Journal of Software Engineering, Information and Communication Technology (SEICT)

Journal homepage: https://ejournal.upi.edu/index.php/SEICT

Implementation of JIProlog on an Android-based Song Expert System to Provide Song Recommendations Based on 16 Human Personality Types

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ABSTRACT

Songs can be enjoyed by someone both in sad and happy heart conditions. The genres of songs are very diverse according to the personality that a person has. Songs also always get attention in society. However, the problem often experienced by some people who rarely enjoy songs is that they don't know what songs suit their personality when they want to listen to music. The purpose of this research is to develop an Android-based Song Expert System application with the implementation of the Java Internet Prolog (JIProlog) library. The method used in designing this expert system is forward chaining; this method aims to browse data on a knowledge base logically. The results of this application will provide song recommendations based on 4 dimensions of personality, namely, dimension 1 (introvert/extrovert), dimension 2 (sensory/intuitive), dimension 3 (thinking/feeling), and dimension 4 (judging/perceiving). Of the 16 human personalities, each personality type will be given 3 song genres. So that users can choose a variety of songs that suit their personality. The test results show that the system successfully displays recommendations with the knowledge base, but the resulting song recommendations still have limitations. Hopefully, this song expert system can help someone get songs that match their personality and the condition of the heart that is being experienced.

ARTICLE INFO

Article History:
Submitted/Received 07 Oct 2021
First Revised 26 Oct 2021
Accepted 1 Nov 2021
First Available Online 27 Nov 2021
Publication Date 01 Dec 2021

Keyword:
16 personalities
JiProlog
Song
Expert system.

1. INTRODUCTION

Songs are one of the entertainments that someone can enjoy in sad and happy heart conditions. Because the genres in songs are very diverse with their respective characteristics that can match a person's personality. Songs also always develop in every era and get community attention. Songs occupy the 1st place in search queries made by YouTube users in Indonesia with an index value of 100, karaoke and dangdut occupy the 6th and 7th positions with index values of 18 and 14, and children's songs are in 16th position with index value of 8.

A problem often experienced by some people who rarely enjoy songs is when they want to listen to music but don't know what song suits their personality. Based on the MBTI personality test, a person's personality is classified into 16 types (ISTJ, ISFJ, INFJ, INTJ, ISTP, ISFP, INFP, INTP, ESTP, ESFP, ENFP, ENTP, ESTJ, ESFJ, ENFJ, and ENTJ). Some platforms that can be used to enjoy songs can usually provide song recommendations based on songs often heard before. So, those who rarely want songs have to play one by one the songs that seem right and good for them to listen to. Therefore, there needs to be an effective, efficient, and appropriate solution to providing song recommendations.

To be able to provide recommendations, a system must have intelligence. The intelligence can be in the form of the intelligence supplied by the creator or intelligence learned by the system itself. This is what is commonly called artificial intelligence. One of the fields of artificial intelligence is expert systems. Expert systems can adopt the knowledge possessed by an expert in their field. In general, expert systems can review the solutions and advice they have provided based on the knowledge present in the system. In addition, expert systems offer the possibility of flexibly integrating new knowledge with existing knowledge.

Based on references in previous years regarding the Prolog (Kowalski & Sadri, 2016; Koch et al., 1996; Dovier et al., 1996), one way of implementing expert knowledge into an expert system is by using Prolog (Programming in Logic). However, based on the literature review that researchers have done (Maulina et al., 2013; Salisah et al., 2015), standard expert systems made with Prolog are usually limited to the SWI Prolog interpreter application. So, it is complicated to be used by the general public to provide tangible benefits. And there is no user interface in the program, only a command line that is unlikely to be understood by everyone.

Based on this condition, this is the background for researchers to create an "Android-Based Song Expert System to Provide Song Recommendations Based on 16 Personality Types with a Knowledge Base Using Prolog". It is hoped that the expert system developed can help someone who wants to enjoy a song that suits their personality and the mood being experienced.

2. METHODS

The product we developed is a system to determine the type of song that matches the personality and mood that the user is experiencing. This system belongs to the field of artificial intelligence, which is commonly called an expert system. The knowledge base in this system is built with Prolog, which is implemented in Android applications using the help of the JIProlog library as an interpreter. And we are using the forward chaining method on the inference engine in determining song recommendations in the knowledge base.

Based on references in the previous years regarding Forward Chaining (Ariawan et al., 2016; Darmansyah et al., 2021; Harjanto et al., 2018; Hayadi et al., 2018; Putri et al., 2020; Rupnawar et al., 2016) forward chaining is a strategy used in expert systems to get conclusions/decisions that start by tracing facts and places. Forward chaining is a matching of

DOI: https://doi.org/10.17509/seict.v2i2.40217
p-ISSN:2744-1656 e-ISSN:2774-1699

facts or statements starting from the left side; that is, reasoning starts from the points first to test the truth of the hypothesis.

3. RESULTS AND DISCUSSION

3.1. Music genres based on personality

The following in **Table 1** is a person's attitude toward music based on 16 personality types, and in **Table 2,** the types of music genres are based on 16 personality types (Dargis, M., et al. 2015)

Table 1. Navigating music by genre

No	Type	Genre of Music
1.	ISTJ	Rock, alternative, pop. Appreciate the sound and rhythm of music more than the meaning behind the lyrics.
2.	ISFJ	Soft rock, alternative, indie. Appreciate emotionally evocative music. Appreciate the sound and rhythm of music more than the meaning behind the lyrics.
3.	INFJ	Indie rock, classical, folk. Appreciate deep and meaningful lyrics and emotionally evocative music.
4.	INTJ	Electronic, classical, and metal. Likes dark and structurally complex music. Appreciate meaningful lyrics.
5.	ISTP	Classic rock, metal, alternative. Appreciate the sound and rhythm of music more than the meaning behind the lyrics.
6.	ISFP	Rock, classical, and alternative. Appreciate the rhythm and cadence of songs and are very sensitive to the emotions that music evokes.
7.	INFP	Rock, metal, folk. Appreciate deep and meaningful lyrics and emotionally evocative music.
8.	INTP	Rock, classical, metal. Likes dark and structurally complex music. Appreciate meaningful lyrics.
9.	ESTP	Hip hop, electronic, rap. I love fast-paced music that is danceable, but I don't care about the actual lyrics.
10.	ESFP	Alternative, rock, rap. Likes fast-moving, danceable music but doesn't care about the lyrics. Appreciate emotionally evocative music.
11.	ENFP	Rock, alternative, pop. Appreciate deep and meaningful lyrics and emotionally evocative music. Likes fast-paced and upbeat music. Eclectic taste.
12.	ENTP	Rock, blues, indie. Eclectic taste. Appreciate meaningful lyrics.
13.	ESTJ	Rock, electronic, pop. Appreciate the sound and rhythm of the music more than the meaning behind the lyrics.
14.	ESFJ	Musical, pop, country. Appreciate emotionally evocative music. Appreciate the sound and rhythm of the music more than the meaning behind the lyrics.
15.	ENFJ	World music, indie, alternative. Appreciate deep and meaningful lyrics and emotionally evocative music.
16.	ENTJ	Rock, alternative, indie. Appreciate meaningful lyrics. Likes music that pumps them up and energizes them to complete tasks.

DOI: https://doi.org/10.17509/seict.v2i2.40217
p- ISSN 2774-1656 e- ISSN 2774-1699

Table 2. Music genres based on personality

No	Type	Genre
1.	ENTJ	*Jazz* (64%) *Classical* (79%) *Electronica* (70%)
2.	INTJ	*Classical* (78%) Metal (42%) *Alternate Rock*
3.	ENTP	*Classical* (76%) *Rock* (84%) *Alternate Rock* (88%)
4.	INTP	*Punk* (51%) *Rock* (82%) Metal (48%)
5.	INFJ	*Alternate Rock* (84%) *World* (46%) *Classical*
6.	INFP	*Punk* (49%) *Rock* (82%) *Alternate Rock* (86%)
7.	ENFJ	*Blues* (52%) *World* (52%) *Jazz* (64%)
8.	ENFP	*Jazz* (62%) *Electronica* (75%) *Ambient* (65%)
9.	ISTJ	*Rock* *Alternate Rock* Pop
10.	ISFJ	*Religious* (42%) *Rock* *Alternate Rock*
11.	ESTJ	*Hip-Hop* (57%) *Religious* (48%) Pop
12.	ESFJ	Pop (80%) *Soul* (57%) *Country* (53%)
13.	ISTP	*Punk* (48%) Metal *Alternate Rock*
14.	ISFP	*Reggae* (46%) *Ambient* (64%) Pop (78%)
15.	ESTP	*Electronica* (79%) Metal (50%) *Hip-Hop* (58%)
16.	ESFP	*Ambient* (62%) Pop (88%) *Hip-Hop* (57%)

DOI: https://doi.org/10.17509/seict.v2i2.40217
p-ISSN:2744-1656 e-ISSN:2774-1699

3.2. Artificial intelligence products

In determining song recommendations, according to some previous references (Ji et al., 2015; Sánchez-Moreno et al., 2020; Kindra et al., 2021; Setiawan, 2021), the system needs to know in advance the facts of the user. Starting from knowing the personality of the MBTI test, which consists of 4 dimensions following some previous references (Dargis et al., 2015; Bess & Harvey, 2002). Dimension 1 to determine "How do users exert and receive energy?" i.e., Introvert or Extrovert; Dimension 2 to determine "How do users take in information?" i.e., Sensory or Intuitive; Dimension 3 to determine "How do users make conclusions and make decisions in life?" i.e., Thinking or Feeling; and Dimension 4 "How do users deal with the outside world?" i.e., Judging or Perceiving, as well as knowing "What is the user's current mood?" i.e., happy or sad.

After knowing these facts, the system will conclude what songs are appropriate based on its knowledge base. Furthermore, it will be presented as a list of songs and connected to the YouTube application to enjoy the suggested song directly. (De Mel et al, 2013; Riza and Nugroho, 2020)

3.3. Knowledge base in Prolog

The following logic rules are created to determine a person's personality based on the 4 dimensions tested in MBTI (Chi & Chen, 2009; Drnevich, 2006; Sidran and Kearney, 2003).

```
% is used to add comments in code in prolog language
personality(estj,A,B,C,D):- A = extrovert, B = sensory, C = thinking, D = judging.
personality(estp,A,B,C,D):- A = extrovert, B = sensory, C = thinking, D = perceiving.
personality(esfp,A,B,C,D):- A = extrovert, B = sensory, C = feeling, D = perceiving.
personality(esfj,A,B,C,D):- A = extrovert, B = sensory, C = feeling, D = judging.
personality(istj,A,B,C,D):- A = introvert, B = sensory, C = thinking, D = judging.
personality(istp,A,B,C,D):- A = introvert, B = sensory, C = thinking, D = perceiving.
personality(isfp,A,B,C,D):- A = introvert, B = sensory, C = feeling, D = perceiving.
personality(isfj,A,B,C,D):- A = introvert, B = sensory, C = feeling, D = judging.
personality(intj,A,B,C,D):- A = introvert, B = intuitive, C = thinking, D = judging.
personality(intp,A,B,C,D):- A = introvert, B = intuitive, C = thinking, D = perceiving.
personality(infp,A,B,C,D):- A = introvert, B = intuitive, C = feeling, D = perceiving.
personality(infp,A,B,C,D):- A = introvert, B = intuitive, C = feeling, D = judging.
personality(entj,A,B,C,D):- A = extrovert, B = intuitive, C = thinking, D = judging.
personality(entp,A,B,C,D):- A = extrovert, B = intuitive, C = thinking, D = perceiving.
personality(enfp,A,B,C,D):- A = extrovert, B = intuitive, C = feeling, D = perceiving.
personality(enfj,A,B,C,D):- A = extrovert, B = intuitive, C = feeling, D = judging.
```

The following logical rules were created to determine songs based on personality and happy mood.

```
%Happy_Mood
song('https://www.youtube.com/watch?v=c8YIlU_30Kk',jazz,M,P):- M = happy ,(P= (entj) ; P=(enfj) ;
P=(enfp)).
song('https://www.youtube.com/watch?v=SsZRci3sA4I',classical,M,P):- M = happy ,(P= (entj) ;
P=(intj) ; P=(entp) ; P=(infj)).
song('https://www.youtube.com/watch?v=XYk2kt8K6E0',electronica,M,P):- M = happy ,(P= (entj) ;
P=(estp) ; P=(enfp)).
song('https://www.youtube.com/watch?v=VguED7BfpgU',metal,M,P):- M = happy ,(P= (intj) ;
P=(istp) ; P=(intp) ; P=(estp)).
```

DOI: https://doi.org/10.17509/seict.v2i2.40217
p- ISSN 2774-1656 e- ISSN 2774-1699

```
song('https://www.youtube.com/watch?v=5f-wQBh-zbQ',alternative_rock,M,P):- M = happy ,(P= (intj) ; P=(entp) ; P=(infj) ; P=(infp) ; P=(istj) ; P=(isfj) ; P=(istp)).
song('https://www.youtube.com/watch?v=lPIiB02uqXM',rock,M,P):- M = happy ,(P= (entp) ; P=(intp) ; P=(infp) ; P=(istj) ; P=(isfj)).
song('https://www.youtube.com/watch?v=PIfJ7nYQFTM',punk,M,P):- M = happy ,(P= (intp) ; P=(infp) ; P=(istp)).
song('https://www.youtube.com/watch?v=eWyeAIlaYUY',world,M,P):- M = happy ,(P= (infj) ; P=(enfj)).
song('https://www.youtube.com/watch?v=qAqKsw4GjB0',blues,M,P):- M = happy ,(P= (enfj)).
song('https://www.youtube.com/watch?v=w47D1Fqn_sA',ambient,M,P):- M = happy ,(P= (enfp) ; P=(isfp) ; P=(esfp)).
song('https://www.youtube.com/watch?v=HA06Rr3bRVc',pop_songs,M,P):- M = happy ,(P= (istj) ; P=(estj) ; P=(isfp) ; P=(esfp)).
song('https://www.youtube.com/watch?v=qCZAynQU_-8',religious,M,P):- M = happy ,(P= (isfj) ; P=(estj)).
song('https://www.youtube.com/watch?v=hvVPMIqRulE',hip_hop,M,P):- M = happy ,(P= (estj) ; P=(estp) ; P=(esfp)).
song('https://www.youtube.com/watch?v=X7ses5rI5U4',soul,M,P):- M = happy ,(P= (esfj)).
song('https://www.youtube.com/watch?v=NKzyyxvNiFc',country,M,P):- M = happy ,(P= (esfj)).
song('https://www.youtube.com/watch?v=oWQpQW95Ru8',reggae,M,P):- M = happy ,(P= (isfp)
```

The following logical rules were created to determine songs based on personality and sad mood.

```
%Sad  Mood
song('https://www.youtube.com/watch?v=McxPJ3RYY4Y',jazz,M,P):- M = sad ,(P= (entj) ; P=(enfj) ; P=(enfp)).
song('https://www.youtube.com/watch?v=R6OElQVVlLo',classical,M,P):- M = sad ,(P= (entj) ; P=(intj) ; P=(entp) ; P=(infj)).
song('https://www.youtube.com/watch?v=ilTbMVG5t6M',electronica,M,P):- M = sad ,(P= (entj) ; P=(estp) ; P=(enfp)).
song('https://www.youtube.com/watch?v=SWkKvDD-Gu4',metal,M,P):- M = sad ,(P= (intj) ; P=(istp) ; P=(intp) ; P=(estp)).
song('https://www.youtube.com/watch?v=-fvBrKeobyA',alternative_rock,M,P):- M = sad ,(P= (intj) ; P=(entp) ; P=(infj) ; P=(infp) ; P=(istj) ; P=(isfj) ; P=(istp)).
song('https://www.youtube.com/watch?v=qGxO2YNFj1o',rock,M,P):- M = sad ,(P= (entp) ; P=(intp) ; P=(infp) ; P=(istj) ; P=(isfj)).
song('https://www.youtube.com/watch?v=2MRdtXWcgIw',punk,M,P):- M = sad ,(P= (intp) ; P=(infp) ; P=(istp)).
song('https://www.youtube.com/watch?v=F90ymkS2dt4',world,M,P):- M = sad ,(P= (infj) ; P=(enfj)).
song('https://www.youtube.com/watch?v=6R9nWRWgl90',blues,M,P):- M = sad ,(P= (enfj)).
song('https://www.youtube.com/watch?v=sbX_aElB2dI',ambient,M,P):- M = sad ,(P= (enfp) ; P=(isfp) ; P=(esfp)).
song('https://www.youtube.com/watch?v=T8-96tqFCFU&vl=en',pop_songs,M,P):- M = sad ,(P= (istj) ; P=(estj) ; P=(isfp) ; P=(esfp)).
song('https://www.youtube.com/watch?v=K_-e99oLp4Y',religious,M,P):- M = sad ,(P= (isfj) ; P=(estj)).
song('https://www.youtube.com/watch?v=0pZmHnj3-jQ',hip_hop,M,P):- M = sad ,(P= (estj) ; P=(estp) ; P=(esfp)).
song('https://www.youtube.com/watch?v=KVIwQFEyZQE',soul,M,P):- M = sad ,(P= (esfj)).
song('https://www.youtube.com/watch?v=ygxmpkHgaC8',country,M,P):- M = sad ,(P= (esfj)).
song('https://www.youtube.com/watch?v=FqQjAUB6DJY',reggae,M,P):- M = sad ,(P= (isfp))
```

DOI: https://doi.org/10.17509/seict.v2i2.40217
p-ISSN:2744-1656 e-ISSN:2774-1699

3.4. System Architecture and Workflow

The process of determining song recommendations on the knowledge base using an inference engine with the forward chaining method can be seen in **Figure 1**.

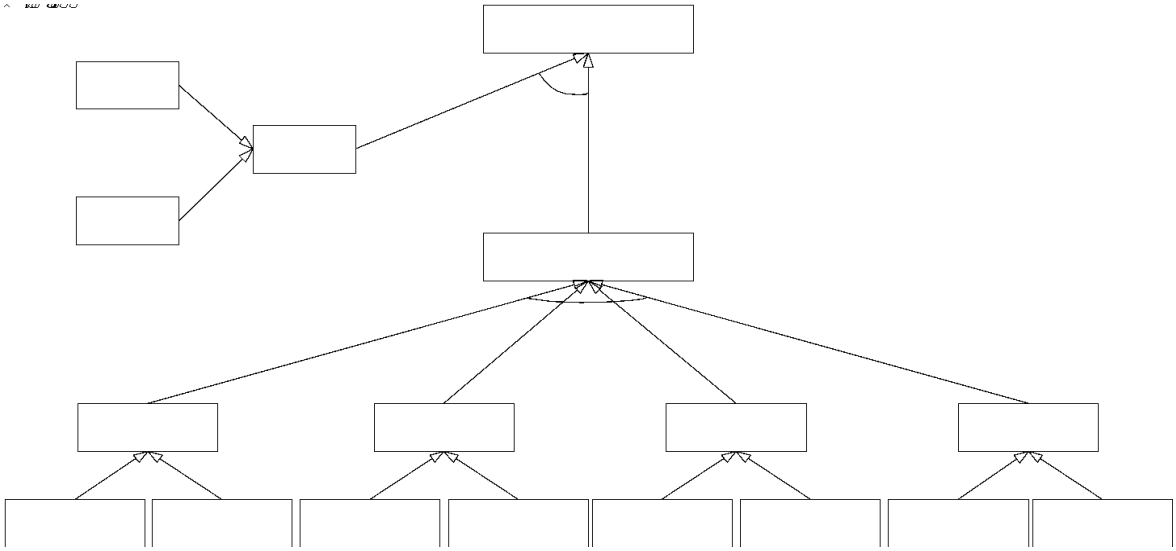

Figure 1. Forward chaining of song expert system

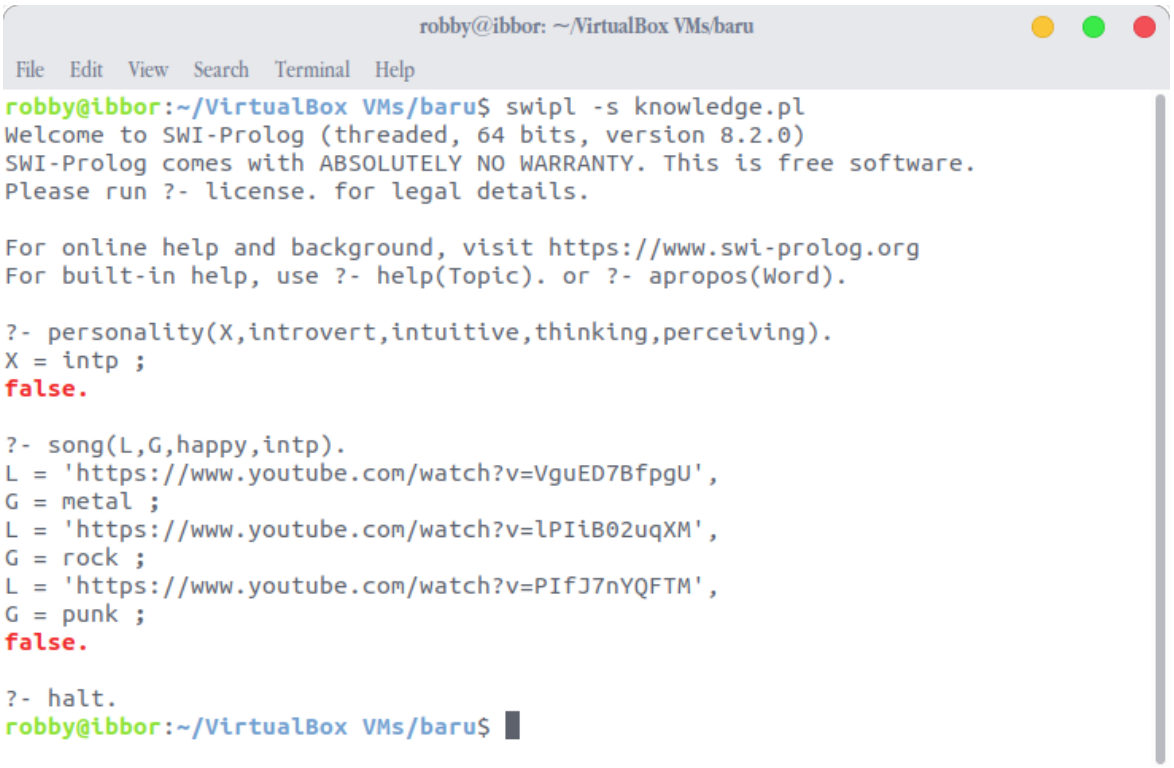

Figure 2. Query prologue of song expert system

An example of a query run to determine the personality type `personality(X, introvert, intuitive, thinking, perceiving)`. And to select the song `song(L, G, happy, intp)`. In doing prologue queries, it is very concerned about uppercase and lowercase letters. So, it needs to be a concern to adjust to the knowledge base that has been created. But because the prologue system that has been made is implemented into an Android application, the

DOI: https://doi.org/10.17509/seict.v2i2.40217
p- ISSN 2774-1656 e- ISSN 2774-1699

executed queries are made dynamically based on what is selected by the user in the application.

```
String query1, query2;
query1 = String.format("personality(X,%s,%s,%s,%s).",a,b,c,d);
query2 = String.format("song(X,Y,%s,%s), write(X), write('@'), write(Y),
write('~'), fail.",mood,personal);
```

To execute prologue in Android applications, use the help of the JIProlog library. The following script is used to consult the prolog file.

```
JIPEngine jip;
jip = JIPrologFactory.newInstance(this);
try {
      jip.consultStream(getApplicationContext().getAssets().open("knowledge.pl"
), "knowledge.pl");
} catch (IOException e) {
      e.printStackTrace();
}
PrintStream result = new PrintStream(new TextViewOutputStream(res));
jip.setUserOutputStream(result);
```

3.5 System functional testing

The product system we developed in its use requires facts in several categories of choice to determine personality in song recommendations. In this functional test, we conducted several experiments and performed input on the available types as follows:

1. When opening the application, the initial display is shown in **Figure 3,** which displays several categories of questions and options to fill them in.
2. Next, the user is asked, "How do you exert and receive energy?" and chooses between Introvert or Extrovert.
3. The second "How do you take in information?" selects the answer, which is Sensory or Intuitive.
4. Next, "How do you make conclusions and decisions in life?" choosing the answer between Thinking or Feeling.
5. Next, "How do you deal with the outside world?" choose Judging or Perceiving.
6. The final step is "What is your current mood?" and choose between happy and sad.
7. When the user clicks the "CHECK SONG RECOMMENDATIONS" menu on the system, then the system will show the results in the form of the user's personality type and several song recommendations, as shown in **Figure 4**.

DOI: https://doi.org/10.17509/seict.v2i2.40217
p-ISSN:2744-1656 e-ISSN:2774-1699

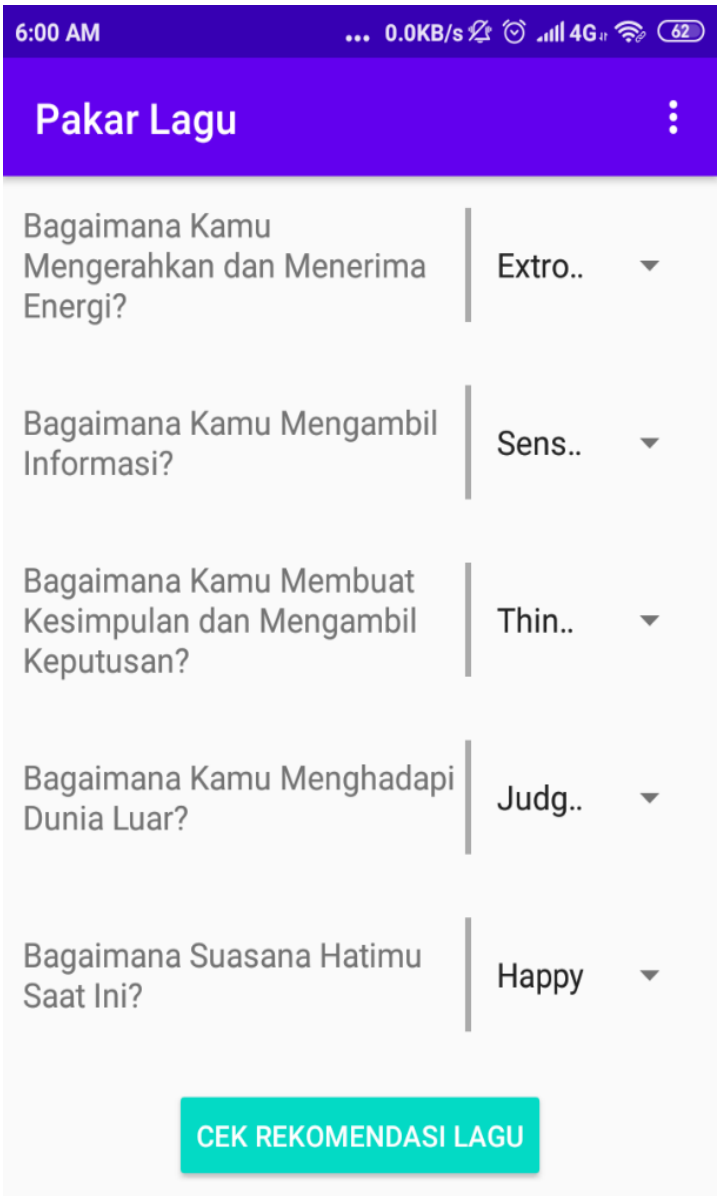

Figure 3. Question display in the application

DOI: https://doi.org/10.17509/seict.v2i2.40217
p- ISSN 2774-1656 e- ISSN 2774-1699

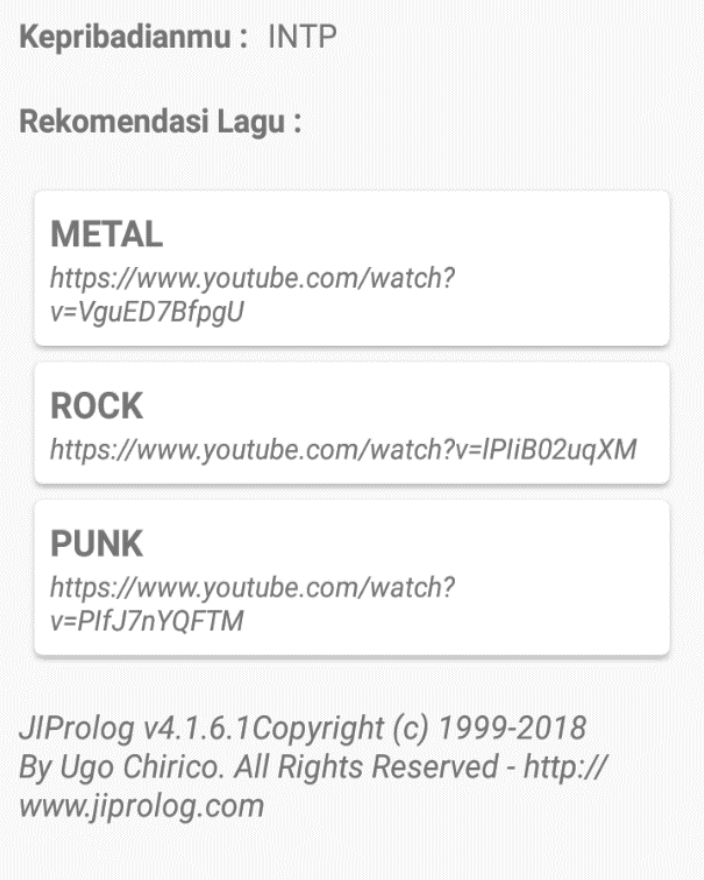

Figure 4. Display of recommendation results

Regarding the accuracy of the programmer, we developed and took the MBTI personality test; our system program has entered data on a person's attitude towards music based on 16 personality types; when the user enters the appropriate facts, the kind and recommendations given will also be appropriate. However, our system does not guarantee 100% accuracy in providing the results of a person's personality type because the fact that we collect from users is in a simple scope; if users want more accurate results about their personality tests, then they can take personality tests that have been provided on the Internet or directly.

4. CONCLUSION

In the song expert application that we have developed, it can be concluded that:

1. Our song expert system that we developed has a simple display so that it is easy to use by users.
2. The song expert system can facilitate users in determining the type of song that suits the personality and mood that the user feeling.
3. In collecting facts to find out the personality type, our system uses the MBTI test, which consists of 4 simpler dimensions that do not reduce the accuracy of the results.
4. The song recommendations generated in this system are still limited. Also, the system displays the song suggestions as a web address and does not provide the song directly.

The suggestions given for the improvement and development of this application in the future are adding a database to store music/songs that will be recommended to users directly without going through a web address, updating the songs available at this time, updating the appearance so that users are comfortable so they can enjoy this application, and adding

DOI: https://doi.org/10.17509/seict.v2i2.40217
p-ISSN:2744-1656 e-ISSN:2774-1699

machine learning to this application so that it can learn from every activity carried out by users.

5. AUTHOR'S NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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DOI: https://doi.org/10.17509/seict.v2i2.40217
p-ISSN:2744-1656 e-ISSN:2774-1699