Blackbox Testing

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Blackbox Testing on the ReVAMP Results of The DutaTani Agricultural Information System

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Abstract

Information technology continues to evolve unceasingly. In line with the evolvement, agricultural sciences also transform the sense of technology utilization in its information systems to improve its quality and service. The Government of Indonesia strongly supports the use of information system technology in agriculture. DutaTani research team has consistently developed Agricultural Information System (AIS) technology since 2016 to achieve precision agriculture. These developments must be followed by continuous improvement of information systems carried out sustainably following changes and developments in the technology used. Testing is sorely needed in the system repair phase so that changes or improvements do not cause conflicts or problems in any pre-existing functions. The number of technologies that are tried to be applied in the repair phase tends to cause high system failures when they are tested on users. Based on these problems, this study aims to implement Blackbox testing to increase the system's success rate before general users utilize it. Blackbox testing is considered capable of bridging the development team and random respondents representing general users later. This research also added iterations to increase the success rate of the system. Respondents are invited to use the system through several main scenarios, but they have to fill in the input with variables that they have never filled in before. Through several iterations and following a test scenario created by an independent test team with ten random respondents, this study increased the system's success rate by 11.79%.

1 Introduction

When an application of an information system finishes the coding phase, the next step is to perform the testing phase. Software testing is a process of executing coding results to find errors,

bugs, or faults (Kumar & Sr, 2019). By definition, an error is generally the difference between the actual and expected output of a program, resulting in execution termination. Bugs are mistakes that programmers make when coding. Lastly, a fault is an error representation that stops execution and produces an incorrect output (Sethi, 2017).

In previous studies, the research team develo agricultural information systems (Delima, Santosa, et al., 2017). In this research, the system that will be tested is the DutaTani Agricultural Information System. This system includes several applications, including land preparation applications, data collection applications for farmers and agricultural activities, land processing applications, sales and purchase applications for crops, to learning applications for farmers and farmer groups (Chrismanto et al., 2019; Delima et al., 2018, 2019, 2020; Delima, Galih, et al., 2017). This system has been developed since 2016 by involving several alternating teams of programmers (Delima, Santosa, et al., 2017)

The dynamics of the development of the system raises several problems, including different programming styles and development tools, some of which are felt to be in need of updating. In the last iteration of development, researchers have implemented Code Smell Identification to test the code which has been hosted live at https://dutatani.id to align the separately developed modules. In addition, researchers also found that it is necessary to apply blockchain technology for data storage which is considered vital.

The discussion in this article will focus on testing with the Blackbox Testing technique on the main portal https://dutatani.id which includes:

1) functionality testing on the Homepage,
2) functionality testing on the login/user authentication section,
3) functionality testing on new account registration,
4) functionality testing of the account menu,
5) functionality testing of the menu details of personal data and member card, and
6) functionality testing of account profile changes.

The previous system (Delima, Santosa, et al., 2017) was developed with rapid application development (RAD) approach and usability testing, not paying attention to functional testing. This research aims to get an application with the best condition possible by seeking the smallest errors, bugs, and faults with the lp of Blackbox Testing and finding out the little things that the programmer team missed. This research also added iterations to increase the success rate of the system. The benefits obtained are an error-free Dutatani portal system that is ready for public use in eral and farmers or farmer groups in particular. This paper is written in the following order: introduction, literature review, research methods, results, and discussion, as well as conclusions and suggestions.

2 Literature Review

An information system is a collection of information technology (IT) that performs specific tasks in an organization or society (Boell & Cecez-Kecmanovic, 2015). Therefore, it is clear that AIS is an information system that carries out the task of managing agriculture business processes to assist farmers in making decisions in agricultural activities (Vidanapathirana, 2012). AIS has been widely developed according to the conditions of each farm. Since 2016, the Dutatani research team has been continuously developing several modules that are integrated into the agricultural information system, which can be accessed on the http://dutatani.id page (Delima, Santosa, et al., 2017)

In 2021, a new portal for IAIS was developed to improve its scalability. To get to an integrated agricultural digital identity system, it is necessary to test the new portal application first before it is

opened or tested to the general public to reduce critical problems that may arise (Mohammed, 2020). Several kinds of research also carry out system testing in software engineering, such as a review of automated testing of information systems (Absharina et al., 2019), where testing uses several automated methods at once. The Blackbox method is unsuitable for visual tests such as zooming or drawing on the screen (Larrea, 2017). Instead, this study tested business processes using the Blackbox method since it is considered more suitable for functionality testing.

The developer must immediately follow the Blackbox Testing carried out, then retest into several iterations (Purnomo et al., 2020). Iteration is the most crucial part of a method (Berente & Lyytinen, 2005) and its implementation. This study will also apply iteration so that the error level found in each test is less and less. Processing iterations is not an easy step. There are many challenging problems encountered in each iteration (Wynn & Eckert, 2017).

3 Research Method

The research was conducted by applying Blackbox Testing. This method performs testing by observing the execution results through the entered data and checking the functional response of the application. This test does not check the program code at all but only pays attention to the input and output of the application.

As stated by Ammann, Offutt, and Nowacka, the use of the Blackbox Testing method provides advantages (Amman & Offutt, 2016; Nowacka, 2021), including:

1) Testers do not need to know specific programming languages;
2) Testing is done from the user's point of view to help reveal any ambiguity or inconsistency in the requirements of the specification;
3) Based on the intuition and creativity of the testers, it is possible to find loopholes or bugs that the programmer has not thought of.

While the weaknesses include:

1) Time-consuming, especially for a menu that has many input fields;
2) If the tester is less creative, then the results will be limited; and
3) Does not discuss a lot about the backend aspect of the application itself.

The test case pass value will be calculated based on the formula (1) below from the six parts of the application that will be tested.

$$Test\ case\ pass = \frac{Test\ case\ passed}{Total\ test\ case} \times 100\% \quad (1)$$

The test case is a document that describes input or action on the system to find out whether the system that has been built can run properly as expected or not. The test case table has Scenario, Test Steps, Expected Results, Results, and Conclusion columns. The Scenario column is a group of test scenarios. The Test Step column contains the steps the user took. The Expected Result column is the condition or response expected from the application. The result contains the number of testers who managed to get the Expected Result. The summary is the predicate of the Test Step test results related to the result. If all testers succeed in getting the Expected Result, then the predicate is "Valid". If only 51-99% of testers succeed in getting the Expected Result, then the predicate is "Needs Rechecked". Meanwhile, if the number of successful testers is below 50%, the predicate is "Needs Revision". The scenarios, test cases, and expected results are described below.

A. Homepage
   1. The user clicks on “Berita” in the menu bar at the top. It is expected that the system will successfully open the News page.

2. The user clicks on every existing news link. It is expected that the system will succeed in bringing up news descriptions related to the attached links.
3. The user clicks on “Profil” in the menu bar at the top. It is expected that the system will successfully open the Profile page.
4. The user clicks on “Materi” in the menu bar at the top. It is expected that the system will successfully open the Material page.
5. The user clicks each “Buka” button in the “Materi” section. It is expected that the system will succeed in opening the details of the material in question.
6. The user types one word in the search field regarding the listed material or author. It is expected that the system will succeed in bringing up matching search results.
7. The user clicks “Login” in the menu bar at the top. It is expected that the system will successfully open the Login page.

B. User Authentication via Login
1. The user fills in the username that has been registered and fills in the correct password. It is expected that the system will successfully accept data entry and continue to the next process.
2. The user fills in the registered username, but the password is wrong. It is expected that the system rejects the data entered, and the process is not continued.
3. The user fills in a username that has not been registered with any password. It is expected that the system rejects the data entered, and the process is not continued.
4. The user checks “Ingat saya”, then logs in with the correct credentials. Then the browser is closed (or the computer is restarted). It is expected that when the web is re-opened, the user does not need to log in again.

C. New User Registration
1. The user clicks on “Daftar Akun Baru”. It is expected that the system will open the new account registration page.
2. The user chooses to register as a “Petani” and then fill in the other input fields correctly. It is expected that the system will successfully accept data entry, and when the account is completed, the account will be in Farmer status.
3. The user chooses to register as an “Pengajar” and then fill in the other input fields correctly. It is expected that the system will successfully accept data entry, and when the account is completed, the account will be in Pengajar status.
4. The user fills in “Username” with one character (or below the minimum limit). Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
5. The user fills in “Username” with 11 characters (or exceeding the maximum limit). Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
6. The user fills in “Username” by including one space in the middle. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
7. The user fills in “Username” with alphabet letters with character length according to the criteria. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the next process.
8. The user fills in “Nama” with a very long name that exceeds the maximum limit). Other input fields are filled correctly. It is expected that the system will warn that the name will be truncated, and the process will continue after the user confirms it.
9. The user fills in “Nama” with non-alphabet characters. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.

10. The user fills in “Nama” with alphabetic characters and character length according to the criteria. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the following process.
11. The user fills in “Email” with email that has been registered. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
12. The user fills in the “Email” with a string that does not meet the email address rules. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
13. The user fills in “Email” with the correct email and has never been registered. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the next process.
14. The user does not fill in “Alamat” with any input. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
15. The user fills in “Alamat” with any input. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the following process.
16. The user does not select “Propinsi” with any province options. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
17. The user selects one of the “Propinsi” options. Other input fields are filled incorrectly. It is expected that the system will successfully accept data entry and continue to the following process.
18. The user fills in “Nomor Telepon” with input other than numbers. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
19. The user fills in the “Nomor Telepon” by inputting numbers with a character length below the minimum limit. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
20. The user fills in the “Nomor Telepon” by inputting a number with a character length above the maximum limit (12). Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
21. The user fills in the “Nomor Telepon” with a total digit in accordance with the criteria. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the next process.
22. The user fills in “Tanggal Lahir” by writing dd/mm/yyyy. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the next process.
23. The user fills in “Tanggal Lahir” by selecting from the date picker. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the next process.
24. The user does not choose “Jenis Kelamin” with any options. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.

D. Account Menu

1. The user clicks on the “Dashboard” text. It is expected that the system will successfully open the Dashboard page.
2. The user clicks on “Data Diri”. It is expected that the system will successfully open the Personal Data page.
3. The user clicks on “Sign Out”. It is expected that the system will successfully log out of the account and return to the login page.

E. Details of Personal Data and Farmer's Card Printing
   1. The user clicks on "Cetak Kartu Anggota" button. It is expected that the system will successfully open the Member Card printing page.
   2. The user clicks the "Ubah Profil" button. It is expected that the system will successfully open the Change Profile page.

F. Edit Farmer's Profile
   1. The user clicks the "Choose File" button in the Change Photo section. It is expected that the system will successfully open the profile photo upload page.
   2. The user chooses and then uploads a file with an extension/type outside the criteria (JPG/PNG) as his profile photo. It is expected that the system rejects the data entered, and the process is not continued.
   3. The user selects and then uploads a file with the appropriate extension (JPG/PNG) as his profile photo. It is expected that the system will successfully accept data entry and continue to the next process.
   4. The user fills in "Nama" with a very long name that exceeds the maximum limit). Other input fields are filled correctly. It is expected that the system will give a warning that the name will be truncated, and the process will continue after the user confirms it.
   5. The user fills in "Nama" with non-alphabet characters. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
   6. The user fills in "Nama" with alphabetic characters and character length according to the criteria. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the next process.
   7. The user fills in the "Email" with an email that has already been registered. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
   8. The user fills in the "Email" with a string that does not meet the rules of the email address. Other input fields are filled correctly. It is expected that the system rejects the data entered and the process is not continued.
   9. The user fills in "Email" with the correct email and has never been registered. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the next process.
   10. The user does not fill in "Alamat" with any input. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
   11. The user fills in "Alamat" with any input. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the following process.
   12. The user does not select "Propinsi" with any province options. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
   13. The user selects one of the "Propinsi" options. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the following process.
   14. The user fills in "Nomor Telepon" with input other than numbers. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
   15. The user fills in the "Nomor Telepon" by inputting numbers with a character length below the minimum limit. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
   16. The user fills in the "Nomor Telepon" by inputting numbers with a total digit above the maximum limit. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.

17. The user fills in the “Nomor Telepon” with a total digit in accordance with the criteria. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the following process.
18. The user fills in “Tanggal Lahir” by writing dd/mm/yyyy. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the following process.
19. The user fills in “Tanggal Lahir” by selecting from the date picker. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the next process.
20. The user does not choose “Jenis Kelamin” with any options. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
21. The user selects one of the “Jenis Kelamin” options. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the following process.
22. The user fills in “Password” with the number of characters below the criteria. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
23. The user fills in “Password” with the number of characters according to the criteria. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the following process.
24. The user does not select “Kabupaten” with any options. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
25. The user selects one of the “Kabupaten” options. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the next process.
26. The user does not select the “Kecamatan” with any options. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
27. The user selects one of the “Kecamatan” options. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the next process.
28. The user does not select “Kelurahan/Desa” with any options. Other input fields are filled correctly. It is expected that the system rejects the data entered, and the process is not continued.
29. The user selects one of the “Kelurahan/Desa” options. Other input fields are filled correctly. It is expected that the system will successfully accept data entry and continue to the following process.
30. The user clicks the Back button. It is expected to cancel all changes, and the profile is displayed according to the previously stored data.
31. The user clicks the Save Changes button. It is expected to save all changes from each field, and the profile is displayed according to the latest data.

Researchers conducted two iterations of testing this application. The first iteration is tested with a black-box test, and the results will show what improvements are needed. After the application is repaired, the application is retested with the same black-box test for the second iteration. From there, there will be visible improvements in the hope for a better application, minimizing the possibility of errors, bugs, or faults.

4 Results and Discussion

The application to be tested is developed using the Laravel framework with software engineering methods in the form of prototyping to accommodate various changing needs due to changes in data. An overview of the application, in general, can be seen in Figure 1.

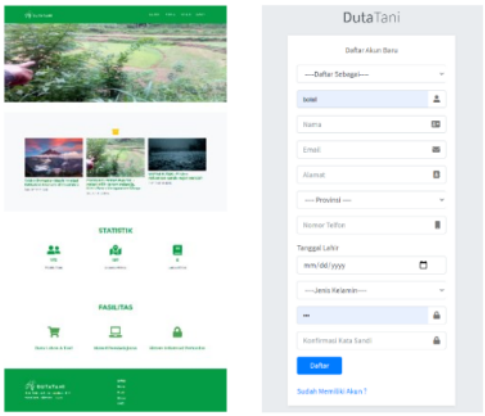

Figure 1. DutaTani Portal and Registration Menu

First-time users will be shown a web portal page containing news, statistical data, and agricultural materials (on the left), and when selecting the registration menu, the user will be shown the registration page (on the right). The site map to be tested is shown in Figure 2. Through the use case diagram, it can be seen the differences in features possessed by farmer users and administrators. Farmer users can only register and change personal data, while administrators can add and change data for all users. Administrators can also manage landing pages that contain news, content, and statistical data. The types of users who will access this application are depicted in Figure 3. The testers are selected from 10 independent developers who are not associated with this system project.

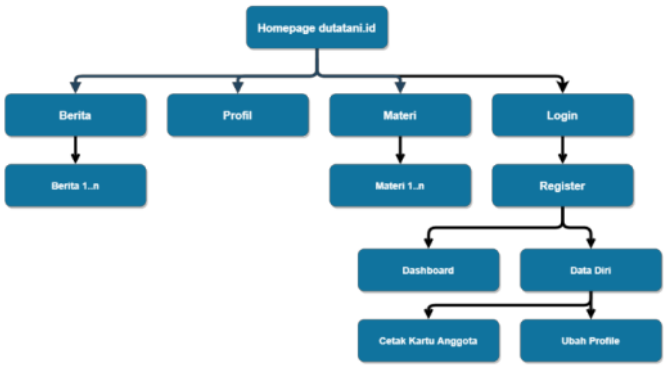

Figure 2. DutaTani Sitemap

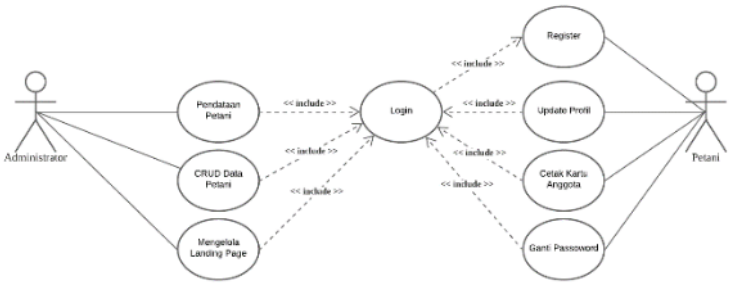

Figure 3. DutaTani Use Case Diagram

Test results for two iterations are described in the following review:

Test Case A (Homepage):

- For all of Test Case A, both iterations result in a 100% test case pass.

Test Case B (User Authentication via Login):

- There is an increase in test case pass by 20% to 77.5% for cases B2 and B3. For case 1 itself, has been successful since the first iteration. While for case B4, there is only one successful tester. Most likely, there is still a bug that does not allow the "Ingat saya" feature to work.

Test Case C (New User Registration):

- The test case results in this section are quite varied.
- Test cases C1, C21, C23, C25, C27, C28, and C29 have been successful since the first iteration.
- Except for the test case above, there was a significant increase increasing by 31.04% so that the final test case score for section C became 94.83%.

Test Case D (Account Menu):

- For all of Test Case D, both iterations result in a 100% test case pass.

Test Case E (Details of Personal Data and Farmer's Card Printing):

- For all of Test Case E, both iterations result in a 100% test case pass.

Test Case F (Edit Farmer's Profile):

- The test case results in this section are pretty varied also.
- Test cases F1, F9, F11, F25, F27, F29, and F30 have been successful since the first iteration.
- A significant increase in test cases F2, F5, F14, F15, and F16 uplifted the score by about 19.68%.
- There is no increasing result for test cases F3, F8, and F20, which is still not 100% successful.
- The test cases that still need to be considered are the F7, F10, F20, F22, F23, F24, F26, and F28 test cases because the successful tester is still below 5.

Based on the test results, the combined results are presented in Tabel 1.

Test Part	Test Case Pass for 2nd Iteration	Test Case		
		Valid	Need Rechecked	Need Revision
A	100%	7 items (100%)	-	-
B	77.5%	3 items (75%)	-	1 items (25%)
C	94.83%	21 items (72.41%)	7 items (24.14%)	1 items (3.45%)
D	100%	3 items (100%)	-	-
E	100%	2 items (100%)	-	-
F	69.68%	15 items (48.39%)	6 items (19.35%)	10 items (32.26%)

Table 1. Test Data Recap

Based on these results, it can be concluded that this system has improved by more than 11% from the old system. Some issues that still need to be addressed include:

1) "Ingat saya" feature is yet to be working,
2) Confirmation of whether a full name is to be truncated or rejected when its total characters entered exceeds the limit,
3) Email uniqueness check is yet to be working,
4) Addresses, provinces, regency, sub-districts, and urban villages data entry can still be passed or are left empty, and
5) Password completion is yet to have a security suggestion limit.

The input from this test will be used as the next step in developing this application.

5 Conclusion

A significant decrease in test case items from the two iterations using Blackbox Testing causes the "Needs Recheck" and "Needs Revision" predicates. By using iterations, the test can increase the success of the program trial by 11.79%. In other words, the validity of the application features has increased quite a bit. The following research will continue usability testing of the system's features equipped and then develop a mobile-based IAIS DutaTani.

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Blackbox Testing

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