

Implementation of Finite State Automata on e-Knows Telegram Chatbot

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ABSTRACT

The State Islamic University of Sunan Gunung Djati Bandung has a bold learning system called e-Knows. So far, if the user has a school, he must contact the admin manually. The problems are diverse, and several issues can bring personal impact. Automata language theory is the basic logic for mapping the telegram e-Knows chatbot system. The mapping is done by dividing each system using finite state automata to facilitate the completion of the system.

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1. INTRODUCTION

Language and Automata theory is a part of computer science which is based on fundamental models and ideas about computers. As an output of automata, language enables the conveyance of human ideas and thoughts, whereas as a science that also studies abstract machines, automata can read input in the form of strings from the given alphabet from the input file.

One of the applications of language and automata theory is in the telegram chatbot e-Knows. There are several problems that occur in using e-Knows, including being unable to log in, incomplete courses, and several other problems. However, the handling of this problem has been done manually by contacting the service department of e-Knows. In fact, some problems can be resolved by itself. Based on this background, research was carried out that applied Language and Automata Theory with the concept of finite state automata on the e-Knows telegram chatbot.

1.1. Theory of Language and Automata

Computer science has two main components, first, basic models and ideas about computing, second, engineering techniques for designing computing systems, including hardware and software, especially the application of design and theory [1]. Theory of Language and Automata is the first part. Theoretically, computer science begins with several scientific disciplines, including biologists studying neural networks, electrical engineers developing switching as a tool for designing hardware, mathematicians working based on logic, and linguists investigating grammar for natural language [2].

Finite automata are a mathematical model of a system with discrete inputs and outputs. State is a system that is in one of a finite number of internal configurations [3]. State is a summary of information related to previous inputs needed to determine system actors for subsequent inputs [4].

Finite state automata and regular expressions were originally developed based on neural networks and switching circuits in mind. Finite state automata are a very useful tool in designing lexical analyzers, which are parts of the compiler that group characters into tokens, which are the smallest units such as names, variables, and keywords [5]. In writing systems, the compiler will automatically transform regular expressions into finite state automata to be used as lexical analyzers. Finite state automata and regular expressions are also used in

text editors, pattern matching, some text processing, and file-searching programs, and as a mathematical concept for applications in other disciplines such as logic [6].

The relationship between language and automata is that language is used as input by an automatic machine, then the automatic machine will decide indicating whether the input is accepted or not [7]. For example, if you have a simple machine that accepts Indonesian words as input, this can be seen in Figure 1 below.

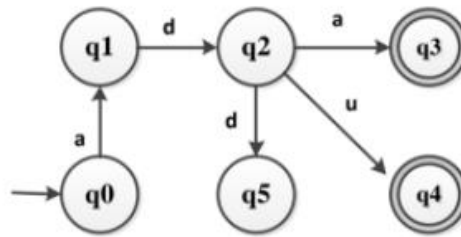


Figure 1. Sample Diagram FA

The image is machine decodable gets the following input string.

- a. there is: accepted
- b. fight: accepted
- c. add: rejected [8]

Finite automata are a mathematical model of a system with discrete inputs and outputs [9]. The system can be in one of a finite number of internal configurations called states [10] State is a summary of information related to the previous inputs needed to determine the system actor at the next inputs [4]

Finite automata are often also called Finite State Automata (FSA). Consists of Deterministic Finite Automata (DFA) and Non-Deterministic Finite Automata (NFA) [11] The basic theory of FA is very general, that is, when a system is in one of several states, it moves between states in a reproducible way that depends on system input. One of its applications is the compilation/translation of high-level programming languages into equivalent engine languages [12]

The working principle of Finite State Automata is as follows: (1) Receiving string input, (2) Reading (absorbing substring) initial character with control in initial state, (3) With control and initial character having been read, state will move to state new, (4) The process continues until all the strings are absorbed out, (5) If the final state occupied when the string runs out is in the set of predetermined final states, then the string is accepted or recognized by the Finite State Automata. If not, then the string is rejected or not recognized by the Finite State Automata.[13]

1.2. Telegram

The Telegram application is a cloud-based messenger application for smartphones and laptops and focuses on security and speed. Smartphone operating systems that can use the Telegram application are iPhone/iPad, Android, Windows Phone, and can be used on laptops with PC/Mac/Linux, macOS operating systems and via the Web-browser application [14].

Communication technology has changed a lot over the last 20 years. From the beginning, what used to be on cellphones was only texting and calling, now there is an instant messaging application that accommodates both and can even make video calls and many other features. Currently there are many instant messaging (IM) applications such as WhatsApp, Line, Snapchat, Facebook Messenger, and Telegram [15]. Telegram is the only short messaging application that provides APIs for users to be able to create bots that can be used for information systems [16].

1.3. Bot Telegram

Bots or robots are usually used for automation of an activity that is repeated and can be used as a monitoring/monitoring tool by the admin. [17] Bots are third-party applications that can run within Telegram. Telegram provides a feature to use instant messenger services automatically, one of which is a bot service.[18] Telegram Bot is a special Telegram account that is designed to handle messages automatically. Users can interact with bots by sending command messages via private or group messages.[19] Chatbots can understand user words so that they can choose or generate responses that can be based on current input and on the context of the conversation.[20] Telegram's cloud base allows for a much faster sending process and large storage media [21].

The bot feature is a feature that is not owned by other applications, which is another special advantage. Bots are autoresponder accounts that can respond to certain texts according to the commands we give them.[22] Bots on Telegram can use custom keyboards for their users. This will facilitate the interaction between the bot

and its users. [23] In the telegram bot, users can send messages, commands, and inline requests. We can control the bot using HTTPS to telegram API. There are so many uses for Telegram bots including:

- The bot can be used as a smart newspaper which will provide news to the bot's subscribers.
- Bot can also be used as a bridge for other services such as Gmail, Images, GIF, IMDB, Wiki, Music, YouTube, GitHub.
- Bots can also be used to accept payments from telegram users. Bots can offer paid services or work as virtual storefronts. Regarding this matter, you can learn more at <https://t.me/shopbot>.
- Bots can also be used as specialized tools such as providing alerts, weather forecasts, translations, formatting, or other services.
- Bots can also be used as either single player or multi-player games.
- Bots can be used as social services connecting the same people looking for conversation partners based on the same interest or affinity.[24]

Bot Father is the only bot that rules it all. This will let us create a new bot as well as changing its settings. Next the most powerful bot platform is ManyBot. ManyBot is the most feature rich platform for bots building. [25]

2. METHODOLOGY

The research stages used in this study can be divided into 5 (five) stages, namely: (1) needs analysis and data collection stage, (2) literature study stage, (3) Finite State Automata design and implementation stage, (4) stage Finite State Automata testing, (5) report writing stage.



Figure 2. Research stages

The stages of the research in Figure 2 can be explained as follows, Needs Analysis and Data Collection Stage: At this stage analysis and data collection are carried out related to the service system provided by the e-Knows service section of UIN Sunan Gunung Djati Bandung. Literature Study Stage: In this stage data is collected from related journals, books, and sources regarding discussions related to the research; Finite State Automata Design and Implementation Stage: At this stage, finite state automata will be designed using N DFA (Non-Deterministic Finite Automata); Finite State Automata Testing Stage: In this final stage, a test was carried out on the application of finite state automata on the telegram chatbot of UIN Sunan Gunung Djati Bandung using the N DFA (Non-Deterministic Finite Automata) that has been made. The test was carried out by evaluating the overall design of the finite state automata on the chatbot telegram e-Knows UIN Sunan Gunung Djati Bandung N DFA (Non-Deterministic Finite Automata) that has been made, whether it is running as it should, if not then the necessary improvements are made; Report Writing Stage: In this stage, a report is written from the stages of the research carried out.

Data collection about what problems often arise in e-Knows is done by direct observation on WhatsApp in the e-Knows service section and questionnaires for e-Knows services which are distributed to the academic community of UIN Sunan Gunung Djati Bandung. From these results, we categorize the problem into 3 parts, namely:

1. Forgot Password.

2. The course is incomplete.
3. Other problems

3. RESULTS AND DISCUSSION

The design of the state diagram for the Telegram chatbot e-Knows can be seen in Figure 3 which explains the mapping of the e-Knows Telegram chatbot system. The following is the system or steps carried out by the user in carrying out the e-Knows telegram chatbot, namely:

1. Enter the e-Knows telegram bot.
2. Click start on the menu.
3. Choose an available service from the main menu.
4. If the user has a problem forgetting the password, they will be directed to the link that has been provided, if it is not successful, they will be instructed to contact the e-Knows admin.
5. If the user has an incomplete course problem, he will be directed to contact the knows admin by sending the problem and the details of the problem.

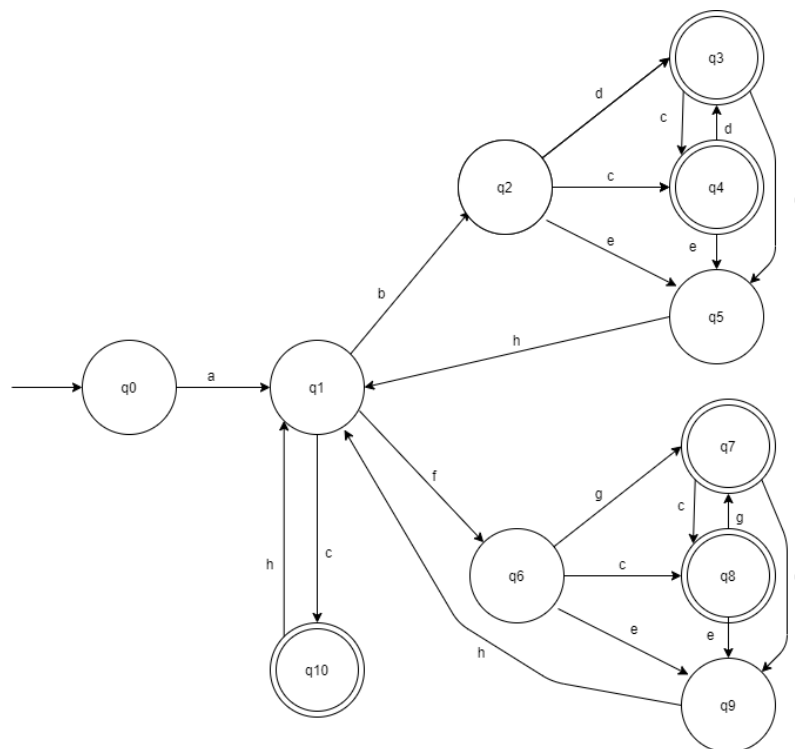


Figure 3. State Diagram Chatbot Telegram e-Knows

The state diagram in Figure 4.1 is expressed in 5 tuples, namely:

$$Q = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9, q_{10}\}$$

$$\Sigma = \{a, b, c, d, e, f, g, h\}$$

$$S = \{q_0\}$$

$$F = \{q_3, q_4, q_7, q_8, q_{10}\}$$

$$\Delta = \{((q_0, a)q_1), (((q_1, b)q_2), ((q_1, c)q_{10}), ((q_1, f)q_6), (((q_2, c)q_4), ((q_2, e)q_5), ((q_2, d)q_3)), (((q_3, c)q_4), ((q_3, e)q_5)), (((q_4, e)q_5), ((q_4, d)q_3)), ((q_5, h)q_1), (((q_6, c)q_8), ((q_6, e)q_9), ((q_6, g)q_7)), ((q_7, c)q_8), ((q_7, e)q_9), (((q_8, e)q_9), ((q_8, g)q_7)), ((q_9, h)q_1), ((q_{10}, h)q_1)\}$$

For alphabetical descriptions, a set of input symbols that state what the user does; (a) selecting the problem menu, (b) the forgot password menu for the account is connected with greetings or not, (c) an order to send a message to e-Knows admin, (d) click forgot password greetings to change password, (e) menu to return to the main menu, (f) the course menu is incomplete (g) command to check course filters, (h) Return to the main menu.

As for the state description which states the output; (q0) start the telegram bot, (q1) menu options for problems with e-Knows, (q2) Forgot password menu (q3) Link to reset password, (q4) Instructions for contacting e-Knows admin, (q5) menu returns to the start menu, (q6)) incomplete course menu, (q7) command to check filter, (q8) Instructions to contact e-Knows admin, (q9) menu Return to main menu, (q10) Instructions to contact e-Knows admin.

Transition relations can be mapped in a table, as shown in table 1.

Tabel 1. Telegram chatbot transition relationship table

Δ	a	b	c	d	e	f	g	h
$q0$	q1	\emptyset	\emptyset	\emptyset	\emptyset	\emptyset	\emptyset	\emptyset
$q1$	\emptyset	q2	q10	\emptyset	\emptyset	q6	\emptyset	\emptyset
$q2$	\emptyset	\emptyset	q4	q3	q5	\emptyset	\emptyset	\emptyset
$q3$	\emptyset	\emptyset	q4	\emptyset	q5	\emptyset	\emptyset	\emptyset
$q4$	\emptyset	\emptyset	\emptyset	q3	q5	\emptyset	\emptyset	\emptyset
$q5$	\emptyset	\emptyset	\emptyset	\emptyset	\emptyset	\emptyset	\emptyset	q1
$q6$	\emptyset	\emptyset	q8	\emptyset	q9	\emptyset	q7	\emptyset
$q7$	\emptyset	\emptyset	q8	\emptyset	q9	\emptyset	\emptyset	\emptyset
$q8$	\emptyset	\emptyset	\emptyset	\emptyset	q9	\emptyset	q7	\emptyset
$q9$	\emptyset	\emptyset	\emptyset	\emptyset	\emptyset	\emptyset	\emptyset	q1
$q10$	\emptyset	\emptyset	\emptyset	\emptyset	\emptyset	\emptyset	\emptyset	q1

Table 4.1 describes the state shift when there is an incoming input. For example, if state $q0$ gets input a , it will move to state $q1$ according to Figure 4.1. Then from state $q1$ getting input b will move to state $q2$, if you can get input c then it will move to $q10$. And so on for how to read transitions from other states. state switching will be worth \emptyset (empty language) if each incoming input does not match. For example, state $q0$ if it gets input b , it will be worth \emptyset (empty language). Likewise for other states, which receive inappropriate input.

The telegram bot e-Knows algorithm is as follows.

1. Click start on the knows telegram chatbot.
2. Select the problem menu on e-Knows.
3. If on the main menu select forgot password, then it will enter the forgot password menu.
4. If the account is integrated with Salam, then click the link provided to reset Salam password.
5. If the account is not integrated with Salam, the user is asked to contact the e-Knows admin.
6. When finished, the user can return to the main menu by pressing the go back button.
7. If the main menu selects an incomplete course, it will enter the incomplete course menu.
8. The user will be asked whether the filter is All or not.
9. If the filter is not All, then the user is asked to change the filter to All first.
10. If the filter is All but the course is still incomplete, then the user is asked to contact the admin to know.
11. When finished, the user can return to the main menu by pressing the go back button.
12. If the main menu selects other problems, then the user is asked to contact the e-Knows admin.

The algorithm explains the description of the telegram chatbot that is made, useful for helping problems that often arise or are experienced by e-Knows users.

The telegram chatbot pseudocode is explained as follows.

Start

READ Main menu.

IF the user selects Forgot Password, THEN Forget password menu.

READ menu forgot password.

IF the account integrated with greetings, THEN reset password greetings.

IF the account is not integrated with the greetings account, THEN contact e-Knows admin.

IF finished THEN go back to the main menu.

IF the user selects an incomplete course, THEN The course menu is incomplete.

READ course menu is incomplete.

IF filter is not all THEN changing the filter to all first.

IF filter all but not complete THEN contact admin know.

IF finished THEN go back to the main menu.

IF the user chooses another problem, THEN contact e-Knows admin.

end

The design of pseudocode is an overview of the concept of the application that is made, useful to help problems that often arise or are experienced by e-Knows users. The program was created using the FatherBot Telegram and Telegram ManyBot bots. The bot concept is designed based on the needs or problems that are often experienced by e-Knows users.

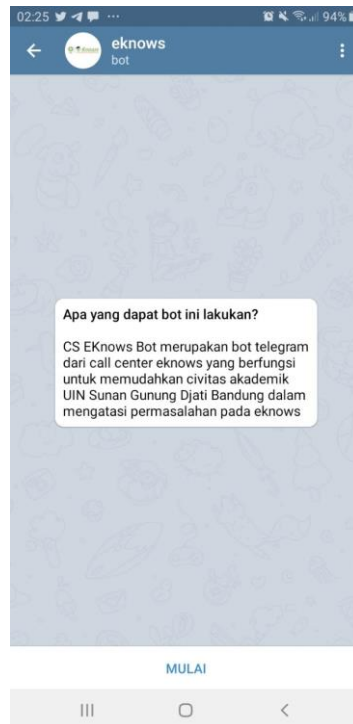


Figure 4. Initial Appearance of Chatbot e-Knows

Figure 4 is a picture of the initial appearance of the knows chatbot. To start the program, press the START button at the bottom.



Figure 5. Display of the chatbot e-Knows menu

Figure 5 is a display of the e-Knows chatbot menu. We can choose the Forgot Password menu, incomplete courses, or other problem menus.

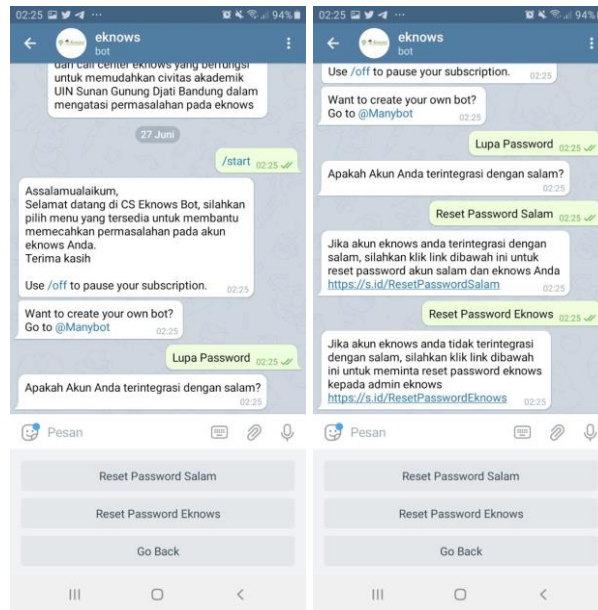


Figure 6. Display of the forgot password menu

Figure 6 is a display of the forgot password menu, if it is integrated with greetings then click reset password greetings, if not then contact the admin by clicking reset e-Knows password. To return to the main menu, click go back.

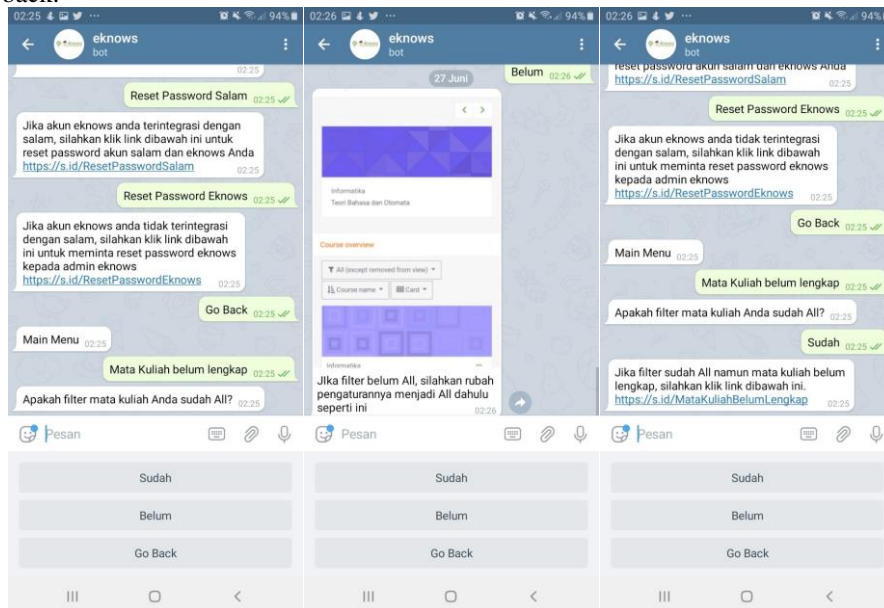


Figure 7. Display of the Course menu is incomplete

Figure 7 is a display of the incomplete course menu, if the filter is not All then the user is asked to change the filter first. If the course is still incomplete, the user is asked to contact the Admin. To return to the main menu, click go back.



Figure 8. Display of the Course menu is incomplete

Figure 8 is a display of the other problems menu, if the problem has other problems besides the two existing categories, the user is asked to contact the admin.

Table 2. Test Analysis and Results

Start State	Input	Passed State	Final State	Number of State Passed	Number of Inputs
q0	a, b, d	q1, q2	q3	2	3
q0	a, b, c	q1, q2	q4	2	3
q0	a, b, d, c	q1, q2, q3	q4	3	4
q0	a, f, g	q1, q6	q7	2	3
q0	a, f, c	q1, q6	q8	2	3
q0	a, f, g, c	q1, q6, q7	q8	3	4
q0	a, c	q1	q10	1	2

The table describes the test analysis and results of the finite state automata concept created. The analysis of the first test and results shows that the start state q0 to the final state q3 through 2 states, namely q1 and q2, has 3 inputs, namely a, b, d. Analysis of the second test and results shows that the start state q0 to the final state q4 through 2 states, namely q1 and q2, has 3 inputs, namely a, b, c. The third test analysis and results show that the start state q0 to the final state q4 through 3 states, namely q1, q2 and q3, has 4 inputs, namely a, b, d, c. The fourth test analysis and results show that the start state q0 to the final state q7 through 2 states, namely q1 and q6, has 3 inputs, namely a, f, g. The analysis of the fifth test and results shows that the start state q0 to the final state q8 through 2 states, namely q1 and q6, has 3 inputs, namely a, f, c. The analysis of the sixth test and results shows that the start state q0 to the final state q8 through 3 states, namely q1, q6 and q7, has 4 inputs, namely a, f, g, c. The test analysis and results of the seventh show that the start state q0 to the final state q10 through 1 state, namely q1, has 2 inputs, namely a, c.

4. CONCLUSION

Based on the results of the research, and the implementation of finite state automata in the e-Knows telegram chatbot, it can be concluded that: (1) Finite state automata can be used as the basic logic for mapping the e-Knows telegram chatbot system. (2) Mapping is done by dividing each system into states to facilitate the completion of the system. (3) The system created in the form of an algorithm and pseudocode is based on the e-Knows telegram chatbot system which is useful for helping solve problems on e-Knows accounts.

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