Expert System Application for Troubleshooting and Maintaining Epson L3110 Printer

Henderi 1, Efana Rahwanto 1, Tri Wahyuningsih 1,∗, Achmad Badrianto 1

1 Informatics Engineering Master Program, Raharja University; Jl. Jendral Sudirman No.40 Modern, Cikokol, Tangerang; e-mail: henderi@raharja.info, efana@raharja.info, triwahyuningsih@raharja.info, badrianto@raharja.info

* Correspondence Author: e-mail: triwahyuningsih@raharja.info

Received: 13 January 2021; Revised: 24 January 2021; Accepted: 19 February 2021; Available online: 24 March 2021

Abstract

Many organizations are making changes by using information technology to support their business activities. Routine and uncomplicated activities tend to be carried out supported by computer-based applications. These activities include diagnosing damage and performing maintenance on the printer. This study aims to develop an Excel system application for fault diagnosis and maintenance of printers. The expert system printer damage diagnosis application in this study was developed based on a knowledge base. The research was conducted through the stages of needs analysis, design, implementation and testing. The test results show that the application developed is able to diagnose and display printer defects and provide solutions and fixed it.

Keywords: android, epson L3110 printer, expert system, web based.
1. Introduction

Printer is a supporting tool needed in computerized activities. In general, users do not know the problem or damage to the printer that they are experiencing and have to bring the printer to a repair shop which costs money and time (Razak & Tanamal, 2019). Though printer problems can be resolved by yourself (Rahmawan, 2014). To overcome this, an expert system for printer damage diagnosis was created using the unified modeling language and reuse method (Putra & Andriani, 2019). Use this application by entering the symptoms that occur on the printer. After that the system displays the damage and provides a solution to fix it (Noviardi, 2020; Suleman et al., 2018).

It is believed that by designing and using the right system, every user can save time and costs that should have been spent for much more important purposes. The system in question is a web-based expert system and an android application that adopts knowledge sourced from an expert in the field of printer failure diagnosis and handling.

The expert system shows that if a match is found between the symptoms and the disease, the system calculates the combination CF value according to the existing rules. The highest level of confidence determines the final decision, following the lower level of confidence in the final decision is the alternative to choose. In other words, Certainty Factor is a mathematical theory to look for evidence based on the belief function and sensible reasoning, which is used to combine separate information and calculate the probability of an event (Riadi, 2017).

2. Research Methods

The system development in this research generally consists of four stages, namely data collection and requirement analysis, design, construction and implementation, and testing. This development stage has several similarities with that carried out in system development in general (Maghfiroh et al., 2020; Sari, 2018). The data collection stage and requirement analysis were carried out by observing the work of experts when dealing with problems with
the printer. The design stage, at this stage the system design is described in the form of use case diagrams and class diagrams.

In addition to using the unified modeling language method, web-based design and an android application for expert system troubleshooting and printer maintenance in this study also used the reuse method. The reuse method is used at the design stage. The reuse method is used with the aim of speeding up the design process and making the developed applications. This is because the reuse method allows the use of elements that already exist in the system to be used in a system that is being developed (Maghfiroh et al., 2020). The reuse method was chosen to accelerate system development (Fikri et al., 2019; Suhartanto et al., 2016). Meanwhile, the construction and implementation stage approach, namely the activities of building a system based on the model described. The last stage is testing the system being developed.

3. Results and Discussion

3.1. System Design

Web-based design (back-end) and an android application for expert system troubleshooting and printer maintenance, especially the Epson L3110 printer developed using the unified modeling language and reuse methods. The system design is based on requirements analysis carried out in analysis activities (Fikri et al., 2019). The system design is described in the form of use case diagrams, activity diagrams and class diagrams.

a. Use case diagram

Web based design design (back-end) and android application (front-end) for expert system troubleshooting and printer maintenance designed to be described in the form of a use case diagram. In Figure 1, access can be seen by two different actors, namely, Admin as a web-based design (back-end) and an android application (front-end) for expert system troubleshooting and printer maintenance and visitors as users of the android application (front-end).

Where if the admin wants to manage this application, they have to log in on the web based (back-end) to be able to add, delete and edit existing data. Users can view information and diagnose in the android application (front-end)
of the printer troubleshooting and maintenance expert system without having to log in. This makes it easier for users to obtain fast and precise information (Suendri, 2018). Figure 1 shows the form of a use case diagram.

![Use Case Diagram](image)

Source: Research Result (2021)

**Figure 1. Use Case Diagram**

b. Class Diagram

Class diagram is an attribute and operations that exist in a system that is being designed. Web based design (back-end) and android application (front-end) for expert system troubleshooting and maintenance of the Epson L3110 printer developed are described in the form of a class diagram. The class diagram of the expert systems application developed in this study is shown in
Figure 2. The class diagram in Figure 2 shows that the system administrator is given the authority to manage data on Printer Symptoms, Printer Faults, Printer Consultation, Application Info and Printer Diagnostic Rules (Heriyanto, 2018). Meanwhile, visitors can only view and access applications, receive information and diagnose printers. Figure 2 shows the class diagram.

3.2. Knowledge Base

Knowledge Base contains knowledge for understanding, formulation and problem solving (Rambing et al., 2016). This knowledge-based system component is proposed on two grounds, namely facts and rules. Facts are...
information about objects in a particular problem area, while rules are information about how to obtain known facts. There are two designs made, namely the design of the symptom data in table 1 and the design of the damage data in table 2.

Table 1. Damage Data

| Code  | Name Damage                                                                 |
|-------|----------------------------------------------------------------------------|
| G001  | The printer can turn on                                                    |
| G002  | The printer is detected on the computer                                   |
| G003  | USB cable is damaged                                                       |
| G004  | Printer software already installed                                         |
| G005  | The printer can print                                                      |
| G006  | Poor print results                                                         |
| G007  | Printing vertical lines or tables are not straight results                 |
| G008  | The print jumps down                                                       |
| G009  | Ink does not come out when printing                                        |
| G010  | There is still ink in the cartridge                                        |

Source: Research Result (2021)

Table 2. Damage Data

| Code  | Name Damage                  | Solution                                                                                   |
|-------|------------------------------|-------------------------------------------------------------------------------------------|
| K001  | The printer cannot turn on   | 1. Make sure the power cable is installed correctly                                        |
|       |                              | 2. Check the adapter with multi meters, if dead replace the adapter                         |
|       |                              | 3. Change the mainboard                                                                   |
| K002  | The printer software is corrupt | 1. Reinstall the printer software                                                         |
|       |                              | 2. Replace the printer USB cable                                                          |
| K003  | Encoder dirty/damaged        | 1. Make sure no foreign objects are stuck in roll printer                                   |
|       |                              | 2. Clean and check the encoder, ink might have been splatted                               |
|       |                              | 3. Make sure the IV line is installed properly and does not interfere with the running of the cartridge |
| K004  | Disk Timing is dirty/damaged | 1. Check the disk timing on the left side of the printer to clean or replace it           |
|       |                              | 2. Clean the disk timing sensor. If it still cannot replace the new disk timing sensor     |
| K005  | The PE/ASF sensor            | 1. Make sure there are no objects / pieces of paper left in the                             |

Source: Research Result (2021)
| Code | Name Damage          | Solution                                                                 |
|------|----------------------|--------------------------------------------------------------------------|
|      | is dirty or damaged  | printer                                                                  |
|      |                      | 2. Check the PE / ASF sensor with a tester. If it doesn't work, replace it with a new PE / ASF sensor |

Source: Research Result (2021)

a. Knowledge Acquisition

Knowledge acquisition is the accumulation, transfer and transformation of problem-solving expertise from knowledge sources into computer programs. This method is usually written in the form if-then (If-Then) (Sinaga et al., 2017). This method implies a relationship of two parts, namely premise and conclusion. If the premise is fulfilled, the conclusion is also true. There are 17 acquisitions used in knowledge based systems to identify printer defects, which is:

1) Rule a: IF Cartridge is not detected AND Carriage Error THEN Damage to P02 on the printer.
2) Rule b: IF Timing Disk is dirty/damaged AND Line feed error THEN Damage to P03 on the printer.
3) Rule c: IF Canon paper detection sensor Error AND ASF sensor error THEN Damage to P05 on the printer.
4) Rule d: IF Overheating in the Canon printer AND Internal temperature error THEN Damage to P06 on the printer.
5) Rule e: IF Printer Canon asks for reset using Software AND Ink absorber full THEN Damage P07 on the printer.
6) Rule f: IF Head heat exceeds the threshold AND Print head temperature rise error THEN Damage to P08 on the printer.
7) Rule g: IF Canon EEPROM board is corrupt AND EEPROM error THEN Damage P09 on the printer.
8) Rule h: IF Cartridge is left empty and used to print continuously AND Logic Board / Carriage Unit/Second Cartridge is Damaged THEN Damage P10 on the Printer.
9) Rule i: IF Printer is overcurrent from USB Printer AND USB VBUS over current cable THEN Faulty P15 on the printer.
10) Rule j: IF Other hardware damage AND other hardware error THEN Damage to the P20 printer.
11) Rule k: IF Scanner does not work AND Scanner error THEN Damage to P22 on the printer.
12) Rule l: IF there is a problem in the printer machine THEN Blinking damage 3 x orange, 1 x green.
13) Rule m: IF Printer absorber is full or printer absorption is maximal THEN Blink Damage 4 x orange, 1 x green.
14) Rule n: IF your color/ lack cartridge is damaged THEN Blinking Damage 5 x orange, 1 x green.
15) Rule o: IF color cartridge is damaged THEN Blink Damage 7 x orange, 1 x green.
16) Rule p: IF Ink tank is full or your ink tank is full THEN Blink Damage 8 x orange, 1 x green.

| Symptom Code | Symptoms                                      | Yes | Not | Damage Code |
|--------------|----------------------------------------------|-----|-----|-------------|
| G001         | The printer can turn on                      |     |     | G002   K001 |
| G002         | The printer is detected on the computer      |     |     | G005 G003 K001 |
| G003         | USB cable is damaged                         |     |     | G004 K013 |
| G004         | Printer software already installed           |     |     | G006 G012 K002 |
| G005         | The printer can print                        |     |     | G007 K015 |
| G006         | Poor print results                           |     |     | G008 K003 G009 K004 |
| G007         | Printing vertical lines or tables are not straight results |     |     | G007 K015 |
| G008         | The print jumps down                         |     |     | G008 K003 |
| G009         | Ink does not come out when printing          |     |     | G010 G011 |

Source: Research Result (2021)

Figure 3. Rules

b. Implementation Result

The results of the implementation of the developed application are shown in Figure 4 to Figure 6. Figure 4 shows the display icon display, splash and main menu. The icon image represents the application that is on the main menu of the android smartphone. While this launcher icon is an expert system logo on troubleshooting and maintenance of Epson L311 printers. The launcher icon serves to run the application when selected. The splash screen is the display
when the application is first run. The splash screen display in Figure 4b in this study is similar to that developed previously (Lengkong et al., 2015). While the main menu display is shown in Figure 4c.

Figure 4a. Icon display

Figure 4b. Splash screen

Figure 4c. Main menu

Source: Research Result (2021)

Figure 4. Application
Figure 4c is the main menu display of the developed expert system application. The main menu describes the name of the application and four sub-menu buttons are provided. The four buttons include the consultation sub-menu, consultation sub-menu, symptoms sub-menu, damage sub-menu, and info sub-menu. The consultation sub-menu functions to start diagnosing printer damage, the symptoms sub-menu serves to display a list of symptoms, the damage sub-menu functions to display a crash list, and the info sub-menu functions to display application identity information.

The expert system application developed through this study also provides a diagnostic sub-menu (Figure 5a and Figure 5b). The diagnostic menu serves as an interface for users to interact with the application. The diagnostics sub-menu contains questions about symptoms of printer failure symptoms. Statements of "yes" and "no" are provided for application users, and users need to answer whether the symptoms asked by the system match what they are experiencing. Furthermore, the application provides a 'next' function to continue with the next symptom question (Tsani, 2018).

Figure 5a. Menu Diagnosis
Figure 5b. Results of diagnosis
Expert System Application for Troubleshooting and Maintaining Epson L3110 Printer

PIKSEL status is accredited by the Directorate General of Research Strengthening and Development No. 28/E.KPT.2019 with Indonesian Scientific Index (SINTA) journal-level of S5, starting from Volume 6 (1) 2018 to Volume 10 (1) 2022.

The implementation of the expert system application developed through this study also provides a diagnosis sub-menu (Figure 5a.), A diagnosis result sub-menu (Figure 5b.), A symptoms sub-menu (Figure 5c.) And a damage sub-menu (Figure 5d.). The diagnosis and diagnostic results sub-menu is a display when the user conducts a consultation and the application displays damage information based on the conclusion of the user's answer. Where the next application provides a solution to deal with the printer damage (Figure 5b.). The solution displayed by the expert system application developed is then used as a basis for the user to take further action.

The expert system application for troubleshooting and maintaining printers developed through this study provides a sub-menu on printer symptoms and malfunctions. The symptom sub-menu is shown in Figure 5c.), And the trouble sub-menu is shown in Figure 5d. However, the symptom sub-menu can be accessed by the admin after logging in (Figure 6a.). The restriction of access to the symptom sub-menu aims to protect the knowledge base of the developed expert system application (Henderi et al., 2020). The symptom list sub-menu and the developed damage list are shown in Figure 6b. and Figure 6c.
On the other hand, the expert system application for troubleshooting and maintaining printers also provides a fault list sub-menu (Figure 7a) and a rules based sub-menu (Figure 7b.). This sub-menu can only be accessed by users at the application admin level. Thus, the expert system for troubleshooting and
maintaining printers developed through this research can help diagnose printer malfunctions and perform maintenance.

Figure 7a. Admin’s view for damage

Figure 7b. Admin’s view for rules

Source: Research Result (2021)

Figure 7. Fault and Rules Admin’s View

4. Conclusion

This research has resulted in an expert system troubleshooting and maintenance application for the Epson L3110 printer. The developed application is able to recognize 16 printer faults. The resulting expert system application can be used as a means for troubleshooting and printer maintenance. Research results can be used as a reference in developing expert system troubleshooting and printer maintenance. Applications in this study can only be used for the Epson L3110 printer brand, and to find out printer damage and provide solutions in the form of descriptions. Therefore, the application still requires additional knowledge of printer failure cases. Similar research needs to be carried out to produce similar applications that are capable of troubleshooting and maintenance of printers in general, and applications that are able to provide solution descriptions equipped with video or animated tutorial images to make it easier for users.
Author Contributions
Henderi the topic; Henderi, Efana Rahwanto, Tri Wahyuningsih and Achmad Badrianto conceived models and designed the experiments; Henderi, Efana Rahwanto, Tri Wahyuningsih and Achmad Badrianto the design, coding and testing; Henderi, Efana Rahwanto, Tri Wahyuningsih and Achmad Badrianto analysed the result.

Conflicts of Interest
The author declare no conflict of interest.

References
Fikri, A., Aknuranda, I., & Pradana, F. (2019). Pengembangan Sistem Informasi Aspirasi Online Berbasis Web Menggunakan Pemodelan Reuse-Oriented Development (Studi Kasus: DPM Universitas Brawijaya). Jurnal Pengembangan Teknologi Informasi Dan Ilmu Komputer, 3(2), 1174–1183.

Henderi, Kurnadi, E., & Trisnawarman, D. (2020). Decision Support System Model Determines the Type of Road Construction in Indonesia. IOP Conference Series: Materials Science and Engineering, 852, 012142. https://doi.org/10.1088/1757-899X/852/1/012142

Heriyanto, Y. (2018). Perancangan Sistem Informasi Rental Mobil Berbasis Web Pada PT.APM Rent Car. Jurnal Intra-Tech, 2(2), 64–77.

Lengkong, H. N., Sinsuw, A. A. E., & Lumenta, A. S. (2015). Perancangan Penunjuk Rute Pada Kendaraan Pribadi Menggunakan Aplikasi Mobile GIS Berbasis Android Yang Terintegrasi Pada Google Maps. E-Journal Teknik Elektro Dan Komputer, 4(2), 18–25. https://doi.org/10.35793/itek.4.2.2015.6817

Maghfiroh, A., Henderi, & Maulani, G. (2020). Rancangan Sistem Informasi Pendaftaran Siswa Baru Berbasis Web Pada SMK Putra Rifara. Jurnal Ilmiah MATEK, 22(1), 1–7. https://doi.org/10.33557/jurnalmatem.atik.v22i1.850

Noviardi, R. (2020). Sistem Pakar Berbasis Web Menggunakan Metode
Forward Chaining Dalam Menganalisa Kerusakan Mesin Fotokopi dan Penanggulangannya (Study Kasus di Q-EI Copier Service Center and Distributor). JURTEKSI (Jurnal Teknologi Dan Sistem Informasi), 6(2), 163–172. https://doi.org/10.33330/jurteksi.v6i2.548

Putra, D. W. T., & Andriani, R. (2019). Unified Modelling Language (UML) dalam Perancangan Sistem Informasi Permohonan Pembayaran Restitusi SPPD. Jurnal TEKNOIF, 7(1). https://doi.org/10.21063%2Fjtf.2019.V7.1.32-39

Rahmawan, A. (2014). Sistem Pakar Diagnosa Kerusakan Mobil Menggunakan Metode Forward Chaining [Universitas Muhammadiyah Ponorogo]. http://eprints.umpo.ac.id/161/1/HAL DEPAN, BAB I adytio.pdf.

Rambling, Y. F., Wikarsa, L., & Sanger, J. B. (2016). Rancang Bangun Aplikasi Reminder Maintenance Aset Berbasis Web. Jurnal Lasallian, 13(1), 55–63. https://doi.org/10.31227/osf.io/cpkuz

Razak, K., & Tanamal, R. (2019). Rancang Bangun Aplikasi Sistem Pakar Berbasis Android Untuk Diagnosa Kerusakan Printer Canon MP Series. JURTI, 3(1), 55–64. https://doi.org/10.30872/jurti.v3i1.2458

Riadi, A. (2017). Penerapan Metode Certainty Factor Untuk Sistem Pakar Diagnosa Penyakit Diabetes Melitus Pada RSUD Bumi Panua Kabupaten Pohuwato. ILKOM Jurnal Ilmiah, 9(3), 309–316. https://doi.org/10.33096/ilkom.v9i3.162.309-316

Sari, N. Z. M. (2018). Pengaruh Strategi Bisnis, Metoda Pengembangan Sistem (System Development Life Cycle), Terhadap Kualitas Sistem Informasi Akuntansi (Survei Pada PT Len Industri Persero-BUMN Industri Strategis di Indonesia). Sosiohumanitas, 20(2), 39–53. https://doi.org/10.36555/sosiohumanitas.v20i2.110

Sinaga, M. T. J., Goejantoro, R., & Amijaya, F. D. T. (2017). Penerapan Metode If-Then dari Rough Set Theory dalam Menangani Kecelakaan Lalu Lintas di Kota Samarinda Tahun 2016 The Application of If-Then Method from Rough Set Theory in Handling of Traffic Accidents in Samarinda City 2016. Jurnal EKSPONSENSIAL, 8(2), 145–150.

Suendri. (2018). Implementasi Diagram UML (Unified Modelling Language)
Pada Perancangan Sistem Informasi Remunerasi Dosen Dengan Database Oracle (Studi Kasus: UIN Sumatera Utara Medan). *Jurnal Ilmu Komputer Dan Informatika*, 3(1), 1–9. http://jurnal.uinsu.ac.id/index.php/algoritma/article/download/3148/1871

Suhartanto, A., Kusrini, & Henderi. (2016). Decision Support System Untuk Penilaian Kinerja Guru Dengan Metode Profile Matching. *Jurnal Komputer Terapan*, 2(2), 149–158.

Suleman, Widodo, A. E., Ardiansyah, A., & Fauzi, A. (2018). Sistem Pakar Diagnosa Kerusakan Printer Menggunakan Metode Naïve Bayes. *IJCIT (Indonesian Journal on Computer and Information Technology)*, 3(2), 228–233.

Tsani, M. R. (2018). Aplikasi Sistem Pakar Untuk Diagnosa Kerusakan Pada Printer Dengan Metode Backward Chaining Pada Bahari Komputer Tegal. *Smart Comp*, 7(2), 274–280.