

BLACK BOX TESTING IN THE ACCESS BY KAI APPLICATION USING BOUNDARY VALUE ANALYSIS AND GRAPH-BASED TESTING**I Gusti Lanang Agung Oka Cahyadi Pradipta¹, Irnayanti Dwi Kusuma², Umi Laili Yuhana³**^{1,2,3}*Teknik Informatika, Fakultas Elektro dan Informatika Cerdas, Institut Teknologi Sepuluh Nopember*
*Email: 6025232021@student.its.ac.id***ABSTRACT**

The Access by KAI application is an application that focuses on the process of ordering train tickets via internet technology. The aim of making this application is to help make it easier for people to order train tickets. By creating this application, it is hoped that it can increase train ticket sales and make it easier for people to order train tickets online. Each feature of this application was subject to testing to ensure that it was running according to the expected functionality. The testing of a Black Box Testing using Boundaries Value Analysis and Graph-Based Test on the Access by KAI has success percentage 78%.

Keywords: Black Box Testing, BVA, Graph-Based Test, KAIPay

ABSTRAK

Aplikasi Access by KAI merupakan aplikasi yang fokus pada proses pemesanan tiket kereta api melalui teknologi internet. Tujuan dibuatnya aplikasi ini adalah untuk membantu memudahkan masyarakat dalam memesan tiket kereta api. Dengan dibuatnya aplikasi ini diharapkan dapat meningkatkan penjualan tiket kereta api dan memudahkan masyarakat dalam memesan tiket kereta api secara online. Setiap fitur aplikasi ini telah diuji untuk memastikan bahwa fitur tersebut berjalan sesuai dengan fungsionalitas yang diharapkan. Pengujian Black Box Testing menggunakan Boundaries Value Analysis dan Graph-Based Test pada Akses oleh KAI mempunyai persentase keberhasilan sebesar 78%.

Kata Kunci: Black Box Testing, BVA, Graph-Based Test, KAIPay

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1. INTRODUCTION

1.1. Background

Testing is an integral part of application development. Testing is a series of activities to find errors in the content, functionality, usability, navigability, performance, and security of an application (Everett, 2007). The importance of application testing and its implications refer to quality assurance and application quality. According to ISO-9216, one of the characteristics of a quality application is that the application is able to work functionally, namely testing that ensures that the application can run according to the expected functional requirements (Tian, 2005). This test is also carried out to find an error after going through the manufacturing or development stage. In addition, this test also aims to make a software better and maintain its quality (Kartiko, Wiguna, & Ma'ruf, 2020).

This Access by KAI application is an application that focuses on the process of booking train tickets through internet technology. The creation of this application aims to help facilitate the community in booking train tickets. With the creation of this application is expected to increase the sale of train tickets and can facilitate the public in booking train tickets online.

This paper aims to explore the application of Black Box Testing on the Access application used by PT Kereta Api Indonesia (KAI). This Access application has an important role in facilitating various operational processes at PT KAI, so ensuring its reliability and functionality is crucial. One type of testing that focuses on the functional requirements of the application is black box testing. The benefits of black box testing can determine how well and deficiencies the system performs its functions and user interaction with the application. Black box testing requires designing test cases that serve to identify and provide conditions that will be implemented in testing, to ensure that the application can meet the functional needs of the user (Ron, 2004). However, researchers will focus on the Boundary Value Analysis and Graph-based testing techniques. The combination of these two techniques is expected to provide comprehensive test coverage, detect bugs or errors that may occur in the Access application. The use of the Boundary Value Analysis technique as a determinant of the upper and lower limits of input. With the research object of this Access by KAI application which has many input features, the Boundary Value Analysis technique as a

guard in the input limit. (Sutantoet al.2018). Graph based testing is a test that represents the relationship between objects in the module so that each object and its relationship can be tested. By using Graph Based Testing the tester can understand the objects modelled in the software and can determine the relationship between these objects. This can be done by creating a graph of important objects. The next step is to determine a series of tests that prove that all of these objects have appropriate relationships with each other.

By understanding the importance of Black Box Testing in effectively testing software applications, as well as applying it to the Access application which is vital for PT KAI, this research is expected to make a significant contribution in improving the quality and reliability of the system, as well as improving the user experience in using the application.

1.2. Literature Review

In this literature study section, the author looks for many sources related to testing to be used as a reference in research. The sources used by researchers are journals, papers, articles, and books to find as many references as possible related to similar studies that have been conducted by previous researchers and to retrieve relevant information related to this research.

1.2.1 Black Box Testing

Black box is a test that only tests the outside of the software. black box testing does not concentrate on the internal behaviour and structure of the program but black box testing is one of the important testing strategies in software testing that concentrates on finding circumstances how the program does not run according to its specifications Black box testing is a testing technique that focuses on the functional requirements of the software, based on the software requirements specification. There are several testing methods in black box testing such as equivalence partitioning, boundary value analysis, cause effect graph, comparison testing, random data selection, feature tests, all-pair testing, fuzzing, orthogonal array testing, sample testing, robustness testing, behaviour testing, performance testing, endurance testing, and others.(Wicaksono, 2022: 43)

1.2.1.1 Boundary Value Analysis

Boundary value analysis is a test that focuses on limits, where extreme values are selected.

Boundary value analysis is a method that tests the maximum and minimum number of limits to produce valid values that are considered relevant enough. Boundary value analysis prefers elements within the equivalence class on the boundary side of the class. Boundary value analysis is a complement to equivalence partitioning (Kartiko, Wiguna, & Ma'ruf, 2020: 16-20).

1.2.1.2 Graph-based Testing

Graph based testing is a test that represents the relationship between objects in the module so that each object and its relationship can be tested. By using Graph Based Testing the tester can understand the objects modelled in the software and can determine the relationship between these objects. This can be done by creating a graph of important objects. The next step is to determine a series of tests that prove that all these objects have an appropriate relationship with each other. (Ammann and Offutt p 3-7).

1.3 Research Methodology

This research uses the Black Box Testing method by applying Boundary Value Analysis and Graph- Based Testing techniques. Researchers compiled test scenarios according to the features that had been analysed and then designed possible test cases for each feature by creating partitions for each object to be tested. Scenario tests are carried out to see if the expected results are the same as the test results obtained. Furthermore, the stage of analysing and reporting evaluation results.

1.3.1 Testing flow

Testing flow on the Access by KAI application
The research flow is in accordance with Figure 1.

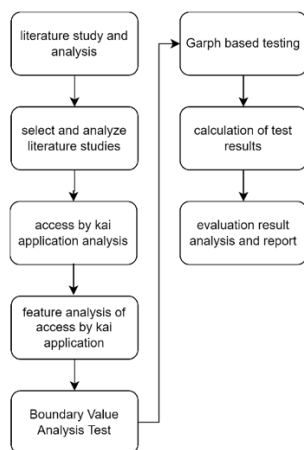


Figure 1. Research Flow

The flow of this research is as follows:

1. Identify the functionality and use cases of the Access by KAI application.
2. Identify the types of data received by the application and categorize them into valid and invalid classes.
3. Identify the upper and lower limit values of each valid and invalid class.
4. Create test cases to test the upper and lower limit values of each valid and invalid class.
5. Using Graph-Based Testing to identify cases that need to be suppressed based on the connections between objects and relations in the application.
6. Create test cases to test the cases found with Graph-Based Testing.
7. Check the results of the test cases that have been created and correct the application if any errors are found.

1.3.2 Boundary Value Analysis (BVA)

Boundary Value Analysis focuses on testing the boundary values of application inputs and outputs. This test aims to find bugs that occur at extreme values.

- Parameter Testing Boundary Value Analysis:
 - Testing minimum and maximum user age limits
 - Testing the minimum and maximum number of tickets booked
 - Minimum and maximum order date testing

1.3.3 Graph-Based Testing (GBT)

- Graph based testing uses graphs to model the application workflow. This test aims to find bugs that occur in complex workflows.
- Parameter testing Graph based testing:
 - Ticket booking flow testing
 - Testing the ticket cancellation flow
 - Payment flow testing

2. RESULT AND DISCUSSION

The application tested in this study is a mobile application of Indonesia Train Transport and the feature tested is listed in Table 1. Each of feature tested with black box testing and graph-based test.

Table 1. List of Tested Feature

Test ID	Name of Feature ID	Payment Method
A01	Registration	-
A02	Login	-
A03	Activation KAIPay	-
A04	Local	QRIS
A05	Commuter line	KAIPay
A06	LRT	KAIPay
A07	Airport	QRIS
A08	Whoosh	QRIS
A09	Passenger List	-

Figure 2. Registration Feature

In Figure 2 Customer Registration Form consists of sections that must be completed so that the customer can be registered in the application. Based on the BVA testing, the test result for Test ID A01 can be seen in Table 2.

Table 2. Analysis Testing for Test ID A01

Test ID	Test Case	Expected Result	Test Result
A01.0 1	Input field gender, full name, ID type, ID number, date of birth, email, Phone number and password then click register	Pop up show "Names cannot exceed 30 characters"	Not Appropriate
A01.0 2	Input password does not meet requirement "minimum 6 characters, combination of letters and numbers"	Pop up show "Format Password invalid."	Appropriate
A01.0 3	Input ID Number, Email, Phone number which already registered	Pop up shown "Identification number or email or phone number has been registered"	Appropriate
A01.0 4	Input form registration with condition email or phone number is empty	The "Register" button cannot be clicked	Appropriate

Test ID A01 consist of 4 scenario which in scenario A0.01 result is not appropriate. However, the GBT

can be seen in Figure 3. The process of Test ID A01 are as follows:

1. If the email and phone number are correct, the display will move to the next form which is fill in a password.
2. If the email and phone number are incorrect or vice versa, there will be a pop up shown "Email or phone number cannot be empty".
3. If the password is match the requirement, then system will send OTP .
4. If the password is not match the requirement, then system shown "The password minimum 8 character and a combination of uppercase, lowercase letters and numbers".

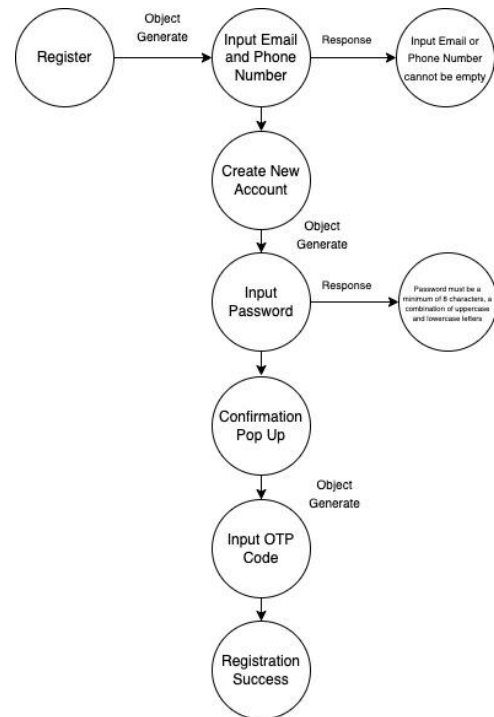


Figure 3. Graph-Based Test Result for Test ID A01



Figure 4. KAI Pay Activation Feature

PT KAI already has its own digital wallet for payment of various transactions in the KAI Access application, namely KAIpay. With the payment for purchasing or booking train tickets in the KAI Access application using KAIpay, of course, it makes it easier for customers to choose a payment

method for train tickets at KAI Access. Figure 4 the feature to activate KAIpay.

Table 3. Analysis Testing for Test ID A03

Test ID	Test Case	Expected Result	Test Result
A03.01	Click button "KAIPay Activation"	Move to page KAIPay	Appropriate
A03.02	Didn't tick checkbox of the terms and conditions then click button "KAIPay Activation"	Pop up shown "Please check the terms and conditions"	Appropriate
A03.03	Tick checkbox of the terms and conditions then click button "KAIPay Activation"	Move to page OTP verification	Appropriate
A03.04	Input wrong OTP code then click button "Next"	Pop up shown "Request processing Failed; nested exception"	Not Appropriate
A03.05	Input correct OTP code then click button "Next"	Move to page PIN activation	Appropriate
A03.06	Input new PIN and confirmation PIN but confirmation PIN isn't match as new PIN then click button "Next"	Shown information that confirmation PIN is not match	Appropriate
A03.07	Input new PIN and confirmation PIN then click button "Next"	Shown information that KAIPay activation is activated	Appropriate

Where the GBT of Test ID A03 can be seen in Figure 5.

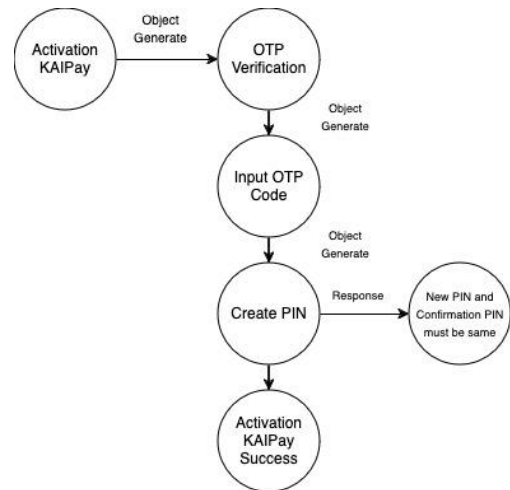


Figure 5. Graph-Based Test Result for Test ID A03

Test ID A03 consist of 7 scenario which in scenario A0.04 result is not appropriate. However, the GBT can be seen in Figure 5. The process of Test ID A03 are as follows:

1. If the new PIN and confirmation PIN is match, activation KAIPay is success.
2. If the new PIN and confirmation PIN is not match, the display shown "New PIN and Confirmation PIN must be same".

The test was continued on other seven features by applying black box testing and GBT. Thus, both of the technique result is shown in Table 4.

Table 4. Test Result

No	Test ID	Test Result
1	A01	Not Appropriate
2	A02	Appropriate
3	A03	Not Appropriate
4	A04	Appropriate
5	A05	Appropriate
6	A06	Appropriate
7	A07	Appropriate
8	A08	Appropriate
9	A09	Appropriate

The test result in table 4 obtained 7 test result were appropriate (78%) and 2 test result were not appropriate (22%). It means that black box testing and graph-based test has optimally found functionality discrepancies in the test case.

Table 5. Defect Found Information

No	Test ID	Defect Obtained	Defect Category	Suggestion
1	A01	Defect that found is the name must not exceed 30 characters	Incorrect input	Still tolerable
2	A03	Defect that found is user	Incorrect Alert Information	It is tolerable but nice if

		input wrong OTP then display shown "Request processing Failed; nested exception"		the alert information is clear enough.
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In Table 5, it can be seen the suggestion of researcher regarding the defect found when testing was carried out on 7 o the 9 features of Access by KAI.

3. CONCLUSION

The result of a Black Box Testing using Graph-Based Test on the Access by KAI consisted of 9 test case and 2 test case have defect that need to be improved. The success percentage of the result is 78%. In conclusion, using Black Box Testing and Graph-Based Test has optimally found functionality discrepancies in the test case.

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