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Boundary Value Analysis Testing Against Library Applications Using the Black Box Method as System Performance Optimization

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Abstract

The development of the use of advanced technology in the form of computerized applications has become a trend and is widely used in all fields. One of the fields that take advantage of the use of automated technology is the library. However, not all of these applications can run well by the application creation hypothesis. For this reason, application testing is required before implementation to avoid bugs or errors. Consider the application testing phase importance, testing with the black box method was carried out on library applications using the Boundary Value Analysis (BVA) technique in this study. These testing methods and techniques were chosen. When the application is implemented, there will be no more errors caused by differences in the value data during the input process with the stored value data, after testing using the black box method with the BVA technique and documentation of each test. All the library application functions have been running according to the initial application plan made, and there are no more bugs or errors when the application is run.

Keywords: Black Box Testing, Library, Java, Boundary Value Analysis

Abstrak

Perkembangan penggunaan teknologi canggih berupa aplikasi yang terkomputerisasi telah menjadi trend dan banyak digunakan di segala bidang. Salah satu bidang yang memanfaatkan penggunaan teknologi otomatis adalah perpustakaan. Namun tidak semua aplikasi tersebut dapat berjalan dengan baik berdasarkan hipotesis pembuatan aplikasi. Untuk itu, pengujian aplikasi diperlukan sebelum implementasi untuk menghindari bug atau kesalahan. Mempertimbangkan pentingnya tahap pengujian aplikasi, pengujian dengan metode black box dilakukan pada aplikasi library menggunakan teknik Boundary Value Analysis (BVA) pada penelitian ini. Metode dan teknik pengujian ini dipilih. Saat aplikasi diimplementasikan tidak akan ada lagi error yang disebabkan oleh perbedaan data nilai pada saat proses input dengan data nilai yang tersimpan, setelah dilakukan pengujian menggunakan metode black box dengan teknik BVA dan dokumentasi setiap pengujian. Semua fungsi aplikasi library sudah berjalan sesuai dengan rencana awal aplikasi yang dibuat, dan tidak ada lagi bug atau error saat aplikasi dijalankan.

Kata-kata kunci: *Pengujian Kotak Hitam, Pustaka, Java, Analisis Nilai Batas*

1. Introduction

The development of the use of advanced technology in the form of computerized applications has become a trend and is widely used in all fields. Even computerized applications have developed in significant business processes and have been commonly used in small business processes to facilitate transactions. The application itself is a program that can be used according to instructions from the user who will use the application to get faster and more accurate results as the application's purpose was made [1]. One area that also uses applications to facilitate data collection and transactions is the library. Among other things, the library's role is as an educational tool to increase knowledge and insight in the learning process [2]. Today, many libraries have implemented the use of applications for transactions. However, not all applications can run appropriately according to the application creation hypothesis. The increasing use of library applications and the many costs incurred due to application failure has motivated this research to be carried out to make the best system through careful testing. It makes application testing an essential step in building a computerized system [3].

Given the importance of the application testing phase, this study will conduct tests using the black-box method for library applications with the Boundary Value Analysis (BVA) technique. Black box testing focuses on the functionality requirements of an application so that during the input process, there are no errors both in function, interface, data structure, database access, and initialization and termination processes [4]. The black box method with the BVA technique is chosen. When the application is implemented, there are no more errors caused by differences in data values during the input process with stored data values.

2. Method

In this study, there are two methods used for data collection. First, the interview method is an activity to exchange ideas and information with questions and answers [5]. This interview process is used to find out how the system to be tested as a whole. Second, using the observation method as a formulation of test rules to be carried out. Observation is part of collecting data that has an innate nature, and actors interact in the observation environment [6].

A test is a process of finding errors in a program [7]. The method used by the author to test this library application uses a black box, where testing of this library application is essential to do before use so that the application can work as desired and there are no more errors in its implementation. The types of software testing include the first is a white box where this test

focuses on testing the input, process and output of a code in the program. In comparison, black-box testing is a method that is often used to test an application without the need to think about or know the application code. This test is done by observing the running of the program and checking the application's functionality.

In black-box testing, there are several techniques, including BVA or Limit Testing **[8].** The BVA technique is determined to be used as a test for Java-based library applications of the many existing methods. Boundary Value Analysis or commonly abbreviated as BVA, is a technique that performs testing for the maximum and minimum limits of the value entered into the program **[9].**

In black-box testing, there are several program testing flows. The test flowchart with the BVA technique is presented in the following **Figure 1.**

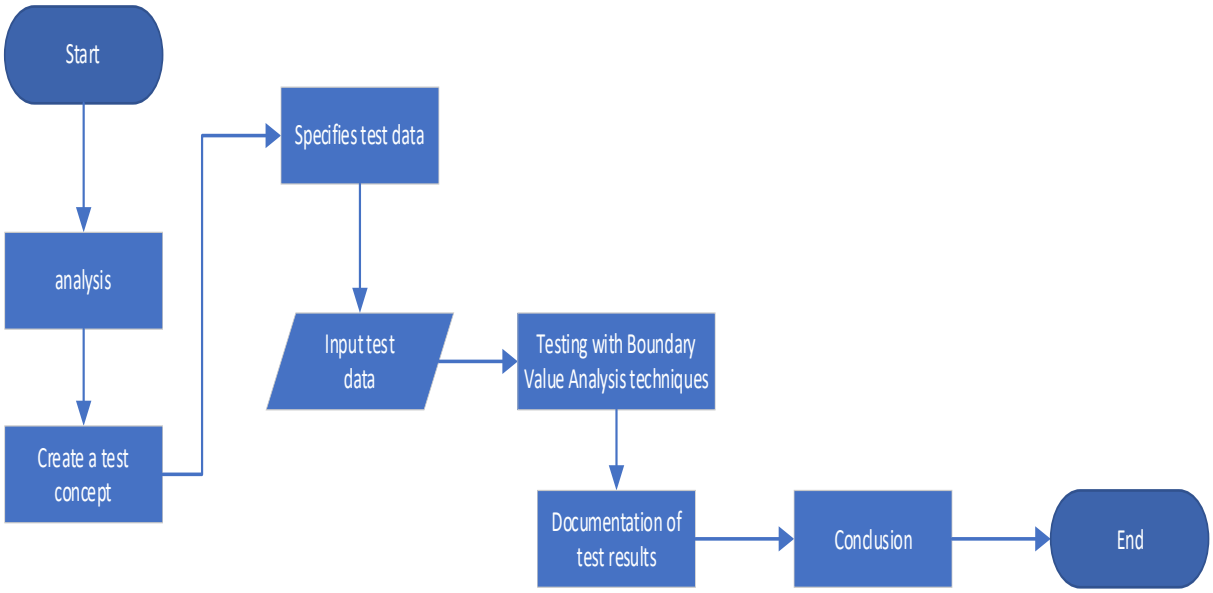

Figure 1. *Flowchart* Testing

The flowchart is a diagram that describes the flow of algorithms to solve a problem **[10]**. The picture above shows the flow of testing that will be carried out in the library program. First of all, it starts with identifying the problem, followed by making the concept of testing that will be used for library applications, determining the data to be tested, inputting the predetermined test data into the application. Next, do application testing using the BVA technique. After that, documentation of the test results is carried out and ends with the conclusions given.

3. Results and Discussion

a) Library Application Testing

Testing the library application using the black box method with the BVA technique will lead to several interface functions in the application, including the form list of books, student accounts and borrowing.

1) Testing List Book Form

In the first test, the author will test the list book form, which can be seen as **Figure 2**.

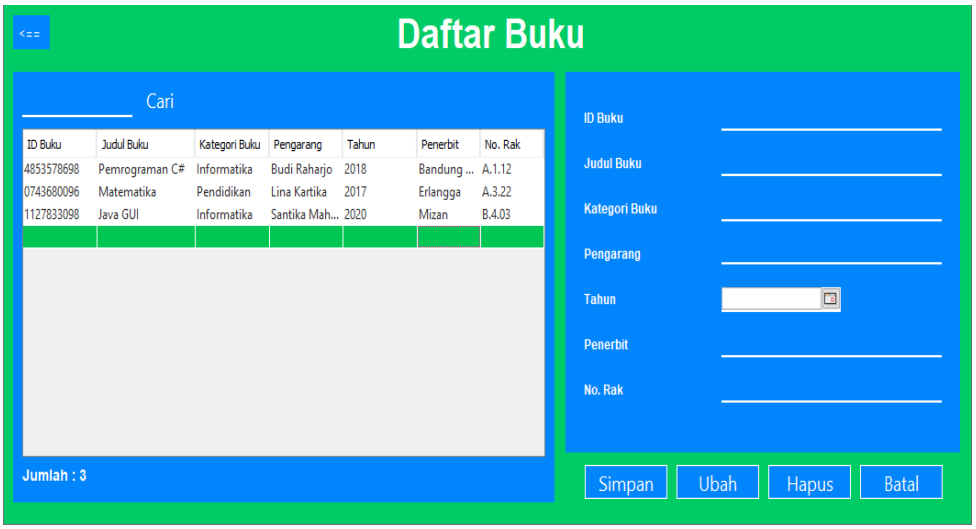

Figure 2. List Book Form

Figure 2 is a display of the form list of books to be tested with predetermined test data. In the results of testing the list book form, there are results as **Table 1**.

Table 1. Testing List Book Form

ID	Testing	Testing concept	Results are expected	Test result	Conclusion
1	Textbox Book ID Rules : Textbox Book ID can be filled with a maximum of 10 characters and cannot be empty.	a. Input 10 characters	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		b. Input less than ten characters	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		c. Input more than ten characters	There is a notification message and cannot input characters after the ten characters.	There is a notification message and cannot input characters after the ten characters.	Accepted
		d. *Textbox* Book ID is empty	There is a message that the Book ID is empty and cannot be saved	There is a message that the Book ID is blank and cannot be saved	Accepted

ID	Testing	Testing concept	Results are expected	Test result	Conclusion
2	*Textbox* Book title Rules : *A textbox* Book title can be filled with a maximum of 150 characters and cannot be empty.	a. Input 150 characters	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		b. Input less than 150 characters	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		c. Input more than 150 characters	There is a notification message and cannot input characters after the 150th character.	There is a notification message and cannot input characters after the 150th character.	Accepted
		d. *Textbox* book title is blank	There is a notification message, and it cannot be saved	There is a notification message, and it cannot be saved	Accepted
3	*Textbox* Book Category Rules : *Textbox* Book categories can be filled with a maximum of 50 characters.	a. Input 50 characters	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		b. Input less than 50 characters	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		c. Input more than 50 characters	There is a message notification that the characters are over and cannot input characters after the 50 characters.	There is a message notification that the characters are over and cannot input characters after the 50 characters.	Accepted
4	*Textbox* Author Rules : *Textbox* Author can be filled with a maximum of 50 characters.	a. Input 50 characters	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		b. Input less than 50 characters	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		c. Input more than 50 characters	There is a message notification that the characters are over and cannot input characters after the 50 characters.	There is a message notification that the characters are over and cannot input characters after the 50 characters.	Accepted
5	*Field* Year Rules : *Field* Year can not be empty	a. Input field year	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		b. Year field is left blank	There is an empty year field notification message and cannot be saved	There is a blank year field notification message and cannot be saved	Accepted

ID	Testing	Testing concept	Results are expected	Test result	Conclusion
6	*Textbox* Publisher Rules : *Textbox* Publisher can be filled with a maximum of 50 characters.	a. Input 50 characters	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		b. Input less than 50 characters	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		c. Input more than 50 characters	There is a message notification that the characters are over and cannot input characters after the 50 characters.	There is a message notification that the characters are over and cannot input characters after the 50 characters.	Accepted
7	*Textbox* No.Rack Rules : *Textbox* No. The rack can be filled with a maximum of 8 characters and cannot be empty.	a. Input 8 characters	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		b. Input less than eight characters	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		c. Input more than eight characters	There is a message notification that the characters are over and cannot input characters after the eight-character	There is a message notification that the characters are over and cannot input characters after the eight-character	Accepted
		d. *Textbox* No. Rack is empty	There is an empty rack notification message and cannot be saved	There is a blank rack notification message and cannot be saved	Accepted

The table above shows that all the functions contained in the booking form are going well.

2) Testing the Student Account List Form

The next test will be carried out on the student account list form, where this form is also essential and is a master form in the library application. The following are the results of tests carried out on the student account list presented **Figure 3**.

Figure 3. Student Account List Form

Figure 3 is the student account list form, where after being tested, there are the following test results in the **Table 2**.

Table 2. Testing the Student Account Form

ID	Testing	Testing concept	Results are expected	Test result	Conclusion
1	Textbox NIM Rules : Textbox NIM can be filled with a maximum of 10 characters and cannot be empty.	a. Input 10 characters	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		b. Input less than ten characters	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		c. Input more than ten characters	There is a message notification that the characters are over and cannot input characters after the ten characters.	There is a message notification that the characters are over and cannot input characters after the ten characters.	Accepted
		d. *Textbox* NIM is empty	There is an empty NIM notification message and cannot be saved	There is a blank NIM notification message and cannot be saved	Accepted
2	Textbox Name Rules : Textbox Name can be filled with a maximum of 50 characters and cannot be empty.	a. Input 50 characters	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		b. Input less than 50 characters	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		c. Input more than 50 characters	There is a message notification that the characters are over and cannot input characters after the 50 characters.	There is a message notification that the characters are over and cannot input characters after the 50 characters.	Accepted
		d. *Textbox* Name is empty	There is a notification message, and it cannot be saved	There is a notification message, and it cannot be saved	Accepted
3	Field Gender Rules : Field Gender cannot be empty	a. Input field gender	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		b. field gender is empty	There is a notification message, and it cannot be saved	There is a notification message, and it cannot be saved	Accepted

4	Date of birth Rules : Textbox The maximum place can be filled with 25 characters, and the date of birth cannot be empty.	a. Input 25 characters	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		b. Input less than 25 characters	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		c. Input more than 25 characters	There is a message notification that the characters are over and cannot input characters after the 25 characters.	There is a message notification that the characters are over and cannot input characters after the 25 characters.	Accepted
		d. field Date of birth is empty	There is a notification message, and it cannot be saved	There is a notification message, and it cannot be saved	Accepted
6	Textbox No. Hp Rules : Textbox No. Hp can be filled with a maximum of 12 digits and cannot be filled with characters.	a. Input 12 digit numbers	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		b. Input less than 12 digit numbers	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		c. Input more than 12 digit numbers	There is a notification message and cannot input numbers after the 12 digit	There is a notification message and cannot input numbers after the 12 digit	Accepted
		d. Input character	It cannot be input, and an error message appears	It cannot be input, and an error message appears	Accepted
7	Textbox Alamat Rules : It cannot be empty	a. Input *Textbox* Alamat	Save successfully, and there are no error messages	Save successfully, and there are no error messages	Accepted
		b. *Textbox* Alamat is empty	There is a notification message, and it cannot be saved	There is a notification message, and it cannot be saved	Accepted

The table above shows that all the functions contained in the student account list form are going well.

2) Testing the Loan Form

At the next stage, the examiner carries out tests on the loan form. This form has an essential role in borrowing books so that the loan form in the library application is designed to minimize human errors or bugs. Book loan from presented in the **Figure 4**.

Figure 4. Book Loan Form

The following is a table that shows testing on the book loan form, where the test results can be seen in **Table 3**.

Table 3. Testing the Loan Form

ID	Testing	Testing concept	Results are expected	Test result	Conclusion
1	Textbox Loan ID Rules : Textbox Loan ID Auto number and locked	a. Check Auto Number	Auto number successfully	Auto number successfully	Accepted
		b. Input Characters	Cannot enter or insert characters	Cannot enter or insert characters	Accepted
2	Textbox NIM Rules : Textbox NIM automatically fills in when selected and locked.	a. Select NIM based on data	Successfully displays selected data	Successfully displays selected data	Accepted
		b. Input Characters	Cannot enter or insert characters	Cannot enter or insert characters	Accepted
3	Textbox Name Rules : Textbox Name automatically fills in when selected and locked.	a. Select Name based on data	Successfully displays selected data	Successfully displays selected data	Accepted
		b. Input Characters	Cannot enter or insert characters	Cannot enter or insert characters	Accepted
4	Textbox Book ID Rules : Textbox Book ID automatically fills in when	a. Select Book ID based on data	Successfully displays selected data	Successfully displays selected data	Accepted
		b. Input Characters	Cannot enter or insert characters	Cannot enter or insert characters	Accepted

	selected and locked.				
6	Textbox Judul Buku Rules : Book Title Textbox automatically fills in when it is selected and locked.	a. Select Book Title based on data	Successfully displays selected data	Successfully displays selected data	Accepted
		b. Input Characters	Cannot enter or insert characters	Cannot enter or insert characters	Accepted
7	Textbox Author Rules : Textbox Author automatically fills in when it is selected and locked.	a. Select Author based on data	Successfully displays selected data	Successfully displays selected data	Accepted
		b. Input Characters	Cannot enter or insert characters	Cannot enter or insert characters	Accepted
8	Borrow Date Rules : The borrow date can only be filled in the current date	a. Input the current date	saved successfully, and there are no error messages	saved successfully, and there are no error messages	Accepted
		b. Input the previous date	there is an incorrect date notification	there is a false date notification	Accepted
		c. input the date the next day	there is an incorrect date notification	there is an incorrect date notification	Accepted
9	Return Date Rules: The return date can only be filled in with the date the next day	a. Input the date the next day	saved successfully, and there are no error messages	saved successfully, and there are no error messages	Accepted
		b. Input the previous date	there is an incorrect date notification	there is a false date notification	Accepted
		c. input the most recent date	there is an incorrect date notification	there is an incorrect date notification	Accepted

It can be seen in the table above that all the functions contained in the loan form went well, and all tests were successful.

3) Test Result

Based on the results of the above application testing, the following test recapitulation presented in the **Table 4**.

Table 4. Results of Application Testing Recapitulation

No.	Form	Percentage of Success (%)
1	Book List	100
2	Student Account	100
3	Loan	100

In table 4, there are three tested application forms. From the tests carried out, the results of the success of each document are 100% success rate. Test chart using a Black Box as presented in the **Figure 5**.

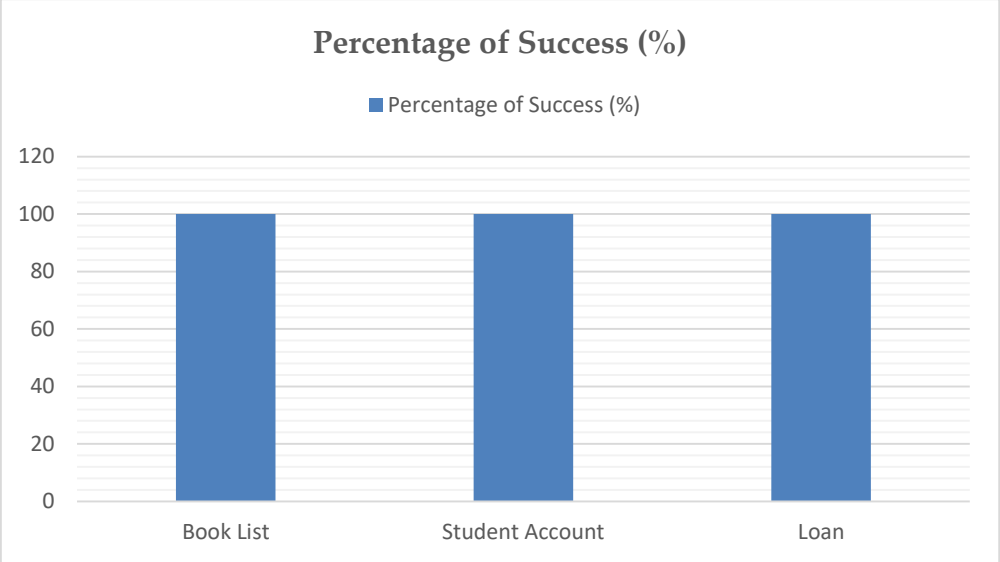

Figure 5. Black Box Testing Chart

It can be seen in the graph that there are no more errors or bugs in the entire library application form so that the application is feasible to implement.

4. Conclusion

The documented test results show that the application can run according to its original purpose with a 100% success rate. Technical errors due to inadequate systems are gone. So that the transaction process in the library application can run smoothly and the application is ready to be implemented.

Following the discussion that has been presented, the results show that application testing using the Black Box method with the BVA technique is a suitable testing technique and is easy to apply to library applications. The testing techniques that have been carried out can find bugs and errors so that they can be fixed immediately. Thus the library application can be implemented by minimizing all existing constraints

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