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

Maulana Muhamad Sulaiman[1], Romi Andrianto[2], Muhamad Arief Yulianto[3]
[1,2,3]Department of Informatics, Pamulang University, Indonesia

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.

Corresponding Author:

Name of Corresponding Author,
Department of Informatics,
UIN Sunan Gunung Djati Bandung,
Jl. AH. Nasution No. 105 Badung, Indonesia
Email: corresp-author@mail.com

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 applicattive 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 applicattive 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.
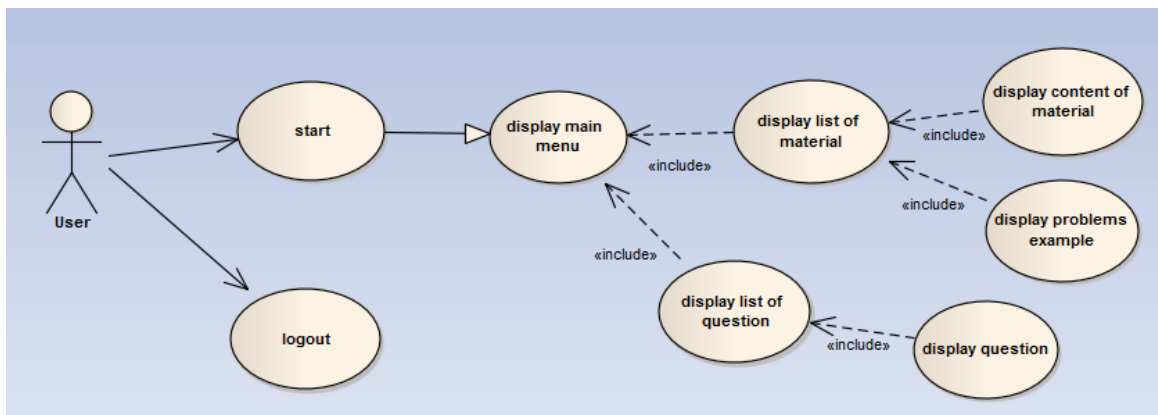

Figure 1. Use Case

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

Table 1. Use Case Information

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

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).
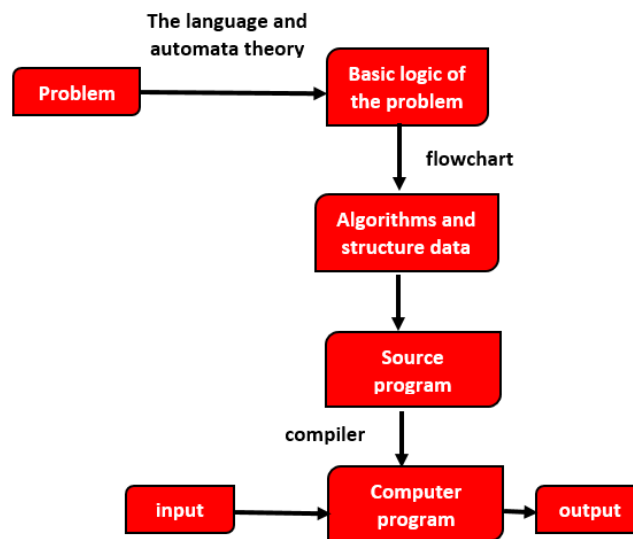
Figure 2. Concept of The Language and Automata Theory

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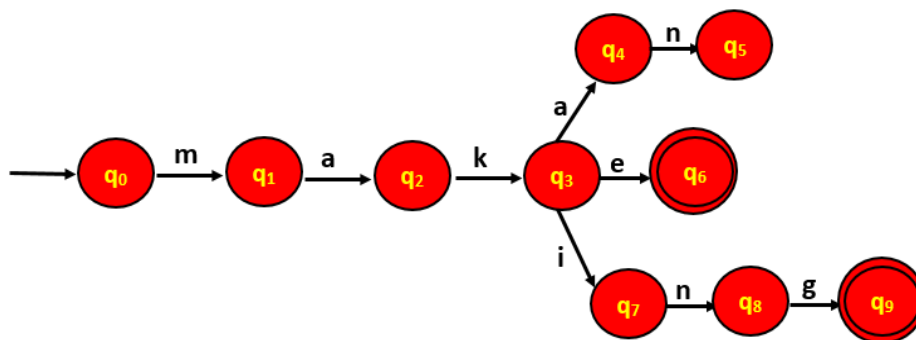

Figure 3. An Automata Machine Model

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
Σ = input of symbol set
δ = functions of transition $\delta : Q \times \Sigma$
S = initial state , $S \in Q$
F = final state, $F \subseteq Q$

Mobile Learning Apps For Developing The Language And Automata Theory For FSA And DFA Material By Using Adobe Air for Android
(Maulana Muhamad Sulaiman[1], Romi Andrianto[2], Muhamad Arief Yulianto[3])

178

Figure 4 is an example of implementation a finite state automata (FSA) machine model.
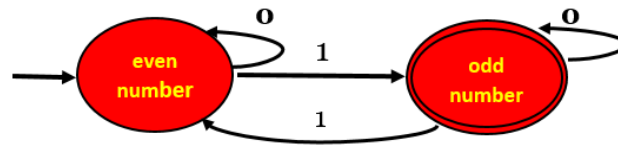

Figure 4. Implementation of FSA Machine Model

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 2. The Transition function of FSA

δ	0	1
even number	even number	odd number
odd number	odd number	even number

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
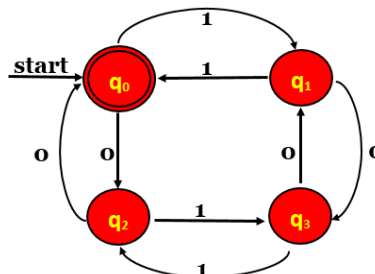2.   10010 : rejected, because the number of 0 is odd

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 3. The Transition function of DFA

δ	0	1
q_0	q_2	q_1
q_1	q_3	q_0
q_2	q_0	q_3
q_3	q_1	q_2

δ (q0,011) = δ(q2,11) = δ(q3,1) = q2 rejected
δ(q0,1010) = δ(q1,010) = δ(q3,10) = δ(q2,0) = q0 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.
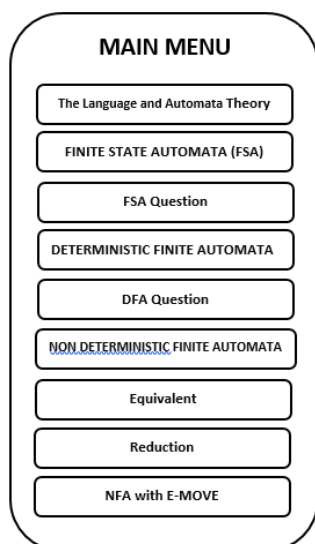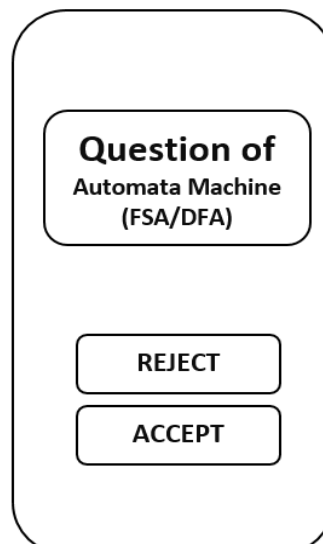

Figure 6. Layout of Main Menu

Figure 7. Layout of Question Menu

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   :

Mobile Learning Apps For Developing The Language And Automata Theory For FSA And DFA Material By Using Adobe Air for Android
(Maulana Muhamad Sulaiman[1], Romi Andrianto[2], Muhamad Arief Yulianto[3])

180

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
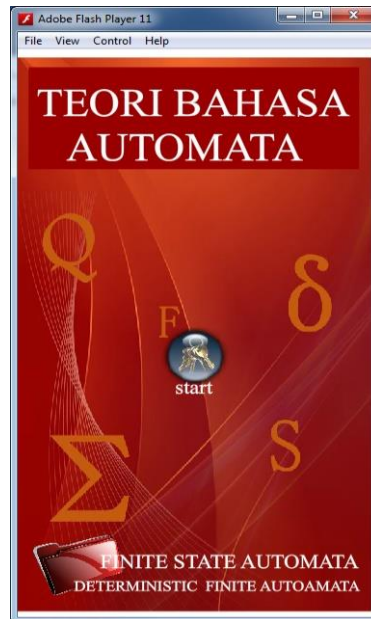

Figure 8. The Initial Display

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 ϵ-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 (EKUIVALENSI), reduction (REDUKSI), and NFA with e-move (NFA dengan E-Move)".

Figure 9. The Main Menu Display

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 student 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 ∈-move. In the material menu display use Indonesian language, it as "Setiap FSA memiliki (Every FSA will consists)".
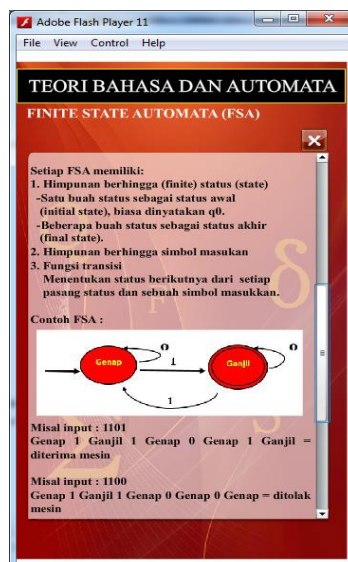

Figure 10. The Material Menu Display

3.1.4 The Question Menu Display

In this question menu display there are accept and reject buttons so user 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

3.2 System Testing

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

Table 4. Cases and Test Result

	Cases and Test Result		
The Input Data	**Expected Result**	**Analysis Result**	**Conclusion**
click button of material	show the material according to user choice	show the material according to *user choice*	accept : √ reject : -
click button of finite state automata (FSA) question	show questions as random strings **0** and **1** and show the option buttons are accepted button and rejected button	the question as strings **0** and **1** to show random and show the option buttons are accepted buttons and rejected button	accept : √ reject : -
click button deterministic finite automata (DFA) question	show questions as random strings **a** and **b** and show the option buttons are accepted button and rejected button	the question as strings **a** and **b** to show random and show the option buttons are accepted buttons and rejected button	accept : √ reject : -

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.

ACKNOWLEDGEMENTS

5.   REFERENCES

[1]   Adil,Ahmat. 2018.” The Introduction to Formal Language Automata Theory and Computation”.Yogyakarta : Deepublish

[2]   Ahmad arfan, ali, et al. 2018 “The Learning Media For Using Adobe Flash CS 6 to Increase Interest Student and Learning Result in Basic Competencies to Describe Payment Systems and Payment Instrument”, Journal of Economic Education: Scientific Journal of Educational Sciences, Economics and Social Sciences, Jember University.

[3]   Ahmad Ma’arif, Ridwan, and Fauziah, 2018.” Implementation of Finite State Automata in Process of Filling in Plan Cards Study For Student”, (JOINTECS) Journal of Information Technology and Computer Science, Jakarta National University.

[4]   Dandy Aryarajendra Suprapto, Dimas, and Fauziah, 2020, “ Implementation of Finite State Automata on DFA and NFA Abstract Machines based on Android “, STRING, Jakarta National University

[5]   Dhilon, M Khariul Ridho , and Pujiyono Wahyu, 2014, “Learning Media of Language and Automata Theory In Automata Pushdown Material Based on Multimedia”, ,Bachelor Journal of Technical Informatic, Ahmad Dahlan University Yogyakarta

[6]   Jamil, A., Engr. AsadUllah, & Rehman, M. (2016). An Infinite Runner Game Design using Automata Theory. In International Journal of Computer Science and Software Engineering (IJCSSE), 5(7), pp. 119-125.

[7]   Jamilah, Masayu and Wawan Nurmansyah, 2018.” The Design and Implementation of Finite State Automata of Visualization Learning Applications (Graph Verification Version to Tuple)”, N ational Seminar Technology and Business IIB DARMAJAYA, Musi Charitas University.

[8]   Handoko, Koko, et al, 2019, “ The Design for Choosing a Wedding Package By Using Finite State Automata in Batam City ”, SNISTEK, Putera Batam University.

[9]   Irawan, J.C., et al. (2016). The Design and Implementation of Finite Automata in Simulation Vending Machine . D'Cartesian : Journal of Mathematic and Application, Sam Ratulangi University.

[10] Latifah Lulu , and Handayaningsih Sri, 2014, "The Learning Media for Language and Automata Theory In Subjects Finite State Automata (FA) Base on Multimedia",Bachelor Journal of Technical Informatic, Ahmad Dahlan University Yogyakarta

[11] M. Y. F. Zaelani and Lelah," Implementation of Finite State Automata in Sunda Literacy Learning Applications", vol. 8, no. 2, 2018.

[12] Mustarin, Amirah, et al, 2019. " Implementation of Adobe Flash CS6 The Learning Media in Improving Result Learning of Class X ATPH Students in course Equipment and Machine at SMAN 4 JENEPONTO", Journal of Education Agricultural Technology, Makassar State University.

[13] Richardson, Benny, et al, 2019, " The Implementation Concept of Non-Deterministic Finite Automata (NFA) On Coffee Vending Machine ", Informatics Journal of Pamulang University, Multimedia Nusantara University.

[14] Sahrul, et al, 2018, " The Development of Game Application "Pilah Sampah" by Using Finite State Machine Modeling, Teknologia Journal , Pertamina Jakarta University.

[15] Saputra, Tri Ichsan, et al, 2018." The   Vending Machine Simulation   By Implemented Finite State Automata",vol.3,no.3,2018.

[16] Sujana, Dadang, et al, 2019, "The Vending Machine Analysis by Using the Finite State Automata (FSA) Method in the Old Building of Syekh Yusuf Tangerang Islamic University ", Journal of Scientific and Engineering Applications, Islam Syekh Yusuf University.

Mobile Learning Apps For Developing The Language And Automata Theory For FSA And DFA Material By Using Adobe Air for Android
(Maulana Muhamad Sulaiman[1], Romi Andrianto[2], Muhamad Arief Yulianto[3])

184