# EXPERT SYSTEM DESIGN FOR PC TROUBLESHOOTING

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## ABSTRACT

Computers 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 Netmeetings 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. LAN and wireless facilities which allow users to access borderless information at anywhere and at any time, turn the computer into a necessity rather than a luxury. However these gadgets sometimes malfunction and not every computer owner is a troubleshooter or able to find out the root cause of the malfunction. This is where the expert system is needed for help to any user as a first aid approach to identifying and solving the problem. This paper presents one of such expert system designs and is limited to PC hardware maintenance and troubleshooting covering to the Monitor, Hard drive, Keyboard, Mouse, Audio device, and Missing/Lost Documents via a rule base diagnostic system using PHP

## INTRODUCTION

Expert system is the human knowledge captured in a computer system/software to solve problem(s) that ordinarily require human expertise. The purpose of this is to capture the specialty and experience of the expert engineer and apply them to the individual problem. All the knowledge are stored and will be manipulated by the system to provide a specific solution, hint, advice, conclusion, recommendation and explanation in readiness to input by the users. With today's development of information and communication technology, the introduction and development of expert system has constructively helped in giving faster, applicable and reliable assistance to PC solution seekers arising from unavoidable PC problems. In dealing with PC's problem and troubleshooting, PC specialists are those who can help to solve them. But sometimes we don't have enough time to see the specialists and maybe the distance is quite far, and we are in hurry. Therefore we need instant help and solution. The development of the system will have significant contribution to PC owners since the system will help the system's owner in making decisions on actions they should take in their attempt to troubleshooting the PC's problem. Save much time, cost and energy for the user, especially to those who don't have to wait for the PC specialists to repair the damages.  Troubleshooting PC problems often starts with the power supply even if the power comes on. In fact, it's easier to diagnose failures where the computer won't turn on at all as opposed to more intermittent issues. While there are a large variety of video problems that may need troubleshooting at one time or another, it's easy enough to diagnose the problem if the monitor, whether an LCD or an old CRT, isn't powering up, but most other issues can be due to either the monitor, the video adapter in the PC, the power supply or the motherboard

## ANALYSIS OF THE EXPERT SYSTEM STRUCTURE

The logical and technical component of this design specification is based on functional decomposition where the system components and their relationships are properly documented to reduce complexity. The process starts with identifying the major functions performed by the system. Each of these major functions are then decomposed into subordinate functions. The process continues in this fashion until the system has been sub divided into elemental units called modules. System inputs which are the raw data captured and used by the system to produce the desired outputs is designed to be compatible with the other components of the system: database and files, procedures, processing and outputs. The output generated by the system is very important as it is the output that users can most easily relate to and discuss. Also, it is the output from the system that is the reason for the system to be developed and thus, the output to be generated is designed followed by the methods, procedures, and database, inputs, or system backup procedures. As each system output for the expert system is identified, a detailed replica of how the output should be presented after processing is designed.

## DATABASE STRUCTURE OF THE EXPERT SYSTEM

This evaluates the database content of the troubleshooting expert system where the primary keys are
underlined
Answer (<u>answer id</u>, question id, answer value, and answer description)
Category (<u>category id</u>, category name, category description)
Question (<u>question id</u>, category name, question value, question description)
User (<u>user id</u>, name, email, username, password, status, registration date)
User (<u>user id</u>, name, email, username, password, registration date)

## METHODOLOGY

In developing the Expert System for Pc Maintenance and Troubleshooting, forward or backward-chaining inference technique can be used. But the forward-chaining was selected to be used in the development of this expert system as depicted in figure 1.1. This is because in PC Maintenance and Troubleshooting problems, there are quite many possibilities we may face, with many different parts of PC with different kinds of problem which need different solution and troubleshooting. Therefore forward chaining is believed to be suitable for the inference process of this system. The following requirements served as the basis of the Expert System design. The system must allow users do the following:
1.      Select the problem category
2.      Enter the problem that is related to the category
3.      Select "YES", "MORE INFO" or "NO" when the solution is given by the expert system
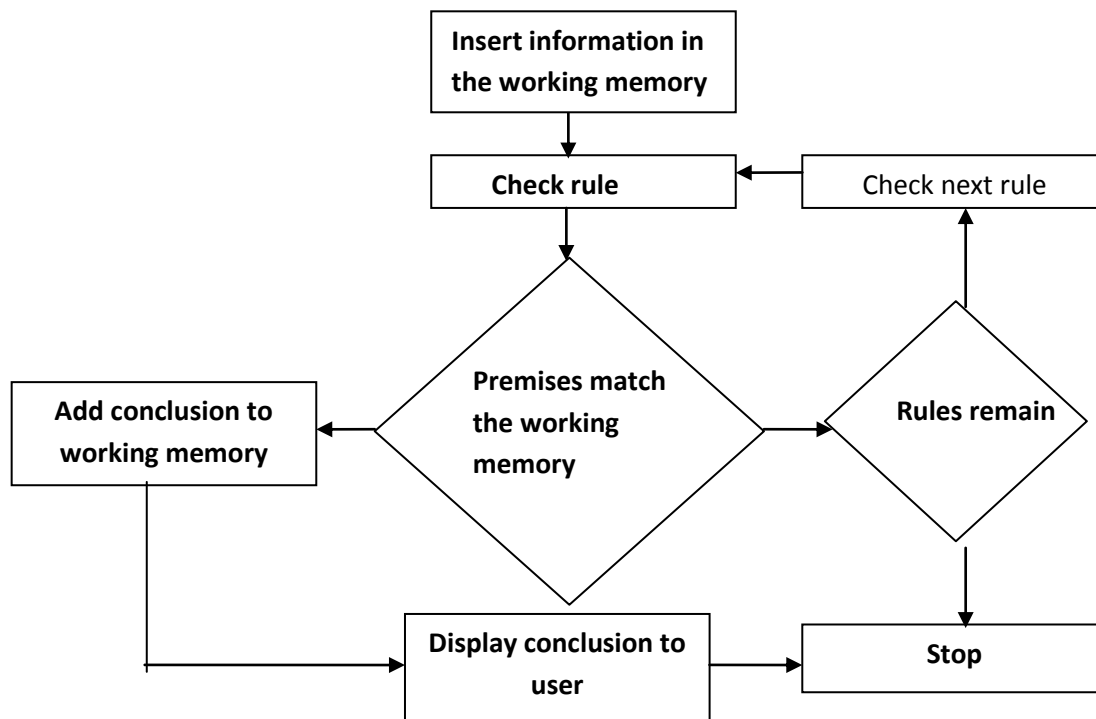
## Figure1.1 Forward Chaining Inference Processes

## USER INTERFACE DESIGN

Good and interactive user interface will encourage user to use the application. For this type of application, where by the objective is to make user self-own the troubleshooting, the friendly and easy graphic user interface will be encouraged. The basic operation of this expert system is a totally interactive procedure shown in figure 1.2 where the users communicate with the system through a user interface. The first level describes the process of developing the knowledge base. In order to generate the targeted result to the user's problem, the application needs the keyword from the user to get them the solution. A knowledge base of the expert system is then structured, and the set of solution and information will be stored inside the databases via SQL Server. When the information and solution is needed and the application accessed by the user, the task and procedure below will happen:

1. User will get into the application web service. User is required to enter the problem keyword and category.

2. The inference engine will retrieve all the relevant knowledge or rules from the knowledge base via SQL server matching with the information provided by the user. This process will happen in working memory of the HTTP server.

3. If the problem solution logged in by the user is available, the inference engine will get and generate a set of recommended solutions and response to the user.

| Expert | → | Knowledge Engineering | → | Knowledge Base (If/then rules) |
|--------|---|-----------------------|---|--------------------------------|

| User | | Queries | → | Inference Engine (Forward chaining) |

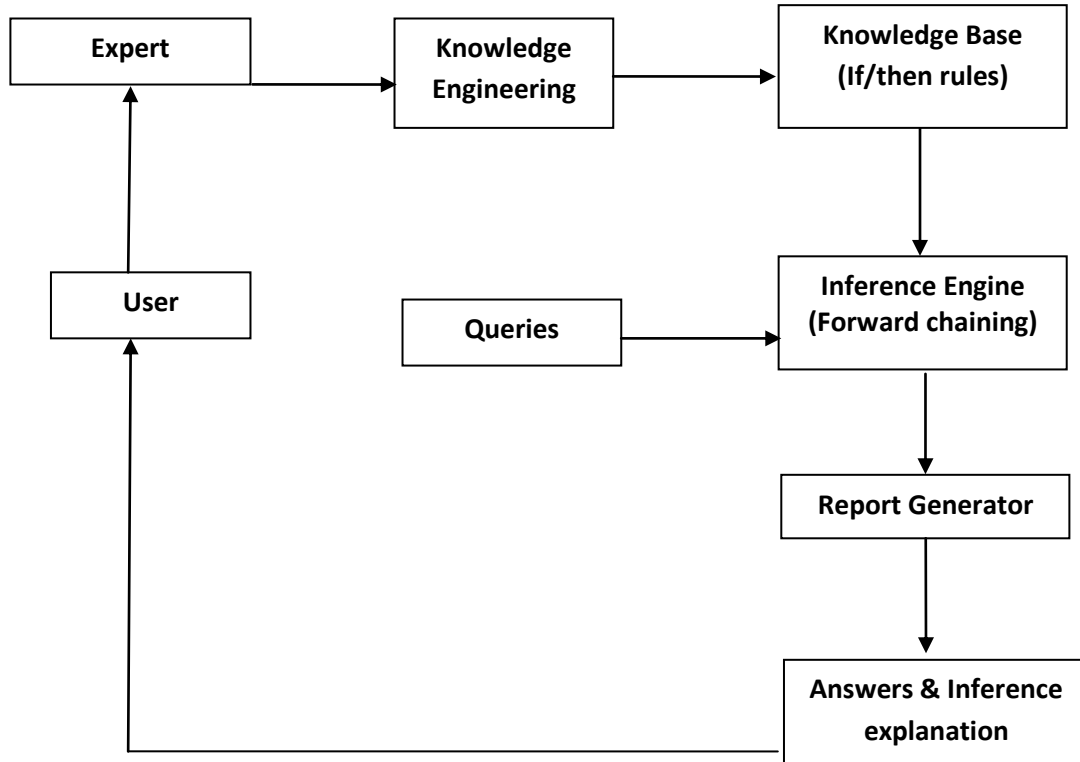Report Generator

Answers & Inference explanation

**Figure 1.2 Interactive Graphic User Interface**

## PROCESS MODEL

The Waterfall Model of software development as outlined by the Software Development Life Cycle is deployed for this design and represents the expert system life cycle as shown in figure 1.3.
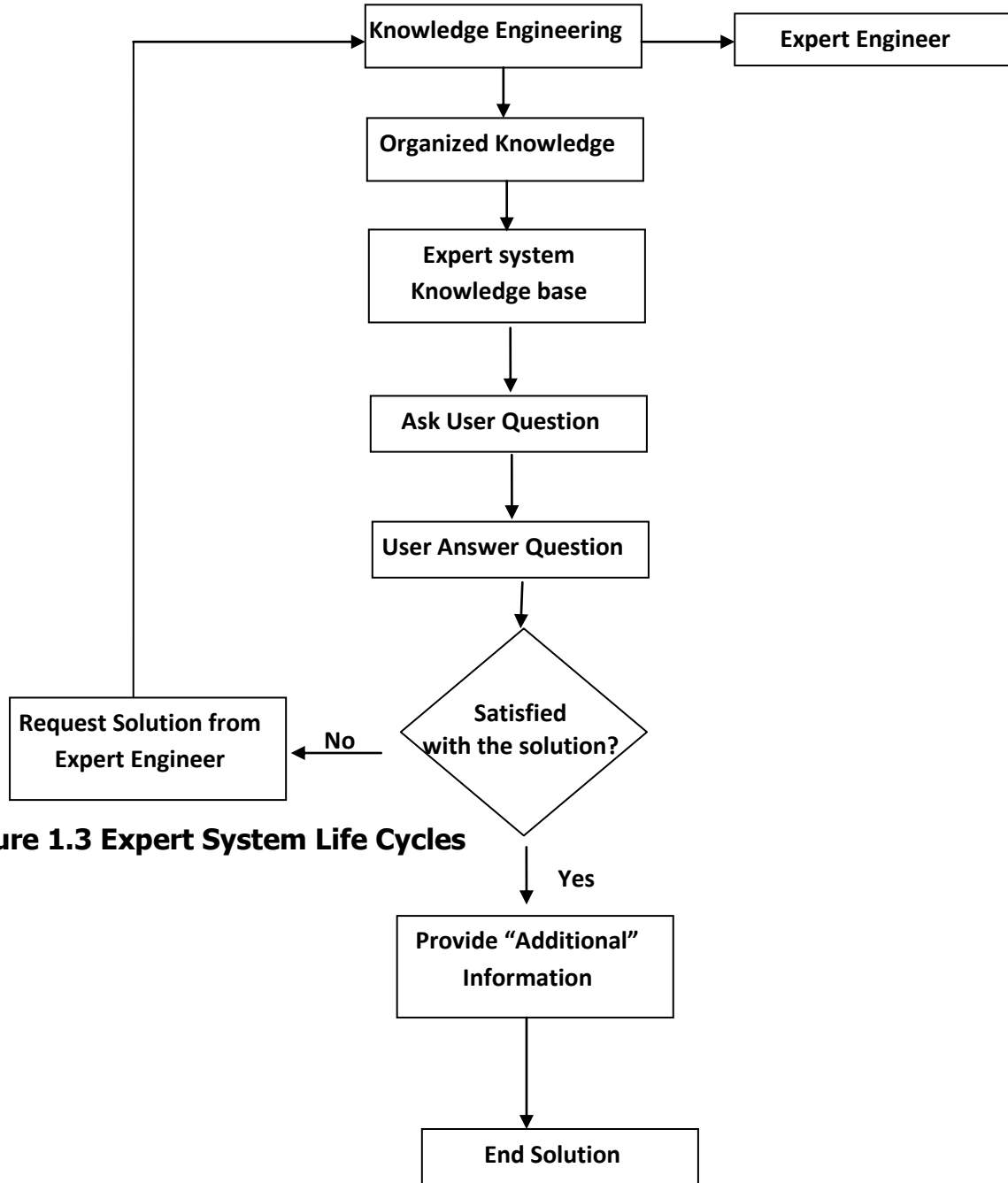
```
                    ┌─────────────────────┐        ┌─────────────────────┐
                    │ Knowledge Engineering│───────▶│   Expert Engineer   │
                    └─────────────────────┘        └─────────────────────┘
                              │
                              ▼
                    ┌─────────────────────┐
                    │ Organized Knowledge  │
                    └─────────────────────┘
                              │
                              ▼
                    ┌─────────────────────┐
                    │    Expert system     │
                    │    Knowledge base    │
                    └─────────────────────┘
                              │
                              ▼
                    ┌─────────────────────┐
                    │  Ask User Question   │
                    └─────────────────────┘
                              │
                              ▼
                    ┌─────────────────────┐
                    │ User Answer Question │
                    └─────────────────────┘
                              │
                              ▼
  ┌────────────────┐       ◇─────────◇
  │ Request Solution│  No  │ Satisfied │
  │  from Expert    │◀─────│ with the  │
  │   Engineer      │      │ solution? │
  └────────────────┘       ◇─────────◇
                              │ Yes
                              ▼
                    ┌─────────────────────┐
                    │ Provide "Additional" │
                    │     Information      │
                    └─────────────────────┘
                              │
                              ▼
                    ┌─────────────────────┐
                    │    End Solution      │
                    └─────────────────────┘
```

**Figure 1.3 Expert System Life Cycles**

## EXPERT SYSTEM DIAGNOSTIC SCENARIO FOR PC TROUBLESHOOTING

The development of any system that is to function successfully will follow the steps of system development. The conceptualization steps involving gathering user requirements, formulating process descriptions (user interface), and creating logical tables for the database. Implementation is the process of designing schemata that are appropriate for storing the data represented in the logical tables, and coding the system using the specified tools. The final step is testing the system against the testing requirements to see

if the system functions properly. The first step in the troubleshooting process is simply determining if the power supply is coming on. You can usually hear those mechanical components in PC systems that make rotational noise when they are powered up. This usually includes the hard drive as it starts up the electric motor to keep the discs spinning, and some fan noise that usually follow. The PC will then give a single beep if it passes its internal start-up diagnostic, to tell you it is on. If power isn't coming on, then the cord is plugged into a live socket and firmly seated in the back of the power supply. It's not necessary to own a DVM (Digital Volt Meter) to check your power outlet. This expert system structure becomes useful if other issues of proper and complete utilization of the PC still exists. The rule based system can then be applied to diagnose further necessary problems to be sorted out and fixed.

The implementation describes how the system is tested and the various inter phases involved based on the expert system troubleshooting rules using PHP
1.      Select the problem category
2.      Enter the problem that is related to the category
3.      Select "Submit"

From the screen the user can select the category that is listed based on the problem and the specific
question that is to be attended. Or the user can directly enter the keyword of the problem.
Example:
Category: Monitor
Question: Screen blank or no power
When in doubt concerning the choice during the Q & A process, users have option to select the expert system with detailed information and explanation. With this approach, users will understand the purpose of the systems question and learns about troubleshooting process setup available.

**Rule1: Monitor**
Q: I can't see anything on my computer screen
A: Is the computer turned on? There is a light on the CPU. If the computer is on, it will be lit.
A: Is the computer plugged in? Check to see if ALL plugs are secured;
•   Power cord from the computer to the power strip
•   Power strip to the wall socket.
A: Is the Power Strip turned on? There is a light on the strip. If the strip is on, the indication light will be on.
A: Is the Monitor on? There is a light on the monitor. If the monitor is on, check the contrast and brightness buttons to see if they have been tampered with.
A: Is the computer in Power save or Sleep mode? Move the mouse or press any key on the keyboard to see if the computer will "wake-up".

**Rule2: Hard Drive**
Q: My computer is on, but it is frozen. My cursor is stuck and won't let me do anything

A: Open task manager; simultaneously press [Ctrl] [Alt] [Delete]. You will see a list of all tasks programs) currently running. You may notice one or more programs have "Not Responding" instead of "running" listed next to it. Select this task(s) one after the other and click the End Task Button.

Another dialog box will open stating that the program is not responding. Choose End Now to close the Program

A: Reboot your computer (Warm boot); rebooting a computer that is already turned on. Press [Ctrl] [Alt] [Delete] once to open the Task Manager. Press [Ctrl] [Alt] [Delete] again to restart the computer.

A: If you restart your computer and the problem isn't resolved, make an attempt to completely shut down the computer by pressing the power button. Let it set for 15-30 seconds then restart the computer.

A: You have run out of Disk space on your computer. Music files, Movies, Digital pictures, and other big data files can fill up your Hard Drive. To check for disk space.

- Open My Computer. Right click on the C: drive and select Properties from the shortcut menu. A pie chart will appear telling you the used and free space.
- Try running the Disk Cleanup Wizard. This utility can tell you whether you are running out of room and help you clear away some space. Click the START button and choose Programs| Accessories| System Tools| Disk Cleanup. Choose the disk to clean up (C:) and let the wizard do the work.

## Rule3: Keyboard
Q: Keyboard doesn't respond.

A: check the plug to make sure it's connected securely. Try unplugging it and re-plugging it again.

A: If there is no response, check the indicator light on the keyboard. Is it on? Do the lights respond when you press the CAPS LOCK or the NUM LOCK key? If not, may your keyboard is faulty.

A: Is a key stuck? Gently pry off the cover and clean it with alcohol. Make sure it is not connected to your machine when you are cleaning it. The space bar frequently comes off track. Gently pry it off, noting which way the bar lies in your particular keyboard so you can replace it properly.

## Rule4: Mouse
Q: Mouse doesn't respond

A: If your mouse starts acting erratic, it could be insufficient memory problem. Reboot and see if that corrects the problem.

A: If your mouse will only move one way, either vertically or horizontally, your mouse may need cleaning.

A: Shut down your machine and unplug your mouse from the computer. Open the underside of the mouse and remove the ball. If the ball is a rubber ball, do not clean it with alcohol. Clean it with a soft cloth. There should be no lubricant on a mouse ball. Clean the roller in the body of the mouse with a cotton swab that is slightly damp with alcohol. Replace the ball when the rollers are dry and replace the bottom part.

## Rule5: Audio
Q: No sound is heard from audio (music) CDS

A: Volume Control or your mixer program mute options and volume sliders are tuned down.

A: Headphones are connected to the stereo phone jack on your CD-Rom drive's front panel; the volume control setting on the drive is adjusted. If there is sound from your headphones, check the CD audio cable connecting the CD-ROM drive to the audio card.

A: Ensure the speakers are properly connected to the audio card's output connector.

Rule8: Missing/ Lost Documents

Q: How do I locate a lost Document?

A: Select SEARCH from the Start Menu – Type in the name of the document – Select the drive you want to search (c: to search the hard drive) and press the Enter key.

A: Check your Recycle bin, if it was deleted. If found, right click on the document and restore back

## Table structure for table 'answer'

```
--
CREATE TABLE IF NOT EXISTS 'answer' (
'ans_id' int(10) NOT NULL AUTO_INCREMENT,
'quest_id' int(10) NOT NULL,
'ans_val' text NOT NULL,
'ans_desc' text,
PRIMARY KEY ('ans_id')
) ENGINE=MyISAM DEFAULT CHARSET=latin1 AUTO_INCREMENT=15;
--
```

## Dumping data for table 'answer'

```
--
INSERT INTO 'answer'('ans_id','quest_id','ans_val','ans_desc') VALUES
```

(1,1,'Is the computer turned on? there is a light on the CPU. If the computer is no, it will be lit.\r\n', 'Sometime the power do not connected properly and avoid any current to flow'),

(2,1,'Is the computer plugged in? check to see if ALL plugs are secure.\r\nA, A. Power cord from the computer to the power.\rnA, A Power strip to the wall socket.\r\n', 'Such circumstance could happen'),

(3,1,'Is the Power Strip turned on? there is a light on the strip. If the strip is on, the indication light will be on. \r\n', 'There is a series of basic step in basic computer operation'),

(4,1,'Is the Monitor on? There is a light on the monitor. If the monitor is on, it will be lit. If it is turned on, check the contrast and brightness buttons to see if they have been tampered with.\r\n',' A simple guide to troubleshoot'),

(5, 1, 'Is the computer in Power saves or Sleep mode? Move the mouse or press any key on the keyboard to see if the computer will "wake-up".\r\n',' Sometimes people tend to panic easily meanwhile the truth thing is the system goes into power saving mode, good decision to check either the computer energy saving function is currently activated or not'.),

(6,2,'Press[Ctrl][Alt][Delete] once to open the Task Manager &Press [Ctrl][Alt][Delete] again to restart the computer.\r\n \r\n-Shut down your computer (Cold Boot). Start-up of a computer from a power-down state.\r\n-if restart computer and the problem isn't resolved; make an attempt to completely shut down the computer by pressing the power button. let it set for 15-30 seconds then restart the computer.\r\n',' All current processes by Windows can be seen through Task Manager and bar activated by hitting Ctrl Alt Del and other steps'),

(7, 2, 'You have run out of disk space on your computer. Music files, Movies, digital pictures, and other big data files can fill up your hard drive. Check you disk space:\r\n\r\n1-open My Computer. right click on the C: drive and select properties from the shortcut menu. A pie chart will appear telling you the used and free space.\r\n Try running the Disk Cleanup Wizard. This utility can tell whether you are running out of space and help you clear away some space. \r\n\r\n2-Click the Start button and choose Programs|Accessories|System Tools|Disk Cleanup. Choose the disk Clean up and let the wizard do the work. \r\n','Disk cleanup is an essential tool to check disk usage'),

(8,3,'Check the plug to make sure it is connected securely. Try unplugging it and re-plugging it again.\r\n', 'sometimes cable can disconnect. Checking the connection is a good action to be taken.'),

(9,3,'If the is no response, check the indicator light on the keyboard. Is it on? Do the lights respond when you press the caps lock or the num lock key? If not, maybe your keyboard is broken.\r\n', 'When the indicator does not light up and the system is on it means that the keyboard is not receiving the electric current or it is broken'),

(10,4,'If your mouse starts acting erratic, it could be an insufficient memory problem. reboot and see if that corrects the problem',''),

(11,4,'If your mouse will only move one way, either vertically or horizontally, your mouse may need cleaning. 'This problem is only applicable for roller ball type. The Laser censoring technology is what is used now.'),

(12,4,'Shut down your system and unplug your mouse from the computer. open the underside of the mouse and remove the ball. If the ball is a rubber, do not clean it with alcohol. Clean it with a soft cloth. There should be no lubricant placed on a mouse ball. Clean the roller in the mouse with a cotton swab that is slightly damp with alcohol. Replace the ball when the rollers are dry and replace the bottom portion','');
--------------------------------------------------------

**Table structure for table 'category'**
CREATE TABLE IF NOT EXISTS category (
cat_id INT (10) NOT NULL AUTO_INCREMENT,
cat_name VARCHAR (50) NOT NULL,
cat_desc VARCHAR (200) default Null,
PRIMARY KEY ('cat_id')
) ENGINE =MyISAM DEFAULT CHARSET=latin1 AUTO_INCREMENT=7;

```
--
```
**--Dumping data for table 'category'**
```
--
INSERT INTO category (cat_id, cat_name, cat_desc) VALUES
(1,'Monitor','Category based on Monitor'),
(2,'HardDrive', Category based on Hard Drive'),
(3,'Keyboard','Category based on keyboard'),
(4,'Mouse','Category based on mouse'),
(5,'Networking','Category based on Networking')
(6,'Printer','Category based on printer')
(7,'Audio','Category based on audio')
(8,'Document','Category based on Document')
------------------------------------------------------------
--
```
**--Table structure for table 'question'**
```
--
CREATE TABLE IF NOT EXISTS question (
quest_id INT (10) NOT NULL AUTO_INCREMENT,
cat_name VARCHAR (50) NOT NULL,
quest_val TEXT NOT NULL
quest_desc VARCHAR (200) DEFAULT NULL,
PRIMARY KEY (quest_id)
) ENGINE =MyISAM DEFAULT CHARSET=latin1 AUTO_INCREMENT=5;
--
```
**--Dumping data for table 'question'**
```
--
INSERT INTO 'question'('quest_id','cat_name','quest_val','quest_desc') VALUES
(1,1,'I can't see anything on my computer screen\r\n', 'The situation where the screen do
not display any light'),
(2,2,'My computer is on, but it is frozen. My cursor is stuck and won't let me do
anything.\r\n', 'this situation sometimes happen and several approach should be taken'),
(3,3,'Keyboard doesn't respond', 'If your machine, when booting, gives off a constant
beeping noise, it is telling you that your keyboard is not connected or not working.\r\n'),
(4,4,'Mouse doesn't respond.\r\n', 'When you try to move the mouse it did not work');
-------------------------------------------------
```

**--Table structure for table 'user'**
```
 --
CRETE TABLE IF NOT EXISTS 'user"(
'user_id' INT(10)NOT NULL AUTO_INCREMENT,
'user_realname' VARCHAR(60) collate latin1_general_ci NOT NULL,
'user_email' VARCHAR(60) collate latin1_general_ci NOT NULL,
'user_name' VARCHAR(40) collate latin1_general_ci NOT NULL,
'user_pass' VARCHAR(250) collate latin1_general_ci NOT NULL,
'user_status' VARCHAR(16) collate latin1_general_ci NOT NULL default 'Registered',
'user_regdate' date NOT NULL default '0000-00-00',
PRIMARY KEY ('user_id')
```

```
)ENGINE=MyISAM DEFAULT CHARSET=latin1_general_ci AUTO_INCREMENT=6;
--
```

--**Dumping data for table 'user'**

```
--
INSERT INTO 'user' VALUES(user_id,name,email,username,password,reg_date) VALUES
--------------------------------------------------------------------------
```

--**Table structure for table 'user'**

```
--
CREATE TABLE 'user'(
'user_id' INT(10)NOT NULL AUTO_INCREMENT,
'name' VARCHAR(60)collate latin1_general_ci NOT NULL,
'email' VARCHAR(60)collate latin1_general_ci NOT NULL,
'username' VARCHAR(40)collate latin1_general_ci NOTNULL,
'password' VARCHAR(250)collate latin1_general_ci NOTNULL,
'reg_date' datetime NOTNULL default'0000-00-00 00:00:00',
PRIMARY KEY ('user_id')
)ENGINE=MyISAM                     DEFAULT                     CHARSET=latin1
COLLATE=latin1_general_ciAUTO_INCREMENT=2
```

## PC TROUBLESHOOTER DIAGNOSTIC CHART

The diagnostic chart is as shown in figure1.4. Also shown in figures 1.5, 1.6, and 1.7 respectively are Sample snapshots interface for the implementation.
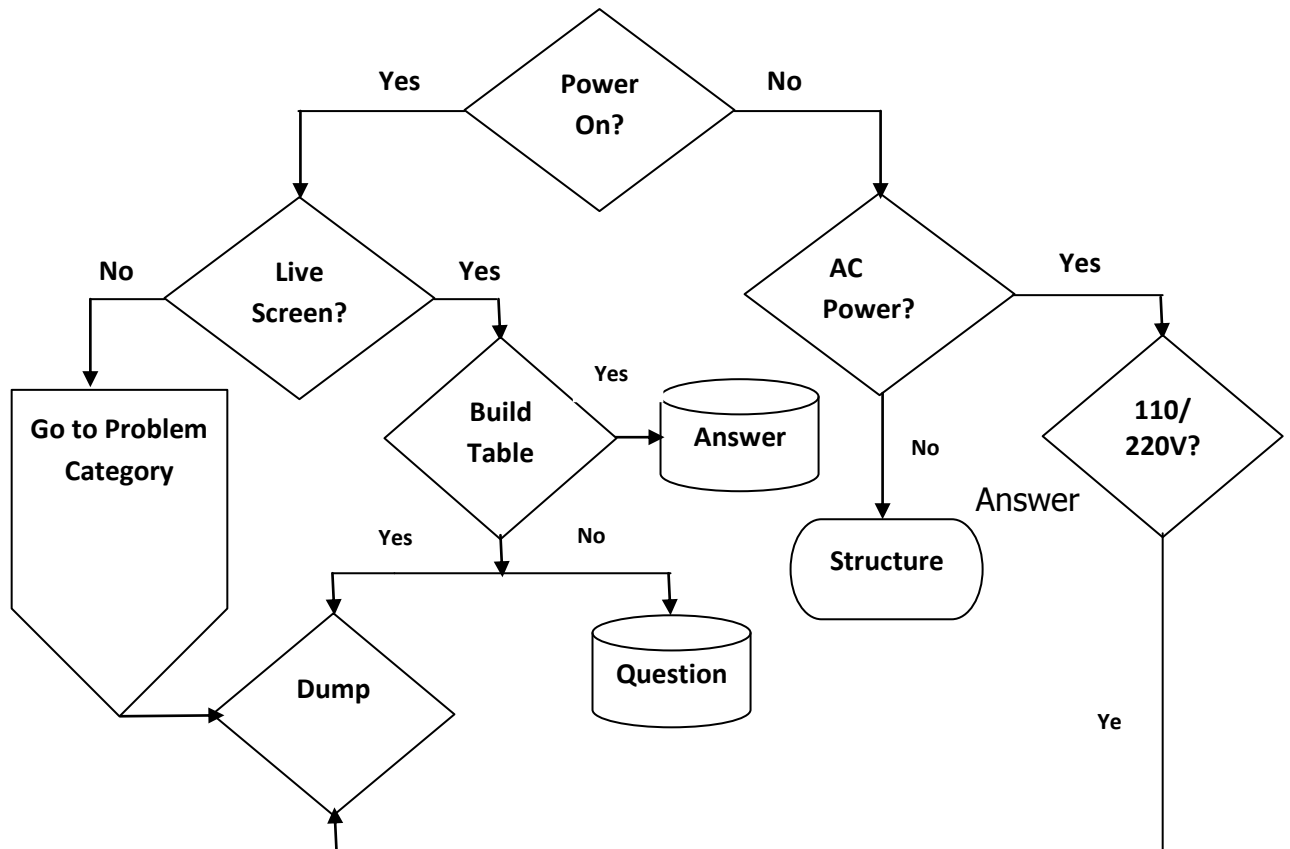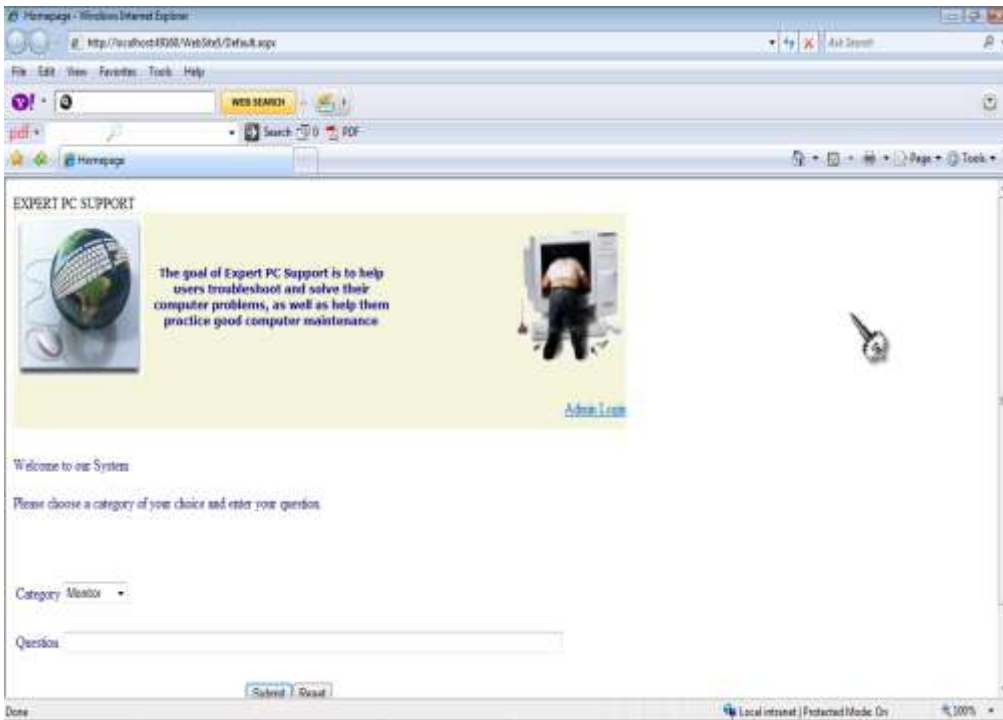


**Figure 1.4 Diagnostic Charts**

**Figure 1.5 User Interface – Question**



**Figure 1.6 User Interface – Answer**

**Figure 1.7 User Interface - Information**

## CONCLUSION

It is not denied that the role of expert system in almost every part of human's life is getting bigger. This is all because of the performance that the expert system has shown of what it can do to help the human beings. People's life seems to be easier in many ways with the presents of expert system. Academically, the expert system can help the human by replacing the human expert function whenever the expert can't be accessed or by assisting the human expert in situations where it has to cover many things. In this case the expert system may be useful to execute the routine works and let the human expert to do the rest especially the more difficult jobs. This Expert System for PC Maintenance and Troubleshooting is believed to be a right and excellent idea as another application of expert system and how we can utilize the enormous function of it. In fact, there are many other domains which are suitable to be introduced with the implementation of expert system and see how we can get into the maximum achievement with it. Although there are also some criticisms and issues evolve regarding the development of expert system which relating to the issues of reliability and human's social life, efforts has been discussed to overcome those problems.

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