Development of Web-Based Network Automation Applications Using the Kano Method and Paramiko Library to Simplify the Configuration of Multivendor Network Devices at PT. Digital Vision Nusantara

Andi Andara[1], Setyawan Widyarto[2], Rusdah[3]
[1,2,3]Universitas Budi Luhur, Jakarta, Indonesia
Email: andiandara54@gmail.com

Abstract

Computer network is never separated with configuration which is the main task which has to be done in order to make it work. As we know, to configure some devices either server, switch, or router has several methods if we understand how we communicate with the system. Configuration on routers and switches is currently still conventionally done, which means that to configure routers or switches one by one. This is very inefficient, because if the routers and switches that you want to configure are carried out in hundreds or many routers, then the time required by a network administrator is very long. Therefore, network automation is needed which is a solution to perform these complex and repetitive tasks. This automation can help network administrators to configure networks with many devices at once and minimize errors that occur when configuring in a short time. Repetitive work such as configuration backups, configuration restores, and others can be automated. In this project create a web-based network administration automation application. For application development using the Kano method to identify application requirements, design, build and implement applications, this application utilizes the main library, namely paramiko as a liaison and network automation from servers to network devices using the SSHv2 protocol and the Django framework as a Web developers. For the tests carried out on the application using the Black-Box Testing method. The results of this project application can be used as network automation in terms of configuration of network devices such as router configuration, switch configuration, backup and restore configuration centrally so that they can be managed better. This research was conducted with the aim of knowing the category of each feature in a network automation application, the results of this study obtained priority ospf dynamic routing configuration features that entered Must be with a satisfaction level of 0.4285 if implemented and a disappointment level of -0.4285 if this feature not stated, while for the ip address configuration feature, and the On-Dimensional Login feature with a satisfaction level of 0.5713 and a disappointment level of -0.5713 if this feature is implemented, unlike the PIM routing feature configuration feature and the Indifferent configuration verification feature, which for this feature is not often used.

Keywords: *Python, Django, KANO, Black-Box, Network Automation, Paramiko.*

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A. INTRODUCTION

The network is never separated from the configuration which is the main task that must be done in order to make it work. As we know, to configure some network devices such as switches, routers, or servers there are several methods if we know how we communicate with the system. We can use the console port for short-range configuration, use telnet for remote network devices, or SSH for remote device configuration and it is also safe with all information encrypted. In general,

conventional methods such as the method just described previously are always used. (Islami et al., 2020)

The process of configuring network devices, one of which is a router, is currently still carried out conventionally, which means that to configure a router in a complex network, a network administrator must configure the routers one by one. In this case it is very inefficient, because if the router you want to configure is done with hundreds of routers, then the time required by the network administrator is very long. (ES Ginting & Hadi, 2020)

Based on previous research conducted by Rheza Adhyatmaka Wiryawan entitled "Development of Website-Based Network Administration Automation Applications Using the Python Programming Language", implementing automation on website-based applications using the Python language in the Paramiko library using the RAD (Rapid Application Development) method and applied to devices Mikrotik and Cisco produce several features, including: routing configuration, restore, backup, settings, and VLAN. Testing on these five features was carried out using the black box testing method on all application functions developed which were successfully implemented on Mikrotik and Cisco devices (Wiryawan & Rosyid, 2019).

Another research was conducted by Ahmad Rosid Komarudin in his book entitled "Automating Network Administration Using Python Scripts", in his book explaining how to implement network administration automation using the netmiko, napalm, paramiko, ansible, and pytnc libraries which are applied to Cisco devices. Ahmad Rosid Komarudin concluded that the Napalm library and Ansible library are libraries with powerful features that can be applied to Cisco devices.

With this new method, the network engineer's job is to configure a network with many network devices, just by using a program that runs on the control node, this really helps many tasks to be done, it will not waste our time, and reduces human errors (Islami et al ., 2020). Therefore, network automation is needed to help the work of a network administrator. This research aims to analyze static and dynamic routing protocols that are often used by network administrators when configuring Mikrotik and Cisco router devices.

B. METHOD

This research is a type of experimental research. The basis for using experimental research is because network automation using the Paramiko library is still rarely tested to automate networks, unlike Ansible, Netmiko and NAPALM which are often used to automate networks. For the proposed method to improve the performance of the paramiko library using observational experimental research.

In this sample selection method, researchers use Simple Random Sampling, which according to Kerlinger (2006: 118), simple random sampling is a method of drawing from a population or universe in a certain way, so that each member of the population or universe has the same opportunity. to be selected or taken. Meanwhile, according to Margono (2004: 126) states that simple random sampling is a technique for obtaining samples that is carried out directly in the sampling unit so that remote

population elements have the same opportunity to become a sample or to represent the population. This method is used if members of the population are considered homogeneous.

In the data collection method, the author uses observation, where the researcher directly observes the object to be studied using notes. According to Riduan, observation is a data collection technique, where the researcher makes direct observations of the research object to see closely the activities carried out. . Meanwhile, according to Margono, observation is used to see and observe changes in social phenomena that are growing and developing and then changes can be made to these assessments, for observers to see certain moment objects, so as to be able to separate what is needed from what is not needed.

C. RESULTS AND DISCUSSION

1. Data Grouping and Analysis

Data grouping is carried out by researchers by identifying the existing data on the research object, the data needed for this research activity. This data includes Router Location Data, Data on the number of routers and types of router vendors at each research location. To get priority in requirements in obtaining functional requirements, researchers carried out observation and interview stages with IT staff, Network Engineers and the Head of Network & Operational security section. In the interview, the researcher asked several questions to IT staff who really understood their job as a Network administrator. Network automation applications do not yet exist and need to be provided to assist network administrators in carrying out their work, especially when configuring the network. From the interview results, the initial functional requirements were obtained, namely:

a. The application can configure Cisco or Mikrotik routers
b. The application can verify Cisco and Mikrotik router configurations
c. The application can record and display activity logs for every configuration activity carried out by the network administrator.
d. The application can configure static or dynamic routing or PIM routing for Multicast video stream configuration purposes.
e. Those involved in using this application are network administrators, Section Head IT network & security solutions.

The next research was to administer the first questionnaire by providing quiz questions consisting of 15 (fifteen) questions. These questions were obtained from the results of observations and interviews with network administrators which the researchers summarized into 15 questions. Following are the results of the questionnaire, the answers of 7 respondents were obtained with the following results:

Table 1. First Questionnaire Results

Respondent	Butir Pertanyaan Kuisioner															Skor Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	4	4	4	4	5	4	5	4	5	5	5	4	5	5	5	68
2	4	4	4	4	4	5	4	5	4	4	5	4	5	4	4	64
3	1		3	4	4	3	4	4	3	3	4	4	5	4	5	51
4	4	1	1	2	3	3	4	3	5	4	3	4	2	2	1	42
5	2	2	3	2	3	2	1	2	2	3	3	5	6	3	2	41
6	3	3	4	2	4	4	2	3	4	2	1	1	2	1	1	37
7	1	1	2	1	3	2	2	3	3	3	1	2	2	4	4	34

From the table above there are respondents' answers regarding the first questionnaire, therefore the researcher carried out validation and reliability measurements to determine whether each question was valid or not using the validity and reliability formula. To get the rtable results from 7 respondents, you can see the following table. From this table, the rtable value with an error rate of 5% is 0.754. Researchers used SPSS v.28 to find validity values, and the results were as follows:

Table 2. Validity Calculation Results

No	Mark r count	Mark r table	Results
1	0.537	0.754	No Valid
2	0.818	0.754	Valid
3	0.552	0.754	No Valid
4	0.910	0.754	Valid
5	0.782	0.754	Valid
6	0.693	0.754	No Valid
7	0.784	0.754	Valid
8	0.789	0.754	Valid
9	0.441	0.754	No Valid
10	0.776	0.754	Valid
11	0.931	0.754	Valid
12	0.488	0.754	No Valid
13	0.614	0.754	No Valid
14	0.659	0.754	No Valid
15	0.626	0.754	No Valid

To search for reliability values, the previous researcher dropped questions that were declared invalid during the validity test, namely items 2, 4, 5, 7, 8, 10, and 11, so a reliability test was obtained as in the table below:

Table 3. Reability Calculation Results with SPSS v.28

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	6	85.7
	Excluded [a]	1	14.3
	Total	7	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
,930	7

Item-Total Statistics

Scale Mean ifItems Deleted		cale Variance if Items Deleted	Corrected Item-Total Correlation	ronbach's Alphaif Items Deleted
VAR00002	19,0000	43,200	,728	,924
VAR00004	19,0000	41,600	,962	,902
VAR00005	17.8333	48,967	,758	,926
VAR00007	18.5000	40,300	,793	,919
VAR00008	18.1667	46,167	,789	,920
VAR00010	18,0000	46,400	,756	,922
VAR00011	18.5000	36,700	,849	,918

From the table calculations above, it is known that the Aplha value = 0.930 > from the r table = 0.754, so it can be stated that question items 2, 4, 5, 7, 8, 10 and 11 are declared reliable or consistent, which can then be used for questions. Kano questionnaire.

Kano Questionnaire

In the previous questionnaire, 7 (seven) questions had been tested for the level of validity and reliability which were questions in the questionnaire using the Kano method. In the Kano method there are 2 (two) types of questions that will be given to respondents, namely functional questions and dysfunctional questions, the list of questions is as follows:

Table 4. Kano Method Functional Questions

No	Question Functional Questionnaire Canoe
1	Application will can Taking notes all device Network Whichconnected It is good Mikrotik and Cisco
2	Application will can do IP configuration address in a wayat a time on Cisco and Mikrotik routers
3	The application will be able to configure static routing onrouters Cisco and Mikroik simultaneously
4	The application will be able to configure OSPF dynamic routing,RIP, EIGRP on Cisco routers And Mikrotik in a way simultaneously
5	The application will be able to configure PIM routing onrouters Cisco and Mikrotik
6	The application will be able to verify the Cisco router configuration And Mikrotik directly simultaneously
7	Application will can take notes Logs on every activity Whichdone by the network administrator

Table 5 . Kano Method Dysfunctional Questions

No	Question Functional Questionnaire Canoe
1	Application will can Taking notes all device Network Whichconnected It is good Mikrotik and Cisco
2	Application will can do IP configuration address in a wayat a time on Cisco and Mikrotik routers
3	The application will be able to configure static routing onrouters Cisco and Mikroik simultaneously
4	The application will be able to configure OSPF dynamic routing,RIP, EIGRP on Cisco routers And Mikrotik in a way simultaneously
5	The application will be able to configure PIM routing onrouters Cisco and Mikrotik
6	The application will be able to verify the Cisco router configuration And Mikrotik directly simultaneously
7	Application will can take notes Logs on every activity Which done by the network administrator

These two types of questions were given directly to 7 (seven) respondents. The results of the Kano questionnaire can be seen from the questionnaire results table below:

Table 6. Kano Method Questionnaire Results

Question		Respondent							Scale					Amount
		1	2	3	4	5	6	7	1	2	3	4	5	
1	+	3	2	1	2	1	1	1	4	2	1	0	0	7
	-	3	2	5	3	5	5	5	0	1	2	0	4	7
2	+	3	2	1	2	1	2	1	3	3	1	0	0	7
	-	3	2	5	3	4	5	5	0	1	2	1	3	7
3	+	3	2	1	2	3	1	1	3	2	2	0	0	7
	-	3	2	5	3	3	2	5	0	2	3	0	2	7
4	+	3	2	1	2	1	1	1	4	2	1	0	0	7
	-	3	2	5	3	5	2	5	0	2	2	0	3	7
5	+	2	3	1	2	2	1	1	3	3	1	0	0	7
	-	4	3	5	3	5	5	5	0	0	2	1	4	7
6	+	2	2	1	2	1	1	1	4	3	0	0	0	7
	-	4	2	5	3	4	5	4	0	1	1	3	2	7
7	+	2	2	1	2	1	1	1	4	3	0	0	0	7
	-	5	2	5	3	5	5	4	0	1	1	1	4	7

From table 6 it can be seen that the questionnaire consists of 7 questions which were distributed to 7 (seven) respondents. Based on the canoe method, these attributes are categorized into 6 categories, namely, Must Be, One Dimensional, Attractive, Indifferent, Reversible, and Questionable, which are symbolized as M, O, A, I, R, and

Q. Then the number of each canoe category in each is calculated. -Each question follows the calculation of one Kano method question.

Table 7. Blauth Formula Calculation Results

1	User Requiremen		Dysfunctional					Total
			1	2	3	4	5	
	Functional	1			1		3	4
		2			1		1	2
		3		1				1
		4						0
		5						0
			0	1	2	0	4	7/7

A	1
M	1
O	3
R	0
Q	0
I	2
Total	7

AMO	RQI
5	2
GRADE	O
BETTER	0,57
WORSE	-0,57

User Requiremen		Dysfunctional					Total
		1	2	3	4	5	
Functional	1					4	4
	2			2			2
	3		1				1
	4						0
	5						0
		0	1	2	0	4	7/7

A	0
M	0
O	4
R	0
Q	0
I	3
Total	7

AMO	RQI
4	3
GRADE	O
BETTER	0,571
WORSE	-0,57

From the results of Kano's calculations, the canoe evaluation results were obtained to determine Grade (A=Attractive, O=One Dimensional, M=Mustbe), better and worse as in the canoe evaluation table below:

Table 8. Kano Evaluation Results

No	Grades	Worse	Better
1	O	-0.5713	0.5713
2	M/O	-0.4285	0.4285
3	I	-0.4285	0.4285
4	O/A	-0.4285	0.5714
5	m	-0.5714	0.4285
6	I	-0.2857	0.5714
7	O	-0.5714	0.5714

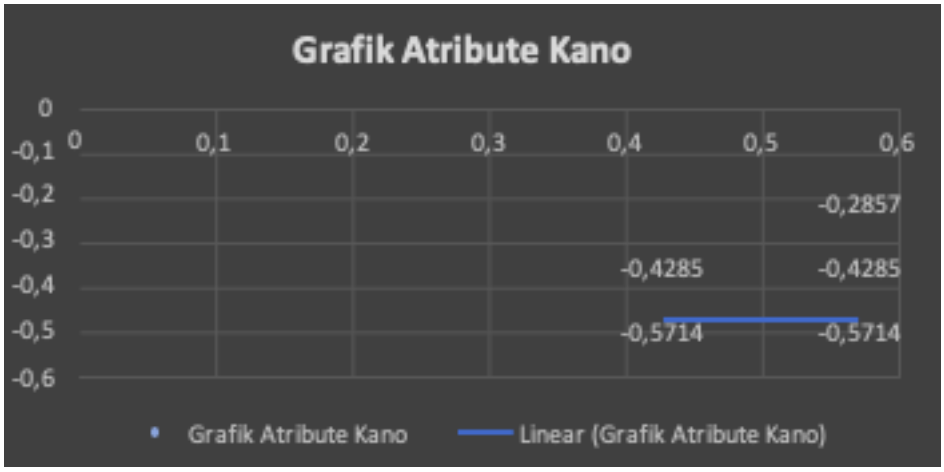

Figure 1. Graph Attribute Canoe

The Scatter Chart image above can be mapped so that each question falls into the canoe quadrant which gets the appropriate results in the following table:

Table 9. Kano Method Results

Question	Quadrant Canoe
1	One-Dimensional
2	Mustbe
3	Indifferent
4	One-Dimensional
5	Mustbe
6	Attractive
7	One-Dimensional

System analysis

Running System Analysis

The ongoing process describes the work system currently implemented by company xyz as in the Flow Map Figure below. The network administrator configures Cisco devices using Putty on each network device one by one as shown in Figure 2.

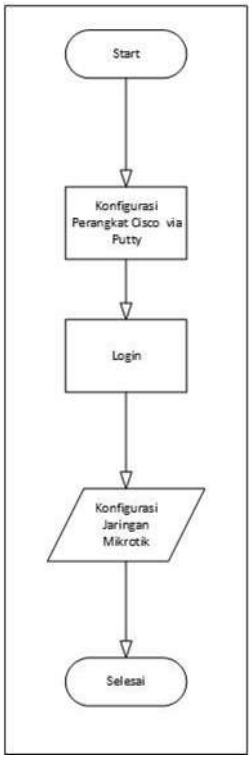

Figure 2. Flow Map of the Running Cisco Configuration

The network administrator configures the Mikrotik device with Winbox on each network device one by one as shown in Figure 3.

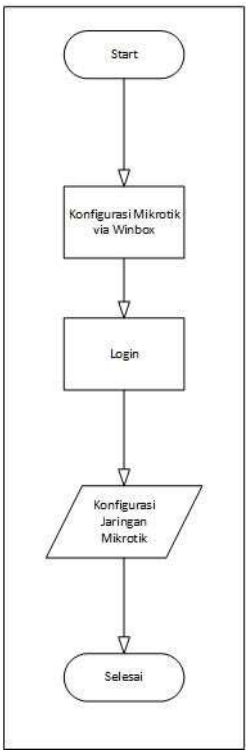

Figure 3. Flow Map of the running Mikrotik configuration

The network administrator verifies the configuration on each Cisco router network device using Putty one by one as shown in Figure 4.

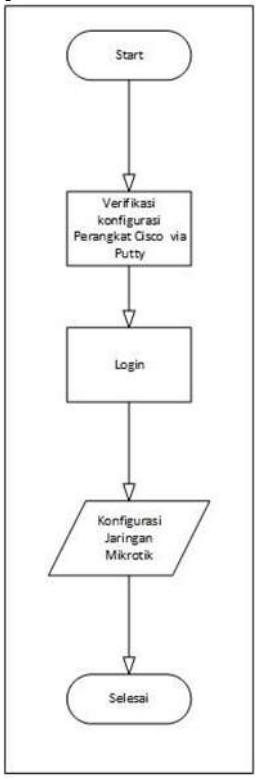

Figure 4 Flow Map Verifying the running Cisco configuration

The network administrator verifies the configuration on each Mikrotik router network device using Winbox one by one as shown in Figure 5.

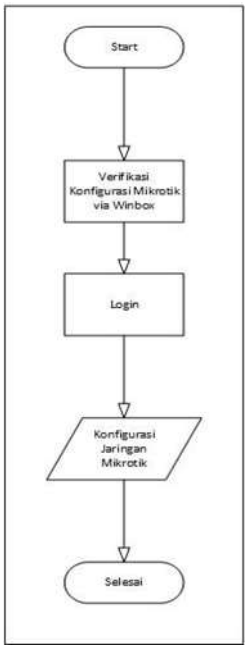

Figure 5. Flow Map Verification of running Mikrotik Configuration

Analysis of the System to be Built

The system that will be built is a system design that will be built at company xyz as in the Flow Map Figure below:

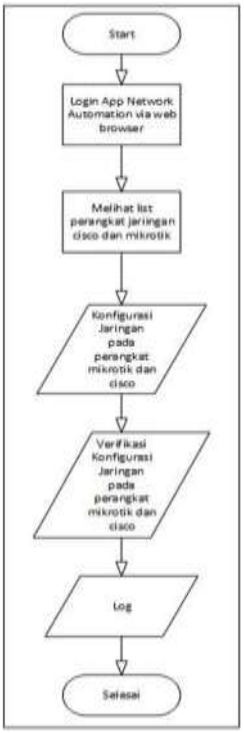

Figure 6. Flow Map of Cisco and Mikrotik configurations to be built

a. The network administrator logs in to the network automation application
b. The network administrator views the list of network devices
c. Network administrators configure Cisco and Mycotic network devices simultaneously

d. The network administrator verifies the Cisco and Mikrotik network configurations simultaneously
e. The network administrator views the log of configuration activity

Use Case Diagrams

Use case diagrams are used to present the interaction between the user and the system and create visualizations of the functions created in the application. The following is a use case diagram of the application system developed in Figure 4.6

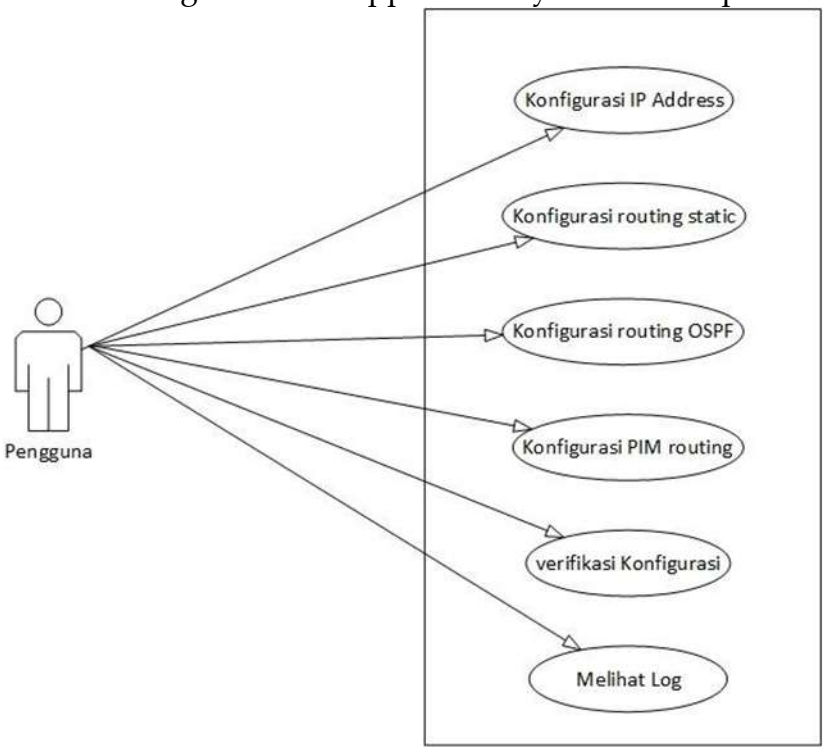

Figure 7. Use Case Application Diagram

In the use case diagram above, it can be seen that users can configure IP addresses, configure static routing on Cisco and Mikrotik routers, configure dynamic OSPF routing on Cisco and Mikrotik, configure PIM routing, verify configurations and view logs of every activity carried out by the user.

Activity Diagrams

Activity Diagram is a UML diagram that is used to describe the work flow and activities that can be carried out within the scope of the system (Wiryawan & Rosyid, 2019). In designing activity diagrams, all activities contained in the application system are displayed according to the features contained in the application. In the activity diagram of the configure feature there are three objects that have their own activities, in the user object there are activities in selecting configurations and adding static or dynamic routing configuration parameters, then for the application object there is the activity of sending configurations and for the device activity it is the object that will be used. configuration. seen in figure 7 activity diagram configure.

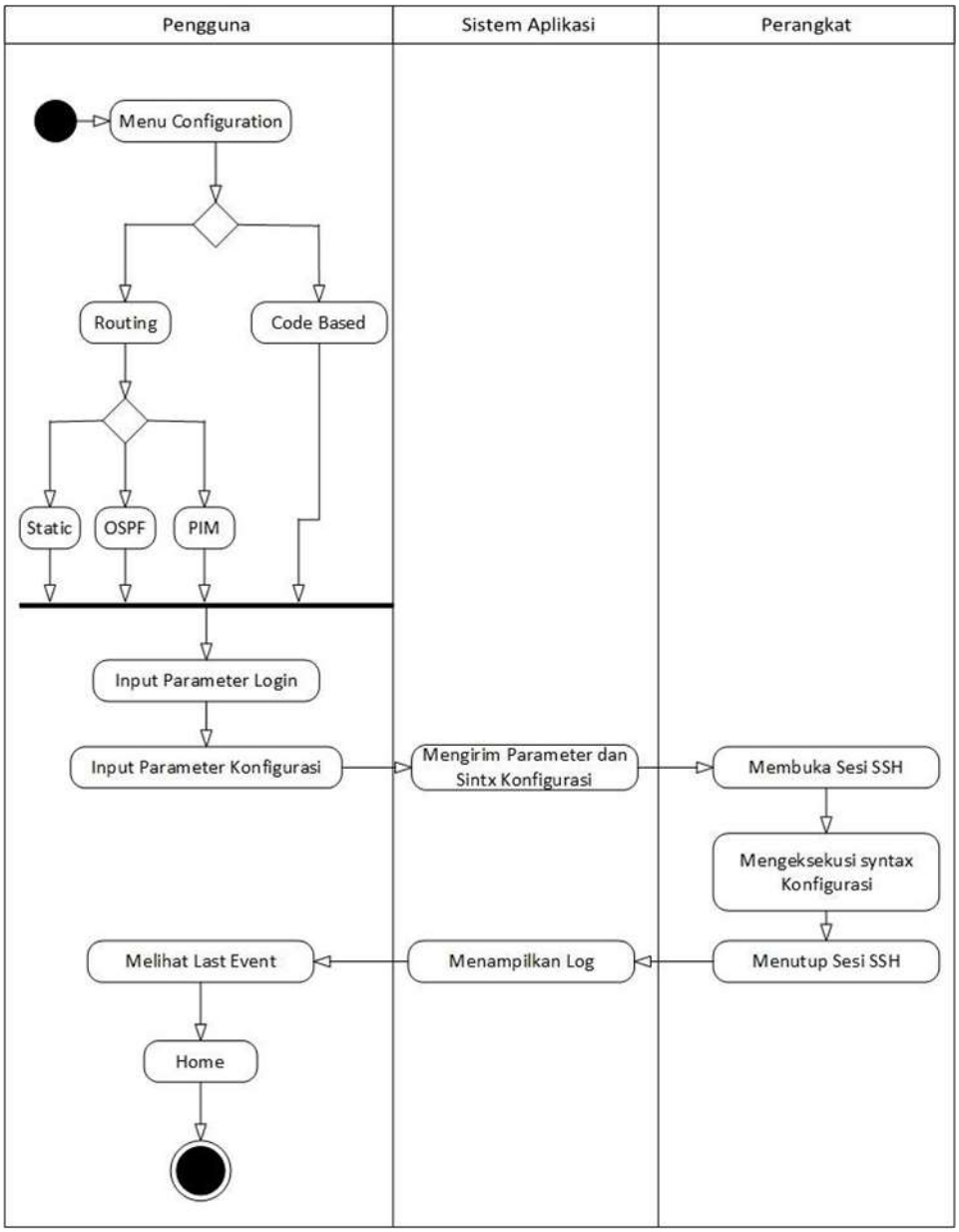

Figure 8. Activity Configuration Diagram

In the activity diagram of the configuration verification feature, there are 3 objects that have their own activities, in the user object, namely having configuration verification that has been carried out previously in the configuration feature or just looking at the current configuration and adding configuration verification parameters such as verifying the configuration of the IP address, IP routing and running config that is currently running. Then, the application object has an activity that sends configuration verification syntax and the device activity is the object that will carry out configuration verification, as shown in Figure 8, the verify configure activity diagram.

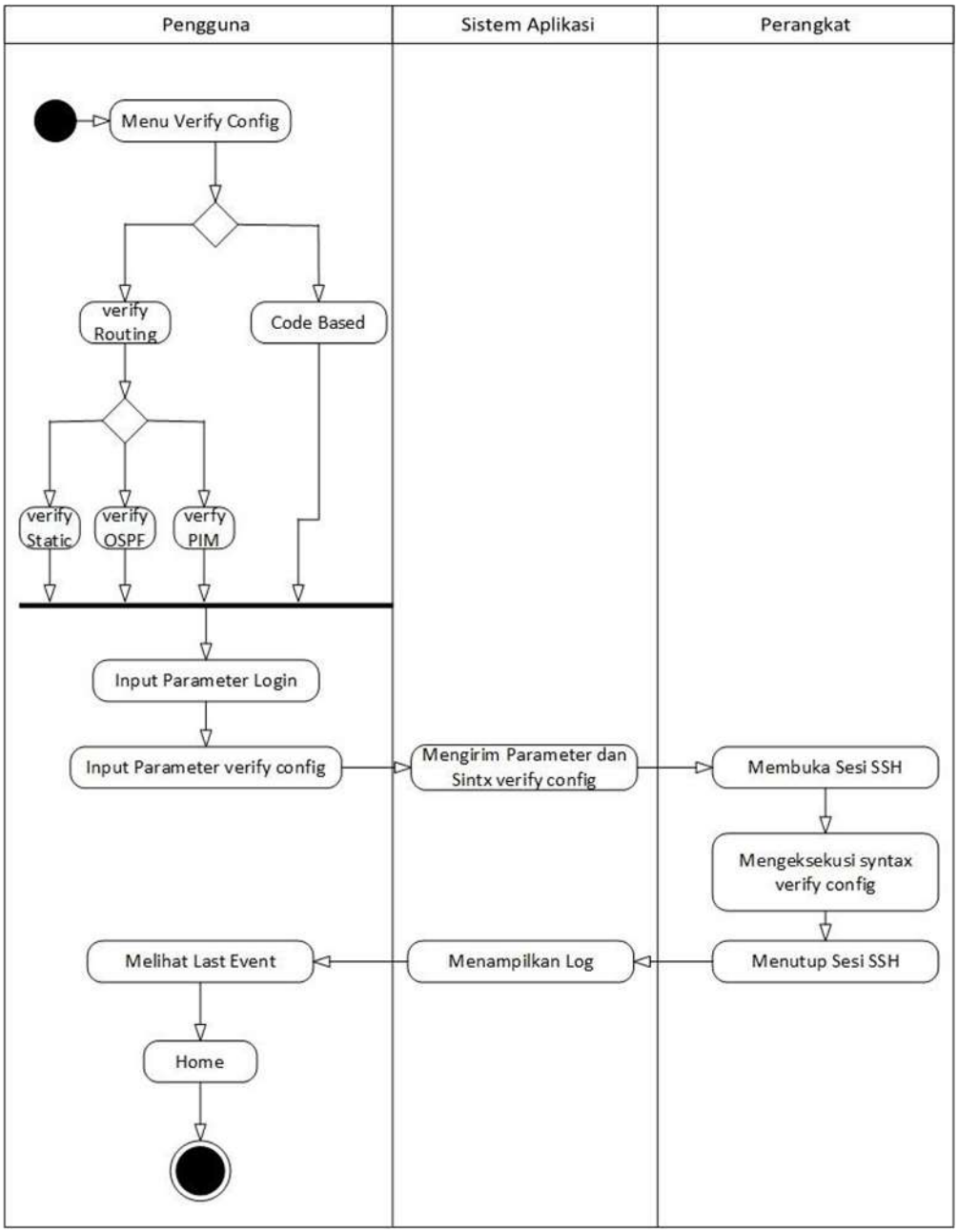

Figure 9. Configuration Verification Activity

Screen Design

The design that will be developed has the name Simple Network Automation or abbreviated as SNA. The application system interface display consists of the home display, the main application system page display, the home display, Device List, Configuration, Configuration Verification, and Log. This application development uses CSS, the Bootstrap framework to make application creation easier. On the main page of the application system there is an Overview which displays information on total devices, number of Mikrotik devices, and number of Cisco devices. Apart from that, there is also the last activity carried out by the network administrator in the form of number, Target Device which contains the device being configured, Action which

contains what the network administrator has done at the last time, status which contains the success or error for each change and finally the time of change which is carried out by the network administrator in making changes to the network devices, where the total devices are taken from the django admin models to which network devices have previously been added. The main page display of the application system can be seen in Figure 9.

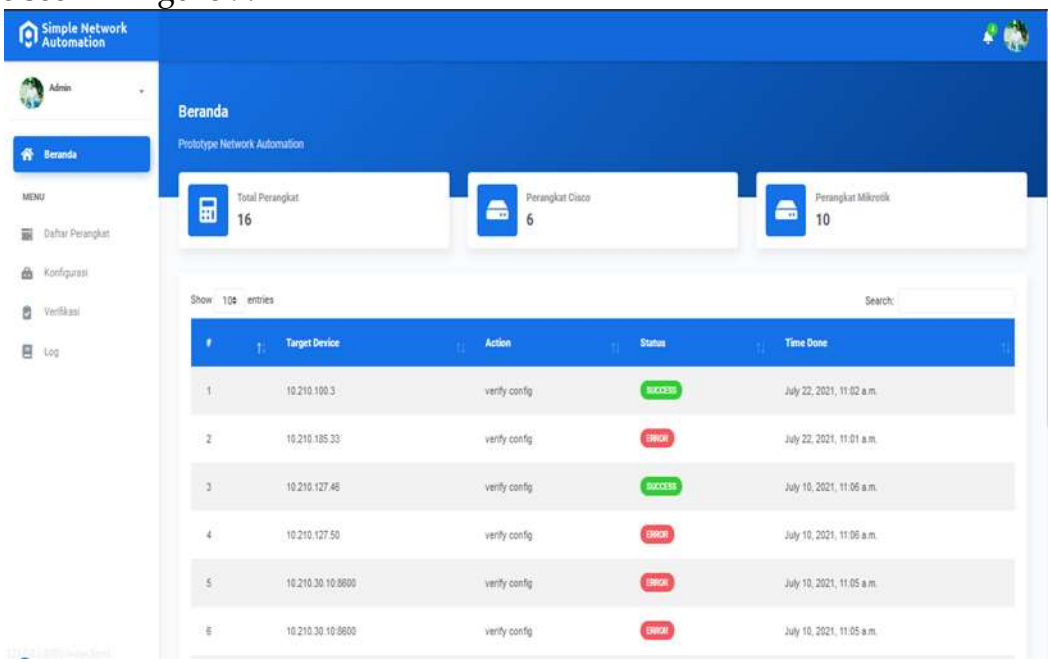

Figure 10. Main Application Display

In the device list feature there are several devices that have been added to the django admin model, where there is information about the IP address of each device, be it Cisco or Mikrotik, the hostname on each device, be it Mikrotik or Cisco, and vendor information for each device. The following is a display of the device list feature in Figure 10.

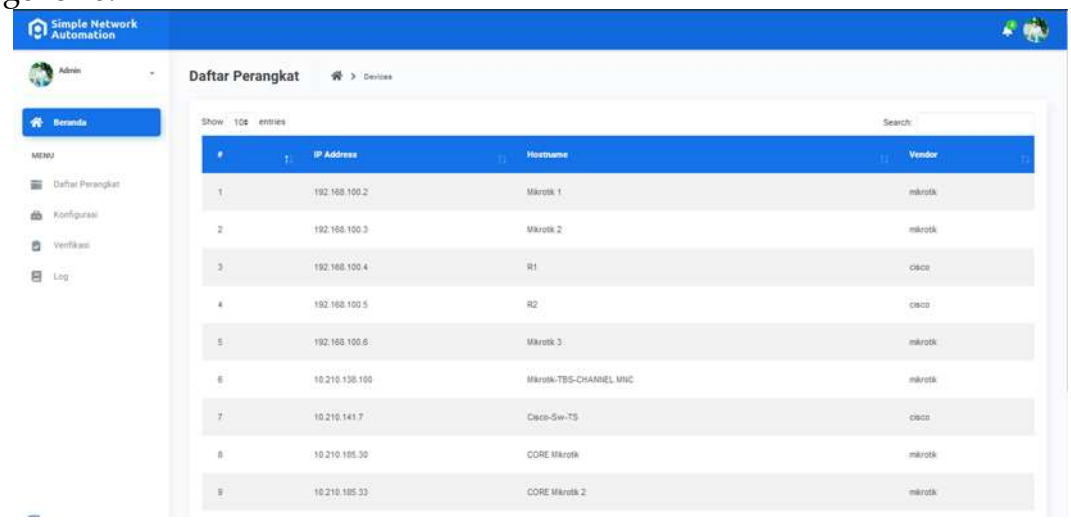

Figure 11. Device List Display

In the Configuration feature there is a target device which consists of the device name, IP address of the device to be configured. Meanwhile, for the configuration

column, there are 2 configuration columns for Mikrotik Command and Cisco Command where these two columns are used to configure. And at the bottom there is a submit button which is used to send the configuration. The following is a display of the configure features in Figure 11.

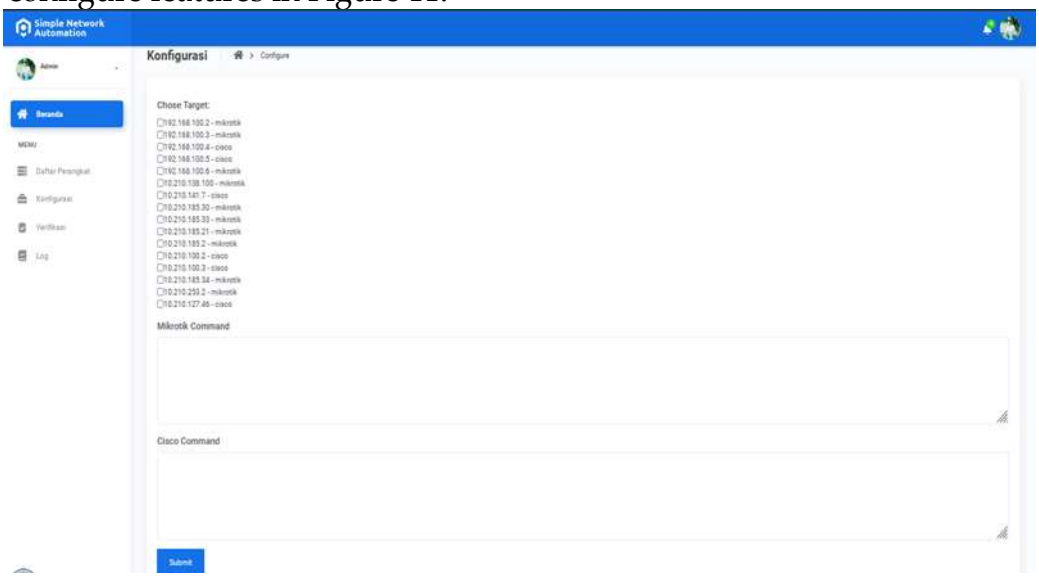

Figure 12. Configuration Display

Then the configuration verification feature is almost the same as the features in configure, the difference is that the verify config feature is sending and displaying the configuration results or current configuration status, which consists of the device name and IP address of the device whose configuration will be verified. The following is the Configuration verification display in Figure 12.

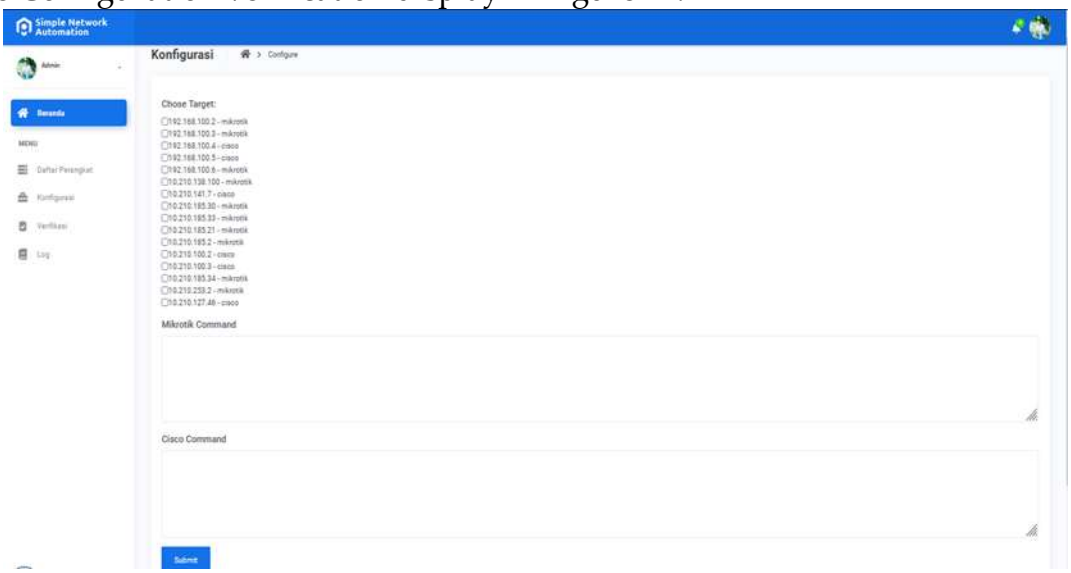

Figure 13. Configuration Verification Feature Display

The last one is the Log feature which records the network administrator's activities in configuring the network and verifying the configuration, which in this log feature records the target device which contains devices from Cisco and Mikrotik, Action which records the activities carried out by the network administrator, status which records the success or error of each activity, time which records the time of each

change and message which records the error status or no error. The following displays the feature log in Figure 13.

D. CONCLUSION

The Network Automation application for the feature of adding Cisco and Mikrotik router devices is included in one-dimensional, which means the features for adding Cisco and Mikrotik router devices are getting better. With a satisfaction level of 0.5713 and a disappointment level of -0.5713 if this feature is not implemented. The Network Automation application for the IP address configuration feature for Cisco and Mikrotik router devices is included in Mustbe, which means this feature should already be present in the network automation application, with a satisfaction level of 0.4285 if implemented and a disappointment level of -0.4285 if this feature is not implemented. The Network Automation application for dynamic routing configuration features OSPF, RIP, on Cisco and Mikrotik routers is included in One-Dimensional, which means the better the features for performing dynamic routing configurations on Cisco and Mikrotik routers with a satisfaction level of 0.5714 and a disappointment level of -0 .4285 if this feature is not implemented, while the PIM routing and Configuration verification features are included in Indifferent, which is why this feature is not often used by network administrators when configuring, but the Log feature in the network automation application is included in One-Dimensional, which means the better the log feature to use with a satisfaction level of 0.5714 and a disappointment level of -0.5714 if this feature is not implemented .

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