

**PROGRAM APPROACH IN MAINTAINING /  
TROUBLESHOOTING PC**

**BY**

**ANJI SILAS ACHI  
PGD/MCS/2000/922**

**A PROJECT SUBMITTED TO THE DEPARTMENT OF  
MATHEMATICS AND COMPUTER SCIENCE FEDERAL  
UNIVERSITY OF TECHNOLOGY,**

**MINNA.**

**SEPTEMBER 2001**

# **TITLE PAGE**

## **PROGRAM APPROACH IN MAINTAINING / TROUBLESHOOTING PC**

**BY**

**ANJI SILAS ACHI  
PGD/MCS/2000/922**

**A PROJECT SUBMITTED TO THE DEPARTMENT  
OF MATHEMATICS AND COMPUTER SCIENCE,  
FEDERAL UNIVERSITY OF  
TECHNOLOGY, MINNA.**

**IN PARTIAL FULFILLMENT OF POSTGRADUATE  
DIPLOMA IN COMPUTER SCIENCE**

**SEPTEMBER 2001**

# CERTIFICATION

We hereby certify that we have supervised, read and approved this  
Project work which we have found to be adequate in scope and  
Quality for the partial fulfillment of the award of a post Graduate  
Diploma in Computer Science of Federal University of Technology  
Minna.

---

**Dr. Aiyesimi Y.M**

Project Supervisor

---

**Date**

---

**Dr. Reju S.A**

Head of Department

---

**Date**

---

**External Examiner**

---

**Date**

# DEDICATION

This project work is dedicated to my parents, and all my brothers and sisters for their patient and encouragement. May almighty God reward you all?

## **ACKNOWLEDGEMENT**

My profound gratitude goes to Almighty God for his infinite mercy and protection throughout the period of this work.

I gratefully acknowledge the assistance, guide and contribution of my Supervisor Dr Aiyesimi Y.M. Mention should also be made of the able and competent Dean Professor Adeboye K.R, Head of Department Dr Reju and all other members of staff of Maths/Computer Science dept., F.U.T Minna not mentioned.

My humble regards goes to my father Mr. Anji Achi my mother and step mother Mr's Hauwa and Mrs Asibi respectively for giving me the opportunity to aquire formal education and also for their moral supports. I can't do without expressing my sincere appreciation to all my brothers and sisters for their understanding and financial contribution.

My regards also goes to the management and staff of LURADD venture for their support and help in typing this manuscript

Finally, I'm also greatly indebted to my colleagues for the many conversation which have helped to clarify thinking in many topics.

Lastly, but not the least I would like to appreciate the contribution of all those who help in one way or the other in making this work

become a reality and whose name are not mention here, I appreciate you all.

**Anji Silas (2001)**

# **ABSTRACT**

Computer Troubleshooting maintenance and Assembly is one of the major problems facing computer user's worldwide

The proliferation of computer system and their purchase in the absence of anywell defined guidelines have some advantages and disadvantages.

The primary concern of this project is to provide overall guide with some possible solutions to common problem, so that computer user's can perform preventive maintenance to keep their computers in good working condition to save cost.

Troubleshooting chart menu was provided for easy understanding of troubleshooting and repairs.

Finally, to enhance the rapid understanding of techniques of troubleshooting and maintenance, developed a tutor program.

# TABLES OF CONTENTS

Title page	ii
Certification	iii
Dedication	iv
Acknowledgement	v
Abstract	vii
Table of contents	viii
<b>CHAPTER ONE</b>	
1.0 Introduction	1
1.1 Computer in historical perspective	2
1.2 Generation of digital computer	3
1.3 objectives	5
1.4 Statement of the problem	6
1.5 Source of Data and information of the study	6
1.6 Significance of the study	6
1.7 Need of the study	6
1.8 Limitation of the study	7
1.9 Equipment	7
1.10 Summary	8
<b>CHAPTER TWO</b>	
2.0 Literature review	9



2.1	Motherboard	9
2.2	The microprocessor	10
2.3	BIOS	10
2.4	Physical aspect of motherboard	11
2.5	Mounting Hardware	11
2.6	Processor	12
2.7	SIMMs	13
2.8	Microprocessor	15
2.9	How microprocessor work	16
2.10	Instruction sets	16
2.11	Registers	17
2.12	Inside the microprocessor	19
2.13	Distinguishing microprocessor	20
2.14	Register effect	21
2.15	Bus effects	22
2.16	Locating microprocessor	23

### **CHAPTER THREE**

3.0	Introduction	24
3.1	Expert system	
3.2	Troubleshooting and repair	
3.3	Problem Definition	27
3.4	Tools	29

3.5 Software tools	29
3.6 Hardware troubleshooting	30
3.7 Repair	32
3.8 Troubleshooting chart	33
3.9 System	33
3.10 Video	36
3.11 Disk drive	37
3.12 Peripherals	37
3.13 Feasibility study	38
3.14 Operation of the existing system	38

## **CHAPTER FOUR**

4.0 Maintaining your system	44
4.1 Developing maintenance program	44
4.2 Active maintenance procedure	45
4.3 Cleaning system	46
4.4 Standard cleaners	50
4.28 Backup power	73
4.29 Uninterruptible power supplies (UPS)	74

## **CHAPTER FIVE**

5.0 RECOMMENDATION	76
--------------------	----

## 5.1 CONCLUSION

77

## REFERENCE

78

# Chapter One

## 1.0 INTRODUCTION

This project is designed to give computer users/computer scientist a broad spectrum of computer troubleshooting/maintenance techniques that can be handle from the users end there are various aspect of troubleshooting and maintenance covered extensively in this project.

The aim of this project is to help create awareness towards full understanding of the present or future personal computers, so that it can be easily used rather than fear it. The project is designed to give an overview of what makes up a computer system and expert techniques (method) of diagnosing the faulty component and the various method of repairs was also highlighted.

Computers are thought fearsome because they are based on electrical circuits. Electricity can be dangerous, as the ashes of anyone struck by lighting will attest. But inside the computer the danger is low. At its worst, it measures 12 volts, which makes the inside of a computer as safe as playing with an electric train.

Computers are thought delicate because they are built from supposedly delicate electronic circuits, the same ones that their manufacturers warn about holding a metal part of the system unit in order to discharge the pulses of static electricity that can damage the circuits.

## **1.1 COMPUTERS IN HISTORICAL PERSPECTIVE**

A computer is any machine which can accept data in a prescribed form, store and process the data and supply the results of the processing in a specified format as information or as signals to control automatically some other machine or processes. There are two major categories of computers, namely: Digital Computers and Analogy Computers.

### **1.1.1 DIGITAL COMPUTERS**

A Digital Computer is an electronic machine capable of performing operations on data represented in number form, that is, the data are represented as a series of discrete element among in a coded form to represent numbers. In most digital computers, the method of number representation is based on the system of binary notation and each element in any series must be capable of representing either of the binary digits 0 and 1. The binary notation system is widely used because of the convenience in constructing logic circuits and storage devices capable of handling data in this form. The individual operations performed by a digital computer are very simply arithmetic or logic processes involving the manipulation of the bits in words or characters of information.

### **1.1.2 ANALOG COMPUTER**

An Analog Computer is an electronic machine capable of performing arithmetic functions upon number, which are represented by some physical quantity such as temperature, pressure, voltage or current.

Essentially, analog computers must be able to accept inputs to various devices within the computer, which perform the computing operations of addition, subtraction, multiplication, division, interpretation and function generation. Analog

computers can perform very complex arithmetic functions at high speed while the actual under study is in operator they can operate in real time mode. Thereby quarantining their wide application in the scientific and industrial fields in simulating various physical systems or automatically controlling industrial processes. In this project emphasis will be on digital computers.

## **1.2 THE GENERATIONS OF DIGITAL COMPUTERS**

Computers have been generally classified into a number of generations on basis of their technology.

In this section, the evolutionary tread of computers and computing will be discussed.

### **1.21 THE FIRST GENERATION**

The first meeting general thought of as an electronic computer was electronic numerical Integration and calculator (EWIAC). It was built in 1946 by maunchy and Eckert at the University of Pennsylvania. The most popular model of the first generation computers was the IBM 650 developed in 1994, which was capable of supporting both scientific and business applications.

### **1.22 THE SECOND GENERATION**

This generation of computers enveloped as a result of technological advances in electronic and solid state physics. The most popular model of this generation is the IBM 1401. may important developments were made during this. This generation employed transistor, diodes and the printed orient board type at writing. The computers of this generation generate less heart, were more reliable and considerably reduced the physical size of the hand ware.

The second-generation computers made great use of high-speed magnetic tape units for reading and writing data. There exist also, technological advancement in data transmission and communication devices motivates real time and time sharing computer system. Data can be sent to and received from both local and remote data processing centers.

### **1.2.3 THE THIRD GENERATION**

The period 1964 was dominated by the third-generation of computers the most popular model of this generation was the IBM 360. During this period, minicomputers of considerable smaller size, compared with the sizes of the early generations of computers, were developed. The important development of this generation includes the monolithic integrated circuitry and hybrid integrated circuitry was developed to replace the diodes and transistors characteristics of the second-generation computers. Monolithic circuitry is concern with the placing of element of a circuit (transistors, resistors and diodes) on a chip at a time.

### **1.2.4 THE FOURTH GENERATION**

The fourth generation of computers took off in the 70's and exists till today. A major motel of these generations is the IBM 370 series.

The following are the important development of this generation

- (a) Large- scale integrated creints
- (b) User- friendly interfaces
- (b) Faster memories and mass storage
- (c) Improved software.

### **1.2.4 THE FIFTH GENERATION**

The conventional computers are widely applied in routine business data processing and in mathematical statistical calculations in science and Engineering the Japanese national Government has initiated a revolution towards the development of the new generation computers described as fifth generation. Is what they refereed to as the artificial intelligence. The fifth generation computer is based on a new architecture, which support very large memory, high parallel processing, text editing, and image processing and reasoning. Thus these generation can learn, associate, make inferences, take decision and otherwise behave in ways we have always considered the exclusive province of human reasoning.

### **1.3 OBJECTIVES**

The aim of this project is to enable the computer user's to be conversant with their computers and also be able to provide an overall trouble shooting/maintenance guide. With some possible solutions to common problems. Hence the user can carry out practical maintenance work such as follows:

- (i) Familiarize themselves with the inside of the computer.
- (2) Handle computer equipment without fear.
- (3) Perform daily maintenance routine.
- (4) Perform daily, monthly, quarterly and annual maintenance routine.
- (5) Run diagnostic to eliminate/find the culprit (faulty device)
- (6) Upgrade the system memory
- (7) Install peripheral device like the monitors, disk drive mouse etc.
- (8) Distinguish between hardware to software faults.
- (9) Troubleshoot computer system to board level.
- (10) To be able to troubleshoot and carry out minor repairs on printers e.g Dot matrix, Deskjet 4L etc.



## **1.4 STATEMENT OF THE PROBLEM**

The problem of this study is to examine the present ways of maintaining and troubleshooting Gateway 2000 PC and to proffer the more efficient, effective, easier, time conserving less labor method of troubleshooting operations.

## **1.5 SOURCE OF DATA AND INFORMATION OF THE STUDY**

The data and information used in this study were obtained from textbooks, journals, handbooks, handout, manual and notebooks.

Data and information were also collected from Electronic/Computer Scientist, users, and personal experience.

## **1.6 SIGNIFICANCE OF THE STUDY**

The researcher hopes that this study would: -

- (i) Contribute in no small measure in both theory and practical to the existing pool of knowledge about computer maintenance and troubleshooting.
- (ii) Eliminate or reduce “try and error” method of maintaining and troubleshooting Gateway PC.
- (iii) Encourage very efficient and effective use of human and materials resources.

## **1.7 NEED FOR THE STUDY**

- (i) The need for this study arose from the researcher’s observation on the present methods of repairing, maintaining and troubleshooting gateway PC.

- (ii) In many instances technicians spent undue time in order to repair simple fault(s). Even some cause more damages to sets than maintaining.
- (iii) Also, there is need for proper recording of troubleshooting using the right tools for the right job cannot be over-emphasized.

## **1.8 LIMITATION OF THE STUDY (SCOPE)**

The study is centered and concentrated to computer maintenance and troubleshooting operations. The study cannot teach a novice computer scientist how to troubleshoot, therefore, basic knowledge is essential.

The scope of this study can only serve as a guide to the likely problem(s) and traced to the general different. The study can never be substitute for the manufacturers, manual/circuit diagram of the computer.

## **1.9 EQUIPMENT/TOOLS NEEDED FOR TROUBLESHOOTING**

- 1 - Needle nose pliers
- 1 - Screwdriver, 6" long, 1/4" blade
- 1 - Screwdriver, 6" long, 3/16" blade
- 1 - Screwdriver, 6" long, Philips head
- 1 - Digital Multimeter (optional)
- 1 - Bottle of Disk cleaning alcohol (Ethanol)
- 1 - Packet of Lint-free dot or cotton swabs
- 1 - Scratch floppy diskettes
- 1 - Diagnostic floppy diskettes preferably 3.25" type
- 1 - Vacuum cleaner (Blower)

## **1.10 SUMMARY**

This chapter has charted the history of computers to highlight the milestones on the road to proliferations of generation of computer systems. And in this context, the character of the earlier computer generations has been profiled.

An effort has been made to indicate the relevance of some current trends – in super computer application, micro-system etc. to fifth generation programs of research and development. Emphasis has been given to the necessary convergence of there trends for the successful realization of fifth generation computers.

Finally, these chapters also highlight the vital tools that can be made use of during troubleshooting/maintenance.

# Chapter Two

## **2.0 LITERATURE REVIEW**

This chapter deals with the study and review of the related literature on the subject in question, that is maintaining and troubleshooting Gateway PC. The problem is trying to find a technical solution to the existing try and error method, and to save computer scientist and engineers time and undue labor spending on the repairs and troubleshooting PC.

## **2.1 INTRODUCTION MOTHERBOARD COMPONENT**

The motherboard of any computer that follows the IBM design scheme performs several major functions. At the most basic level, it is the physical foundation of the computer. It holds all the expansion boards in place. Provide firm territory to attach connection, to external circuit element and provide the base of support for the central electronics of the computer. Electrically the creative etched upon it includes the 'brain of the computer and the most important element required to nourish that brain. This circuitry determines the entire personality of the computer, how it functions, how it reacts to your every keystroke and what is do.

No one part of a system board completely defines a computer personality. Its essence is spread through the circuitry traces and component.

## **2.2 THE MICROPROCESSOR**

The microprocessor does the actual thinking inside the computer which microprocessor of the dozen currently available is used determines not only the processing power of the computer but also what software language it understands (and thus what programs the computer can run).

### **2.2.1 COPROCESSOR**

An adjunct to the microprocessor enables a computer to carry out certain operations much faster. A coprocessor can make a computer run five to ten times faster in some operations.

### **2.2.2 MEMORY**

Required by the microprocessor enables a computer to carryout certain operations much faster. A coprocessor can make a computer run fine.

Required by the microprocessor to carryout its calculations. The amount and architecture of the memory of a system determines how it can be programmed and, to some extent, the level of complexity of the problem upon which it can work.

## **2.3 BIOS**

The Basic input/output system or Bios of a computer is a set of permanently recorded program routines that gives the system its fundamental operational characteristics. The BIOS determines what the computer can do without loading a

program from disk and how the computer reacts to specific instructions that are part of these disk based programs.

### **2.3.1 EXPANSION SLOTS**

As portals that allow new signals to enter the computer and directly react with its circuitry, expansion slots allow new features and enhancement to be added to the system (UPGRADING) and enable the quick and easy alternation of certain computer prerequisites, such as video adapters.

### **2.3.2 SUPPORT CIRCUITRY**

A microprocessor, although the essence of a computer, is not a computer in itself (fi it were, it would be called a computer). It requires a number of additional circuits to bring it to life; decks controller and signal converters. Each of these support circuits has sits own way of reacting to program, and thus helps determine how the computer works.

## **2.4 PHYSICAL ASPECT OF MOTHERBOARDS**

Although all motherboards are not exactly interchangeable, some share physical characteristics that enable them to fit the same physical constraints. A result, a computer maker designs his product to accept a given size of the motherboard has his choice of products that screw in.

## **2.5 MOUNTING HARDWARE**

A motherboard must somehow be mounted in its cabinet, and PC manufacturers have devised a number of ways to hold motherboard down. This

simple sounding job is more complex than you might think. The motherboard cannot simply be screwed down flat. The projected cut ends of pin-in-hole component make the bottom uneven, and forcing the board into place is apt to stress it, even crack hidden circuit trace. Moreover, most PC cases are metal, and laying the motherboard must not only be held secure, but it must be spaced a fraction of an inch (typically in the range  $3/5$  to  $1/2$ ) above the bottom of the cases. The balance of the routing holes in the motherboard is devoted to Nylon fasteners that insulate the boards from the metal chassis while holding them in place. These fasteners have two wings that pop through the hole in the motherboard and snap out to lock themselves in place the bottom of these fasteners slides in special channel in the bottom of the PC case.

Mechanically, the two or three screw that holds the motherboards, in place and the nylon fasteners are designed to space the board vertically and fit special channels in the metal work of the case, enabling the boards to slide into place.

## **2.6 PROCESSOR**

A computer is a computer because of the microprocessor, more commonly referred to as the processor. Without the processor, there is no computer. A processor can be a computer by all itself without any other circuits. It is the heart of any computer.

The processor is robotic in nature. It is a lot of capability but it can't do a thing without being told what to do. Its orders are contained in some sort of memory like a ROM. The ROM contains what is known as an operating system, which is the program that runs the processor without the operating system the processor and the computer are helpless.

### **What does a processor do?**

First of all, the processor is able to store digital bits in memory registers. This is called writing to memory. The once the bits are stored in memory, the processor is able to obtain a copy of the bit and load than back into its own register. This is called loading from memory. Besides writing the bits to memory, the processor can write these bits to an I10 chip. When it does this the I10 chips in turn can output the bits to a peripheral like a printer or disk drive. The processor can also read bits from a 110 chip. When it does that the I10 chip can take in bits from a peripheral like a printer or disk drive. The processor can also read bits from an IO chip. When it does that the I10 chip can take in bits from a peripheral like a keyboard or cassette player. The reading and writing of bits works just like human mind.

In addition to reading and writing the computer processor must process the digital bits while they are not its grasp. In the processor is a group of circuit that can do mathematical and logical manipulation to the digital bits. The spectacular thing about this manipulation is the SPEED. A processor is given a number of address lines. It sands out consummations of hits that in lock and accesses every memory location. A process is also givens a number of data lines.

It can write combination of bits to addressed locations or read bits out of the locations.

## **2.7 SIMMs (SINGLE INLINE MEMORY MODULES)**

In many personal computers, memory drips are installed in sockets. Sockets have many advantages for test and replacement purposes, but socket also, on occasion present a problem. Everytime a computer is turned off at the end of the work day, allowed to cool overnight, and is than turned on the following morning, the socket and the chips in the sockets pass through a heating, cooling, and then reheating cycle. The sockets and chips will expand as they are heated, shrink as



they are called, and then reheat once again. This happens daily. Every day the chips will creep over so slightly out of the socket. Then one day a print disconnect from a socket hole and the computer goes down. The one is very simple, press the chip back into the socket. However, a failure is a failure and is often a trying and expensive experience no matter how simple the actual repair turns out to be. Designers in an effort to eliminate this common chip, popping out of the circuit, trouble came up with SIMMs.

A typical SIMM is a plug-in device. It is simply a little plug in print board that goes into a connector socket on the motherboard. The memory chips, instead of being soldered on the motherboard, are soldered onto the SIMM board. The SIMM board is considered a module. The SIMM board is very small one and is about the size of a 6-inch ruler.

It usually contains with DRAMS. There are eight DRAMS to supply the bytes of memory and a ninth DRAW that provides a set of parity bits for the memory, SIMMs, as seen come in various by bytes capacities. The most common ones have memories of 250k, 512k, 1024k (1 MEGA-BYTE), and 2048k (2 MEGA BYTES).

A typical SIMM is a collection of memory chips mounted on a thin print board. It is considered a module or one component. When one chip fails, the entire module is changed. The module conveniently plugs into the motherboard.

Computers that use SIMMs have SIMM connectors mounted on the motherboard. The SIMM plugs into the connectors and has a tab at each end of the module that snaps into place. To remove a SIMM, all you have to do is open the tabs and rock the SIMM gently out of the motherboard connector. The SIMMs is fairly rugged, but as with all print board components, remove it slowly and with care.

A SIMM is much easier to remove and is also diagnose as defective than an individual chip. You don't have to pin a trouble on an individual chip. You simply change the entire suspected SIMM.

## **2.8 MICROPROCESSOR**

The microprocessor is the heart and brain inside every personal computer. This tiny chip of silicon determines the speed and power of the entire computer by handling most, if not all, of the data processing in the machine.

All personal computers and a growing number of more powerful machines are based on a special type of electronic circuit called the microprocessor often termed "a computer on a chip", today microprocessor is a master piece of high tech black magic. It starts as a single slice of silicon that has been carefully grown as an extremely pure crystal, sliced thin with great precision and is then subjected to high temperature in ovens containing gaseous mixture of impurities that diffuse into the silicon and change its electrical properties. This alchemy turns sand to gold, creating an electronic brain as capable as that of our average arthropod.

The operating principle of the microprocessor need not be made from Silicon; scientists are foying with advanced semi conducting materials that promise higher speed. A microprocessor also does not need to be based on electronics. The advantage of electronics and the microprocessor is speed and size. Electrical signals travel at the speed of light; microprocessor carryout their instruction at rates up to several million per second. Without that speed elaborate programs would never have been written. Executing one with a steam driven computing engine might have taken lifetime, not to mention wondrous full of equipment. The speed of the microprocessor and its small, portable size, make it into the miracle that it is.

## **2.9 HOW MICROPROCESSORS WORK**

The working of a modern Silicon based microprocessor is not difficult to understand. They are the electronics equivalent of a knee-jerk. Every time you hit the microprocessor with an elaborate hammer blow the proper digital input – it reacts by doing a specified something, always the same thing for the same input, kicking out the same function. The complexity of the microprocessor and what it does arises from the wealth of input of can react to and the interaction between excessive inputs. Although the microprocessor's functions is precisely defined by its inputs, the output from that functionaries with what the microprocessors had to work upon and that depends on previous inputs for example, the result of you carry out a specific command.

## **2.10 INSTRUCTION SETS**

The simple Silicon circuits that microprocessor are made from don't understand English Command, however, They react to electronic signals with today's microprocessors, each microprocessor command is coded as the presence or absence of an electrical signals at one of the pins of the microprocessor package. These signal each one representing a digital information bit pattern. Certain bit pattern are given specific meaning by the designers of a microprocessor and thus become microprocessor instructions. For example, the bit pattern 0010110 is the instruction that tells Intel 8086 family microprocessor to subtract.

The entire repertoire of commands that a given microprocessor model understand and can react to is called that microprocessor's instruction set or it's command set. Different microprocessor designs recognize different instruction set.

Instruction sets can be incredibly risk and diverse. For example a simple command to subtract is not enough by itself. The microprocessor also needs to know what to do with the result. The microprocessors in PCS are told what numbers to subtract by variations of the subtract instruction of which there are about seven, depending on what you cannot as a subtractions. Each different tells the microprocessor to take numbers from different places and to find the difference in slightly different manners. Microprocessor registers handle some of these duties.

## **2.11 REGISTERS**

Before the microprocessor can work on numbers or any other date, it must first known numbers to work on. The most straight forward method of given the chip the variables it needs would seem to be supplying more coded signals at the sometimes the instruction in given. This simple method has its shortcomings, however. Somehow, the proper numbers must be routed to the right microprocessor inputs. Either the microprocessor and the computer circuiting would have to do the routing, or you would be stuck with manually loading the number into different inputs. The job is best left to the microprocessor. All that signal routing would substantially complicate the external circuiting leading to the microprocessor.

Instead of working directly with two inputs simultaneous, today's microprocessor take one input at a time. The first input pattern is loaded into a special area called a REGISTER.

A register functions both memory and a workbench. It hold bit pattern unit they can be worked upon or output. The register is also connected with the

processing circuit of the microprocessor so that the charges ordered by the instructions actually appear in the register. Most microprocessors typically have several registers, some dedicated to specific functions (for example remembering which step in a function the chip is currently carrying out) and some designed for general purposes.

Other microprocessor instructions tell the chip to put numbers in its registers to be worked on later and to move information from a register somewhere else for example to memory or an output port. Some microprocessor instructions require a series of steps to be carried out. For example, the subtraction instruction given previously tells the microprocessor to subtract an immediate number one in memory from another number in the microprocessor's Accumulator, a particular register favored for calculations.

Everything that the microprocessors do consists of nothing more than a series of these one-step at a time instructions. Simple subtracting or addition of two numbers may take dozens of steps, including the conversion of the numbers from decimal to binary notation that the microprocessor understands. Computer programs are complex because they must reduce processes that people think of as one step in itself adding numbers, typing a letter moving a block of graphics into a long and complex series of tiny, incremental steps.

Microcode instructions are the basic unit for commanding a microprocessor, telling it what to do. Internally, however, the circuiting of the microprocessor often has to go through several steps to carry out one instruction. The instruction tells the microprocessor to carry a list of steps that make up one operation. The complete collection of these lists corresponding to each instruction is called the microprocessor's MICROCODE.

## **2.12 INSIDE THE MICROPROCESSOR**

The circuitry inside a microprocessor is divided into three functional parts, the INPUT/OUTPUT (or I/O unit), the CONTROL UNIT, and the ARITHMETIC LOGIC UNIT (OR ALU). The last two are often jointly called the CENTRAL PROCESSING UNIT OR (CPU), although the same term often is used as a synonym for the entire microprocessor. The input/output unit links the microprocessor to the rest of the circuitry of the computer, passing along program instructions and data to the registers of the control units and arithmetic/logic unit. The I/O unit matches the signal levels and timing of the internal solid state circuitry of the microprocessor to the other components inside the PS. For example, the internal circuits of a microprocessor are designed to be parsimonious with electricity so that they can operate faster and cooler. These delicate internal circuits cannot handle the higher currents needed to link to external components. Consequently, each signal buffers (INTERFACE) in the input/output unit that boost its current capacity.

The input/output unit can be as simple as few buffers, or it can involve many complex functions. In the latest Intel Microprocessors used to power some of the most powerful PCs, the input/output unit include, CACHE MEMORY AND CLOCK-DOUBLING LOGIC to match the high operating speed of the microprocessor to shower external memory.

The control unit of a microprocessor is a clocked logic circuit that as its name implies controls the operations of the entire circuit. Unlike more common integrated circuits, the entire functions of which are fixed by hardware designs, the control unit is more flexible. The control unit follows the instructions contained in an external program and commands the arithmetic/logic unit what to do. It receives instruction from the input/output unit, translate them into a form that can be understood by the arithmetic/logic unit and keeps track of which step of the program is being executed. The arithmetic/logic unit handles all the decision

making. The mathematical computation and logic functions – that are performed by the microprocessor it takes the instruction decoded by the control unit and either carries than out directly or executives the appropriate microcode to modify the data contained in it's registers.

The result is passed back out of the microprocessor through the inputs/output unit.

## **2.13 DISTINGUISHING MICROPROCESSOR**

All the three parts of the microprocessor interact together. In all but the simplest microprocessor designs, the input/output unit is under control of the control unit, and the operation of the control unit may be determined by the results of the calculations of the arithmetic/logic units. The combination of the three parts determines the power and the performance of the microprocessor.

Each part of the microprocessor also has it's own effect on the processing speech of the system. The control unit operates the microprocessor's internal clock, which determines the rate at which the chip operates. The input/output unit determines the bus with of the microprocessor's which influence how quickly data and instructions can be moved in and out of the microprocessor. And the registers in the arithmetic/control unit determine how much data the microprocessor can operate on at one time.

## **2.14 REGISTER EFFECTS**

Not only to microprocessor have differing numbers of registers, but the register may be different sizes, registers are measured by the number of bit that they can work with at one time. For instance a 16 – bit microprocessors should have one or more registers that each holds 16-bits of data at a time. Adding more registers to microprocessors does not make it inherently faster. The design of the

microprocessors in PCs allows performing only one operation at a time, involving at most two registers. However a greater number of registers helps the software writer makes more efficient programs. With more places to put data, potentially saving several programs steps and clock cycles.

The size of the register does, however have a substantial impact on the performance of a microprocessor.

The more bits designed to each register, the more information that can be processed in every microprocessor operations consequently, a 16-bit register holds the potential of calculating time as fast as an 8-bit register.

## 2.15 BUS EFFECT

The microprocessor used in IBM – Computer personal computers have two kinds of external connections to their input/output units. Those that indicate the address of memory location to or from which the microprocessor will send or receive data or instruction and those that convey the meaning of the data or instruction.

The former is called of the ADDRESS BUS of the microprocessor; the latter the DATA BUS. The number of bits in the data bus of a microprocessor directly influences how quickly it can move information. The more bits that a chip can use at a time, the faster it is. Microprocessors with 8-bit and 32 bit data buses are all used in various IBM personal computers.

The number of bits available on the address bus influences how much memory a microprocessor can address for instance, a microprocessor with 16 address lines can directly work with  $2^{16}$  address that's 65,536 (or 64k) different memory locations. The different microprocessor used in various PCs span a range of address bus from 20 to 32 bits.



## **2.16 LOCATION YOUR MICRPROCESSOR**

Ordinarily, you should have no need to see or touch the microprocessor in your PC. As long as your computers works and considering the reliability that most have demonstrated, that will be a long, long time in you really need have no concern over your microprocessor except to know that it is inside your computer doing it's job.

However, some modern system upgrades require that you play a new microprocessor into you system or even replace the one that you have before you can replace you microprocessor, you have to identify which chip it is that's easy.

As a general rule, all you have to look for is the largest integrated circuit chip on your computer's motherboard. Almost invariably it will be the microprocessor that's only fitting because the microprocessor is also the most important chip in the computer.

If you find several large chips on your system board odds are that one of them is the microprocessor. Others may be equally big because they have elaborate functions and need to make many connection with the system board, which means they need relatively large packages to accommodate their may leads.

Almost universally, the microprocessor chip will be installed in a socket. While most support chips will be soldered directly to the system board. Sometimes the microprocessors will be hidden under a heat sink, which you can identify, by its heat radiating fins.

### **SUMMARY**

This chapter highlighted some of the main features of the microprocessor given much emphasis on the importance of the microprocessor and how it functions.

Emphasis was also laid on how the microprocessor can be located and also how it eventually communicates with various registers in the internal Architecture of the computer. Finally, some practical way of handling these components during, troubleshooting, maintenance and assembly of personal computers have been briefly profiled.

# Chapter Three

## TROUBLESHOOTING

### 3.0 INTRODUCTION

This chapter contains common problem and solutions that one might encounter with his computer, the first section of the chapter deals with expert system while the other ones that follows, "Troubleshooting step-by step and Error messages" help one solve more complex problems.

### 3.1 EXPERT SYSTEM

Expert system is often regarded as representing sub class of Artificial Intelligence, and they often (wrongly) identified with fifth generation of computers.

Expert system has been working with varying degree of success for many years. However, as usual conventional systems relying on progress in knowledge engineering, expert system are at the key development contributing to the fifth generation programs

An expert system may be regarded as a means of recording and accessing human competence in a particular specialist field. The most robust interpretation suggests that an expert system is human like performance and can serve thereby as a replacement expert. It was in view of these that I resolved to adopt the expert system in troubleshooting, maintenance of PC to the beet of my knowledge.

Hardware and software crashes can lead to frustration, hours of wasted effort or worse catastrophic accidents, and it is clearly time that the concept of expert system of troubleshooting and maintenance was carefully adopted as a vital tool in the project.

The majority of computer crashes are caused by fairly trivial events, such as a momentary loss of power or the accidental disconnection of a peripheral device: operator error can also be the cause accidentally pressing the wrong key can wipe out all the data stored in memory or disk. Hard disks head crash when 20 MB of invaluable data programs just disappear into thin air. are directly identifiable hardware faults.

Whatever, the cause, computer faults, both hardware and software, can have catastrophic results. Computer failures can cause loss of life, bankrupt companies and bring nations to brink of war.

When a fault is detected in the computer, by various techniques described in this project, the next stage is to determine the exact source of the fault. This is because a fault is not detected until some time after fault has occurred. This allows the fault to spread across much more of the system than is initially apparent.

Fault can be characterized by duration and extent.

1. A fault is referred to as LATENT when it occurs without producing errors during system operation.

2. TRANSIENT FAULTS are temporary conditions, usually the result of electromagnetic, temperature, humidity, incorrect operating, or other external disturbances. Transient fault typically disappear as soon as the external condition is eliminated

3. A w Intermittent Fault: Alternates between active and dormant state and is usually caused by poor design. Borderline operating conditions. for both transient and intermittent fault, errors may remain after the fault disappears.

### **3.2 TROUBLESHOOTING AND REPAIR**

When your computer system fails to operate the way it should, it can be hard to know where to start and what to do. There are so many complex interacting elements in the system that a subtle error in the set up information, for example, can cause all sorts of mysterious faults. A bad keyboard can cause the system to appear to freeze or to wild. A bad RAM chip can cause a system to fail to boot, or to periodically crash.

Troubleshooting a faulty system is a methodical process in which you track down and eliminate possible causes of a problem until it disappears. There are no quick solutions or shortcuts, except the experience to know where to start looking and thus save yourself wasted time. This section of the project is meant to be an introduction to fundamentals of troubleshooting a computer system.

### **3.3 PROBLEM DEFINITION**

Before you can start chasing down a problem, you have to know what it is, exactly what it is, and some of its likely causes as Viz;

#### **EFFECTS**

When your system behaves unexpectedly, you should immediately exit important program you are running and make certain your data are safe. Never perform the testing described in this project work with important irreplaceable files

If the problem is critical (is causes the system to lock up at boot) or prevent you from using the machine in any fashion, make careful note of when the fault occurs, and what seems to be causing it to occur (boot, first key pressed, first attempt to read from a disk, etc)

If the problem seems to be transient, try to determine the exact sequences of events that cause it.

#### **PHYSICAL CONSIDERATION**

Software testing can be done without disturbing the computers hardware and physical setup. If the troubleshooting or repair both indicate that you will have to deal expensively with the hardware, you should consider at the start whether you want to move the computer to a location where it will be more accessible. Fixing a loose video cable can and should be done with the computer in its usual place.

Testing and repair involving the internal hardware and expansion cards should probably be done with the computer spread out, as it was when you first powered it up.

## HANDLING CONSIDERATION

Handling computer under repair is much like that of handling is being assembled. When removing expansion cards and Ics, you should observe the anti static precautions. When connecting or disconnecting cables or any place of hardware, the system power should be off never pull a board, change jumper or switch setting, or switch cables with the power on.

When working with systems that contain hard disk drives, you need to be more gently than when you first installed the drive. An initialized hard drive can even more prove to damage than a new one, since it contain data that can be lost. This is especially true if the system fault prevents you from panking the hard disk drive's head. If the had disk drive is not a self panking type and your system failed in use, preventing you from running a head packing utility, handle the system unit with extreme care.

Since you will probably have to power the system up and down several time during hardware troubleshooting, be certain that pank the heads each time. Always allow the hard disk a minute or two to spin down to a halt before moving or bumping the case.

### **3.4 TOOLS**

Many troubleshooting and repair operations can be accomplished without tools. The tool set needed to assemble the computer should be sufficient, but the complete set listed in this project work is recommended as repair often involves steps more complicated than those of assemble.

More advance tools such as a soldering pencil, logic probe, multimeter, oscilloscope, cable tester, etc. one not required for board level testing and repair the scope of this project work.

### **3.5 SOFTWARE TOOLS**

Software diagnostic tools can be very useful reference manual, which accompanies some system when bought, has a number of diagnostic routines that can help you pinpoint problems.

There are also many other routines programs, and software tools available in the public domain and shareware market, which can be obtained from local bulletin boards, computer user groups, and online information services sometimes a small, specialized testing routine can save us hours of labor.

Commercial diagnostic programs are also indispensable to anyone who does a lot of computer troubleshooting and repair. A software tool that is certainly needed for troubleshooting at no cost is a RAW.



## **SYSTEM BOOT DISK**

A Raw boot disk should be a floppy disk with the operating boot files, but no configuration files for DOS, AUTO EXEC. BAT and CONFIG.System.

To simplify some steps of software troubleshooting copy all of the drives and utilities normally used when a system is booted. A text editor such as EDLIN. COM, which comes with most versions of DOS, should be included, so that one can create and modify configuration files as necessary.

### **3.6 HARDWARE TROUBLESHOOTING.**

Hardware troubleshooting and repair is much like that of software although it is more involved because of the system disassembly required. Again, it is probably easier to proceed with hardware trouble shooting if the computer system is moved to a test bench like area.

## **LIMITED TROUBLESHOOTING**

If one is certain that a particular problem lies with a specific expansion card or other device, one can begin by inspecting that device. Check all of its connections and its installation, if everything appears normal cables correctly attached, and seated in expansion slot, all jumpers firmly in place-then remove the device for closer inspection. Check the placement of all jumpers and the position of all dip switches on the card. Check the entire one after the other. Don't assume or overlook anything.

Remove and reinstall any attached enables, looking for bad connector pins, a bad attachment of the cable or signs that the cable may have been

damaged.e.g any Ic's or other devices are installed in socket, check to see that they are firmly and correctly seated in the sockets.

When the card and devices condition are verified, reinstall it and carefully reconnect it as necessary. power up the system to see if the problem has been cured. If it has not been cured, then certainly the problem lies in that devices that component will have to be repaired or more likely replaced.

## **EXTENDED TROUBLESHOOTING**

If a problem to a single component cannot be pinpointed or if a problem that appeared to be the fault of a single device turned out to be one has to troubleshoot the entire. If this because necessary it's best to take the wide angle approach discussed here, rather than try to troubleshoot sections of the system individually.

Take the system and strip it down to bare essentials. If possible, the only expansion devices in the system unit should be a video card and a floppy drive controller. The only devices attached to the system should be a keyboard and monitor. If the system does not function properly in this configuration, the fault lies with whatever hardware is installed.

Motherboard, RAM, floppy controller, keyboard or video adapter. Without substitute puts to swap into the system (e.g. a temporary replacement for the floppy controller or video card), it can hard to trace the problem further.

If the stripped system works correctly, reinstall the removed component one at a time until the malfunction occurs. If more than one optional device is install at that point, try removing some of the earlier installed ones to see if the problem disappears again. This process should lead to the deflection of the faulty component or problem-causing device.

The most common problem, assuming that none of the device was actually faulty, is an improperly shared system resource, such as a DMA channel or interrupts request (IRQ) line.

Shared hardware point addresses also occasionally occur, especially with multiple parallel points and EMS (Expanded Memory) cards. No shared hardware point addresses or signal lines is permitted.

One the fault is narrowed down to one or two devices, check their configuration to see if they are perhaps sharing a system resource or are otherwise improperly configured. If everything appears to be correct, one of the components is most likely faulty. The best way to test hardware is in a working computer system.

### **3.7 REPAIR**

Repairing computer systems consist mostly or replacing faulty in their entirety. During repair with a soldering iron at the level of board's integrated circuits, resistor, and other components requires skill and experience. It is often simpler and more cost effective to replace an entire expansion card then to try repairing it, even if the fault is detected.

There are a few items that can be repaired with minimum skill. Cables are one example. If a cable developed a broken conductor inside one of the connector shells, a few minutes work with a soldering iron can save the replacement cost of the cable.

However, if the cable has molded on connectors or the break is somewhere along its length, no repair is possible.

Newly all computers component and product have warranties. If a product fail within the warranty period, one should constant the seller or manufacturer about repair or replacement of the defective pent.

### **3.8 TROUBLESHOOTING CHART**

Troubleshooting is much easier if you have a guide to the possible problems and related symptoms that a malfunctioning system can display.

This project is intended to provide an overall troubleshooting guide with some possible solutions to common problems, both in CHART FORM AND COMPUTER PROGRAMS known as TUTOR programs on how to troubleshoot. Which will go a long way to help computer user perform preventive maintenace on their system to save cost. In some cases, the fault is self-explanatory. In others, the problem is simply narrowed to a particular area of the system, and you will have to use the various information provided in this project work to computer the troubleshooting.

### **3.9 SYSTEM**

The following problems with overall system may be encountered.

## **SYSTEM DOES NOT POWER UP**

- System unit not plugged in
- Power cord loose or broken
- Wall socket faulty, or circuit breaker open
- Short circuit in computer system causing power supply shutdown
- Power supply faulty

## **SYSTEM DOES NOT BOOT**

- Non- bootable diskette in drive A
- Hard disk drive not initialized
- System file on hard disk drive missing or damaged.
- Faulty Cmos set setup information, and / or incorrect motherboard dipswitch setting.
- Faulty RAM device
- Loose disk drive control, data, or power cable.
- Power supply loaded pass voltage limit
- Expansion card loose in slot.

## **SYSTEM FREEZES, CRASHES, OR REBOOTS SPONTANEOUSLY**

- Faulty RAM device
- Loose motherboard power connector
- Expansion card loose in slot.
- Conflicting hardware assignments
- Incorrect or conflicting software configuration
- Memory- resident program and driver conflicts

## **KEYBOARD DOES NOT RESPOND**

Keyboard not firmly plugged into motherboard port

- TX- style keyboard used with wrong motherboard
- Switchable keyboard set to wrong type (VT I AT) for motherboard.
- Keyboard lock switch in locked position
- Keyboard lock switch wiring loose on motherboard, or connector reversed.

## **NOISE FROM SYSTEM UNIT**

- Normal power supply noise (fanhum, air movement)
- Normal hard disk drive noise (hum or slight whine while running.
- Faulty hard disk drive (loud or repeated chatter or thump, loud whine)
- Faulty cooling fan (loud hum, chatter overheating smells)

## **NO SOUND FROM SPEAKER**

- Speaker connection to motherboard loose
- Speaker or wiring faulty
- Programs not making use of speaker

## **REAL-TIME CLOCK / CALENDER MARFUNCTIONS**

- No real-time clock/calendar installed
- Clock battery weak, dead or missing
- Clock / calendar not set properly (correctly)
- Real-time, time and not retired and used to set DOS system clock

### **3.10 VIDEO**

The following problems commonly occur with

#### **NO VIDEO DISPLAY**

- Monitor not plugged in, or not turned on
- Video cable not connected to video adaptor, or connection to adaptor or monitor loose.
- Video cable faulty
- Incorrect monitor type for video adaptor in use
- Motherboard color/mono select dipswitch set incorrectly.
- Incorrect video type specified in set up
- Video adaptor incorrectly configured
- Incorrect video mode selected
- Software incorrectly configured
- Monitor incorrectly configured (applies monthly to multiscan and VGA monitors)
- Monitor brightness or contrast turned down
- Software screen- blanking utility in operation

#### **FAULTY VIDEO DISPLAY**

- Incorrect video mode selected
- Video adaptor incorrectly configured
- Monitor vertical and horizontal hold and controls misadjusted.
- Monitor brightness and /or contrast control misadjusted
- Software incorrectly configured
- Insufficient video RAM (VGA, older EGA only)
- Motherboard master oscillator trimmed (older CGA systems only)

### **3.11 DISK DRIVE**

Hard and floppy disk drive can display the following problems

#### **WRITE FAILURE**

- No disk on diskette drive
- Diskette not firmly seated in drive (3.5inch drives) or drive door close (5.25- inch drive)
- Disk not formatted to drive only) not initialized
- Diskette writes protected.
- Diskette drive write-protect sensor blocked or faulty.
- Hard disk partition flagged read only.

#### **READ FAILURE**

- No disk on diskette drive
- Diskette not firmly seated on diskette drives or drive door not closed.
- Disk not formatted or (hard drive only) not initialized

#### **DISKETE FAILS TO RECOGNIZE NEW DISK**

- Change disk jumper on diskette drive incorrectly set
- Diskette cable loose or faulty.

### **3.12 PERIPHERALS**

The following problems with peripherals devices may be encountered

#### **SERIAL PORT NOT FUNCTIONING.**

- Expansion card incorrectly configured



- Software incorrectly configured.
- Serial port not initialized (use MODE command)
- Incorrect parameters (band rate, stop bits, parity) specified
- VART and or drivers lces installed (secondary ports only)
- Serial cable incorrectly wired.
- Cable connections loose.
- Serial device (printer, plotter, mouse) incorrectly configured)

### 3.13 FEASIBILITY STUDY

Feasibility study is concerned with preliminary investigation and it is upon to determine whether the proposed project is feasible or not feasible. The objectives of the analyst is to clarify and understand the scope of the project which are list in chapter one, starting from the statement of the problem through the end of that chapter.

### 3.14 OPERATION OF THE EXISTING SYSTEM

This is concerned with the ways and manners by which computer are being repair/troubleshoot. The following methods are the most common ways to troubleshoot computer as at the time of designing this project work.

- Try an error method
- Sets comparison method
- Personal idea method
- Group/Team work method
- Impromptu repair method.

## TRY AN ERROR METHOD

This has to do with removing, testing and replacing any or all components the computer scientist/engineer feel or assume is likely to be the problem source. Until he is tired or the fault is detected. This method may take hours, day, weeks or even months depending on the nature of problem and luck/chance of success on the part of the engineer.

## SET COMPARISON METHOD

Require that there have to be good working computer system of the same MAKE MODEL and equal circuit board. The engineer will thereby be comparing the values of the measure components of the two systems until the fault is detected. This is a good method and required good professional skill so as not to damage the other working system.

## PERSONAL EXPERIENCE/IDEA METHOD

Professional engineer with a lost of practical experience, having good record keeping on repaired system will use this experiences to troubleshoot/repair another system with similar problem.

## GROUP/TEAM WORK METHOD

Sometimes in an organization having skill personal, with their wealth of different experience do jointly repair complicated problems. Since it is believed that two heads are better than one, irrelevant parts on the circuit board will not be disturbs.

## IMPROMPTU REPAIR METHOD

This is mostly on a partial contact component when a faulty system start working fine soon as the printed wiring board is touched, shapes, tampered with or disturbed without knowing the particular fault area. Therefore, no real working is done on the system.

## PROBLEM WITH THE EXISTING SYSTEM

After going though the existing method of diagnosing and troubleshooting of computer system, the problem identified with the system/methods are: -

- Damage to the printed board
- Undue delayed in repairs
- Malfunctioning of system
- Laborious and Boredom in repair
- Lack of uniformity of repair
- Cumbersome or congestion of workshop
- Deception repair

### (1) Damage to the printed circuit (wiring) Board.

Due to continuing removing and replacing of components as a result of try and error method of repair damages are usually dons to the printed circuit board.

### (2) Undue delay in Repair

It is common practice for engineers to delay job especially when the fault has not been detected.

They can keep a job for days; weeks, months and even year only to be promising the customer endlessly and at the end the job may not be done. Meanwhile, it could be a very simple problem, having his propose troubleshooting kit at hand.

### (3) Manufacturing of System

At times the repaired system using the aforementioned methods may be manufacturing after sometime, if not properly diagnosis and cleared.

### (4) Laborious and Boredom in Repair

Engineers may spend the whole day without success trying to clear a fault; some of them sweat and are restless.

## SYSTEM SPECIFICATION

The system specification consists of the hardware and software and the personnel that would operate the computer.

IBM Machine or Compatible (PC)

Processor

500MB Hard Disk

16MB RAM

3.5 Floppy Disk Drive

Color Graphic Monitor

Keyboard

EPSON Printed LQ1170

UPS 500VA

MS DOS Version 6.0

Q Basic

## COST ANALYSIS

ment

Cost (N)

IBM or compatible	90,000.00
Printer	50,000.00
UPS 500VA	20,000.00
MS Dos Version 6.0	10,000.00
Printing Papers	3,000.00
Installation	20,000.00
Maintenance	12,000.00
Q Basic	10,000.00
Personnel Training	5,000.00
TOTAL	220,000.00

The initial cost of a PC for maintaining/troubleshooting operation excluding the cost of repairing stood at two hundred and twenty thousand naira (220,000.00) only.

### BENEFIT ANALYSIS

The benefits/advantages to be derived when the proposed system takes off are: -

- Timely repair of computer system
- Labour saving and interesting repair
- Uniformity of repair
- Many jobs could be done with a very short time
- Few numbers of Engineers in workshop
- Very Economical
- Effective and efficient troubleshooting is attained
- Good service to customers maintained
- Workshop is tide up

Other services such as training, record keeping from the above analysis, it is therefore necessary to improve in maintaining/troubleshooting operations for effective, efficient, speedy and smooth running at any computer system.

Economically, the investment on the proposed system through could appear high initially but shall surely be recovered in uncountable fold within a short time, as the advantages to be derived are great as discussed under the benefit analysis. Remember it is less costly to train a child, then not to train a child.

START THE TROUBLESHOOTING PROCESS HERE. FOLLOW THE CHART, ANSWER THE FOLLOWING QUESTIONS

TURN ON THE COMPUTER

Does the computer have video?

Yes

ADJUST THE VIDEO CARD SOLUTIONS

Is the video quality OK?

Yes

THE SYSTEM ROM CONTAINS A SET OF ERROR CODES TO HELP WITH TROUBLESHOOTING. WE RECEIVE THEM AS BEeps, MESSAGES OR NUMBER CODES.

Yes

PROBLEM SOLVED

Does computer boot?

Yes

No

Does error show?

Yes

FIND THE ERROR MESSAGE AND FIX THE PROBLEM

CHECK THE HARD DISK

Yes

No

Go to the floppy disk section

Is the PSU blowing?

No

TURN OFF THE COVER AND CHECK FOR BUBBLES.

Are these parts these burnt?

Yes

REPLACE THE BURNT PARTS

No

CHECK MOTHERBOARD AND THE PSU

THE COMPUTER BEeping WHEN SWITCHED

Yes

MOST PCs USE A SERIES OF BEeps TO SIGNAL A PROBLEM. AMI BEeps USES ONE OR TWO BEeps..

IS MAINBOARD TEST MEMORY FIRST

No

Is the computer still beeping after 3 minutes?

Yes

Does the computer have BIOS?

No

PROBLEM SOLVED

THE BEep CODES GIVE MOST ERROR

CHECK ERROR CODES

# Chapter Four

## **MAINTAINING YOUR SYSTEM: PREVENTIVE MAINTENANCE**

### **4.0 INTRODUCTION**

Preventive maintenance is the key to obtaining years of trouble-free service from your computer system. A properly administered preventive maintenance program pays for itself by reducing problem behavior, data loss, component failure, and by ensuring a long life for your system. In several cases, I have “repaired” an ailing system with nothing more than a preventive maintenance session. Preventive maintenance also increases your system’s resale value because it will look and run better. This chapter describes preventive maintenance procedures and how often you should perform them.

### **4.1 DEVELOPING A PREVENTIVE MAINTENANCE PROGRAMME**

Developing a preventive maintenance program is important to everyone who uses or manages personal computer systems. Two types of preventive maintenance procedures exist – active and passive.

Active preventive maintenance includes steps you apply to a system that promote a longer, trouble-free life. This type of preventive maintenance primarily involves periodic cleaning of to system and its components. This section describes several active preventive maintenance procedures, including cleaning and lubricating all major components, reseating chips and connectors, and reformatting hard disk.



Passive preventive maintenance includes steps you can take to protect a system from the environment, such as using power-protection devices; ensuring a clean, temperature controlled environment; and preventing excessive vibration. In other words, passive preventive maintenance means treating your system well. This section also describes passive preventive maintenance procedures.

## **4.2 ACTIVE PREVENTIVE MAINTENANCE PROCEDURES**

How often you should implement active preventive maintenance procedures depends on the system's environment and the quality of the system's components. If your system is in a dirty environment, such as a machine shop floor or a gas station service area, you might need to clean your system every three months or less. For normal office environments, cleaning a system every one to two years is usually fine. However, if you open your system after one year and find dust bunnies inside, you should probably shorten the cleaning interval.

Another active preventive maintenance technique discussed in this section is reformatting hard disks. Low-level reformatting restores the track and sector marks to their proper location and forces you to back up and restore all data on the drive. Not all drives require this procedure, but if you are using drives with a stepper-motor head actuator, periodic reformatting is highly recommended. Most drives with voice-coil head actuators run indefinitely without reformatting due to their track following service mechanisms that prevent temperature induced mistracking.

Other hard disk preventing maintenance procedures include making periodic backups of critical areas such as Boot Sectors, File Allocation Tables, and Directory structures on the disk.

## 4.2 CLEANING A SYSTEM

One of the most important operations in a good preventive maintenance program is regular and thorough cleaning of the system. Dust buildup on the internal components can lead to several problems. One is that the dust acts as a thermal insulator, which prevents proper system cooling. Excessive heat shortens the life of system components and adds to the thermal stress problem caused by wider temperature changes between power-on and power-off states. Additionally, the dust may contain conductive elements that can cause partial short circuits in a system. Other elements in dust and dirt can accelerate corrosion of electrical contacts and cause improper connections. In all, the removal of any layer of dust and debris from within a computer system benefits that system in the long run.

All PC-compatible systems use a forced-air cooling system that allows for even cooling inside the system. A fan is mounted in, on, or near the power supply and pushes air outside. This setup depressurizes the interior of the system relative to the outside air. The lower pressure inside the system causes outside air to be drawn into openings in the system chassis and cover. This draw-through, or depressurization, is the most efficient cooling system that can be designed without an air filter. Air filters typically are not used with depressurization systems because there is no easy way to limit air intake to a single port that can be covered by a filter.

Some industrial computers use a forced-air system that uses the fan to pressurize, rather than to depressurize, the case. This system forces air to exhaust from any holes in the chassis and case or cover. The key to the pressurization system is that all air intake for the system is at a single location – the fan. The air flowing into the system, therefore, can be filtered by simply integrating a filter

assembly into the fan housing. The filter must be cleaned or changed periodically. Because the interior of the case is pressurized relative to the outside air, airborne contaminants are not drawn into the system even though it may not be sealed. Any air entering the system must pass through the fan and filter housing, which removes the contaminants. Pressurization cooling systems are used primarily in industrial computer models designed for extremely harsh environments.

Most systems you have contact with are depressurization systems. Mounting any sort of air filter on these types of systems is impossible because air enters the system from too many sources. With any cooling system in which incoming air is not filtered, dust and other chemical matter in the environment is drawn in and builds up inside the computer. This buildup can cause severe problems if left unchecked.

One problem that can develop is overheating. The buildup of dust acts as a heat insulator, which prevents the system from cooling properly. Some of the components in a modern PC can generate an enormous amount of heat that must be dissipated for the component to function. The dust also might contain chemicals that conduct electricity. These chemicals can cause minor current shorts and create electrical signal paths where none should exist. The chemicals also cause rapid corrosion of cable connectors, socket-installed components, and areas where boards plug into slots. All can cause intermittent system problems and erratic operation.

Floppy disk drives are particularly vulnerable to the effects of dirt and dust. Floppy drives are a large “hole” within the system through which air continuously

flows. Therefore, they accumulate a large amount of dust and chemical buildup within a short time. Hard disk drives do not present quite the same problem. Because the head disk assembly (HDA) in a hard disk is a sealed unit with a single barometric vent, no dust or dirt can enter without passing through the barometric vent filter. This filter ensures that contaminating dust or particles cannot enter the interior of the HDA. Thus, cleaning a hard disk requires simply blowing the dust and dirt off from outside the drive. No internal cleaning is required.

### **4.3 DISASSEMBLY AND CLEANING TOOLS**

To properly clean the system and all the boards inside requires certain supplies and tools. In addition to the tools required to disassemble the unit, you should have these items:

- \* Contact Cleaning Solution
- \* Canned air
  - A small brush
  - Lint-free foam cleaning swabs
  - Antistatic wrist-grounding strap

You also might want to acquire these optional items:

- Foam tape
- Low-volatile room-temperature vulcanizing (RTV) sealer
- Silicone type lubricant
- Computer vacuum cleaner

These simple cleaning tools and chemical solutions will allow you to perform most common preventive maintenance tasks.

Chemicals: You can use several different types of cleaning solutions with computers and electronic assemblies. Most fall into the following categories:

- Standard Cleaner
- Contact Cleaner/Lubricants
- Dusters

Many specific chemicals are used in cleaning and dusting solutions, but five types are of particular interest. The EPA has classified ozone-damaging chemicals into two classes - Class I and Class II. Chemicals that fall into these two classes have their usage regulated. Other chemicals are non-regulated. Class I chemicals include:

- Chlorofluorocarbons (CFCs)
- Chlorinated solvents

Class I chemicals can only be sold for use in professional service and not to consumers. A law that went into effect on May 15, 1993, requires that the containers for Class I chemicals be labeled with a warning that the product “Contains substances that harm public health and the environment by destroying ozone in the atmosphere.” Additionally, electronics manufacturers and other industries must also apply a similar warning label to any products that use Class I chemicals in the production process. This means that any circuit board or computer that is manufactured with CFCs will have this label!

Class II chemicals include hydrochlorofluorocarbons (HCFCs). These are not as strictly regulated as Class I chemical because they have a lower ozone depletion

potential. Many cleaning solutions have switched to HCFCs because they do not require the restrictive labeling required by Class I chemicals and are not as harmful. Most HCFCs have only one tenth the ozone damaging potential of CFCs.

Other nonregulated chemicals include Volatile Organic Compounds (VOCs) and Hydrofluorocarbons (HFCs). These chemicals do not damage the ozone layer but actually contribute to ozone production, which, unfortunately, appears in the form of smog or ground level pollution. Pure isopropyl alcohol is an example of a VOC that is commonly used in electronic part and contact cleaning. HFCs are used as a replacement for CFCs because the HFCs do not damage the ozone layer.

#### **4.4 STANDARD CLEANERS**

Standard cleaning solutions are available in a variety of types and configurations. You can use pure isopropyl alcohol, acetone, Freon, trichloroethane, or a variety of other chemicals. Most board manufacturers and service shops are now leaning to the alcohol, acetone, or other chemicals that do not cause ozone depletion and that comply with government regulations and environmental safety. You should be sure that your cleaning solution is designed to clean computers or electronic assemblies. In most cases this means that the solution should be chemically pure and free from contaminants or other unwanted substances. You should not, for example, use drugstore rubbing alcohol for cleaning electronic parts or contacts because it is not pure and could contain water or perfumes. The material must be moisture-free and residue-free. The solutions should be in liquid form, not a spray. Sprays can be wasteful and you almost never spray the solution directly on components. Instead, wet a foam or chamois swab used for wiping the component. These electronic-component cleaning solutions are available at any good electronic parts stores.

## **4.5 CONTACT CLEANER/LUBRICANTS**

These are very similar to the standard cleaners but include a lubricating component. The lubricant eases the force required when plugging and unplugging cables and connectors, which reduces strain on the devices. The lubricant coating also acts as a conductive protectant that insulates the contacts from corrosion. These chemicals can greatly prolong the life of a system by preventing intermittent contacts in the future.

Contact cleaner/lubricants are especially effective on I/O slot connectors, adapter card edge and pin connectors, disk drive connectors, power supply connectors, and virtually any connectors in the PC.

An excellent contact enhancer and lubricant is Stabilant 22. It is more effective than conventional contact cleaners or lubricants. This chemical is available in several forms. Stabilant 22 is the full strength concentrated version, while Stabilant 22a is a version diluted with isopropyl alcohol in a 4 to 1 ratio. An even more diluted 8 to 1 ratio version is sold in many high end stereo and audio shops under the name "Tweek." Just 15ml of Stabilant 22a sells for about \$40, while a liter of the concentrate costs about \$4,000. While Stabilant 22 is expensive, very little is required and an applicant can provide protection for a long time. Stabilant is manufactured by D.W. Electrochemical, which is listed in the Vendor List in Appendix B.

## **4.7 DUSTERS**

Compressed gas often is used as an aid in system cleaning. The compressed gas is used as a blower to remove dust and debris from a system or component. Originally, these dusters used CFCs such as Fresno, while modern dusters now use

HFCs or carbon dioxide, neither of which is damaging to the ozone layer. Be careful when you use these devices because some of them can generate a static charge when the compressed gas leaves the nozzle of the can. Be sure that you are using the kind approved for cleaning or dusting off computer equipment, and consider wearing a static grounding strap as a precaution. The type of compressed-air cans used for cleaning camera equipment can sometimes differ from the type used for cleaning static sensitive computer components.

Most older computer-grade canned gas dusters consisted of dichlorodifluoromethane (Freon R12), the same chemical used in many automotive air-conditioning systems built until 1996, when a ban of the manufacture and use of R12 takes place. In 1992 many automobile manufacturers began switching to an ozone-safe chemical called R134a, and most had switched to the new refrigerant by 1994. Manufacturing of R12 has ceased, and the regulations placed on its use have forced companies to use other products such as carbon dioxide for compressed gas dusters. In addition to the environmental concerns about depleting the ozone layer, Freon can be dangerous if exposed to an open flame.

Related to compressed-air products are chemical-freeze sprays. These sprays are used to quickly cool down a suspected failing component, which often temporarily restores it to operation. These substances are not used to repair a device, but to confirm that you have found a failed device. Often, a component's failure is heat-related and cooling it temporarily restores it to function. If the circuit begins operating normally, the device you are cooling is the suspect device.



## **4.8 VACUUM CLEANERS**

Some people prefer to use a vacuum cleaner instead of canned gas dusters for cleaning a system. Canned gas is usually better for cleaning in small areas. A vacuum cleaner is more useful when you are cleaning a system loaded with dust and dirt. You can use the vacuum cleaner to suck out dust and debris instead of blowing them on other components, which sometimes happens with canned air. For outbound servicing (when you are going to the location of the equipment instead of the equipment coming to you), canned air is easier to carry in a toolkit than a small vacuum cleaner. There are also tiny vacuum cleaners available for system cleaning. These small units are easy to carry and may serve as an alternative to compressed air cans.

Note that there are special vacuum cleaners specifically designed for using on and around electronic components. They are designed to minimize ESD (Electro Static Dis-charge) while in use. If you are using a regular vacuum cleaner and not one specifically grounding wrist strap. Also be careful if the cleaner has a metal nozzle not to touch it to the circuit boards or components you are cleaning.

## **4.9 BRUSHES AND SWABS**

A small brush (makeup, photographic, or paint) can be used to carefully loosen accumulated dirt and dust before spraying with canned air or using the vacuum cleaner. Be careful about generating static electricity. In most cases the brushes should not be used directly on circuit boards but should be used instead on the case interior and other part such as fan blades, air vents, and keyboards. Wear a grounded wrist strap if you are brushing on or near any circuit boards, and brush slowly and lightly to prevent static discharges from occurring.

Use cleaning swabs to wipe off electrical contacts and connectors, disk drive heads, and other sensitive areas. The swabs should be made of foam or synthetic chamois materials that does not leave lint or dust residue. Unfortunately, proper foam or chamois cleaning swabs are more expensive than the typical cotton swabs. Do not use cotton swabs because they leave cotton fibers on everything they touch. Cotton fibers are conductive in some situations and can remain on drive heads, which can scratch disks. Foam or chamois swabs can be purchased at most electronics-supply stores.

One items to avoid is an eraser for cleaning contacts. Many people (including myself) have recommended using a soft pencil type eraser for cleaning circuit board contacts. Testing has proven this to be bad advice for several reasons. One is that any such abrasive wiping on electrical contacts generates friction and an Electro-Static Discharge (ESD). This ESD can be damaging to boards and components, especially with newer low voltage devices made using CMOS (Complimentary Metal Oxide Semiconductor) technology. These devices are especially static sensitive, and cleaning the contacts without a proper liquid solution is not recommended. Also, the eraser will wear off the gold coating on many contacts, exposing the tin contact underneath, which will rapidly corrode when exposed to air. Some companies sell premoistened contact cleaning pads that are soaked in a proper contact cleaner and lubricant. These pads are safe to wipe on conductor and contacts with no likelihood of ESD damage or abrasion of the gold plating.

#### **4.10 FOAM TAPE OR RTV SEALER**

Hard disks usually use a small copper strap to ground the spindle of the disk assembly to the logic board, thus bleeding off any static charge carried by the

spinning disk platters. Unfortunately, with most older drives, this strap often can begin to harmonize, or vibrate, and result in an annoying squealing or whining noise. (Sometimes the noise is similar to fingernails dragged across a chalkboard). This spindle motor ground strap has been redesigned and can be hidden on newer drives, making it difficult to see. Fortunately, it rarely makes noise on the 3.5 inch or smaller drives.

To eliminate the source of irritation, you can stop the strap from vibrating by weighting it. One method is to use a piece of foam tape cut to match the size of the strap and stuck to the strap's back side. Another way to dampen the vibration is to apply a low-volatile RTV sealer. You apply this silicone-type rubber to the back of the grounding strap. After it hardens to a rubber-like material, the sealer stops the vibrations that produce the annoying squeal. You can buy the RTV sealer from an automotive-supply house.

I prefer using the foam tape rather than the RTV because it is easier and neater to apply. If you use the RTV, be sure that it is the low-volatile type, which does not generate acid when it cures. This acid produces the vinegar smell common to the standard RTV sealer, and can be highly corrosive to the strap and anything else it contacts. The low-volatile RTV also eliminates the bad vinegar smell. You can purchase the foam tape at most electronics-supply stores, where it often is sold for attaching alarm switches to doors or windows. The low-volatile RTV is available from most auto-supply stores. To be sure that you buy low-volatile RTV, look for the packaging to state specially that the product is either a low-volatile type or is compatible with automobile oxygen sensors.

## **4.11 SILICONE LUBRICANTS**

Silicone lubricants are used to lubricate the door mechanisms on floppy disk drives and any other part of the system that may require clean, non-oily lubrication. Other items you can lubricate are the disk drive head slider rails or even printer-head slider rails, which allow for smooth operation.

Using silicone instead of conventional oils is important because silicone does not gum up and collect dust and other debris. Always use the silicone sparingly. Do not spray it anywhere near the equipment as it tends to migrate and will end up where it doesn't belong (such as on drive heads). Instead, apply a small amount to a toothpick or foam swab and dab the silicone on the components where needed. You can use a lint-free cleaning stick soaked in silicone lubricants to lubricate the metal print-head rails in a printer.

Remember that some of the cleaning operations described in this section might generate a static charge. You may want to use a static grounding strap in cases in which static levels are high to ensure that you do not damage any boards as you work with them.

## **4.12 OBTAINING REQUIRED TOOLS AND ACCESSORIES**

Most cleaning chemicals and tools can be obtained from a number of electronics supply houses, or even the local Radio Shack. A company called Chemtronics specializes in chemicals for the computer and electronics industry. These and other companies that supply tools, chemicals, and other computer and electronic cleaning supplies are listed in the Vendor List in the Appendix. With all these items on hand, you should be equipped for most preventive maintenance operations.

### **4.13 DIASSEMBLING AND CLEANING PROCEDURE**

To properly clean your system, it must be at least partially disassembled. Some people go as far as to remove the motherboard. Removing the motherboard results in the best possible access to other areas of the system but in the interest of saving time, you probably need to disassemble the system only to where the motherboard is completely visible.

All plug-in adapter cards must be removed, along with the disk drives. Although you can clean the heads of a floppy drive with a cleaning disk without opening the system unit's cover, you probably will want to do more thorough cleaning. In addition to the heads, you also should clean and lubricate the door mechanism and clean any logic boards and connectors on the drive. This procedure usually requires removing the drive.

Next, do the same procedure with a hard disk: clean the logic boards and connectors, as well as lubricate the grounding strap. To do so, you must remove the hard disk assembly. As a precaution, be sure it is backed up before removal.

### **4.14 RESEATING SOCKETED CHIPS**

A primary preventive maintenance function is to undo the effects of chip creep. As your system heats and cools, it expands and contracts, and the physical expansion and contraction causes components plugged into sockets to gradually work their way out of those sockets. This process is called chip creep. To correct its effects, you must find all socketed components in the system and make sure that they are properly resealed.

In most systems, all the memory chips are socketed or are installed in socketed SIMMs (Single Inline Memory Modules). SIMM devices are retained securely in their sockets by a positive latching mechanism and cannot creep out. Memory SIPP (Single Inline Pin Pack-age) devices (SIMMs with pins rather than contacts) are not retained by a latching mechanism and therefore can creep out of their sockets. Standard socketed memory chips are prime candidates for chip creep. Most other logic components are soldered in. You can also expect to find the ROM chips, the main processor of CPU, and the math coprocessor in sockets. In most systems, these items are the only components that are socketed; all others soldered in.

Exceptions, however, might exist. A socketed component in one system might not be socketed in another – even if both are from the same manufacturer. Sometimes this difference results from a parts-availability problem when the boards are manufactured. Rather than halt the assembly line when a part is not available, the manufacturer adds a socket instead of the component. When the component becomes available, it is plugged in and the board is finished. Many newer systems place the CPU in a Zero Insertion Force (ZIF) socket, which has a lever that can release the grip of the socket on the chip. In most cases there is very little creep with a ZIF socket.

To make sure that all components are fully seated in their sockets, place your hand on the underside of the board and then apply downward pressure with your thumb (from the top) on the chip to be seated. For larger chips, seat the chip carefully in two movements, and press separately on each end of the chip with your thumb to be sure that the chip is fully seated. (The processor and math coprocessor chips can usually be seated in this manner). In most cases, you hear a crunching sound as the chip makes its way back into the socket. Because of the

great force sometimes required to reseat the chips, this operation is difficult if you do not remove the board.

For motherboards, forcibly seating chips can be dangerous if you do not directly support the board from the underside with your hand. Too much pressure on the board can cause it to bow or bend in the chassis, and the pressure can crack it before seating takes place. The plastic standoffs that separate and hold the board up from the metal chassis are spaced too far apart to properly support the board under this kind of stress. Try this operation only if you can remove and support the board adequately from underneath.

You may be surprised to know that, even if you fully seat each chip, they might need reseating again within a year. The creep usually is noticeable within a year or less.

#### **4.15 CLEANING BOARDS**

After reseating any socket devices that may have crept out of their sockets, the next step is to clean the boards and all connectors in the system. For this step, the cleaning solutions and the lint-free swabs described earlier are needed.

First, clean the dust and debris off the board and then clean any connectors on the board. To clean the boards, it is usually best to use a vacuum cleaner designed for electronic assemblies and circuit boards or a duster and dirt off the boards.

Also blow any dust out of the power supply, especially around the fan intake and exhaust areas. You do not need to disassemble the power supply to do this, just use a duster can and blast the compressed air into the supply through the fan

exhaust port. This will blow the dust out of the supply and clean off the fan blades and grille, which will help with system airflow.

#### **4.16 CLEANING CONNECTORS AND CONTACTS**

Cleaning the connectors and contacts in a system promotes reliable connections devices. On a motherboard, you will want to clean the slot connectors, power-supply connectors, keyboard connectors, and speaker connector. For most plug-in cards, you will want to clean the edge connectors that plug into slot on the motherboard as well as any other connectors, such as external ones mounted on the card bracket.

Submerge the lint-free swabs in the liquid cleaning solution. If you are using the spray, hold the swab away from the system and spray a small amount on the foam end until the solution starts to drip. Then, use the soaked foam swab to wipe the connectors on the boards. Pre-soaked wipes are the easiest to use. Simply wipe them along the contacts to remove any accumulated dirt and leave a protective coating behind.

On the motherboard, pay special attention to the slot connectors. Be liberal with the liquid; resoak the foam swab repeatedly, and vigorously clean the connectors. Don't worry if some of the liquid drips on the surface of the motherboard. These solutions are entirely safe for the whole board and will not damage the components.

Use the solution to wash the dirt off the gold contacts in the slot connectors, and then douse any other connectors on the board. Clean the keyboard connector, the



grounding positions where screws ground the board to the system chassis, power-supply connectors, speaker connectors, battery connectors, and so on.

If you are cleaning a plug-inboard, pay special attention to the edge connector that mates with the slot connector on the motherboard. When people handle plug-in cards, they often touch the gold contacts on the connectors. Touching the gold contacts coats that with oils and debris, which prevents proper contact with the slot connector when the board is installed. Make sure that these gold contacts are free of finger oils and residue. It is a good idea to use one of the contact cleaners that has a conductive lubricant, which allows connections to be made with less force, and also protects the contacts from corrosion.

#### **4.17 CLEANING FLOPPY DRIVES:**

Because Chapter 13 explains the procedure for cleaning floppy drives, the information is not repeated here. The basic idea is to canned a gas duster to dust off the interior of the drive, use the silicone lubricant on whatever items need lubrication, and follow up with a head cleaning, either manually with a foam swab or most likely with a chemical soaked cleaning disk.

For hard disk, take this opportunity to dampen or lubricate the grounding strap if you have a noise problem as described earlier. Dampening is the recommended solution because if you lubricate this point, the lubricant eventually dries up and the squeal can come back. Because the dampening is usually a more permanent fix for this sort of problem, I recommend it whenever possible. Most newer disks have this dampening material applied at the factory and are not likely to generate noise like older drives.

## 4.18 CLEANING THE KEYBOARD AND MOUSE

Keyboards and mice are notorious for picking up dirt and garbage. If you have ever opened up an older keyboard, you often will be amazed at the junk you will find in there.

To prevent problems, it is a good idea to periodically clean out the keyboard with a vacuum cleaner. An alternative method is to turn the keyboard upside down and shoot it with a can of compressed gas. This will blow out the dirt and debris that has accumulated inside the keyboard and possibly prevent future problems with sticking keys or dirty keyswitches.

If a particular key is stuck or making intermittent contact, you can soak or spray that switch with contact cleaner. The best way to do this is to first remove the keycap and then spray the cleaner into the switch. This usually does not require complete disassembly of the keyboard. Periodic vacuuming or compressed gas cleaning will prevent more serious problems with sticking keys and keyswitches.

Most mice are easily cleaned. In most cases there is a twist off locking retainer that keep the mouse ball retained in the body of the mouse. By removing the retainer, the ball will drop out. After removing the ball, you should clean it with one of the electronic cleaner. I would recommend a pure cleaner instead of a contact cleaner with lubricant because you do not want any lubricant on the mouse ball. Then you should clean off the rollers in the body of the mouse with the cleaner and some swabs.

Periodic cleaning of a mouse in this manner will eliminate or prevent skipping or erratic movement that can be frustrating. I also recommend a mouse pad for

most ball type mice because the pad will prevent the mouse ball from picking up debris from your desk.

Mice often need frequent cleaning before they start sticking and jumping, which can be frustrating. If you never want to clean a mouse again, I suggest you look into the Honeywell mouse. These mice have a revolutionary new design that uses two external wheels rather than the conventional ball and roller system. The wheels work directly on the desk surface and are unaffected by dirt and dust. Because the body of the mouse is sealed, dirt and dust cannot enter it and gum up the positional sensors. I find this mouse excellent to use with my portable system because it works well on any surface. This mouse is virtually immune to the sticking and jumping that plagues ball and roller designs and never needs to be cleaned, so it is less frustrating than conventional mice.

Other pointing devices requiring little or no maintenance are the IBM designed Trackpoint and similar systems introduced by other manufacturers, such as the Glidepoint by Alps. These devices are totally sealed, and use pressure transducers to control pointer movement. Because they are sealed, cleaning need only be performed externally, and is as simple as wiping the device off with a mild cleaning solution to remove oils and other deposits that have accumulated from handling them.

#### **4.19 HARD DISK MAINTENANCE**

Certain preventive maintenance procedures protect your data and ensure that your hard disk works efficiently. Some of these procedures actually minimize wear and tear on your drive, which will prolong its life. Additionally, a high level of data protection can be implemented by performing some simple commands

periodically. These commands provide methods for backing up (and possibly later restoring) critical areas of the hard disk that, if damaged, would disable access to all your files.

## 4.20 DEFRAGMENTING FILES

Over time, as you delete and save files to a hard disk, the files become fragmented. This means that they are split into many noncontiguous areas on the disk. One of the best ways to protect both your hard disk and the data on it is to periodically defragment the files on the disk. This serves two purposes. One is that by ensuring that all of the files are stored in contiguous sectors on the disk, head movement and drive wear and tear will be minimized. This has the added benefit of improving the speed at which files will be retrieved from the drive by reducing the head thrashing that occurs every time a fragmented file is accessed.

The second major benefit, and in my estimation the more important of the two, is that in the case of a disaster where the File Allocation Table (FATs) and Root Directory are severely damaged, the data on the drive can usually be recovered very easily if the files are contiguous. On the other hand, if the files are split up in many pieces across the drive, it is virtually impossible to figure out which pieces belong to which file without an intact File Allocation Table (FAT) and directory system. For the purposes of data integrity and protection, I recommend defragmenting your hard disk drives on a weekly basis, or immediately after you perform any major backup.

The main functions are found in most defragmenting programs:

- File Defragmentation
- File Packing (Free Space Consolidation)

- File Sorting

Defragmentation is the basic function but most other programs also add file packing. Packing the files is optional on some programs because it usually takes additional time to perform. This function packs the files at the beginning of the disk so that all free space is consolidated at the end of the disk. This feature minimizes future file fragmentation by eliminating any empty holes on the disk. Because all free space is consolidated into one large area, any new files written to the disk will be able to be written in a contiguous manner with no fragmentation necessary.

The last function, file sorting, is not usually necessary and is performed as an option by many defragmenting programs. This function adds a tremendous amount of time to the operation, and has little or no effect on the speed at which information is accessed. It can be somewhat beneficial for disaster recovery purposes because you will have an idea of which files came before or after other files if a disaster occurs. These benefits would be minimal compared to having the files be contiguous no matter what their order. Not all defragmenting programs offer file sorting and the extra time it takes is probably not worth any benefits you will receive. Other programs can sort the order that files are listed in directories, which is a quick and easy operation compared to sorting the file ordering the disk.

Several programs are available that can defragment the files on a hard disk. Both the Windows 95 and DOS contain built-in defragmenters. The Windows 95 version is a graphical application that runs within the Win 95 environment. It has the ability to defragment disks in the background while other applications are running, making it more convenient than conventional defragmenters. While it is

running, you can see details of the defragmenting process or display a minimal status view of the process.

DOS 6 and newer versions also include a defragmenting programme called DEFRAG. This is a reduced function version of the SPEEDISK program that is normally sold as a part of the Symantec Norton Utilities. If you have the Norton Utilities, by all means use the higher function (and faster) SPEEDIS program instead of DEFRAG. The DOS DEFRAG program offers all three functions including defragmenting, packing, and sorting. The SPEEDIS program performs these operations faster and with more efficient use of memory. Many of these programs will have problems on very large disks, and SPEEDIS will work on drives as large as 2G (the maximum DOS volume size), while DEFRAG is limited to disks of about 512M or less due to memory constraints.

Several aftermarket defragmenting programs are more powerful or faster than the DOS DEFRAG program. They include:

- SPEEDIS by Symantec (Norton Utilities)
- Power Disk by PC-KWIK
- Optune by Gazelle
- VOPT by Golden Bow

All of these are highly recommended and usually perform much better than the DEFRAG program in DOS. The power Disk, Optune, and VOPT programs are also much faster than DEFRAG. The VOPT program is the simplest and quickest of these, and is the one I use myself. It is a simple command-line program – not a menu driven program – like the others. Although VOPT does not offer a sort capability, the speed at which it operates is second to none, and the visual display

is very entertaining as well! VOPT offers the ultimate in speed and efficiency in defragmenting and packing files.

Currently, some of these programs may have problems with large partitions and lots of files, however VOPT will handle partitions of up to 2G (the maximum allowable under DOS). These types of programs are updated constantly; contact the manufacturer for more detailed specifications if you are interested. Each of these manufacturers is listed in Appendix B.

No matter which program you end and using, defragmenting and packing your disk helps to reduce drive wear and tear by minimizing the amount of work required to load files. It also greatly increases the chances for data recovery in the case of serious corruption in the File Allocation Tables (FATs) and directories on the disk.

#### **4.21 BACKING UP THE FAT AND DIRECTORY SYSTEM**

The operating system uses several areas on a formatted disk to manage the files stored on the disk. These areas are extremely critical. If they are damaged, all access to the drive volume may be compromised or completely disabled. In some cases, these critical areas can be rebuilt using known data recovery procedures and tools, but the easiest and best way to recover from damage to these areas is to simply have a backup of them to restore.

The critical areas of hard disk file system are the following:-

- Master (Partition) Book Record (MBR)
- Extended (Partition) Book Record (EBR)
- DOS Boot Record (DBR)

- File Allocation Tables (FATs)
- Root Directory

These areas are stored on the disk in the order listed, except that each volume will start with an MBR or EBR but not both. Unlike complete file backups of the entire hard disk, a backup of these system areas is relatively quick and easy. This is because these areas are very small in comparison to the remainder of the drive and normally occupy a fixed amount of space on the disk. For example, the MBR, EBRs, and DBRs are only one sector long each, while the two FATs used on each volume cannot exceed 256 sectors each (512 sectors or up to 256K total for both), and the Root Directory is limited to 32 sectors (16K). This means that even for the largest hard disk drive, these areas will not consume more than about 300K of space.

The boot record (sector) areas do not change during day to day usage of the disk. These areas will change only if you reformat, repartition, or change operating system versions. Because they are relatively constant, it makes good sense to back up these areas to a file on a floppy disk for later restoring if necessary.

Each normal disk volume will have two File Allocation Tables and a single Root Directory. These areas change constantly as files are written and deleted from the disk. A backup of these areas is only good for temporary purposes and can be useful when trying to undelete files. Because of this, these backups are often written on the hard disk in a special hidden file near the end of the disk. Other recovery or restoration programs can then look for this special file and use the information within it to rebuild the FATs or directory system. Often this type of backup is very useful in a situation where file need to be undeleted.



## **4.22 PASSIVE PREVENTIVE MAINTENANCE PROCEDURES**

Passive preventive maintenance involves taking care of the system in an external manner: basically, providing the best possible environment – both physical as well as electrical – for the system to operate in. Physical concerns are conditions such as ambient temperature, thermal stress from power cycling, dust and smoke contamination, and disturbances such as shock and vibration. Electrical concerns are items such as electron-static discharge (ESD), power-line noise and radio-frequency interference. Each of these environmental concern is discussed in this section.

## **4.23 EXAMINAING THE OPERATING ENVIRONMENT**

Oddly enough, one of the most overlooked aspects of microcomputer preventive maintenance is protecting the hardware-and the sizable financial investment it represents-from environmental abuse. Computers are relatively forgiving, and they generally are safe in an environment that is comfortable for people. Computers, however, often are treated with no more respect than desktop calculators. The result of this type of abuse is many system failures.

Before you acquire a system, prepare a proper location for your new system, free of air born contaminants such as smoke or other pollution. Do not place system in front of a winder: The system should not be exposed to direct sunlight or temperature variations. The environmental temperature should be as constant as possible. Power should be provided through properly grounded outlets, and should be stable and free from electrical noise and interference. Keep your system away from radio transmitters or other sources of radio frequency energy. This section examines these issues in more detail.

## 4.24 HEATING AND COOLING.

Thermal expansion and contraction from temperature changes place stress on a computer system. Therefore, keeping the temperature in your office or room relatively is important to the successful operation of your computer system.

Temperature variations can lead to serious problems. You might encounter excessive chip creep, for example. If extreme variations occur over a short period, signal traces on circuit boards can crack and separate, solder joints can contacts in the system undergo accelerated corrosion. Solid-state components such as can be damaged also, and a host of other problems can develop.

Temperature variations can play havoc with hard disk drives also. Writing to a disk at different ambient temperatures can, on some drives, cause data to be written at different locations relative to the track centers. Read and write problems then might accelerate later.

To ensure that your system operates in the correct ambient temperature, you first must determine your system's specified functional range. Most manufacturers provide data about the correct operating temperature range for their system. Two temperature specifications might be available, one indicating allowable temperatures during operation and another indicating allowable temperatures under non-operating conditions. IBM, for example, indicates the following temperature ranges as acceptable for most of its system:

System on: 60 to degree fahrenheit

System off: 50 to 110 degrees fahrenheit

For the safety of the disk and the data it contains, avoid rapid changes in ambient temperatures. If rapid temperature changes occur—for example, when a new drive is shipped to a location during the winter and then brought indoors—let the drive acclimate to room temperature before turning it on. In extreme cases, condensation forms on the platters inside the drive Head Disk Assembly—disastrous for the drive if you turn it on before the condensation can evaporate. Most drive manufacturers specify a timetable to use as a guide in acclimating a drive to room temperature before operating it. You usually must wait several hours to a day before a drive before a drive is ready to use after it has been shipped or stored in a cold environment.

Most office environments provide a stable temperature in which to operate a computer system, but some do not. Be sure to give some consideration to the placement of your equipment.

#### **4.25 POWER CYCLING (ON/OFF)**

As you have just learned, the temperature variations a system encounters greatly stress the system's physical components. The largest temperature variations a system encounters, however, are those that occur during system warm-up when you initially turn it on. Turning on (also call powering on) a cold system subjects it to the greatest possible internal temperature variations. For these reasons, limiting the number of power-on cycles a system is exposed to greatly improves its life and reliability.

#### **4.26 PHONE LINE SURGE PROTECTORS**

In addition to protecting the power lines, it is critical to provide protection to your systems from any phone lines that are connected. If you are using a modern or

fax board that is plugged into the phone system, any surges or spikes that travel the phone line can potentially damage your system. In many areas, the phone lines are especially susceptible to lightning strikes, which is the largest cause of fried modems and any computer equipment attached to them.

Several companies manufacture or sell simple surge protectors that plug between your modem and the phone line. These inexpensive devices can be purchased from most electronics supply houses. Most of the cable and communication products vendors listed in Appendix B sell these phone line surge protectors.

#### **4.27 LINE CONDITIONERS**

In addition to high-voltage and current conditions, other problems can occur with in-coming power. The voltage might dip below the level needed to run the system and result in a brownout. Other forms of electrical noise other than simple voltage surges or spikes might be on the power line, such as radio-frequency interference or electrical noise caused by motors or other inductive loads.

Remember two things when you wire together digital devices (such as computers and their peripherals). A wire is an antenna and has a voltage induced in it by nearby electro-magnetic fields, which can come from other wires, telephones, CRTs, motors, fluorescent fixtures, static discharge, and of course, radio transmitter. Digital circuitry also responds with surprising efficiency to noise of even a volt or two, making those induced voltages particularly troublesome. The wiring in your building can act as an antenna and pick up all kind of noise and disturbances. A line conditioner can handle many of these types of problems.

A line conditioner is designed to remedy a variety of problems. It filters the power, bridges brownouts, suppresses high-voltage and current conditions, and generally acts a buffer between the power line and the system. A line conditioner does the job of a surge suppressor, and much more.. It is more of an active device functioning continuously rather than a passive device that activates only when a surge is present. A line conditioner provides true power conditioning and can handle myriad problems. It contain transformers, capacitors, and other circuitry that temporarily can bridge a brownout or low-voltage situation. These units usually cost several hundreds of dollars, depending on the power-handling capacity of the unit.

#### **4.28 BACKUP POWER**

The next level of power protection includes backup power-protection devices. These units can provide power in case of a complete blackout, which provides the time needed for an orderly system shutdown. Two types are available: the standby power supply (SPS) and the uninterruptible power supply (UPS). The UPS is a special device because it does much more than just provide backup power: it is also the best kind of line conditioner you can buy.

#### **2.29 STANDBY POWER SUPPLIES (SPS)**

A standby power supply is known as an offline device: It functions only when normal power is disrupted. An SPS system uses a special circuit that can sense the AC line current. If the sensor detects a loss of power on the line, the system quickly switches over to a standby battery and power inverter. The power inverter converts the battery power to 110-volt AC power, which then is supplied to the system.

SPS systems do work, but sometimes a problem occurs with the switch to battery power. If the switch is not fast enough, the computer system unit shuts down or reboots anyway, which defeats the purpose of having the backup power supply. A truly outstanding SPS adds to the circuit a ferroresonant transformer, a large transformer with the capability to store a small amount of power and deliver it during the switch time. Having this device is similar to having on the power line a buffer that you add to an SPS to give it almost truly uninterruptible capability.

SPS units also may or may not have internal line conditioning of their own; most cheaper units place your system directly on the regular power line under normal circumstances and offer no conditioning. The addition of a ferroresonant transformer to an SPS gives it additional regulations and protection capabilities due to the buffer effect of the transformer. SPS devices without the ferroresonant transformer still require the use of a line conditioner for full protection. SPS systems usually cost from \$200 to several thousand of dollars, depending on the quality and power-output capacity.

#### **4.29 UNINTERRUPTIBLE POWER SUPPLIES (UPS)**

Perhaps the best overall solution to any power problem is to provide a power source that is both conditioned and that also cannot be interrupted – which describes an uninterruptible power supply. UPSs are known as online systems because they continuously function and supply power to your computer systems. Because some companies advertise ferroresonant SPS devices as though they were UPS devices, many now use the term true UPS to describe a truly online system. A true UPS system is constructed much the same as an SPS system; however, because you always are operating from the battery, there is not switching circuit.

In a true UPS, your system always operates from the battery, with a voltage inverter to convert from 12 volts DC to 110 volts. AC. You essentially have your own private power system that generates power independently of the AC line. A battery charger connected to the line or wall current keeps the battery charged at a rate equal to or greater than the rate at which power is consumed.

In a true UPS, your system always operates from the battery, with a voltage inverter to convert from 12 volts DC to 110 volts AC. You essentially have your own private power system that generates power independently of the AC line. A battery charger connected to the line or wall current keeps the battery charge at a rate equal to or greater than the rate at which power is consumed.

When power is disconnected, the true UPS continues functioning undisturbed because the battery-charging function is all that is lost. Because you already were running off the battery, no switch takes place and no power disruption is possible. The battery then begins discharging at a rate dictated by the amount of load your system places on the unit, which (Based on the size of the battery) gives you plenty of time to execute an orderly system shutdown. Based on an appropriately scaled storage battery, the UPS functions continuous, generating power and preventing unpleasant surprises. When the line power returns, the battery charge begins recharging the battery, again with no interruption.

# **CHAPTER FIVE**

## **5.0 RECOMMENDATION**

Although as application of expert system to troubleshooting, maintenance and Assembly of PC, the new techniques now developed in this project, if followed closely will definitely make our computer-controlled world much safer and more reliable. Finally I also recommend that research work should be embarked upon to design a fault –tolerant computers in the nearest future.

I strongly believe if these suggestion is taken into consideration the prospect of troubleshooting and maintenance of personal computers will be realized. And this will go a long way in saving high cost of computer maintenance



## **5.1 CONCLUSION**

There are currently over 800 products of micros in the market. It is important to note that this proliferation of systems and their purchase in the absence of any well-defined guidelines, have some advantages and disadvantages.

The aim of this project is to find a way maintaining a faulty computer at a minimum cost, and also suggest possible guiding principles in selecting computers for home and business use.

1. Avoid rushing at new systems as spare parts may not be easily available
2. The compatibility issues should be carefully studied when selecting computer systems. This is important for easy access to the available software packages and peripherals.
3. Some system are very fanciful in their appearance but fragile in nature. They should be avoided if possible.

The above mentioned points are deemed necessary because of the maintenance problems of the proliferation of systems.

## REFERENCE

1. R.F. VEARS,  
BUTTERWORTHS 1981: MICROELECTRONIC SYSTEM.
2. GLYN MARTINS,  
HUTCHSON 1982: MICROPROCESSOR  
APPRECIATION.
3. OBSORNE, OSBORNE, 1978: AN INTRODUCTION TO  
MICROCOMPUTER, VOL. 2.A
4. R.S. COMPONENT LTD. 1982: MICROCOMPUTER  
BOARD MANUAL
5. G.L. SIMONS, 1983: TOWARDS FIFTH-GENERATION  
COMPUTERS.
6. PELTU M, NCC: INTRODUCTION TO COMPUTER.
7. MEEK, BRIAN L, ELLIS  
HORWARD UK, 1987: USING COMPUTERS.
8. BY PRINCE BADMUS: HANDOUT ON INTRODUCTION  
TO COMPUTER SCIENCE

... SIMPLE PROGRAMS ON TROUBLESHOOTING OF COMPUTER SYSTEM

EM TUTORIAL PROGRAM FOR SYSTEM TRUOBLE SHOOTING

EM DESIGNED BY ANJI SILAS ACHI

EM DEPARTMENT OF COMPUTER SCIENCE/MATHEMATICS

EM FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGERIA.

LS

) LOCATE 12, 20: PRINT "WELCOME TO TUTORIAL ON COMPUTER TROUBLESHOOTING"

) LOCATE 20, 20: INPUT "CONTINUE WITH THE TOTURIAL (Y/N)"; AN\$:

IF AN\$ = "N" OR AN\$ = "n" THEN END ELSE GOTO 80

CLS

LOCATE 12, 35: PRINT "(1): SYSTEM UNIT"

LOCATE 13, 35: PRINT "(2): MONITOR"

LOCATE 14, 35: PRINT "(3): KEYBOARD"

LOCATE 15, 35: PRINT "(4): EXIT"

LOCATE 17, 35: INPUT " SELECT ONE OPTION FROM OPTINS 1-4"; N

IF N < 1 OR N > 4 THEN GOTO 10:

N GOSUB 200, 10

N GOSUB 100, 290, 400, 430: END: RETURN 80

) REM SUBROUTINE TUTORIAL FOR SYSTEM UNIT

INT "IF SYSTEM DOES NOT POWER UP"

INT " \_\_\_\_\_ "

INT "\*SYSTEM UNIT NOT PLUG IN ": PRINT "\*POWER CORD LOOSE OR BROKEN"

INT "\*WALL SOCKET FAULTY OR CIRCUIT BREAKER OPEN"

INT "\*SHORT CIRCUIT IN COMPUTER SYSTEM CAUSING POWER SUPPLY SHUTDOWN'"

INT "\*POWER SUPPLY FAULTY"

INT

INT "\*IF SYSTEM DOES NOT BOOT": PRINT " \_\_\_\_\_ "

```
RINT "*NON-BOOTABLE DISKETTE IN DRIVE A"
RINT "*HARD DISK DRIVE NOT INITIALISED"
RINT "FAULTY CMOS SETUP INFORMATION"
RINT "*LOOSE DISK DRIVE CONTROL, DATA OR POWER CABLE"
RINT "POWER SUPPLY LOADED PAST WATTAGE LIMIT"
RINT "*EXPANSION CARD LOOSE IN SLOT"
RINT "*IF SYSTEM FREEZES, CRASHES, OR REBOOTS SPONTANEOUSLY"
RINT " _____ "
RINT "*FAULTY RAM DEVICE": PRINT "*LOOSE MOTHERBOARD POWER CONNECTOR"
RINT "*EXPANSION CARD LOOSE IN SLOT'"
RINT "*CONFLICTING HARDWARE ASSIGNMENTS (DMA CHANNEL, IRQ, HARDWARE PORT AD
RINT "*MEMORY-RESIDENT PROGRAM AND DRIVER CONFLICT "

O PRINT "NOISE FROM SYSTEM UNIT "
O PRINT " _____ "

O PRINT "*NORMAL POWER SUPPLY NOISE (FAN HUM, AIR MVEMENT)"
PRINT "*NORMAL HARD DISK DRIVE NOISE (HUM, OR SLIGHT WHINR RUNNIG,"
PRINT " CHATTER OR FAINT SQUEAKING WHEN HEADS MOVE)"
PRINT "*FAULTY COOLING FAN (LOUD HUM, CHATTER, OVERHEATING SMELLS)"

O PRINT "*FAULTY HARD DISK DRIVE (LOUD OR REPEATED CHATTER OR THUMP,"
PRINT " LOUD WHINE)"

O PRINT "NO SOUND FROM SPEAKER "
O PRINT " _____ "

O PRINT "A SPEAKER CONNECTION TO MOTHER BOARD LOOSE."
```

```

PRINT "**PROGRAMS NOT MAKING USE OF SPEAKERS."

61 PRINT "DISK DRIVES"
62 PRINT " _____ "

63 PRINT "HARD AND FLOPPY DISK DRIVES CAN DISPLAY THE FOLLOWING PROBLEMS:"
64 PRINT "READ FAILURE": PRINT " _____ "

65 PRINT "**NO DISK IN DISKETTE DRIVE."
PRINT "**DISKETTE NOT FIRMLY SEATED IN DRIVE (3.5-INCH DRIVES) OR DRIVE"
PRINT " DOOR NOT CLOSED (5.25-INCH DRIVE"
PRINT "**DISK NOT FORMATTED OR (HARD DRIVE ONLY_) NOT INITIALIZED"
66 PRINT "WRITE FAILURE": PRINT " _____ "

67 PRINT "**NO DISK IN DISKETTE DIVE"
PRINT "**DISKETTE NOT REALLY SEATED IN DRIVE (3.5-INCH DRIVES) OR DRIVE"
PRINT " DOOR NOT CLOSED ( 5.25-INCH DRIVES)"
PRINT "**DISKETTE WRITE POTECTED ": PRINT

68 INPUT "CONTINUE WITH THE DIAGMOSES", A$
IF A$ = "Y" OR A$ = "y" THEN CLS : GOTO 20

69 RETURN: CLS
70 REM SUBROUTINE TUTORIAL FOR THE MONITOR:CLS
71 CLS : PRINT "IF THER IS NO VIDEO DISPLAY"
72 PRINT " _____ "

73 PRINT "** MONITOR NOT PLUG IN, OR NOT TUNED ON"

```

```
PRINT "*VIDEO CABLE NOT CONNECTED TO VIDEO ADAPTER"
PRINT "*VIDEO CABLE FAULTY"
PRINT "*INCORRECT MONITOR TYPE FOR THE VIDEO ADAPTER IN USE"
PRINT " A MOTHERBOARD COLOR/MNO SELECT DIP-SWITCH SET INCORPORATED"
30 PRINT "*INCORRECT VIDEO TYPE SPECIFIED IN SET UP (80386/8048 SYSTEM ONLY)
PRINT "VIDEO ADAPTER INCORRECTLY CONFIGURED"
PRINT "* INCORRECT VIDEO MODE SELECTED"
PRINT "SOFTWARE INCORRECTLY CONFIGURED"
0 PRINT "*MONITOR INCORRECTLY COMNFIGURED (APPLIES MOSTLY TO MULTISCAN AND
PRINT "VGA MONITOR) "
PRINT "*SOFTWARE SCREEN-BLANKING UTILITY IN OPERATION."
0 PRINT "FAULTY VIDEO DISPLAY"
0 PRINT " _____ "
0 PRINT "*INCORRECT VIDEO MODE SELECTED ."
PRINT "*VIDEO ADAPTER INCORRECTLY CONFIGURED."
PRINT "*MONITOR VERTICAL AND/OR HORIZONTAL HOLD AND SIZE CONTROLS"
PRINT " MISADJUSTED "
PRINT "*MONITOR BRIGHTNESS AND/OR CONTRAST CONTROLS MISADJUSTED."
PRINT "*SOFTWARE INCORRECTLY CONFIGURED."
PRINT "*INSUFFICIENT VIDEO RAM (VGFA, OLDER EGA ONLY) ."
PRINT "*MOTHERBOARD MASTER OSCILLATION INCORRECTLY TRIMMED"
PRINT " (OLDER CGA SYSTEMS ONLY) ."
0 RETURN: CLS
0 REM SUBROUTINE TUTORIALS FRO THE KEYBOARD MALFUNTIIONS
```

```
CLS : PRINT "IF THE KEYBOARD MALFUNCTIONS "  
PRINT "*KEYBOARD NOT FIRMLY PLUGED INTO MOTHERBOARD PORT."  
PRINT "*XT-STYLE USED WITH 80386 OR 80486 MOTHERBOARD"  
PRINT " OR AT-STYLE KEYBOARD USED WITH 8088 OR 8086 MOTHERBOARD."  
PRINT "*SWITCHABLE KEYBOARD SET TO WRONG TYPE (XT/AT) FOR MOTHERBOARD."  
PRINT "*KEYBOARD LOCK SWITCH IN LOCK POSITION."  
PRINT "*KEYBOARD LOCKED SWITCH WIRING LOOSE ON MOTHERBOARD,"  
PRINT " OR CONNECTOR REVERSED."  
INPUT "DO YOU WANT TO EXIT THE TUTORIAL"; Y$  
IF Y$ = "N" OR Y$ = "n" THEN GOTO 20 ELSE  
END
```