DEVELOMPENT OF INTERACTIVE MULTIMEDIA APPLICATIONS INTRODUCTION OF ASTRONOMICAL USING SPEECH RECOGNITION METHOD

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ABSTRACT

Indonesia has great potential in utilization and development of space technology moreover it is supported by the geographical situation of Indonesia is located on the equator and has three time zones. But unfortunately existence of astronomy education in Indonesia somewhat less attention both from the community and the government though. People's interest in astronomy is not channeled properly and fully astronomy education in particular are not taught to students independently.

Therefore need for a media that can be used as an alternative to learn to understand the science of astronomy, the learning media is packed with interactive multimedia, with user interaction and using a speech recognition system.

Development of multimedia applications are built using object-oriented modeling with UML (Unified Modeling Language) and go through the stages in accordance with the method of multimedia development and testing system consisting of black box testing and beta, where the black box testing focuses on functional requirements of the software, while beta testing focused on field testing a questionnaire. Based on the results of testing the system, it can be concluded that the interactive multimedia application built to help students in the study of astronomy and can provide a visualization of astronomy through images and animation.

Keywords: Applications, Learning, Astronomy, Science

1. PRELIMINARY

Indonesia has great potential in the use and development of space technology moreover it is supported by the geographical situation of Indonesia is located on the equator and has three time zones. Location of Indonesia which as many as 13% are below the equator makes it an ideal place to launch satellite rocket. But it is unfortunate existence of astronomy education in Indonesia somewhat less attention both from the community and the government though.

Until now, people's interest in astronomy is not entirely properly channeled. Astronomy education in particular are not taught to students independently. Typically, this knowledge obtained from the lessons of Natural Sciences (IPA), which is taught by the school from Elementary School, Junior High School, up to High School with the intensity of which is limited to the outer layer of understanding related sciences.

According to the journal created by Mellie Cynthia, this time giving the material facts of astronomy is very little. 100% of materials science are given, only 5-10% portion for astronomy. That, too, was included in the sub-sections of physics, then moved to geography, and to physics. This reflects the creator of this curriculum does not understand how it should be astronomical issued and given to the students [1]. In fact, this science has a very broad scope so it is fitting for this education branch can stand independently. But the development of education was only halted until the high school educational institutions through science like physics.

Based on the problems studied takes an interactive multimedia to help students in studying astronomy, provides a media that can provide a visualization of astronomy through pictures and animations relating to astronomy and also provides a media that can be used to understand the science of astronomy.

2. RESEARCH CONTENT

2.1 Problem Analysis

Analysis of the problem is the stage of elaboration of the problems that exist before the application is built and aims to help the development of multimedia applications. Analysis of existing problems include the following:

1. *Submission of materials was limited to the outer layer of understanding of the science involved, where 100% of the material science are given only 5-10%. And also the delivery of content using the lecture system. It can be seen from the lack of interest to learn more about astronomy and the lack of interactive so that it becomes saturated to learn.*

2. *Learning requires alternative media to learn the science of astronomy and so we need an application for the delivery of a material about astronomy that can help students to learn more.*

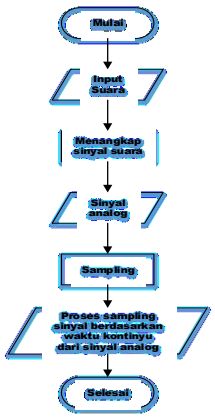
2.2 Analysis of Speech Recognition

In the analysis of speech recognition can be explained as follows. User first utter a sentence, after which the system will process the voice signal. Once processed, the sound signal will include the extraction process, a process to produce an information from a sound file. It will then be entered into phase of matching words, if the match, then the system will process regarding to the user utterance. Picture below is a block diagram of the voice recognition system.



Picture 1. Process of Voice Recognition Systems

In the first process performed by processing the signal, the sound signal processing analysis is divided into several stages. The first stage is Usara signal filtering in the form of an analog signal and converts the analog signal to digital, with the analog to digital conversion (ADC) using sampling. The second stage is to extract the sound file that generates an information of the sound file with a Fast Fourier Transform (FFT). The third stage is to match the sound file file with the appropriate sample using Hidden Markov Models (HMM).



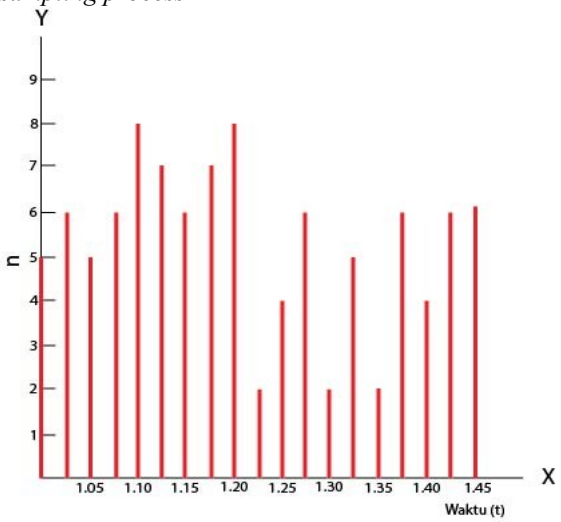
Picture 2. Flowchart sampling

The signal that has passed the stage of discrete sampling based on the index numbers are taken from the sampling process will be quantized. The stage of determining discrete value points, namely by drawing a line from the time index close to the sampling point discrete index number (n). From the results of quantization in Figure 3.8, it can be the result of the voice data is represented as a discrete signal with value f (x) as follows :

Table 1. Result of Discrete Signal

Frekuensi	***Titik diskrit***
f(0)	*5*
f(1)	*6*
f(2)	*5*
f(3)	*6*
f(4)	*8*
f(5)	*7*
f(6)	*6*
f(7)	*7*

And the following image below is the result of a signal that has been quantized from previous sampling process



Picture 3. Signals are quantized

Fast Fourier Transform (FFT) was in charge of extracting sound files which results in an update of the sound file. Fast Fourier Transform (FFT) algorithm is implemented Discreet Fourier Transform (DFT) with engineering calculations quickly and take advantage of the periodic nature of Fourier transformation.

DFT is done by implementing a transformation, with the length of the vector N by the formula :

$$x(m) = \sum_{n=0}^{N-1} x(n)\, e^{-\frac{j2\pi nm}{N}} \quad (1)$$

While x(n) is a sequence of discrete sample values in the time function of variables continue x(t)

Equation (1) that when expressed in the form of rectangular obtained :

$$x(m) = \sum_{n=0}^{N-1} x(n) \left[cos\left(\frac{2\pi nm}{N}\right) - jsin\left(\frac{2\pi nm}{N}\right) \right] \quad (2)$$

While
x(m) = output component DFT to-m (example : x(0), x(1), etc)
m = 0,1,2,3,...,N-1
x(n) = sequence sample input, x(0), x(1), etc.

n = index sample input in function of time, n=0,1,2,3,...,N-1
j = V-1
N = number of samples the input sequences and the number of points in the output frequency of the DFT

For more details, for example when N = 8, n and m is 0 to 7, the equation (2) will have the following output :

$$x(m) = \sum_{n=0}^{N-8} x(n)\left[cos\left(\frac{2\pi nm}{8}\right) - jsin\left(\frac{2\pi nm}{8}\right)\right]$$

As an example for m = 0

$$x(0) = x(0)\ cos\ (2\pi * 0 * \tfrac{0}{8}) - jx(0)sin(2\pi * 0 * \tfrac{0}{8}) + x(1)\ cos\ (2\pi * 1 * \tfrac{0}{8}) - jx(0)sin(2\pi * 1 * \tfrac{0}{8}) + x(2)\ cos\ (2\pi * 2 * \tfrac{0}{8}) - jx(0)sin(2\pi * 2 * \tfrac{0}{8}) + x(3)\ cos\ (2\pi * 3 * \tfrac{0}{8}) - jx(0)sin(2\pi * 3 * \tfrac{0}{8}) + x(4)\ cos\ (2\pi * 4 * \tfrac{0}{8}) - jx(0)sin(2\pi * 4 * \tfrac{0}{8}) + x(5)\ cos\ (2\pi * 5 * \tfrac{0}{8}) - jx(0)sin(2\pi * 5 * \tfrac{0}{8}) + x(6)\ cos\ (2\pi * 6 * \tfrac{0}{8}) - jx(0)sin(2\pi * 6 * \tfrac{0}{8}) + x(7)\ cos\ (2\pi * 7 * \tfrac{0}{8}) - jx(0)sin(2\pi * 7 * \tfrac{0}{8})$$

m = 1,2,3, ..., 8 have a settlement like the one above. Each output value x (m) is the summation of the dot product between the value of the input signal sequences and complex sinusoidal shape. The value of sinusoidal waves of different frequencies depending on the sampling rate (fs), sampling the initial signal, and the number of samples N.

For example if we mensampling continuous signal with 800 samples / sec, carried out with sample rate DFTE 8-point, the fundamental frequency sinusoidal wave is fs / N = 800/8 or 100Hz. Another frequency analysis is an integral multiple of the fundamental frequency

*x(0) = frekuensi pertama, dengan frekuensi analisa = 0 * 100 = 0Hz,*
*x(1) = frekuensi pertama, dengan frekuensi analisa = 1 * 100 = 100Hz,*
*x(2) = frekuensi pertama, dengan frekuensi analisa = 2 * 100 = 200Hz,*
...
...
*x(7) = frekuensi pertama, dengan frekuensi analisa = 7 * 100 = 700Hz,*

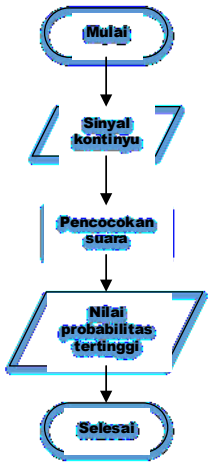
The voice data is taken from the quantization of discrete signal with value f (x) as follows :

f(0)	*5*
f(1)	*6*
f(2)	*5*
f(3)	*6*
f(4)	*8*
f(5)	*7*
f(6)	*6*
f(7)	*7*

$$x(m) = \frac{1}{N}\sum_{x=0}^{x=N-1} f(x)exp\left[-\frac{2j\pi ux}{N}\right] \quad (3)$$

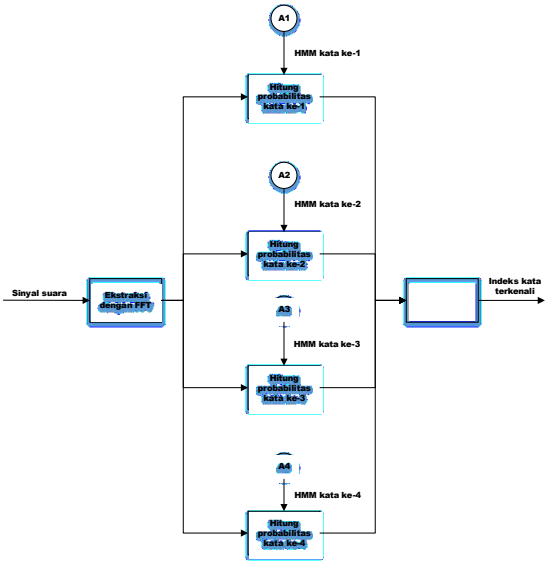
$$x(m) = \frac{1}{N}\sum_{x=0}^{x=N-1} f(x)\left(cos\left(\frac{2\pi ux}{N}\right) - fsin\left(\frac{2\pi ux}{N}\right)\right) \quad (4)$$

In a word matching using Hidden Markov Models (HMM), which is tasked with ensuring HMM matching sound files with sound templates provided. There are several stages of extraction of the voice signal by using FFT and determine the probability that the maximum value by using Hidden Markov Models (HMM). Matching the new voice data and the extraction will use binary search technique.



Picture 4. Process flow matching words

While the picture below is a general process Markov models



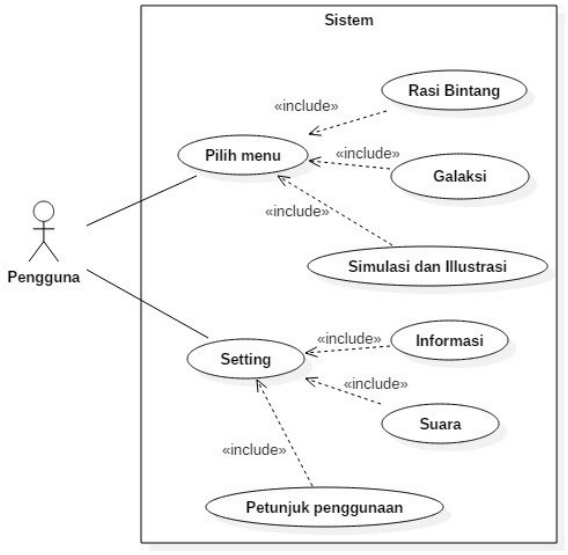
Picture 5. Process Markov for matching words

The above picture shows the process of Hidden Markov Models in general. Where the analog signal is extracted in advance using an FFT and calculated the value of its highest probability until all values of n, where n is the number of voice signals template.

2.3 Functional Needs Analysis

2.3.1 Use Case Diagram

Use case is the system modeling of a perspective view of the end user. Use case diagrams are the highest part of the functionality of the present system which will describe how a person or actor will use and utilize the system. Use case of interactive applications introduction to astronomy can be seen in the picture below

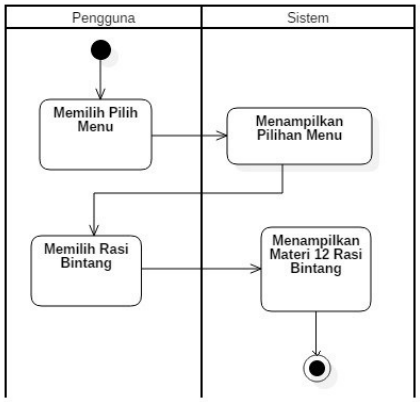


Picture 6. Use Case Diagram

2.3.2 Activity Diagram

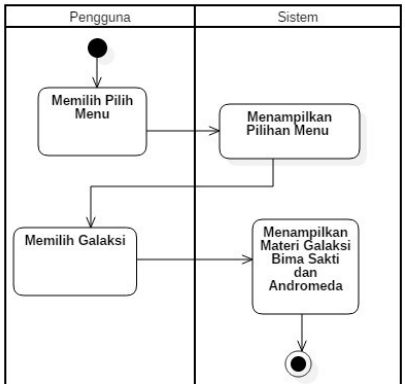
Activity diagrams model the flow of work from the order activity in a process that refers to the existing Use Case diagram.

1. *Activity Diagram Rasi Bintang*



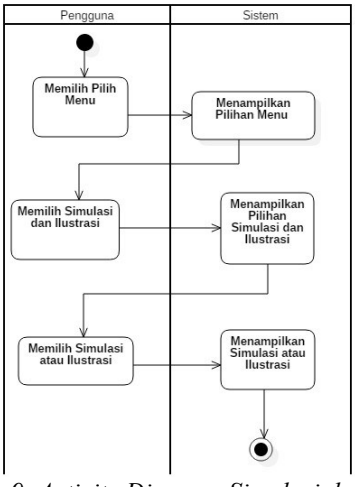
Picture 7. Activity Diagram Rasi Bintang

2. *Activity Diagram Galaksi*



Picture 8. Activity Diagram Galaksi

3. *Activity Diagram Simulasi dan Ilustrasi*



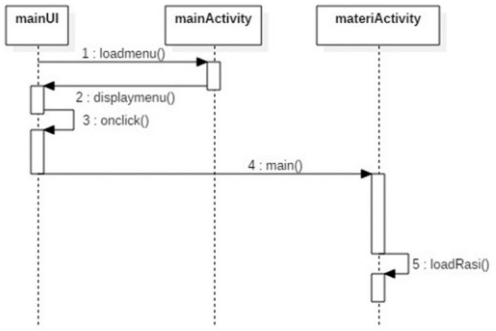
Picture 9. Activity Diagram Simulasi dan Ilustrasi

2.3.3 Sequence Diagram

Sequence diagram is a two-dimensional graph where the objects / processes indicated in the

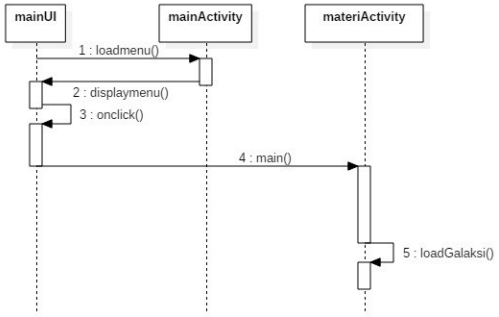
horizontal dimension, while the lifeline is shown in the vertical dimension. Sequence diagram below shows the lifeline of the Use Case above method

1. Sequence Diagram Rasi Bintang



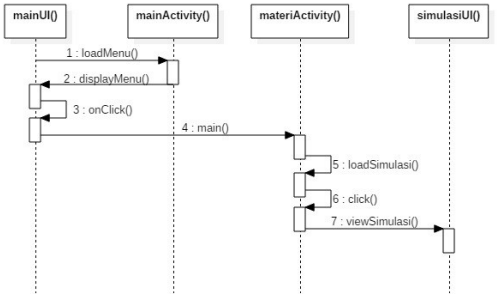
Picture 10. Sequence Diagram Rasi Bintang

2. Sequence Diagram Galaksi



Picture 11. Sequence Diagram Galaksi

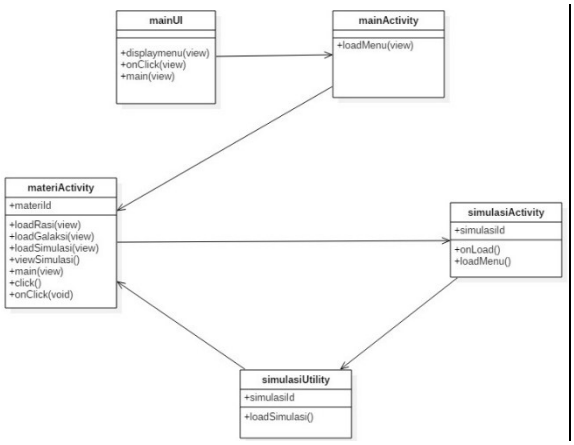
3. Sequence Diagram Simulasi dan Ilustrasi



Picture 12. Sequence Diagram Simulasi dan Ilustrasi

2.3.4 Class Diagram

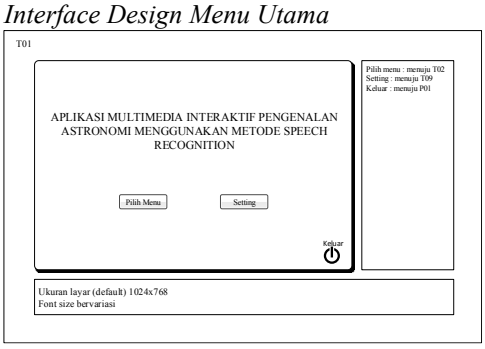
Class diagrams describe the types of objects in the system and various kinds of static relationships that exist between them. Class diagram also shows the properties and operations of a class and restrictions contained in the object relationships.



Picture 13. Class Diagram

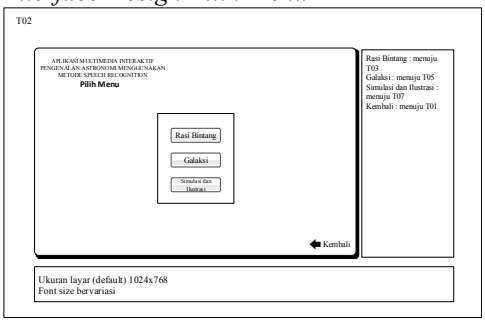
2.4 Interface Design

1. Interface Design Menu Utama



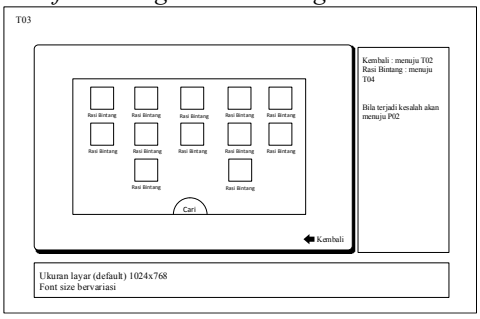
Picture 14. Interface Design Menu Utama

2. Interface Design Pilih Menu



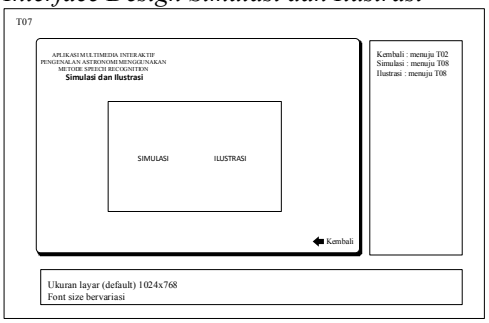
Picture 15. Interface Design Pilih Menu

3. Interface Design Rasi Bintang



Picture 16. Interface Design Rasi Bintang

4. *Interface Design Simulasi dan Ilustrasi*



Picture 17. Interface Design Simulasi dan Ilustrasi

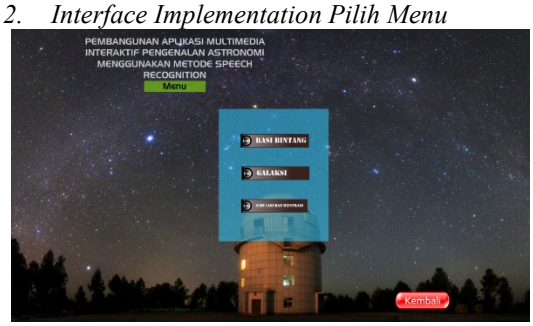
2.5 *Interface Implementation*

1. *Interface Implementation Menu Utama*



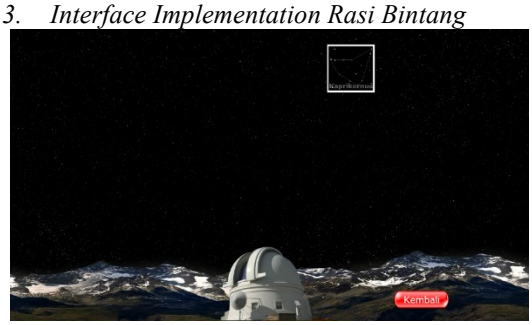
Picture 18. Interface Implementation Menu Utama

2. *Interface Implementation Pilih Menu*



Picture 19. Interface Implementation Pilih Menu

3. *Interface Implementation Rasi Bintang*



Picture 20. Interface Implementation Rasi Bintang

4. *Interface Implementation Simulasi dan Ilustrasi*



Picture 21. Interface Implementation Simulasi dan Ilustrasi

2.6 *Black Box Testing*

Testing of the system is the cornerstone that aims to find errors or deficiencies in the application to be tested. The test intends to determine an application made in accordance with the performance has met the design objectives.

Black box is a testing method that will be used to test the new system, black box testing focused on testing the functional requirements in applications that have been built

Based on test results with the black box test cases above it can be concluded that the introduction of interactive multimedia applications of astronomy still allow for errors, but a functional process is running as expected.

2.7 *Alpha Testing*

Testing the voice recognition data is divided into 3 parts, i.e :

1. *Silent sound condition*

   Testing was conducted on a sound matching with the condition of the atmosphere in the room was silent.

Table 2. Silent sound condition

No	*Nama rasi bintang*	*Intonasi Suara*	*Keterangan*
1	*Aries*	*Aries*	*Dikenali*
2	*Taurus*	*Taurus*	*Dikenali*
3	*Gemini*	*Gemini*	*Dikenali*
4	*Cancer*	*Cancer*	*Dikenali*
5	*Leo*	*Lew*	*Tidak Dikenali*
6	*Virgo*	*Virgo*	*Dikenali*
7	*Libra*	*Libra*	*Dikenali*
8	*Scorpio*	*Scorpio*	*Dikenali*
9	*Sagitarius*	*Sagitarius*	*Dikenali*
10	*Kaprikornus*	*Kaprikornus*	*Dikenali*
11	*Akuarius*	*Akuarius*	*Dikenali*
12	*Pises*	*Pises*	*Dikenali*

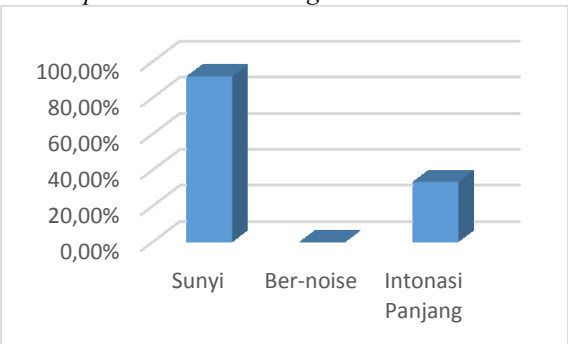
2. *The Condition of the Atmosphere is not silent*

   Testing was conducted on a sound matching conditions with no ambiance mute(noise)

Table 3. The Condition of the Atmosphere is not silent

No	*Nama rasi bintang*	*Intonasi Suara*	*Keterangan*
1	*Aries*	*Aries*	*Tidak Dikenali*
2	*Taurus*	*Taurus*	*Tidak Dikenali*
3	*Gemini*	*Gemini*	*Tidak Dikenali*
4	*Cancer*	*Cancer*	*Tidak Dikenali*
5	*Leo*	*Leo*	*Tidak Dikenali*
6	*Virgo*	*Virgo*	*Tidak Dikenali*
7	*Libra*	*Libra*	*Tidak Dikenali*
8	*Scorpio*	*Scorpio*	*Tidak Dikenali*
9	*Sagitarius*	*Sagitarius*	*Tidak Dikenali*
10	*Kaprikornus*	*Kaprikornus*	*Tidak Dikenali*
11	*Akuarius*	*Akuarius*	*Tidak Dikenali*
12	*Pises*	*Pises*	*Tidak Dikenali*

Based on testing of voice data above, we can see the results of the matching sound in the hushed sound condition, no hushed atmosphere (noise) which has been implemented in the image below



Picture 21 Alpha test chart

2.8 Beta Testing

Beta testing is testing conducted objectively, where testing is done directly in the study. The method used in the beta test by giving questionnaires to users of the application is built. Questionnaires were administered to the user is a student who wants to learn the science of astronomy. Samples were taken each user as many as 30 students, and the results of the questionnaire will be calculated for the later can be concluded ratings.

3 CLOSING

4.1 Conclusion

The results obtained from studies conducted in the preparation of this paper as well as referring to the purpose of research, it can be concluded :

1. *Application of interactive multimedia introduction to the science of astronomy can assist students in studying astronomy.*
2. *Application of interactive multimedia introduction to the science of astronomy can provide a visualization of astronomy through images and animation.*

4.2 Recomendation

Based on the positive results achieved so far, that the application of interactive multimedia applications introduction of astronomy has several that should be recommended to add things that can complete this interactive multimedia applications that will come, i.e

1. *It is recommended to teachers in order to guide the students to learn independently using interactive multimedia applications, because students will get the information they want through this application.*
2. *Addition simulations, illustrations and materials to broaden insight into astronomy*
3. *The use of touchscreen technology can provide more interactive learning atmosphere between users and applications*

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