# Design of Computer Fault Diagnosis and Troubleshooting System (CFDTS)
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## ABSTRACT
*Detection of personal computer (PC) hardware problems is a complicated process which demands high level of knowledge and skills. Depending on the know-how of the technician, a simple problem could take hours or even days to solve. Our aim is to develop an expert system for troubleshooting and diagnosing personal computers thereby assisting personal computer owners in dealing with their computer problems especially when the time is limited and human expert is not available. We model our system using Object-Oriented Analysis and Design (OOAD) and UML (Unified Modeling Language). In this paper we adopt method of fact-finding called knowledge acquisition which is a knowledge-based approach to extract facts and we introduce various sets of rules into our system for detecting different types of failures which can be easily handled by the PC owners and will give their causes. The data extracted from experts is stored in the knowledge-base of the Expert System shell. The graphical user interface, the expert system shell and the database of the model are developed by integrating Netbeans, Java language, MySQL database tool and the dynamic linking library (DLL) files.*

**Keywords**: Diagnosis, Expert System, Knowledge-based, Troubleshooting, Knowledge Acquisition, UML.

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1. **Introduction**

Computers are machines and the more we rely on them the more vulnerable we find ourselves when they fail. The consequences are damage to important data, waste of resources and frustration. According to Ikekeonwu [1], before one can use a computer, the computer must be operating. One sets the computer operating by starting (or booting) it. Many things can obstruct the operation and performance of the computer. Troubleshooting and diagnosing a computer system is a knowledge-intensive task. Depending on the experience of the technician, a simple problem could take hours or even days to solve. An Expert System offers a viable solution to the problem. According to Pomykalski, Truszkowski and Brown [2], an Expert System is a computer program that is designed to imitate the decision-making ability of a decision maker in a particular narrow field of expert knowledge or skill.

The specific task of an Expert System is to be an alternative source of decision-making ability for organization to use instead of relying on the expert knowledge or skill of few people or just one person. The focus in the development of expert system is to acquire and represent the knowledge and experience of a person(s) who have been identified as possessing the special skill or mastery [2]. The primary intent of expert system technology is to realize the integration of human expert knowledge into computer process. This integration allows humans to be freed from performing the more routine activities that might be associated with a computer-base system. This agreed with Kaushik et al [3], who acknowledged the ability of Artificial Intelligence for creating machines that can engage on behaviors that humans consider intelligent.

Expert systems have caused revolution in the way we think about work, skill and their possibilities for computerization. Expert system addresses real needs [4]. Knowledge is of central importance to expert system. Data, facts and information are terms used with the meaning of knowledge. The process of building an expert system is commonly known as knowledge engineering. Knowledge engineering implies acquisition of knowledge from a human or other source and coding it into the knowledge base of the expert system [5].

According to Jones and Barrett [6], Expert systems are not suited for all types of problems. Initially, many developers actively sought problems amenable to expert system solution or try to solve all problems encountered using Expert system. Expert systems are verified specifically. Petrovic [7] also noted to be that expert systems are tailored-made for specific and narrowly defined problem area. For example, a diagnostic expert system for troubleshooting computers must actually perform all the necessary data manipulation as a human expert would. The developer must limit his or her scope of the system to just what is needed to solve the target problems. Duke and Regenie [8] admitted that expert system technology has been identified as a potential solution to some of these problems.

Several general approaches for developing expert system have been proposed. Waterman [9] has provided the most widely accepted approach: identification, conceptualization, formalization, implementation and testing. Despite its potential for bringing automation and computer aided decision making into areas that are time and information demanding, Jones and Barrett [6] noted that expert systems are complex information systems that are expensive to build and difficult to validate. According to the author, several knowledge representation approaches such as rules, semantic networks, frames, objects and logical expressions have been developed to provide high-level concept of a system. Gathering, analyzing and modeling of knowledge are activities necessarily undertaken when developing expert system.

Fault diagnosis is very important in the field of computer engineering and information technology, especially in personal computer (PC) troubleshooting. Today, the use of computers is widespread. However, the knowledge in computer troubleshooting is limited, and this poses difficulties among organizations when faced with computer problems. This expert system is developed to assist and advise computer users in the diagnosis and troubleshooting of computer system.

The acquisition of knowledge in this paper is conducted through interviews with technicians in the computer repairs workshop and the Technical staff of Cross River State ICT development department (maintenance and engineering section),

Calabar. The main objective of this research is to develop an Expert System for diagnosing and troubleshooting Personal Computers (PC) faults that can assist PC end-users in dealing with their PC problems and also assist PC technicians in accurate diagnosis of PC fault by providing a systematic and step-wise analysis of failure, possible cause (s) of the failure and offer maintenance recommendations. The specific objectives to meet the above are: to examine the situation base on the user's input to the system, identify the problem and provide a systematic and step-by-step analysis of the causes of the problems, as well as provide maintenance recommendations to users, and

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also guide them on how to get help from a more technical expert in situations which are less clear.

## 2.0 The Computer Fault System

The Computer Faults troubleshooting Expert System, like any other knowledge-based expert system consists of the knowledge-base, the inference engine, the explanation facility system, and the user interface. The architecture presented below show the cycle of activities and interaction in the development of the PC faults troubleshooting system
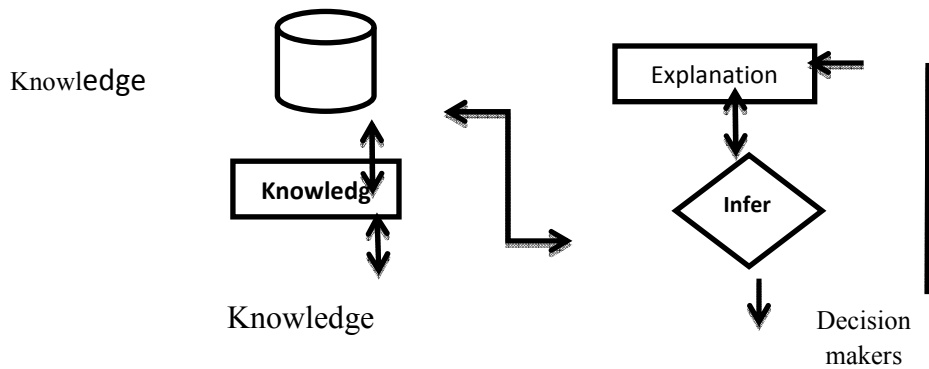
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Knowledge

Knowledge

Knowledge

Explanation

Infer

Decision makers

**Fig. 1 : Architecture of the Faults Troubleshooting System**

### 2.1 Different Types of Problem Modules in Computer Fault

In a computer system, different faults may arise from its different parts, in which an expert System is able to detect those faults and also to suggest for possible rectification [10]. In our program for the application design, these faults were divided into

different modules. The problems includes CD/DVD problems, system's Boot failure, Monitor/screen problems, Power problems, Sound problems, printer problems, and other miscellaneous faults
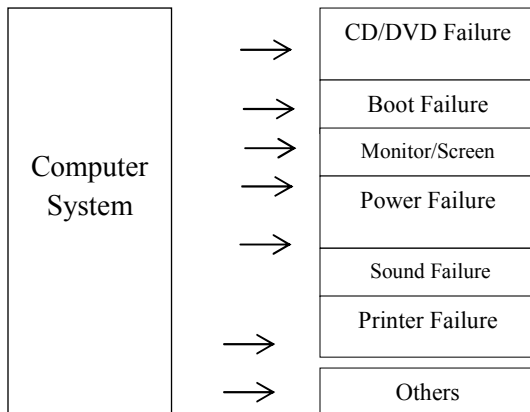
**Figure 2: Different Problem Modules of Computer System Faults.**

**Table 1: Sample Data (Computer System Problem) for Knowledge-based Creation**

| SYMPTOM | POSSIBLE CAUSE/FAULTS | POSSIBLE SOLUTION |
|---------|----------------------|-------------------|
| Screen goes Blank Periodically | Screen saver is enabled | Disable screen saver |
| Keyboard failure | Keyboard is disconnected | Reconnect keyboard. Check keys again, if no improvement replace keyboard. |
| C: drive failure. | SET UP program does not have correct information. Hard drive cable not connected properly. | Boot from drive A: using DOS system disk. Input correct information to SETUP program. Check hard drive cable. |
| Screen is blank. | No power to monitor. Monitor not connected to computer. Network card I/O address conflict. | Check the power connector to monitor and to system. Make sure monitor is connected to display card. Change I/O addresses on network card if applicable. |

## 3.0 Methodology

In this research work, an extensive study on the design of an expert system for computer fault diagnosis was conducted. The design model adopted in this work is the

object-oriented analysis and design (OOAD) with Unified Modeling Language(UML).UML is a graphical language that allows people who design software systems to use an industry standardnotation to represent them. The UML is now the most widely used graphical representation scheme for modeling object systems. An attractive feature of the UML is its flexibility. UML modelers are free to use various processes in designing systems. The UML is a complex, feature-rich graphical language [11]. The UML specifies diagram for documenting the system behaviour. Two UML diagrams (Use Case and Activity diagrams) are used to explain the behaviour of the Expert System as shown in the figures 3and 4below.
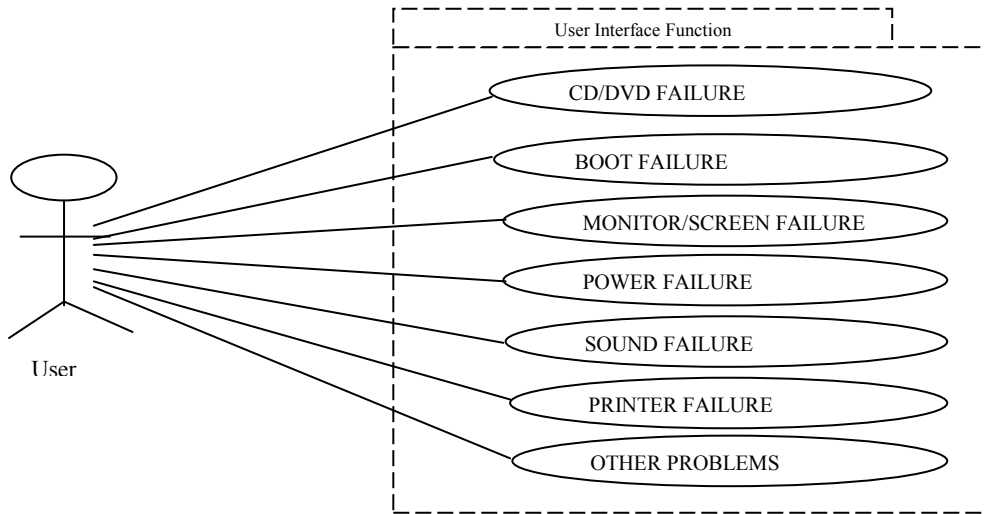


**Figure 3: Use Case Diagram showing the interaction between the user and the system.**
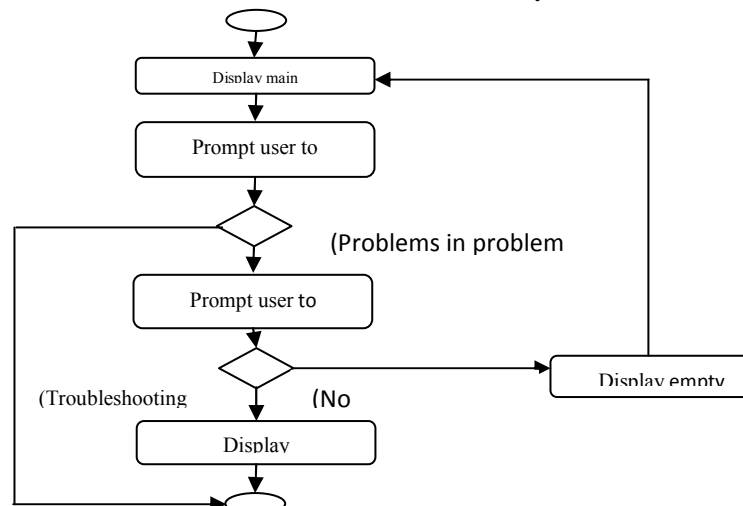


**Figure 4: Activity diagram of the Computer Troubleshooting Expert System.**

The expert system shell development in this research work involves the user interface, the explanation facility, the knowledge base, and the inference engine. The knowledge base of the expert system stores the extensive knowledge gathered from experts, in the form of production rules, which contains the IF THEN rules. The data gathered are put in the data base of the application. The inference engine provides the system control. It matches facts in the working memory against rules in the rule base, and it determines which rules are applicable according to the reasoning method adopted by the engine.

The User Interface will allow users to consult the expert system in a user friendly manner for decision support.

The working memory contains the information that the system has received about the problem at hand. In addition, any information the expert system derives about the problem is also stored in the working memory.

## 3.1 **SampleRules in the Rule-base**

*I F*         *No live screen*

      *AND*    *Power diagnostic is done*

      *AND*    *Video diagnostic is done*

**The Database Design of the Fault Diagnosis Expert System**

The table below shows the data base structure of the Variable attributes used in the development of the database. The data base tool used is the MySQL server.

**Table 2: Data base Structure**

| FIELD NAME | DATA TYPE | FIELD SIZE | NULL | OTHERS |
|---|---|---|---|---|
| Problem ID | AutoNumber | | No | Primary Key |
| Problem | Text | 80 | No | **Look up**: Computer takes longer time to boot; Computer makes strange noise; Computer can't boot from HDD, Computer Can't read CD/DVD ROM etc. |
| Problem Category | Text | 80 | No | **Look up**: CD/DVD failure; HDD failure; Screen/Monitor failure; Other Problems |
| Expert Advice | Text | 80 | No | |

### 3.2.2 The Database Data Items

Table 3 below shows a list of some entities about which information will be captured in the database; for each of these, the lists of specific information which will be needed are shown below:

Table 3:

| Entity | Associated Data |
|---|---|
| Problem Category | • D/DVD Failure <br> • : drive failure. <br> • Screen/Monitor Failure <br> • Boot Failure <br> • Power Failure <br> • Found Failure <br> • rinter Failure <br> • Others |
| Problem | Computer takes longer time to boot <br><br> Computer makes strange noise <br><br> Computer can't boot from HDD <br><br> Computer Can't read CD/DVD ROM <br><br> Screen/Monitor goes blank <br><br> Monitor make strange noise <br><br> Mouse not working properly <br><br> Printer fail print |
| ExpertAdvice | Boot from drive A: using DOS system disk. <br> Input correct information to SETUP program. <br> Check hard drive cable. |

### 3.2.3 The Database Entity Relationship model

Related entities in the database are shown with lines that connect the entities; these lines are either solid or dashed. These lines terminate in either a "Single Toe" or a

"Crow's Foot". An optional relationship is shown between *Problem Category* and *Problem*, *Problem* and *ExpertAdvice.* The symbols closest to the *Problem* entity in the relationship between Pro*blemCategory* and *Problem* represents "one and only one, or one or more", whereas a *Problem* belongs to one and only one *Problem Category*, Each *ProblemCategory* must have one or more

*Problem*. Similarly, the symbols closest to the *ExpertAdvice* entity in the relationship between *Problem* and *ExpertAdvice* represents "one and only one, or one or more", whereas each *ExpertAdvice* is given to one and only one *Problem, E*ach *Problem* must have one or more *ExpertAdvice*.
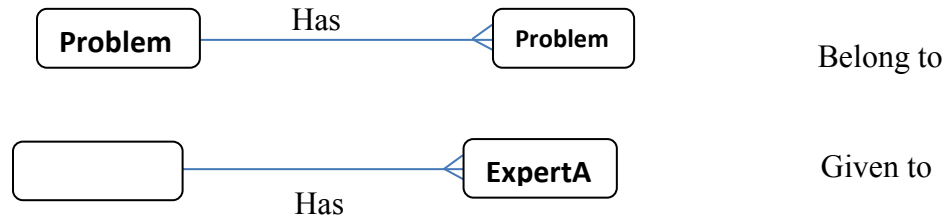
Problem — Has — Problem     Belong to

[ ] — Has — ExpertA     Given to

**Fig 3.2: Conceptual model of relationship between some of the entities used**

## 4.0 Implementation

The expert system is implemented using Java with MYSQL. The design phase consists of the use case diagram and activity diagram. The choice of the programming language 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.[12]. The key features are inheritance, polymorphism, reusability, knowledge representation, integration or extensibility. Java support procedural programming. Java is used for opened distributed application, has rich type system and is an object-oriented language. Net Bean is used to draw the user interface (UI) design. It is efficient, effective and reduces time used in designing user interface for desktop application with java.

### 4.1 User Interaction with the System

Communication between the user and the system is done through the user interface. The user interface is represented as a menu which displays lists of PC problems for users to select based on the nature of their problems. The input will be entered using the keyboard as an input device. On launching the application the system displays a welcome message printed in English language and prompts user to 'Click here to continue'. When the user clicked the 'click here to continue' button, system login form appears prompting the user to enter application code (user password). When user typed password wrongly, it respond with an error message. The user is allowed a maximum of three trials before access is denied. If the password tally with the existing password in the database, sample menu pages from whence appropriate selections and requests for solutions to the hardware faults are entered as step by step questions with the system responding to each of the request is as displayed as follows.
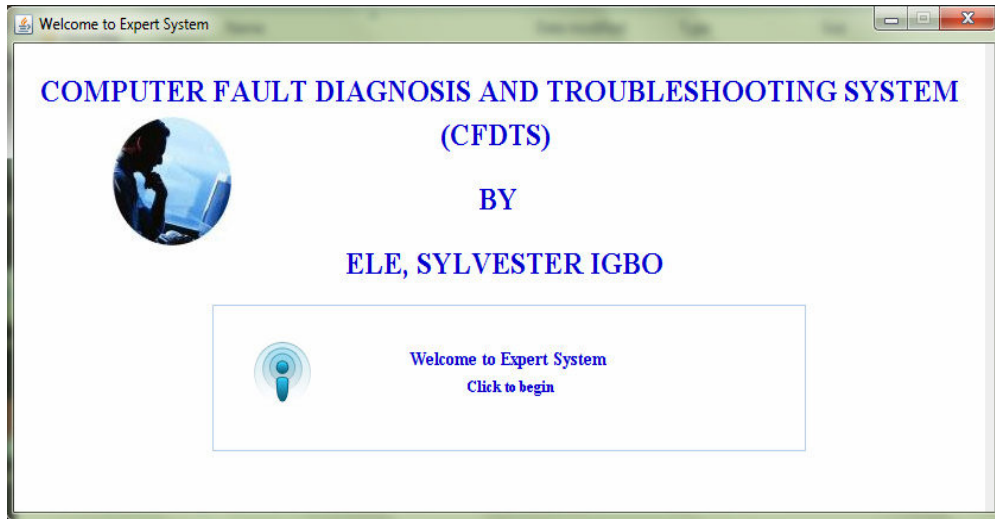
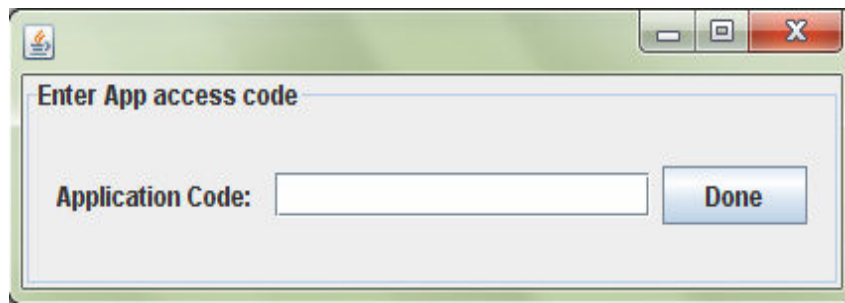**Figure 5: Introductory page of the CFDTS Application**


**Figure 6: System prompt user to enter password as user click to login.**
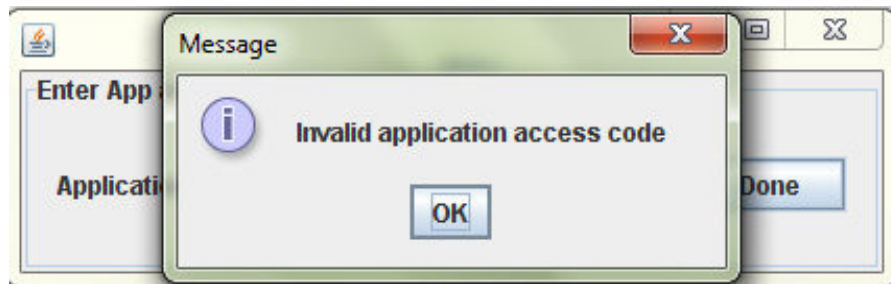

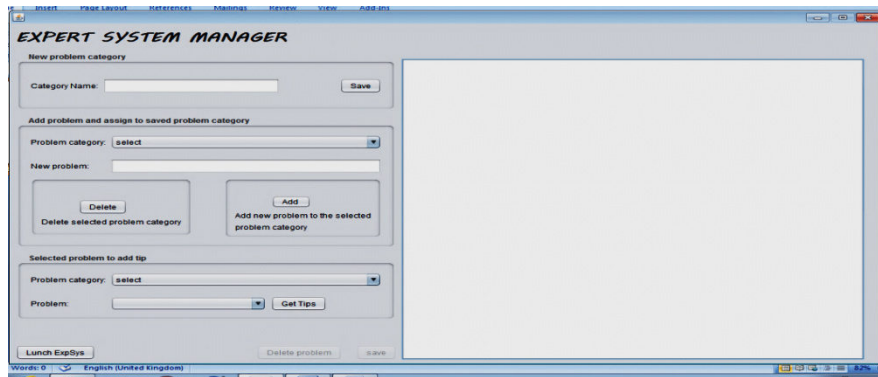**Figure7: Application Showing Error Message as User Enter Wrong Code (Password).**

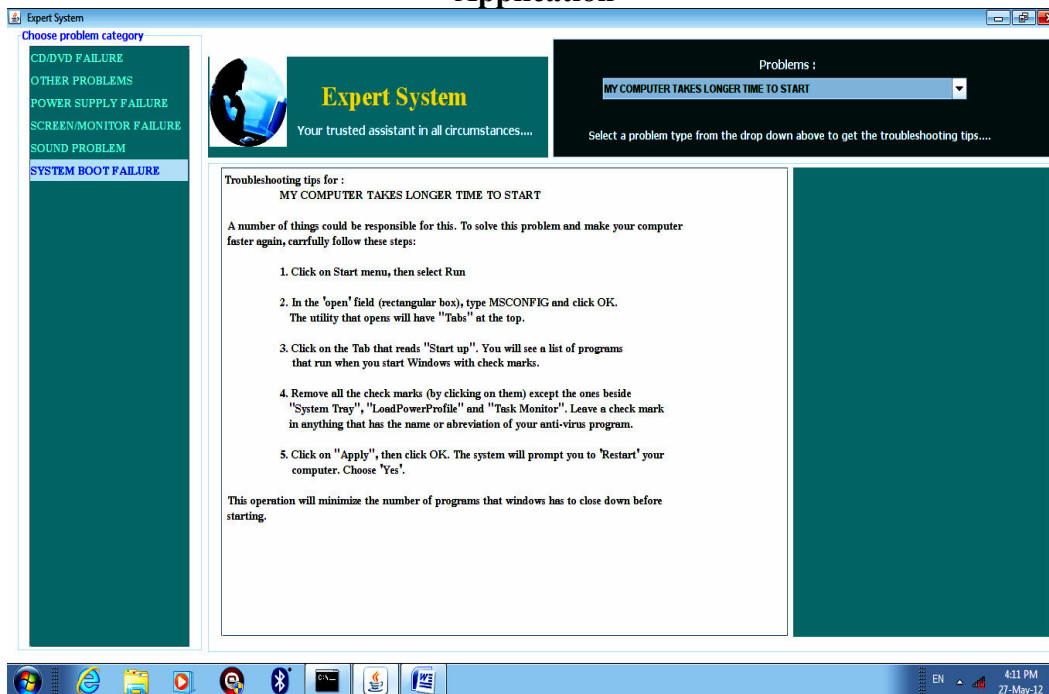**Figure8: Administrator (Working Memory) module of the Expert System Application**



**Figure 9: A user interface module of the Application showing how the system responds to user's request.**

## 5.0 Summary and Conclusion

The design of an expert system for computer fault diagnosis and trouble shooting is presented in this work. A brief description of expert system architecture and issues involved in developing expert system shell and the technology used is discussed. The package is developed on the basis of experts experience in computer fault diagnosis and troubleshooting. The package

is developed to have the characteristics of good expert systems, such as high performance and adequate response time. The goal achieve in this research is the production of a pragmatic PC Fault
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Diagnosis Software that assist users and Technicians to arrive at solutions to problems encountered in the use of modern day PC.

# References

[1] Ikekeonwu, G.A.M.(2003) "Computer Applications", Immaculate Publication Limited, Enugu, Nigeria.

[2] Pomykalski, J. J., Truszkowski, W. F. & Brown, D. E.(1999) "Expert System", In The WileyEncyclopedia for Electrical and Electronics Engineering (edited by J. Webster), February, 1999.

[3] Kaushik, A., Satvika, B. & Manoj, B. (2012), "Printer Troubleshooting Expert System", In the International Journal of Advanced Research in Computer Science and Software Engineering, Vol. 2 (10). Available at http:\\www.ijarcsse.com.

[4] Doyle, J.(1984) "Expert System without computers", In The AI magazine, Vol. 5, No. 2: 4-5, February, 1984.

[5] Giarratano, J. & Riley, G.(1998) "Expert System: Principles and programming, 3ed", PWS publishing company, Boston.

[6] Jones, D.D. & Barrett, J.R.(1989) (eds), "Building Expert Systems", in The ASAE Monograph No.8, ASAE, St. Joseph, MI.

[7] Petrovic, S. (2003) "Decision Support Methodologies", School of computer science, University of Nothingham.

[8] Duke, E.L. & Regenie, V.A.(1985) "Expert Systems Development and Application", in The national Aeronautics and Space Administration", Ames Research Centre, Edwards, California.

[9] Waterman, S.A.(1986) "A Guide to Expert Systems", Addison-Wesley Publishing co., Inc., Reading, M.A.

[10] Sourav, M., Chatterjee, S. and Neogi, B. (2013). "Diagnosing and Troubleshooting of Computer Faults Based on Expert System and Artificial Intelligence, In the International Journal of Pure and Applied Mathematics, Vol. 8 Issues 5, 2013.

[11] Deitel, H.M. & Deitel, P.J.(2004) "Java™ How to Program 6/ed", Prentice Hall, 2004.

[12] Su , M.S. & May .P.Z.(2008) ''Design and Implementation of Rule-based Expert System Fault Management", in The World Academy of science, Engineering and Technology, vol.48.