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DEVELOPMENT OF ANDROID APPLICATION RECOMMENDER SYSTEM FOR KIDS ON KAKATU

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ABSTRACT

Kakatu is a parental control media on Android device which has several key features including application restrictions, usage time limitation, and application's activity reports. Application restrictions feature will lets parents choose which applications allowed to be used by their children. Based on interviews with kakatu team, with various kinds of applications on Android, users find it difficult to determine suitable application for children. In order to reach the goal, parents should have knowledge about applications which are children-friendly.

Recommendation system is a program or techniques which can be a solution for that problem by automatically filter and display children-friendly applications. Knowledge-based is a recommender system approach which recommends suitable item to the user's needs based on several features of the item. In the Android application domain, textual review is one of the parameters that can be considered to generate a recommendation. To be able to be used by the knowledge-based, reviews must be labeled positive or negative by using sentiment classification. One of the sentiment classification methods is Support Vector Machine.

Based on the analysis and experiment that has been done, the system have been able to produce a recommendation in accordance with the terms of recommendation that previously been analyzed and confirmed by involving Kakatu. It can be conclude that the system has met the standard to be used by Kakatu to provide recommendations for users.

Kata kunci : *Kakatu, Knowledge-based, Klasifikasi Sentimen, Sistem rekomendasi, SVM.*

1. INTRODUCTION

Kakatu is a parental control media on Android device which has several key features including including application restrictions, usage time limitation, and application's activity reports. Application restrictions could be used by parents to choose which applications are allowed to be used by children. Applications that have been restricted are expected to be free of pornographic content, horror, and violence.

To reach the goal, the parent must have knowledge of what applications are well used by children. Based on the results of interviews with Kakatu, it is known that the large number and types of applications on Android devices makes the difficulty in finding or determine a good application. Parents may inadvertently permit applications that are not good for use by children. A recommendation system is a model of a program or techniques that can be the solution of the problem by automatically filtering and displays what applications are well used by children.

Knowledge-based Recommendation system approach recommending an item based on a match parameters or features possessed by the item to the needs of the user. In Android application domain, textual review is one of the parameters that can be considered to produce a recommendation. To be able to be used by the knowledge-based, the review is first labeled positive or negatif by using a sentiment classification. According to [2] one of a good method for sentiment classification is Support Vector Machine.

Based on these problems, an Android application recommendation system for parental control of children in the media Kakatu with knowledge-based and sentiment classification is required.

1.1. Parental Control

Parental control is a feature that is typically used in digital television services, computers, video games, phones or software. In general, parental control is divided into four categories: content filtering, which restricts access to content that is not fit for use by a certain age; usage controls, serves to limit the use of the device by specifying a time limit or prohibit the use of use of certain features; computer usage management tool, which requires the use of some specific software; and monitoring, which is used to track the location or activity while using the device [3].

1.2. Kakatu

Kakatu is an application developed by PT. Kinest Kreatif Ideata and is under the Director of Research and Development. This application is a safe, easy, and fun for children to use Android device. In addition it can be a parental controls media to monitor and restrict the use of mobile phones by children so that children will not access the content of applications that should not be accessed. The application offers different functionality for two users with different roles, i.e. parents and children. The application offers different functionality for two users with different roles, i.e. parents and children. Parents can take advantage of features application restrictions, restrictions incoming telephone calls, Restriction of the use of HP children's time, and continues to see a history of the use of device subsidiary.

1.3. Knowledge-based Recommender Systems

The recommendation system approach that is often used (content-based and collaborative filtering) are very effective when used to recommend items based on user preferences such as in the case with items of books, movies, or news article [1]. When the system is dependent on the needs of users who are defined explicitly, the two approaches is not the best option because the form or formulation of the needs of users who are explicitly defined is not fit with the framework of the approach to content-based and collaborative filtering.

Knowledge-based recommendation system approach is using user needs defined explicitly in the form of recommendation rules. This approach was divided into two basic types which are case-based and constraint-based [4]. Case-based produce a recommendation by calculating the similarity measure items (using a certain threshold) with needs that have been specified by the user. Constraint-based produce a recommendation by finding a set of items that can meet the recommendation rules. In general, constraint-based can be presented as a constraint satisfaction problem (CSP) and can be solved by using CSP solver or using conjunctive queries that are executed and completed by the database engine. Conjunctive query is querying a database that contains a set of selection criteria that are connected, the query is defined as:

$$\sigma_{[criteria]} (P) \quad (1)$$

σ represents the operator selection, the criteria is the recommendation rules, and P is a table of the collection of products that are available.

1.4. Support Vector Machine

Sentiment classification is the process of categorizing a document into pre-defined categories. In general, problems in the sentiment classification can be described with: when given a set of documents D, a function called classifier will classify each document d ε D to one of the positive or negative grade. Positive means that the document d expresses the opinion of the positive and negative means that the document d expresses negative opinion [2].

On sentiment classification the data that are used comes from unstructured text. Therefore, text preprocessing which serves to change the shape of the original unstructured data into structured data is required.

1.5. Web Scraping

Web scraping is a set of techniques to obtain information from a website automatically without having to manually copy them. The purpose of the web scraping is to look for specific information, extracting the information, and then compile new web pages. Some web scraper devote himself to convert unstructured data and store it into structured data.

Web scraping application (generally referred to as intelligent agents and automated) focuses only on getting data by retrieval and extraction, and may involve the collection of data to measure significant differences [5].

2. RESEARCH CONTENT

2.1. Analysis of System Architecture

Analysis of system architecture is used to analyze the software that is built in the form of a general overview of the system. The system architecture can be seen in Figure 1.

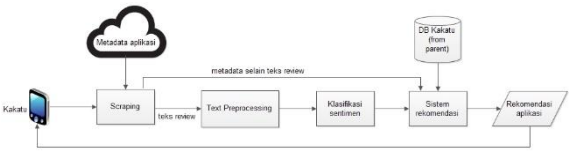


Figure 1 Recommendation system's architecture

Here is an explanation of the system architecture:

1. Users use Application Restrictions on application functionality Kakatu. The application then sends the id of each application that is installed on the device through the Internet and API.
2. The system performs scraping against the Android Market to use the id of each application to obtain the metadata of the application.
3. Metadata application that text is going through a review of the preprocessing stage consists of a folding case, stopword removal, covert emoticons, convert negation, tokenization, stemming, and term weighting. This stage aims to review the text is free from noise and can be identified by the classifier which are at the stage of sentiment classification.

4. Sentiment classification stage will perform classification by providing a positive or negative label to each review in accordance with the sentiments or opinions contained in the review. The reviews that have had the label will be one parameter determining the stage of recommendation systems.
5. Knowledge-based recommendation system will generate recommendations based on the requirements defined explicitly. The requirements in the form of provision of metadata that must be met by an application of which is the review already has a positive or negative label.
6. Furthermore, the recommendation in the form of a set of applications that have been through the filtering sent back to the user through the Internet and API.

2.2. Analisis Data Masukan

The input data used is a collection of application ID that is installed on the user device Kakatu, licensing history of each application, as well as application metadata acquired from the Android Market. Such data will be used as a parameter to produce a recommendation. Here is an explanation of each of the input data:

1. Application ID

Application ID is a unique variable owned by each application. In this study, the ID application form obtained from the package name Kakatu users..

2. User rating

Android Market such as Google Play using a rating scale with a scoring system of 1 to 5.

3. Content Rating

App content rating is a rating according to their level of maturity. This rating would suggest the suitability of the age of the user of the content contained in the application or game. Content rating on Google Play including: Rating for 3+, Rating for 7+, Rating for 12+, Rating 16+, and Rating 18+.

4. User Review

User review in text form may have a sentiment (opinion) positive or negative.

5. Application's history permissions

This parameter is present the number of times an application has been allowed to be used by parents to their children. This data was obtained in the form of a percentage value from the API provided by the Kakatu.

2.3. Analysis of Scraping Method and API's Utilization

Scraping is used to obtain metadata relevant application from the Android Market. Figure 2 illustrates a flowchart of web scraping process in general.

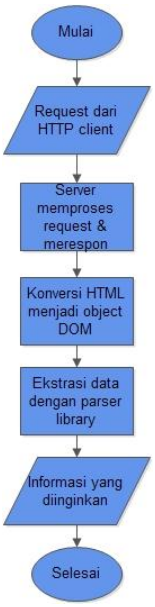


Figure 2 Flow diagram of web scraping

To get a history of permissions applications use an API that has been available on the server by accessing https://www.kakatu.web.id/status-history.json Kakatu using the HTTP POST method. For example, the output permissions history of Youtube application in the form of JSON format is as follows:

```
{
    "result": "success",
    "description": "OK",
    "apps": [
        {
            "app_status": "ok",
            "package_name": "com.google.android.youtube",
            "status_history": 5.9
        }
    ]
}
```

Figure 2 Youtube app permissions history

2.4. Analysis of Sentiment Classification Method

In order to classified properly, review firstly conducted preprocessing stage. At this stage of the review of data used for training data and testing the data is reduced, cleared of noise, and made into structured. Here are the stages of preprocessing performed in this study:

1. Case folding

Case folding is a phase to change capital letters (uppercase) to lowercase. This is done so that all the letters in the reviews be uniform.

2. Stopword removal

Some words that do not contain the sentiments put in stopword list. This word is usually in the form of personal pronouns, relative pronoun, paranomial instructions and so forth. At this stage in the review said that also included in stopword will be eliminated.

3. Convert emoticon

Convert emoticons are converting stage emoticon into a string corresponding to the emoticon expression itself. This phase is done because

emoticon be one way of expressing the opinion. It can have an influence on sentiment classification.

4. Convert negation

Convert negation is a conversion stage negation words contained in a review of the application, said negation have an influence in changing the value of sentiments in a review. If there is a word of negation on a review of the word is to be united by the word thereafter.

5. Tokenization

Tokenization phase is done by separating the words by a space which is located between two words. This stage also eliminate or punctuation symbols contained in the review application.

6. Stemming

At this research stage of stemming used to get every word the base of each word using the Porter algorithm.

7. Term Weighting

Last preprocessing stage in this research is a term weighting. Data reviews that have gone through the stage of case folding, stopword removal, convert emoticons, convert negation, tokenization and stemming will be indexed and given weight.

After going through the preprocessing phase, the review of the data are classified into two distinct classes of items, namely negative class and positive class by using Support Vector Machine (SVM). There are two main stages in the SVM algorithm training stage and the classification stage. The training phase serves to create a model that will be used by the SVM algorithm for classifying the data that had not been previously seen. In the training phase the document with positive and negative class in which the negative and positive assessment which is done manually are needed. This study used 500 user review from some android application which is divided into 250 positive reviews and 250 negative reviews. Once the model is established, the process of classifying a new review can be done.

2.5. Analysis of Recommender System

In this research, system recommendations are using constraint-based approach. In general, this method relies heavily on information characteristics of the item to be recommended. To produce recommendations Kakatu has some characteristics criteria that must be met by each application such as:

1. Rating content of the application must be rating for 3+ and rating for 7+.
2. Applicatio's User Rating must at least 3.5.
3. The application must at least allowed more than 5% by parents to their children.
4. Applications must have positive user reviews that exceeds 50% of the overall review.

Rating content, user ratings, and user reviews of the application obtained from scraping stage. To determine the number of positive user reviews, the text preprocessing stage and sentiment classification were done so that the review has a positive or negative label. The percentage positive for the review of an application is calculated by:

$$Persentase\ review\ positif = \frac{jumlah\ review\ positif}{total\ review} \times 100$$

The application's permissions history obtained from the database system by using the API provided by the Kakatu.

For example, Table 1 illustrates the list of applications installed on the Android device users and has gone through stages of scraping, text preprocessing and classification sentiment.

Table 1 A list of applications that are installed on user's Android device

Aplikasi	Rating Konten	Rating pengguna	Riwayat perizinan (%)	*Review* positif dari pengguna (%)
YouTube	Rated for 12+	4.1	15	60
Instagram	Rated for 12+	4.5	0	70
Teach Kids Arabic Alphabet	Rated for 3+	4.0	50	80
Playtime With Dora	Rated for 7+	3.9	60	53
SimSimi	Rated for 16+	4.1	3	73
Pepi Bath	Rated for 3+	3.0	21	68
Chrome Browser - Google	Rated for 3+	4.2	6	88
Barbara's Second Child Birth	Rated for 7+	3.8	39	55

Problems in constraint-based recommendation can be completed by conjunctive query that done by executing database queries with a set of criteria which are connected conjunctively. Based on pre-defined criteria and a list of available applications, recommendation can be generated by using equation (1) where:

P : {Youtube, Instagram, Teach Kids Arabic Alphabet, Playtime With Dora, SimSimi, Pepi Bath, Chrome Browser – Google, Barbara's Second Child Birth}

criteria : rating_konten = rating 3+ or rating_konten = rating 7+, rating_pengguna > 3.5, riwayat_perizinan > 20, review_positif > 50

Therefore:

$\sigma_{[criteria]}$ (P) = {Teach Kids Arabic Alphabet,Playtime With Dora,Barbara's Second Child Birth}

It can be concluded that from a set of applications contained in the table Teach Kids Arabic Alphabet, Playtime With Dora, and Barbara's Second Child Birth are applications that will be recommended by the system.

2.6. Anylisis of Functional

Use case diagram of the proposed system can be seen in Figure 4.

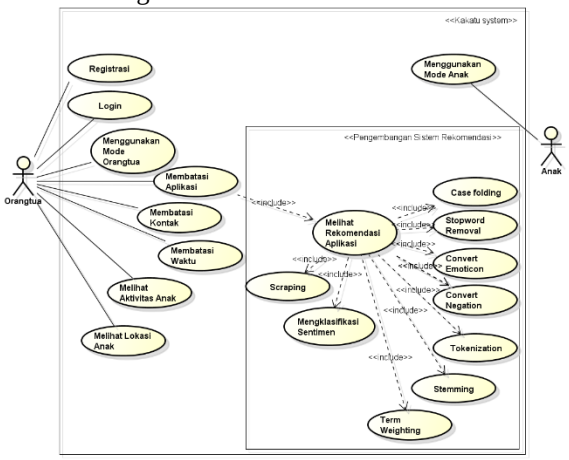


Figure 4 Use case diagram of the proposed system

2.7. Implementation and Testing

This section describes the part of the implementation and testing of the system is built.

2.7.1. Implementation of Environment

Hardware specifications (hardware) used in the design and implementation can be seen in Table 2.

Table 2 Hardware spesification

No	Hardware	Specification
1	Processor	Intel(R) Core(TM) i3 CPU M 350 @ 2.27Ghz (4 CPUs), ~2.3GHz
2	Harddisk	340 GB
3	Memory	4GB
4	VGA	2438 MB
5	Monitor	14 inch
6	Mouse	Wireless Logitech
7	Keyboard	QWERTY
9	Koneksi Internet	Ya

Software specification used in the design and implementation can be seen in Table 3.

Table 3 Software spesification

No	Software	Spesification
1	Operation System	Windows 8.1 Professional
2	Programming Language	PHP, JSON
3	DBMS	MySql
4	Browser	Google Chrome Ver 43.0.2357.132 m (64-bit)
5	Text Editor	Sublime Text 3
6	Web Server	XAMPP ver 3.2.1

2.7.2. Data Implementation

In this study, the design of the data is implemented by using MySQL. An implementation are as follows:

1. Database creation

Query:

```
CREATE DATABASE sistem_rekomendasi;
```

2. Table aplikasi creation

Query:

```
CREATE TABLE IF NOT EXISTS
`aplikasi` (
`id_aplikasi` int(11) NOT NULL
AUTO_INCREMENT,
`nama_aplikasi` varchar(100) NOT
NULL,
`package_name` varchar(100) NOT
NULL,
`rating_pennguna` double NOT NULL,
`rating_konten` varchar(50) NOT
NULL,
`riwayat_perizinan` float NOT NULL,
`status` enum('y','t') DEFAULT NULL,
PRIMARY KEY ('id_aplikasi')
) ENGINE=InnoDB;
```

3. Table review_pengguna creation

Query:

```
CREATE TABLE IF NOT EXISTS
`review_pengguna` (
`id_review` int(11) NOT NULL
AUTO_INCREMENT,
`id_aplikasi` int(11) NOT NULL,
`review_teks` varchar(500) NOT NULL,
`hasil_preprocessing` varchar(500)
DEFAULT NULL,
`kelas` varchar(15) DEFAULT NULL,
PRIMARY KEY ('id_review'),
FOREIGN KEY ('id_aplikasi')
REFERENCES 'aplikasi'
('id_aplikasi')
) ENGINE=InnoDB;
```

4. Table training_svm creation

Query:

```
CREATE TABLE IF NOT EXISTS
`data_training` (
`id_training` int(11) NOT NULL
AUTO_INCREMENT,
`review_teks` varchar(300) NOT
NULL,
`kelas` varchar(15) NOT NULL,
PRIMARY KEY (‘id_training’)
) ENGINE=InnoDB;
```

5. Table stoplist creation

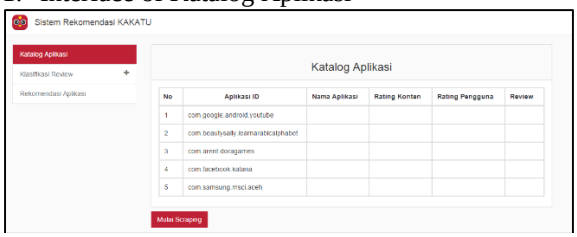
Query:

```
CREATE TABLE IF NOT EXISTS
`stoplist` (
`id_stopword` int(11) NOT NULL
AUTO_INCREMENT,
`stopword` varchar(50) NOT NULL,
PRIMARY KEY (‘id_stopword’)
) ENGINE=InnoDB;
```

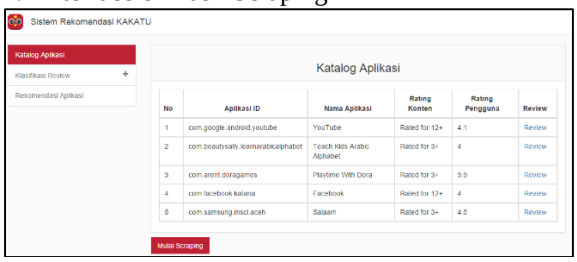
2.7.3. User Interface Implementation

Results of the implementation of the design of the interface are as follows:

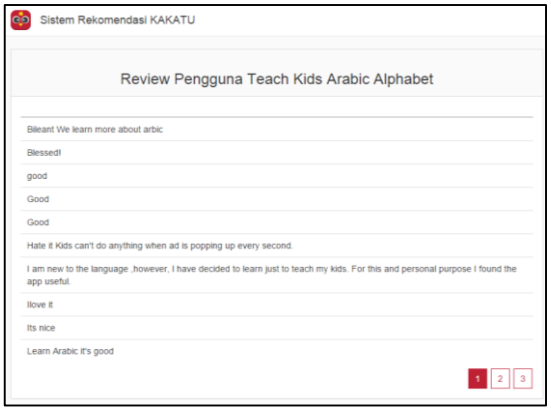
1. Interface of Katalog Aplikasi



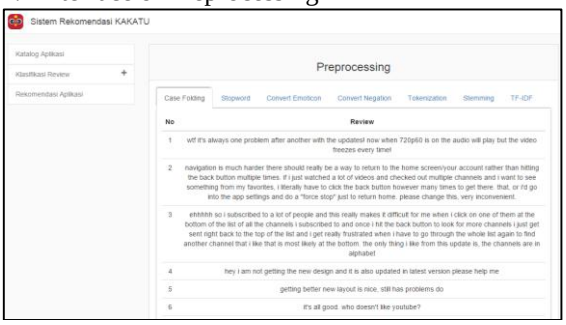
2. Interface of Hasil Scraping



3. Interface of Review Pengguna



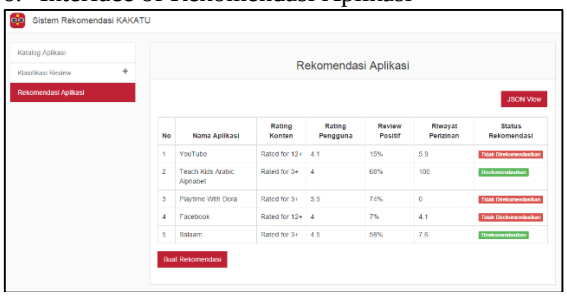
4. Interface of Preprocessing



5. Interface of Klasifikasi Review



6. Interface of Rekomendasi Aplikasi



2.7.4. Testing

Results and evaluation of the system testing that have done functionality testing, acceptance testing, testing of sample testing, and testing of measurement accuracy is as follows:

1. Functionality testing

Functionality testing focuses on functional requirements of a system built and fault finding program. Here are the results of several test classes:

a. Scraping Testing

The test results for scraping functionality can be seen in Table 4.

Table 4 Results of testing functionality scraping

Execution conditions	Expected output	Observation	Conclution
Click button Scraping	After pressing the scraping, the system displays the application name, rating content, user ratings and reviews of the package name in question.	The system displays the application name, rating content, user ratings and reviews of the package name in question.	Accepted

b. Preprocessing Testing

The test results for preprocessing functionality can be seen in Table 5.

Table 5 Results of testing functionality preprocessing

Execution conditions	Expected output	Observation	Conclution
Click button Preprocessing	After pressing the button Preprocessing , the system displays a review of the relevant package name that has been through a preprocessing stage.	The system displays a review of the relevant package name that has been through a preprocessing stage.	Accepted

c. Klasifikasi Review Testing

Results of testing for functionality Classification Review can be seen in Table 6.

Table 6 Results of testing the functionality of the klasifikasi review

Execution conditions	Expected output	Observation	Conclution
Click button Klasifikasi	After pressing the classification, the system displays a review of the relevant package name which has had a positive or negative grade.	The system displays a review of the relevant package name which has had a positive or negative grade.	Accepted

d. Pembuatan Rekomendasi Testing

Results of testing for functionality Making Recommendations can be seen in Table 7.

Table 7 Results of testing functionality of pembuatan rekomendasi

Execution conditions	Expected output	Observation	Concluti on
Click button Buat Rekomendasi	After pressing the button Make Recommendations, the system displays the application name, rating content, user ratings, number of positive reviews in terms of percent, permissions history, and the status of the recommendations of the package name in question.	The system displays the application name, rating content, user ratings, number of positive reviews in terms of percent, permissions history, and the status of the recommendations of the package name in question.	Accepted

Based on the results of functional testing is done it can be concluded that the system shows the expected output.

2. Acceptance Testing

Acceptance testing is carried out by interviewing the informant directly to the CEO and CTO at PT. Creative Kinest Ideata. Conclusions answers from the interview can be seen in Table 8.

Table 8 Interview's conclusion

No	Qustions	Conclusion
1	Whether the system has been built android application can provide a good recommendation for children?	Yes
2	Whether the determination on android applications using the approach of knowledge-based recommender system (making recommendations based on the terms defined explicitly) is in conformity with the vision of the features possessed by the application restrictions Kakatu?	Yes
3	Whether the recommendations generated by the application of the system is valid or according to predefined criteria?	Valid
4	Overall, if the system is built to be implemented against the restriction features applications that are already running?	Yes

Based on acceptance test results in Table 8, it can be concluded that the system has been able to provide recommendations android applications correctly.

3. Testing Sample

Testing is done by comparing the output of the system against the data sample has been prepared. This phase is done to test whether there is a mistake in implementing the logic of the methods applied. The data sample used is some data review that has been labeled (positive / negative) and some package name of the application that has had the status of recommendations (recommended / not recommended). Data review of sampled testing can be seen in Table 9.

Table 9 Data review sample

No	Review	Label
1	Its nice At least can full fill the basic things.	Positive
2	Great When I give my phone to my sister I never have to worry if she touches my clan in coc	Positive
3	Thank you for the reply. Working well now.... Loving it again!	Positive
4	Nice app	Positive
5	Best Free App Lock It's give more features than any other paid app.	Positive
6	Hated it This is such a bad app, it worked fine for a day and then all of a sudden it stopped locking the stuff that I want locked. I twerked with some settings but I get no result	Negative
7	Not fun	Negative
8	Horrible	Negative
9	worst app when i was opened any video my phone is not displaying anything.if you have this app uninstall it!!!!!!!!!	Negative
10	Hated it. At the meat it won't let me do it	Negative

Data package name is used as sample testing can be seen in Table 10.

Table 10 Data package name of the application sample

No	Package Name	Recommendation Status
1	com.google.android.youtube	Not Recommended
2	com.beautysally.learnarabicalphabet	Recommended
3	com.arent.doragames	Not Recommended
4	com.facebook.katana	Not Recommended
5	com.samsung.msci.aceh	Recommended

Results of testing the labeled sample testing of the review can be seen in Figure 5.

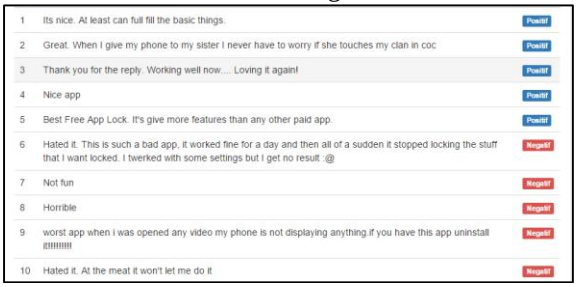


Figure 5 The results of the classification by system

Results of the test data package name with the status of recommendations can be seen in Figure 6.

No	Nama Aplikasi	Rating Konten	Rating Pengguna	Review Positif	Riwayat Perizinan	Status Rekomendasi
1	YouTube	Rated for 12+	4.1	23%	6	Tidak Direkomendasikan
2	Teach Kids Arabic Alphabet	Rated for 3+	4	68%	100	Direkomendasikan
3	Playtime With Dora	Rated for 3+	3.9	74%	0	Tidak Direkomendasikan
4	Facebook	Rated for 12+	4	5%	4.1	Tidak Direkomendasikan
5	Salaam	Rated for 3+	4.5	53%	7.6	Direkomendasikan

Figure 6 The recommendations result by the system

Based on test results of sample testing has been done, directing that the output of the system is not different from the data used as sample testing.

4. Accuration Testing

Testing accuracy measurements performed using the k-fold cross validation with k values as much as 10 fold. This test aims to test the stability of accuracy when tested with the training data and test data are different. Tests carried out on the review text classification using support vector machine. Data review of the use of 500 data is divided into 10 subsets, each subset totaling 50 data. The review of the data has had a positive or negative label. Scenario test the accuracy of the method 10-fold cross validation can be seen in Table 10.

Table 10 Test Scenario of 10-fold cross validation

Percobaan	Data Review	*Subset*
Fold 1	Data Training	$S_2, S_3, S_4, S_5, S_6, S_7 S_8, S_9, S_{10}$
	Data Testing	S_1
Fold 2	Data Training	$S_1, S_3, S_4, S_5, S_6, S_7 S_8, S_9, S_{10}$
	Data Testing	S_2
Fold 3	Data Training	$S_1, S_2, S_4, S_5, S_6, S_7 S_8, S_9, S_{10}$
	Data Testing	S_3
Fold 4	Data Training	$S_1, S_2, S_3, S_5, S_6, S_7 S_8, S_9, S_{10}$
	Data Testing	S_4
Fold 5	Data Training	$S_1, S_2, S_3, S_4, S_6, S_7 S_8, S_9, S_{10}$
	Data Testing	S_5
Fold 6	Data Training	$S_1, S_2, S_3, S_4, S_5, S_7, S_8, S_9, S_{10}$
	Data Testing	S_6
Fold 7	Data Training	$S_1, S_2, S_3, S_4, S_5, S_6, S_8, S_9, S_{10}$
	Data Testing	S_7
Fold 8	Data Training	$S_1, S_2, S_3, S_4, S_5, S_6, S_7, S_9, S_{10}$
	Data Testing	S_8
Fold 9	Data Training	$S_1, S_2, S_3, S_4, S_5, S_6, S_7, S_{10}$
	Data Testing	S_9
Fold 10	Data Training	$S_1, S_2, S_3, S_4, S_5, S_6, S_7 S_8, S_9$
	Data Testing	S_{10}

In the test scenario with the number of 10-fold cross validation and iterations were performed 10 times iteration. The first iteration of the first fold using combined data from a subset of 450 of the 2nd to the 9th remaining subset of 50 data used as the testing on a subset of data first, the training process and the process of testing carried out until the 10th iteration. Details of the results of the testing accuracy of each scenario on its fold can be seen in Table 11.

Table 11 Results accuracy with SVM classification review

Fold	Total Data Training	Total Data Testing	
1	450	50	
2	450	50	
3	450	50	
4	450	50	
5	450	50	
6	450	50	
7	450	50	
8	450	50	
9	450	50	
10	450	50	
Accuracy			66%

On testing using 10-fold cross validation shows that the SVM method and data used 500 reviews have a level of accuracy that is quite satisfactory with 66%.

3. CONCLUSION & SUGGESTION

3.1. Conclusion

Based on the analysis and testing that has been done, it is concluded that the system was built on android application which has been able to produce a good application recommendations for children in accordance with the terms perekomendasian previously been analyzed and confirmed by involving Kakatu.

3.2. Suggestion

The system built packaging product did not discuss in depth, therefore, as for the advice that can be given in the further development of the system increases the computing time with regard to the use of resource and data access speed of the server.

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