APPLICATION DEVELOPMENT OF NEAREST OBJECT RECOGNITION FOR THE BLIND USING MLKIT AND TEXT TO VOICE BASED ON ANDROID

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ABSTRACT

The lack of applications that can support people with retardation (disability), especially blind people to recognize objects in the surroundings. Although some objects can be perceived through the sense of touch, but there are some objects that are difficult or even can not be recognized by the sense of touch like recognizing wages sheets or embossed image features. To overcome these problems required an application that can enable blind people can recognize objects in the surroundings. Through Android smartphone powered by google assistant feature can help blind people to run the application without navigation. It is backed by MLKit technology. So that blind people can recognize objects with the help of hardware found on a smartphone camera. Blind people can easily know the description of objects that have been caught on camera through the features of Google Voice To Text. Based on the application of MLKit and Voice To Text-based android provide convenience to the blind people to be able to recognize objects without the need for other people to recognize objects

Keywords: *Firebase MLKit, Introduction to Object, Blind, Text To Voice, Camera, Android.*

1. PRELIMINARY

1.1 Background

National Social Economic Survey (SUSENAS) implemented the Central Bureau of Statistics (BPS) in 2012 put the number of blind people in Indonesia reached 1.7802 million people. Type the highest difficulty occupied by difficulty seeing, ie by 3.05% compared to other difficulties that only around 1-2% [1], Blind people still underestimated and do not have the ability to live their lives independently. It takes the role of the institutions and other community participation through guidance and mentoring, one of them is through social institutions. Social Institution Bina Guna Bandung Netra Wyata a technical unit in the field of rehabilitation and social services in the Ministry of Social Affairs. Homes that have been established on August 6, 1901 This became the oldest and largest blind in Indonesia. BRSPDSN Wyata To Bandung is located in Jalan Pajajaran No. 52 Village Cicendo, Pasir Kaliki, Bandung.

The use of Android smartphones can not be separated from human activity today, including in BRSPDSN Wyata Guna Bandung increasingly adapt to the sophistication of the technology development. The use of technology in the form of an application can help blind people to recognize objects in a more effective and efficient. Blind people is the condition of a person who has a disorder or obstacles in sight. Based on the level of interference, blind people are divided into two, namely the total blind (totally blind) and who still have some usable vision (low vision)[2], For normal people, certainly easy to be able to recognize objects around without the use of tools. However, blind people need a sense of touch to recognize objects that are around. Certainly not easy because there are some objects that can not be recognized by the sense of touch alone, such as banknotes are still difficulties touched by the blind. Often the blind people could not identify with either sheet wages when buying or selling, features embossed image is still difficult to be touched.

Through the use of the android smartphone, the blind can be opened without using a navigation application. With the help of google assistant, blind people can open the app by mentioning the name of the application. In addition to the development memaanfaatkan smartphone technology to help the introduction of the object, other conveniences can be helped by using technology MLKit. MLKit a Google technology that has artificial intelligence in the form of image labeling, face recognition, and barcode scanner, so as to facilitate in recognizing objects around using hardware that is embedded in a smartphone camera. While in giving any detail object in front of it in use Google Voice To Text that can describe what has been caught by the camera.

1.2 Formulation of the problem

Based on the background that has been described above, for the formulation of this thesis is the difficulty in recognizing objects with visual impairment.

1.3 Purpose and objectives

The purpose of this research is to make the object recognition applications for blind people to implement technology MLKit and Text To Voice-based android. While the purpose of this application is made to help blind people to recognize objects in the form of the voice output.

1.4 Scope of problem

In this study, some of the restrictions that the discussion more focused issue in accordance with the objectives to be achieved. The limit problem is as follows:
1. Applications are public.
2. Utilizing MLKit as image labeling technology.
3. This application can only recognize objects such as household goods, electronic goods.
4. Object detection using only MLKit.

1.5 Research methodology

The research methodology is a process used to solve a logical problem, which requires data to support the implementation of a study. The methodology used is descriptive analysis method. Descriptive analysis method is a method that describe the facts and information in the current situation or event in a systematic, factual and accurate. This research method has two stages, namely data collection phase and stage of software development.

1.5.1 Method of collecting data

The method is performed in order to collect the data of this study are as follows:
1. Study of literature
   The collection of data by collecting literature, papers and journals related to the title of the study.
2. Observation
   Data collection techniques by conducting research and direct observation of the captured.
3. Interview
   Data collection is done by asking / interview to the informant related to the research.

1.5.2 Software Development Methods

The method used in the manufacture of software using the paradigm of the waterfall [3], According to Pressman waterfall model is a classic model that is systematic, sequential in building a piece of software. Here is a picture of a waterfall which includes several processes, namely:
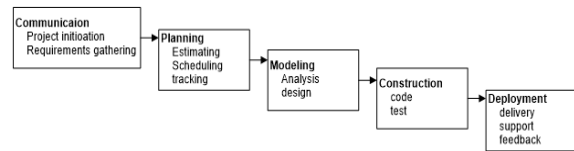
Picture 1.1, Stages of Software Development.

1. Communication
   Communication is the stage of software requirement analysis and data collection. Software needs identified by means of observation in the study, then by means of a spread sheet questionnaire questions related to pemelitian title, and collect the data required.
2. plan
   Planning is the planning phase-rencanan to be conducted during the development of software includes scheduling of each phase is done and prepares all necessities.
3. modeling
   During this stage, be the implementation of the requirement of making application in the form of presentation of the interface as well as a series of application architecture design for front-end applications to provide informative information to users of these applications from the back-end processing systems.
4. Development
   At this stage, the application design is implemented in the form of a code or a series of program unit. Implementing at this stage using android studio.
5. spread
   This stage can be said to be final in making a piece of software or system. After doing the analysis, design and coding of the system is finished will be used by the user. Then at this stage we got the result and also feedback from the use of applications that have been designed.

2. THEORETICAL BASIS

The cornerstone of the theory is an explanation of the various concepts and theories relating to pembangungan object recognition applications.

2.1 definition of Blind People

Visual impairment is a condition for the vision loss of power to function properly so that individuals who experience blindness must use their sense of hearing, touch and smell in his education[4], The opinion explains that visual impairment is a condition experienced by a person, that is not properly functioning of the sense of vision. Therefore, someone who is visually impaired have to use senses other than vision in education.

Blind children is a child in need of tools, methods or specific techniques in learning activities so that the child can learn without vision or with functional vision. The opinion explains that from the

standpoint of education, blind children in need of tools, methods, and certain techniques in learning activities. It is important that blind children can stay abreast of the learning even without vision or with functional vision[5],

2.1.1 Causes of Visual Impairment

Broadly speaking, based on the sharpness of vision remaining, visually impaired are classified into two major categories, namely less see (low vision) and are totally blind or totally blind. Someone children said to be less seen (low vision) if the child is still able to receive light stimuli from the outside, but the sharpness of the senses pengelihatannya more than 6/21, or if the child is only able to read the headlines in the newspaper. Based on these opinions, a child is said to be low vision if the child is only able to read the headlines that exist on paper. When measured sharpness pengelihatannya, anakk pengelihatannya low vision acuity of more than 6/21, meaning that the child can only see / read clearly the objects within 6 meters,[6],

Another opinion suggests that a child fall into the category of less seen (low vision) if the child is still having bad eyesight although it has been corrected, but pengelihatannya function can be improved through the use of optical aids and environmental modifications[5], The opinion explains that although it has been corrected, vision low vision children are poor. However, pengelihatannya function can still be added or improved with the help of optical devices and environmental modifications.

A blind boy who fall into the category of less seen (low vision) requires some adaptation, such as a magnifying glass or a printed book is great. From these opinions, children with low vision require modification in learning activities, such as the use of a magnifying glass to read and books whose writing has been enlarged[2],

Based on those opinions, it can be affirmed that if a child can still read the headlines or after pengelihatannya acuity measured more than 6/21 (only able to see an object in the distance of 6 meters, whereas normal people can see it in the distance of 21 meters) and can still be optimized by the use of optical aids, the child belongs to the category of blind children less see (low vision). Blind children less category view (low vision) require adaptation in learning, such as requiring a magnifying glass to read, requiring a book with the words that have been enlarged, and environmental modifications. This is of course different from the needs of children with visual impairment are totally blind category (totally blind).

2.2 MLKit For Firebase

At Google I / O this year we saw the introduction of Firebase MLKit, which is a part of the present Firebase provides the ability to support applications such as artificial intelligence features more easily. SDK is currently present with a collection of predefined capabilities and typically required in an application. You can deploy your application, regardless of whether you are familiar with machine learning or not[7],

Now, what is offered to us all MLKit Firebase already allows for the application of the technology we are using a variety of learning machines.
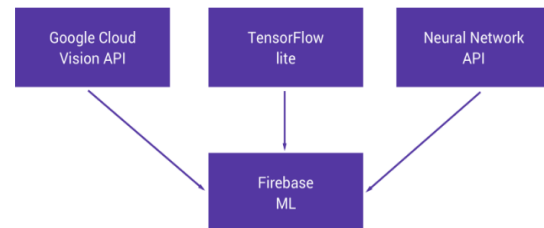
Source image:https://joebirch.co/2018/05/22/exploring-firebase-mlkit-on-android-introducing-mlkit-part-one/

Picture 2.1 diagram MLKit

Although we can implement things without Firebase MLKit, there are several reasons why we may not be able to do so, the possibilities for:

1. Lack of knowledge about the learning machine can hold us to not be able to apply a variety of other features, we may feel overwhelmed or do not have time to be able to improve capabilities in this field.
2. Finding a machine learning models are super accurate and properly trained, at the same time difficult to choose which one to use and then optimized for your platform.
3. Hosting the model MLKit you to access cloud storage could also be something difficult for you MLKit application. To pack in your application can sometimes be an easier approach, but this in itself has some drawbacks.

With that in mind the following points, it may be difficult to know where to start. This is one of the main goals Firebase MLKit to make a machine learning app to Android and iOS, is more accessible to developers and is available in more and more applications [6], Currently, MLKit offers the ability to:

1. Recognize text,
2. Recognizing landmark,
3. face recognition
4. Scanning the barcode
5. Labeling of image

2.2.1 Image Labeling

Labeling Image (Image Labeling) is the process of identifying differences in the form of an

image. We can recognize a variety of beings such as animals, plants, food, activity, color objects, fictional characters, drinks, and others. With MLKit's Image Labeling Technology API we can recognize about 400 form[8],

	On-device	Cloud
Pricing	Free	Free for first 1000 uses of this feature per month: see Pricing
Label coverage	400+ labels that cover the most commonly-found concepts in photos. See below.	10,000+ labels in many categories. See below. Also, try the Cloud Vision API demo to see what labels can be found for an image you provide.
Knowledge Graph entity ID support	✓	✓

Source image:https://firebase.google.com/docs/ml-kit/label-images

Picture 2.2 Table API Image Labeling.

MLKit's Image Labeling provides API-based devices and storage. We can choose one to use depending on a case. API-based device is fast and does not require an internet connection. Conversely, based storage more accurate but requires an Internet connection. We can see the level of accuracy of the API based peragkat and storage in the image below:
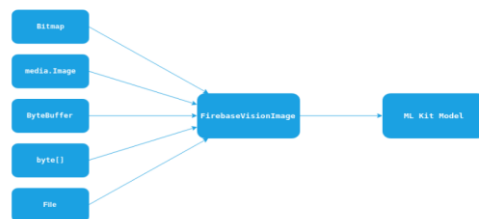
source image : Google I / O 2018.

Picture 2,3 Figure Accuracy API.

Based devices: neon infrastructure in the sky which please the cloud-based or storage: windmills in the amusement park recreational outdoor evening. The following steps in the application or code generation Image Labeling

1. The first step: Add Firebase on the application.
2. Step two: Requires MLKit Dependencies.
   Furthermore spesfikasikan ML models (conditional), For API-based device configuration you can select the application in automated download ML after the install of the play store. Otherwise, the model will be downloaded when you first installed the app on your device. To install this feature, you need the specification of the model in the application.
3. Step three: Take a Picture
   MLKit provide easy steps to label pictures of various types of images such as Bitmap, media. Image, ByteBuffer, bytes, or file from the device. You only need to create an object

Firebase Vision Image of the types of images that have been mentioned and forward it to the model.

Source image:https://developers.google.com/android/reference/com/google/firebase/ml/vision/common/FirebaseVisionImage

Picture 2.4 Diagram Image Labeling

In this example using the types of images to create objects FirebaseVision Bitmap Image.

4. Step four: Set the model
   Now is the time to prepare our image. Labeling the image.
   a. Model-based devices:
      Labeling device based image restore is not more than 10 labels. You can change the configuration of the object passes from Firebase Vision Detector Label Options for image labeling models.
   b. Model-based Cloud Storage
      Cloud storage based image labeling using stabel version of the model and return no more than 10 labels. You can change the configuration of the object passes from Firebase Vision Detector Label Options for image labeling models.
5. Step Five:
   Finally, we can pass the images to model the image labeling.
6. Step six: Extract Information
   If labeling the image is successful, the listener will successfully receive a list of objects Firebase Vision Label. Tangible representation of the object from the label and contains all the information associated with that label. You can dig up all the information like this [8],
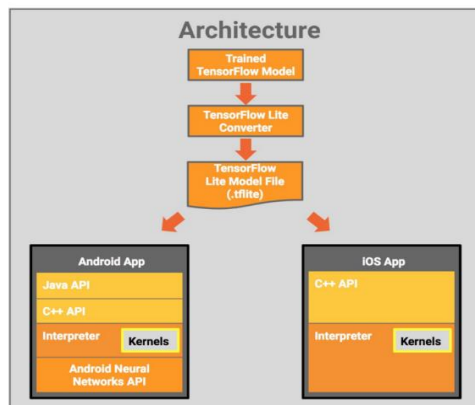
2.3 *TensorFlow Lite*

*TensorFlow Lite*is TensorFlow solutions for mobile phones and embedded devices. TensorFlow will run the model search engines on mobile devices with low vision. So you can take advantage of the existing classification. Recovery or whatever it may be desirable without having been continuously to the server.

*TensorFlow*supported on Android and IOS type C ++ API that has a Java wrapper for android developers. In addition, the android devices that support, translators can also use Android Neural Networks APIs for hardware acceleration. If your

android device does not support, then the default settings will lead to the CPU for execution. In this article, will focus more on how you use it in your android app [9],

TensorFlow Lite consists of the software to run the pre-existing models, and a set of tools that can be used to prepare the model for use on a mobile device is implanted.

It is not designed for training model, instead you can train models in the higher-powered engine, then convert it to a format models. TensorFlow Lite, which is the model used for mobile translator.

Source image:
https://www.tensorflow.org/lite/guide

Picture 2.5 Architecture Tesnsorflow Lite.

TensorFlow Lite currently used in the review of development, so it may not support TensorFlow operates in all models. Nonetheless, TensorFlow can run common image classification models including the inception and mobilenets. In this article, you will see how to use the model MobileNet on Android. This app will see a feed of the camera and use the MobileNet to classify the dominant image in the main image [9],

2.4 *API Google Cloud Vision*

API Google Cloud Vision allows developers to understand the content of your image by encapsulating the advanced machine learning models with a REST API that is easy to use. Quickly classify images into thousands of categories (for example, "sailboat", "lion", "Eiffel Tower"), to detect objects and individual faces in images, and find and read the printed words contained in the image. You can build your image metadata catalogs, moderate offensive content, or enable new marketing scenarios through sentiment analysis image. Analysis of the images uploaded in demand or integrate with your image storage on Google Cloud Storage.

2.5 *Text To Voice*

Text-to-Speech is a process in which the text is converted into digital audio and then "talk." Most machines Text-to-Speech can be categorized according to the methods they use to translate phonemes into audible sound.

Functionally, Text to Speech or TTS perform the reverse process of Speech recognizer system. However, a completely different approach to its implementation. That is, the components forming the two systems are completely different [10],

2.6 analysis Maslah

A problem analysis aims to identify the problems to be solved. Analysis of the problem is also the first step in the analysis phase of the system. Problems will be identified could be from a question. This problem causes the target system is not reached. Therefore, the first step that must be done at the stage of problem analysis is to identify in advance the problems which occurred following an analysis of the problem:

1. Blind people are still a lot of wrong in recognizing objects.
2. Blind people still need other people to recognize objects.

2.6.1 Built Systems Analysis

The system architecture is proposed in this study has the architectural design as follows:
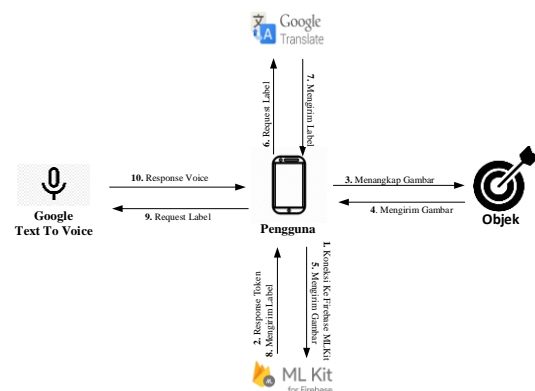

Picture 2.6 System Architecture.

Description of architectural design drawings above are as follows:

1. The application will connect to Firebase MLKit API.
2. *Firebase* MLKit API will be giving out the appropriate response if the token will then give a response http ok if appropriate, will send a response failed.
3. The system activates the camera.
4. The camera will restore color information such as resolution and format of the camera API 2
5. From the camera API 2 the system will send each frame captured as an input medium to via MLKit Firebase.
6. The system sends the processed label MLKit Firebase to Google Translate to translate into Indonesian.

7. *Google Translate* send the labels that have been translated.
8. MLKit Firebase will read and extract meta data into the form of JSON
9. Furthermore, JSON will be sent to Google Text to Voice as an input medium.
10. *Google Text to Voice* The JSON returns in the form of sound.

2.6.1.1 Analysis MLKit Firebase

Firebase MLKit machine learning is a service API that allows applying a machine learning using a variety of highly accurate models applied Android.
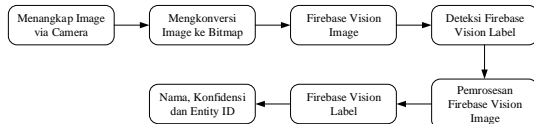
Picture 2.7 How to Work With Firebase Vision MLKit Image.

From figure 2.7 it can be seen in the process of object recognition MLKit use firebase vision image with the camera as his next input will be converted into a bitmap and uploading to firebase vision for the image for more details as follows:

1. Via Camera Image capture
   At this stage the camera media into a media input by reading the frame image captured by the camera android android.hardawe.camera2.API This API supports only JPEG / YUV_420_888 format.
2. Input Media Convert to Bitmap
   Convert using the camera into a media input each object will be captured by using surfaceview, surfacetexture Surface (SurfaceTexture), MediaCodec, MediaRecorder, Allocation, and ImageReader, Bitmap.createBitmap ()
3. *Firebase Vision Image*
   Bitmap image converted from the next is to recognize objects by using the Cloud Vision Detector which is one of Google's API services use MLKit because this feature has been available in the SDK.
4. *Firebase Vision Label*
   Firebase Vision Label is the process of detecting and look for the label of the image that has been processed by the vision image for its integration simply use:
   ```
   FirebaseVisionLabelDetector
     labelDetector =
     FirebaseVision.getInstance ().
     GetVisionLabelDetector ();
   FirebaseVisionImage image =
   FirebaseVisionImage.fromBitmap
   (bitmap);
   ```
5. Vision Image Processing
   At this stage, after passing through the object detection process and the label will be converted into a meta data in an array.

```
fromByteBuffer (ByteBuffer
ByteBuffer,
FirebaseVisionImageMetadata
metadata)
Creates a FirebaseVisionImage from a
ByteBuffer.
```

6. *Firebase Vision Label*
   After each image with the object identified the next step is labeling to identify each object in the array return list.
7. Giving confidence and Entity id
   After giving vision label next stage is to restore confidance of every object that recognition and its id entity by using the function graph of google with json form.
   ```
   GenericUrl url = new GenericUrl (
   "https://kgsearch.googleapis.com/v1/
   entities:search");
   ```

It can be concluded in recognizing camera media object used as input media in image processing after the image will be converted into a bitmap format and perform image processing.

### 2.6.1.1.1 Integration MLKit Firebase

There are several stages in integrating MLKit in because MLKit is a machine learning technology and facilitate its integration depelover. The following stages in integrating MLKit:
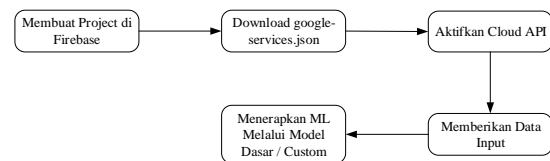


Picture 2.8 Integration MLKit.

By integrating MLKit Firebase into Kriya cloud vision API will facilitate the creation of applications that have been supported by an AI that can perform complex tasks related to detect objects around. But can only detect objects google vision standards that already exist in the vision of cloud storage API. If it will detect the new object, must bring a custom model that we bring and it will be processed later through Tensorflow Lite.

### 2.6.2 Tensorflow Analysis Lite

*TensorFlow Lite* is a set of tools to help developers TensorFlow model run on mobile devices, embedded, and IOT. Learning inference engine on devices with low latency and a small binary size.
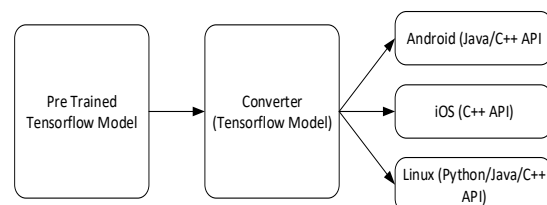


Picture 2.9 Supported Platforms.

*TensorFlow Lite* platform supports Android / iOS and Linux platforms (such as Raspberry Pi). In devices such as Raspberry Pi, Python API help. Platform TensorFlow Lite also supports Core models ML and iOS platforms. To use Tensorflow Lite can use existing models, while the stage to start building:
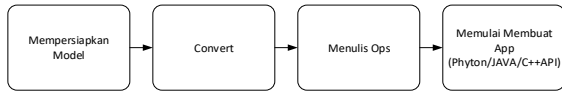


Picture 2,10 Stages Tensorflow Lite

Using real-time Tensorflow Lite consists of four steps:

1. Using an existing model or set up your own model and the model train.
2. Once the model is ready and should be converted into TensorFlow Lite format using a converter.
3. Then, write ops on it for any kind of optimization.
4. Then can start creating projects.

Converts the model into a model TensorFlow Lite ML can be done only in one line of code to call the conversion method. Here is a simple Python commands that change the existing model into TensorFlow Lite format. (Tflite).

### 2.6.3 *Text To Voice API*

Use of Google Text To Voice on this application to convert the label results obtained from the detection of an object that has been processed by MLKit and the output of the sound output (speech). The process will be done as shown below:
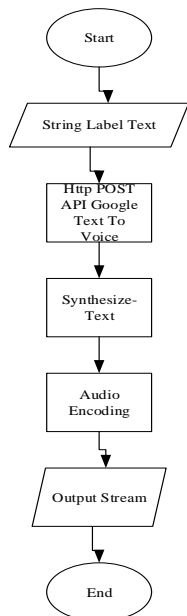


Picture 2.11 Flow Text To Voice.

Description of images groove Text to voice the above as follows:

1. From the results of the detection of label objects, those objects are used as inputs his next text will be processed by Google's API Text To Voice.
2. Labels generated will be converted into a string.

```
String = label_text.xml
```

3. Furthermore, the text will be sent using the Post to Google Text to Voice.

```
POST
https://texttospeech.googleapis.com/v1/
text:synthesize
```

4. Google Text will proceed synthesize voice-text, text Syntesys a transformation of the text in the direction of the sound (speech) with the body's response Json as follows:

```
{
  "Input": {
  object (SynthesisInput)
},
```

5. After synthesize the next step is to perform an audio encoding, is the process whereby generating mp3 files based on the profile that is used for its sample as below:

```
AudioConfig        audioConfig      =
AudioConfig.newBuilder           ()
.setAudioEncoding (AudioEncoding.MP3)
// MP3 audio.  .addEffectsProfileId
(effectsProfile)  //  .build  audio
profile ();
```

6. After success in the next encoding is set up output stream, the output stream is a process where the conversion from mp3 into the ByteArray.

```
// Write the response to the output
file. try (OutputStream out = new
FileOutputStream  (  "output.mp3"))
{out.write  (audioContents.toByteArray
());  System.out.println  (  "Audio
content  written  to  the  file  \"
output.mp3 \ "");
```

2.6.4 Software Requirements Analysis

Software requirement analysis contains the minimum software requirements that must be met by the user. The following are the software requirements needed:

Table 2.1 Software Requirements Analysis.

| No.	Software Requirements
1	Version 4.0 (Ice Cream Sandwich)
2	Minimal 8MP Camera
3	Display 854 x 480 pixels
4	Memory 2 GB

2.6.5 Hardware Requirements Analysis

The system requires a user's smartphone hardware with the following minimum requirements:

Table 2.2 Hardware Requirements Analysis.

No.	Software Requirements
1	Quad-core processor, 1.2GHz

| 2	Minimum 2 GB RAM

2.6.6 Use Case Diagram

*Use Case*Diagram is a model diagram UML (Unified Modeling Language), which serves to illustrate the functional agreement that is expected of a system. Here is a use case diagram of the deal of functionality that will be created on the system.
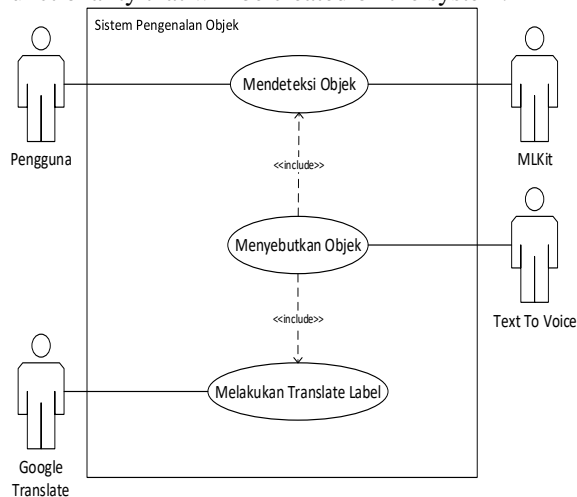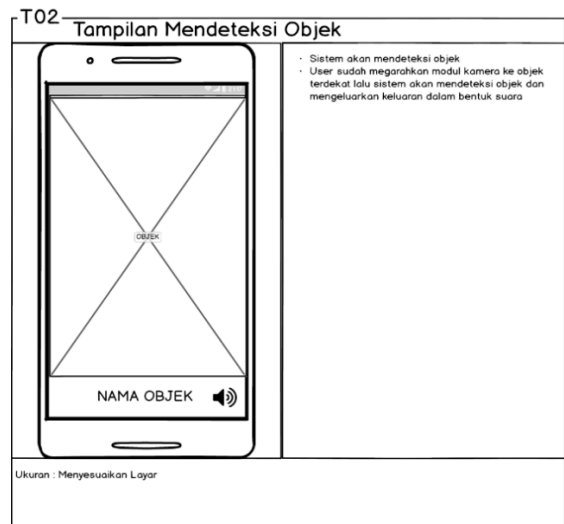
Picture 2.12 Use Case Diagram.

2.6.7 Interface Design

Interface design done to design the look of the application before it is built, designed to illustrate the application of which will be built. Here is a picture that describes the application interface design to be built.
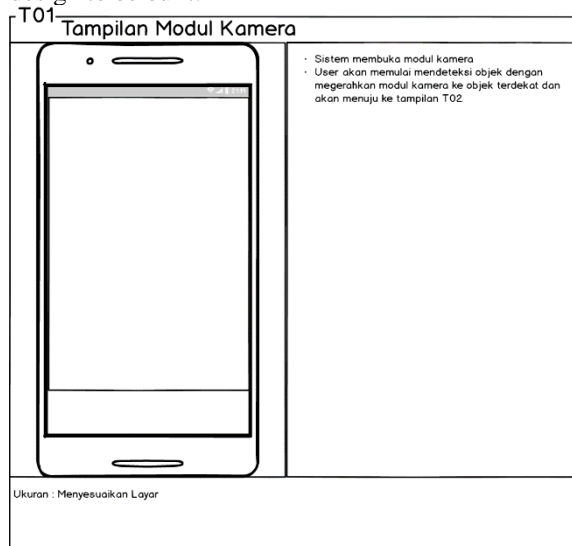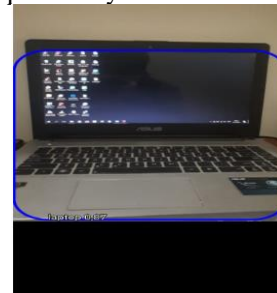
Picture 2,13, Camera Interface Design.

Picture 2.14 Detect Object Interface Design.

2.6.8 Results Implemantesi Applications

Here is the implementation of a design that has been created previously:

Picture 2,15 Results Implemntas interface.

2.6.9 Scenario Testing

Tests carried out by trying the possibilities that occur and testing is done repeatedly, if the test is found error then do a search or repairs to correct errors. If you have finished making repairs, it is carried out continuously in order to obtain the best results. Plans alpha testing will be done on this software can be seen as follows:

Table 2.3 Planning Table Alpha Testing

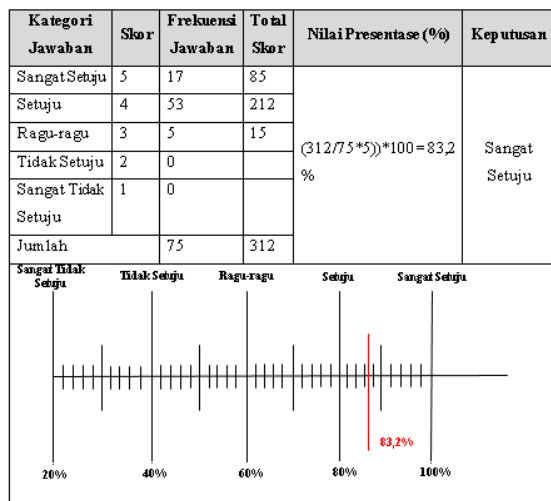| class Test	Testing points	types of Tests
Detecting Objects	Zdan detect objects displaying the detection results in the form of a label	Blackbox
Doing Translate Label	Showing results already ditranslate label to Indonesian	Blackbox
mention Objects	Mention the detection results	Blackbox

Based on the results of alpha testing has been done on Applications Introduction This maket it can be concluded that the system has been running in accordance with the needs of the system that has been designed

2.6.10 Beta Testing Scenarios

Beta testing is testing conducted objectively conducted directly by the users who will be using object recognition applications. This is done in order to determine the extent to which applications built to help facilitate and address the issues described in the formulation of the problem.

Table 4 Questions Tests Questionnaires.

No.	Question
1	Do you agree that these applications can help to recognize objects?
2	Do you agree with this application can be used to recognize objects without needing the help of others?
3	Do you agree that this application is easy to operate?
4	Do you agree the sound generated from the application is self-explanatory?
5	Do you agree that these applications can recognize a wide variety of objects?

Kategori Jawaban	Skor	Frekuensi Jawaban	Total Skor	Nilai Presentase (%)	Keputusan
Sangat Setuju	5	17	85		
Setuju	4	53	212		
Ragu-ragu	3	5	15	(312/75*5))*100 = 83,2 %	Sangat Setuju
Tidak Setuju	2	0			
Sangat Tidak Setuju	1	0			
Jumlah		75	312		

Picture 2,16 Conclusions The results of the questionnaire.

3. COVER

Cover is an explanation of the conclusions which contains the results obtained subsequent to the analysis and design phase of the development of object recognition application And there are some suggestions for further research better.

The conclusions and recommendations obtained from the results of this study are:

3.1 Conclusion

Based on the test results in the previous chapter, it could be concluded that the application was built to provide convenience to the blind to be able to recognize objects without the need for other people to recognize objects.

3.2 Suggestion

Introduction Application object is an application that can allow blind people to perform object recognition. Therefore, given the advice that can be used as a further development of this application is the application should be able to recognize objects in more detail in the detection and response must be quicker in order to facilitate the blind in recognizing objects.

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