SAGA: Journal of Technology and Information Systems
Vol 3, Issue 1, February 2025, Page 363-372
ISSN: 2985-8933 (Media Online)
DOI: 10.58905/SAGA.v3i1.476

Android-based Programming Language to Natural Language Translator App

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Abstract. Translation between programming languages and natural languages is an important solution to improve the understanding of coding in informatics students who often have difficulty understanding the syntax rules of programming languages. This research develops a translator application that is integrated with OCR technology and uses GPT Chat API to automatically translate text. This application supports seven programming languages (Python, Kotlin, CSS, Dart, HTML, Javascript, and Java) and two natural languages (Indonesian and English). This research uses the Waterfall software development method, starting from requirements analysis, system design, implementation, to testing using the blackbox method. The results show that this application can help users understand coding more effectively and efficiently through translation features, interactive quizzes, and user activity history. Thus, this application has the potential to be an innovative learning media that improves the programming skills of informatics students.

Keywords: Coding Learning, Programming Language, Translator

1 Introduction

Understanding the source code of programming languages is the main foundation in education in the field of information technology and computer science. Source code has writing rules that have been determined by the programming language used. A programming language is a formal language designed to write instructions that can be understood by machines, such as computers, in order to perform certain tasks. Programming languages have defined writing rules that programmers must follow when they write statements or commands to run certain processes. However, the writing structure seems rigid or unnatural, making it difficult to understand [1].

In contrast, natural languages are languages used by humans to communicate on a daily basis, such as Indonesian and English. Natural languages have more flexible grammatical rules than programming languages. Understanding programming languages, which are more formal and structured, is often a challenge for many students in informatics and computer science.

Informatics or computer science students often have difficulty understanding the syntax of programming languages, which is the basis of education in the IT field. As a result, most of them lack understanding of coding so they tend to look for jobs outside their field of study. If this problem is not solved, the shortage of IT labor in Indonesia will be even greater [2].

From 2016 to 2020, there were at least 2,457,321 graduates, while the number of ICT-related jobs increased to 2,849,540 in the same period, according to the Central Bureau of Statistics' Sakernas data. This means that there is a digital skills shortage of 392,219 people during that period [3].

A number of solutions have been developed in the past to help with this problem, including a natural language to source code translation application for looping cases [1]. There are also function translation systems between C++, Java, and Python with high accuracy [4]. However, these solutions are less interactive, effective and efficient to use in learning media.

In this context, translator technology has an important role in connecting two different languages, whether in the form of text or instructions. Universally, translation technology is a system that uses linguistic algorithms, artificial intelligence, or computational rules to convert one language to another automatically [5]. The technology to be developed translates programming languages to natural languages.

Through observation of technological advances and existing needs, it is necessary to develop a Programming and Natural Language Interpreter application integrated with OCR technology that allows users to quickly scan text from a particular source or image [6], [7]. Furthermore, the translation process will use a third party, namely the GPT Chat API. This proposed API forwards invitations to the system in the form of proof of translation and

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translates text into the user's preferred language [8], [9]. With the development of the Translator application between Programming Language and Natural Language, it is hoped that learning coding can be effective and

2 Methods

This research uses the Waterfall software development method, which consists of a series of systematic stages. The first stage is the Needs Analysis, which aims to identify and document the needs of the system as a whole. Next, the System Design stage is carried out to design technical solutions as a guide before entering the development process. In the Implementation stage, the system design is converted into an application that functions as needed. After implementation, testing is carried out to ensure the application runs according to specifications and meets user needs. The last stage is Maintenance, which includes bug fixes and system optimization to keep it running well and as needed in the future [10].

Each stage in the Waterfall method is carried out sequentially and structured to ensure the results of application development are in line with expectations. This development flow is depicted more clearly in Figure 1.

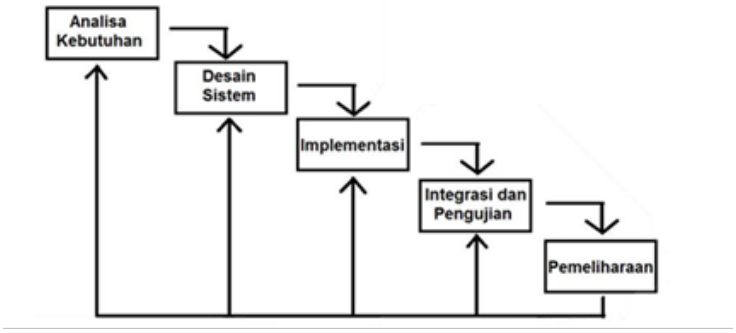

Figure 1. Stages of the Waterfall Method

3 Results and Discussion

3.1 Needs Analysis

The analysis stage was carried out through observations of several students majoring in Informatics. From the observation, it was found that many students still have difficulty in understanding and memorizing the writing rules in programming source code. Based on the understanding of user needs obtained from this analysis, the appropriate application interface can be designed at the next design and design stage.

3.2 System Design

At this stage, the ideas obtained from the results of the needs analysis in the previous stage are further developed. The ideas are then poured into the form of diagrams and user interface designs. The results of this design will be the main reference for the development process at the next stage [11].

3.2.1 Flowchart

A flowchart is created to show the flow of the application features. At the translation stage, it starts with the user entering the source code in the text field provided, if the source code is in the form of an image it will go through the scanning process using OCR then the source code text is displayed before being translated by the system. After validation and translation is done, the results will be displayed. The flow of this system is depicted by the flow chart in Figure 2.

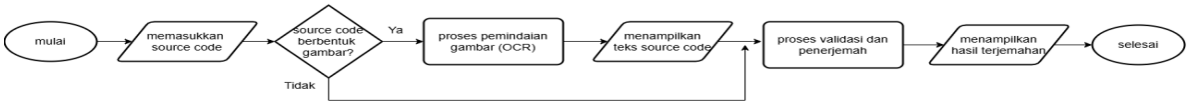

Figure 2. Translation Flowchart

In the quiz feature, users are required to choose a programming language first, then choose a quiz topic and start doing the quiz. After the quiz is done, the score calculation process will be carried out, the user will be considered to have passed the quiz topic if the score is above 10, and if the score is below 10 then the user does not pass. The flowchart of the quiz feature is shown in Figure 3.

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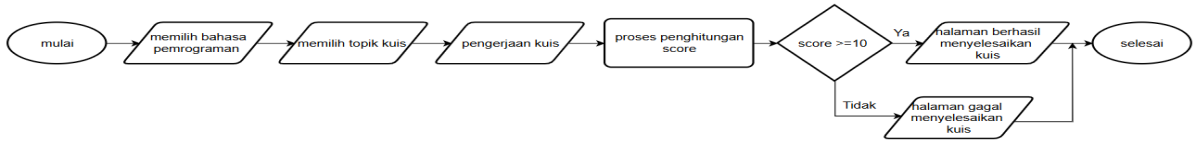

Figure 3. Flowchart of Quiz Feature

3.2.2 *Use Case Diagram*

This diagram is made to show the behavior pattern of the application to be developed [12]. Users can login by including a register, can perform translation that includes language selection, users can also view user history and profile. Use Case Diagram of this application is shown in Figure 4.

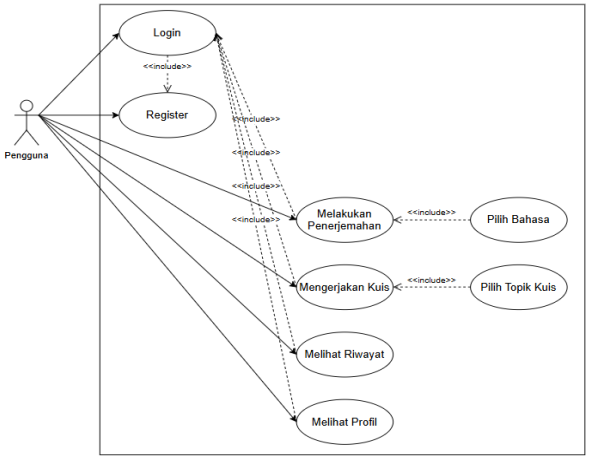

Figure 4. Use Case Diagram

3.2.3 Activity Diagram

Activity Diagram aims to show the flow of process activities of the system to be developed [13]. In the translation feature, the user enters the text to be translated, then the system will detect the type of input. If it is an image, it will pass the scanning process using OCR and then the source code text is displayed before being translated by the system. After validation and translation is done, the results will be displayed. The Activity Diagram of the translation feature is shown in Figure 5.

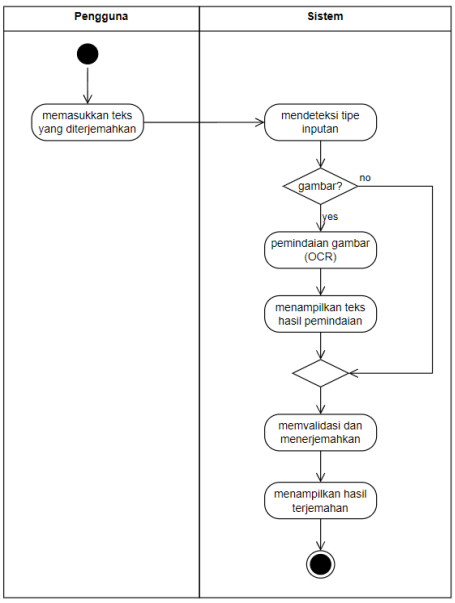

Figure 5. Translation Activity Diagram

SAGA: Journal of Technology and Information Systems
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In the quiz feature, after the user selects the programming language and quiz topic the system will display quiz questions that will be done by the user. After the user takes the quiz, the score will be calculated by the system. The activity diagram of the quiz is shown in Figure 6.

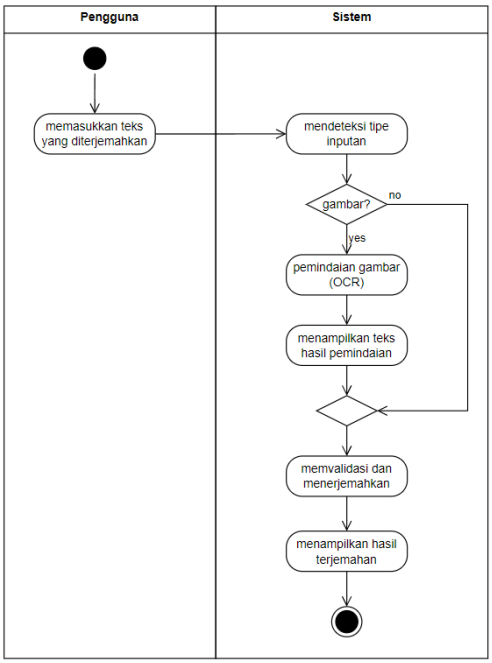

Figure 6. Activity Diagram

3.2.4 System Architecture Diagram

The System Architecture Diagram is created to show how the system components in the application interact. Users will send scripts that will be translated by the application, will be analyzed and converted image-shaped scritp into text with OCR before being translated by the GPT API. After the translation process is carried out, the results will be stored in the system database and can be called back by the application which is then sent to the user. System Architecture Diagram can be seen in Figure 7.

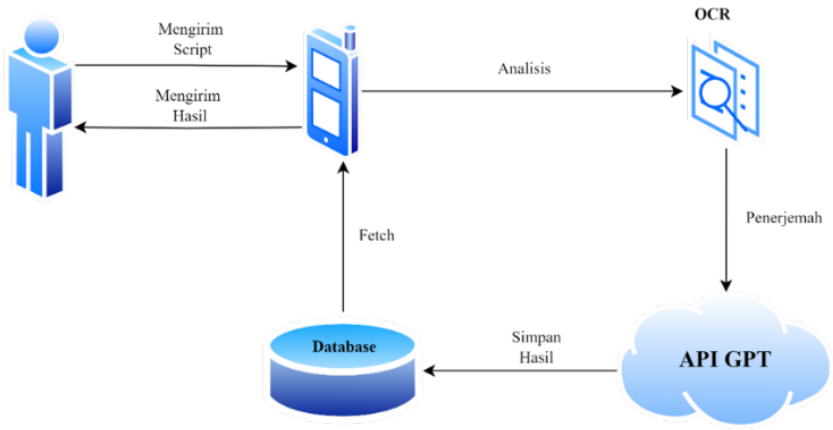

Figure 7. Architecture Diagram

3.3 Implementation

At this stage, the design in the previous stage is realized in the form of a series or program unit. To ensure that the program is ready to use, testing of each program unit is required [14].

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3.3.1 Login and Add Username Page

This page is where users authenticate their Google account before starting to use the application [15]. The Login page is shown in Figure 8.

If the authentication process is successful the user will be directed to the main page. If the google account selected by the user on the login page has not been registered then the user will be directed to the page to add a username first before starting the use of the application. The add username page is shown in Figure 9.

Figure 8. Page

Figure 9. Add Username page

3.3.2 Home Page and Translations

On the Main Page there is language selection, input type selection and also the latest activity of the translation process. The Main Page can be seen in Figure 10.

The Translation page is a page where the results of the translation process that has been carried out are displayed. The Translation page is shown in Figure 11

Figure 10. Main Page

Figure 11. Translation page

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3.3.3 Page

On the quiz page, users can choose the programming language quiz they want to take. On the quiz topic page there are various quiz topics based on 3 different levels. The quiz topic page is shown in Figure 13. The quiz question page displays the quiz questions and answers that are done. The quiz result page shows the results of the score of the quiz that has been done with the conditions of passing, namely a score equal to or greater than 10. The quiz result page can be seen in Figure 15.

Figure 12. Quiz Page

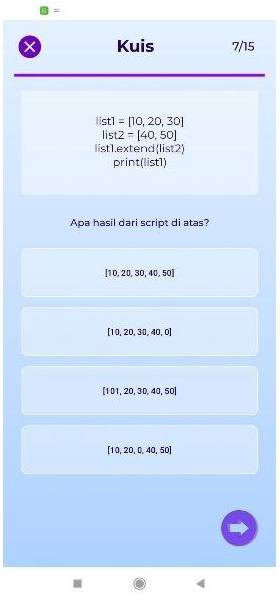

Figure 14. Quiz Problem Page

Figure 13: Quiz Topic Page

Figure 15. Quiz Result Page

The History page is a page that displays the last activity carried out both the translation process and quiz work. The display of the translation history page can be seen in Figure 16 and the quiz history page in Figure 17.

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Figure 16. Translation History

Figure 17. Quiz History

The Profile page displays the user's name and also the topic of the quiz that the user has successfully done with the pass category. The profile page can be seen in Figure 18

Figure 18. Profile Page

3.4 Testing

At this stage, the design in the previous stage is realized in the form of a series or program unit. To ensure that the program is ready for use, testing of each program unit is required.

3.4.1 Blackbox Testing

Testing is done using the Blackbox Testing method to ensure that the application runs according to specifications. The results of the tests carried out are shown in Table 1

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Table 1. *Blackbox* Testing Results

No.	Tested Features	Test Steps	Expected Results	Testing Results
	Sign in with a account	Select the sign in button, select email, add username	User name saved in database, display page	Successful
	Sign in with an account already in	Select the login button, select email	The application displays the page	Successful
	Scanning	Capture images with text using the camera and gallery to detect	The text on the image is successfully detected and	Successful
	Source Selection	Select Python as the source language in the	Display Python as the language	Successful
	Target Selection	Select Indonesia as the target language in the	Featuring Indonesian as the language	Successful
	Code translation to language	Enter the code print("Hello World"	Display the translation result as The Python code works to print the text "Hello World" on the screen	Successful
	Natural language to code translation	Select the switch button, Enter "generate looping code in multiples of	Display the translation result as for i in range(1,101) if i % 5 == 0 print(i)	Successful
	Quiz Completion with Score >=10	Take a quiz with a score above	Display quiz page successfully, display quiz score with color	Successful
9	Quiz Completion with Score	Take a quiz with a score below	Displays the failed quiz page, displays the quiz score in color	Successful
10	Exi	Press the exit button, confirm the selection	Successfully logged out of the account, displaying the login page	Successful

3.4.2 User Acceptance Test (UAT)

This test is conducted to assess the extent to which the developed application has met the needs of end users. This test involved 10 students of the Informatics study program who were the main target users of the application, and the evaluation was carried out using a questionnaire with the weighted values listed in Table 2.

Table 2. Weighted *User Acceptance Test* Score

Answe	Weigh
Strongly Agree (SS	
Agree (S	
Neutral (N	
Disagree (TS	
Strongly Disagree (STS	

In this test there are 10 total questions covering ease of use, functionality, performance, and user satisfaction. The data that has been collected from respondents is then sorted by answer and processed to obtain a total score.

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Table 3. *User Acceptance Test* Questionnaire Data Processing

No	Question	ST	T	S
	Does the login feature work well			
	Is the app interface clear and intuitive			
	Does the navigation process between pages (e.g. Dashboard, Quiz, History, Profile) run smoothly			
	Is the OCR result of the uploaded image accurate			
	Does the code translation to natural language feature deliver the results you expect?			
	Does the code-to-programming language translation feature deliver the results you expect?			
	Is the quiz system working properly, including grading and quiz results			
	Does the history display translation and quiz results properly?			
	Do you find this app easy to use			
	Does the app run smoothly without lag or glitches			
Tota				
Data Processing Results (Number X Weight Value				

Based on the total of the data processing results in table 3, the total score is 446. To determine the UAT Percentage value, the total score is calculated using the following formula:

$$Persentasi\ UAT = \frac{Total\ Skor}{Bobot\ tertinggi\ x\ (total\ pertanyaan\ x\ total\ responden)} x100\%$$

From the calculation of the formula, a value of 89.2% can be obtained. From this UAT test it can be concluded that of the 10 respondents 89.2%. agreed that the Ngothing application is easy to use, intuitive, and very helpful in understanding programming languages.

3.5 Maintenance

Maintenance is the final stage in the waterfall method. At this stage the application will be maintained, and improved to ensure the application can run optimally over time. This stage includes several activities as follows.

a. Improved Bugs and Errors
b. Feature enhancements, adapting to changing user needs over time
c. Monitoring and Logging

4 Conclusion

An Android-based programming language to natural language translator application was successfully developed to answer problems in understanding programming language syntax by informatics and computer science students. With the integration of OCR technology and API, this application is able to translate text from images or code input directly, thus providing an interactive, effective, and efficient learning solution.

Testing using the Blackbox Testing method showed that all features, including login, username addition, code translation, and quiz completion, functioned according to specifications. Meanwhile, the results of *User Acceptance Testing* (UAT) show that users find this application easy to use, intuitive, and helpful in understanding programming languages.

The results of testing and implementation of the application provide several development prospects, among others: 1) Adding support for more programming languages and natural languages to expand user coverage. 2) Integration of collaborative features for more interactive group learning. 3) Improving the performance of the application to be able to handle large data more efficiently. With these developments, the app is expected to continue to contribute in supporting education and digital skills development, especially in Indonesia.

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