Editors

Reviewers

Dr.Eng. Listiani Nurul Huda, MT (Industrial Engineering Department, Universitas Sumatera Utara, Indonesia).

Dr. Sri Ratna Sulistiyanti (Electrical Engineering Department, Universitas Lampung, Indonesia).

Dr. Eng. Handri Santoso (Computer Science Department, Universitas Bandar Lampung, Indonesia).

I Dewa Made Cipta santosa, ST, M.Sc, PhD (Mechanical Engineering, Politeknik Negeri Bali, Indonesia).

Prof. Dr. Moechammad Sarosa (Electrical Engineering Department, Politeknik Negeri Malang, Indonesia).

Dr. Eng. Cahya Rahmad (Information Technology Department, Politeknik Negeri Malang, Indonesia)

Dr. Dewi Yanti Liliana (Information Technology Department, Politeknik Negeri Jakarta, Indonesia).

Dr. F. Yudi Limpraptono (Electrical Engineering Department, Institut Teknologi Nasional, Indonesia).

Dr. Isdawimah (Electrical Engineering Department, Politeknik Negeri Jakarta, Indonesia).

Mohammad Noor Hidayat, ST., M.Sc., Ph.D. (Electrical and Electronics Engineering Department, Politeknik Negeri Malang, Indonesia).

PREFACE

We would like to present, with great pleasure, the first issue of Matrix: Jurnal Manajemen Teknologi dan Informatika in Volume 11, 2021. This journal is under the management of Scientific Publication, Research and Community Service Center, Politeknik Negeri Bali and is devoted to cover the field of technology and informatics management including managing the rapid changes in information technology, emerging advances in electrical and electronics and new applications, implications of digital convergence and growth of electronics technology, and project management in electrical, mechanical or civil engineering. The scientific articles published in this edition were written by researchers from Politeknik Negeri Malang, PSDKU Politeknik Negeri Malang, Universitas Jenderal Achmad Yani, Politeknik Negeri Bali and UIN Sunan Ampel Surabaya. In the field of Information Management, scientific articles in this issue covers topics including livE (onLine – java Exercise) Java Programming Language Learning System for Lab and Online Test, Web and Android-based Application for Monitoring Tuberculosis (Tb) Patients in Kediri City, The Uses Of Educational Data Mining in Academic Performance Analysis at Higher Education Institutions (Case Study at UNJANI) and Designing a Microsoft Access-Based Administration Letters and Archives System at BPJS of Employment Regional Office of East Java. In the field of Mechanical Engineering, one scientific article covers topic on The Analysis of Work Improvement of Short Ergonomics Break on the Rice Weeding Farmers in Kebon Bantiran, Bajera, Tabanan. Finally, we would like to thank reviewers for their efforts and hard work in conducting series of review phase thoroughly based on their expertise. It is our hope that the work of the authors in this issue will be a valuable resource for other researchers and will stimulate further research into the vibrant area of technology and information management in specific, and engineering in general.

Politeknik Negeri Bali, 31 March 2021

Editor-in-chief

Gusti Nyoman Ayu Sukerti, S.S., M.Hum.

Table of contents

livE (onLine – java Exercise) Java Programming Language Learning System for lab and online test

Mamluatul Hani'ah [1]*, *Yogi Kurniawan* [2], *Imam Fahrur Rozi* [3]

[1] *Politeknik Negeri Malang, Indonesia*
[2] *Universitas Brawijaya, Indonesia*
[3] *Politeknik Negeri Malang, Indonesia*

Corresponding Author: *mamluatulhaniah@polinema.ac.id*

Abstract: Java programming language is one of the most popular programming languages among IT developers. There are common problems in the beginning learning process such as the installation and configuration process of java software like JDK (Java Development Kit). During the online class session, it takes a lot of time and a large internet data packet to solve this problem. This research proposes a website-based system called livE (online - java Exercise). Students can practice coding and also do exams in real-time, simply by using a web browser and the internet. If lecturers want to make corrections, lecturers do not need to download student answer files. They can directly run the program code from student answers in the livE system. This indicates that the system implementation provides process efficiency in the student's job sheet exercises and lecturer's corrections. The result from the test that has been carried out shows that livE is running as expected. Usability testing shows that users are "totally agree" with system quality.

Keywords: Java Programming Language, livE, lab, online examination system

How to Cite: M. Hani'ah, Y. Kurniawan, and I. F. Rozi, "livE (online – java Exercise) Java Programming Language Learning System for Lab and Online Test," Matrix: Jurnal Manajemen Teknologi dan Informatika, vol. 11, no. 1, pp. 1–10, 2021.

Introduction

Information technology is developing so rapidly. It cannot be denied that in Indonesia, information technology had a lot of influence on many sectors. Of course, information technology is commonly used to improve education [1][2], economy [3][4], transportation [5], health [6][7], agriculture [8] and data security [9]. Developing information technology cannot be separated from the role of IT developers. One of the programming languages that IT developers learn is the Java programming language.

Java programming language is one of the most popular programming languages among IT developers. This programming language is usually used as basics programming education material on informatic studies programs at the college. Of course, the Java programming language is fundamental for students because it will be the opening gate for informatics engineering students to learn other programming languages. One way to improve student skills and abilities is by doing practical work or exercise using the Java programming language.

In offline class, many students experience problems. The problem occurs when students perform installation and configuration process on practical devices like installation and configuration of Java JDK (Java Development Kit). It is often happening in the beginning semester, especially students who come from non vocational high school and are not familiar with computer programming. Students that fail to install and configure the practical supporting software, cannot perform an experiment and practical exercises. To resolve these problems, the lecturer must provide assistance and direction to the students.

However, during the online lecture session, lecturers could not directly assist students. Meanwhile, if the problem is solved by lecturers using video conferencing, it will take a relatively long video conference time and spend relatively many internet data packages. When a student

does not immediately repair the problem, the student will not be able to do the experiment steps or exercises from the practical's job sheet.

Several studies have been conducted by other researchers, developing systems for learning and coding in real-time programming languages. Research by M. Guo et al. developed an automatic assessment for learning the introduction of the Java programming language for computer science students [10]. The system built aims to make students learn interactively and in real-time. Furthermore, research conducted by A. N. Kumar made an online compiler as a system designed for learning the C ++ programming language [11]. The system also provides animations to assist students in learning se-mantic pointers in the C ++ programming language.

Research by N. Funabiki et al. designed a website-based application, called the Java Programming Learning Assistant System (JPLAS) [12]. It proposes to improve student skills in the Java programming language. JPLAS was designed for the teacher so the teacher can provide questions and program code. Then students can answer questions from the lecturer by creating program code that can be compiled directly on the JPLAS web.

This research proposes a website-based system called "livE (online - java Exercise)" to improve the learning process using Java programming language. Students can work on job sheets and question exercises through the livE system (online - java Exercise). Lecturers can use the livE system to conduct online exams that require students to practice coding java programming language directly. Students can answer the exam by coding in the livE system. Furthermore, students can run the program code to find out the output of the program code. This system also provides a reporting feature, how many times a student-run program code to answer a case study/question. The benefit of this system is students can practice coding, and also they can carry out practical tests in real-time, just using a web browser and the internet. Lecturers will also find it easy by using this system. If lecturers want to make corrections, lecturers do not need to download student answer files. They can directly run the program code from student answers in the livE system. This indicates that the system implementation provides process efficiency in the student's job sheet exercises and lecturer's corrections.

Methodology

Figure 1 shows the process/stages in this research include literature review and observation, system requirements analysis, systems design, build software based on the design, and last is software testing. Literature review and observation is to study the latest problems and research. System requirements analysis is to find out the needs of the system.
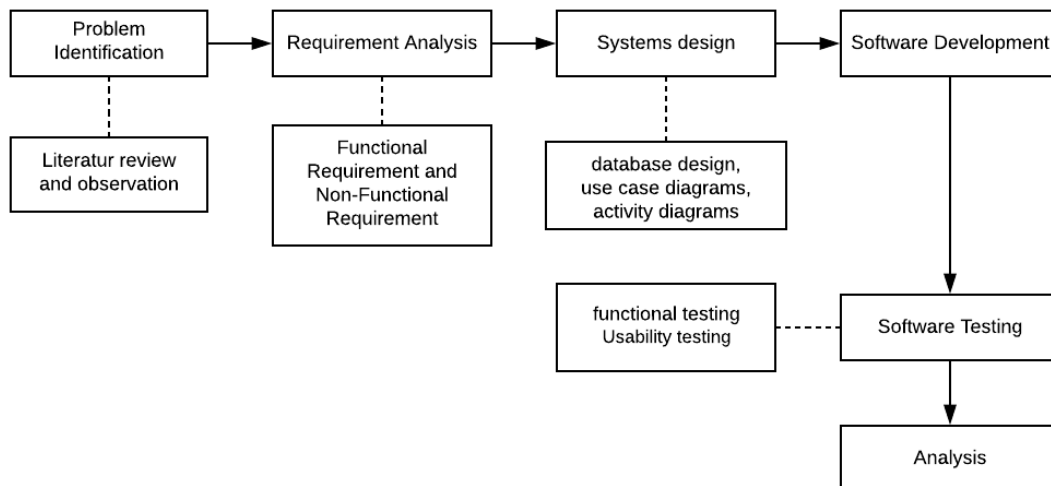

Figure 1. Stages of system development

The first stage is to identify the problem through literature review and observation. Literature reviews are concerned with an understanding of the theoretical and technical basics of this study. The literature review process resulted in the theory used as well as previous studies. Furthermore, Researchers find research problems through observation by surveyed 31 students who have used the Java programming language in the first semester. From this survey, it turns out that 41.9% (13) of students experience difficulties in installing and configuring Java software such as JDK. Apart from solving software installation and configuration problems, the "livE" system hopefully makes lecturers easier. Lecturers can check student answers in practice exam using Java programming language.

The requirements analysis stage is the second stage in this study. At this stage, the functional requirements of the system are determined that consist of hardware and software required by the system also be analysed that functional requirements and hardware and software requirements.

Functional requirements consist of:
1. Users of the system, divided into three: admin, lecturers, and students.
2. All users can login to the system.
3. All users can make changes to data such as username, name, and password, especially student users can make changes to data from the school.
4. Lecturers can add exams/job sheet list, add exams/job sheet questions, add exams/job sheet participants, and give score to participants.
5. Students can take exams/ job sheet practice and can see the result of the exam/ job sheet results.

Hardware and software requirements consist of:
1. Hardware requirements. The computer specifications used in the development of this system are computers with an Intel (R) Core (TM) i5-3230M CPU @ 2.60GHz 8.00GB RAM.
2. Software requirements. The software environments used in the development of this system are Centos 8 Operating System, Apache Web server, Database Management System (DBMS) MariaDB, PHP Programming Language.
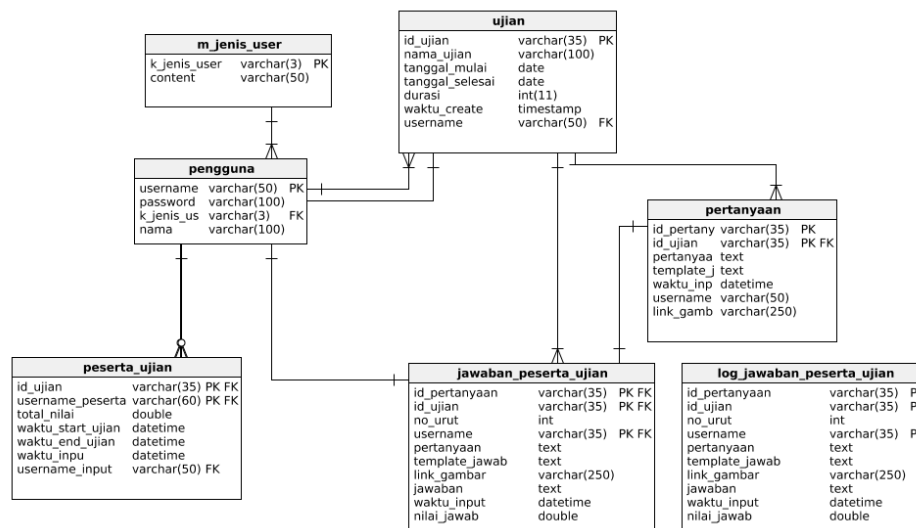
Figure 2. Database design of livE system

The third stage is the system design stage. This stage is needed to find a picture of what features are needed to support the function of the system. In this design process, it is done by creating the required database design, making use case diagrams to determine the role of each user, and activity diagrams to determine the flow of each feature. The database required in this study is illustrated with the physical diagram in Figure 2. In this study, seven tables were used, namely the *m_jenis_user*, *ujian*, *pengguna*, *pertanyaan*, *jawaban_peserta_ujian*, *peserta_ujian*, *log_jawaban_peserta_ujian*. The next design is making use case diagrams which can be seen in Figure 3. Use case diagrams are closely related to the scenario. Scenarios must be able to explain the complete and valid functionality of the system [13]. The interaction between users (actors)

in the livE system is clearly illustrated in the use case diagram. The last design process is making an activity diagram which is used to describe the workflow of a system. Following the use case that has been made, there are 8 activity diagrams for the livE system.
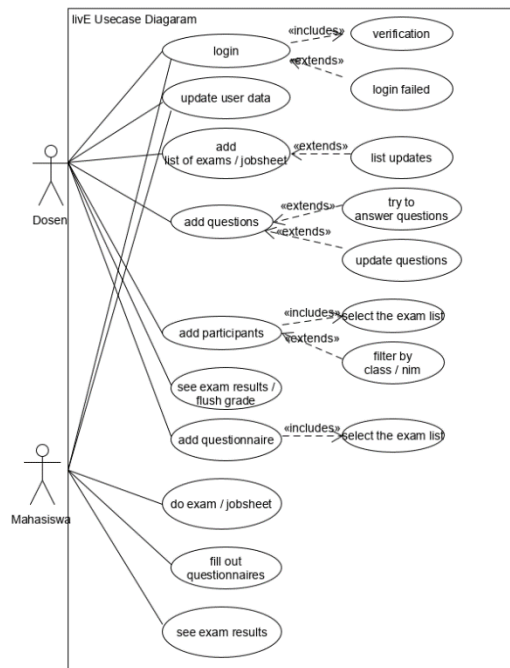
Figure 3. Use case diagrams of livE system

The fourth stage is making the system. In this process, the system coding carried following the design. livE implemented using JDK 14, Apache web server, Centos 8 operating system, DBMS (Database Management System) Maria DB 10.3, and the PHP programming language. When the user enters the Java program code in a web browser, These codes store on a text file. Then the text file will be compiled and executed using the Shell Function in PHP. After the execution is complete, the results store on the text file, and PHP will read them and return them to the user. The system architecture created is shown in Figure 4.

Figure 4. System architecture of livE

The fifth stage is system testing. The system is tested using functional testing and usability testing. Functional testing aims to test system features, whether these features are running well. This functional testing creates a test cases based on the requirement or design specification [14]. Meanwhile, usability testing measures the quality of a product or system-based experience of users when using the product [15]. This test aims to find out how good the system is, based on a questionnaire that has been filled in by the user [16].

Results and Discussions

Students can use the "livE" system when they want to do job sheets or take online exams when to practice coding in the Java programming language. This chapter will present the results of the system and also a discussion of system testing.

Results

The livE (online - java Exercise) can be used by students in lab experiments and carrying out online exams. So that students can practice coding in the Java programming language. Three types of users can interact with the system, the first user is a lecturer user, the second user is a student, and the last is a lecturer who is the administrator.
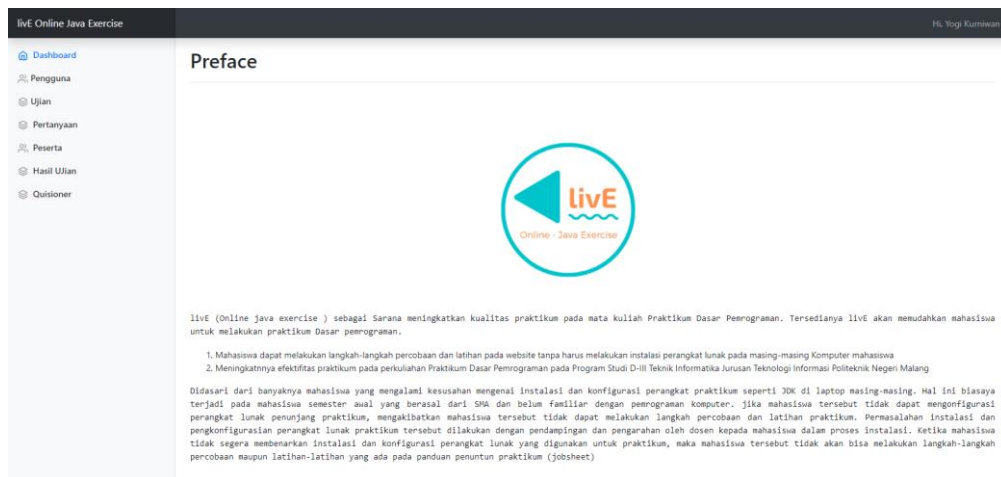

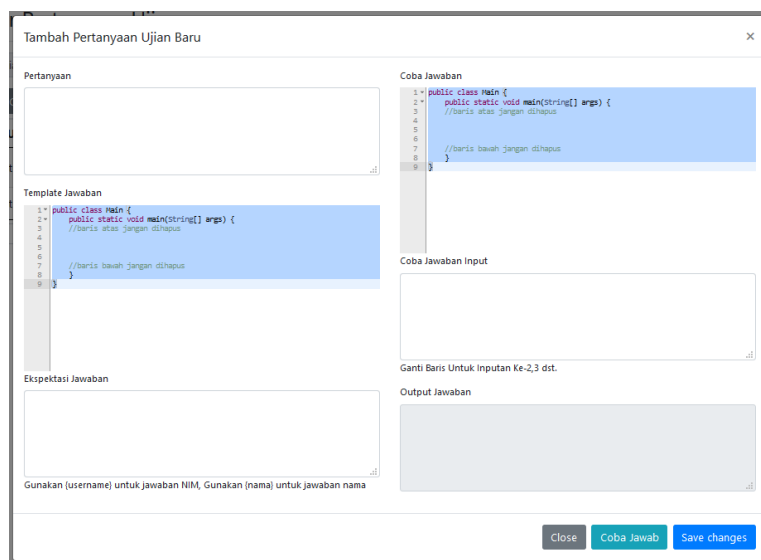**Figure 5.** Lecturer dashboard

Figure 6. Add question interface

Figure 5 is the starting page when the lecturer successfully logs in. Lecturer users can make improvements to user data, schedule exams, add and subtract test participants, add, and subtract questions on the exam. They can also review the results of exams that have been done by students, provide scores on each exam participant's answer, and provide specific questionnaire questions on each exam.

Figure 6 is the interface when the lecturer adds new questions for both lab experiments and online exams. Experiment's command or question's description typed in the questions section. The answer template will always prefix with the Main class name. livE only execute the Main class. Every change on the answer template editor will be changing The Try Answer's editor. It makes easy for lecturers to try to answer the questions given. The Answer Expectations section contains the answers that the livE (Online - Java Exercise) considers correct. This section highly recommends being filled so that the assessment can be done automatically. Try Answer's Editors section can be used by the lecturer to verify the questions and answer templates that have been prepared. If there is input for the code, the try input answer section can be fulfilled.

Figure 7. Exam/ practicum interface

For student users, the features provided are editing user data, viewing exams registered by lecturers to students, and seeing the exam scores. Figure 7 is the interface for the exam/practicum page. On the test page, there is time remaining in the top right corner. Below the remaining time, there are the question numbers from the exam. The active question number will be green and the other question numbers will be blue.

Discussions

This section discusses system testing performed on livE systems. System testing carried out in this study is functional testing and usability testing. Functional testing or BlackBox testing is one of the software testing methods. Functional testing is performed to ensure the product behaves according to functional requirements [14]. The results of functional testing in this study are shown in Table 1. Based on Table 1, it can be seen that the livE system has provided the expected results and has been running properly.

After the functional testing is complete, the next step is the usability test. A usability test in this study is done by giving a questionnaire to system users. livE users who fill out the questionnaire divided into two users, namely lecturers who teach Basic Programming courses and students who take fundamental programming courses. Lecturers need to fill in ten questions and were filled in by eight respondents, then the questionnaire to students was filled in by 40 respondents with six questions. Table 2 is the list of questions for the lecturer then Table 3 is the list of questions for students. User satisfaction ratings are measured using the Likert scale method [16]. In this study, the Likert scale used is five scales as shown in Table 4.

Table 1. Functional testing results

No.	Testing	Scenario	Status
1.	Login	The system has successfully received the data entered in the login menu. The data in the form is a username and password so that the user can access the system.	succeed
2.	Logout	The system has successfully accepted the logout process so system user can log out of the system.	succeed
3.	Update user data	The system displays user data changes according to user input.	succeed
4.	Add list of exams/ job sheet	The system displays the "Add a list of exams or job sheet" interface then the system will save input data and display that data. The system can also display a list of completed exams or job sheets.	succeed
5	Add questions	The system displays an interface for adding exam questions/job sheet questions then the system will save the user's input data and display it.	succeed
6	Add participants	In the selected exam/job sheets, the system can display a list of students who will add to the exam/job sheets. Then the system will save the list of participants.	succeed
7	Exam results	The system can display the predicted score by the system. Lecturers can make changes to that score. When the lecturer changes the score, the system will display the score according to the input.	succeed
8	Add questionnaire questions	The system can display the "add questionnaire" interface then the system will display the saved questions.	succeed
9	Start exams/ job sheet	The system displays the entire list of available exams/job sheets. The system will display exam questions when students press the start button.	succeed
10	Start coding	The system can display exam questions. The user can change the program code in the "write code" textbox.	succeed
11	Time-out	When the time for solving the questions runs out, the system automatically closes the questions. Then the system will redirect the user to the questionnaire page.	succeed
12	Fill in questionnaire	The system will display a list of questions and save the questionnaire answers.	succeed
13	Exam score	The system will display the score based on the test conducted by the user.	succeed

The questionnaire is processed using a Likert scale by calculating the percentage (%) index formula in Equation (1). Y is the highest Likert score multiplied by the number of respondents. Then the calculation of the interval using the formula in Equation (2) to classify response categories from users.

$$Percentage\ (\%)Index\ =\ \frac{SumTotal\ of\ the\ Product}{Y}\ x\ 100 \tag{1}$$

$$Interval\ =\ \frac{100}{SumTotal\ of\ Skor\ (Likert)} \tag{2}$$

Table 2. List of questions for lecturers

No	Questions
1	Is the "update user data" features easy to use to view data or make changes to user data?
2	Is the "Add list of exams/job sheets" feature on the livE System (online java exercise) easy to use?
3	Is the "Add questions" feature of the livE System (online java exercise) easy to use?
4	Is the "Add participants" feature on the livE system (online java exercise) easy to use?
5	Is the "Exam results" feature suit the lecturer's needs?
6	Is the "Add questionnaire " feature of the livE System (online java exercise) easy to use?
7	Overall, Is the livE system comfortable to use?
8	Overall, Is the livE System (online java exercise) easy to operate?
9	Overall, can this application be useful for the teaching team lecturers?
10	In your opinion, does the livE system (online java exercise) meet the student's requirement for Lab and Online Test?

Table 3. List of questions for students

No	Questions
1	Is the "exams/job sheets" feature on the livE system easy to use?
2	Can you easily code the java programming language using livE system?
3	Is the livE system help you in the Practice programming skills using java language?
4	Is the livE system meet your requirement?
5	Is the livE allow you to Practice programming skills using java language wherever you are?
6	Overall, is the livE easy to operate?

Table 4. Likert scale

Variable	Response Categories
1	Strongly disagree
2	Disagree
3	Neither agree nor disagree
4	Agree
5	Strongly agree

The interval value from the calculation using Equation (2) is 20 resulting in response categories shown in Table 5. Furthermore, Equation (1) produces a percentage usability testing. Lecturer users give 92.75%, student users give 86.58%. So, it can be concluded by Table 3 that the lecturers and students "totally agree" with the livE system.

Tabel 5. Classification based on interval value

Percentage	Response Categories
0% - 19.99%	Strongly disagree
20% - 39.99%	Disagree
40% - 59.99%	Neither agree nor disagree
60% - 79.99%	Agree
80% - 100%	Strongly agree

Conclusion

Students can use the "livE" to practice coding and also do exams in real-time. Lecturers can use the "livE" system too. Lectures can carry out online exams, which require students to practice coding using Java programming language directly. Based on the functional testing, the livE system can run according to the scenario. Meanwhile, usability testing shows that users "strongly agree" based on the user's experience interacting with the system. In the class sessions, the lecturer often wants to be able to identify student difficulties in coding. In computer programming, there are three kinds of errors: syntax errors, runtime errors, and logical errors. So, for further research, a livE system will be developed in which lecturers will get syntax errors/logic errors information.

References

[1]   K. A. T. Indah and P. G. Sukarata, "Penjadwalan perkuliahan dengan metode metaheuristic ant colony optimization studi kasus Politeknik Negeri Bali," *Matrix: Jurnal Manajemen Teknologi dan Informatika*, vol. 9, no. 2, pp. 74–82, 2019.

[2]   C. A. Cholik, "Pemanfaatan teknologi informasi dan komunikasi untuk meningkatkan pendidikan di Indonesia," *Syntax Literate: Jurnal Ilmiah Indonesia*, vol. 2, no. 6, pp. 21–30, 2017.

[3]   I. G. P. F. P. Sudhana, I. K. Suwintana, A. D. Yulianthi, and I. G. A. O. Sudiadnyani, "Pengembangan aplikasi internet banking koperasi simpan pinjam berbasis web," *Matrix: Jurnal Manajemen Teknologi dan Informatika*, vol. 9, no. 3, pp. 89–95, 2019.

[4]   B. Berlilana, R. Utami, and W. M. Baihaqi, "Pengaruh Teknologi Informasi Revolusi industri 4.0 terhadap perkembangan UMKM sektor industri pengolahan," *Matrix: Jurnal Manajemen Teknologi dan Informatika*, vol. 10, no. 3, pp. 87–93, 2020.

[5]   D. A. Fitri, E. Rohadi, and E. Ekojono, "Optimasi biaya dan waktu jalur angkutan kota (angkot) Malang dengan metode ant colony berbasis perangkat android," *JIP (Jurnal Informatika Polinema)*, vol. 3, no. 1, p. 20, 2016.

[6]   M. Hani'ah, C. S. K. Aditya, A. Harto, and A. Z. Arifin, "Cortical bone segmentation using watershed and region merging based on statistical features," *Jurnal Ilmu Komputer dan Informasi*, vol. 8, no. 2, pp. 76–82, 2015.

[7]   A. Ririd, M. Hani'ah, and I. Putri, "Analisis pertumbuhan balita menggunakan algoritma kmeans++ untuk mengetahui resiko obesitas," *SENTIA 2020*, vol. 12, no. 1, 2020.

[8]   K. Karsid, A. W. Ramadhan, and R. Aziz, "Perbandingan kinerja mesin penetas telur otomatis dengan menggunakan kontrol on-off dan kontrol PWM," *Matrix: Jurnal Manajemen Teknologi dan Informatika*, vol. 8, no. 1, pp. 1–5, 2018.

[9]   Y. Kurniawan and A. Tohari, "Pengembangan metode pengamanan berkas memafaatkan pewarnaan graf," *JUTI: Jurnal Ilmiah Teknologi Informasi*, vol. 14, no. 2, pp. 190–197, 2016.

[10]   M. Guo, T. Chai, and K. Qian, "Design of online runtime and testing environment for instant Java programming assessment," in *2010 Seventh International Conference on Information Technology: New Generations*, 2010, pp. 1102–1106.

[11]   A. N. Kumar, "Data space animation for learning the semantics of C++ pointers," in *Proceedings of the 40th ACM technical symposium on computer science education*, 2009, pp. 499–503.

[12]   N. Funabiki, Y. Matsushima, T. Nakanishi, K. Watanabe, and N. Amano, "A Java programming learning assistant system using test-driven development method," *IAENG International Journal of Computer Science*, vol. 40, no. 1, pp. 38–46, 2013.

[13]   T. A. Kurniawan, "Pemodelan use case (UML): Evaluasi terhadap beberapa kesalahan dalam praktik," JTIIK: *Jurnal Teknolologi Informasi dan Ilmu Komputer*, vol. 5, no. 1, pp. 77–86, 2018.

[14]   S. Nidhra and J. Dondeti, "Black box and white box testing techniques - A literature review," *International Journal of Embedded Systems and Applications*, vol. 2, no. 2, pp. 29–50, 2012.

[15]   I. S. Junus, H. B. Santoso, R. Y. K. Isal, and A. Y. Utomo, "Usability evaluation of the student centered e-learning environment," *The International Review of Research in Open and Distributed Learning*, vol. 16, no. 4, pp. 62–82, 2015.

[16]   B. Klug, "An overview of the system usability scale in library website and system usability testing," *Weave: Journal of Library User Experience*, vol. 1, no. 6, Apr. 2017.

Web and Android-based application for monitoring tuberculosis (TB) patients in Kediri City

Toga Aldila Cinderatama [1]*, Ashafidz Fauzan Dianta [2], Fery Sofian Efendi [3], Kunti Eliyen [4]

[1,2,3,4] *PSDKU Polinema di Kota Kediri, Jawa Timur, Indonesia*

*Corresponding Author: toga.aldila@polinema.ac.id

Abstract: Tuberculosis (TB) is a chronic disease that is still a public health problem globally, including Indonesia, due to its easy transmission. Treatment for TB sufferers consist of several drug combinations that are intended to eradicate germs. For TB sufferers, the key to successful treatment is the patient's compliance with taking medication every day. The lengthy treatment time is usually at least six months allowing non-adherence to taking the medication by the patient. If not treated properly, there will be a risk of disease complications, such as tuberculosis bacteria resistant to drugs, making TB treatment more difficult. In this study, an Android-based was built to remind TB sufferers to take their medication during the treatment process. In addition to the mobile-based application, there is also a web application used by drug drinking supervisors (PMO; *Petugas Minum Obat* in Indonesia) in monitoring TB patients, where the application can also view patient compliance statistics in taking medication and historical data on TB patients' medical treatment. After completion and development, the application will be given to PMO officers and patients to be tested. It is hoped that the application can help the TB treatment process become more effective and prevent treatment failure from the implementation.

Keywords: *Android application, Drugs, TBC sufferers, Tuberculosis, Web Application*

How to Cite: T. A. Cinderatama, A. F. Dianta, F. S. Efendi, and K. Eliyen, "Web and Android-based application for monitoring tuberculosis (TB) patients in Kediri City," Matrix: Jurnal Manajemen Teknologi dan Informatika, vol. 11, no. 1, pp. 11–25, 2021.

Introduction

Tuberculosis (TB) is a chronic disease that is still a public health problem globally, including Indonesia, due to its easy and fast transmission. Worldwide, about 10 million people fall ill with tuberculosis (TB) each year. Figure 1 describe the TB incidence for countries with at least 100,000 incidents, this disease is spreading mostly in Asia and Africa Ocean, TB is one of the top 10 causes of death. The main reason is an infectious agent (Mycobacterium Tuberculosis). This TB disease is at the top of the HIV / AIDS ranking in the list of deadly diseases. The condition can affect anyone anywhere, but most people with TB are adults (about 90%). The male and female ratio is 2:1, and the national case rates vary from less than 50 to more than 5,000 per year, one million populations per year. Nearly 90% of cases each year are in 30 high TB countries. Globally, it is estimated that 1.7 billion people are infected with Mycobacterium Tuberculosis and at risk of developing the disease [1].

Treatment for TB sufferers can be done with several drug combinations that are intended to eradicate germs. For TB sufferers, the key to successful therapy is patient compliance with taking medication every day. The lengthy treatment time is usually at least six months, namely category one TB treatment consisting of two phases: an intensive phase for two months and a follow-up phase for four months. This allows for non-adherence to taking the medication by patients with the long duration of the treatment. If not treated properly, there will be a risk of disease complications, such as tuberculosis bacteria resistant to drugs so that TB treatment will be more difficult [2]. One of the health office's duties and functions is to carry out monitoring, evaluation, and reporting on the implementation of services in the health sector. In the case of

intensive TB patient treatment, a drug drinking supervisor will continue to supervise TB patients to take their medication regularly.
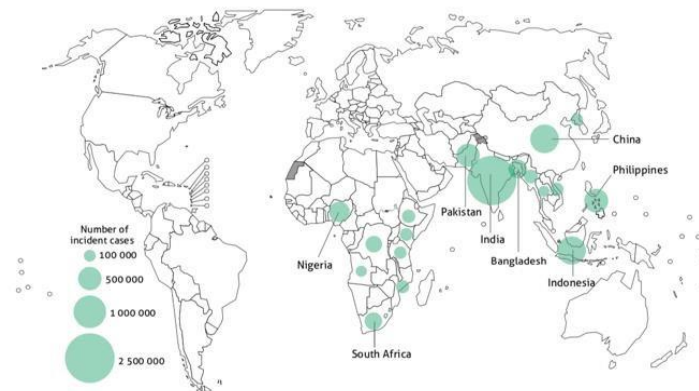

Figure 1. TB incidence estimates in 2018, for countries with at least 100,000 incident cases

During the process, the supervisor will record the patient's medication time, and there will be a history of recording the patient's prescription. The drug drinking supervisor then reports what has been manually recorded to the local community health centre, which will then be informed by the community health centre to the local health officer where the recapitulation is carried out. The information will be reported in the final stage to the head of the health service.

From the description above, the key to successful treatment in TB patients is the patient's compliance with taking medication every day. The lengthy treatment time is usually at least six months allowing non-adherence to taking medicines by the patient. If not treated properly, there will be a risk of disease complications, such as tuberculosis bacteria that are resistant to drugs, so that TB treatment will be more difficult. A tool is needed in the form of an Android-based Tuberculosis (TB) Patient Treatment Monitoring Application and a Website at the Kediri City Health Office to remind TB sufferers to take medication regularly. Supervisory officers (PMO) are taking medication in monitoring TB patients where the application can also be seen patient adherence statistics in taking medication and historical data on TB patients in medication treatment. With this application system, it can reduce the number of TB treatment failures and decision making by stakeholders as mitigation or prevention efforts can be done more quickly and accurately.

Several studies that have relevance to the development of the Tuberculosis (TB) Patient Treatment Monitoring Application include the research with the title "Design of TB Treatment Compliance Application" [3]. This study aims to develop the mHealth PATUH OAT application; an android-based application is expected to be a solution by inviting family/friends, health workers (doctors, nurses, TB officers), health cadres, peer educators and even psychologists to support TB patients in monitoring and to motivate their treatment so that can increase the success rate of treatment. Meanwhile, M. I. Musa conducted research in 2019 entitled "Monitoring Application for Adult TB Patients Based on Android". This study aims to create a web-based system for storing data and displaying TB patient information in real time at the patient's treatment area. Hence, the treatment of these TB patients is more comfortable to monitor their patients and can help TB patients adhere to taking medication [4]. In 2018, F. A. Putri conducted research on "Analysis of Acceptance Attitude Analysis of TB Suspect Screening Information System Using an Android Application at the Tanah Kali Kedinding Surabaya Community Health Centre" where she analysed the acceptance attitude of the TB suspect screening information system using the Android application at Community health centre Tanah Kali Kedinding Surabaya. This research was conducted at Tanah Kali Kedinding Public Health Centre, Surabaya City from April to June 2018. The study population was all health workers and health cadres in the locus [5]. Another research reported by A. Wardatul in implementing an information system in the monitoring process for mental illness patients, where it is expected to assist in implementing mental health monitoring by adequately managing and storing data [6]. R.H. Kamagi and L. O. A. Rahman in 2020 conducted a study entitled "Use of M-Health / Smartphone Applications Treatment Compliance in Tuberculosis Patients". The purpose of this study was to see the level of usefulness of the M-Health / Smartphone application on treatment adherence to tuberculosis patients [7]. An online

street vendor guidance and monitoring application was developed by S. A. Asri et al. This application was expected to overcome distance and time constraints in the guidance process and assist the coordinator of street vendors to help better management. Applications was created using the waterfall method [8]. I. K. Suwintana et al. were develop an Android-based mobile teller LPD application; the facilities provided in this application are deposit transactions, cash withdrawals, savings, loan and time deposit statements, and teller daily transaction reports [9]. Meanwhile D. Abel et al. presented a system that integrating Android-based mobile application with a selected open source EMR system to create appointments with medical practitioners. The Android application allows the patient and the medical practitioners to manage appointments through the electronic messaging facility and the application will send reminders when the appointed time is approaching [10]. A combination of web and mobile application was developed by T. D. Indriasari et al. for mapping disaster volunteer's position in Indonesia to detect the position of the volunteers in order to improve disaster management services [11]. A mobile application for monitoring also was developed by Ji-Eun Lee et al. namely "Diet-A for Dietary Intake Through Realtime Feedback". This mobile application examines whether Diet-A could be used to monitor dietary intake among adolescents [12]. Another mobile application for disease surveillance was developed by Rajvanshi et al. about solution for community health-workers (SOCH), it was an Android native application developed using android SDK and web-based tool using MVC.net framework. The aim of this application was for disease surveillance, human resources management, and supply chain management for malaria elimination efforts throughout the country [13]. Other mobile apps have been developed to support the main web application [15],[16].

Methodology

Data Collection Methods

The method of collecting data or information used in this study as follows:

1. Interview
    The interview method is carried out by asking questions to related parties. In this case, the speakers were the head of the Prevention and Control of Communicable Diseases (P2PM) section and the Sukorame Community Health Center's head. Based on the interviews that have been conducted, it can be concluded that currently, the health office needs a monitoring system for the treatment of TB patients and can be accessed anytime or anywhere using internet technology. The system that is currently running is still using the manual method, namely recording treatment information on paper and face to face monitoring. This is considered less effective and efficient if we look at the availability of existing technology. That is way, it is necessary to create an application to monitor TB patient treatment that can increase effectiveness and efficiency.
2. Literature Review
    A literature study is a method of data collection carried out with search, read, and collect documents as references such as books, articles, and final project literature related to selected topics related to the object of research. So it gets useful theoretical overview helps analyze and design as well as writing this report.

System Development Methods

This study implements the waterfall method [13] which consists of several stages as shown in Figure 2, including system requirements analysis, system design, writing program code, testing programs, and implementing programs and maintenance which will be explained as shown in Figure 2.

System Requirements Analysis

In this stage is an analysis of system requirements. Data collection was carried out by conducting interviews or literature studies. Interviews were conducted with several people, namely the head and staff of the Prevention and Control of Infectious Diseases Kediri City's Health

Office and Sukorame Community Health Center officers. Also, they conducted a literature study that was described in previous research. This stage will produce a user requirements document, or it can be said as data related to the user's wishes in making the system. This document will be a reference for the analysis system to translate into a programming language.
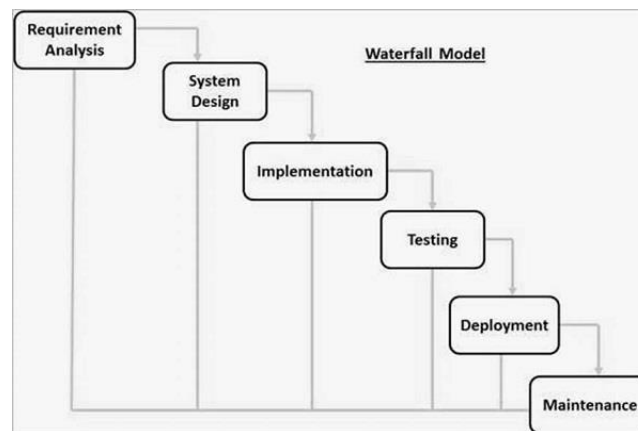

Figure 2. TB incidence estimates in 2018, for countries with at least 100,000 incident cases

System Design

The design process will translate the requirements into a software design that can be estimated before coding is made. This process focuses on data structures, software architecture, interface representations, and procedural details (algorithms). The system design stage will produce a document called a software requirement. Programmers will use this document to carry out system creation activities.

Writing Program Code

Coding is the translation of designs in a language that can be recognized by computers performed by the programmer who will translate the user's transactions. This stage is the real stage in working on a system, in the sense that will maximize computer use. An application was developed in the form of a website used by administrator, health service officer and drug drinking supervisor, and a mobile application operated by drug drinking supervisors and patients. After the coding is complete, testing will be carried out on the system that was created earlier. The goal of testing is to find errors in the design and then fix them.

Program Testing

This stage is final step in making a system. After analyzing, designing, and coding the system that has been used by the user. In this case, system testing is carried out by Kediri City's health service officers, community health service officers, and drug drinking supervisors.

Maintenance

Software requires continuous maintenance to keep up with developments in hardware technology. Treatment is also carried out to meet the needs felt by supervisors and TB patients.

Functional Requirement

Functional requirements are system process requirements that run according to user functions of the system [14]. For web application, this system has three users, namely system administrator, health service officer and drug drinking supervisor. While in the mobile application has two users: drug drinking supervisor and TB patients.

Table 1. Functional requirement

User	Requirements
Administrator (web)	- Manage users data - Manage community health center data
Health service officer (web)	- Manage drug drinking supervisor - Assign patient to drug drinking supervisor
Drug drinking supervisor (web)	- Submit patient data - Set patient medication schedule
Drug drinking supervisor (mobile)	- Insert/Update patient medication history
TBC patient	- View treatment information - Get reminder to drink drugs

System Architecture

In this research works, we develop web and mobile-based application for monitoring TB patient treatment which has system architecture as shown in Figure 3. The application is divided into web applications and mobile applications. There are three user levels in the web application namely, The System Administrator, Kediri City Health Centre Officers, and Drug Drinking Supervisor. Whereas in the mobile application, there are two user levels, namely Drug Drinking Supervisor and TB patients.
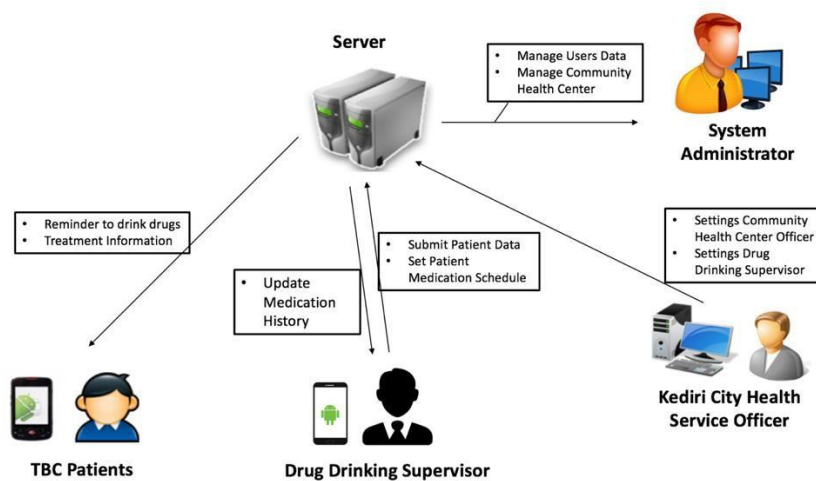
Figure 3. System architecture

In the web-based application, the system administrator has right and authority to add data to the community health center and manage users. The community health center officer is authorized to add user as drug drinking supervisor and assign patients to individual drug drinking supervisors. In the mobile-based application, there are two user levels, namely Drug Drinking Supervisors and TB Patients. Drug drinking supervisors have the authority to set the patient's medication schedule and report whether the patient is taking medication or not and update the patient's history. Meanwhile, the patient user has a reminder to take medication and treatment information.

Use Case Diagram

Designing a use case diagram is a process where a diagram shows the relationship between the actors and the use case is used for the analysis and design of a system. Use case diagram

Application for Monitoring Treatment of Tuberculosis (TB) Patients based on Android and the website explain the activities that each user can carry out. In this application, the administrator can manage user data and community health center data.
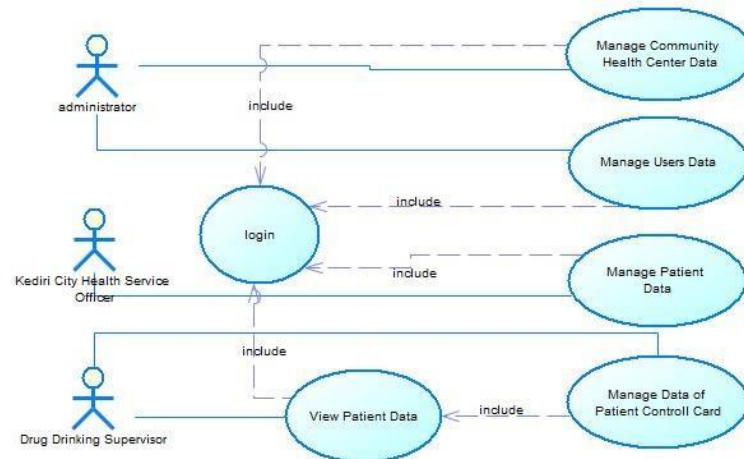
Figure 4. Use case diagram

Meanwhile, the Kediri Health Service officer can manage patient data and can manage user data especially for community health center admin. Drug drinking supervisor user can view patient data and manage patient control card data as illustrated in Figure 4.

Entity Relationship Diagram

In an application, Entity Relationship Diagram (ERD) is the underlying structure of a database system and is used to illustrate the data model concept that happens to the system that is being built. In research, there are relations between table namely users, drug drinking supervisor, patients, control card, address, and community_health_center. Figure 5 illustrated the relationship between the tables, which provides an overview of each system's relationship processes.

Figure 5. Entity relationship diagram of TB application

Results and Discussions

The results of the development of a web and Android-based tuberculosis (TB) patient treatment monitoring application are described in the section below.

Results of Web Application

Administrator Page

The initial login page display for all user levels is shown in Figure 6. When the username and password are wrong, it will display the warning. Figure 7 shows the dashboard of the admin. The page will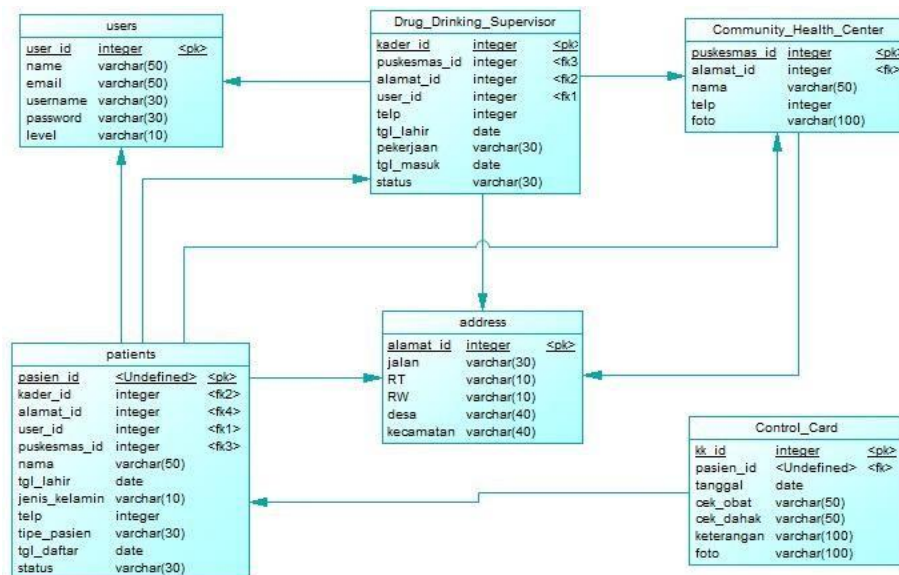 be displayed when successfully logged in as admin. As illustrated in the Figure 7, there are three menu that consist of Dashboard, Community Health Center Menu, and the User Menu.
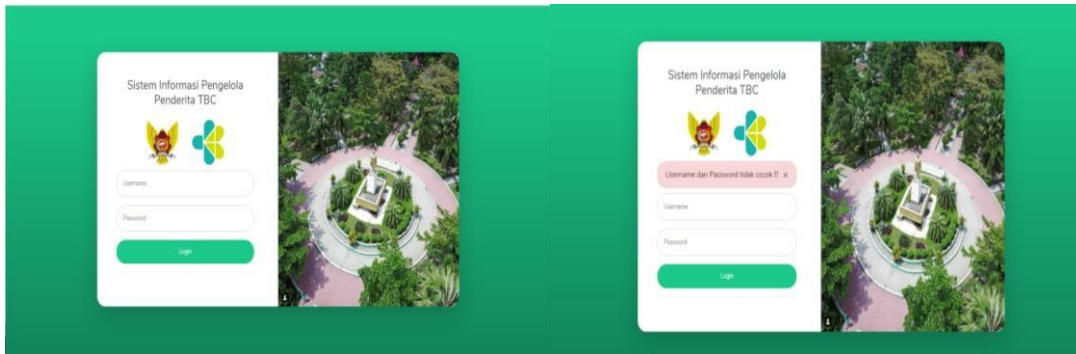
Figure 6. Login page
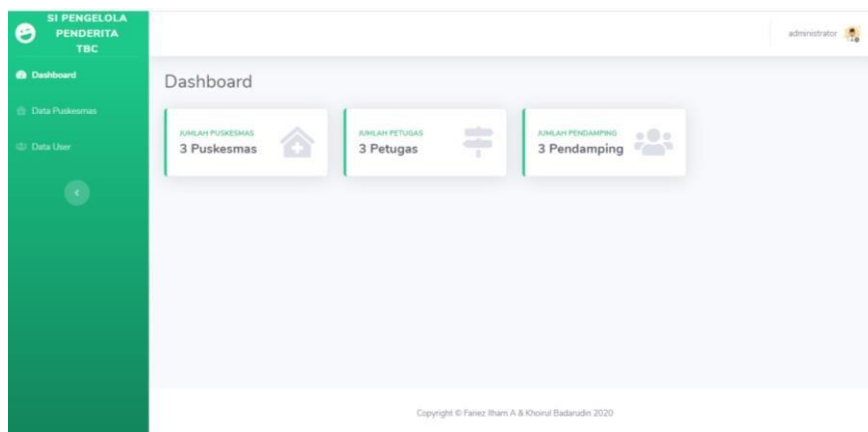
Figure 7. Home of administrator page

Community health center data management page are located on the Community Health Center Data Menu as shown in Figure 8. In this menu, the administrator can do Create, Read, Update, Delete process for community heath center data. The page for adding community health center data is shown in Figure 9. Meanwhile in this page also possible to edit or change one of the community health center data. Figure 10 shows the User Data Page on the User Data Menu. In this menu, the administrator can view and manage the data of Kediri City Health Service User. The additional data of the health officer is managed in the User Menu which is illustrated in Figure 11.
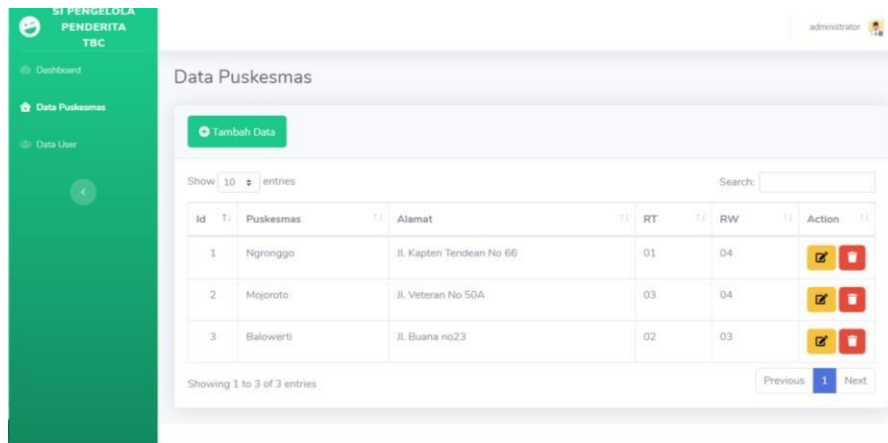
Figure 8. Community health center data management page
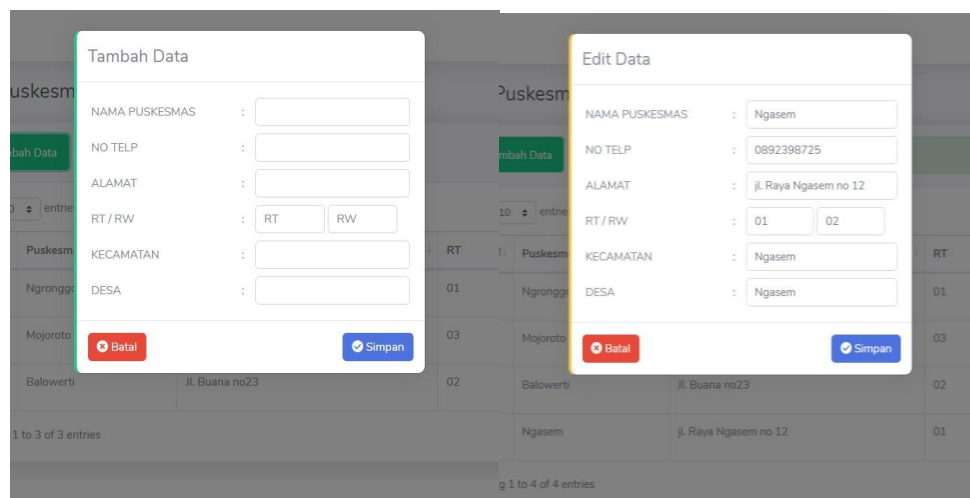
Figure 9. Add and edit community health center data
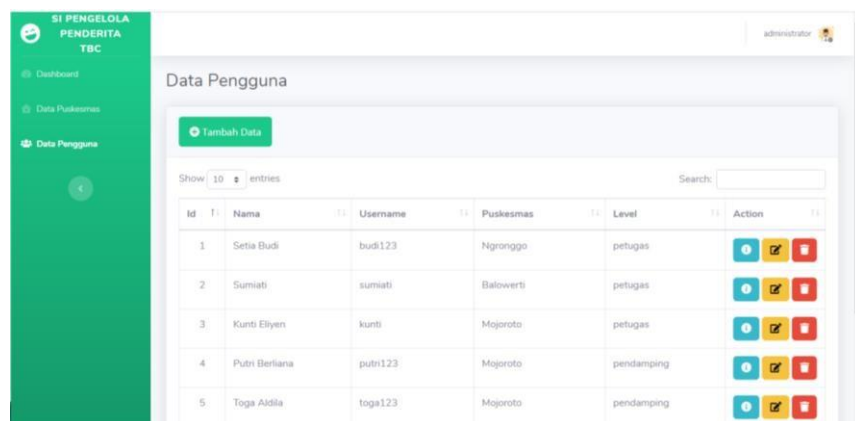
Figure 10. Health service user data page
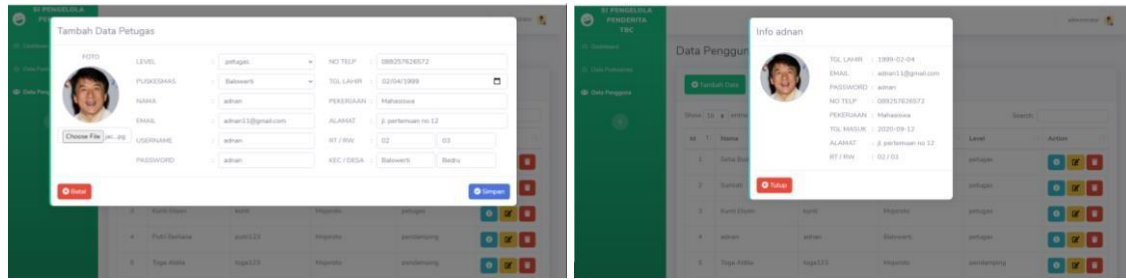
Figure 11. Add and details of Kediri City health service user data

Drug Drinking Supervisor Page

Figure 12 is a page when someone successfully logged in as a drug drinking supervisor and will display the dashboard. Figure 13 shows the Patient Data Management Page on the Patient Data Menu. Here they can view which TB patients who needs to be treated. When a user opens the Patient Data Page and select the patient details button, the application will display the patient details and control card data. This process is illustrated in Figure 14.
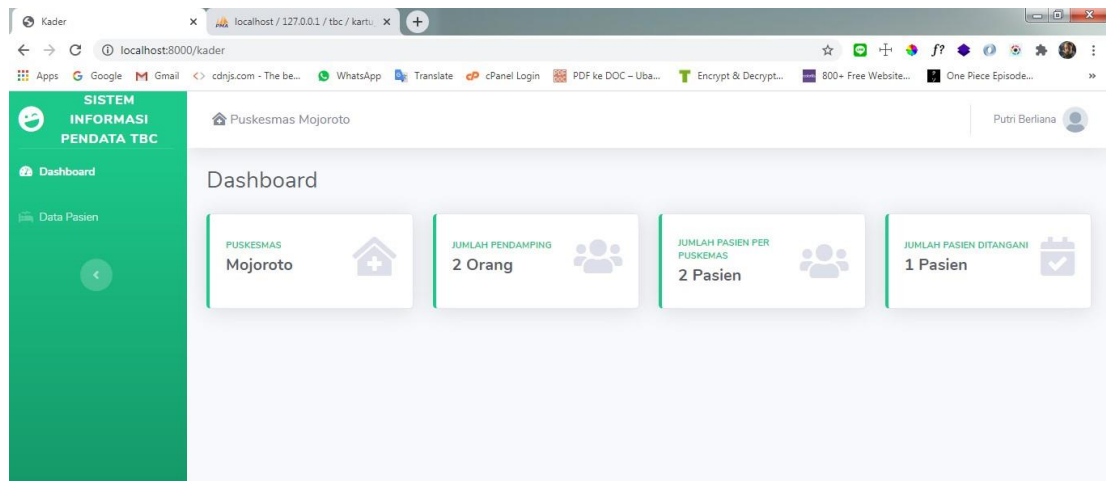
Figure 12. Drug drinking supervisor dashboard page
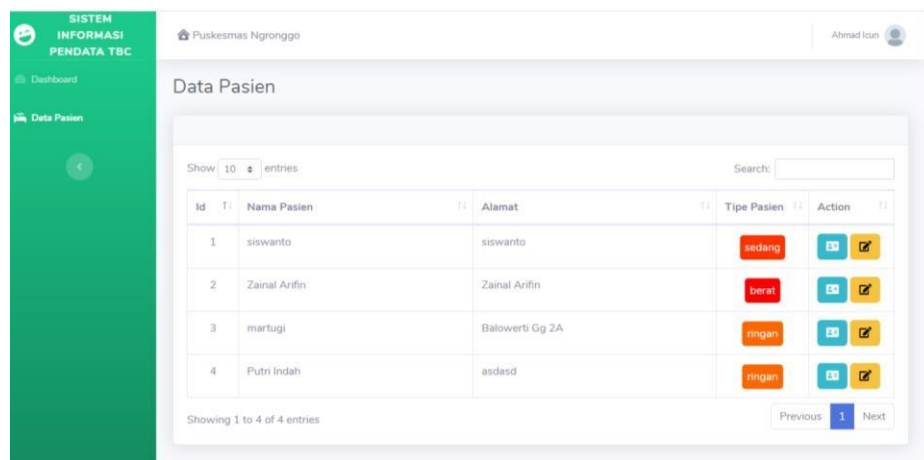
Figure 13. Page management of patient data on drug drinking supervisor accounts
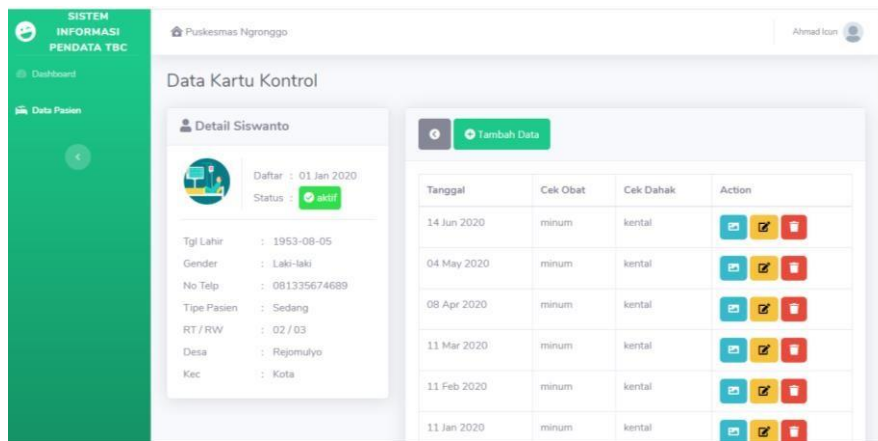
Figure 14. Patient detail page and control card

Figure 15 displayed if the drug drinking supervisor want to add a control card for each patient. This form will be displayed if the supervisor selects the image button, which will later display the control card's image and description.
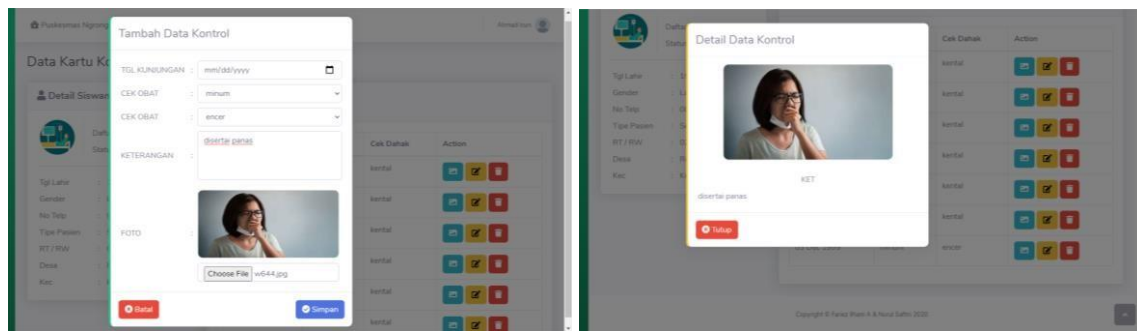
Figure 15. Add patient control data

Results of Android Application

A mobile application is developed in this research to support the main web application which has two user level: Drug Drinking Supervisor and Patient.

Drug Drinking Supervisor Page

There are four features for drug drinking supervisor as user to take medication: login, view patients, add control cards, and view the patient's medication history. Drug drinking supervisor (PMO) login is an access feature to manage the features provided for PMO. Here, Figure 16 is displayed the login form for PMO.

Figure 16. Drug drinking supervisor (PMO) login page

After drug drinking supervisor fills in the username and password form, it will go to the dashboard display and patient list as shown in Figure 17. Drug drinking supervisor can see a list of patients who are being monitored, then the Patient Menu has a patient list display. In the Patient Menu, there is a patient list and the profiles of the patients treated by the supervisor. Drug drinking supervisor also carries out the process of adding a control card by entering the Patient Menu. After selecting the patient who will take the drug by long clicking on the selected patient, a modal form pop up window will appear. After filling in all the forms then click add, a notification will appear successfully adding. The process of the additional data of control card shown in Figure 18.
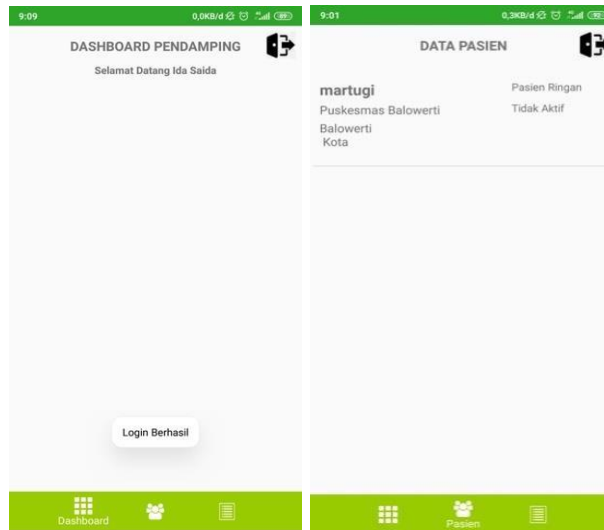
Figure 17. Drug drinking supervisor dashboard and patient list
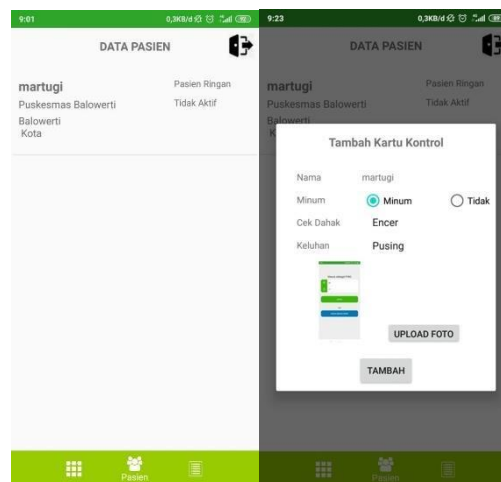
Figure 18. Add control card

On the History of Medication Page, the patient's history when taking medication based on the latest date is listed, as shown in Figure 19.

Figure 19. Patient's medication history

Patients Page

In the Patient Page, there is a feature that is to see the history of taking medication from the Patient and an alarm reminder to take medication for patient. In the Patient Login feature, the form of this feature will be displayed as shown in Figure 20.
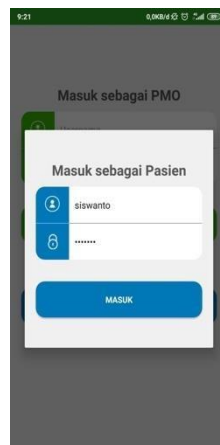
Figure 20. Patient Login

After login, the patient can see the history of taking medication as shown in Figure 21. Beside that, using the Medication Reminder Alarm as illustrated in Figure 22, the patients will get an alarm to remind them to take medication every day, for example at 7 AM. At this certain time, the reminder alarm will sound and warn that patient must take medication. The implementation in mobile application is shown in Figure 22.

Figure 21. History of taking medicine
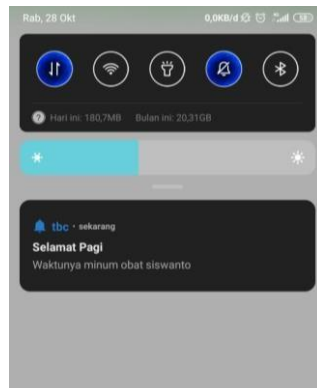
Figure 22. Medication reminder alarm

Discussions

Black box testing is used to determine whether the application features are well developed or not by trying all the available features, as shown in Table 2.

Table 2. Blackbox testing result

No	Scenario	Expected Result	Valid / Not Valid
1	Open the web application	The application shows the login screen	Valid
2	Show health service officer menu dashboard	Health officer menu dashboard successfully displayed	Valid
3	Show community health centre data	Menu Community health centre successfully displayed	Valid
4	Delete community health centre data	The selected data can be removed from the database.	Valid
5	Show drug drinking supervisor menu dashboard	Health officer menu dashboard successfully displayed	Valid
6	Open the Android application	The application shows the login screen	Valid
7	Show drug drinking supervisor page	Menu drug drinking supervisor successfully displayed	Valid
8	Show patient data	Patient data successfully displayed	Valid
9	Add control card data	Successfully insert data to the database	Valid
10	Show history of taking medicine	History of taking medicine data successfully displayed	Valid
11	Show medication reminder alarm	Medication reminder alarm successfully displayed	Valid

As we can see in the Table 2, all functional requirements can be fulfilled in the application and run well, for example, the essential functions of data management for the community health center and user data, then the user who takes medication can see patients who need to be treated and can add a control card.

Conclusion

This research was successfully built an Android-based Tuberculosis (TB) Patient Treatment Monitoring Application and a Website Application at the Kediri City Health Office. There are three user levels on the website application: admin, health service officer, and drug drinking supervisor. There are two levels of users in the mobile application: drug drinking supervisor and TB patient users. All the functions of the application are running well and fulfilled user requirements. Besides, this application helps health officers work more effectively and efficiently to monitor TB patients' treatment. "test"

Acknowledgments

References

[1]   WHO. Global Tuberculosis Report. 2019. [Online] Available: https://www.who.int/tb/publications/global_report/en.

[2]   Depkes RI, Pedoman Nasional Penanggulangan Tuberkulosis., Jakarta: Depkes RI, 2007.

[3]   F. Yunita, R. I. Veronica, L. Ratnasari, A. Suhendra, and H. Basuki, "Rancang bangun aplikasi kepatuhan pengobatan TBC," Jurnal Ilmiah Informatika Kedokteran, pp. 54-69, 2019.

[4]   M. I. Musa, Aplikasi Monitoring Untuk Pasien TBC Dewasa Berbasis Android. Yogyakarta: Universitas Islam Indonesia, 2019.

[5]   F. A. Putri, "Analisis Sikap penerimaan sistem informasi penjaringan suspek TB menggunakan aplikasi Android di Community Health Center Tanah Kali Kedinding Surabaya," Jurnal Keperawatan Muhammadiyah, pp. 13-20, 2018.

[6]   A. Wardatul, Rancang Bangun Sistem Informasi Monitoring Pengobatan Pasien Gangguan Jiwa Berbasis Web Pada UPT Puskesmas Pasar Usang. Diploma Thesis. Padang: Universitas Andalas, 2018.

[7]   R.H. Kamagi and L. O. A. Rahman, "Penggunaan aplikasi m-health /smartphone terhadap kepatuhan pengobatan pada pasien tuberkolosis," Jurnal Mitra Kesehatan, vol. 2, no. 2, pp. 36-48, 2020.

[8]   S. A. Asri, "Aplikasi monitoring praktek kerja lapangan secara online (studi kasus Jurusan Teknik Elektro Politeknik Negeri Bali)," Matrix: Jurnal Manajemen Teknologi dan Informatika, pp 53-58, 2017.

[9]   I. K. Suwintana, I. G. P. F. P. Sudhana, N. K. Hariyanti, "Pengembangan aplikasi mobile teller lembaga perkreditan desa berbasis Android," Matrix: Jurnal Manajemen Teknologi dan Informatika, pp. 59-66, 2018.

[10]   D. Abel, B. Gavidi, N. Rollings, and R. Chandra, Development of An Android Application for An Electronic Medical Record System in An Outpatient Environment for Healthcare in Fiji, Fiji: Software Foundation, 2015.

[11]   T. D. Indriasari, K. Anindito, E. Julianto, B. Pangaribuan, "A mobile and web application for mapping disaster volunteers' position in Indonesia," International Journal of Interactive Mobile Technologies, pp. 98-112, 2017.

[12]   J. E. Lee, S. Song, J. S. Ahn, Y. Kim, and J. E. Lee, "Use of a mobile application for selfmonitoring dietary intake: Feasibility test and an intervention study," Nutrients, vol. 9, no. 7, p. 748, 2017.

[13]   H. Rajvanshi, et al. "A comprehensive mobile application tool for disease surveillance, workforce management and supply chain management for Malaria Elimination Demonstration Project," Malaria Journal, vol. 20, no. 91, 2021.

[14]   W. W. Royce, "Managing the Development of Large Software Systems: Concepts and Techniques," In: Technical Papers of Western Electronic Show and Convention (WesCon), 1970.

[15]   Y. Watequlis, Y. Yunhasnawa, Y. Pramitarini, A. Setiawan, E. Rohadi, and P. Y. Saputra. "A proposed framework of campus-oriented online text messaging system," International Journal of Interactive Mobile Technologies, vol. 14, no. 16, pp. 194-209, 2020.

[16]   B. I. Ya'u, N. Salleh, A. Nordin, A. A. Alwan, N. B. Idris, and H. Abas, "A systematic mapping study on cloud-based mobile application testing," Journal of Information and Communication Technology, vol. 18, no. 4, pp. 485-527, 2019.

The uses of educational data mining in academic performance analysis at higher education institutions (case study at UNJANI)

Yulison Herry Chrisnanto [1]*, Gunawan Abdullah [2]

[1,2] *Universitas Jenderal Achmad Yani, Indonesia*

*Corresponding Author: *y.chrisnanto@gmail.com*

Abstract: Education is an important thing in a person's life, because by having adequate education, one's life will be better. Education can be obtained formally through formal institutions that constructively provide a person's abilities academically. This study aims to determine student performance in terms of academic and non-academic domains at a certain time during their education using techniques in data mining (DM) which are directed towards academic data analysis. Academic performance is delivered through the Educational Data Mining (EDM) integrated data mining model, in which the techniques used include classification (ID3, SVM), clustering (k-Means, k-Medoids), association rules (Apriori) and anomaly detection (DBSCAN). The data set used is academic data in the form of study results over a certain period of time. The results of EDM can be used for analysis related to academic performance which can be used for strategic decision making in aca-demic management at higher education institutions. The results of this study indicate that the use of several techniques in data mining together can maximize the ability to analyze academic performance with the same data source and produce different analysis patterns.

Keywords: educational data mining, academic performance, educational institution, data mining technique.

How to Cite: Y. H. Chrisnanto and G. Abdullah, "The uses of educational data mining in academic performance analysis at higher education institutions (case study at UNJANI)," Matrix: Jurnal Manajemen Teknologi dan Informatika, vol. 11, no. 1, pp. 26–35, 2021.

Introduction

A person's academic ability can usually be measured by a measure of intelligence known as the intelligence quotient (IQ), however, the level of IQ does not correlate with a person's level of success. There is a weak positive correlation between IQ and academic achievement. Various dimensions of emotional intelligence were found to be predictors of academic success [1].

Educational Data Mining (EDM) is an application in data mining and statistics to form infor-mation from a specific educational area, such as a school or college. EDM refers to tools and techniques for automatically extracting meaning from a large repository of learning activities in an educational environment [2]. The techniques used depend on the required data analysis. The Association Rule technique can be used to evaluate student behavior. K-Means Clustering can be used to find the best centroid in student data such as attendance, GPA, final grades, and others. Meanwhile, the Rule Based Classification (RBC) technique can also be used to extract the rela-tionship between attributes from the dataset and class labels [2]. EDM is an analysis mechanism related to educational data mining to find out interesting patterns and knowledge in educational organizations [3].

Student academic performance will determine the level of success in completing the study according to the required academic load. The education system based on semester credit units (SKS) is designed to make it easier for students to manage the learning process independently. However, there are still many students who have not met the required academic performance. In the case study in this study, UNJANI determined a target of 80% of graduation on time, but in 2016-2019, the average graduate on time from students averaged 68.5% [4][5]. This indicates that the learning process carried out has obstacles. The ability of education managers in

analyzing student performance is still limited to using the data on the accumulated results of the course scores obtained by students at a certain time.

This study aims to use data mining techniques to explore the heaps of academic information that are already owned to become knowledge in the form of analysis results that can support strategic decision making related to student academic performance. The data mining techniques used will be integrated into one data mining system for academic purposes, this system is known as Educational Data Mining (EDM).

Related Work

Educational Data Mining (EDM) is a mechanism for the use of interdisciplinary knowledge that ap-pears in research areas related to the development of methods for exploring data originating from an educational context with a computational approach to analyzing educational data, for studying educational questions [6]. Various techniques used in EDM have emerged over the last few years. Several techniques in general have similarities with the use of data mining in other domains be-sides education. There are 4 (four) main method classes that are very often used in EDM, including: (a) Prediction models, (b) Structure discovery, (c) Relationship mining, and (d) Discovery with models [7].

Using EDM in higher education institutions can improve the teaching and learning process. EDM, is useful in many different areas of higher education including identifying students who are at risk of failure, identifying prioritized learning needs for specific groups of students, increasing graduation rates, effectively assessing institutional performance, maximizing college resources, and optimizing curriculum reform [8]. Based on the results of 402 studies, it was found that certain EDM techniques and learning analytics (LA) can be used as the best way to solve certain learning problems. Implementing EDM and LA in tertiary institutions can develop strategies that are directed at students and provide the tools necessary so that they can be used by institutions for continuous improvement purposes [9].

Algorithms in data mining (DM) are used to analyze academic performance. The DM algorithm used includes clustering and classification. Clustering is used to group student learning patterns to be more efficient, classification algorithms are used to predict future student behavior with de-tailed learning information such as student scores, knowledge, achievement, motivation, and attitudes [10]. The EDM system is also used as a reminder to students, which uses classification and clustering techniques in building system intelligence. This system can be used as a consultation tool for students in the first year to reduce the academic failure rate [11]. The most widely used technique in the EDM system is the Decision Tree Algorithm in the classification with the best accuracy (99.7%), while the clusterization technique is the Expectation Maximization (EM) algorithm which is the best [12] . Another DM technique is the ensemble method used to improve classification performance. By using Bagging, Boosting and Random Forest (RF), which are generally an ensemble method that is widely used in the literature [13].

EDM has the power to use raw data effectively where it has been generated by various academic activities in higher education, as well as to create a significant impact on the academic domain that can illustrate hidden patterns and relationships between attributes used in predicting student performance, or their behavior. effectively, so that strategic decisions can be taken appropriately [14][15]. EDM is an emerging cross-disciplinary research field that deals with the development of various methods for exploring data that come from an educational context. EDM uses a computational approach to analyzing educational data to study educational questions [16].

Methodology

The system for detecting student academic performance using data mining techniques can involve two actors, namely academic managers and students as parties whose academic performance needs to be measured. The data used for the detection process involves academic systems and support systems that generate data temporally. The result of the EDM process is in the form of new knowledge that will be used by the academic manager in developing academic programs. Figure 1 below illustrates the EDM utilization model. The main data source in this system is a dataset that comes from a database on the higher education academic system.

Two actors who interact with the system include management, namely the management of education and students who receive educational services. The external part of the system is

the academic program, which is the current academic system owned by the institution. The academic system in the form of academic implementation governance, can be the main data source related to academic activities, student data, curriculum data and data related to the academic process.

Educational environment is a data processing environment originating from the academic system, which is then managed with the help of a software system dedicated to managing academic data owned by the institution. Especially in this study, the academic data needed is in the form of temporal data, where academic activities are recorded temporarily through the e-learning system equipped with a temporal data design that established in previous studies. In addition to temporal data that stores academic aspects, the system is expected to record non-academic data that represents a student's EQ ability.
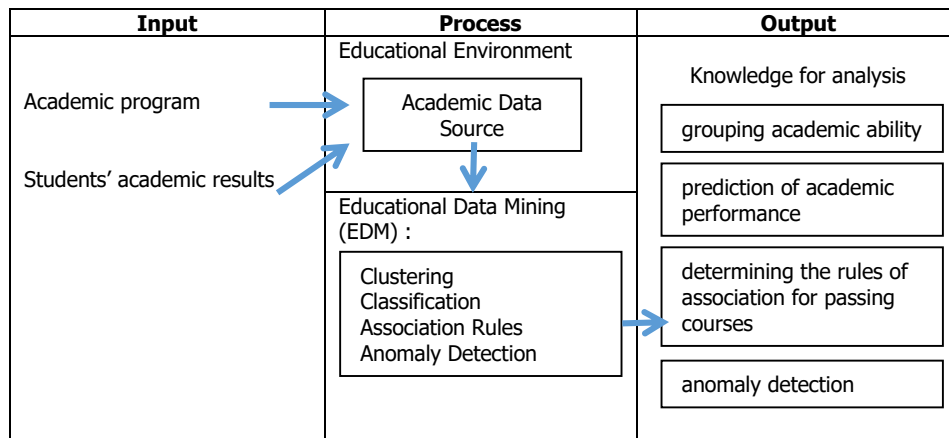
Input	Process	Output
Academic program Students' academic results	Educational Environment Academic Data Source Educational Data Mining (EDM) : Clustering Classification Association Rules Anomaly Detection	Knowledge for analysis grouping academic ability prediction of academic performance determining the rules of association for passing courses anomaly detection

Figure 1. EDM concept

The concept of data mining is implemented using EDM, where the techniques used are analytical support in accordance with the requirements to be able to identify student academic performance. Before entering the main process, the system will pre-process, which is to prepare the dataset according to the technique to be used. The dataset used is the academic data record of students majoring in Informatics at UNJANI with the 2015/2016 and 2016/2017 Academic Years, in which these students have completed their studies. The data mining models used include: Association Mining Rules, Classification and Clustering, and Outlier's Detection. The stages carried out in this study are as follows:

1. Preparation of the main dataset: In this study, a dataset will be used in the form of scores of students who have completed the study for 8 (eight) semesters and have declared their graduation status. Value data is in the form of all course scores that have been converted into numbers. Non-academic data is data in the form of student activities that are recorded and interpret the attitudes or behaviour of students during lectures.
2. Pre-processing: namely the process of forming a final dataset that can be used for the entire EDM process. In this process, first the main dataset is prepared which comes from the data-based on the academic system that has been used. The data is transferred into a comma separator (CSV) text format. There are several datasets in the CSV format that will be used in this EDM process.
3. Determination of parameter values: Each data mining technique used requires parameters before the mining process is carried out, including the parameters for conducting the clustering process in the form of a k value which states the number of clusters to be formed. Other parameters, namely the value of support and confidence to carry out the mining process in the form of association rules formation. For the classification process, some parameters are needed to determine the depth of the decision tree to be formed.
4. Selection of data mining models: There are several datasets that are prepared through pre-processing which will be used by different mining techniques. The clustering model uses a dataset of average scores for odd semesters and even semesters. The association rule model

uses a dataset that contains the value of courses with a quality value of 'A', while the dataset used for the classification process is in the form of all courses for 8 (eight) semesters.

Results and Discussions

In accordance with the research flow that the educational data mining (EDM) concept uses a data mining model with machine, either supervised or unsupervised, learning in determining the pattern of relationships between data with one another in the form of association rules. The dataset used is then entering the pre-processing stage so that each data mining model will use a different dataset. The data mining techniques used consist of clusterization, classification, association rules and detection of outliers. EDM implementation uses Python programming tools version 3.8.5 with IDE Spyder 4.1.4 and uses RapidMiner Studio Educational 9.6.0. The use of this tool is in consideration of adequate library support and features in data mining processes.

As previously stated, the dataset used is an academic database obtained from the university's academic system. Furthermore, pre-processing is carried out to become a dataset that is ready to be mined.

Results

The first function in EDM is the application of a clustering model using the k-Means algorithm. Before clustering, it is necessary to determine the ideal k value (number of clusters) first, that is, it can use the calculation of the Sum of Square Error (SSE). The SSE results can be visualized to see the formation of an elbow that tends to be sharp one. The following is the result of the visualization of the elbow determination as shown in Figure 2.
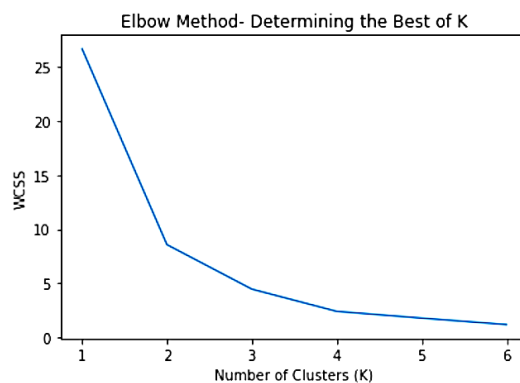
Figure 2. Elbow visualization results

By using the dataset that has been previously presented, the results of calculations with SSE obtains the ideal k value of 2 (two). This can be seen from the visualization with the formation of an elbow. The clustering process is then determined by k value of 2. By using the same dataset, the clustering process can be visualized (Figure 3) as follows.
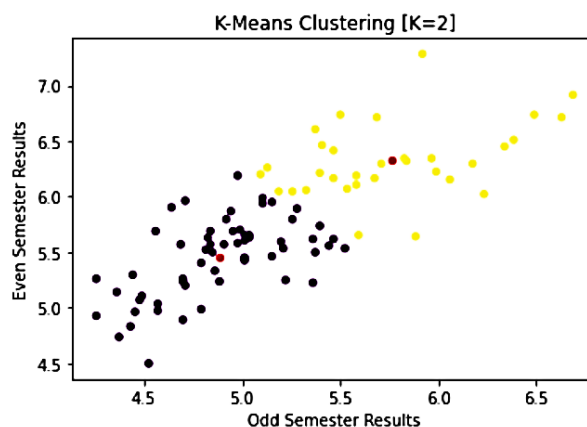

Figure 3. Clustering results with k of 2

The number of datasets used is 91 data (representing the number of students) who have completed the study for 8 (eight) semesters. Based on the cluster formed (Figure 5) it can be interpreted that good academic abilities are less when compared to moderate and less academic abilities. The horizontal axis represents the grade in the odd semester, and the vertical axis represents the even semester grade. Cluster analysis is also carried out using the k-Medoids algorithm, where this algorithm determines the data center (medoid) by calculating the closest distance (cost) between the non-medoid data objects and the randomly selected medoid candidate. It also compares the average distance of average non-medoid data objects with old medoids. The data is processed using the Davies-Bouldin Index (DBI), that when the k-Means algorithm is smaller when compared to the DBI results for k-Medoids, thus the accuracy of the clusters formed for the 2 k-Means algorithm clusters is slightly better. Table 1 shows the results of the cluster analysis.

Table 1. Cluster analysis results

Methods	DBI	Avg. Dist	Analysis		Amount of data	
			Cluster 1	Cluster 2	Cluster 1	Cluster 2
k-Means	0.714	0.251	31.38%	63.80%	61	30
k-Medoids	0.770	0.269	41.29%	51.85%	50	41

The next EDM process is to determine the pattern of relationships between passing courses of one another. Whether the passing of one course will be influenced by the passing of other courses. The level of relationship between one data object and another data object is determined based on the value of support (*Masukan Support* in Indonesian) and the value of confidence (*Masukan Konfiden* in Indonesian). This EDM process uses the Apriori algorithm in the association rule (AR) model. Figure 4 below shows the results of the execution of the association rule formation as follows in Indonesian.

Figure 4. The results of the formation of association rules with the passing grade of subject is A.

The result of association rule will be influenced by the value of support and confidence given as parameters. The higher of the confidence value, the more confidence of the rules are formed, where each antecedent will determine the consequences. With a support value of 80% and a confidence value of 90%, it obtains 25 rules consisting of courses with A grade, as shown in Figure 4 above.

Another EDM process is the classification process using the Decision Tree (DT) model, which is a model that can be used to determine the status of an unknown student's graduation based on new data objects. Classification is the process of determining a new data class based on a training dataset (past dataset). DT is a data mining model that uses a decision tree pattern, where each node in the tree is an attribute in the dataset. The initial node of DT is determined based on the entropy value. The result of the decision tree is knowledge of conditional rule patterns (if-then-else) which can be used to determine previously unknown data classes. It can be seen in Figure 5.
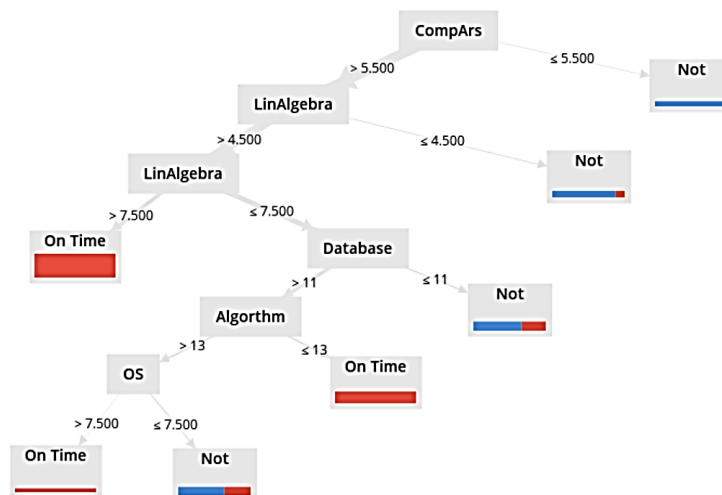
Figure 5. The results of the formation of a decision tree using ID3

Figure 5 shows the tree structure generated by the DT algorithm, where root is the initial attribute determined based on the entropy value calculation. The DT data mining model can be used to determine labels / data classes that are not yet known and will be assigned a class (test dataset). Based on the DT performance measurement, the rule formation process in the decision tree is very good, as can be seen in Table 2 and 3. While the value of AUC (optimistic): 0.993 (positive class: right), AUC (pessimistic): 0.946 (positive class: right), thus the resulting classification is said to be a very good classification.

Table 2. Decision Tree (DT) performance measurement

Measurement	
Accuracy	93.41%
Precision	92.54%
Recall	98.41%

Table 3. Confusion matrix

True	True Not On Time	True On Time	Class Precision
Predictions Not on time	24	3	88.89%
Predictions on time	4	60	93.75%
Class Recall	85.71%	95.24%	

Another EDM process is to determine the outliers of student grade data using the DBSCAN model, which is a model with the same way of working with clustering such as k-Means. DBSCAN determines the farthest object from the cluster formed, so that the farthest object can be identified as an outlier. In the student academic score dataset, the object farthest from the cluster can be interpreted as a data anomaly. Figure 6 below visualizes the results of the DBSCAN execution process to determine anomalous data as follows.
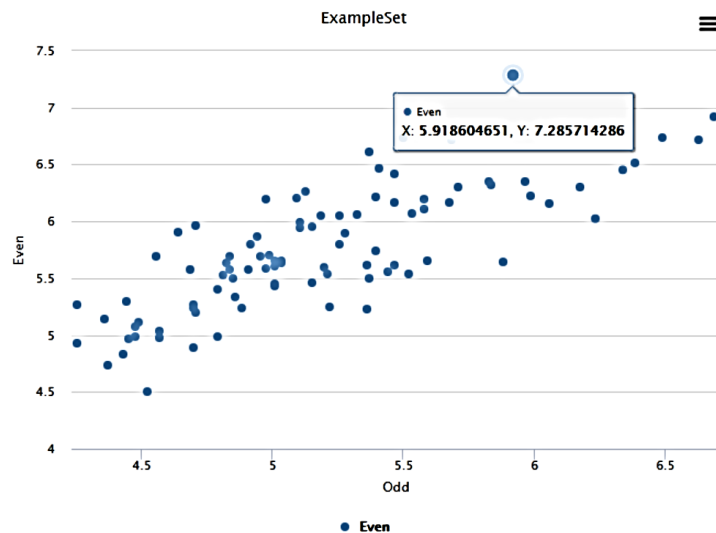
Figure 6. The results of the visualization of data anomaly determination with DBSCAN

The picture above shows that based on the same academic dataset, the farthest data can be seen from other data sets and can be interpreted as an anomaly. In this case, it can be interpreted as a student's academic ability that is more prominent when compared to other academic abilities. Based on the measurement of the performance of the formation of outliers using the DBSCAN algorithm with an epsilon value of 0.6 and main points value of 10, one data is produced that is outside the other data objects that can be identified as anomalies, namely data with x of 5.92 and y of 7.29. By changing the epsilon value, it will affect the formation of the resulting data anomaly. The following Table 4 shows the anomalous changes that can be detected which are influenced by the epsilon value as follows.

Table 4. Change in the value of epsilon in DBSCAN for min points of 10

epsilon	average	anomaly
0.2	64	27
0.3	77	14
0.4	84	7
0.5	87	4
0.6	**90**	**1**
0.7	91	0

The best data anomaly is obtained at the epsilon value of 0.6 (Table 4), where the number of anomaly formed is 1. The resulting anomaly data is outside the data object set with average density, thus it can be identified that the anomaly data is beyond average of academic scores. Based on the results of anomaly detection data (Table 4), only one data indicates that academic performance is very good or above average, where the data is the farthest data from other data sets as shown in Figure 6 and 7.
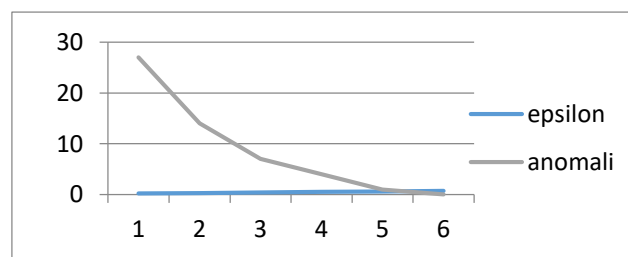
Figure 7. The epsilon and anomaly value.

Discussions

After conducting a series of experiments by applying various techniques in data mining, where the dataset used is the recording of student academic results in the UNJANI Informatics Department, with the academic years 2015/2016 and 2016/2017 having produced various information that can be interpreted as a description of student academic abilities. Table 5 shows an overview of the results of the analysis of the use of EDM to analyze student academic performance.

Table 5. The results of the academic performance analysis through the application of EDM

| Data Mining Algorithms				EDM analysis
Clustering	Algoritma	DBI	Cluster-0	Cluster-1	
	k-Means	0.714	31.38%	63.80%	As many as 61 students have moderate academic ability
					As many as 30 students have good academic abilities
Classification	Algoritma	Accuracy	Precision	Recall	If the value of MK-13 courses> 2.5, it will be determined by the MK-11 course, if MK-11> 7.5, then it will be on time
	ID3	93.41%	92.54%	98.41%	
					If the value of the MK-13 course <2.5, it will be determined by the MK-5 course, if the MK-5> 13, then it will be on time
					If the MK-11 course score is <7.5, the MK-9 course score must be> 11 to be able to graduate on time
					outside of the above provisions, it is not able to pass on time
Outliers Detection	DBSCAN	*epsilon*	Min points	anomali	Based on the results of anomaly detection data (Table 4), only one data indicates that academic performance is very good or above average, where the data is the farthest data from other data sets.
		0.6	10	1	
Association Rules	Support	Confidence	Sum of rules		shows that passing the database course also has an effect on passing data communication courses with a confidence level of 98.7%.
	80%	90%	25 rules		

Conclusion

Educational Data Mining (EDM) has become an adequate tool to be used as a support for strategic decision making, especially in higher education institutions. EDM is a relatively new concept used for the acquisition of knowledge in the field of education through techniques in data mining. The techniques used in this study including clusterization, classification, association rules and anomaly detection.

The dataset used in this study comes from the academic data of students majoring in Informatics, Faculty of Science and Informatics UNJANI, batch 2015 and 2016, in which these students have taken all the required semesters (8 semesters) so that their graduation status is known. By using this dataset, the EDM process can be carried out in acquiring knowledge. The clustering process uses the k-Means technique using the ideal k value = 2, after first measuring the SSE (sum square of error) = 18.1388, the result of clustering is that there are 2 (two) groups of student academic patterns. The k-Means algorithm gives better results when compared to the k-Medoids algorithm. Another technique used is the classification technique with a decision tree algorithm, where the result of this technique is the formation of a conditional rule pattern (if-then-else) by determining the attribute as the initial root to calculate the entropy value. By comparing the two algorithms in the classification (ID3 and SVM) it can be seen that the ID3 algorithm has better performance, this can be influenced by the dataset used. To determine data anomalies from academic data using the DBSCAN algorithm, this algorithm can detect academic data anomalies with epsilon value of 0.6 and a min points value of 10.

The techniques in EDM can be used as a way to analyse patterns that are formed into new knowledge in the management of education in higher education using academic data sets generated through various information systems available at higher education institutions.

Acknowledgments

References

[1]	N. Shipley, M. Jackson, and S. Segrest, "The effects of emotional intelligence, age, work experience, and academic performance," *Research in Higher Education Journal*, pp. 1–18, 2010.

[2]	P. M. Kumari, S. A. Nabi, and P. Priyanka, "No educational data mining and its role in educational field," *International Journal of Computer Science and Information Technologies*, vol. 5, no. 2, 2014.

[3]	A. Abu, "Educational data mining & students' performance prediction, "*International Journal of Advanced Computer Science and Applications*," vol. 7, no. 5, pp. 212–220, 2016.

[4]	Y. H. Chrisnanto and A. Kanianingsih, "Identifikasi pola kemampuan akademik menggunakan teknik association rules," in *Sentika*, 2017.

[5]	Y. Chrisnanto and G. Abdillah, "Penerapan algoritma partitioning around medoids (PAM) clustering untuk melihat gambaran umum kemampuan akademik," in *Seminar Nasional Teknologi Informasi dan Komunikasi*, 2015, pp. 444–448.

[6]	C. Romero and S. Ventura, "Educational data mining and learning analytics: An updated survey," WIREs Data Mining and Knowledge Discovery, vol. 10, no. 3, 2020.

[7]	R. S. Baker and P. S. Inventado, *Educational Data Mining and Learning Analytics*. 2014. [Online]. Available: https://www.semanticscholar.org/paper/Chapter-X-%3A-Educational-Data-Mining-and-Learning-Baker-Inventado.

[8]	A. Algarni, "Data Mining in Education, "*International Journal of Advanced Computer Science and Applications*," vol. 7, no. 6, 2016.

[9]	H. Aldowah, H. Al-samarraie, and W. Mohamad, "Telematics and Informatics Educational data mining and learning analytics for 21st century higher education: A review and synthesis," *Telematics and Informatics*, vol. 37, pp. 13–49, 2019.

[10]	R. Ahuja, A. Jha, R. Maurya, and R. Srivastava, "Analysis of educational data mining," in *Harmony Search and Nature Inspired Optimization Algorithms*, Springer, 2017, pp. 897–907.

[11]	H. M. Nagy, W. M. Aly, and O. F. Hegazy, "An Educational Data Mining System for Advising Higher Education Students," *International Journal of Computer, Electrical, Automation, Control and Information Engineering*, vol. 7, no. 10, pp. 1266–1270, 2013.

[12] S. Hari Ganesh and A. Joy Christy, "Applications of Educational Data Mining: A survey," in *ICIIECS 2015 - 2015 IEEE International Conference on Innovations in Information, Embedded and Communication Systems*, 2015.

[13] E. A. Amrieh, T. Hamtini, and I. Aljarah, "Mining Educational Data to Predict Student's academic Performance using Ensemble Methods," *International Journal of Database Theory and Application*, vol. 9, no. 8, pp. 119–136, 2016.

[14] H. Kaur and G. Bathla, "Student performance prediction using classification data mining techniques," *International Journal on Future Revolution in Computer Science & Communication Engineering*, vol. 4, no. 12, pp. 93–97, 2007.

[15] A. Hicham, A. Jeghal, A. Sabri, and H. Tairi, "A survey on educational data mining [2014-2019]," in *2020 International Conference on Intelligent Systems and Computer Vision, (ISCV)*, 2020, pp. 21–25,.

[16] J. D. Patón-romero, M. Teresa, M. Rodríguez, and M. Piattini, "Computer standards & interfaces application of ISO 14000 to information technology governance and management," *Computer Standards & Interfaces*, vol. 65, no. April, pp. 180–202, 2019.

The analysis of work improvement of short ergonomics break on the rice weeding farmers in Kebon Bantiran, Bajera, Tabanan

I Nengah Darma Susila [1]*, I Ketut Sutapa [2], I Nyoman Sutarna [3]

[1,3] *Mechanical Engineering, Politeknik Negeri Bali, Indonesia*
[2] *Civil Engineering, Politeknik Negeri Bali, Indonesia*

*Corresponding Author: *nengahdarmasusila@pnb.ac.id*

Abstract: Weeding rice in paddy fields is mostly done by female farmers, as it is done by farmers in Kebon Bantiran village, Bajera, Tabanan. The body position of the female farmers when weeding the rice in the paddy field is bent and both feet are buried in the mud. The purpose of this study was to find out and describe the workload of female farmers when weeding rice plants in the rice fields. The sample for this study is 10 female farmers. The method of this research is the measurement of pulse with the 10 pulse-method. Data collection is done twice, after-work and after a short break. The data obtained are analysed by a t-paired test. The calculation results obtained the mean after-work pulse rate of 115.25 pulse per minute, while the resting pulse rate was 95.50 pulse per minute, decreased pulse rate was 19.75 pulse per minute or decreased by 20.68 percent. In the statistical test, the t-paired test decreased significantly (p is less than 0.05). The workload of female farmers to weed rice is a mild category. The percentage of cardiovascular load (CVL) for female farmers when weeding rice was 19.99 percent which indicates the category required for work improvement. The percentage of CVL value is calculated from the level of workload classification based on the increase of work pulse compared to the Vanwonteghem maximum pulse and categorized it into the classification of light or moderate workloads, so this need improvement by taking a short break.

Keywords: ergonomics, short breaks, female farmers

How to Cite: I. N. D Susila, I. K. Sutapa, and I. N. Sutarna, "The analysis of work improvement of short ergonomics break on the rice weeding farmers in Kebon Bantiran, Bajera, Tabanan," *Matrix: Jurnal Manajemen Teknologi dan Informatika*, vol. 11, no. 1, pp. 36-41, 2021.

Introduction

The human factor plays an important role in the sustainability of a company, so it is important for companies to focus on the conditions of their workers in completing work. Each type of work performed will have a different workload. Ideally, the workload received by a worker is in accordance with his abilities. However, several adverse effects can occur if the physical load of a job has exceeded the physiological capacity experienced by the worker. The impact of work activities from the exertion of human resources that exceeds their ability is low work comfort, high levels of worker absenteeism, causing physical and mental stress and affecting the health of workers [1].

Physical work (manual operation) requires human physical energy as a source of energy (power), where work performance will fully depend on humans who function as a source of power or work controllers [2]. The energy released or consumed occurs because of the metabolic processes that occur in the muscles which are supported by the cardiovascular system and the respiratory system in the body [3].

The human factor plays an important role in carrying out activities, so it is important to focus on the conditions of workers in completing work. Each type of work performed will have a different workload. Ideally, the workload received by a worker is in accordance with his abilities. However, several adverse effects can occur if the physical load of a job exceeds the physio-logical

capacity experienced by the worker. The impact of work activities from the deployment of human resources that exceed their abilities, namely low work comfort, high levels of worker absenteeism, causing physical and mental stress and affecting the health of workers.

Tabanan Regency is famous for the nickname of rice bowl because most of its inhabitants, both men and women work as farmers, with the rice fields that stretched very wide. Before planting, the rice fields are plowed first using the tractor and hoe. The process of plowing is prepared for planting rice at the period of the next, which is done 6 months once by planting the best rice seed.

When the rice is 30 days old, the farmers hold a weeding process because the roots of rice have spread in the mud. Weeding is the process of removing and cleaning the grass in the middle of the rice fields. The weeding process carried out by farmers is generally still done traditionally. The position of the body of the farmers at the time of weeding is bent, and both of his legs up to the calves are set in the mud. Positions of the body carried out by farmers by force can increase the workload and can reduce work productivity [4].

Research on the CVL percentage that has been carried out is according to, which states that CVL percentage of female operators are in the category of needed repair and only 60% of male operators are in the category of needed repair, the rest are in the category of not experiencing fatigue [3]. There are 3 out of 15 employees who receive physical workloads that need improvement with the percentage of CVL respectively 38.12%, 32.12% and 35.40% [5]. The percentage of CVL (31.72%) that it is suggested for improvement or recovery is workers with assembling operator positions [6]. CVL percentage of craftsmen included in the classification of physical workload needs improvement, namely craftsman 2 with a value of 54.65% while other craftsmen get a value of <30% which means it is included in the classification the workload does not occur fatigue [7].

Labor in farming is one important element besides land, capital, and management. There are 3 types of labor in farming, namely human labor, animal labor, and mechanical labor. Meanwhile, human labor can also be divided into three type, namely male workers, female workers, and child labor. In agriculture, women are not only act as a housewife only, but not infrequently also found the women who work for the farm. They work in several aspects of production, post harvest, food distribution and consumption. They do not only play a role in agricultural activities which aims to increase income family, but they do play important part of the decision maker too [8].

In connection with the foregoing, this research is carried out related to the ergonomic problems that exist in farmers in carrying out rice weeding activities in the fields. Doing rice weeding in a body position that is not forced or comfortable, safe, healthy, effective, and efficient to increase the work productivity of farmers [9] and taking short breaks can reduce the workload [10]. Based on the description above, the purpose of this study is to focus on the ergonomics application of female rice farmers with short breaks to reduce workload.

Methodology

This research uses experimental methods, namely direct observations of the farmers perform weeding of rice. The subjects of this study were 10 workers with an age range between 23 - 47 years who worked for a period of 8 hours of work a day. Meanwhile, the object of research is the measurement of work and rest pulses (heartbeat). Data processing to assess the level of lightness or severity of physical workload is carried out in several stages, starting from measuring the pulse, calculating the 10-pulse method, and calculating CVL percentage.

As state by A. Manuaba, short breaks reduce the workload [10]. The workload can be determined by measuring the pulse rate of workers, in this case, are the farmers. The method of measurement of the pulse is using the method of 10 rates [9]. The type of data used in the research is the data quantitative data sourced from the primary data are directly collected from the results of the experiments on the farmers to do weeding rice paddy in the village of Kebo Bantiran, District of Bajera, Tabanan Regency. According to the measurement of mental workload, this can be done in general in three ways, namely as follows: Measurement of workload objectively; Measurement of workload by task selection; Subjective measurement of workload [11]. The maximum pulse rate is (220-age) for men and (200-age) for women. From the CVL

percentage calculation, it will then be compared with the predetermined classification [12] as follows.

1. Less than 30% = There is no fatigue
2. 30- <60% = Need improvement
3. 60- <80 = Short time work
4. 80- <100% = Immediate action is required
5. More than 100% = Not allowed to move

The classification assessment of the level of indirect workload can be determined from the percentage of cardiovascular load (CVL percentage) [13] [14]. Mental workload is a person's mental needs, such as: thinking, calculating, and estimating something [15].

Results and Discussions

Results

The number of samples in this study were 10 female farmers who do the weeding rice plantation. Data collection was conducted three times measurement of the pulse, i.e., early in the morning before doing the job and during the day after work, as well as short breaks in everyone hour of 5 minutes. Data characteristics of 10 female farmers weeding rice plantation are shown in Table 1.

Table 1. Data Characteristics of the female farmers weeding the rice plantation

Parameter	Mean	Standard Deviation	Range
Age (Year)	65.50	5.45	60-75
work experience (Year)	12.00	6.50	4.00-30.00

Data collection is performed to 10 female farmers doing the weeding rice field in the village of Kebon Bantiran, district of Bajera, Tabanan Regency, obtained several data before and after work as shown in Figure 1. The observations are made for 7 days. The data obtained are further analyzed using the SPSS (Statistical Package for the Social Sciences) version 15. The statistical test used a paired t–test [16]. The results of the data analysis are shown in Table 2.

Figure 1. Female farmers weeding the rice field

Table 2. The pulse rate after intervention

Variable	Mean	Standard. Deviation	Range
Pulse before work	65.75	5.20	60-75
Pulse when work	115.25	7.65	90-125
Pulse during break time (5 minutes) every 1 hour	95.50	6.30	75-100

The analysis of the significance of CVL percentage for the two periods is presented in Table 3. The CVL percentage for the two periods is different significantly, with a probability value of 0.001 (p <0.05).

Table 3. Paired T-test of CVL percentage before and after treatment

Variable	Period	Mean	Different mean	T	P
	before work	44.16			
% CVL			5.51	22.56	0.001
	when work	38.65			

Discussions

Table 2 shows that the calculation result of the pulse rate obtained when work is 115.25 pulse/minute. According to Grandjean, the workload of weeding rice farmers belongs to the category of moderate. The average pulse of heartbeat during break time for 5 minutes every 1 hour is 95.50 pulse/minute. Therefore, the pulse rate during break time turns out to decrease of 19.75 pulse/minute or decrease of 20.68%. Table 3 shows a statistical test with paired t-test. It turns out that the decrease was significant (p<0.05).

Another way to determine the magnitude of the classification of physical workload carried out by female farmers do the weeding of rice is the use of Vanwonterghem classification [17], namely the classification of physical workload on the cardiovascular load. The classification is based on the average pulse rate of rest (break time), the pulse rate of working time and the pulse rate maximum of 8 hours [6], with the following formula in Equation (1) and (2).

Pulse a maximum of 8 hours = 200 − age (in years for female)   (1)

$$\% \text{ CVL} = \frac{100 \times (pulse working - pulse break)}{pulse \max 8 \, hours - pulse break}$$ (2)

CVL = Cardiovascular load

So, the percentage of the cardiovascular load (% CVL) of female weeding rice farmers amounted to = 19.99%. According to Vanwonteghem, it can be categorized into light or moderate category from the classification workload. The body position of the farmer at the time of weeding the rice in rice fields are bending with both of her feet immersed in the mud up to the calf. The job of a farmer is monotonous and repeated, the working environment of the scorching sun at daytime and the wind is relatively tight. The body position of the working female farmers weeding rice is bent continuously in a long time. It is very unfavorable.

It is difficult to provide an ergonomic intervention on the work position of the female farmers at the time of weeding of rice in the rice fields because of the work in the rice fields that demanding the position of a body is always bent. Intervention can be done on work time to provide short breaks of 5 minutes in every hour. This is similar with the study conducted by R. S. Ayuba [7], and short breaks for a few minutes every hour to reduce musculoskeletal disorder and can reduce the workload as stated by H. I. Suyasning [18].

Figure 2. The working position of a female farmer in weeding rice field

Conclusion

The position of working female farmers do the weeding of the rice fields is bent, with both feet set in the dirt more or less up to the calf. The workload of the female farmers while weeding rice in the rice fields of 115.25 pulse/minute, after a short break the workload of 95.50 pulse/minute and decrease the workload of 19.75 pulse/minute or decrease of 20.68%, categorized of light (moderate), while the load cardiovascular also categorized of light, CVL of 19.99%, shows that the work category needs improvement which indicates the category of light work, so the improvement needs to be done is to perform short breaks.

Acknowledgment

References

[1]   D. Wahyuni, I. Budiman, M. T. Sembiring, E. Sitorus, and H. Nasution, "The workload analysis in welding workshop,". in *IOP Conference Series: Earth and Environment Science*, vol. 126, 2018.

[2]   Andriyanto and C. Bariyah, "Analisis beban kerja operator mesin pemotong batu besar (sirkel 160 cm) dengan menggunakan metode 10 denyut," *Jurnal Ilmiah Teknik Industri*, vol. 11, no. 2, pp. 136-143, 2012.

[3]   E. Purba, A. J. M. Rambe, and Anizar, "Analisis beban kerja fisiologis operator di stasiun penggorengan pada industri kerupuk," *E-Jurnal Teknik Industri FT USU*, vol. 5, no. 2, pp. 11–16, 2014.

[4]   I. M. Nada, *Perbaikan Sikap Kerja Perontok Padi Lokal Pada Penyosohan Beras "Su" di Desa Babahan Penebel – Tabanan*. Denpasar: Universitas Udayana, 2003.

[5]   D. Diniaty and Z. Muliyadi, "Analisis beban kerja fisik dan mental karyawan pada lantai produksi di PT pesona laut kuning," *Jurnal Sains, Teknologi, dan Industri*, vol. 13, no. 2, pp. 203–210, 2016.

[6]   A. Hakiim, W. Suhendar, and D. A. Sari, "Analisis beban kerja fisik dan mental menggunakan CVL dan NASA-TLX pada divisi produksi PT X," *Barometer*, vol. 3, no. 2, pp. 142–146, 2018.

[7]   R. S. Ayuba, I. H. Lahay, and E. Wolok, "Pengukuran beban kerja fisik pengrajin kopiah keranjang di Desa Batulayar, Kec. Bongomeme, Kab. Gorontalo," *Seminar Nasional Teknologi dan Humaniora*, vol. 1, no. 1, pp. 281-288, 2019.

[8]   D. Nurmayasari, *Peran Anggota Wanita Tani Laras Asri Pada Peningkatan Kesejahteraan Keluarga*. Semarang: Universitas Negeri Semarang, 2014.

[9]   A. Manuaba, *Masalah Ergonomi Pertanian*. Denpasar: Universitas Udayana, 1998.

[10] A. Manuaba. *Penerapan Ergonomi Kesehatan Kerja Mutlak Perlu Pada Industri Pakaian Jadi*. Denpasar: Universitas Udayana, 1998.

[11] A. S. Mariawati, *Penilaian Beban Kerja Psikologis Operator Stasiun Kerja Menggunakan Metode National Aeronautics and Space Administration-Task Load Index.* Banten: Universitas Sultan Ageng Tirtayasa, 2013.

[12] M. Mutia, *Pengukuran Beban Kerja Fisiologis Dan Psikologis Pada Operator Pemetikan Teh Dan Operator Produksi Teh Hijau Di PT Mitra Kerinci*. Padang: Universitas Andalas, 2014.

[13] A. D. Sari, M. R. Suryoputro, M. D. Pramaningtyas, and P. S. Putra, "Work physiology evaluation of laundry workers," in *IOP Conference Series: Materials Science and Engineering,* vol. 105, 2016.

[14] R. A. Simanjuntak, "Penilaian resiko manual handling dengan metode indikator kunci dan penentuan klasifikasi beban kerja dengan penentuan cardiovasculair load," in *Proceeding of Seminar Nasional Industrial Services*, 2011.

[15] A. F. Hima and M. K. Umami, 'Evaluasi beban kerja operator mesin pada departemen log and veeeneer preparation di PT. XYZ," *Teknik dan Manajemen Industri*, vol. 6(2). pp. 106-113, 2011.

[16] B. Soepeno, *Statistik Terapan*. Jakarta: Rineka Cipta, 1997.

[17] I. P. G. Adiatmika, *Perbaikan Kondisi Kerja Dengan Pendekatan Ergonomi Total Menurunkan Keluhan Muskuloskeletal Dan Kelelehan Serta Meningkatkan Produktivitas Perajin Logam Di Kediri-Tabanan (Disertasi)*. Denpasar: Program Pascasarjana Universitas Udayana, 2007.

[18] H. I. Suyasning, *Penggunaan Lintas Berundak Ergonomis Dan Penampungan Sementara Meningkatkan Produktivitas Kerja Wanita Pengangkut Batu Padas*. Denpasar: Universitas Udayana, 1998.

Designing a microsoft access-based administration letters and archives system at BPJS of employment regional office of East Java

Yuniar Farida [1]*, Latifatun Nadya Desinaini [2]

[1,2]*Department of Mathematics, Faculty of Science and Technology, UIN Sunan Ampel Surabaya*
*Corresponding Author: yuniar_farida@uinsby.ac.id

Abstract: The role of technology in an institution is beneficial for any activities, especially in managing documents administration, which is now most of the company used digital archive systems. That's because the manual archive system is considered less effective and efficient, where it takes a lot of space and time to search for document archives. Microsoft Access is a windows-based database processing program with Visual Basic for Application (VBA), commonly used to create a windows-based application. The purpose of this paper is to make an administration letter and archives system based on Microsoft Access. The results of this design have passed the trial process for approximately two weeks and received a positive response. The system design can be run well, and its functions correctly without errors. So it can help the secretary or other employees to manage all documents (letters and archives) more accessible and faster.

Keywords: microsoft access, VBA, letters administration, digital archive, database

How to Cite: Y. Farida and L.N. Desinaini, "Designing a microsoft access-based administration letters and archives system at BPJS of employment regional office of East Java," Matrix: Jurnal Manajemen Teknologi dan Informatika, vol. 11, no. 1, pp. 42–54, 2021.

Introduction

Following technological advances globally, information technology has become a basic necessity for every individual and institution in carrying out their daily activities. In this situation, mathematics has made its contribution. Various applications and programs on computers can't be separated from applications of mathematics. For example, discrete mathematics is used as the foundation of computer science. One of them is the presentation of a database that uses concepts from mathematical relations [1].

The role of technology requires the institution to have an information system that can support the management to make decisions for its progress and prosperity. Implementing an institution's information system is beneficial for any activities, especially in managing the institution's letters and archives administration, such as using computer technology to support correspondence management activities and information management. Changing data from existing letters into the correct quality information will help company leaders make the right decisions. It also has an impact on work activities. Computers have many programs that can make it easier for employees of institutions to complete their work. One of them is Microsoft Access, which can simplify employees' work in managing computer-based data [2] [3].

There has been much research that designed a program based on Microsoft Access. For example, research by Safria Bintahir [4] design a sales system for PT Mitra Sukses Batam, and research by Fauzi Akbari and Bambang Seopeno [5], who design a sales system for CV. Mega Prima Mandiri Mojosari. The two studies above have similarities that develop a Microsoft Access-based sales system with the VBA programming language. The advantage of the system designed in the study is to make it easier for sellers to record their sales. In addition to using Microsoft Access, the seller no longer need to install any additional application to run this system.

In addition to the two studies above, research uses Microsoft Access to design a library information system conducted by Amiruddin Nahlah [6]. This research aims to manage information, book borrowing, book collection and book transactions in the library using Data Flow Diagram (DFD) as an overview of the system. The advantages of using this DFD is that the required data flow can be described in detail. Still, this system has a drawback: the absence of physical flow that occurs so that there will potentially be a condition of data redundancy in the system. Further research conducted by Hengki Tamando Sitohang [7] where research makes a web-based archiving system, the advantages of the system made in the study are to facilitate its users in managing mail data the web-based system has a more accessible look. It has the flexibility of an operating system where the system is made can be run both on desktop and mobile. But the shortcomings of the web-based system made in the study are the need for an internet connection to run it. This web-based system can be an obstacle if the system's intended area has a poor internet connection, making it less efficient. It will further hinder the user's work. Also, web-based systems have a low-security level, such as system users' unprotected sensitive data properly. Risk of essential components of the database can be stolen. Finally, web-based systems often do redirect or forward to other websites that direct users to phishing/malware [8].

In this research case study, The BPJS of employment is an institution that also has a secretarial and archival sub-section. In this sub-section, incoming, outgoing, and other letters still use the manual method. This manual method system is considered ineffective because it takes a long time to search for letters. Besides that, poor management and storage will make the letters be scattered and wasted. Based on this background, the author is interested in creating a mail management system based on Microsoft Access. Due to the ease in setting up an operating system where users do not need to install applications and incur additional costs because every computer that has Microsoft Office software certainly also has Microsoft Access. Also, Microsoft Access-based systems have a higher level of data security, which is very important for BPJS Employment because both corporate data and personal data of BPJS users are mandatory to be protected confidentially. The system made is expected to solve the problem, so it is expected that the management of mail data can be done more effectively and efficiently without reducing the data security of BPJS companies.

Letters and Archives

Letters are essential for an institution because every institution is still communicating using letters to obtain or send information. Letters are long-distance communication tools between people/institutions using written language and a piece of paper [9]. Letters can also be defined as written information, which needs specific requirements applicable in correspondence procedures [10]. According to the Great Dictionary of the Indonesian Language, another definition of a letter is a script that can mean a letter or a letter's contents. In a broader sense, the letter is written, printed, or visual information that still has uses as information for the people or an institution [11] [12].

The International Standard Organization (ISO) states that archives are information stored in various forms, including data on computers, created or received and managed by organizations and people in business transactions and store as evidence of activity [13]. According to The Georgia Archives, it is summarized and collected to be accessed and used [14].

Archives for an institution are one of the most important supporting elements for operational activities. From libraries, authentic information and data can be obtained quickly and accurately. One of the functions of the archive is as a tool for storing letters [15]. In general, there are two types of archives:

1. Manual Archives
   Manual archives are stored and still managed in the paper, CD, or another physical form (manually). The manual archives system is less popular because many institutions have started implementing paperless office programs and digital archives [3].
2. Digital Archives
   It is an archives management with electronic media in the system or application made explicitly by the institution. Many benefits can be obtained using digital archives; here are some of the benefits of a digital archive system [15] [16] [17]:

a. The digital archives system is easy to process, research, and present the required information.
b. The digital archives system didn't need a lot of saving place.
c. The digital archives system is easy to do back-up files.
d. The digital archives system is fast and efficient for access and does a data distribution.

Other than benefits, digital archives also have some drawbacks [18]:

a. The cost of creating a digital system is relatively expensive.
b. The possibility of file corruption without any indication, such as a server affected by computer viruses or a personal error that accidentally deletes the file permanently.

But it can be solved by the selection of software devices and restrictions on system access.

Concept of Relations in Information Technology

The contribution of mathematics is substantial in building and developing information technology and computers because [19]:

1. Mathematics knows the science of logic, which in information technology and computers was created as the basis of programming.
2. Programming languages in information technology and computers use binary numbers, i.e., 1 and 0, and their operations use mathematical algebra operations.
3. Application of Boolean algebra in electrical circuits, which is a mathematical science
4. Basic hardware and software development
5. Basic development and determination of bits in the computer
6. Basic application and development of network programming

Discrete mathematics is a branch of mathematics that deals with everything that is discrete objects. Discrete mathematics plays a lot in the development of information technology. One example is the concept of relations and functions in discrete mathematics, which has a role in databases. This relationship is an application of the n-array procedures and relations concept [1].

In discrete mathematics, a function is related to the requirement that each domain area's value leads precisely one value of the result area. Meanwhile, the n-array relation is a relation that connects more than two sets. For example, there are sets $A_1, A_2, A_3, ... A_n$, then the n-array relation R from the sets is a subset of $A_1, A_2, A_3, ... A_n$, or it can be written as $R \subseteq A_1, A_2, A_3, ... A_n$ where the sets $A_1, A_2, A_3, ... A_n$ is called the origin or domain area, while n is called the degree [1].

Database

The database is data from collecting files that have a relationship between one file and another file to form unity data to inform an institution [20]. The database is similar to a library that stores many books from different categories. One book stores various data involving book title, author name, content summary, publisher, year of publication, etc. In the mid-1960s, computer storage emerged with computer storage equipment, and data management was also introduced during this period. Database storage technology has improved significantly for an institution's benefit [21].

The database can also be defined as collecting data or information consisting of one or more tables related to one another and systematically and systematically, making it easy to access a computer program to obtain data information. The computer program used to manage or create this database is called a database management system (DBMS), for example, Microsoft Access, Microsoft SQL Server, Oracle, MySQL, PostgreSQL, Sybase, etc. A DBMS makes it possible for users to create, read, update and delete data in a database [21] [22] [23]. Meanwhile, according to Simarmata et al., the database contains essential information by the organization/ institution/ company [24]. In the database, there are three components [25]:

1. Data is a record or collection of facts.
2. A field is a group or category of data.
3. Record is a collection of data fields.

Methodology

Microsoft Access and Visual Basic for Applications

Currently, computers have provided programs that make it easier for employees to complete their work; one of them is Microsoft Access. Microsoft Access is a windows-based database processing program issued by Microsoft Office. The various facilities provided by Microsoft Access will help create and present data in the form of important information that is accurate and efficient. Microsoft Access can work with earlier popular database systems such as dBase, Microsoft SQL Server, Oracle, MySQL, PostgreSQL, etc. [24] [25].

One of Microsoft Access's advantages from a programmer's perspective is its compatibility with the programming language, Structured Query Language (SQL); queries can be viewed and edited as SQL statements. SQL statements can be used directly in VBA. In Microsoft Access, programming adds functionality to the database using Visual Basic for Applications (VBA). VBA is a software released by Microsoft company. VBA lets adding automation and other functionality to Microsoft, which programmers generally use to create windows-based applications. For example, adding a command button to the form that, when clicked, opens the report [21] [26]. Microsoft Access and VBA is the right combination that can make a database processing system that is easy, accurate, and efficient.

Method of Collecting Data

In this research, the authors designed an administration letter system based on Microsoft Access 2016. The data used is secondary data with the data collection techniques below:

1. Observation
   Collecting data by direct observation on the object of research. In this case, the authors directly collect letters data, arranges letters, and archives them manually.
2. Interview
   Collecting data by interviews with people who can provide information related to the issues. In this case, the authors collect data by consultation with the secretary and archival employees of the BPJS employment Regional Office of East Java.

Design the System

Identification of Problems

This administration letter system's model is made from the BPJS of employment Regional Office of East Java problems, hoping to facilitate existing employees. These problems are the ineffective management of letters or storage in the archives, which causes some letters to be scattered and difficult to find back—the inefficient data collection of letters is done manually.

Choosing a Programming Language

In designing this administration letter system, the Microsoft Access 2016 program is used, equipped with Visual Basic for Application.

Application Design

1. Analysis of data collection
   The data needed are employee data and samples of incoming letters, outgoing letters, internal memos, and warrants of the BPJS employment Regional Office of East Java.
2. Design of login page
   The login page is beneficial for the initial display when opening the administration letter system. On this page, there will be two possible users who will log in. First, the secretary/archive, and second is employees, where both have differences when entering the next page.
3. Design of the home page
   The home page is designed to be visible after logging in. There are three types of scripts on this page, first the script for the button to the letter menu page, second, the script for the letter report page, and last, the script for the log out button. The authors will provide a hand when the username log is an employee for the letter page button. The letter menu button

will be locked. When the login username is a secretary/archive, the letter menu button will be open.

4. Design of letter input and edit page
   The letter input and edit page is designed following the data from the letter of the BPJS of employment Regional Office of East Java

5. Design of letter report page
   The letter design's report page displays the primary data of the letter and attachments of the letter that the secretary/archives have inputted. This page can be accessed both by secretaries/archives and employees of other sections.

6. Creating a startup page
   The startup page is designed to set what facilities and page will appear first, so the page will determine whether the system can be run or not. In this system, the authors will use the login page as a startup.

Design Testing

After the system design is complete, then the results of the invention are tested. At this stage, the system is tested whether it can function properly or it has an error. The testing technique is used in the test scenarios provided by the BPJS employment Regional Office of East Java.

Results and Discussions

System Design Result

Login Page

The login page is used for the initial display when opening the administrative letter system. There will be two possible users who will log in on this page, first the secretary/archive and second the other employees, where both of them have differences when entering the next page. The display for this login page is shown in Figure 1.
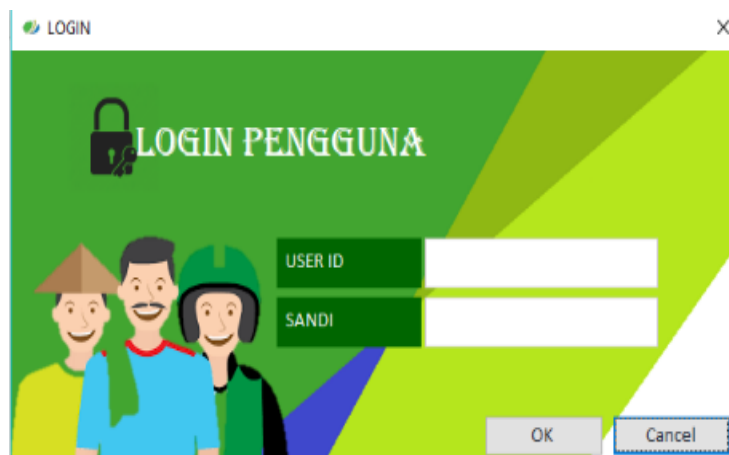

Figure 1. Display of login page

Home Page for Secretary/Archive and Employees

The home page is used for the display that will be seen after logging in. In this form, the secretary/ archive and other employees will have a different page design. For secretary/ archives, all menu buttons will open and have full access to the system. In contrast, other employees don't have full access to this system. The letter menu button will be locked, so only the secretary/ archive can process the letter data.

1. Home Page Views for Secretary/ Archive
   The Home page display for the secretary/ archive is shown in Figure 2, where all buttons are unlocked, so the secretary/ archive has full access to this system.

Figure 2. Display of home page for secretary/archive

2. Home Page Views for Employees

   Home page display for employees shown in Figure 3, where the letter menu button is locked, means that employees other than secretary/ archives cannot add/ subtract/ edit the letter's contents already in the system.

Figure 3. Display of home page for employees

Administrative Letter System Page

Display the administrative letter system page shown in Figure 4, where this view can only be seen or accessed by the secretary/ archive before processing existing letter data.

Figure 4. Display of administrative page

Enter and Edit Letter Page

This page is used for inputting or adding letter data as well as editing data that already exists in a letter that has been previously inputted. This page consists of incoming letter pages, outgoing letter pages, internal memo pages, and warrant pages. Each display is shown in Figure 5, Figure 6, Figure 7, and Figure 8.

Figure 5. Display of entering/ editing incoming letter page

Figure 6. Display of entering/ editing outgoing letter page

Figure 7. Display of entering/ editing internal memo page

Figure 8. Display of entering/ editing warrant letter page

Report Letter Page

The report letter page is designed to display letter data that has been stored in the database. Secretaries/archives and employees can access this letter report page. In this administrative letter system, there is 4 page according to the types of the letter; they are the incoming letter page report, the outgoing letter page report, the internal memo page report, and the warrant page report. Each display of the letter report page is shown in Figure 9, Figure 10, Figure 11, and Figure 12.

SURAT MASUK

NO.	No. dan tgl Agenda	Pengirim	Lampiran	Nomor, tanggal Surat	Disposisi Kepala Unit Kerja	Perihal	Pemroses	Lampiran File
1	00001 04-01-2019	Kantor Pusat BPJS Ketenagakerjaan	1 berkas	B/25237/122018 31-12-2018	Bagian Umum & SDM	Feedback Laporan Pelaksanaan Kegiatan Coaching di BPJSTK Th.2018 dan Permintaan Data Pelaksanaan Kegiatan Coaching	Deputi Direktur Wilayah	D:\Sistem Manajemen Surat\Ikons\contoh surat.pdf
2	00002 04-01-2019	Kantor Cabang Karimunjawa		B/29819/122018 29-12-2018	Kepala Bidang Umum & SDM	Permohonan Koreksi Upah	Bidang Umum & SDM	

Figure 9. Display of incoming letter report page

Surat Keluar

NO.	omor Surat	Tanggal Surat	Nomor Surat	Dari	Perihal	Kepada	Klasifikasi	Lampiran File
1	00001	08-01-2018	B/25237/122018	Kantor Wilayah Jawa Timur	Breakdown Target Kepesertaan dan Iuaran Tahun 2019	All Kacab & KCP	KP.02.06	

Figure 10. Display of outgoing letter report page

MEMO INTERN

NO.	ner Surat	nggal Surat	Dari	Perihal	Tujuan	Klasifikasi	Lampiran File
1	00001	07-01-2018	Bidang Umum & SDM	Pengadaan Kupon BBM	Deputi Direktur Wilayah	KP.02.06	
2	00002	08-01-2019	Bidang Umum & SDM	Penggantian Ban Mobil Toyota Fortuner W 1211 SH	Deputi Direktur Wilayah	KP.02.06	

Figure 11. Display of internal memo report page

SPRINT

NO.	mor Surat	Tanggal Surat	Dari	Perihal	Kepada	Klasifikasi	Lampiran File
1	00001	08-01-2018	Bidang Umum & SDM	Pertemuan Teknis Bidang Keuangan dan TI BPJS Ketenagakerjaan Kantor Wilayah Jawa Timur	Bidang Umum & SDM	KP.02.06	

Figure 12. Display of Warrant Report Page

System Design Testing

The system design will be tested using the test scenario that BPJS has made of the employment Regional Office of East Java. So it can be seen whether the system created can function properly or has an error. BPJS will create the testing scenario by following the following testing procedure:

1. Test the login page

   Testing this login page is a valuable test to test whether the login page works according to the username data that has been created or not, where the username is designed differently for the secretary and employees of other divisions.

2. Test the home page

   When the home page opens, it determines whether the previous login page works according to the username created. For the home page secretary, all access button for all letter editing will be active. Also, home page testing is used to test whether all existing buttons will move to a page that matches its function when pressed.

3. Test letter menu pages and letter recaps

   Similarly, when testing the home page, testing for the letter menu page is done to test whether all existing letter menu buttons will move to the corresponding letter page when pressed. The letter recap button is tested to whether all the data entered in the database has been stored correctly in the letter recap or missing. The letter recap button is also tested whether the attachment button functions correctly in displaying scans of the original letter.

4. Test letter input

   Testing letter input is done by trying to insert some new letter data and inserting letter's attachments in the form of scans to be known if the system managed to save new data or cause errors.

The system testing results are shown in Table 1.

Table 1. System Testing Result

Testing page	System status	Testing scenario	Testing result
Login	The login page is open	Enter username and password data	the main page opens according to the entered username and password
Home	The home page is opened with the secretary/archive username	Clicking the letter menu button, report letter, log out	1. After clicking the letter menu button, the page moves to the administrative letter page 2. After clicking the report letter button, the page displays all report letters 3. After clicking the log out button, the page moves back to the login menu
Administration letter	The administrative letter page opens	Clicking the incoming/outgoing letter/internal memo button/ warrant letter button and report letter button	1. After clicking the incoming/outgoing/internal/memo/warrant letter button, the page moves to the incoming/outgoing/internal memo/warrant letter input page. 2. After clicking the report letter button, the page displays all report letters

Letter input	Form of input incoming/outgoing/internal memo/ warrant letter is already open	Enter letter data/edit letter data	The system managed to save letter data into the database

The table above indicates that all pages in this administration letter system can run and function properly without any errors. The login page test shows that the data was entered to match with the database, and there is no error. This system design is practical because it can run by Microsoft Access under Microsoft Office without installing additional software. Although this system design can be run and functions well, there are still shortcomings. This application is not yet integrated with the scanner machines system, so to develop further this system design, adding a connection system to the scanner application automatically, so it will make the job easier and more efficient. Also, for the following similar application research, the suggestions are (a) need to know the application well, so that the application can fit its function and purpose; (b) in making an application, it is designed not only using Microsoft Access but with Php or MySQL, so that the final product results can be converted into an executable format to be installed on the computer.

User Experience

In this study, the authors only engaged 12 respondents to provide feedback on implementing the system that has been created. The number of respondents is only 12 people representing each division in the BPJS employment office of the East Java region. This respondent includes the region's deputy director, secretary, archival officer, regional examiner officer, and other divisions (each one person in each division). In this case, the author used an exploratory interview to gather feedback from the respondents, namely by asking some questions about the system that has been tested for approximately two weeks, including:
1. Do respondents like the system that has been created?
2. Has the system been made more efficient in making it easier for respondents to search letter and archives?
3. Is the system made more efficient in saving time to record and search letter and archives?
From the exploratory interview, 10 respondents stated that they liked the system design because it is easier and faster to search for letters and archives. Only 2 respondents stated that they do not like the system design that has been created. The reason is that respondents do not understand how to operates the system. This is understandable because both respondents are older than the ten respondents who like the design, both people are less accustomed to technology, so it takes more effort to learn the new system. Also, both respondents are familiar with the existing manual system.

Conclusion

The design administration letter and archives systems based on Microsoft Access have been created and proven to function properly from the test scenario results. The trial process of this system design shows that the output and process results match expectations and function well without any errors. This system design has passed the trial use process for approximately two weeks and received positive responses from the BPJS employees. A positive response from users was shown by 10 of 12 respondents expressing their love for this system design. This is because This system design can manage all existing letters and archives easier and faster for secretaries even though other employees in BPJS of employment Regional Office of East Java.

Acknowledgements

References

[1]   R. Munir, *Matematika Diskrit*, Ketiga. Bandung: Informatika, 2005.

[2]   L. K. A. D. Setiawati and I. M. D. J. Sulastra, "Rancang bangun sistem informasi inventory berbasis client server pada PT Arpan Bali Utama di Denpasar," *Matrix: Jurnal Manajemen Teknologi dan Informatika*, vol. 10, no. 3, pp. 94–102, 2020.

[3]   S. Badri Munir, *Manajemen Administrasi Perkantoran Modern*. Surabaya: Erlangga, 2006.

[4]   S. Bintahir, *Perancangan Sistem Penjualan Menggunakan Microsoft Office Access Pada PT. Mitra Sukses Batam*. Batam: Skripsi Politeknik Negeri Batam, 2010.

[5]   F. Akbari and B. Seopeno, "Penerapan microsoft acces untuk penjualan barang di CV Mega Prima Mandiri Mojosari Kabupaten Mojokerto," *Jurnal Aplikasi Bisnis*, vol. 3, no. 1, pp. 340–344, 2017.

[6]   A. Nahlah, "Sistem informasi perpustakaan berbasis Ms Access pada Jurusan Administrasi Niaga Politeknik Negeri Ujung Pandang," *Sainsmat: Jurnal Ilmiah Ilmu Pengetahuan Alam*, vol. IV, no. 2, pp. 175–195, 2015.

[7]   H. T. Sitohang, "Sistem informasi pengagendaan surat berbasis," *Journal of Informatic Pelita Nusantara*, vol. 3, no. 1, pp. 6–9, 2018.

[8]   H. Hasyim *et al.*, "Potential for a web-based management information system to improve malaria control : An exploratory study in the Lahat District, South Sumatra Province, Indonesia," *PLoS One*, pp. 1–13, 2020.

[9]   Agusfina and Selfiana, "Proses menangani surat masuk pada bagian sekretariat di Kantor Pelayanan Pajak Pratama Cibitung," *Jurnal Mahasiswa Bina Insani*, vol. 1, no. 2, pp. 161–176, 2017.

[10]   Meliagustin, E. Harijaty, and Harmin, "Kemampuan menulis surat dinas siswa kelas VII SMP Negeri 11 Kendari," *Jurnal Bahasa dan Sastra*, vol. 4, no. 2, pp. 284–298, 2019.

[11]   KBBI, *Kamus Besar Bahasa Indonesia*, 3rd ed. Jakarta: Balai Pustaka, 2002.

[12]   R. Anbarrini, R. Susilana, and H. Silvana, "Pengelolaan arsip pada Badan Perpustakaan Dan Kearsipan Daerah Provinsi Jawa Barat," *Journal of Library and Information Science*, vol. 3, no. 1, 2016.

[13]   R. P. Ramudin, "Pengelolaan arsip sesuai standar internasional (ISO 15489-1: 2016) studi kasus pengelolaan arsip Bank Indonesia," *Jurnal Kearsipan Terapan*, vol. 3, no. 1, pp. 14–25, 2019.

[14]   William, A. P. U. Sembiring, and K. F. Ndruru, "Perancangan sistem informasi manajemen dokumen (studi kasus STMIK Mikroskil)," in *CITISEE 2017*, 2017, pp. 203–206.

[15]   W. Reza and H. Andry, "Pelaksanaan pengelolaan arsip pada bagian seksi pelayanan lelang di Kantor Pelayanan Kekayaan Negara dan Lelang Pekanbaru," *Jurnal Valuta*, vol. 1, no. 2, pp. 353–367, 2015.

[16]   M. Rifauddin, "Pengelolaan arsip elektronik berbasis teknologi," *Khizanah Al-Hikmah: Jurnal Ilmu Perpustaaan, Informasi dan Kearsipan*, vol. 4, no. 2, pp. 168–178, 2016.

[17]   I. K. G. Sudiartha and I. G. N. Bagus Caturbawa, "Perancangan dan implementasi aplikasi tata arsip pribadi dosen menggunakan manajemen folder di Politeknik Negeri Bali," *Matrix: Jurnal Manajemen Teknologi dan Informatika*, vol. 5, no. 2, pp. 35–40, 2015.

[18]   Y. Zhao and H. Yang, "Postgraduates' personal digital archiving practices in China : Problems and strategies," *The Journal of Academic Librarianship*, vol. 45, no. 5, p. 102044, 2019.

[19]   C. R. Rakes, R. N. Ronau, S. B. Bush, S. O. Driskell, M. L. Niess, and D. K. Pugalee, "Mathematics achievement and orientation: A systematic review and meta-analysis of education technology," *Educational Research Review*, vol. 31, p. 100337, 2020.

[20]   B. Endriawan and P. Swasti, "Pemanfaatan database online UPT. Perpustakaan Universitas Trunojoyo Madura sebagai sumber informasi bagi pemustaka," *BIBLIOTIKA: Jurnal Kajian Perpustakaan dan Informasi*, vol. 3, no. 2, pp. 105–113, 2019.

[21]   Y. Wang, J. Liu, X. He, and B. Wang, "Design and realization of rock salt gas storage database management system based on SQL Server," *Petroleum*, vol. 4, no. 4, pp. 466–472, 2018.

[22]   Amiruddin, A. Sahur, and Aisyah, "Perancangan basis data pengawasan ujian masuk Politeknik Negeri Ujung Pandang berbasis microsoft access," in *Prosiding 4th Seminar Nasional Penelitian & Pengabdian Kepada Masyarakat 2020*, 2020, pp. 66–71.

[23]   L. Carral, C. Alvarez-feal, M. J. Rodríguez-guerreiro, A. Vargas, N. Arean, and R. Carballo, "Methodology for positioning a group of green artificial reef based on a database management system , applied in the estuary of Ares-Betanzos (Nw Iberian Peninsula)," *J. Clean. Prod.*, vol. 233, 2019.

[24]   J. Simarmata and I. Paryudi, *Basis Data*. Yogyakarta: Andi Offset, 2006.

[25]   K. Wahana, *Microsoft Access 2013 Untuk Perkantoran Modern*. Yogyakarta: Andi Offset, 2014.

[26]   M. Eslami, V. Mahmoodian, I. Dayarian, H. Charkhgard, and Y. Tu, "Query Batching Optimization in Database Systems," *Comput. Oper. Res.*, vol. 121, p. 104983, 2020.

POLITEKNIK NEGERI BALI

9 772580 563008