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Designing Android-Based Library Application with Rough Set Method

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Abstract: The development of information technology is increasingly rapid to bring change in various fields, one of which is the field of libraries. The use of information technology as a means of improving service and operational quality has brought about a significant change in the library. An example from the application of information technology can be seen from the application of digital libraries with the android mobile system. Problems in the library that often occurs is the difficulty of finding books that are in accordance with the study program or interests. In this study, to simplify the search for appropriate books using the rough set method on mobile android to form a pattern from the history of borrowing books where the application is for a book recommendation that will be adjusted to the origin of the borrowing department. The expected result of this study is an android-based library application using a rough set to facilitate users.

Keywords: *library, rough set, android mobile system*

INTRODUCTION

The development of information technology has affected services in various aspects, including servants borrowing books in the library. Library management needs to adjust to the development of information technology. The use of information technology as a means of improving service and operational quality has brought about a major change in the library. One example of the application of information technology can be seen from the digital application libraries in the form of mobile android (Pu *et al*, 2015).

Digital library is a collection of information by the following, service where information is stored in digital format and can be accessed through a network. The digital library can be a mobile device and android-based that is integrated with the library database automatically (Arms, 2001). Databases contained in libraries include member databases, book databases, lending transaction databases and book returns, the database for calculating late fees, and others. However, in reality, they are still many libraries that have not utilized operational data management properly (Safaat, 2012).

Utilization of data contained in the database can be used to support decision-making activities, and it is not enough to rely solely on operational data, it requires a data analysis to explore the potential of existing information problems or patterns that important or interesting from large amounts of data, which called data mining. The use of techniques data mining expected to provide knowledge that was previously hidden in the database so that it becomes valuable information (Han, 2012).

One of the data mining techniques is a rough set. The rough set approach is an important basis for Artificial Intelligence and cognitive science, especially in the area of machine learning, knowledge acquisition, decision analysis, knowledge discovery from the database, expert system, inductive reasoning, and pattern recognition (Zarandi and Kazemi, 2008). The advantage of the rough set is that it provides an efficient algorithm for finding patterns hidden in the data, producing a set of decision rules from data and easy to understand (Komorowski et.all, 2002). *The rough set* is an efficient method or technique for either data mining or knowledge

finding on the relational basis data. *The rough set* was utilized for some problems such as uncertainty knowledge representation, knowledge analysis, quality analysis, and information data providing in relation to consistency (Rissino & Lambert-Torres, 2009). Based on the occurring trend for library needs, applying the rough set method on the android mobile to form a pattern from the history of borrowing books is interested in being observed. The application is in the form of a book recommendation that would be adjusted to the origin of the borrowing department. To design an android-based library application and make book recommendations based on the result of analysis of rough set in the application are the purposes for this research

The importance of this research is to make it easier for students to search for books based on classes and departments by book recommendations. Variables used are book titles, authors, DDC (Dewey decimal classification), publisher, ISBN (International Standard Book Number, number of books available, number of books borrowed.

The result of this research is android-based library applications that have a book recommendation feature based on student force and majors and can be used to borrow books and extend loan books in android applications and other features.

METHODS

Decision Support System

According to Turban *et al* (2011), *Decision Support* System (DSS) is a system to support the decision decision maker in situation decison unstructured and structured. DSS serves as an extra or support for policy makers, be able to widen knowledge and the possibility, But not substitute for judgment. DSS devoted to the needs assessment and decision that could mixed with algorithms or technically.

Rough Set

Rough set theory is a new mathematical tool for imperfect data analysis. Rough set philosophy is founded on the assumption that with every object of the universe of discourse, some information (data, knowledge) is associated. In other words, problems imperfection on data characterized by that there are problems of the facts in which the same condition, but having a conclusion different (Pawlak, 2002). Some of the basic concepts from rough set theory are Information system (decision), Indiscernibility relation, Approximation set, and Reduction data (Pancerz, 2010):

i. Indiscernibility Relation

Indiscernibility Relation is key concepts used in variable selection in rough set. Every subset P of A, $P \subseteq A$, determine a relationship binary $IND(P)$ in U called an indiscernibility relation, which is defined as $(x,y) \in IND(P)$ if and only if $a(x)=a(y)$ for every $a \in P$. Where $a(x)$ indicates value of an attribute of a for x. Suppose , $IS = (U,A)$ is an information system, so with every $P \subseteq A$, there is a relationship equivalent, which is defined as the following:

$$IND(P) = \{ (x,y) \epsilon U^2 \mid \forall a \epsilon P, a(x) = a(y)\} \quad (1)$$

ii. Approximation Set

On decision system , very important find the entire a subset use equivalent class those which have the value of the same class. In fact every subset cannot always be defined by right, This phenomenon insurmountable by conducting an estimate of using the lower and upper approximations defined as follows:

$$\underline{B}\, X = \{x \epsilon U : B(x) \subseteq X\} \text{ and } \overline{B}\, X = \{ x \epsilon U: B(x) \cap X \neq X'\} \quad (2)$$

iii. Reduction of Data

According to polkowski (2002) in information systems, is expected to attribute kept can keep the indiscernibility. While, attributes left can be regarded as attributes excessive.

The validation or evaluation perform of the rough set can be seen from two values, namely *support*, and *Laplace Correction* (Pawlak, 1991):

a) *Support*

Support is the number of objects by antecedent and conclusion appropriate. Suppose *SD = (U, A, D)* is decision system, support in Φ⇒Ψ is defined as:

$$Suppo(\Phi \Rightarrow \Psi) = card\ (||\Phi||i \cap ||\Psi||\mathrm{i}) \quad (3)$$

Card indicating the number of a set and $card\ (||\Phi||i \cap ||\Psi||\mathrm{i})$ is the sum all classes in accordance with Φ and Ψ. In the decision it is possible conclusion rule produced more than one point, that support is divided into two , *left support* and the *right support*.

b) *Laplace Accuracy*

Laplace Accuracy is certainty values on decision rule often interpreted as an indicator of whether the decision formed is correct or proper. According to Han (2006) from many data on training set, for each of the data plus one to avoid cases zero probability.

$$Laplace\ (\Phi \Rightarrow \Psi) = \frac{Support\ (\Phi \Rightarrow \Psi)+1}{card||\Phi||_i+|\mathrm{C}|} \quad (4)$$

Where $|C|$ is the number of classes attribute decision and $card\ ||\Phi||$is the number of all classes in accordance with attribute Φi.

Methodology

This research using data lending the books in the library central UII on 2017. Variable are used Generation of 2010 until 2017, Department for undergraduate consisting of 24 department, and Category of book.categorized be 10 category. The number of the data used for analysis of 55.982 data.

Equipment used to support success in this study is two categories, namely main and supporting. The following are the main equipment specification used: one MacBook unit with 2.5 GHz Intel Core i5 processor, 16GB RAM Memory, and 120 GB SSD, macOS Mojave operating system version 10.14.4, Android Studio, Maria Database, mobile device base on Android operating system version 5.1: a smartphone.

The experimental work on this adopt four phases of system development lifecycle among others (Conolly dan Begg, 2015):

a) System Need Identification System

Requirements in this Android-based library application, namely the system developed, must be able to provide book recommendations needed by each user based on force and department. Identifying system requirements consist of: Display book recommendations based on the force and department of each user, searching for books, borrowing books, proposing new books, viewing the collection of books, looking at library news, giving criticism and suggestions as well as viewing and reading journals.

b) Designing an Application System

This process is used to change the system requirements into a form of software to build an android application. It requires an Application Programming Interface (API); an API is created using laravel. Designing User Interfaces, this process will become a software intermediary that can be estimated before making coding.

c) Coding
Application is built using the java android programming language, the software used is an android studio, while the API is created using visual studio code.

d) Run Project
The application will be tested whether it can be run or not using the Android Emulator.

In the initial phase of the research, the researcher will collect preliminary data in the form of book lending data that will be used to test the system recommendations on the application.

RESULTS AND DISCUSSION

Making an Android-based library application start from analyzing system requirements. Then proceed with designing the application interface design. The next stage is the implementation of interfaces that have been designed into a system that can be read by the system (coding). After that, the application is tested to find out whether the application has an error. The relation user with the database is schematically presented in Figure 1.

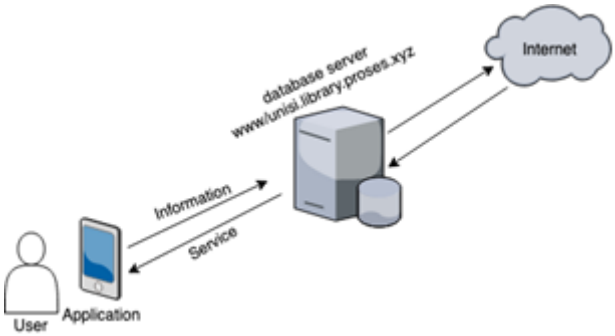

Figure 1. System Overview

Figure 1. describes a flowchart of the system. Firstly, the user needs to login with a username, which is Student Number or Membership ID, and the password. Book recommendation will be appeared to refer to major and level of the student, so they can select the proper book based on the title of books for furthermore borrowing. The flowchart of research is schematically presented in Figure 2.

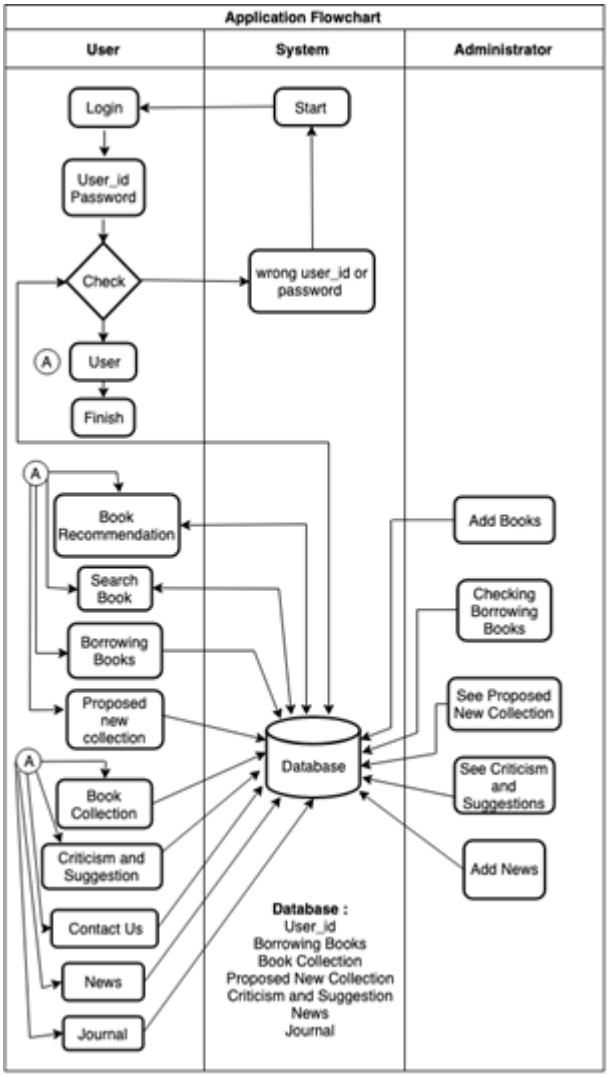

Figure 2. Application Flowchart

Based on Figure 2, the database structure is presented in Figure 3.

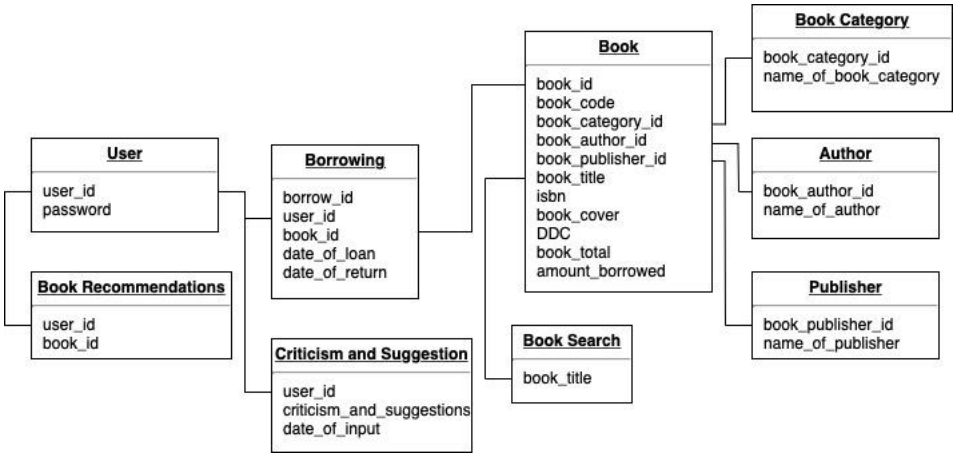

Figure 3. Structure Databases

Database structure comprises of correlated elemental data inputted by a user, which automatically accessible by user and admin.

Login Page, Book Recommendation Page, and Menu Page

The process of login until the recommendation is presented in Figure 4. As the major and level data are unavailable, the system will release the data randomly.

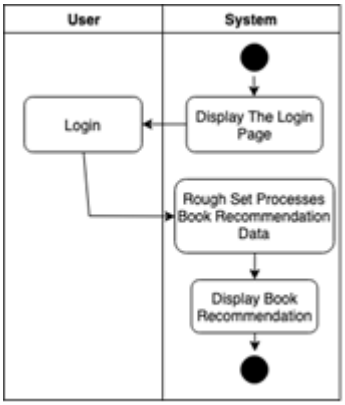

Figure 4. Book Recommendation Flow

The recommendation system constructed based on the rough set will form 14 rules by the limit of *support value of* 0.0001 (0.01%) and *the laplace accuracy* limit of 0.8 (80%). The *support* and *laplace accuracy* limit values are presented in Table 1 shows the mean of *support* of 0.0111 (1,11%) and *laplace accuracy mean of* 0.8742 (87.42%).

Table 1. Results from Rough Set

No	The Rule of Association	Support (%)	Laplace Accuracy (%)
1	Generation of 2013, and Department is Economics Then Category of book is Social Science	0.003506	0.829787
2	Generation of 2011, and Department is Civil Engineering Then Category of book is Applied Science Technology	0.0084	0.905983
3	Generation of 2012, and Department is Civil Engineering Then Category of book is Pure Science	0.041465	0.843296
4	Generation of 2010,and Department is Civil Engineering Then Category of book is Applied Science Technology	0.002383	0.909091
5	Generation of 2014, and Department is Mechanical Engineering Then Category of book is Applied Science Technology	0.001748	0.846154
6	Generation of 2011, and Department is Management Then Category of book is Applied Science Technology	0.002304	0.935484
7	Generation of 2010, and Department is Islamic Economics Then Category of book is Religion	0.000426	0.857143
8	Generation of 2012, and Department is Pharmacy Then Category of book is Applied Science Technology	0.005402	0.894737
9	Generation of 2013, and Department is Mechanical Engineering Then Category of book is Applied Science Technology	0.002224	0.903226

No	The Rule of Association	Support (%)	Laplace Accuracy (%)
10	Generation of 2010, and Department is Industrial Engineering Then Category of book is Applied Science Technology	0.002621	0.891892
11	Generation of 2011, and Department is Law Then Category of book is Social Science	0.001798	0.952381
12	Generation of 2012, and Department is Chemistry Then Category of book is Pure Science	0.001061	0.800000
13	Generation of 2017, and Department is Islamic Law Then Category of book is Religion	0.064594	0.859301
14	Generation of 2017, and Department is Mechanical Engineering Then Category of book is Pure Science	0.017511	0.809816

From 14 rules in Table 1, it is found that there are three rules having high *support* values and *laplace accuracy* deeds 3, 13, and 14. The rule having the highest *support* is rule 13 of 0.064594. The value of a 6.45% borrowing transaction occurs with the rule that as the student borrowing the book is coming from Department of Law with registered in 2017, so the book category is religion.

The page of this login will appear when the user opens the application, and then the user enters a username and password in order to enter the application system (see Figure 5). The book recommendation is a page that appears when a user has logged into the application. The recommendations are generated from a rough set analysis that matches the force and department using a book lending database. (see Figure 6)

Figure 5. Login interface.

Figure 6. Book Recommendation interface.

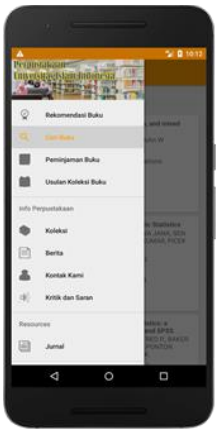

Figure 7. Menu interface.

The menu is a page that appears when pressing the application icon; the application menu includes: book recommendations, search for books, borrowing a book, propose new book collection, collections, news, our contact, criticism and suggestions, journal, and logout (see Figure 7).

Book Search Page, Propose Book Collection Page and Collection Book Page

The diagram of the activity is presented in Figure 8**.** The system will show the menu for the user to select a book based on the title by presenting a form. The book title will be forwarded by the system for searching in the web service. As the chosen book not found, the user will be notified, meanwhile as the book is found, the detail information, as well as availability in the library, will be informed.

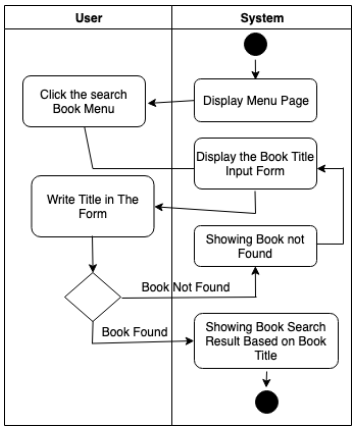

Figure 8. Programming Scheme

Search is a page that appears when a user selects a book search menu, and the user only needs to click on the search menu and fill in the form with the name of the book want to search and press the search button to start the search. (Figure 9)

The proposed book collection is a new collection proposal page. The user can propose a new book using the application, after filling in the new book collection proposal from it will automatically enter the database which will be checked by the library admin. (Figure 10)

The collection is a book collection page; users can view collection books by category, categories of books, namely: public work, philosophy, religion, social sciences, languages, pure sciences, applied sciences (technology), arts (sport), literature, and history and also geography. (Figure 11)

Figure 9. Book search interface.

Figure 10. Proposed Book Collection interface.

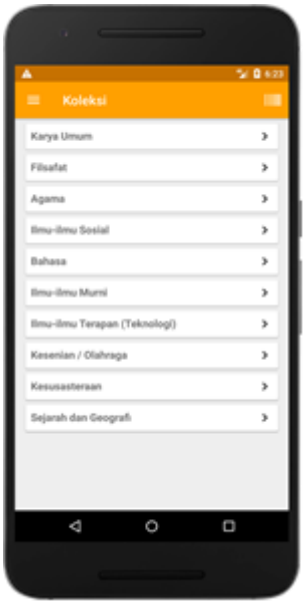

Figure 11. Book Collection interface.

Loan Books Page

On the menu page for borrowing books, there are two sub-menus, namely the submenu list of loans and loan transactions. Submenu loan list is a page that appears when a user has borrowed a book; the user can also extend a book if the book return time is near. Users can borrow a maximum of 7 books (see: Figure 12). The submenu loan transaction is a borrowing book transaction page.user can borrow book using barcode number or scan a barcode in the book (see: Figure 13)

Figure 12. Loan Lists interface.

Figure 13. Loan Transactions interface.

Figure 14. Library News interface.

The news page, Contact page, Criticism and Suggestion Page and Journal Page

The news page is a library news page that has been integrated with the website https://library.uii.ac.id/category/berita/; the user can see the latest library news in the application (see: Figure 14). Contact page. Users can see library contact information, namely the location of the library, library website, library telephone number, email library, and working hours of the library. (Figure 15). Criticism and Suggestions page, The user can submit criticism and suggestion regarding the library using the application. (Figure 16). Journal page, user can view or read journals using the application. Available journals are *Springer, ScienceDirect, ProQuest, EBSCO Host, Westlaw, IG Publishing, JStor, SciFinder*. (Figure 17)

Figure 15. Contact Us interface.

Figure 16. Criticism and Suggestions interface.

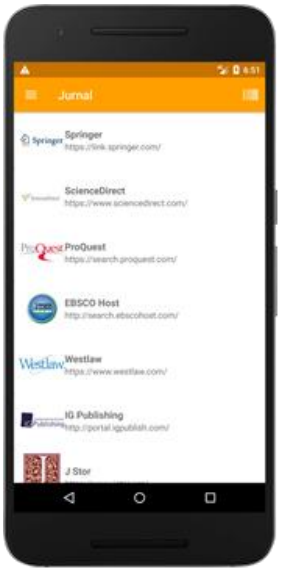

Figure 17. Journals interface.

The results obtained from this study are as follows :

a) Application of an android-based library can display book recommendations based on force and majors obtained from the analysis of rough sets in the book lending database.
b) Users who can use the application are UII students and lecturers who have been registered in the system.
c) Registered users can search for books according to their wishes, after borrowing will automatically appear on the loan list sub-menu, propose new book collections, view book collections, view library news, view library contacts, give criticism and suggestions, and see the journal.

CONCLUSIONS

After designing and completing this research, the researchers draw some conclusions, among others: the method of a rough set can be used for a book recommendation system, this application utilizes the barcode book as an identifier to borrow books, this application can run smoothly in android version 5.1

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