are expected	**Observation**	**Results**	
1. If the username and password entered match, it will go to the home page.	1. Because there is no database, when entering arbitrary data, it will still go to the home page.	Succeed	

Function Testing

Function Testing is software testing that focuses on verifying whether each function in an application or system works according to its specifications. This testing involves providing input, observing output, and ensuring that the expected results are in accordance with the objectives that have been set.

Table 4. Home Function Testing Table

Test Case Name	Case Description	Initial Conditions	Tester
Home Function	Sign up function - Normal conditions, incomplete fields	Login view with empty fields.	Salman Al-farisi, Ika Septia Anggraeni, Annisa Aulia Rohim
Scenario			
Test procedure steps for test case [DUPL.CARBONAREA.003] 1. There is a slider to support the display 2. There is a distribution map feature, if clicked, a map of the distribution of CO_2 levels on the island of Java will appear. 3. There is an agricultural adaptation feature. If clicked, it will continue to the agricultural adaptation feature which contains some information about the adaptation of food commodities. If you click on commodity adaptation, the development of the food harvest area that we choose will appear. 4. There is an Agricultural Production Level feature. If clicked, the production level of several foods will appear 5. There is a consultation video feature. If clicked, it will be connected to the YouTube video 6. There is a Consultation Message feature. Name, email, drop down field to select a crop expert, and datepicker to select a consultation date will be displayed. Consult Now button to send a complaint. If you press the button and the fields are filled in completely and correctly → the consultation is sent. If you press the button but the field is incomplete → a notification appears. 7. There are several crop experts and ratings 8. There are testimonials from several farmers that will slide to the next farmer.			
Results			
Which are expected		**Observation**	**Results**
1. In the image if we click it, it will slider to another image 2. The distribution map feature, if clicked, a map of the distribution of CO_2 levels on the island of Java will appear. 3. Agricultural adaptation feature. If clicked, it will continue to the agricultural adaptation feature which contains some information about the adaptation of food commodities. 4. Agricultural Production Level feature. If clicked, several food production levels will appear 5. If you click the play button on the consultation video, it		will continue to the YouTube video.	6. Consultation Message Feature. Name, email, drop down field to select a crop expert, and datepicker to select a consultation date will be displayed. Consult Now button to send a complaint. If you press the button and the fields are filled in completely and correctly → the consultation is sent. If you press the button but the fields are incomplete → a notification

1. The slider image will change when clicking the button
2. The map appears when the distribution map feature is clicked.
3. The adaptation feature appears when clicked, but the data in the feature still does not match the data that should be in the feature.
4. The agricultural production level feature appears when clicked, but the data in the feature still does not match the data

appears. 7. Farmer testimonials have a left-right arrow. If you click right, it will move to the next testimonial (right). If you click left, it will move to the previous testimonial (left).		that should be in the feature. 5. YouTube videos appear when the play button on the consultation video is clicked. 6. When filling in data on the consultation message feature if there is empty data and click submit there is no notification. 7. There is an arrow on the farmer's testimony which, if clicked, will move to the next testimony.	

Article Function Testing Results

The Article Function Testing Results table shows the results of testing the function of an article in a system, including its performance, validity, and conformance to expected specifications.

Table 5. Article Function Test Results Table

Test Case Name	Case Description	Initial Conditions	Tester
Article Function	Article function - normal conditions, article display appears	Table column along with article supporting image	Salman Al-farisi, Ika Septia Anggraeni, Annisa Aulia Rohim

Scenario

Test procedure steps for test case [DUPL.CARBONAREA.004]

1. There are several articles about food, if we click the arrow it will continue to the full article and there is a source.
2. We can also choose to read more to read the full article.

Results

Which are expected	Observation	Results
1. User can see the selected article	1. Articles can be viewed in the article menu.	Succeed

Consultation Function Testing Results

The Consultation Function Testing Results table displays the results of consulting function testing in the system, which includes performance and accuracy based on test scenarios.

Table 6. Consultation Function Test Results Table

Test Case Name	Case Description	Initial Conditions	Tester

Consultation Function	Consultation function - normal conditions, a consultation view appears	Form to perform consultation	Salman Al-farisi, Ika Septia Anggraeni, Annisa Aulia Rohim

Scenario
Steps of test procedure for test case [DUPL.CARBONAREA.004] 1. Name, email, drop down field to select a plant expert, and datepicker to select a consultation date will be displayed. 2. Consult Now button to send a complaint 3. If you press the button and the fields are filled in completely and correctly → consultation sent 4. If you press the button but the field is incomplete → a notification appears

Results		
Which are expected	**Observation**	**Results**
1. Fill in the personal data completely, email using @, and if it has been filled in all will be sent to the plant expert 2. if the personal data is incomplete the data has not been sent to the plant expert 3. if the wrong email does not use @, it will appear "please include an @ in the email address"	*The consultation button when clicked does not bring up the personal data form that should be filled in.*	Succeed

CO_2 Level Distribution Map Function Test Results

The CO_2 Level Distribution Map Function Test Results table contains the test results of the CO_2 level distribution map function, including data accuracy and map visualization performance based on the test scenarios.

Table 7. CO_2 Level Distribution Map Function Test Results Table

Test Case Name	Case Description	Initial Conditions	Tester
CO_2 Level Distribution Map Function	Distribution map function - normal conditions, GIS appears	GIS display of the distribution of CO_2 levels on the island of Java	Salman Al-farisi, Ika Septia Anggraeni, Annisa Aulia Rohim

Scenario
Test procedure steps for test case [DUPL.CARBONAREA.006] 1. On the home menu there is a distribution map feature, if we click the arrow, a map of the distribution of CO_2 levels on the island of Java will appear. 2. If we click on one of the city points, the CO_2 levels in that city will appear. 3. There are + and - signs to enlarge and minimize the map.

Results		
Which are expected	**Observation**	**Results**

1. Users can see data on CO_2 levels and the level of danger	1. Data on CO_2 levels and the level of danger can be seen on the CO_2 level distribution map.	Succeed

Plant Expert Login Function Testing Results

The Plant Expert Login Function Testing Results table displays the results of the plant expert login functiontesting, including the performance and accuracy of system access according to the test scenario.

Table 8. Plant Expert Login Function Test Results Table

Test Case Name	Case Description	Initial Conditions	Tester
Plant Expert Login Function	Sign up function - Normal conditions, incomplete fields	Login view with empty fields	Salman Al-farisi, Ika Septia Anggraeni, Annisa Aulia Rohim
Scenario			
Test procedure steps for test case [DUPL.CARBONAREA.008] 1. Username and password fields will be displayed 2. The sign in button will be displayed 3. There is a remember me checkbox above the sign in button 4. If the data is correct → homepage 5. If the data is incomplete → notification to complete the field 6. Can login using Facebook, Twitter and Google. If you log in using the social media account, it will continue to the social media.			
Results			
Which are expected		**Observation**	**Results**
1. After the username and password are entered, it will lead to farmer complaints		1. Because there is no database, when entering arbitrary data, it will still go to farmer complaints.	Succeed

Consultation Reply Function Test Results

The Consultation Reply Function Test Results table presents the results of the consultation reply function test, which includes the accuracy and effectiveness in providing responses to user questions.

Table 9. Consultation Reply Function Test Results Table

Test Case Name	Case Description	Initial Conditions	Tester
Reply to Consultation Feature Function	Plant expert function to reply to farmer complaints	*Inbox of farmers who have sent complaints*	Salman Al-farisi, Ika Septia Anggraeni, Annisa Aulia Rohim
Scenario			
Test procedure steps for test case [DUPL.CARBONAREA.009] 1. The log out button and inbox list will be displayed 2. In the chat room there is a chatbox to reply to farmer complaints 3. There is an airplane icon to send a message			
Results			

Which are expected	Observation	Results
1. The advice given by the crop expert can be received by the farmer.	1. The advice given by the expert is	Succeed

		available but the farmer cannot send the consultation.	

Admin Login Function Testing Results

The Admin Login Function Testing Results table shows the results of admin login function testing, including performance, security, and accuracy of access to the system based on various test scenarios.

Table 10. Admin Login Function Test Results Table

Test Case Name	Case Description	Initial Conditions	Tester
Admin Login Function	Sign up function - normal conditions, incomplete fields	Login view with empty fields	Salman Al-farisi, Ika Septia Anggraeni, Annisa Aulia Rohim
Scenario			
Test procedure steps for test case [DUPL.CARBONAREA.011] 1. The username and password fields will be displayed 2. The sign in button will be displayed 3. There is a remember me checkbox above the sign in button 4. If the data is correct → homepage 5. If the data is incomplete → notification to complete the field 6. Can login using Facebook, Twitter and Google. If you log in using the social media account, it will continue to the social media.			
Results			
Which are expected		**Observation**	**Results**
1. After the username and password are entered, it will lead to the admin homepage		1. Becausethere is no database, when entering arbitrary data, it will still go to the farmer's complaint.	Succeed

CO_2 Level Data Input Function Test Results

The CO2 Level Data Input Function Test Results table records the results of the CO2 level data input function test, which includes the accuracy, validity, and efficiency of the data input process.

Table 11. CO_2 Level Input Function Test Results Table

Test Case Name	Case Description	Initial Conditions	Tester
CO_2 Level Data Input Function	Admin function to add CO_2 level data	CO_2 level data table that has been published on the website	Salman Al-farisi, Ika Septia Anggraeni, Annisa Aulia Rohim

Scenario

Test procedure steps for test case [DUPL.CARBONAREA.012]

1. The number, region, and CO_2 level data fields will be displayed. There is also a month drop down.

2. An add data button will be displayed to save the data
Results

Which are expected	Observation	Results
1. The data that has been added is in the agricultural adaptation data CO_2 levels	1. Because there is no database, when entering data and clicking the submit button the data does not enter the C02 level table on the website.	Succeed

Production Increase Data Input Function Test Results

The Production Increase Data Input Function Test Results ttable displays the results of the production increase data input function test, including the accuracy, validity, and effectiveness of processing the input information.

Table 12. Table of Production Increase Data Input Function Test Results

Test Case Name	Case Description	Initial Conditions	Tester
Production Increase Data Input Function	Admin function to add production improvement data	Production improvement data table that has been published on the website	Salman Al-farisi, Ika Septia Anggraeni, Annisa Aulia Rohim
Scenario			
Test procedure steps for test case [DUPL.CARBONAREA.013] 1. Number, agricultural commodity, and link fields will be displayed. 2. An add data button will be displayed to save the data			
Results			

Which are expected	Observation	Results
1. The data that has been added is in the production improvement data	1. Because there is no database, when entering data and clicking the submit button, the data does not enter the production improvement table on the website..	Succeed

Agricultural Adaptation Data Input Function Test Results

The Agricultural Adaptation Data Input Function Test Results table presents the results of the agricultural adaptation data input function test, including the accuracy and effectiveness of processing the input data.

Table 13 . Agricultural Adaptation Data Input Function Test Results

Test Case Name	Case Description	Initial Conditions	Tester
Agricultural Adaptation Data Input Function	Admin function to add agricultural adaptation data	Agricultural adaptation data table that has been published on the website	Salman Al-farisi, Ika Septia Anggraeni, Annisa Aulia Rohim
Scenario			
Test procedure steps for test case [DUPL.CARBONAREA.014] 1. The number field, agricultural commodity, and link will be displayed 2. The add data button will be displayed to save the data			
Results			
Which are expected		**Observation**	**Results**
1. The data that has been added is in the agricultural adaptation data		1. Because there is no database, when entering data and clicking the submit button, the data does not enter the agricultural adaptation table on the website.	Succeed

Results of Article Data Input Function Testing

The Results of Article Data Input Function Testing table presents the results of article data input function testing, which includes accuracy, validity, and efficiency in entering information into the system.

Table 14. Table of Results of Article Data Input Function Testing

Test Case Name	Case Description	Initial Conditions	Tester
Article Data Input Function	Admin function to add article data	Article data table that has been published on the website	Salman Al-farisi, Ika Septia Anggraeni, Annisa Aulia Rohim
Scenario			
Steps of the test procedure for test case [DUPL.CARBONAREA.015] 1. The field number, article title, link, and source will be displayed 2. The add data button will be displayed to save the data			
Results			
Which are expected		**Observation**	**Results**

1. Data that has been added is in the article data	Because there is no database, when entering data and clicking the submit	Succeed

button, the data does not enter the article data table on the website..

CONCLUSION

This study uses the User Centered Design (UCD) approach in developing user interfaces (UI) and user experiences (UX). The initial step is to determine the target users to analyze system requirements through information gathering, which is done through interviews. The information obtained is then analyzed to formulate system requirements, which are the basis for developing system features and workflows. The system requirements analysis stage aims to identify user needs so that the designed system is easy to understand and use. This analysis process involves four main stages, namely Understand the context of use, Specify user requirements, Design solutions and Evaluate against requirements. Through the UCD approach, system development becomes more focused because each stage is based on a deep understanding of the user. This process includes four important stages: understanding the context of use, determining user needs, designing solutions, and evaluating designs against requirements. By using interview data and a systematic development flow, the results of this study indicate that the UCD method is effective in creating functional interface designs that meet user expectations.

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