Jurnal Mantik, 5 (3) (2021) 1535-1542

Published by:Institute of Computer Science (IOCS)

Jurnal Mantik

Journal homepage: www.iocscience.org/ejournal/index.php/mantik/index

Student Final Project Recommendation System Model Using Case-Based Reasoning (CBR) Method

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A R T I C L E I N F O

Article history:

Received: August 27, 2021
Revised: September 18, 2021
Accepted: October 14, 2021

Keywords:

Model;
Recommendation System;
Student Final Project;
Case Based Reasoning (CBR) Method.

A B S T R A C T

The purpose of this study is to develop a student final project recommendation system model that can be used to improve the quality of final assignments in universities, especially AMIK Indonesia, and compare it with similar applications currently used. Agile Development Methods (ASD) is used in software development where this method is widely used for software development because it can produce system requirements data that is more descriptive and easy to implement into software. The researcher also uses the Case-Based Reasoning algorithm, which will later be implemented as the basic concept of developing a recommendation system prototype. The results of the study found that; 1) In knowing the topic or research theme in the student's Final Project with an expert system, it can be seen from the themes and sub-themes and valid calculations are carried out in helping students to quickly find out the research title for the final project, 2) By applying the Case-Based Reasoning method in detecting research topics or themes at AMIK Indonesia can produce valid calculations that are the same as manual calculations so that the selection process can be carried out quickly and accurately, and 3) in designing this application it consists of the main menu page, a list of research topics, FAQs and about applications using PHP, ReachJS and MySQL programming languages as data processors in the recommendation of a student's final project.

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1. Introduction

The recommendation system has been widely used as a system to predict information according to user interests (Sanjung & Maharani, 2011), which information will be recommended to the user (Akbar & Nurdiyansyah, 2018). Recommendation systems are generally intended for individuals who lack sufficient experience or competence information to evaluate alternatives in a particular case. Recommendation systems have been widely used on social media such as Youtube (Qin, Menezes, & Silaghi, 2010), SoundCloud (Hiebner & Hiebner, 2014) and also e-commerce (Wang et al, 2020). Writing scientific papers in the form of a final project is one of the requirements for completing a three-diploma study program (AMIK Indonesia, 2016). In addition, the final project is also to determine the level of student ability (Anggaeni & Sujatmiko, 2013), and to grow creative ideas for the students themselves (Maryadi, 2019). Some universities have implemented technology for final project management, the process for submitting final project titles and theses has been based online (Kurniawan & Bondowoso, 2020), so titles that have been used previously cannot be resubmitted (Anggaeni & Sujatmiko, 2013).

Currently, AMIK Indonesia has taken advantage of online title submissions, the application is only in the data collection process and appointment of guidance lecturers. However, the submission of the title of final student tends to lack novelty. The result of the researcher's observation is that this is due to the lack of student knowledge of the current trend. Seeing this, it is necessary to have a final project recommendation system which can provide information and the theme of the final project for students so that later it is hoped

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that improving the quality of student writing will be directed and have novelty value. The final project recommendation system has not been widely applied in universities, it is also hoped that the results of this study will provide a model recommendation system for universities in accordance with the vision and mission as well as the quality of scientific work of students in each university, especially AMIK Indonesia. Researchers also use the Case Based Reasoning (CBR) algorithm which will later be implemented as the basic concept of developing a prototype recommendation system built. The use of technology in software development provides an opportunity for researchers to build applications and find out their effectiveness in the process of making a final project recommendation system. In addition, with the increasing development of technology, especially in software development, it triggers research on services and applications for a final project recommendation system with various service management features that have been studied before.

Fathurrahman, Nurjanah, and Rismala, (2017), conducted a study on the Recommendation System on Books Using the Trust-Aware Recommendation Method. Based on the results of testing and analysis that have been carried out, that the recommendation system using the Trust-Aware method can provide fairly accurate recommendations by providing an MAE value of 1,267 in 101 books, 1,294 in 51 books, and 1,181 in 11 books and is not affected by any number of books. used. It is different with Prastyo and Rosmawanti (2017), conducting research on a Web-Based Final Project Management Information System, the results of this study are a system as a solution for academics in managing final project data, especially in making final project data recapitulation, also helping students and lecturers in conducting final project consultations without having to meet face-to-face to determine the consultation schedule, as well as assisting academics and lecturers in making announcements related to the implementation of the final project without having to print the announcement and stick it on the bulletin board. Pamungkas (2020) conducted research to build a web-based final project scheduling information system (sijukir). Scheduling the screening test with this system can make it easier for officers to schedule and be real-time and this trial scheduling application is used in the Informatics Study Program, University of Technology Yogyakarta. Of the three studies that have been carried out only on the management of the title submission process, documenting the final project, and determining the schedule. So it can be concluded that the research proposed by the researcher has the latest in handling final project recommendations and has high originality.

2. Method

This research is divided into three stages, namely pre-development data collection, development and implementation, and post-development data collection. Pre-development data collection is intended to provide preliminary studies on the core problems being faced, while the development and implementation stages focus on modeling software designs into diagrams and creating programming code to implement the designs that have been made. While the post-development data collection stage is for revamping the applications made, drawing conclusions, and suggestions for further research topics. This research will principally be carried out at the AMIK Indonesia Software Engineering Laboratory. In the laboratory, there is a computer that can be used to develop a final project recommendation system software. In addition, this research will also involve students and academics outside the lab to test the applications that are made.

The research model used is qualitative research, meaning that the data collected and used for research is not statistical data. In qualitative research, the data that is processed is in the form of words collected by interview or group discussion methods. Agile Development Methods (ASD) is used in software development where this method is widely used for software development because it can produce system requirements data that is more descriptive and easy to implement into software. The researcher also plans to use the Case-Based Reasoning algorithm, which will later be implemented as a basic concept for developing a recommendation system prototype.

The data collected in qualitative research is textual data in the form of words and sentences. The most widely used method for collecting qualitative data in this research is through literature study and group discussion. In this study, the initial data collection used to obtain a list of system requirements was to conduct a literature study on the final project recommendation system. Furthermore, the literature study data is listed to be analyzed between the management standards of the final project recommendation system to be achieved and those that currently exist. Furthermore, documentation studies and analysis of the development pattern of additional components (plugins) were also carried out which could be accommodated by the final project recommendation system. This is needed to determine a proper communication strategy between the

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application made and the software developer to be developed on the Agile Development Methods (ASD) model.

3. Result and Analysis

3.1 Analysis and Discussion

One of the main elements that must be considered in the analysis stage of this system is the software problem, because the software used must be in accordance with the problem to be solved. In this stage, the search and collection of data and knowledge obtained by the expert system is carried out. So that in the end the analysis obtained must be in the form of a structured system that can be defined properly and clearly. The system built to find out trends in popular scientific titles is by consulting someone who is an expert or technology activist and Indonesian AMIK lecturer. In this study, 8 (eight) samples of research titles / students' final project themes were used.

Table 1
Research Fields on the Theme of Student Final Project

No	Theme Code	Theme
1	T01	Economic Empowerment
2	T02	Urban and Rural
3	T03	Regional Potential Development according to One Village One Product (OVOP) Featured Natural Resources
4	T04	Development of Tourism Potential to Support PAD
5	T05	Humanities and HR Management
6	T06	Improving the Quality of Humanities and Human Resources
7	T07	Humanities and HR development
8	T08	Stock and Bond Research, in the capital market
9	T09	General and Sharia Banking, Entrepreneurship, Utilization of IT for Global Business Development
10	T10	Product Positioning Research
11	T11	Company HR Development
12	T12	Application in the company
13	T13	Industrial Sector Services
14	T14	Service in the Global world
15	T15	Information Network and telecommunication system
16	T16	Information Exchange
17	T17	Digital broadcasting
18	T18	Hardware (computers, instruments, network devices)
19	T19	Community Access Point
20	T20	Cloud Computing
21	T21	Operating system
22	T22	Application System
23	T23	Open Source
24	T24	Simulation and Computing
25	T25	Repository and Information Sharing
26	T26	Creative digital
27	T27	Data security
28	T28	e-service
29	T29	Big Data
30	T30	Information Management System

Source: Results of Consultation with Experts

Table 2
Research Fields in Student Final Project Sub-themes

No	Theme Code	Sub-Theme Code	Sub-theme/Research Topic	Expert Value
1	T01	ST01	Role of Physical Capital & Human Capital in Long-term Growth, Growth Implications of Savings & Investment, Rural Entrepreneurship and Inclusive Growth, Infrastructure and Creation of New Opportunities, Childhood Development, Education & Skill Development, and Transition to Work, Universal Health and Sanitation for Human Development, Women Empowerment, Agriculture and Agri- Business.	0.8

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No	Theme Code	Sub-Theme Code	Sub-theme/Research Topic	Expert Value
2	T02	ST02	Climate, Energy, Natural Resouces, Environment and Development, Water Resources, Geography.	0.8
3	T03	ST03	Rural, Local Economic, and SME Cluster Development.	0.8
4	T04	ST04	Entrepreneurship and start-ups in the tourism industry, Digital marketing, Event tourism, Destination management, Business planning activities for tourism.	0.8
5	T05	ST05	Emotional Intelligence, Transformational Leadership, Work Life Balance, Employee Engagement and work culture, Performance Management Rgds Sujata.	1
6	T06	ST06	Emotional Intelligence, Transformational Leadership, Work Life Balance, Employee Engagement and work culture, Performance Management Rgds Sujata, Artificial Intelligence, Remote Employees, Virtual Team Building, Automation, Data-Driven Strategies, Employee Learning, Better Onboarding, Workplace Experience	1
7	T07	ST07	Strategic HR Management and Planning, Workers, Jobs, Job Analysis, Human Resource Planning and Retention.	1
8	T08	ST08	Trends in earnings growth, Company strength relative to its peers, Debt-to-equity ratio in line with industry norms, Price-earnings ratio can help provide market value, How is a company treating its dividends?, Effectivness of executive leadership.	0.6
9	T09	ST09	FinTech (Financial Technology) implementations and challenges, Green finance/Social funding of green financing, Blockchain implementations, Cryptocurrencies (Bitcoin, Ethereum, etc.), Crowdfunding implementations, Corporate governance.	0.6
10	T10	ST10	Information Technology, Computer Science, MBA, Accounting, Management, Education, Engineering, Marketing.	0.6
11	T11	ST11	Artificial Intelligence, Remote Employees, Virtual Team Building, Automation, Data-Driven Strategies, Employee Learning, Better Onboarding, Workplace Experience	0.6
12	T12	ST12	Smart practices to increase motivation among employees, Women leadership, Managing conflict in a team, Networking between business and companies, Organizational crisis management, Social entrepreneurship, Causes of low employee retention rate.	0.4
13	T13	ST13	Carbon nanotubes, Graphene, Nanomanufacturing, Nanotechnology, Distributed information and automation, Engineering design and design management, Global supply networks and international manufacturing, Industrial photonics, Industrial sustainability, Inkjet science and technology.	0.4
14	T14	ST14	Technology,Religion, Social media, Music, Education, Health, Social issues, Environment.	1
15	T15	ST15	Telephone network, the radio broadcasting system, computer networks and the Internet.	0.8
16	T16	ST16	Social Science Approach, Interpretive Approach, Critical Approach, Postmodern Approach.	0.8
17	T17	ST17	Television Broadcasting Research, Next-generation digital television terrestrial broadcasting, Digital Television Regulation	0.6
18	T18	ST18	design, analysis and modeling of complex systems on a chip, including gates, architectures, and networks	0.6
19	T19	ST19	NFV for Future Communication, Cognitive and Green Radio Communication, Wireless and Mobile IP Based Communication, SDN/NFV based 5G Architecture, Smart Grid and Power Line, Wireless Multicasting, and also Broadcasting, Resource Management for Cellular Communication	0.6
20	T20	ST20	Load balancing, Security and integrity, Privacy in multi-tenancy clouds, Virtualisation, Data recovery and backup, Data segregation and recovery, Secure cloud architecture, Cloud cryptography.	0.4

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No	Theme Code	Sub-Theme Code	Sub-theme/Research Topic	Expert Value
21	T21	ST21	Defining deadlock with fungible resources, Optimal strong-password authentication protocols, Parallizable simple authenticated key agreement protocols, Partitioning based operating systems, Reservation aware operating system for grid economy.	0.4
22	T22	ST22	abortion, birth control, child abuse, gun control, history, climate change, social media, AI, global warming, health, science, and technology	0.4
23	T23	ST23	PHP scripting language, Python programming language, Apache HTTP web server, Flutter, First Contributors, TensorFlow, React-Native, Kubernetes(K8s), DefinitelyTyped, Ansible.	0.4
24	T24	ST24	Integration of machine learning and mechanistic models in biomedicine, Challenges of the hybrid model computing framework, Multi-scale modelling in areas of physiology, bioengineering and medicine, Machine learning as surrogate models of complex mechanistic models, Parameter reduction and uncertainty quantification in machine learning and mechanistic models.	0.4
25	T25	ST25	Data is Plural, Data World, Google Data Set Search, Kaggle, Makeover Monday, r/datasets/, UCI Machine Learning Repository	1
26	T26	ST26	Create a website, Create a screencast video, Make a single multimedia webpage, Connect with a cause, Create an infographic, Create a series of podcasts, Do a genius hour-style project, Create an annotated collection.	1
27	T27	ST27	Secure quantum communications, Secure communications for space, Cyber autonomy and automation, Internet of things (IoT) and cyber physical security, Data privacy and user data control, Cyber law and ethics, Secure software engineering, National security and cyber policies	1
28	T28	ST28	Supply of video, music, games, lotteries and other games of chance, Downloads of films or broadcasts to PC's, laptops and phones, Website services. Self-help website services, Software services, Supply of distance teaching, Provision of text, images and databases	0.8
29	T29	ST29	Big Data for cybersecurity, Health status prediction, Anomaly detection in cloud servers, Recruitment for Big Data job profiles, Malicious user detection in Big Data collection, Tourist behaviour analysis, Credit Scoring, Electricity price forecasting	0.8
30	T30	ST30	Big data, data mining, Business Intelligent tools and techniques, Social commerce, Fog computing, Internet of Things, Dark web. and Mobile payments.	0.8

Source: Results of Consultation with Experts

Table 3
Research Fields on the Theme of Student Final Project

No	Field Code	Theme Code	Final Project Research Bidang
1	B01	T1, T2, T3, T4	Environmental and Natural Resources Management
2	B02	T5, T6, T7	Governance Management (Good governance)
3	B03	T8, T9, T10, T11	Business management, Entrepreneur and Technopreneur
4	B04	T12, T13, T14	Organizational Service Management
5	B05	T15, T16, T17, T18, T19, T20, T21, T22, T23, T24, T25, T26, T27, T28, T29, T30.	Information and Communication Technology (ICT)

The analysis of the expert system built is a rule that applies the CBR method. In the system input session, the user is given the option to choose the confidence weights, each of which has the following weights:

Table 4
Terminology of Certainty

No	Information	Fixed Weight
1	Certainly	1
2	Almost Sure	0.8
3	Sure enough	0.6

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No	Information	Fixed Weight
4	Not sure	0.4
5	Doubt	0.2
6	Not known	0

From the table above, it is presented as the rule below. This representation is used to obtain a search and determine diagnostic conclusions, the following is the discussion:

Rule:

Rule1 : If T01 AND B03 THEN Environmental and Natural Resources Management
Rule2 : If T02 THEN Environmental and Natural Resources Management
Rule3 : If T05 AND T06 AND T12 THEN Good Governance
Rule4 : If T015 THEN Information and Communication Technology (ICT)
Rule5 : If T10 AND T11 THEN Business Management, Entrepreneur and Technopreneur
Rule6 : If T07 THEN Good Governance
Rule7 : If T12 AND T13 THEN Organizational Service Management
Sample Data: T01, T02, T03, T05, T06, T10, T11, T12, T13.
Old Case

Table 5
Cases

Case Number	Case Name
B01	Environmental and Natural Resources Management
B02	Governance Management (Good governance)
B03	Business management, Entrepreneur and Technopreneur
B04	Organizational Service Management
B05	Information and Communication Technology (ICT)

To find the similarity value between the new case base and the old case, a calculation is carried out using the similarity formula. For old case data or here, the title of the old student's final project is taken from the AMIK Indonesia repository application.

Table 6
Calculation of New Cases with Case 1

Old Case Code 1	New Case Code	Certainty Weight	Weight Determination
T01	T01	0.8	1
-	T02	0.8	0
T03	T03	1	1
-	T09	0.6	0

$$= \frac{(0.8 * 1) + (0.8 * 0) + (1 * 1) + (0.6 * 0)}{(0.8 + 0.8 + 1 + 0.6)}$$

$$= \frac{1.8}{3.2}$$

= 0.5625 * 100
= 56.25 %

3.2 Implementation

Implementation is a step used to operate the system that was built. The display of the program in implementing the test results of the Case Based Reasoning method on the front page is shown in Figure 2 below.

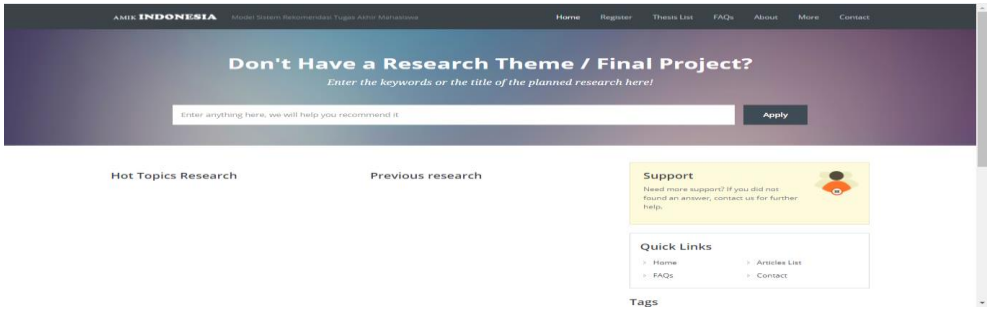

Fig 1. Application Start Page

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Seen in Figure 2, this page is used as a title search or research theme for the final project. Each user or student can type keywords or a title in the search bar. As seen in Figure 3 below.

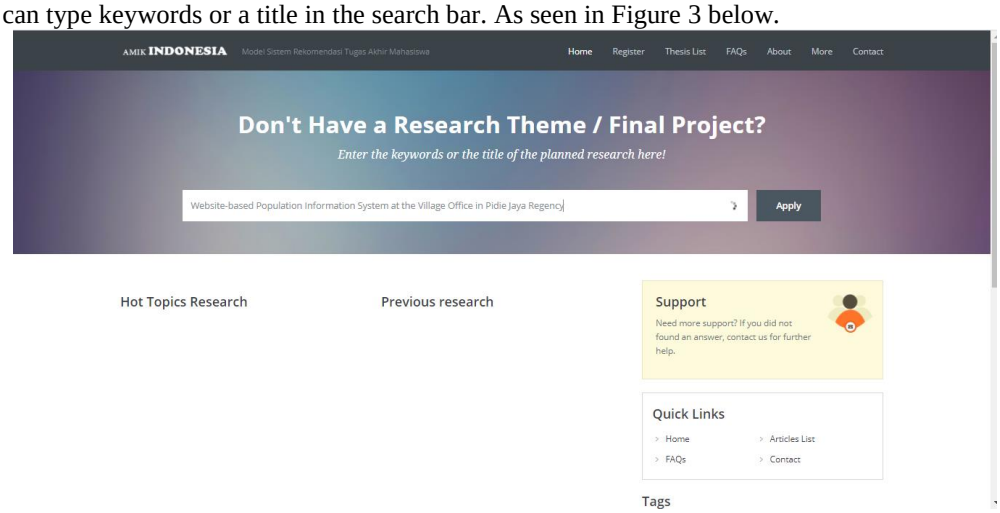

Fig 2. Entering research title keywords

Furthermore, the user or student can type in a title and click the Apply button, then information about the recommended research theme or title will be displayed along with the title/topic of research previously made by alumni. Each result is presented based on the implementation of Case-Based Reasoning (CBR) so that comparisons between old cases and new cases are separated according to the weights made by the researcher.

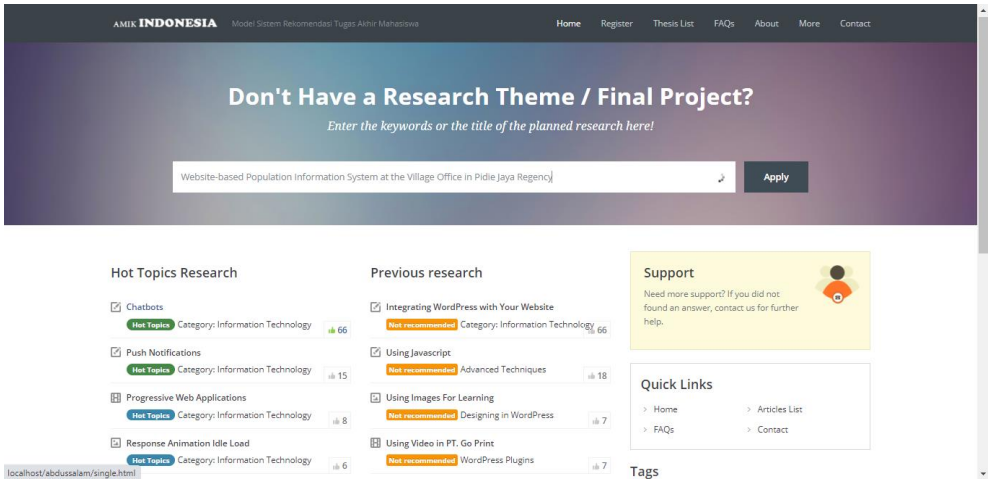

Fig 3. Results of each keyword

4. Conclusion

After going through the process of completing this research, the authors draw the following conclusions:

a) In knowing the topic or research theme in the student's Final Project with an expert system, it can be seen from the themes and sub-themes and valid calculations are carried out in helping students to find out the title of the research for the final project quickly.

b) By applying the Case-Based Reasoning method in detecting research topics or themes at AMIK Indonesia, it can produce valid calculations that are the same as manual calculations so that the selection process can be carried out quickly and accurately.

c) In designing this application, it consists of the main menu page, a list of research topics, FAQs, and about the application using the PHP, ReachJS, and MySQL programming languages as data processing in the recommendation of a student's final project

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