EXPERT SYSTEM TO TROUBLESHOOT AND MAINTAIN HP LASER JET PRINTERS

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Abstract-Expert system is the first realization of research in the field of Artificial Intelligence (AI), in the form of a software technology. It addresses the decision-making process with the use of symbols rather than numbers [12]. This paper presents an expert system to troubleshoot and maintain HP Laser Jet printers. An interface is designed for computer users to insert or input their printers’ problems and then provide appropriate and correct solutions to those problems. Updating of knowledge base and view of various printers problems with their solution can also be done from the interface. This system is greatly applicable and useful for computer users that are amateurs in troubleshooting computer peripherals especially printers to ease their works and promote their business.

Keywords: troubleshooting, expert system, Laser Jet, Personal Computer

I. INTRODUCTION

Printers of any series are expensive that need proper and adequate maintenance so as to have long life span. Complex electronic devices that are neglected or not using correctly can result into serious and complex problems that will be difficult to solve for any investment. However, one can avoid the problem through proper setup, regular maintenance and purchasing of quality supplies and consumables.

There are various problems being faced by businessmen that are using printers for their business activities in Federal Polytechnic, Offa and its environments to have their daily income. Among problems being faced is the problem of poor print-out, paper jams, cartridge problem, drum palaver and all other minor problems and these have led to poor patronage by the students because students prefer good quality work to the poor ones. Most of the assignments, seminars and projects to be submitted which are of lower quality are always rejected by the lecturer(s). Therefore, the students’ patronages to business centers where they can get better quality jobs are very high. However, it is of high importance to design an expert system that will be able to diagnose printers’ problems and provide solutions to those problems since printers’ engineers are not always available as at when their services are needed and only few of them are residing in Offa making it difficult to get engineer when minor error occurs.

An expert system is a computer system that emulates decision making ability of a human being. Therefore, designing an expert system will allow the businessmen to troubleshoot their printers and provide solutions to problems encountered before the arrival of the engineer. The aim of this research work is to design an expert system to diagnose HP Laser Jet Printers and suggest appropriate solutions to the problems and this will definitely make work easier and faster.

Expert system to diagnose printers will assist not only the businessmen, but also schools and individuals that are making use of printers to increase the life span of the printers, boost business activities as well as having good print-out quality. Moreover, this will also reduce the efforts of engineers because tampering with printers before locating problems will be drastically reduced.

II. RELATED WORKS

Over the past several years [7], there have been many implementations of expert systems using various tools and various hardware platforms, from powerful LISP machine workstations to smaller personal computers. The technology has left the confines of the academic world and has spread through many commercial institutions. The expert intelligent system is introduced to develop hardware fault detection for any computer system. Author [1] emphasized on an automated system which accepts faults of any system and make consultation with intelligent database and then diagnoses and advises for proper rectification. The paper was implemented by Turbo prolog programming language. The paper also extended the concept of exploring Objected Oriented web based programming approach.

Successful machine diagnosis consists not only of sound diagnostic reasoning, but also the selection of appropriate repairs, sequencing the repairs correctly, interactively validating the success of each repair, and performing follow-on diagnosis in case of repair failure [2]. The paper focused on issues involved in formulating a repair strategy for an expert system and also review some aspects of expert human behavior with respect to repair strategy in a complex domain. Implementation of a repair strategy in the TEST diagnostic shell was also discussed in their paper.

Professional expertise and artistic accomplishment are required in production of a map or an atlas because it is a creative procedure [3]. MAPKEY was developed by the authors, which is based upon GIS systems and integrates Database, Knowledge base and computer graphics. MAPKEY covers almost all procedures of thematic map making, such as map type selection, symbol design, data grading, color design, four color separation and film output, and provide a color environment. The paper discussed ‘inside story’ of MAPKEY and...
revealed some concepts of map design.

Author [4] did a research on survey and extension on the use of Artificial Intelligence and expert systems in accounting databases. The paper elicits a number of concerns often voiced about accounting databases. Artificial Intelligence and expert system served as basis to mitigate those problems. Demons and objects are found to be useful devises to facilitate the organization, storage and application of intelligence for accounting database systems and Models for their use were also presented.

In troubleshooting Computer Systems the two most common causes of delay are Trial and Error and having Incomplete Information. The problems in Computer Systems will be fixed faster if the Possible Cause of the Problem is already known. A solution to this is to use an Expert System [5]. Expert System Algorithm that creates the rules of an Expert System was employed in solving the two most causes of delay which are Trial and Error and having Incomplete Information. The rules created from the algorithm are nominal in terms that only the necessary information needs to be inputted. In instances that the data gathered are incomplete the correct Possible Cause can still be suggested. The research provided a theorem about the Information Dependency of Data which can be used with Incomplete Information Systems and unknown data; Formal Proof of the theorem was provided and its correctness was also verified with actual data.

Acquiring knowledge has long been the major bottleneck preventing the rapid spread of AI systems [6]. The paper discussed various ways of acquiring knowledge with their limitations: (1) Manual approaches are slow and costly (ii) Machine-learning approaches have limitations in the depth and breadth of knowledge they can acquire and (iii) The spread of the Internet has made possible a third solution. The research was in support of building knowledge bases by mass collaboration with thousands of volunteers also contributing simultaneously. The approach promises large improvements in the speed and cost of knowledge base development, it can only succeed if the problem of ensuring the quality, relevance and consistency of the knowledge is addressed, if contributors are properly motivated. The paper proposed an architecture that meets all these desiderata. It uses first-order probabilistic reasoning techniques to combine potentially inconsistent knowledge sources of varying quality, and it uses machine-learning techniques to estimate the quality of knowledge.

Computers [8] have simplified our working life to be more efficient and productive, for example, communication can be done through mail and instant messaging, presentation can be shared through Net-meetings and meeting minutes can be stored in workspace or shared drives. Computers, especially notebooks and laptops are very synonymous with mobile lifestyles as it is very convenient. However these gadgets sometimes malfunction and not every computer owner is a troubleshooter or able to find out the root cause of the malfunction. The paper presented an expert system that is limited to PC hardware maintenance and troubleshooting covering the Monitor, Hard drive, Keyboard, Mouse, Audio device, and Missing/Lost Documents via a rule base diagnostic system using PHP.

Computer security auditing [9] constitutes an important part of any organization’s security procedures. Be- cause of the many inadequacies of currently used manual methods, thorough and timely auditing is often difficult to attain, the paper presented an example of a novel expert systems application, an Expert System for Security Auditing (AudES) and discussed Issues in development and use of the expert system that are unique to the application domain.

Emerging integration of the printing requestor with the manufacturing operations for printed products and how expert systems software engineering makes this possible was presented by [10]. In addition, an “Economic DNA” metaphorical model was also presented whereby each individual printed work being produced can automatically report basic cost building blocks from the manufacturing process that are unique to that work being produced. This Economic DNA in turn communicates with the expert systems in the network, offering a cybernetic system for print production control. Some examples of off- the-shelf emerging technologies as well as impact of the technology on people were also discussed.

In the current world [11], the most popular communicating device is the personal computer and its downtime will prove fatal for the corporate competence. Apparently most of the computer users are amateurs when it comes to the area of troubleshooting, a predicament that arose in computer hardware. One such computer hardware that is essential part of every office is printer. The authors proposed a new expert system named “Printer Troubleshooting Expert System” for troubleshooting printer issues in MS-Window based Personal Computers. If the printer in the office or at home is malfunctioning, then the situation requires a hardware specialist. However, using an expert system will be an economic and rapid solution and will overcome the need of a hardware expert.

III. DESIGN OF THE PROPOSED SYSTEM

Expert systems are computer applications which embody some non-algorithmic expertise for solving certain types of problems. For example, expert systems are used in diagnostic applications servicing both people and machinery. They also play chess, make financial planning decisions, configure computers, monitor real time systems, underwrite insurance policies, and perform many other services which previously required human expertise.

The major components of an expert system are:

1. **Knowledge base**: This is a declarative representation of the expertise, often in IF-THEN rules
2. **Working Storage**: The data that is specific to a problem being solved
3. **Inference Engine**: The code at the core of the system which derives recommendations from the knowledge base and problem-specific data in working storage.
4. **User Interface**: The code that controls the dialog between the user and the system.
There are stages involved in the achievement of this research. The first stage is the collection of knowledge required to solve various problems or faults that may be associated with HP Laser Jet printers. This stage involves acquisition of knowledge from printers’ engineer. We consulted, at least, two of the engineers that are very good in aspect of repairing printer to seek for likely faults associated with printers and possible solutions to those faults. These set of facts are stored in a database to make inference or find solution to a given problem. Fig.1 illustrates the architectural design of our work.

![Architecture of the Expert System](image)

**Figure 1: Architecture of the Expert System**

The Fig. 1 has clearly explained the design steps which involve collection of useful facts from printers’ expert that is stored in computer which was later coded for the users to infer or draw conclusion from the knowledge base. Fig. 2 indicates the interface for our system.

![Troubleshooting and Maintenance Interface](image)

**Figure 2: Troubleshooting and Maintenance Interface**

The troubleshooting and maintenance interface is sub-divided into four (4) submenu which are:

(i) Knowledge
(ii) Troubleshoot/Maintain printer
(iii) View and
(iv) Exit

Knowledge submenu is provided for the printer expert to be able to insert other discovered problems, their causes and likely solutions for those problems. The essence of this is to be able to update and store all the necessary information relating to any fault into our working storage.
The most paramount submenu of all the menus is troubleshoot/maintain submenu as shown in Fig. 4.

This interface is provided for the users to diagnose and maintain their printers effectively without the need of an expert. Here, the user can enter problem they are experiencing along with the keyword. Once this information has been entered and the user click “show” button, then the solutions for the problems is displayed which directs the users to diagnose their printers.

View submenu is provided just to display the list of printer problems, their causes as well as solutions to the problems.
The last submenu on our interface is the Exit key where the users can stop and close the environment.

IV. RESULT AND DISCUSSION

Once the expert system is developed, then it is ready for implementation in the real world. This section is very important because the system must work perfectly and give correct solutions to real world problems. Our system was tested and provided accurate results as required. The figures below show the result of the system when used to diagnose HP laser Jet 2015.

Fig. 6 shows an interface to diagnose printers if there is a paper jam. The solutions to the problem as well as pictures to guide the users to appropriately fix those problems were displayed. From fig. 6, the solution to the problem is that the user should clean the pickup roller by listing the procedures to be followed.
Our result also displayed solutions to problem of having poor printing or fade printing as shown in Fig. 7 and lists solutions to tackle the problem. The research is applicable to any kind of problems or faults like picking of more than one sheet, no power etc that are associated with HP Laser jet printers.

V. CONCLUSION

This paper proposes expert system on troubleshooting and maintenance of HP Laser Jet printers that is capable of handling any predicament associated with printers. The result of our research shows that the system works excellently with all kind of printers. The system can be used to train apprentice, technicians and computer users to diagnose and troubleshoot any kind of printers with little assistance of experts. Our system makes provision for updating of knowledge base when the need arises.

REFERENCES


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