

Laserjet Printer Troubleshooting Expert System

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Abstract

This paper model an expert system called LAPTEX for troubleshooting LaserJet printers' faults. Today, with the innumerable advances in information technologies, computerizing printer's fault troubleshooting and identifying faults is far becoming so vital. Also, printers' fault detection is a complicated process that requires a high level of expertise (formal or informal) and depending on the know-how of the technician, a printer could be abandoned for just a minor fault. Our objective is therefore, to develop an Expert System for troubleshooting a LaserJet printer's faults. The Expert System comprises of a user interface, a rule-base, an inference engine, and a knowledge editor interface. The system is meant to computerize the maintenance, and repair process of LaserJet printers, and give a time-based assistance to those who are in need of instant help when the maintenance experts are not handy. The method of fact-finding called knowledge acquisition which is a knowledge-based approach to extract facts was adopted. The methodology follows the waterfall model of software development life cycle. Java programming language platform was used to implement this system while Net Bean was used to draw the user interface (UI) design.

Keywords: Expert System, LaserJet Printer, Knowledge-Base.

1.1. Introduction

Expert System is a knowledge-based computer program comprising of expert domain about objects, events, situations and causes of actions, which emulates the process of human experts in the particular domain [1]. It is also defined as an intelligent computer program that uses knowledge and inference procedures to solve problems that are difficult enough to require significant expertise. In other words, expert system is a computer application that performs an assignment that would otherwise be performed by a human expert.

Expert systems are one of the branches of artificial intelligence research. Although ExpertSystems do not actually "reason", they are able to apply information

assembled from human experts by a knowledge engineer to new problems. Their suggested solutions to these problems can help users determine the best course of action. Artificial Intelligence's scientific goal is to understand intelligence by building computer programs that exhibit intelligent behavior. It has to do with the concepts and methods of symbolic inference, or reasoning, by a computer, and how the knowledge used to make those inferences will be represented inside the machine.

Much current work in artificial intelligence focuses on computer programs that aid scientists with complex reasoning tasks. Recent works has indicated that one key to the creation of intelligent systems is

the incorporation of large amounts of task-specific knowledge [2].

Several Expert Systems have been developed performing different task ranging from interpretation, prediction, design, planning, model-based to diagnostic and troubleshooting systems.

This paper, LaserJet Printer Troubleshooting Expert System, presents issues in the design of an Expert System while it aimed to develop an Expert Intelligence System for troubleshooting LaserJet Printer.

1.2. LaserJet Printer Mechanics

From manufacturer to manufacturer, and model to model, the exact arrangement and combinations of components can vary in laser printers. However, the order of operations is always the same. The six phases of operation in a laser printer include Cleaning, Conditioning, Writing, Developing, Transferring and Fusing. When character data is received from the host computer, it is converted into a serial bit stream, which is applied to the scanning laser. In Hewlett-Packard printers, the main portion of the printing system is contained in the electro-photographic cartridge. This cartridge contains the toner supply, the corona wire,

the drum assembly, and the developing roller [3].

1.3. The Need for the New System

At this age of information, it is required that all communication devices should be up and running. Printers are essential output devices attached to PCs which need to be functional at all time. Its down time therefore will prove vulnerable, and worst still, if there is no technician to fix the problem immediately. As noted by Kaushik et al [4], most computer users are amateurs when it comes to the age of troubleshooting. According to Deepa and Packiaavathy [5], Expert system is justified when human experts are unavailable or unable to do the job. This Expert System is expected to help those amateurs who are in need of guides to deal with their LaserJet printer problems. Specific objectives of this system are:

- i. To assemble a knowledge-based system that is common to the troubleshooting and intenance of LaserJet printers of various models.
- ii. To present this knowledge in a diagnostic format such that will enable even a non-printer specialist solve their printer problems, and give time-based assistance to those who are in need of instant help when the maintenance experts are not handy.

2.0. Architecture of the LAPTEX Expert System

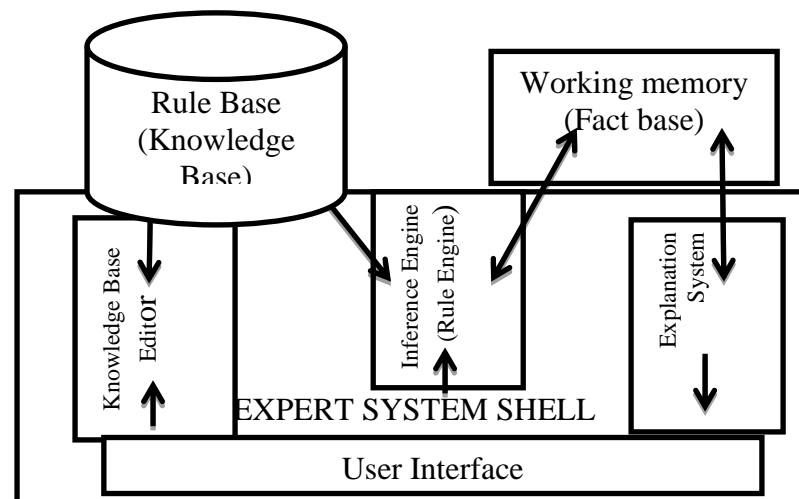


Figure 1: Architecture the LAPTEX Expert System of the

2.1. The User interface

The user interface is the means of communication between the user and the expert system problem solving process [6]. The user interface in this system will be able to accept instructions from user. Users will be asked several questions which they have to answer and will be displayed on the screen in responds to user's request.

2.2. The Knowledge Base

The knowledge base of expert systems contains both factual and heuristic knowledge. Factual knowledge is that knowledge of the task domain that is widely shared, typically found in textbooks or journals, and commonly agreed upon by those knowledgeable in the particular field.

In this study, knowledge acquisition was done through experts in printer repairs, service stations, documented printers faults etc.

2.3. The Inference Engine

This is the code at the core of the system which derives recommendations from the knowledge base and problem specific-data in the working memory [7]. It is the brain logical reasoning on rules and problem-

solving strategies to draw answers and conclusions and infers new knowledge [8]. In the propose system, the authors adopted the goal driven or backward chaining inference technique using the IF-THEN rules to break our goal repetitively into smaller sub-goals for easy proving.

2.4. Different Types of Problem Modules in LaserJet Printer Faults

One of the biggest problems associated with any printer occurs when the wrong paper type, or paper type setting, is used. Because of the extreme complexity of the laser printer's paper handling system, paper jams are a common problem. This problem tends to increase in frequency as the printer's components wear from use. Expert System is able to detect those faults and also to suggest for possible rectification [9]. In the program for the application design, these faults were divided into different modules. The problems includes paper jammed, printer refusal to on, printer start up to offline mode, Image appeared watched out, printer produces missing beam errors, paper not feeding, and other miscellaneous faults

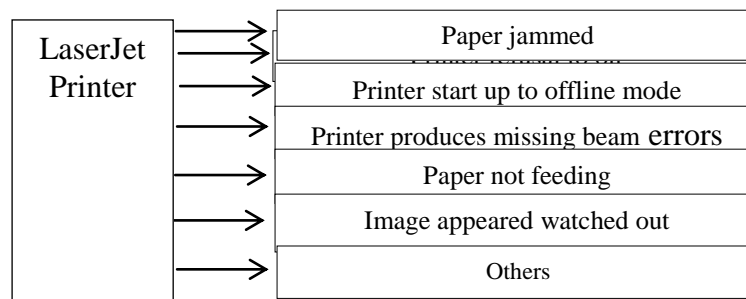


Figure 2: Different Problem Modules of LaserJet Printer Faults.

2.7. Sample Data (LaserJet Printer Problem) for Knowledge-based Creation.

Table 1:sample Data (LaserJet Printer Problem) for Knowledge-based Creation.

| SYMPTOM | CAUSES | SOLUTION |
|--------------------------------------|--|---|
| Printer Does not start up | Power supply cord and outlet is bad Internal fuses are bad The motor and gear train is bad | Check all the normal power supply components. Check the internal fuses. Replace these components if they are gone bad. |
| Image appeared watched out | Power supply that serves the corona wire is bad. The Drum section of the printer is also faulty. | Replace high voltage section of the power supply. Allow printer to cool sufficiently and then replace the corona wire with a new one. Always avoid placing conductive instruments in the high voltage area. |
| Printer produces missing beam error. | The DC portion of the power supply has failed. The laser/scanning module is affected. Control board is affected. | Replace DC of the power supply. |
| Paper jammed | This is result from incorrectly setting the paper tray switches in a laser printer. | Troubleshoot the particular section of the printer where the jam is occurring-pickup, registration, fusing area, and output devices (collators and duplexers). |

3.0. Methodology

The methodology adopted in the design of this system is presented in the figure 4 below. The methodology follows the waterfall model of software development life cycle and the 2.0 Specification of Unified Modelling Language (commonly known as UML 2) .Java programming language platforms was used to implement this system. The choice was as a result of features supported by the language. Java is a powerful programming language, it is portable, robust, multi-platform enabled,

has rich library, simple, etc. [10].The key features are inheritance, polymorphism, reusability, knowledge representation, integration or extensibility. Java is an object-oriented language and it's used for opened distributed application [11]. Net Bean is used to draw the user interface (UI) design. It is efficient, effective and reduces time consuming to draw User Interface in writing desktop application with java.

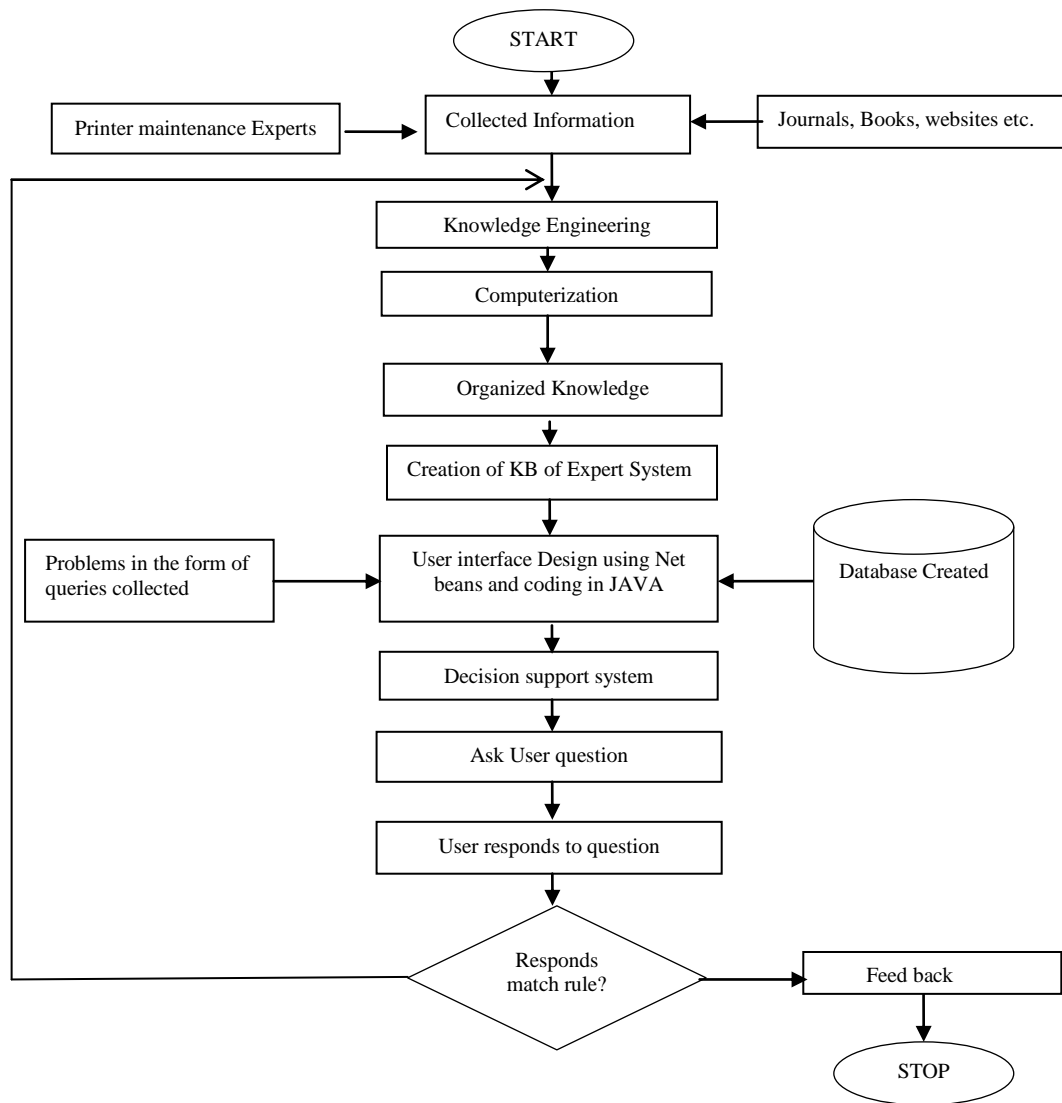


Figure 3: Waterfall Model of the LAPTEX Expert

3.1. Algorithm of the LaserJet Printer Expert System

Below is the algorithm used by the inference engine of the LaserJet printer (LAPTEX) troubleshooting Expert System.

Step 1: Get the facts and stored them in the working memory

Step 2: Check the condition part of the rule of the rule-base (at left hand side)

Step 3: If conditions matched, execute the right hand side (fire the rule).

ELSE

Repeat, if more facts are present

Step 4: Load the next facts and update the working memory with it.

Step 5: Goto step 2

Step 6: Use conflict resolution strategy to select more appropriate rule, and fire the rule if all conditions matched.

Step 7: Continue until all facts are treated

3.2. Decision Tree for Knowledge base Creation

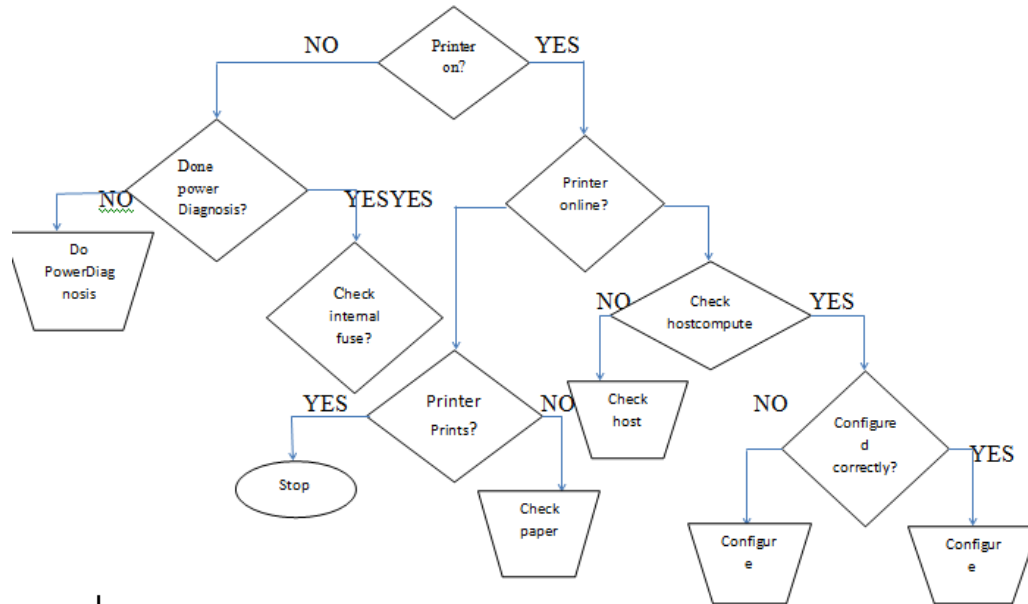


Figure 5: Decision Tree for KB Creation

3.3. Sample Rules in the Rule-base

IF *Printer is on*
 AND Printer is on to online mode
 AND Printer refuses to print
 AND Red light lit on

THEN There is Paper Jam or the right paper is not used. Use right size of paper.

4.0. Implementation

Java programming language platform was used to implement this system. The choice was as a result of features supported by the language. Net Bean is used to draw the user interface (UI) design. It is efficient, effective and reduces time consuming to draw UI in writing desktop application with java. Good and interactive user interface will encourage users to use the application [12]. A user friendly interface was designed in the system. When the user has launched the application after finishes all required installations. When the application has started, it display a welcome message printed in English language and prompts user to Click on “Welcome”. When the

user clicked the ‘Welcome’ button, system login form appears prompting the user to enter user name and user password. When user typed password correctly, it takes the user to the main screen (user interface screen), else, it respond with an error message.



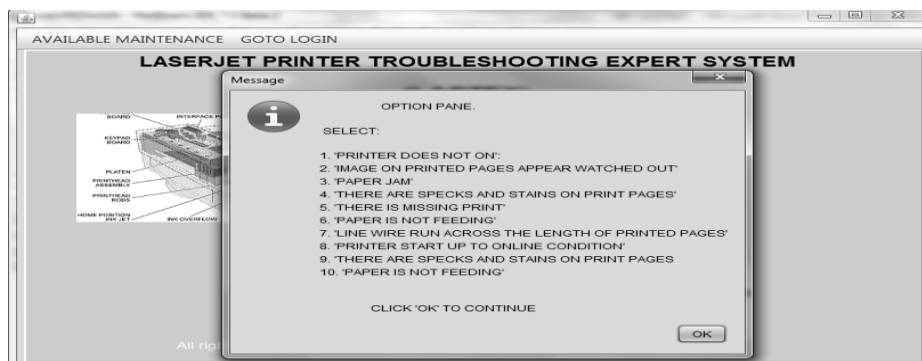
Display 1: Welcome Message of the LAPTEX



Display 2: System prompts Users to Login



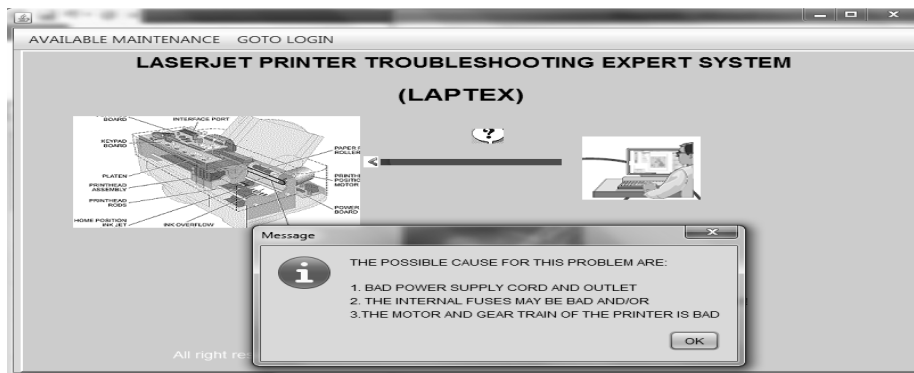
Display 3: User Interface Main Screen



Display 5: System Instructs User on how to Interacts with the Interface



Display 6: System Prompts User to Enter a Number that Corresponds to his Problem



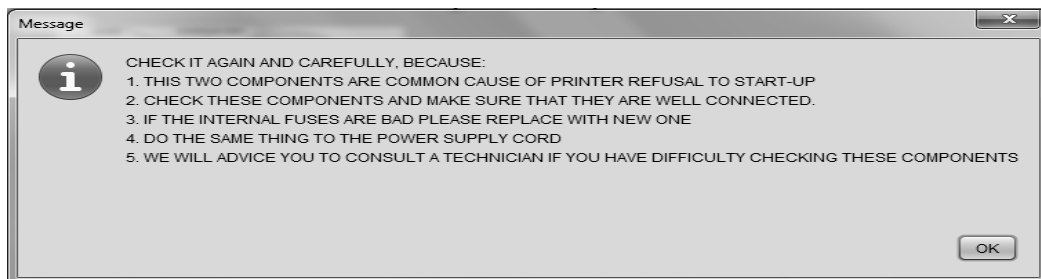
Display 7: System Responds to User Request.



Display 8: System Starts a YES or NO Query with the User as Troubleshooting Begins



Display 9: Query continues



Display 10: **System Display Troubleshooting Summary to User at the End of the Interactions.**

5,0 Conclusion

This paper presents Expert System to troubleshoot LaserJet printer's faults. The System, LAPTEX, was develop and tested.

It diagnoses the problem, and gives advice to the user on how to locate the exact cause of the problem and to repair it.

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