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DEVELOPMENT OF ANDROID MOBILE APPLICATION TO HELP MANTAIN EYE HEALTH USING SMARTPHONE SENSORS

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ABSTRACT

Eyes are the five senses that are bestowed to humans. Cataracts are a disease of the human eye. Cataracts are the number one cause of blindness that occurs in Indonesia. Cataracts can be a cause of blindness in Indonesia because people who get this disease are too late to realize that they have cataracts. In take care of eye health , is also needed knowledge unfortunately there are still many Indonesians who have not yet obtained this knowledge, this is certainly also a problem that occurs. to deal with these problems, an Android-based application is built that can help people detect cataracts and provide knowledge in the form of articles about eye health. This application uses the opencv library to process input images, then it will be processed using the pixel comparison method combined with the K-nearest Neighbors classification algorithm. Firebase Cloud Messaging technology is used to send notification of articles about eye health obtained by crawling techniques. In this study the application that was built has been able to detect the presence of cataracts in the eye, the application built has also been able to send notification of eye health articles. based on the results of the final questionnaire research to 30 respondents 93.33% of respondents agreed if the system built makes it easy to detect cataracts

Keywords: Cataract, Android, Firebase Cloud Messanging, KNN.

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1. PRELIMINARY

Vision is one of the most beautiful grace that has been given by Allah SWT. The eye has a very important function for our lives. Maintaining health is very important but in reality there are still many people who do not realize the importance of maintaining good health. Kesehaatan is expensive, according to the World Health Organization (WHO) in Indonesia increased health care costs increased by 36% over the last ten years. On February 15, 2000 the mother Megawati as vice president when it launched a program of Vision 2020. The program is a global movement made by the World Health Organization (WHO) to reduce blindness by 2020.

Based on data from the Ministry of Health Rrepublik Indonesia cause of blindness in Indonesia are cataract by 70% -80%. A cataract is a type of disease in the eye for the eye lens becomes cloudy and thus block the incoming light. This causes the disease is impaired vision, cataracts can lead to blindness if not treated properly. Based Riskesdas in 2013, 51% of cataract patients are unaware that they suffer from cataracts.

Based on the results of questionnaires distributed via social media with 52 participants, the fact that 92.3% or 48 respondents said they never perform cataract examination of the eyes. this indicates a problem. Indonesian society is still less concerned about his health.

Maintaining eye health is not very difficult to do, the virtual world a lot of articles from a trusted source that contains about how to maintain eye health. But according to the results of a questionnaire which was distributed 38.5% of respondents claimed to have never read an article about how to maintain eye health in a span of one month, 25% of respondents read one article, if added meaning as much as 63.5% of respondents not knowing how to maintain health eyes. if people want more to read would be nice and help can turwujudnya Vision 2020 program.

From the results of questionnaires that have been distributed all respondents are users of smartphones with various brands. Android became the operating system most widely used by percentage of 88.5%, the remaining 11.5% are users of the iOS operating system. Since the

number of android smartphone users would be better if we use these technologies to solve the problems mentioned above. We can utilize the camera on android smartphone technology combined with OpenCV library to detect cataracts. By utilizing the OpenCV we can extract the characteristics of an image. OpenCV has many functions therein that may dugunakan to cultivate the image of a picture, one of its functions is to detect patterns in an image of the image circle. this function allows us to detect the iris of the eye to be further feature extraction according to the needs. OpenCV will be combined with the KNN algorithm to classify the input image in the form of an eye. By using this way we can make cataract detection devices that can be accessed So many people can help as an early detection tool in order to reduce the risk of blindness caused by cataract. Notification feature found on Android smartphones can be utilized to enhance the public reading of the articles on how to maintain eye health community sehigga smarter. Thus it will be made to study with the title " OpenCV will be combined with the KNN algorithm to classify the input image in the form of an eye. By using this way we can make cataract detection devices that can be accessed So many people can help as an early detection tool in order to reduce the risk of blindness caused by cataract. Notification feature found on Android smartphones can be utilized to enhance the public reading of the articles on how to maintain eye health community sehigga smarter. Thus it will be made to study with the title " OpenCV will be combined with the KNN algorithm to classify the input image in the form of an eye. By using this way we can make cataract detection devices that can be accessed So many people can help as an early detection tool in order to reduce the risk of blindness caused by cataract. Notification feature found on Android smartphones can be utilized to enhance the public reading of the articles on how to maintain eye health community sehigga smarter. Thus it will be made to study with the title " By using this way we can make cataract detection devices that can be accessed So many people can help as an early detection tool in order to reduce the risk of blindness caused by cataract. Notification feature found on Android smartphones can be utilized to enhance the public reading of the articles on how to maintain eye health community sehigga smarter. Thus it will be made to study with the title " By using this way we can make cataract detection devices that can be accessed So many people can help as an early detection tool in order to reduce the risk of blindness caused by cataract. Notification feature found on Android smartphones can be utilized to enhance the public reading of the articles on how to maintain eye health community sehigga smarter. Thus it will be made to study with the title "android-based smartphone application development helps maintain eye health by utilizing the smartphone sensor ".

1.1 Purpose and Objective

The purpose of this research is to build an android based mobile application that can help the people of Indonesia in maintaining eye health, especially cataracts. While the purpose of this study is as follows:

1. Still difficult to maintain eye health, especially cataract, cataract makes the number one cause of blindness in Indonesia.
2. The difficulty people get information about the health of the eye, causing a lack of knowledge.

2. ISI RESEARCH

2.1 Research methods

Software development methods used perangakat is a RAD (Rapid Application Development). This method emphasizes the development cycle is short, short and quick. Here are some steps in the RAD method:

Figure 1 Method *Rapid Application Development*

1. Planning requirements

At this stage defines the scope of the system to be built. Identify needs and problems faced by the system to determine the purpose, limitations, constraints and problem solving alternatives.

2. *workshop* RAD design

At this stage do design a program that will be built. Then programmers create prototypes and display them on the user to be given feedback by the user in order to be with improvements thus becomes faster development process.

3. Implementation

At this stage, the programmer developing a prototype that has been dipebaiki into the program. After the testing of the program. If the process has been carried out it will be produced in accordance with the program which is expected at the beginning.

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2.2 Problem analysis

Analysis of the problem is the elaboration of the problems that existed before the application was built with the intention that the development of this application can help resolve the problems that exist. As for the problems.

Here are the problems that exist based on the analysis that has been done:

1. A cataract is a cloudiness of the lens (lens opacity). Cataract lens is characterized by edema, protein changes, increased proliferation, and damage to the continuity of the lens fibers. In general edema lens directly related to the development of cataracts. Cataracts cause of the disease is still unclear this causes difficulty in maintaining healthy eyes from cataracts, because the cataract becomes the number one cause of blindness in Indonesia. Cataracts can be treated surgically. Therefore it is important to quickly realize whether we are healthy or infected eye cataracts. Applications to be built will be easier for people to detect cataracts because it is easily accessible, yet pembanguanan this application is not to replace the doctor analysis.

2. From the results of the questionnaire note that 63.5% of respondents rarely read articles eye health, causing a lack of knowledge about how to maintain eye health. Applications that will be built will be easier for people to get articles related to eye health so that people get more information and find out the good things to maintain healthy eyes.

2.3 Built Systems Analysis

Analysis system to be built contains a complete overview of the system to be built. With the new system to be built is expected to facilitate the user in achieving its goals. Explanation of procedures system to be built:

1. Users make the registration process in advance to gain access to the application.
2. Users logged into the application
3. The system will display the main menu and also displays a list of articles about eye health
4. The user enters the eye image if you want to make the detection of cataracts
5. The system will process the detection of cataracts and displays the results.

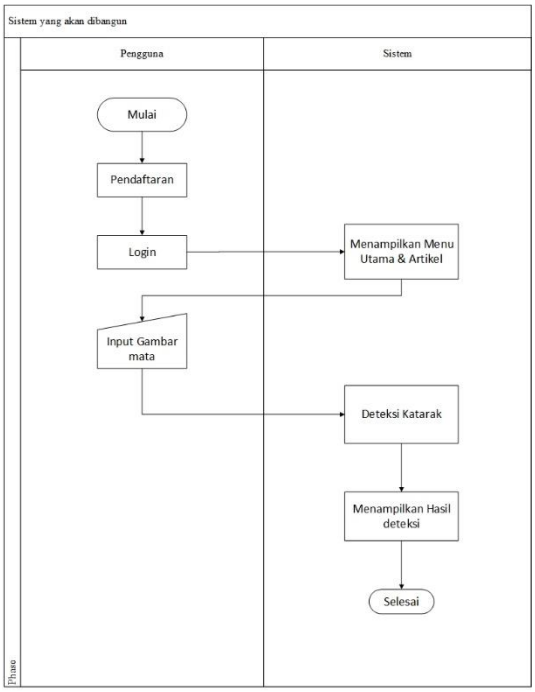

Figure 2 Flow System To Be Built

2.4 System Architecture Analysis

The analysis aims to identify the system architecture system architecture to be built based on two subsystems and mobile websites. Here is a picture of a system architecture that will be built. This image illustrates the overall system architecture.

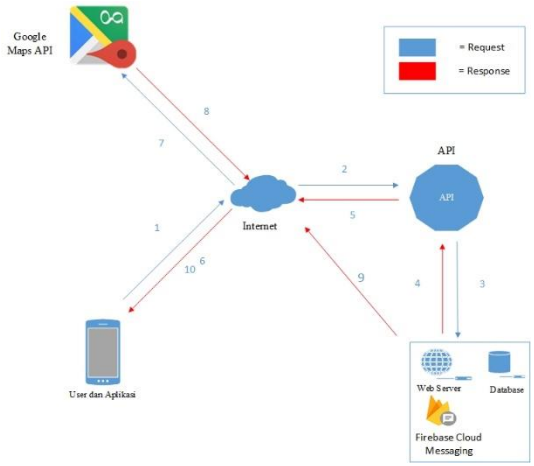

Figure 3 System Architecture

Below is a description of the image system architecture:

1. Application to request data to the server via the Internet
2. Then from the Internet network requests forwarded to the server via an API
3. *server* receiving a data request from fire

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4. *server* take the desired data from the database and then send it back via API
5. Fire sends the desired reply through the Internet
6. Users receive a desired response in the form of an article database
7. Application to request through google to fire through the Internet
8. *Google maps* give response to request an application form of data a nearby hospital.
9. *Firebase cloud messaging* receives the data necessary to provide notification to the application and sends a notification via the Internet
10. *Firebase cloud messaging* sent a notification to the application.

2.5 Cataract Detection Method Analysis

This analysis aims to illustrate how the system will be made to make the detection of cataracts in the eyes. Dilakukkan cataract detection by comparing the amount of pixels of black and white pixels in the input image that has been converted into a binary image, then the comparison will be processed using an algorithm KNN (K-nearst Neighbors) for classification of the input image detection results.

Step completion cataract detection as follows:

1. Image retrieval Eyes

At this stage, the eye image acquisition process by using a camera sensor on android smartphone. Image acquisition performed at room have enough light. To minimize the chances of reflected light on the image of the shooting was done without turning on the flash. At this stage produces the input image from RGB (Red, Green, Blue).

Figure 4 Image Input (RGB)

2. *cropping*

By using the technology of OpenCV iris system detects the input image input and perform automatic cropping. Results cropping square shaped and contain the iris with the image of a black background. Results cropping has a size of 100x100 pixel format. * .Jpg.

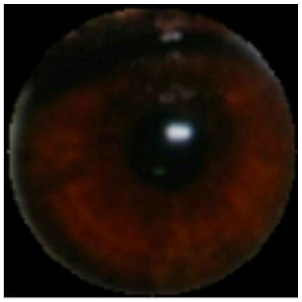

Figure 5 Image Cropping Results

3. Feature extraction

This process aims to determine the pattern of each image to obtain the characteristics to be used in the classification process. The pattern of eye types specified in this process is the pattern of a normal eye and eye cataracts. In the early stages of this process image cropping results will be transformed into the image of gray (Grayscale) with the aid of OpenCV. The process continued with Tresholding is to change the image of gray into a pixel image containing black and white pixels only. Pixels with a value less than the threshold value will be changed to black, and a pixel with a value more than the threshold value will be converted into white pixels. The threshold value used in this system is 80.

Figure 6 Image Results Tresholding

4. Comparison of Black and White

In this process the input image has only black and white pixels only. Then will be the process of calculating the ratio between the intensity of white pixels to the total number of pixels. The result of the calculation process will be a reference in the classification process. The following formula:

$$x = y \div z$$

information :

x = value comparison
y = white pixel
z = sum of black and white pixels

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Case in point was calculated as follows:
An input image after a process of feature extraction have white pixels by 1177, and pixel black 8823

$$x = 1177 \div 10000 = 0.1177$$

5. Creating Data *training*

At this stage of the process stage 1 to stage 4 we can create a database. The database contains the pixel values of white, black pixel, a white pixel comparison with the total pixels, and also a label on each ditelah input image is processed. The database will be used in the classification process using KNN algorithm.

6. Classification

The process after the last one processed input image is classified. KNN is a supervised learning algorithm, the new data will be classified Based on the majority of categories of k-nearest neighbors. The number of k-neighbors can be determined. New data classification is done based on parameters that have been set. In this system the attributes that use is the number of black pixels and the value of the ratio between the number of white pixels to the total number of pixels. Determination of the closest neighbors of the new data is done by calculating the distance between the new data with all the data samples that have been prepared perhituangan distance on this system using the Euclidean Distance with the following equation:

$$d_{ij} = \sqrt{\left[(x_i - x_j)^2 + (y_i - y_j)^2\right]}$$

d_{ij} = Distance of the data *sample* with new data

x_i = The value of the parameter x to the data *sample*

y_i = Y parameter values for the data *sample*

x_j = The value of the parameter x for new data

y_j = Y parameter values for the new data

Examples of the case as follows:

There are data from the input image processing with the pixel value comparison between the number of black and white pixels to the total number of pixels as follows:

Table 1 Results of calculation of Euclidean Distance

No.	X = black pixel	Y = white pixel / total pixels	Label
1	9449	0.0551	Normal
2	8823	0.1177	Normal
3	9783	0.0217	Normal
4	5534	0.4466	Cataract
5	6870	0313	Cataract
6	8181	0.1819	Cataract

There is a new data unknown label with a value of x = 7590 y = 0241 value In an example of this case is determined value of K = 3,

Table 2 Nearest Neighbor

No.	*Euclidean Distance*	Order	Label
6	591	1	Cataract
5	720	2	Cataract
2	1233	3	Normal

By looking at the above table cataract numbered label and label 2 normal 1, 2 is greater than 1 then the new data will have a label has a cataract.

2.6 Technology implementation

Implementation of the technology is an important part of the development of this system, at this stage the results of the analysis of the technology applied in a tangible form that is built into the application. Without the application of technology that has analyzed the system is built will not work as expected, because mobile technology is the main key to a system built to run. Here is a technology implementation on systems that have been built:

1. Android OpenCV4 Library

OpenCV technology used to make the detection of cataracts. The use of this technology by making use of functions - the functions contained in the librarynya. Here is a function of the OpenCV library is used:

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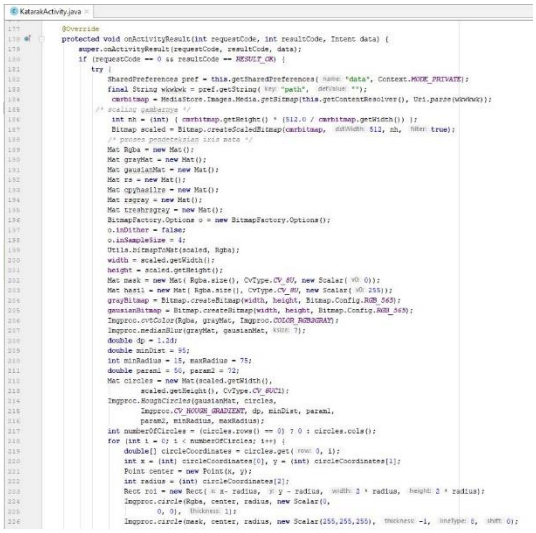

Figure 7 Implementation of Technology OpenCV Library

2.7 Implementation Database

The system is built has a web service, this database is connected to the web service. The database is designed to store data relating to users of the application. created database consists of three tables, namely users, data tables articles, data tables crawling. User table is a table containing the data of users who have registered applications for entry into the built application. Crawling data table is the table used to store the results of retrieval of information in the form of links from websites doktersehat.com. the article data table is the table used to store the results of the processing of information from the data table in the form of articles crawling eye health. Here is the implementation of a database on a system that is built:

Table 3 Implementation Database

No.	Table name	SQL
1	users	CREATE TABLE `pengguna` (Id_pengguna` `int (11) NOT NULL, `Name` varchar (100) NOT NULL, Email` `varchar (150) NOT NULL, Pass` `varchar (150) NOT NULL, Api_key` `varchar (100) NOT NULL, Usia` `int (10) UNSIGNED NOT NULL
		) ENGINE = InnoDB DEFAULT charset = latin1;
2	Data Crawling	CREATE TABLE `datacrawling` (Id_crawling` `int (11) NOT NULL, `COLLATE utf8_unicode_ci link_crawling` text NOT NULL, `COLLATE utf8_unicode_ci judul_crawling` text NOT NULL, `COLLATE utf8_unicode_ci desc_crawling` text NOT NULL, `COLLATE utf8_unicode_ci internal_link` text NOT NULL) ENGINE = InnoDB DEFAULT charset = utf8 COLLATE = utf8_unicode_ci;
3	Data Pages	CREATE TABLE `dataartikel` (Id_artikel` `int (11) NOT NULL, `Judul_artikel` varchar (50) NOT NULL utf8_unicode_ci COLLATE, Link_artikel` `varchar (100) NOT NULL utf8_unicode_ci COLLATE, `Sumber_artikel` varchar (20) NOT NULL utf8_unicode_ci COLLATE, `Input_time` timestamp NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP) ENGINE = InnoDB DEFAULT charset = utf8 COLLATE = utf8_unicode_ci;

2.8 Use Case Diagram

Use case diagrams on the system to be built describe the interaction between actors and activities that are present on the system.

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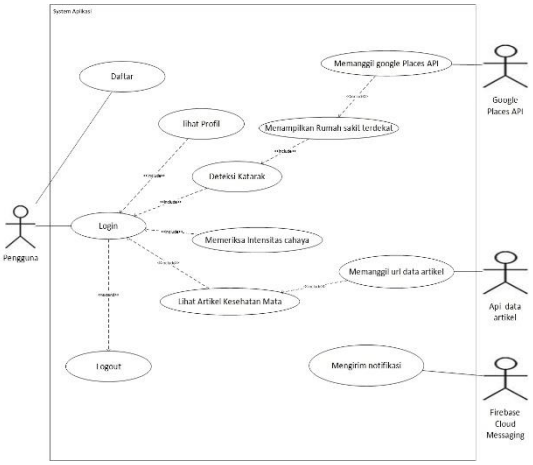

Figure 8 Use Case Diagram

2.9 Activity Diagram

Activity Diagram is used to describe the process flow of each of the scenarios that have been designed for each use case. By using activity diagram can be seen the interaction between actors with the system to be built.

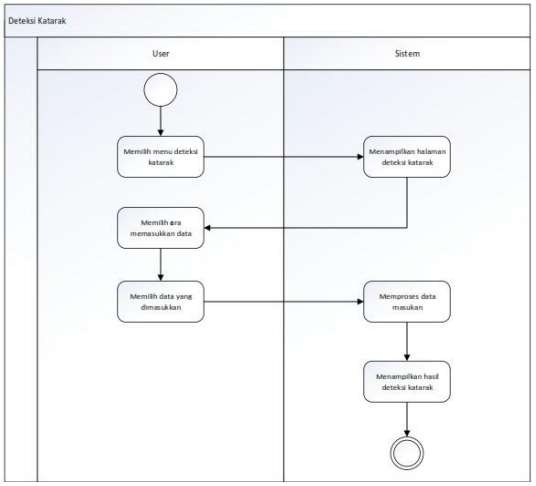

Figure 2.7 Activity Diagram Detect Cataracts

2.10 Class Diagram

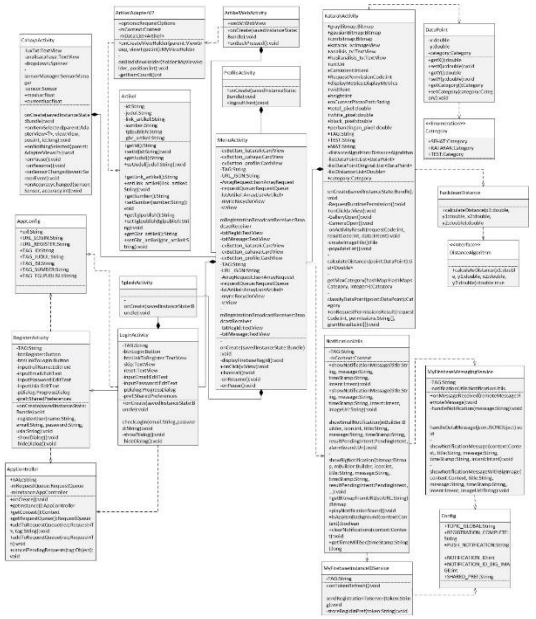

Figure 9 Class Diagram

2.11 sequence Diagram

Here is a sequence diagram cataract detection

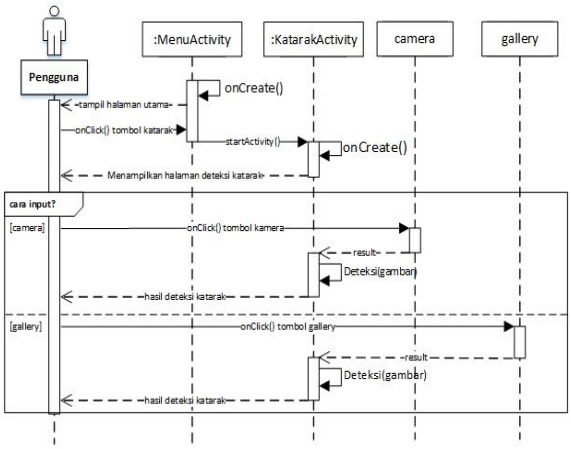

Figure 10 Sequence Diagram Detect Cataracts

2.12 Functional Testing Results

In this study, functional testing is done using blackbox. Testing by the use of blackbox method focuses on functional requirements perangakat software. The following is a functional test using the method of blackbox in this study.

1. Cataract Detection Assay results page

Table 4 Results of Testing Page Detect Cataracts

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No.	Scenario	Data input	Expected results	Observation	Conclusion
1	Cataract detection with the correct input data	The image of the eye image (.jpeg)	Eye images processed image cataract detection	Shown the results of the analysis of cataract	Be accepted
2	Cataract detection by the input data is wrong	The image of the image instead of the eye (.jpeg)	The image of the eye image processed cataract detection	Performing cataract detection page	Rejected

2:11 Beta Testing

Beta testing is testing conducted objectively to assess the application. Beta test is part of acceptance testing. The test is performed to determine how the user response to the applications that have been built in order to assess the extent to which users feel the benefits.

2:12 Beta Testing Plan

Testing is done by distributing questionnaires to a number of respondents who have tried the application has been built. The questionnaire has questions with answers. There are 5 pieces of selection which has a Likert scale of 1 to 5. Here is the detail of Likert scale:

Table 5 Scale*Likert*

answer	Score
Strongly agree	5
Agree	4
Doubtful	3
Disagree	2
Strongly agree	1

a. Calculate the maximum amount criterion value

- jumalah Rating = 5,
- Number of Respondents = 30

$Kriterium = Jumlah\ Penilaian \times Jumlah\ Responden$

Then the maximum value of the criterion is 5 x 30 = 150

b. Counting the number of answers from respondents as a percentage

Formula :

P = (Total value) / (Score base) x 100%

Information:

P = percentage value sought

Total score = number of frequency multiplied by the value that the set answers

Score Ideal = highest score performed by the number of samples

c. Scores have been obtained are then put into the form of rating scale intervals as follows:

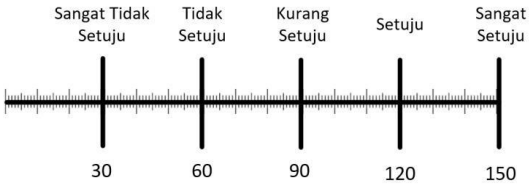

Figure 11 Interval Rating Scale

The following is a questionnaire that will be submitted to the respondents who have tried to use an application that is built. Here are the questions:

Table 1 Questionnaire Questionnaire Testing

No.	Question
1	Does This application allows you to detect cataracts in your eyes?
2	Is this application allows you to get an article about eye health?
3	Is this app helps you in providing an analysis of the intensity of light in the room?
4	Whether the application is sufficient to assist you in maintaining the health of your eyes?
5	Is the application easy to learn?
6	Is the application easy to use?

2.12 Conclusion Testing Results

Based on test results blackbox which has been made known that the output of applications that are built are in accordance with the scenario and the expected application functionality and also based on the testing of applications built already passed the blackbox testing. Applications built beta testing has been done to evaluate the response of users to the applications that are built

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following the recapitulation of the results of beta testing:

Table 7 Summary of Results of Beta Testing

No.	Question	Score	Percentage	Decision
1	Does This application allows you to detect cataracts in your eyes?	136	90.7 %	Approaching Strongly Agree
2	Is this application allows you to get an article about eye health?	138	92%	Approaching Strongly Agree
3	Is this app helps you in providing an analysis of the intensity of light in the room?	138	92%	Approaching Strongly Agree
4	Whether the application is sufficient to assist you in maintaining the health of your eyes?	134	89.3 %	Agree
5	Is the application easy to learn?	137	91.3 %	Approaching Strongly Agree
6	Is the application easy to use?	135	90%	Agree

3 COVER

3.1 Conclusion

The conclusion of a study can be taken after a process of implementation and testing, here are some points that can be concluded in this study based on the test results:

1. Make it easier for users to detect cataracts. over 60% of respondents stated strongly agree that an application built to help make it easier to detect cataracts.
2. Make it easier for users to obtain eye health articles. 63.33% of respondents stated strongly agree that an application built to help Easing in getting eye health articles. 3:33% of respondents still have doubts that the application is built to facilitate in terms of getting eye health articles.

3.2 Suggestion

In the process of testing a user feel things can still be improved in applications that have been built. Suggestions in this study are based on questionnaire responses testing has been done. The suggestions for application development are as follows:

1. Adding the application's ability to detect two eyes simultaneously
2. Adding the application's ability to detect other eye diseases.

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