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MODEL-VIEW-CONTROLLER DESIGN SYSTEM OF MOTORCYCLE DAMAGE DETECTION USING FORWARD CHAINING METHOD

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***Abstract*--This study aims to design a motorbike damage detection system using the forward chaining method with a view controller model that can be run on a mobile-based system. Dealers and motorbike service providers receive and fulfil customer requests for motorbike service services. Mechanics who service vehicles still use conventional methods to check vehicle damage by scanning the paper (form). There is a list of vehicle damage. This method takes quite a long time, and it is not sure that the problem will be resolved quickly. The research method used is forward chaining, and the model used is the Model View Controller, which separates data from the display by processing it. The result of this research is that with a motorbike damage detection system, mechanics from dealers and service areas do not have to carry out initial checks manually but instead use a system with a view controller model and initial check results. Detection can also be determined by applying the forward chaining method. Based on functional testing of the system using a black box, valid results were found; then, for logic testing using the forward chaining method, the results were free from logical errors.**

***Keywords*: Damage; Detection; Forward Chaining; Model-View-Controller; Motorcycle.**

I. INTRODUCTION

Owner of two-wheeled vehicle ought to regularly service their motorcycles. By doing so, they can find damage to the motorcycle if it gets damaged. So far, the traditional way of recording motorcycle damage is still done, namely, the mechanics who will perform the service check the available forms and write down the notes needed before the service process begins. Motorcycle dealers and services can use this research because they receive and handle customer requests for motorcycle service; mechanics who service vehicles still use the traditional method of checking for vehicle damage by writing it on paper (form). A list of vehicle damage is available. Every year, technological advancements increase, enabling processes that are now carried out in a traditional manner to transition to a mobile-based computerized system.

The challenge in this study is to create a mobile-based motorbike damage detection system utilizing the forward chaining approach and the view controller model. Additionally, the goal of this research is to create a motorbike damage detection system that can be used on a mobile platform by employing the forward chaining approach and a view controller model. The advantage of this research is that it can assist mechanics at dealerships and auto services in documenting motorized vehicle damage and can observe the outcomes of early detection of motorcycle damage with the forward chaining method supported by an appealing appearance because it implements MVC (Model View Controller).

The author consults specific theoretical literature for research purposes and as a source of information. Multiple independent system components are arranged or planned as one unit in a system design[1]. The system design includes a description of the new system as well. A web-based mobile approach is an organization of work systems between hardware and software on mobile devices using a web platform[2]. The Model View Controller (MVC) is an architectural design pattern for websites that consists of three components: the model, which controls and interacts with the database; the view, which displays the information to the user; and the controller, which links the model and the idea to

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handle user requests[3]. The Forward Chaining method is a way to search or track forward, beginning with already accessible information and integrating rules to produce objectives; forward chaining conducts reasoning from issues to solutions beginning with already available data, and conclusions are reached[4]. The system types are as follows:

1. The system is displayed under a single or several situations.
2. The knowledge base is searched for a rule that matches the "if" condition for each system circumstance.
3. Every rule creates a new condition based on the conclusion specified in "then," and that new condition is then added to the other existing conditions.
4. Each condition added to the system is processed; if a new state is discovered in the sought conclusion, the system goes back to step B and searches for the rules once more in the knowledge base; however, if no new decision happens, the step is complete.

Additionally, some other studies have been conducted by other writers on the topic of sending motorized vehicle owners periodic service alerts using an SMS gateway and a mobile device[5], a study that aims to assist users in identifying damage and being able to fix motorcycles earlier so that continued deterioration does not develop[6]. The development of a website employing forward chaining technology to assist bikers in spotting damage to their machines[7]. In further studies, the authors aim to streamline and to accelerate the precise management of motorcycle damage using the forward chaining approach to raise customer satisfaction in managing motorcycle damage at Heri's workshop[8]. Next, more studies aimed at enhancing the company's administration of two-wheeled motorized vehicle repairs by supplying information and developing an expert system on mechanical motor engine damage[9]. Studying problem codes on Suzuki motorbikes with suitable technological models[10]. Additionally, research on the design of decision-making in the course of detecting engine damage makes use of forward-tracking inference[11]. A study that examines the use of RFID (Radio Frequency identification) and GPS security technologies for tracking motorbike vehicles[12]. Research that develops a technique that makes it easier to detect damage to web-based injection motors using the forward chaining method[13]. Research that develops a technique that makes it easier to detect damage to web-based injection motors using the forward chaining method[14]. A different study discusses the development of a tool enabling consumers to check for motorbike damage before visiting a repair shop[15]. A web-based system for diesel pump damage detection that facilitates users using the forward chaining approach is discussed in further study[16]. Another study area is creating an expert system model utilized in motorcycle damage cartels to convert motorcycle mechanics to computers[17]. Studies that track leisure and activity in the province of South Sulawesi using MVVM (Model-View-ViewModel)[18], after which, the Haversine and Euclidean distance methodologies were used to create an android-based application to offer early warning of road deterioration[19].

II. METHOD

The several methods used in this study are as follows:

1. The type of research used is as follows:
   a. The author conducted literature study by looking for references or research references in books and journals pertaining to Model View Controllers, Detection of Damage to Vehicles, Particularly Motorcycles, and Regarding Forward Chaining.
   b. During the author's field investigation, which included on-site inspections of motorcycle dealers and service cars.
2. Data collection techniques were carried out as follows:
   a. Observation: The authors observed dealers and auto services at the study site to identify the necessary indicators.
   b. Interviews were conducted by the author with several mechanics who specialize in vehicle maintenance, particularly for motorcycles, to learn about the first inspections and processes carried out.

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3. The research tools and materials used to support the system design process are:
   a. Hardware consisting of 1 unit of laptop, 1 unit of smartphone.
   b. The software used is Windows 10, PHP, MySQL, PhpMyAdmin, and Apache Web Server.
   c. The research materials used are information data on types of spare parts, service data, data on types of motorcycle damage and data on repair solutions.
4. The stages of the research carried out are as follows:
   a. Survey of research locations at motorcycle vehicle dealers and services.
   b. Data collection, the authors collect the data needed to support research related to motorcycle vehicle damage service.
   c. System analysis, do an analysis in advance of what is needed in designing a system.
   d. System design, the author makes a design of the system in the form of designing forms, databases and flowcharts using a motorcycle vehicle damage detection system that uses the forward chaining method with a view controller model.
   e. Coding, the design results of the system are added programming commands that will make the system function as expected.
   f. Testing, in this stage testing of all functions of the system is carried out as well as testing of the logic of the methods used in detecting motorbike damage.
   g. Implementation, then the system that has been completed is implemented for motorcycle dealers and service vehicles.
5. The method used in detecting motorcycle damage is the forward chaining method using mobile web technology and the view controller model.
6. Fig. 1 shows the system architecture for a mobile-based system that can be used on a smartphone device. The mechanic enters complaints of damage to motorcycle vehicles using the system display, which employs a view controller model. Utilizing the forward chaining approach, administration inputs data processing from dealers and services linked to motorcycling vehicle damage detection data.

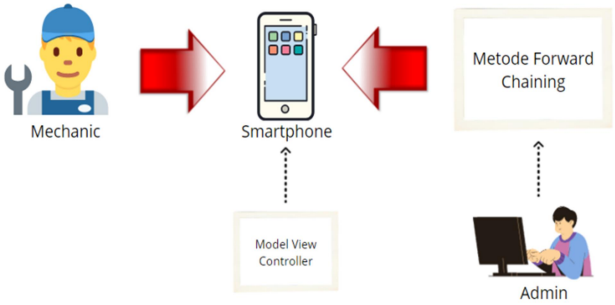

Fig. 1. Architecture System

7. Design System

Fig. 2 shows a use-case diagram for a system with two actors: the admin and the user (mechanic). The admin actor handles login tasks, enters spare part data, enters indicators to check for motorcycle vehicle damage, and processes user data. Additionally, the user (mechanic) logs in, displays spare parts data and then completes the question indicator by the damage to the motorcycle vehicle that needs to be serviced. The detection results are managed using the forward chaining method and a mobile web-based system display using the view controller model.

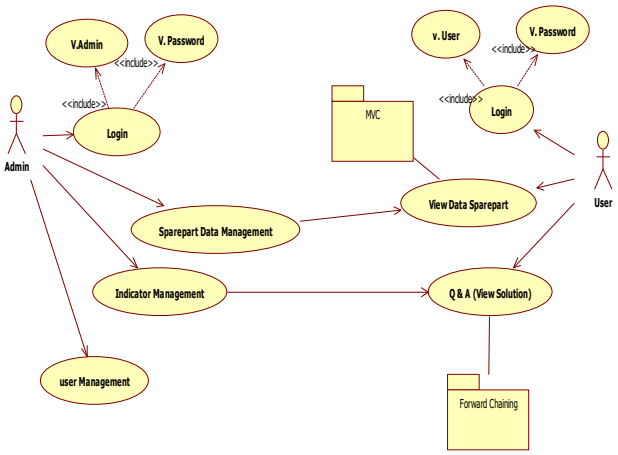

Fig. 2. Use Case Diagram System

Fig. 3 depicts the system's activity diagram, in which the user and system interact to implement the procedures for inspecting and diagnosing (detecting) damage to motorcycle vehicles. Fig. 4 shows the user menu flow. After successfully logging in, the user is presented with the main menu and given the option to browse spare parts information or detect motorcycle damage.

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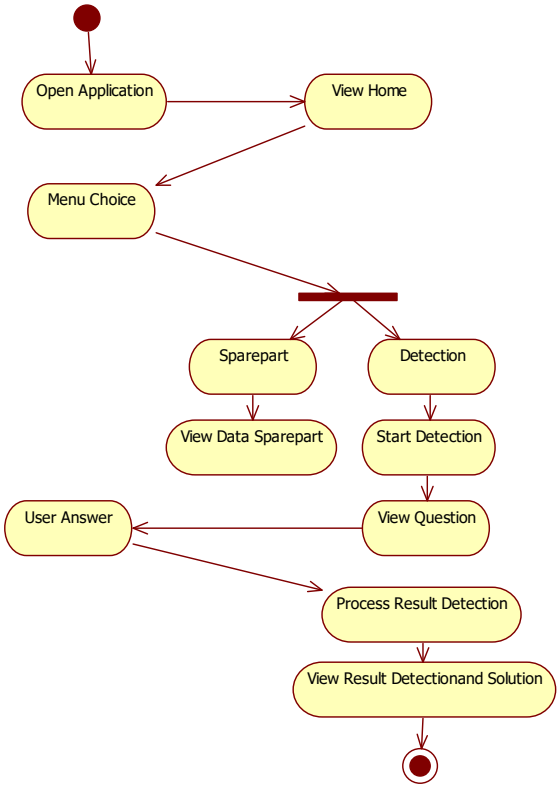

Fig. 3. Activity Diagram System

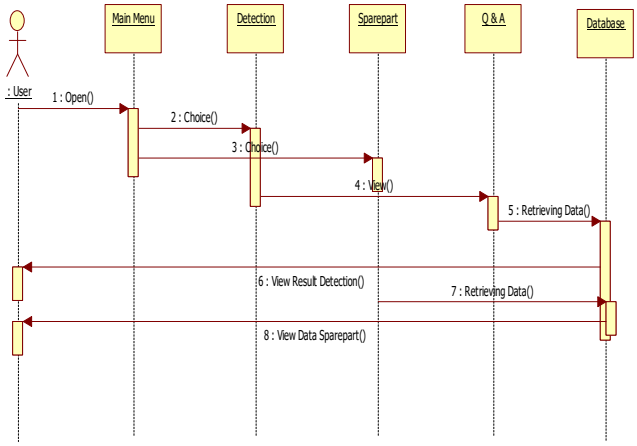

Fig. 4. Sequence Diagram System

III. Result and Discussion

The results and discussion of the research conducted are as follows:

A. Scenario

Customers submit requests for motorcycle servicing to motorcycle dealers and services, and they complete such requests. In the first inspection of every vehicle, mechanics still check for motorcycle damage using the traditional procedure, which involves looking at the paper (form) that contains a list of vehicle damage.

B. Display System

Fig. 5 shows a login screen with a login button and fields for entering a username and password. Fig. 6 shows the home screen, which includes choices for managing data, users, replacement parts, and logout. Fig. 7 shows a display of data management for motorcycle vehicle spare parts. Fig. 8 shows a display of user data management from motorcycle vehicle service mechanics.

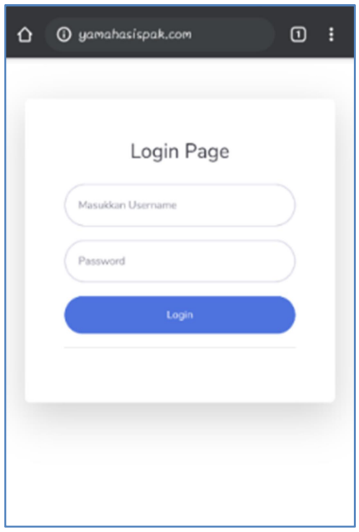

Fig. 5. View Login

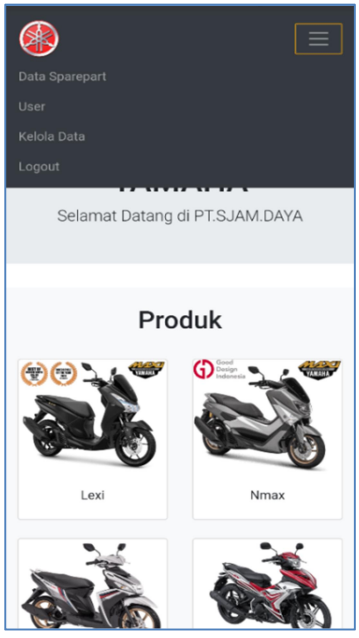

Fig. 6. View Main Home

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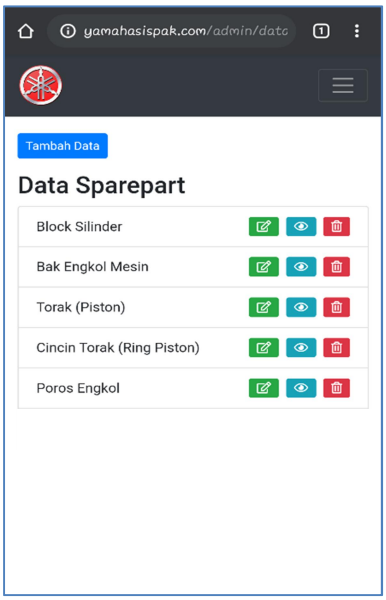

Fig. 7. Spare Part Data

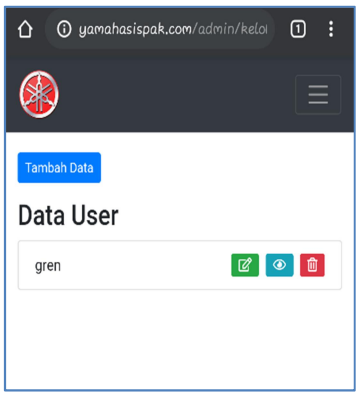

Fig. 8. User Data

Fig. 9 shows a display of the management of motorcycle vehicle damage detection data, where there are input damage data, cause data, rules data and solution data. Fig. 10 shows a display of the motorcycle vehicle damage detection data input. Fig. 11 shows a display of data input causing damage to motorbike vehicles.

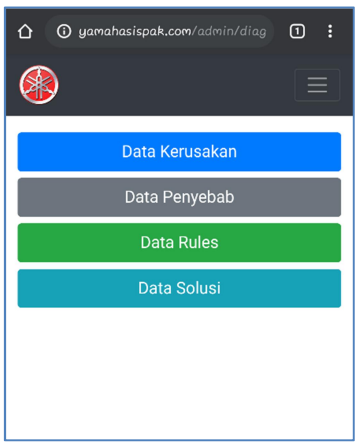

Fig. 9. Management Data

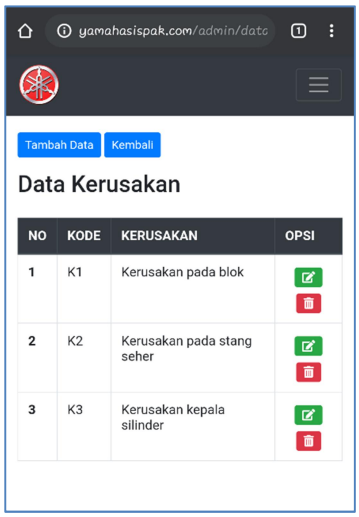

Fig. 10. Damage Data

Fig. 11. Parameter Data

Fig. 12 shows a display of the data input rule for detecting motorbike damage. Fig. 13 shows a display of data input for repair solutions for damage to motorcycle vehicles. Fig. 14 shows the display of the main user menu, namely the mechanics consisting of damage detection, spare parts and logout menus. Fig. 15 shows a display of damage detection which consists of questions related to the condition of the motorbike to be serviced.

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Fig. 12. Rule Data

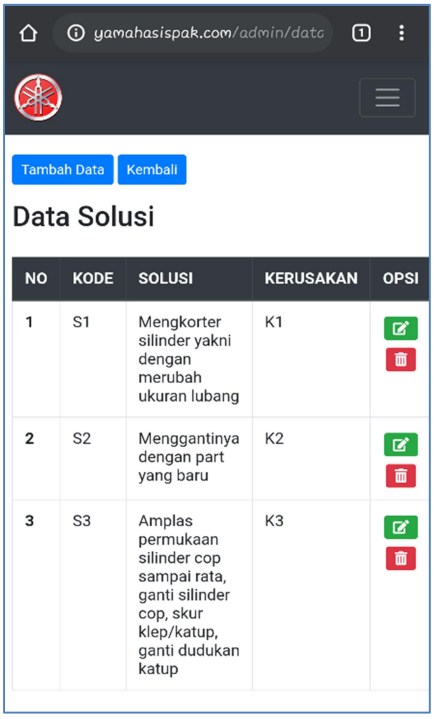

Fig. 13. Solution Data

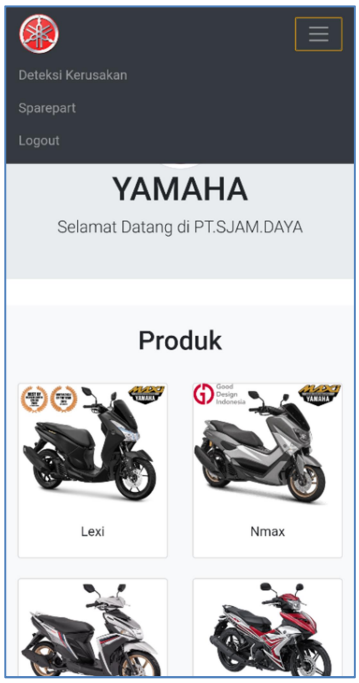

Fig. 14. Main Menu User

Fig. 15. Question Detection Damage

Fig. 16 shows a display of damage detection results based on questions related to the condition of the motorbike to be serviced. Fig. 17 shows a list of data and detailed spare parts for motorbike vehicles.

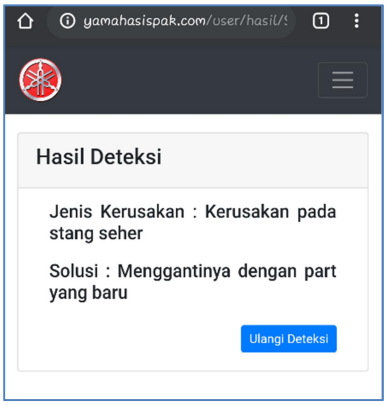

Fig. 16. Result Detection

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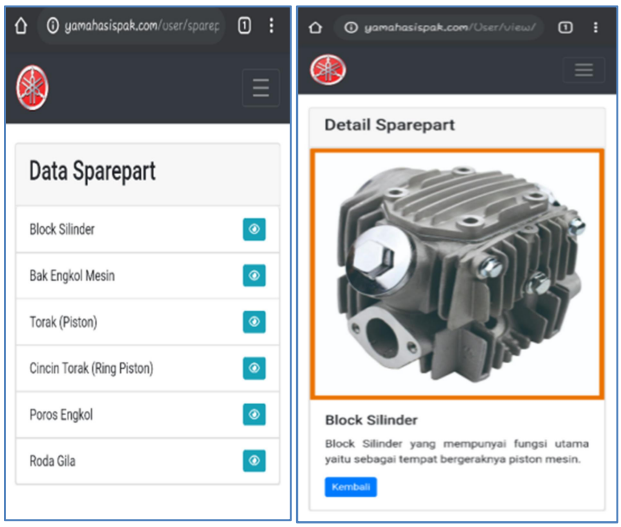

Fig. 17. List and Detail Spare Part

C. Forward Chaining Analyzed

The results of the analysis from the use of the forward chaining method are as follows:

Rule 1
If the power generated by the engine is weak
And the engine heats up quickly
And white smoke comes out of the exhaust
And spark plugs die easily
And the oil runs out quickly
And slow to change the oil
And the motor suddenly broke down
And the machine is started or does not start at all
And blocks expand
And the piston is stuck in the cylinder bore due to overheating.
And use fake oil
And the piston ring sticks
And damage to the piston ring and cylinder bore
Then Damage to the block

Rule 2
If there is a severe rough sound on the engine when it is turned on
And the motor suddenly broke down
And the machine started or does not start at all
And slow to change the oil
And use fake oil
Then Damage to the piston stand

Rule 3
If the engine is not stationary (gas is not fixed, sometimes it is small, and sometimes it is large)
And the engine heats up quickly
And white smoke comes out of the exhaust
And rough sound on the cylinder head
And black smoke comes out of the exhaust
And wasteful fuel
And the machine started or does not start at all
And slow to change the oil
And the entry of water or dirt into the engine
And use fake oil
And the remaining combustion gases cannot come out smoothly from the exhaust
And shil clap oil is leaking
Then Damage to the cylinder head

TABLE I
Rules Decision

Rule	IF	THEN
1	P1, P2, P3, P5, P9, P15, P11, P12, P13, P14, P16, P17, P21	A
2	P11, P10, P12, P15, P17	B
3	P6, P2, P3, P4, P7, P8, P12, P15, P17, P18, P19, P20	C

Information:
P = Cause
A = Damage to the block
B = Damage to the piston stand
C = Damage to the cylinder head

TABLE II
Result Decision

Num.	Code	Parameter	A	B	C
1.	P1	The power generated by the engine is weak	*		
2.	P2	Engine heats up fast	*		*
3.	P3	White smoke comes out of the exhaust	*		*
4.	P4	Rough sound on cylinder head			*
5.	P5	Spark plugs die easily	*		
6.	P6	The engine is not stationary (gas is not constant, sometimes it is small, sometimes it is large)			*
7.	P7	Black smoke comes out of the exhaust			*
8.	P8	Wasteful fuel			*
9.	P9	Oil runs out quickly	*		
10.	P10	Severe rough sound in the engine when started		*	
11.	P11	Motor stops suddenly	*	*	
12.	P12	The engine has started or cannot start at all	*	*	*
13.	P13	Block expands	*		
14.	P14	Piston stuck in a cylinder bore due to overheating	*		
15.	P15	Slow to change oil	*	*	*
16.	P16	Damage to the piston ring in the cylinder bore	*		
17.	P17	Does Not Use Standard Oil	*	*	*
18.	P18	The remaining combustion gases cannot exit smoothly from the exhaust			*
19.	P19	Entry of water or dirt into the			*

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Num.	Code	Parameter	A	B	C
		engine			
20.	P20	Entry of water or dirt into the engine			*
21.	P21	Piston ring sticks	*		

Fig. 18 shows a decision tree that explains the path leading to each damage destination which is symbolized by the letters A, C and B, while P followed by a number is the cause for finding damage.

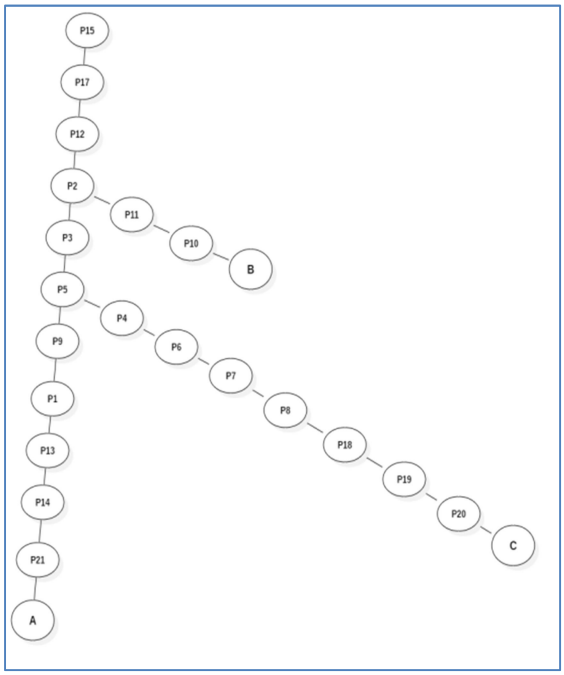

Fig. 18. Decision Tree

D. Testing

The functional testing of the damage detection system on motorbikes, black box testing is used with the results shown in Tabel III. Then, do the logical typing of the method used. The results is shown in Fig. 19.

TABLE III
Black Box Testing

Num	Indicator	Result
1	Login Page Test	Valid
2	Spare part Data Page Testing	Valid
3	Testing User Pages	Valid
4	Crash Data Page Test	Valid
5	Cause Data Page Test	Valid
6	Testing the Data Rules Page	Valid
7	Solution Data Page Test	Valid
8	Crash Detection Page Test	Valid
9	Testing the Detection Results Page	Valid
10	Spare part Page Testing	Valid

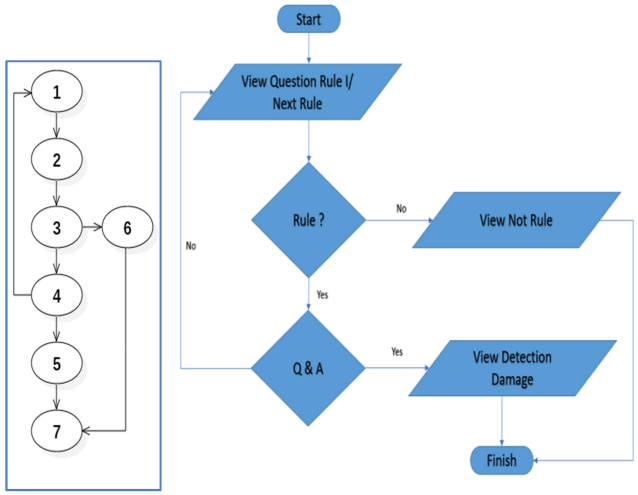

Fig. 19. Flowchart and Flowgraph

Cyclomatic Complexity as follows:

$$V(G) = (E - N) + 2$$
$$= (8 - 7) + 2$$
$$= 3$$

Information:
E = the number of arcs in the flow graph is 8
N = the number of nodes in the flow graph is 7

There are 2 free paths in the flow graph notation to be tested. Based on the flow graph sequence above, the flow graph basis groups are obtained as follows:

1. Route 1: 2 3 4 5 7
2. Route 2: 1 2 3 4 5 6 7
3. Route 3: 1 2 3 4 1 2 3 4 5 7

IV. Conclusion

The study finds that a motorcycle damage detection system allows mechanics from dealers and service areas to do initial checks without having to do it manually since the system already has a view controller model and the results of the early tests. The forward chaining approach may be used to determine detection as well. Valid findings are achieved based on the functional testing of the system using black boxes, and the results are clear of logical faults when tested logically using the forward chaining approach. The Model View Controller technique is used to create a motorbike damage detection system by separating HTML code from PHP code.

Incorporating suggestions for system development into Android-based technology may be done by employing alternative, more pertinent algorithm techniques.

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