Mobile Learning Application for Language and Automata Theory using Android-based

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ABSTRACT

The language and automata theory are which required course must implemented by college student in informatic engineering study program. In this course, there are finite state automata (FSA) and deterministic finite automata (DFA) which are important materials in language and automata theory. This material requires more understanding of mathematical logic from students to determine an input which can be accepted or rejected in an abstract machine system. The assist students to understand the material, it is need to develop the learning media for mobile learning applications for language and automata theory on finite state automata (FSA) and deterministic finite automata (DFA) based on android as an evaluation of learning media for students. And the development of this learning media use the ADDIE development model (analysis, design, development, implementation, evaluation) to design language and automata theory applications learning so can be support the learning process for students and then assist lecturer to explain the material more dynamic and applicative.

1. INTRODUCTION

One of the requirements for students to graduate and get a bachelor's degree is must to complete all courses. In the informatics engineering study program, there are required courses that must be taken by students, that is language and automata theory. The language and automata theory is part of computational theory in science computer. Some computational theories come from language and system engineering, especially based on mathematic [2]. This material requires more understanding of mathematical logic from students to determine an input which can be accepted or rejected in an abstract machine system. The automata machine in this case is not real machine, but abstract machine which manifest systems.

In this course, there are finite state automata (FSA) and deterministic finite automata (DFA) which are important materials in language and automata theory. Finite State Automata is abstract machine part of the language and automata theory. This theory very useful for technology development both software and hardware [2]. Finite state automata (FSA) which covers deterministic finite automata (DFA) will done if get an input and the result of the process is a accepted decision or not the input is given. DFA is a computational theory part of theoretical computer science. Therefore, the college students are required to understand the learning material for language and automata theory because used to find solution to solve problem the basic logic of a problem.

In general of learning process a lecturer gives explanations by speech and assisted to display the material use power point slide or take notes directly on the board. Then students listen and record the explanations from the lecturer. This learning process is more dominant to listen lecturer explanations cause the student less active, and not all students can understand the material because to understand of their different perception. So the lecturer is required to give the learning materials clearly and need to use of learning media can to bridge the process of material explanation more applicative so the learning process is easier to understand.

Based on the background of the problem, so need a mobile learning application for developing the language and automata theory for FSA and DFA material by using Adobe Air for Android as a learning media.
which can assist students to support the learning process is easy to use and can be used flexible in terms of place and time and can assist the lecturers to explain more dynamic and applicative of material.

2. METHOD

The development of learning media for mobile learning application of language and automata theory, the method used is ADDIE development (analysis, design, development, implementation, evaluation). ADDIE is one of learning system model that shows simple learning system and easy to learn. This model has five systematic components which related. So, this model must be used systematically and cannot be randomized to application. This model is simple and systematically structured, it is easier to understand. This method is used to create product application which concentrate on needs analysis so can be applied to user. The ADDIE development method has a systematic sequence, so the process when implementation can't be random.

2.1 Analysis

The development of learning media for language and automata theory begins by analyzing of some the necessary needs. They are analyzing the content of the material which easy to understand, analyzing questions that can be understand by student, and analyzing of the display application which easy to use for student. And for the student understanding, all of learning materials related to finite state automata (FSA) and deterministic finite automata (DFA) will be displayed to covers Non Deterministic Finite Automata (NFA) because NFA is part of Finite State Automata (FSA), equivalence, reduction, and NFA with ε-move.

![Figure 1. Use Case](image)

This table is a description of the use case information. Use case begins from user start the application until logout the application.

<table>
<thead>
<tr>
<th>NO</th>
<th>INFORMATION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Actor : User Use case : Start</td>
<td>- To start this application the user must first start</td>
</tr>
<tr>
<td>2</td>
<td>Use case : Main Menu</td>
<td>- This case show list of material and list of question</td>
</tr>
<tr>
<td>3</td>
<td>Use case : List of Material</td>
<td>- This case show the materials to be studied</td>
</tr>
<tr>
<td>4</td>
<td>Use case : List of Question</td>
<td>- This case only show question of finite state automata and deterministic finite automata</td>
</tr>
<tr>
<td>5</td>
<td>Actor : User Use case : Logout</td>
<td>- User logout from this application</td>
</tr>
</tbody>
</table>

2.1.1. The Language and Automata Theory

The language and automata theory is part of computational theory in science computer. Some computational theories come from language and system engineering, especially based on mathematic [1]. The Language and automata theory usually implemented to make programming language and compilers in the form of mathematical model to determine an input can be accepted or rejected on an automata machine (abstract machine).
Mobile Learning Apps For Developing The Language And Automata Theory For FSA And DFA Material

By Using Adobe Air for Android

(Maulana Muhamad Sulaiman¹, Romi Andrianto², Muhamad Arief Yulianto³)

For the example, implement an automata machine only accept input in English. Then the automata machine model can be described as follows:

The example above it is an automata machine which only accept input in english, if the machine gets the input string:
1. makan : rejected
2. make     : accepted
3. making  : accepted

A string will be accepted when it towards the final state (double circle) in this case is $q_6$ and $q_9$. The initial state is always preceded by an arrow without input (state $q_0$).

**2.1.2. Finite state automata (FSA)**

Finite State Automata is abstract machine part of the language and automata theory. This theory very useful for technology development both software and hardware. It is described as a mathematical model can accept input and produce output has a number of states and can move from one state to another based on input and transition functions. Finite state automata is expressed by pairs of 5 tuples, they are:

\[ M = (Q , \Sigma , \delta , S , F) \]

- $Q$ = the state set
- $\Sigma$ = input of symbol set
- $\delta$ = functions of transition $\delta : Q \times \Sigma \rightarrow Q$
- $S$ = initial state, $S \in Q$
- $F$ = final state, $F \subseteq Q$
Figure 4 is an example of implementation a finite state automata (FSA) machine model.

![Finite State Automata Diagram](image)

**Figure 4. Implementation of FSA Machine Model**

1. For example get to input : 1101
   Even number is 1, odd number is 1, even number is 0 even number is 1 so odd number → machine accepted
2. And get an input : 1100
   Even number is 1, odd number is 1, even number is 0, even number is 0 so even number → machine rejected

From the example above is :
Q = \{even, odd\}
Σ = \{0,1\}
S = even
F = \{odd\}

<table>
<thead>
<tr>
<th>even number</th>
<th>odd number</th>
<th>odd number</th>
<th>even number</th>
</tr>
</thead>
<tbody>
<tr>
<td>even number</td>
<td>odd number</td>
<td>odd number</td>
<td>even number</td>
</tr>
</tbody>
</table>

Table 2. The Transition function of FSA

2.1.3. Deterministic Finite Automata (DFA)

Deterministic finite automata (DFA) is part of the finite state automata (FSA) which is described a state there is exactly one next state for each received input symbol. For example, the test is to accept a bit string with an even number of 0, and an even number of 1.

1. **0011** : accepted
2. **10010** : rejected, because the number of 0 is odd

![DFA Diagram](image)

**Figure 5. DFA Machine Model**

This is a deterministic finite automata (DFA) of question above.
Q = \{q0,q1,q2,q3\}
Σ = \{0,1\}
S = q0
F = \{q0\}

Table 3 is the table of transition functions of deterministic state automata :

<table>
<thead>
<tr>
<th>q0</th>
<th>q1</th>
<th>q2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

\[ \delta(q0,011) = \delta(q2,11) = \delta(q3,1) = q2 \text{ rejected} \]
\[ \delta(q0,1010) = \delta(q1,010) = \delta(q3,10) = \delta(q2,0) = q0 \text{ accepted} \]
2.2. Design

After analyzing the material requirement, the next step is to design. This step is to design of application, it will be made with the application layout concept. This step the product design must consider all of components which are determined to make the next step easier. This development of learning media for language and automata theory, the implementation of the main menu is a priority because it displays the material to be displayed. The main menu design is designed to be as simple as possible to make it easier for user to use the automata learning media application.

![Figure 6. Layout of Main Menu](image1)

![Figure 7. Layout of Question Menu](image2)

The development of automata learning media is focused on finite state automata (FSA) and deterministic finite automata (DFA) materials. So design this learning application, only display finite state automata (FSA) and deterministic finite automata (DFA) questions.

2.3. Development

This step is step of the application production. The development of learning media for language and automata theory is implemented use Adobe Flash CS6 actionscript 3.0 as the main software developer. Adobe Flash CS 6 is a software is used to create animation more attractive and dynamic. Adobe Flash CS6 has many functions such as create animation, support to create web page animation, and can be used to create android application. The Development of this software same as create a flash project. The difference is the step of setting project execution is changed first to Air for Android.

2.4. Implementation

The implementation step is product trial has been developed to some respondents. In the development of learning media for language and automata theory, the respondents are students who are taking courses in language and automata theory. This step allows each student to give assessment and input this application used. The respondent assessment is the student to application based on specified criteria to test this learning application. Based on the criteria or assessment points are the material or learning, media, and user.

2.5. Evaluation

The evaluation was carried out to determine the results of the respondent's assessment, in this case the students about feasibility of development learning media for this learning application of language and automata theory. Critics and suggestion from the respondents of this application are needed to evaluate the product overall.

3. RESULTS AND DISCUSSION

The implementation of development for mobile learning application the language and automata theory on finite state automata (FSA) and deterministic finite automata (DFA) materials use Adobe Air for Android are
3.1. Display Interface

3.1.1 The Initial Display

The initial display is made very simple, that is to display the title of this course the language and automata theory on finite state automata (FSA) and deterministic finite automata (DFA) material then there is only one “start” button which functions to go to the main menu page.

![Figure 8. The Initial Display](image)

3.1.2 The Main Menu Display

In the main menu display is designed as simple as possible so the students will be able to use this application easier. This main menu layout, there are several buttons with material content and language theory and also automata questions. The material displayed are language and automata theory, finite state automata (FSA), deterministic finite automata (DFA), non deterministic finite automata (NFA), equivalence, reduction, NFA with c-move. And the question displayed are about finite state automata (FSA) and deterministic finite automata (DFA) question. In the main menu display it as “language and automata theory (Toeri Bahasa Automata), question displayed for FSA (SOAL FSA), question displayed for DFA (SOAL DFA), equivalence (EQUIVALENSI), reduction (REDUKSI), and NFA with e-move (NFA dengan E-Move”).

![Figure 9. The Main Menu Display](image)
3.1.3 The Material Menu Display

In this material menu display will be displayed is the material along with the sample question. To make it easier for students to understand the material, each material will be included with each sample question. And the material will be displayed in this course of language and automata theory is about finite state automata. The material of finite state automata covers deterministic finite automata, non-deterministic finite automata, equivalence, state reduction, and NFA with $\epsilon$-move. In the material menu display use Indonesian language, it as “Setiap FSA memiliki (Every FSA will consists)

![Figure 10. The Material Menu Display](image)

3.1.4 The Question Menu Display

In this question menu display there are accept and reject buttons so users can choose whether each input string can be accepted or rejected from each displayed question. The button display use Indonesian language, it as “accept (Diterima) and reject (Ditolak)

![Figure 11. The Question Menu Display](image)
3.2 System Testing

System testing is carried out by involving several students and lecturers to test the readiness and effectiveness of applications in the process to learn mobile learning of language and automata theory on finite state automata (FSA) and deterministic finite automata (DFA) materials.

<table>
<thead>
<tr>
<th>The Input Data</th>
<th>Expected Result</th>
<th>Analysis Result</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>click button of material</td>
<td>show the material according to user choice</td>
<td>the question as strings 0 and 1 to show random and show the option buttons are accepted button and rejected button</td>
<td>accept ✓</td>
</tr>
<tr>
<td>click button of finite state automata (FSA) question</td>
<td>show questions as random strings 0 and 1 and show the option buttons are accepted button and rejected button</td>
<td></td>
<td></td>
</tr>
<tr>
<td>click button deterministic finite automata (DFA) question</td>
<td>show questions as random strings a and b and show the option buttons are accepted button and rejected button</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

System testing of this application is used to test application feasibility. The test starts from the input data, it is function of button, and next the expected results, and analysis results, and the last step is conclusion the application feasibility.

4. CONCLUSION

Based on the result of research and discussion previously described, so there are the conclusions: (1) The development of learning media for language and automata theory assist to student understand language and automata theory course, especially finite state automata (FSA) and deterministic finite automata (DFA) materials; (2) The development of learning media for language and automata theory can be used as a learning media for student and lecturer to support a better learning process; and (3) This research implementation is to result development of learning media for mobile learning application of language and automata theory on finite state automata (FSA) and deterministic finite automata (DFA) materials use adobe air for Android.

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5. REFERENCES

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