COMPUTER MAINTENANCE AND REPAIR INFORMATION MANAGEMENT SYSTEM

(A CASE STUDY OF COMPUTER CENTRE, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA)

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DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE,

IN PARTIAL FULFILMENT OF THE REQUIREMENTS GOVERNING THE AWARD OF
POST-GRADUATE DIPLOMA IN COMPUTER SCIENCE
OF THE FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA. NIGERIA

MARCH, 1998

DECLARATION

I solemnly declare that this project was undertaken by ZUBAYR EMIMARU and that it has not been submitted or being submitted to any University for the award of Degree or Diploma.

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CERTIFICATION

This is to certify that this project captioned "*Computer Maintenance and Repair Information Management System*" was undertaken by **ZUBAYR EMIMARU**, department of Mathematics and Computer Science, Federal University of Technology, Minna meeting the requirements/ regulations governing the award of **Post-Graduate Diploma in Computer** Science of the Federal University of Technology, Minna. Nigeria.

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DEDICATION

This project is dedicated to the Almighty **ALLAH** the Exalted, the Wise.

ACKNOWLEDGEMENT

Firstly, I wish to appreciate with thanks the effort of my Project Supervisor Dr. Aiyesimi Y. M. for guiding me in this project both in structure and contents to a conclusive end.

My thanks also go to Dr. K. R. Adeboye, the Head of Department of Mathematics and Computer Science for his nobble leadership and upholding of academic and professional standards.

I also appreciate with thanks the relentless effort of Prince R. Badmus, the course co-ordinator who has left some positive impressions on the Post-Graduate class and their works.

I equally extend the same appreciation to other academic staff members of the Mathematics and Computer Science department in persons of Dr. S. A. Reju, Mr. L. N. Ezeako, Mal. Audu Isah, Mr. I. K. Adewale, Mr. John Echoga, Mal. Abdul Mohammed, and the Department Secretary, Mal. Habib Garba.

My special thanks to Mal. Abdul Kola Raimi for his moral supports. Others are the Hardware specialists in persons of Mr. Tosan Whyte and Mr. M.I.B. Dogara both of the Computer Centre; my colleagues in the course, friends and well wishers.

ABSTRACT

This project is about the effective management of computer maintenance and repair information. It examines the needs for proper maintenance and repair of computers as well as effective use of the information obtained from the maintenance work.

However, a computer-based information system on maintenance and repair of the computer equipment was developed.

Since these equipments consist of electronic components: transistors, capacitors, resistors and of course integrated circuits or microchips; a database of these components with their equivalent (alternatives) is incorporated.

From the database, statistics of computers that developed fault and frequency of such occurrences for a given period of time can be generated from which estimated level of reliability of the computers are calculated and depicted graphically to facilitate decision making.

On the whole, this project is aimed at improving the maintenance and repair culture not only of the Computer Centre, Federal University of Technology, Minna but of any other establishment or organisation charged with similar responsibilities.

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CHAPTER ONE

I N T R O D U C T I O N

The common theme through all the different uses of computers is that they are employed by public and private organisations because they can perform various tasks more effectively and therefore more economically than other machines or people; in other words they cut costs and/or improve profits.

However, the personal computer did not become a reality until progress in microelectronics produced the microcomputer, based on microprocessor and storage chips and interfaces to cheap and small-scale terminals.

The continued development of the microprocessor has led to more powerful models appearing in the market, primarily from Intel, Motorola, Pentium etc. These models are described by the size of the unit of data that can be carried through the processor; thus the first widely available micros were 8-bit micros; most commercial microcomputers are based on 16-bit microprocessors, and the latest 32-bit microprocessors are now being used to produce single or multi-user microsystems that rival in power and performance the current competition from smaller mainframe computers and minicomputers.

Meanwhile the original 8-bit micros are available at such a low cost that they can represent a potential monitoring and control components inside many other electronic or electro-mechanical systems, e.g car controls, heating systems etc.

1.1 AIMS AND OBJECTIVES

This project is aimed at achieving certain technical and management goals. Some of which is facilitating decision making as regards the type or model of computer to acquire or use. This can be achieved by determining the behaviour of various types of computers over a period of time. That is, a gradual study of these computers in the aspect of maintenance requirements, failing parts, and performance would reveal some characteristics of these computers.

Therefore, the main objective of this project is to carry out a careful study of various types of computers by keeping accurate records of their problems - failing parts and other routine maintenance. By this way, it could eventually be necessary to compute the frequency of their respective breakdowns and also, take note of the components or parts that fail more often.

Such information can be used to decide on the type of computer to purchase and/or parts whose stock should be kept in anticipation of their failure.

Computer consultants would one time or the other be contacted to advise on the type of computer to be used or acquired by an organisation; apart from the processor speed, storage capacity, display etc., the consultant must put into consideration the durability of the system to recommend. Parts that fail mostly after some time could be recommended to the management of the organisation from the knowledge-based system to place order for such parts to enable quick replacement thereby reducing the computer down-time.

1.2 SYSTEM OVERVIEW

The case study of this project which is the Computer Centre, Federal University of Technology, Minna is an organ of the University. Established some time in 1984 with initial number of about twenty (20) personal computers (PC XT). The centre now has more than forty (40) personal computers (PC XT and AT) and a good number of related equipment.

The Computer Centre is charged with various responsibilities. Some of these include the followings :

i) Provision of computer practical facilities for the students of the University.

ii) Offer computer services to the University community.

iii) Provide computer training and employment for suitable Nigerians.

iv) Offer computer services to reputable organisations.

v) Procure, assemble, install and repair computer equipment.

The Computer Centre is made up of three sections namely : Operations, System Development and Maintenance sections.

Director - The centre is headed by a director, who coordinates the activities of these three sections.

Operations Manager - The Operations Manager is responsible for the continuous operation of the computers, peripherals, Disks and Books Library and reports to the Director.

Chief Computer Operator - Supervises the operators and library clerks, students practicals; and reports to the Operations Manager.

Operators and Library clerks - The Computer operators interact

with the computer via keyboard to process jobs and produce reports (output). While library clerks keep documentations (books and disks) and monitor their circulation.

Chief System Analyst - Charged with the responsibility of coordinating the system development activities amongst Analysts and Programmers; and reports to the Director.

Analysts and Programmers - These are people who produce system/application programs and maintain existing ones both for the University community and reputable organisations that may request for their services.

Chief Technical Officer (Service Engineer) - Coordinates Computer hardware maintenance and repair activities; and reports to the Director.

Technical Officers - Are responsible for troubleshooting faulty computers, and carrying out maintenance and repair on them.

Appendix I shows the organisation structure of the Computer Centre, Federal University of Technology, Minna.

1.2 PROJECT SIGNIFICANCE

Ever since manufactured computers were first introduced, it has been generally accepted without question that, before they are released to customers, the manufacturers should establish that it has been assembled correctly and is working as it was intended to do.

For a long time, and for very many computers, the implementation of this concept has not been seen to present any particular problem ; test and maintenance procedures could be informal, based on intuitive understanding of the computer by the quality control and maintenance department.

Even so, for a simple system such as radio, additional performance criteria can be suggested on an intuitive basis; perhaps just a subjective assessment of sound quality obtained from one station on each waveband. This can be augmented with objective measurements such as frequency responses.

Now, the problems become more severe when the systems that we are dealing with are intended to perform data processing, operating on data supplied to the unit from an external source. Such system (computer) are nowadays largely, if not entirely digital in nature.

The need for maintaining and repairing arise in connection with the maintenance of faulty computers including both the results of unsatisfactory manufacture and parts that have failed in operation in the field.

It is important to recognise that economic considerations are at the heart of all maintenance problems. Basically, repair costs money, and good quality maintenance (ie that which covers a large proportion of the unit) is preferred to poor maintenance.

However, failing to maintain or maintaining adequately, also cost money in that a faulty part or computer that results from non-maintenance will nonetheless eventually have to be put right or repaired, entailing the use of diagnosis and repair routines that cannot by their very nature be fully automated.

The cost of not maintaining therefore, can be very high. In addition to labour costs for carrying out the actual repair, there are considerable administrative costs involved with any form of special treatment that takes place outside the standard or normal operation process.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION TO COMPUTER

A computer system consists of the physical components of the computer and its peripherals. Basically, the computer unit is made up of a central processing unit (CPU), the Visual Display Unit (VDU) and a keyboard. The peripherals include: printers, modem, mouse, plotters, scanners, uninterruptable power supply (UPS) etc.

In terms of logic used, computers can be classified into the following :

i) **Analog computer :**

This kind of computer performs its operation by measuring or relating physical phenomena or changes and variables in the form of mathematical equation in some notable quantities. It processes data that varies continuously such as variation in temperature, speed, current flowing through an electric conductor. They are used for variety of industrial and scientific applications that require the processing of data that are measured continuously.

ii) **Digital computer :**

This is one which performs its operations and assesses logical decisions according to instruction coded to it in advance. While Analog computer signal used sinusoidal wave form the digital computer signal is a rectangular wave form.

iii) **Hybrid computer :**

This type of computer combines the characteristics of the analog and digital computers. It is used to solve sophisticated problems such as those from the study of process control and optimization.

In terms of size, computers can be classified as :

i) **Super computer :**

Also known as maxicomputer or in some cases monster computer. It has the capability of performing over ten million arithmetic operations per second. It is the fastest class of computers. Such computers are used by scientists for example in air flow simulation around an airplane at different speeds and altitudes.

ii) **Mainframe computer :**

This is a larger computer commonly used in business and industry. It supports large networks of individual terminals and remote job-entry locations among others.

iii) **Minicomputer :**

The minicomputer is almost like the mainframe computer but less powerful - lower processing speed, and supports less number of computer terminals.

iv) **Microcomputer :**

The microcomputer is the type of computer often found in small businesses and in homes. They are generally less complex, small in size, and execute programs at slower speeds. The refinement of the computing concept focused on speed, size and cost, and gave birth to computer generations which is intended to suggest different development of the hardware

components. These include :

i) **First generation computers :**

The first generation computers use vacuum tubes which control the internal operation of the computer. These type of Computers were mostly huge and require cooling system.

ii) **Second generation computers :**

Solid state transistors replaced the vacuum tubes thereby increasing the speed and storage capacity of the system in the second generation.

iii) **Third generation computers :**

The development of integrated circuit (IC) industry emerged. In this generation, remote terminals (i.e microcomputers and minicomputers) came into being.

iv) **Fourth generation computers :**

Introduction of large and very large scale integration (VLSI) technology. Densely packed chips were developed leading to the manufacture of small home or personal microcomputers.

v) **Fifth generation computers :**

Development of the Japanese industrial robots as a distinct generation. This generation influenced by the advent of Artificial Intelligence (AI), and Expert system.

Artificial Intelligence is the ability of the computer to exhibit behaviours like an intelligent person. The aim is to speak to the computer and obtain solutions through voice output.

An expert system on the other hand is an application program that has the capability of making judgements and decisions like

an expert in a particular field of application. For example, in the field of medicine, where a computer would prescribe like a doctor after performing the necessary diagnosis.

Recent years have seen the appearance of inexpensive microcomputers. The reduction in price since the mid-1970s has meant that even small organisations and businesses can consider the purchase of a computer of some kind. The result has been a wide-spread use of computing power in a way which was unforeseen a few years ago.

Indeed computers have spread so widely that it is unlikely that anyone starting out on a career today will find a job in which computers are not being used in some way or another.

Any large volume of repetitive work can be considered as a potential task for a computer. Invoicing, payroll, inventory, and other accounting routines are typical clerical jobs being extensively performed by computers today.

Technical or scientific work on the other hand relies heavily on the calculating power of the computer. Engineering calculations involving stresses, complex problems in physics, and other related disciplines all exploit this facility.

Other ways in which computers are used include forecasting - where instead of merely recording stock levels the computer can monitor demand and produce forecasts of stock required in the future; and using the computers to hold a mathematical model of the way in which a company works. This enables them to assess the effect of possible causes of action and to avoid those which are likely to produce a loss.

Computer Hardware :

The term computer hardware refers to the physical components of a computer system ie. electronic device used for processing data.

Generally, the computer hardware is made up of three main parts namely :

i) **Input devices**

1) Punched cards
2) Punched paper tape
3) Keyboard
4) Magnetic Ink Reader
5) Optical Scanner
6) Magnetic tape
7) Cathode Ray Tube etc.

ii) **Output devices**

1) Printer
2) Plotter
3) Cathode Ray Tube
4) Punched cards
5) Magnetic tape etc.

iii) **Central Processing Unit (CPU)**

Every computer system contains a unit whose primary objective is to process data. The unit is the control centre of the entire computer system; it accepts data from the various input devices, processes these data according to the instructions, and sends the results to the printer or other output devices for recording. This unit performs operations in

millionths of a second. The unit comprises of three functional sub-circuits. They are :

a) **Control Unit (CU)**

This unit controls and coordinates the activities of a computer system much as the human brain coordinates and controls the activities of a human body. Some of the functions performed by the control unit include the followings :

1) Determines the instruction to be executed.
2) Causes the instruction to be carried out or executed.
3) Determines what data, if any are needed and where they are stored.
4) Determines the operations to be performed by the instructions.
5) Determines where any results are to be stored.

b) **Arithmetic and Logic Unit (ALU)**

This unit performs the basic functions of data transfer, arithmetic calculations, and decision making. Data transfer involves moving data from one location to another memory location within a computer system. Decision making is the ability to speedily compare two quantities to evaluate a given condition.

c) **Internal Storage or Memory Unit**

This is the principal storage and sometimes called the main storage, main memory or high speed storage. It is usually referred to as Random Access Memory (RAM).

All data or instructions entering or leaving the central processing unit must pass through the primary storage. The primary storage or RAM holds all instructions and data that are currently being processed by the central processing unit.

Input/Output devices :

- **Optical Character Recognition (OCR)**

  This is a process in which printed documents are scanned by photo-electric method; the pattern of light reflected from the document reveals to the machine the specific characters that are recorded. It is employed in the area of test/examination scoring particularly for recording answers to multiple choice questions.

- **Magnetic-Ink Character Recognition (MICR)**

  This is based on data recorded in stylized print form with special magnetized ink, so that machines can process the recordings. This method is primarily used in the banking industry, and most cheques are now processed under the MICR approach.

- **Plotter**

  It works by moving a pen in two mutually perpendicular directions over a sheet of paper. There are two main types - flat bed and drum. In former, a sheet of paper is laid by two small motors. In the later case, the paper passes over a drum and is rotated back and forward in a perpendicular direction. Coloured pens, selected automatically, can be used for colour graphs and drawings. Plotters are used in computer aided drafting to produce drawings for engineering, printed circuit boards etc.

- **Cathode Ray Tube**

  Video displays are used for the display of graphical information. With the visual display unit (VDU) it is

possible to type directly into the computer, edit or modify programs while they are on the screen.

- **Printers**

Unlike video terminals where the old information disappear off the screen as new information is written, printers produce a permanent record on paper. This is often called "hard copy". There are various types of printers, these include :-

i) Daisy wheel printers - which consists of a disc with the letters formed at the end of the petals. The required letters are positioned beneath a small hammer which hits the letter against the ribbon and paper. Its' speed is about 30 to 60 characters per second.

ii) Drum printers - characters are mounted on a drum which is set in from of the paper and as it spins, little hammers hit paper and ribbon against the characters. One revolution of the drum prints the entire line.

iii) Electrostatic printers - deposit electric charge on specially prepared paper using an electrostatic print head. The charge pattern is developed using a toner in much the same way as occurs in modern photocopiers.

iv) Ink Jet printers - In these printers, small electrostatically charged droplets of ink are squirted at the paper. The correct positioning of the droplets is achieved by passing them between charged deflection plates.

v) Thermal printers - A print head with heated tips is used to print an image on specially prepared paper

which uncolour when heated. Up to 250 line per second are possible.

vi) Laser Xerographic printers - A beam of light is to write the characters on to a specially prepared drum. This results in an electrostatic charge pattern on the drum and then transferred to plain paper. Very high quality and speed are possible in this method.

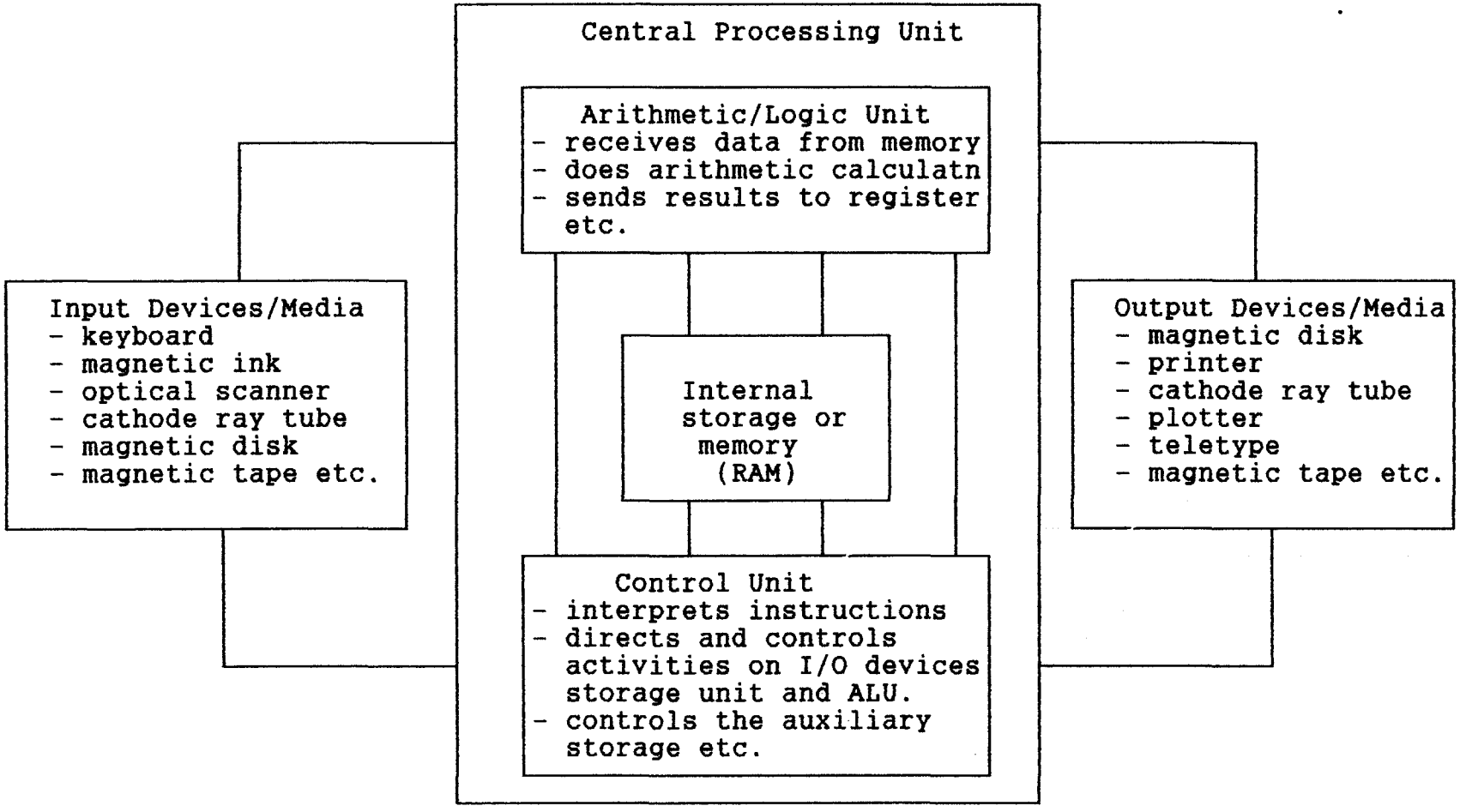


Fig. 2.1 Central Processing Unit - showing various circuits and I/O devices.

2.2 OVERVIEW OF SEMICONDUCTOR TECHNOLOGIES

Today, microprocessors are available in many different technologies, but the most common processors are the cheap, single-chip, metal-oxide semiconductor (MOS) devices.

Many of the characteristics of a semiconductor technology affect the properties of the resulting microprocessors. Among the significant characteristics are :

i) **Speed**

The delay of a gate (components) is a common measure of speed. If the delay is short, the microprocessor can decode instructions, perform arithmetic, and calculate address rapidly. The speed of technology depends on switching time (ie. time required to change from one logic state to the other).

ii) **Power consumption**

The operating power requirements of a technology determine the size of the needed power supplies and the amount of heat that is produced during operation. The standby power requirements determine how much power is needed to retain during periods when the microprocessor is not operating. A measure of power consumption is the power dissipated in a gate.

iii) **Density**

The typical size of a gate is a measure of density. Very dense technologies can produce single-chip microprocessors that are cheap to manufacture, small size, and require few connections or additional components.

iv) **Ruggedness**

Ruggedness refers to the ability to withstand extreme conditions or variations in such factors as temperature, pressure, humidity, shock, torque, vibrations, chemical conditions (such as acid and salt building), and nuclear radiation.

v) **Cost**

Material costs, process complexity, and length of experience all affect the cost of production. A measure of the cost is the typical cost of a gate.

vi) **TTL Compatibility**

The Transistor-Transistor Logic (TTL) compatibility is important because most electronic systems are built with standard TTL circuits. Thus if the technology is TTL compatible, the resulting microprocessor will be simple to interface and can use the same power supplies and clocks as the rest of the systems. Otherwise level shifters, pull-down resistors, additional power supplies and clocks, and other interfacing circuitry may be necessary.

2.3 INTRODUCTION TO TROUBLESHOOTING

Integrated circuit technology is advancing rapidly. Logic gates on tiny chips of silicon are getting smaller and faster. This has been welcome by all, but coming with these advances in microelectronics are more challenges to overcome in determining whether a chip, board, or computer system is functioning correctly and has been properly maintained. Faults can occur that are difficult to locate.

A fault is any physical condition that causes incorrect output when a circuit is exercised to perform a function.

Solving computer system problems requires application of the deductive technique called "*troubleshooting*". A professional approach requires gathering clues and applying deductive reasoning to isolate the problem.

The use of special test equipment such as logic probes, logic clips, digital multimeters, oscilloscopes, and logic analyzers are the technicians tools of the trade to help speed the process.

In fact, troubleshooting and repair can be relatively simple if you know how the system should operate and understand how electronic components fail. Failures generally occur in the circuits that are used or stressed the most. These include the RAM and ROM memory chips, central processing unit, and the input/output chips between the mother board and the peripherals.

2.3.1 Components Failures

Failures generally occur in the circuits that are used or stressed the most. The failure of integrated circuit (chip) is caused by a phenomenon called "*metal migration.*" The second most important failure mechanism in integrated circuits is caused by electrical overstress.

Diodes are one-way valves for electric current, allowing current flow in only one direction. Diodes are usually made of either silicon or germanium. They are used in power supplies as rectifiers and in some circuits to maintain a constant voltage level.

Transistors are used in various places in the computer circuitry as amplifiers or electronic switches.

Transistors and diodes fail by disconnecting inside, which causes an open or break in the circuitry, or by having their output short. Either kind of failure causes total loss of signal.

Devices can be "*blown-up*" by improper handling. This problem occurs when someone picks up ROM, or CPU chips without first grounding any static electricity that a person might be carrying (ie. electrostatic discharge).

2.3.2 Localizing Failures

There are two ways to localize failures and determine which computer part is broken: the software approach, and the hardware approach.

The software approach is applicable as long as the disk drive will boot up properly using built-in diagnostic software

program that checks out the machine each time you apply power. This program tests main memory, system read-only memory (ROM), the random access memory (RAM), the central processing unit (CPU), the monitor, the keyboard, the disk drive speed, and many peripherals.

In the hardware approach, troubleshooting tools are used to measure voltage (logic) levels in the circuitry of the computer. These tools include the logic probe, the logic pulser, the current probe, the oscilloscope, the multimeter, the logic analyzer, and the signature analyzer. This approach requires a knowledge of electronics and test equipment.

Technicians are often interrupted during their analysis. To help them quickly refocus and again concentrate on the failure, always write down key points during the process. when interrupted, it will be possible to return later and quickly refresh, and continue the analysis.

2.3.3 Circuit Testing

When a suspected circuit network is found, there are two ways to test the board: in-circuit testing and functional testing.

In-circuit testing treats the system board as a collection of parts. Testing is accomplished on each individual part as though it were all alone. In-circuit testing relies on the ability of the tester to isolate and test the board components separately.

Functional testing treats the system board as a single functioning entity. This test technique evaluates the board in

an environment that closely emulates the system for which it was targeted. Subset of functional testing is found in the short programs that can be written to exercise certain functions in the system. When these programs are executed, test equipment monitor specific test points to determine the proper (or improper) operation at those nodes.

2.4 COMPUTER MAINTENANCE IN NIGERIA

The maintenance and service of computers have not received the much desired attention in Nigeria. This gave rise to the considerable number of computers staying idle today. It must not also be forgotten that the computer is as important as what it does or its applications in diverse disciplines.

One way of dealing with this problem is to appoint permanent on-site maintenance staff and equip them with appropriate maintenance test, and service equipment (ie. tools and devices). So that helped by gradually acquired knowledge of the particular installed system and its habits and parculiarities, they can keep the system running with a minimum of down-time. This arrangement is certainly effective but it is also expensive; an installation has to be large or very large to justify it.

With the more usual arrangement, where field-service Engineers have to deal with system failures as they arise. The problems of fault diagnosis and repair have to be faced. One technique that has traditionally been widely used is board swapping, based on the idea that the field Engineer, equipped with a complete spare set of boards, or parts simply changes the

board or part in the system one by one until the fault disappears.

The board or part that have been removed, at least one of which is presumably faulty, are then returned for repair to a central maintenance workshop or section which can now be a gradual process.

It is a matter of fine economic judgement to choose the quality and quantity of maintaining, such that the cost of this maintaining is practically less than the consequential cost of not maintaining.

CHAPTER THREE

COMPUTER MAINTENANCE INFORMATION SYSTEM ANALYSIS AND DESIGN

3.1 SYSTEM ANALYSIS

3.1.1 Problem Definition

The project title is "Computer Maintenance and Repair Information Management System".

3.1.2 Scope of the Study

This study focuses mainly on the aspect of how to effectively manage the information on computer maintenance and repair so as to make meaningful use of the maintenance records in decision making process relating to computer hardware management.

3.1.3 Methodology

The techniques employed during fact finding were interview and observation.

Interview :- This is a fact finding technique used to collect information directly from individuals or groups. In this case, majority of the respondents were from Computer Centre and particularly maintenance section of the department.

Observation :- This technique gives first-hand information about the activities of a system. As a staff member of the department (Computer Centre), several observations about the system in question could be made.

3.1.4 Feasibility Study

This is a systematic way of carrying out a study of any given system to uncover its procedural, technical and operational bottlenecks with a view to proffering solutions to such problems.

A. Procedure

The techniques used to collect data during investigation are personal interview and observation. These method of data collection although expensive are the most effective way of gathering information. Hence they provide reliable first hand data. This is the main reason why the methods were chosen for the purpose of data collection during investigation.

Nonetheless, it was also possible to use observation technique for data collection as a result of the fact that the writer happens to be a member of the establishment (computer centre) used as a case study.

B. Findings

From the two fact finding techniques employed, the following information about the present system were gathered during the investigation.

Observations:

i) Computers are usually brought to the section for maintenance and repair almost every week.

ii) Maintenance personnel are sometimes invited to carry out maintenance and repair in other departments or even outside the University community.

iii) Records on these maintenance activities are being kept in note books.

Personal Interview:

iv) Question : Was there anything that happened to these note books ?

Answer : when note books are used over a long period, they do get torn or misplaced.

v) Question : How useful are the records being kept ?

Answer : Only to document the maintenance activities.

vi) Question : How strict is access to records of maintenance?

Answer : Whoever comes across the record book accesses it

vii) Question: Does that mean that anyone can alter these data?

Answer : Perhaps that could be possible by chance.

C. Conclusion

From the investigation, one can conclude that, although the maintenance section carries out a lot of maintenance and repair works, the system had suffered bad records keeping.

Besides, access to the records has no control and they have not devised any meaningful way of using the information being recorded.

D. Recommendations

Based on the conclusion drawn, it is recommended that a computer-based information management system be developed to improve or facilitate records keeping and also serve as a decision support system.

In addition, quality, speed and volume of information to be supported by the proposed system will definitely be helpful.

Finally, proper access and data control will be mounted to ensure data security and integrity thereby enhancing system reliability.

3.2 COST/BENEFIT ANALYSIS OF THE PROPOSED SYSTEM

The cost/benefit analysis which establishes relationship between the cost of developing a system and benefits derivable from the implementation of the new system is as shown below. It portrays at a glance estimates of the proposed system.

	₦ : k
System development cost :	
- System analysis and design	13,000.00
- Software acquisition/development	27,000.00
- Computer procurement/installation	-
Operating cost :	
- File conversion	5,000.00
- Staff training	1,000.00
- Stationery	1,000.00
Net Benefit	*53,500.00*
T o t a l	100,500.00
Benefits :	
- Timeliness of report	8,500.00
- System accuracy	14,000.00
- Decision support services	78,000.00
T o t a l	100,500.00

Note that the computer procurement and installation cost was intentionally reduced to zero (nil) because the department

already has the computer system meeting the proposed system hardware and software requirements.

From the analysis, we can conclude that the management will save about fifty three thousand, five hundred naira (₦53,500.00) only annually; which is the net benefit of the proposed system in the analysis shown above.

3.3 SYSTEM DESIGN

Increasingly, in transaction processing systems, forms and documents are being replaced by screen layouts for visual display units. The design considerations, however, are often similar, the major concern being the reactions of users to particular formats. **James Martin** in his book "*Design of Man - Computer Dialogues*" describes twenty-three different types of on line computer interactions, with the type of dialogue chosen depending primarily on the application. The major design consideration is which format will be convenient for the users and will make it as simple as possible to enter the data correctly.

To design a model that best describes an effective way of managing information on "*Computer Maintenance and Repair*" in such a way that meaningful ideas could be deduced or derived from the information managed by the system.

Although there are certain constraints, some of which include time available for the completion of the project and the cost of executing the project.

However, it must be ensured that an efficient and reliable system was designed and implemented by the end of this project. The technical and operational feasibility of the proposed system

does not constitute any problem in this project, hence the equipment and manpower required are readily available as such no extra cost will be incurred in that regard.

3.3.1 SYSTEM REQUIREMENTS SPECIFICATION

For the proposed system to work efficiently and with high level of reliability, the following computer configuration would be required for the new system.

The choice or selection is purely based on the needs of the new system objectives with respect to the volume and nature of data to be processed so as to meet up with the challenges ahead.

Hardware:

The hardware configuration for the proposed system is as follows :

Machine	-	IBM or compatible
Microprocessor	-	Pentium 200 MHz
RAM	-	32 Mb
Hard-disk	-	1 Gb
Floppy disk drive	-	1.44 Mb
Monitor	-	S.V.G.A.
Keyboard	-	102 Enhanced
Printer	-	Epson LQ 1170 or similar
Paper size	-	80 column listing paper (2 parts)
Power source	-	Uninterruptable Power Supply (UPS).

Software:

Since the proposed system is designed to operate in DOS environment, below is the system software required to facilitate the operation of the new system.

- Pre-installed DOS Ver 6.0 or higher
- Pre-installed dBASE IV

3.3.2 OUTPUT DESIGN

Different reports are expected at different levels from the new system. These reports although may be produced on the screen or printer include the followings :

i) Maintenance report

ii) Electronic components data report

iii) System (computer) information report

iv) Statistical report on computer maintenance

v) Graph showing computer hardware reliability

The on-screen reports will be provided to minimize cost of printing. The on-screen reports will therefore be available in the system in form of enquiries in Maintenance, Components Data Bank and System Inf. menu respectively.

However, the reports menu of the system will provide room for producing hard copies of the reports.

i) **Maintenance Report:**

In this report, details of various computer maintenance and repairs activities entered into the file are printed.

Name of the Organisation

Report Name

Date :   Page No:

Computer code	F a u l t	A c t i o n
xxxxxxxx	xxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxx
xxxxxxxx	xxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxx
xxxxxxxx	xxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxx
xxxxxxxx	xxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxx
xxxxxxxx	xxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxx
xxxxxxxx	xxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxx

ii) Electronic components data report:

This report produces hard copies of electronic components contained in database file.

Name of the Organisation

Report Name

Date : Page No:

Component code	Component Description	Replacement
xxxxxxxx	xxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
xxxxxxxx	xxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
xxxxxxxx	xxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
xxxxxxxx	xxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
xxxxxxxx	xxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
xxxxxxxx	xxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx

iii) System Information report:

Information about all the computer models being handled by the system will be printed using the format below.

Name of the Organisation

Report Name

Date :   Page No:

Computer code	Computer Description	Date of registratn
xxxxxxxx	xxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
xxxxxxxx	xxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
xxxxxxxx	xxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
xxxxxxxx	xxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
xxxxxxxx	xxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx
xxxxxxxx	xxxxxxxxxxxxxxxxxxxxx	xxxxxxxxxxxxxxxxxx

iv Statistical report on Computer maintenance:

To produce this report, we must compute breakdown frequency and the percentage breakdown frequency for each computer using the following expressions.

Total computer breakdown frequency,

$$T_f = \sum f \quad \ldots eqn(1)$$

Individual computer breakdown frequency,

$$I_{f(i)} = \sum_{i=1}^{n} f_{(i)} \quad \ldots eqn(2)$$

where : i = Control variable
n = Number of types of computers

From eqns (1) and (2), breakdown ratio for each computer is

$$I_{pr(i)} = \frac{I_{f(i)}}{T_f} * 100 \quad \ldots eqn(3)$$

Name of the Organisation

Report Name

Date : Page No:

Computer code	Computer Name	Break-down freq.	Percentage
xxxxxxxx	xxxxxxxxxxxxxxxx	9999	99.9
xxxxxxxx	xxxxxxxxxxxxxxxx	9999	99.9
xxxxxxxx	xxxxxxxxxxxxxxxx	9999	99.9
xxxxxxxx	xxxxxxxxxxxxxxxx	9999	99.9
xxxxxxxx	xxxxxxxxxxxxxxxx	9999	99.9
xxxxxxxx	xxxxxxxxxxxxxxxx	9999	99.9

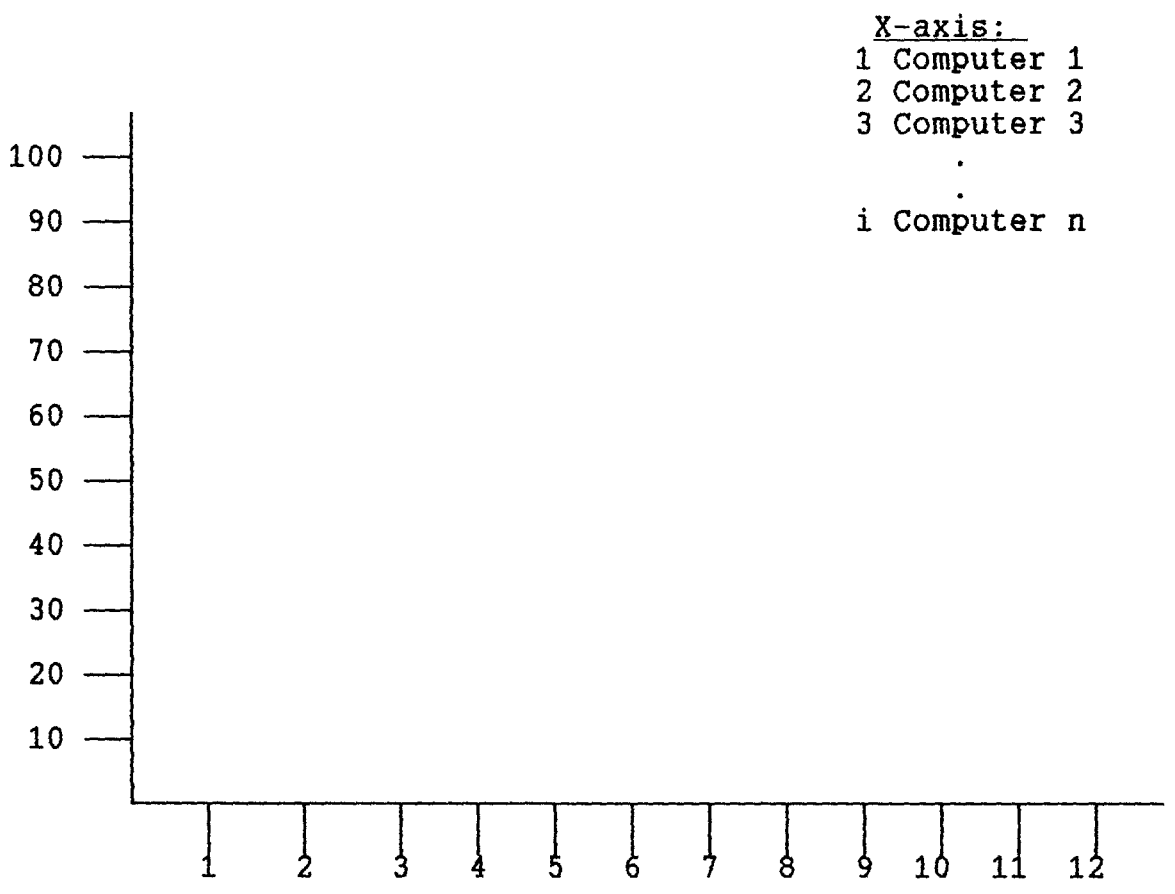
v) **Graph showing computer hardware reliability:**

The computer reliability is obtained for this purpose by the following expression.

From equation (3);

Estimated computer percentage reliability,

$$R_{(i)} = \frac{1}{I_{pr(i)}} * 100 \quad \ldots eqn(4)$$

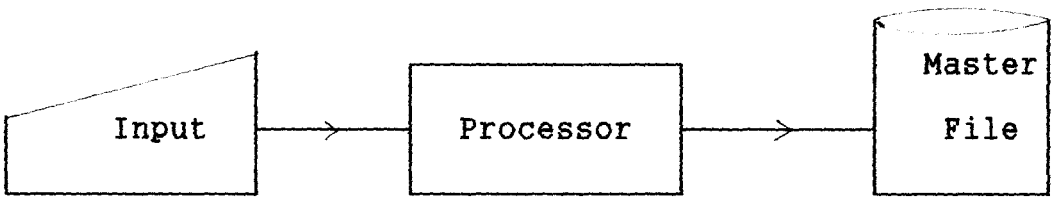


3.3.3 PROCESS DESIGN

The processing here include input, enquiry, statistical computation and reports. It is pertinent to establish relationships between files as used by the system.

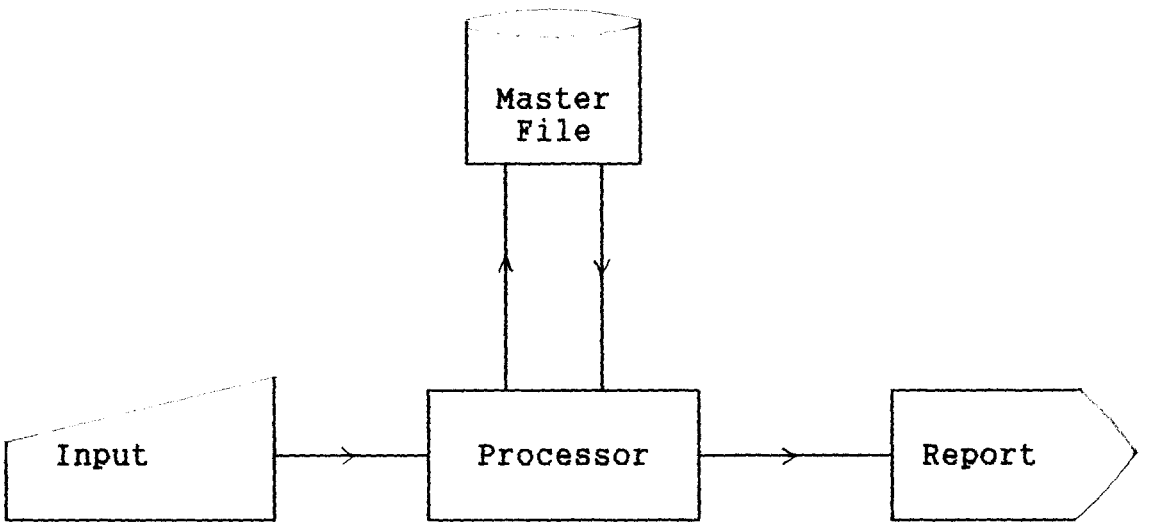
The technique employed to accomplish this task (ie. establishment of relationships between files) is the system flowchart approach.

i) Input processing system flowchart



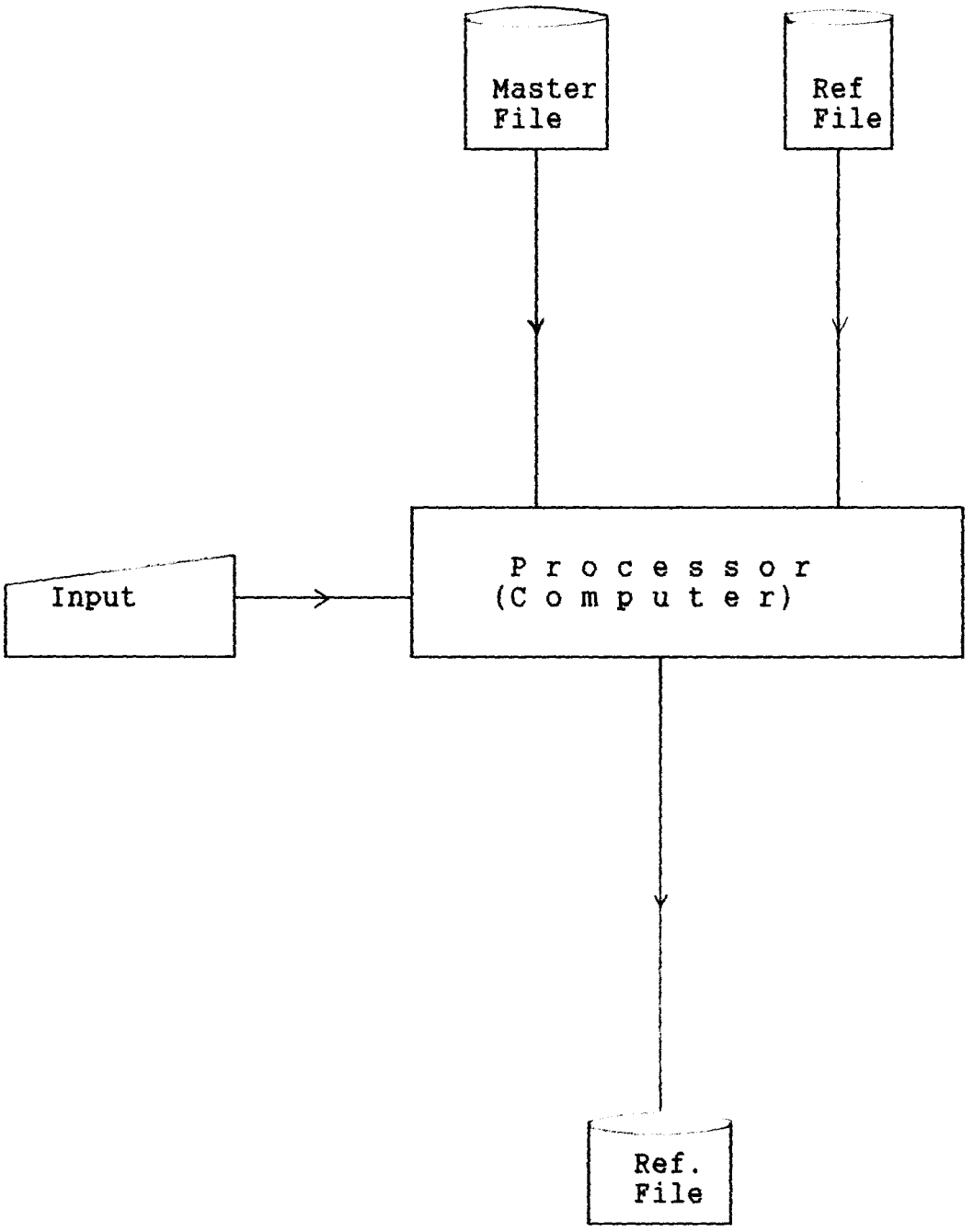
In the above flowchart, keyboard is the input device, through which data are entered into the computer and stored on a disk.

ii) Enquiries processing system flowchart



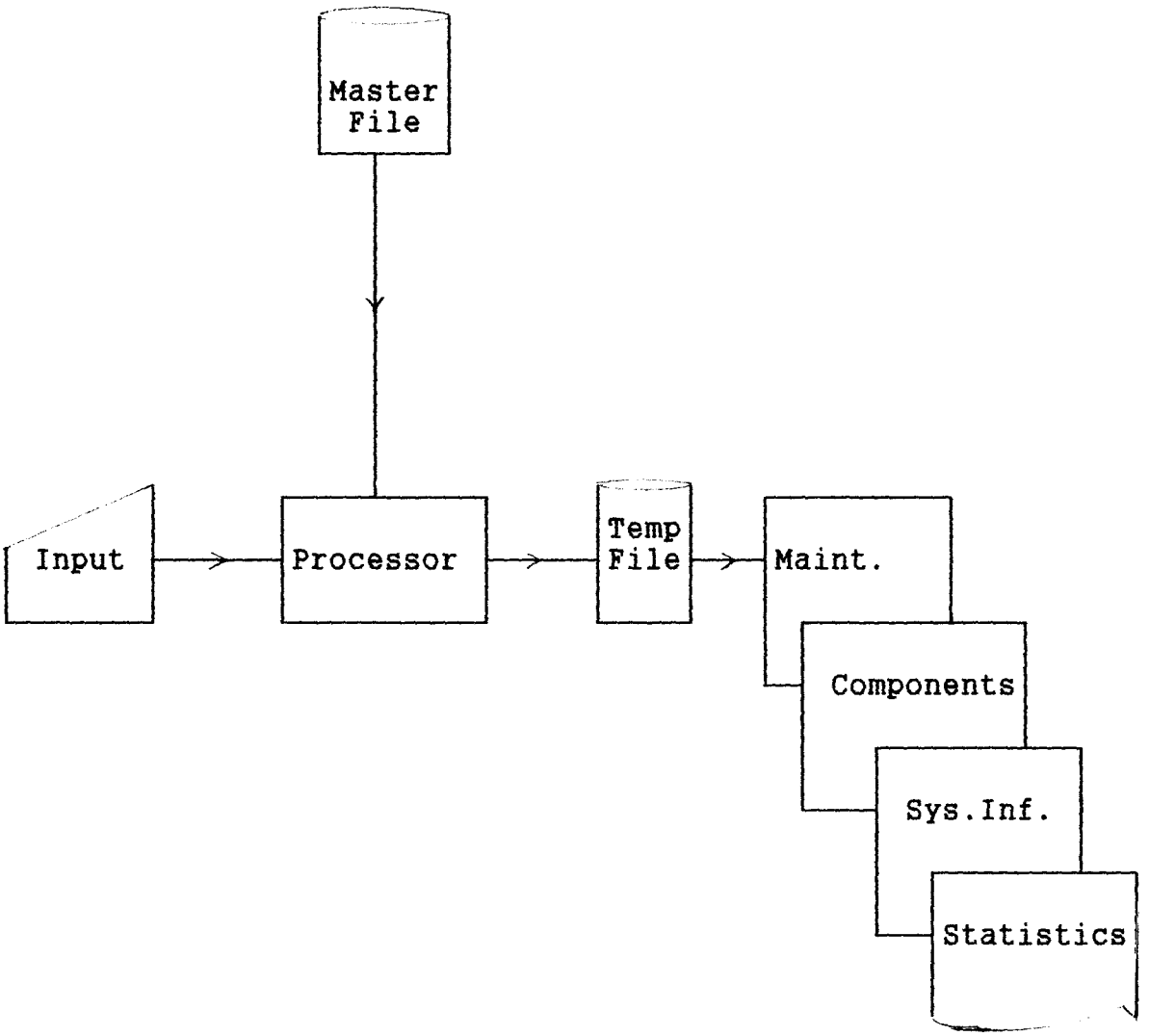
Enquiries are made via keyboard to the computer, which obtains information from the master file and sends the same to the screen.

iii) Statistical computation processing system flowchart



During the statistical computation, data are obtained from both the master and reference files, processed and the information stored in reference file.

iv **Reports processing system flowchart**



To obtain or print report in any case, request is made via keyboard to the computer (processor) and information obtained from master or reference file (or both) directed to a temporary file and then printed.

3.3.4 INPUT FORM/FILE DESIGN

The definition of the information that appear on the system's outputs (visual or printed) enabled one to design the input data required for their preparation.

The number of characters a file holds can be found by multiplying the record size by the number of records in the file. For example, if we expect that the files to be used by this system will have approximately two thousand items, then each of these files will hold almost three million characters of data if the record size is about 1,500 characters each. And in this case, we are going to maintain three of such files as master files.

Also, temporary (report) files will be required by the system in each case; this surely doubles the storage capacity required.

Therefore, if six files of three million characters each are envisioned, then the system must have minimum secondary storage capacity of six million bytes (60 Mb).

As such, an optimal secondary storage capacity of 1 billion bytes (1 Gb) was earlier recommended for the system under system configuration in system requirement specification (see 3.3.1). This is because, other programs like Operating System and dBase IV would be used along with the new system which will occupy storage space among other programs.

a) **Forms design**

The form design describes the pattern or layout of various types of computer forms to be used in the most acceptable fashion to facilitate file conversion process.

Below are the various forms designed to be used by the new system.

i) **Maintenance and Repair data input form**

Code	CompName	Fault	Action	Date	Init.	Remark
xxxx	xxxxxxxxx	xxxxxxxxx	xxxxxxxxx	d/m/y	xxxxx	xxxxxx
xxxx	xxxxxxxxx	xxxxxxxxx	xxxxxxxxx	d/m/y	xxxxx	xxxxxx
xxxx	xxxxxxxxx	xxxxxxxxx	xxxxxxxxx	d/m/y	xxxxx	xxxxxx

ii) **Electronic components data input form**

Comp.code	Description	Replacement	Remark
xxxxxx	xxxxxxxxxxxxxxx	xxxxxxxxxxxxxxx	xxxxxxxx
xxxxxx	xxxxxxxxxxxxxxx	xxxxxxxxxxxxxxx	xxxxxxxx
xxxxxx	xxxxxxxxxxxxxxx	xxxxxxxxxxxxxxx	xxxxxxxx

iii) **System (computer) Information data input form**

Comp.code	Comp. Name	Date-Reg.	Frequency	Percentage
xxxxx	xxxxxxxxxxx	dd/mm/yy	9999	99.9
xxxxx	xxxxxxxxxxx	dd/mm/yy	9999	99.9
xxxxx	xxxxxxxxxxx	dd/mm/yy	9999	99.9

b) **Files Design**

For any database system, the definition of database files structure is of paramount importance. These definitions are based on the information to be kept by the new system in various database files.

Below are the components of different types of database files to be used by the new system.

i) **Maintenance & Repair database File**

Field Number	Field description	Field type	Field size
1.	Computer code	Character	10
2.	Fault	Character	30
3.	Action	Character	30
4.	Date received	Date	8
5.	Date despatched	Date	8
6.	Engineer's Initial	Character	15
7.	Remark	Character	20

ii) **Electronic components database file**

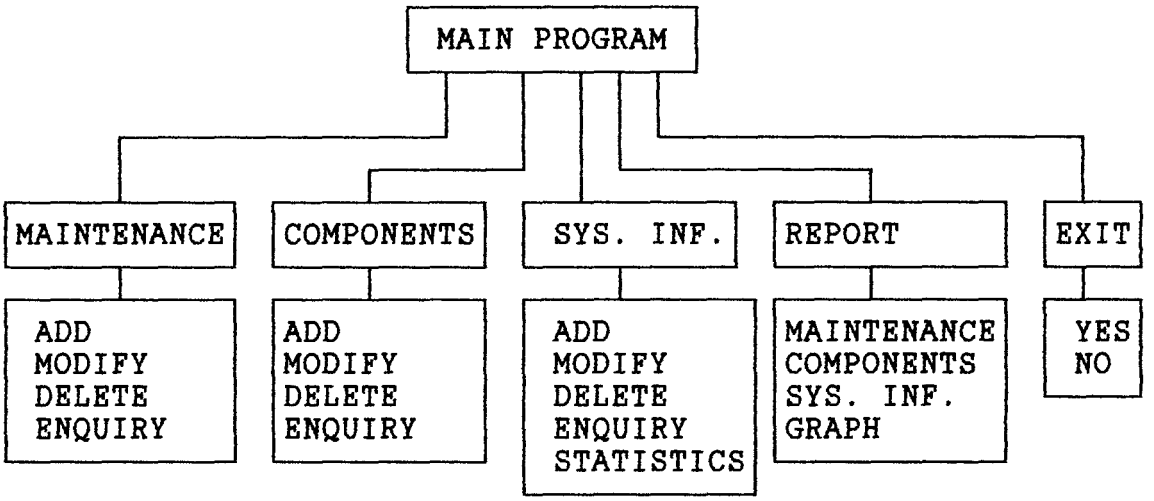
Field Number	Field description	Field type	Field size
1.	Component code	Character	10
2.	Component descriptn	Character	30
3.	Replacement	Character	30
4.	Remark	Character	20

iii) **System (computer) Information database file**

Field Number	Field description	Field type	Field size
1.	Computer code	Character	10
2.	Computer name	Character	30
3.	Date registered	Date	8
4.	Break-down Freq.	Numeric	5
5.	Percentage estimate	Numeric	4

c) System Menu structure

The new system main menu design is given below.



d) System Files

Below is a list of program, and database files to be used by the new system.

1. MSYS.PRG ---------> Program file
2. MSYS.DBO --------> Program object code file
3. MAINT.DAT --------> Maintenance database file
4. COMPONTS.DAT -------> Electronic components data file
5. REFERENC.DAT -------> Reference/table database file

The MSYS.PRG contains all sub-programs or procedures making a complete whole the programs required to make the new system operational/functional.

CHAPTER FOUR

SOFTWARE DEVELOPMENT AND IMPLEMENTATION

4.0 INTRODUCTION

The software development is a process of transforming the newly designed system into a computer program using a high level language or software development package.

The choice of software development package or high level language to use for coding was oriented towards database management software. This is as a result of the fact that the proposed system involves a lot of record keeping and not much of scientific computations. Hence dBASE IV was used as the choice of software development package for the proposed system.

4.1 DATABASE MANAGEMENT SYSTEM (DBMS)

The Database Management System is a software system capable of supporting and managing an integrated database. It handles all access to database. Usually every access request from the user is intercepted by the Database Management System.

For instance, when an application program reads a record by means of a Database Management System; the Database Management System examines the physical database description, issues a command to the Operating System instructing it to read the requested record; transfers the data or record from the system buffer (where the Operating System places the data) to the work

area of the application program providing error messages (if any); and the application program can then operate with the record or data in the work area. Similar operation applies to storage, retrieval and updating procedures.

4.1.1 Database

This is a collection of logically related data elements that may be structured in various ways to meet the processing and retrieval needs of people and organisations. dBASE IV is an advanced version of dBASE that provides a full relational database environment to users.

4.1.2 Advantages of Database System

i) **Data Integrity Control** - The purpose of this is to see that all input data are correctly recorded, all transactions are processed without additions or omissions, and all output are accurate, timely and distributed only to those authorized to receive them.

ii) **Data Independence** - This means the isolation or independency of the application program from a wide variety of changes in the specific logical organisation, physical organisation and storage consideration of the computerized database.

iii) **Data Security** - It involves ensuring that the only means of access to database is through the proper channel.

iv) **Data Redundancy** - Storing the same data in more than one file leads to wastage of storage space. This is greatly reduced in database system thereby saving memory space.

v) **Standardization** - With centrally controlled database, it is possible to ensure that the installations and industrial

standards are followed in representation of data. This simplifies problem of maintenance and data interchange between installations.

4.2 PROGRAMS ALGORITHM

The next challenge is to translate the system design and specifications into instructions that can be interpreted into programs and executed by the computer. This of course is the programming phase of the system development process; through which ideas formulated in the last chapter (i.e chapter three) are translated to reality.

An algorithm is a finite set of instructions or operators for carrying out a specific task or solving specific problems. In other words, it is a crude set of instructions from which programs (ie. an algorithm specifically expressed in a high level language capable of execution by a computer) are developed.

An algorithm is valid if it possesses the following characteristics :

i) Finiteness of instructions - there must be finite number of steps or instructions in an algorithm.

ii) Precision - steps or instructions must be void of obstruction or vagueness but rather explicit.

iii) Effectiveness - execution of impossible tasks must be avoided in an algorithm.

iv) Termination - there must be a stopping criteria for terminating algorithms, especially in the case of instructions having repeated execution.

v) Experimentation - an algorithm should provide output of experimentation or implementation as required.

```
ALGORITHM  ADD_COMPUTER_MAINTENANCE_DATA
     (*  Append records to maintenance and repair database file
     *)
DECLARE
     compcode, compname, fault, action, date, remark : character
     Esc    :  Boolean
EXECUTE
     Repeat
     Output 'Computer code ' more
     Input compcode
     Output 'Computer name ' more
     Input compname
     Output 'Fault         ' more
     Input fault
     Output 'Date received ' more
     Input R_date
     Output 'Action        ' more
     Input action
     Output 'Date despatched' more
     Input Date_desp
     Output 'Remark        ' more
     Input remark
     Output 'Press [Esc] key to exit '
     Until Esc
END   ADD_MAINT_DATA
```

```
ALGORITHM  MODIFY_ELECTRONIC_COMPONENTS_DATA
     (*   To effect changes (edit) the existing records in
electronic components data bank  *)

DECLARE
     compcode, comp_numb, replcmt, remark    :  Character
     Esc  : Boolean
EXECUTE
     Esc <-- False
     Repeat
     Output 'Component code ' more
     Input compcode
     Output 'Component number ' more
     Input comp_numb
     Output 'Replacement    ' more
     Input replcmt
     Output 'Remark         ' more
     Input remark
     Output 'Press [Esc] key to exit '
     Until Esc
END  MODIFY_COMPONENTS_DATA
```

```
ALGORITHM  DELETE_COMPUTER_SYSTEM_INFORMATION
     (*  To delete computer system information  from the table
(reference) file  *)

DECLARE
     compcode, compname, reg_date, ch    :  Character
     Frequency, Percentage                : Numeric
     Esc  : Boolean
EXECUTE
     Esc <-- False
     Repeat
     Output 'Computer code ' compcode
     Output 'Computer name ' compname
     Output 'Frequency of break-down    ' frequency
     Output 'Percentage break-down      ' percentage
     Output 'Date registered            ' reg_date
     until Esc
     Output 'Press [Esc] key to select '
     Output 'Delete the highlighted record ? (Y/N) ' more
     Input ch
     If ch = "Y"  or ch = "y"
        Delete record
     Endif ch
END  DELETE_COMPUTER_SYSTEM_INFORMATION
```

```
ALGORITHM  PRINT_COMPUTER_MAINTENANCE_REPORT
DECLARE
     K    :  Character
     Row  : Numeric
EXECUTE
     Row <-- 60
     Output 'Is the Printer READY ? (Y/N) ' more
     Input k
     If k = 'N' or k= 'n' THEN EXIT
     Open MAINT.DAT
     Set Print ON
     While not eof DO
     IF Row > 56 THEN
        Output 'Computer Maintenance And Repair System '
        Output '             Report'
        Output 'Computer code      Fault          Action'
        Row <--  9
      End if Row
        Output compcode
        Output fault
        Output action
        Incr Row
     End while not eof
     Close MAINT.DAT
     Set Printer OFF
END  PRINT_COMPUTER_MAINTENANCE_REPORT
```

```
ALGORITHM  COMPUTE_COMPUTER_MAINTENANCE_STATISTICS
DECLARE
     K,code     :  Character
     mfreq, mpfreq, mtot, Row  : Numeric
EXECUTE
     Output 'Computing statistics,  wait... '
     Open MAINT.DAT  as 1
     Open REFERENC.DAT  as 2
     While not eof DO
        Store compcode to code
        Count FOR compcode = code TO mfreq
        Replace frequency with mfreq
     End while not eof
     Select 2
     Sum frequency to mtot
     While not eof Do
        mfreq  <-- frequency
        mpfreq <-- (mfreq/mtot)*100
        Replace percentage with mpfreq
    End while not eof
    Output 'Is the Printer READY ? (Y/N) '  more
    Input k
    If k = 'N' or k = 'n' THEN EXIT
    ELSE GOTO Algorithm  Print_Statistics
    Close all files
END  COMPUTE_MAINTENANCE_STATISTICS
```

```
ALGORITHM  PRINT_STATISTICS_REPORT
DECLARE
     K    :  Character
     Row  : Numeric
EXECUTE
     Row <--- 60
     Open REFERENC.DAT
     Set Print ON
     While not eof DO
     IF Row > 56 THEN
        Output 'Computer Maintenance & Repair System '
        Output '             Report'
        Output 'Comp.code   Description   Frequency    % Estimate
        Row  <-- 9
      End if Row
        Output compcode
        Output compname
        Output frequency
        Output percentage
        Incr Row
     End while not eof
     Close REFERENC.DAT
     Set Printer OFF
END  PRINT_STATISTICS_REPORT
```

```
ALGORITHM  PLOT_GRAPH_ON_STATISTICS_DATA

DECLARE
     p,x,y,n,c,percent,reliab :  Numeric

EXECUTE

     (*  Vertical scale *)
     y  <-- 0; p <-- 100
     While y <= 20 DO
      At y,x output chr(170)
      If mod(y,2)=0 THEN
         AT y,x output chr(180)
         AT y,x-3 output ltrim(str(p))
         Decr p by 10
      End  if mod
      Incr y
      End while y

     (*  Horizontal  scale  *)
      y <-- 20; x <-- 11; c <-- 1
      While x <= 64
        At y,x output chr(196)
        If mod(x,4) = 0
           At y,x output chr(194);  Ltrim(str(c))
           Incr c
        Endif  mod
```

```
        Incr x
      End while x

      Output 'Graph Showing Computer Hardware Reliability'
      While not  eof  DO
       y <-- 19;  Percent <-- percentage
       If percent > 0 THEN
          Reliab <-- 1/percent * 100
          Do while c <= Reliab
            At y,c output chr(219)
            Incr c
            Decr y
         End while c
       End if percent
     End while not eof
END  PLOT_GRAPH_ON_MAINTENANCE_STATISTICS_DATA
```

4.3 PROGRAM CODING, TESTING AND DEBUGGING

Once the algorithm or flowchart of the programs have been completed, the next stage is to code, test and debug the programs.

4.3.1 Coding

The narrative (algorithm) design were translated into machine - readable instructions or program to be precise.

This process was straight forward because the design logic is sound and the documentation of the program is thorough. The argument is backed up by the program algorithm provided earlier on.

4.3.2 System Testing

Once the program was entered into the computer, and test-data prepared; individual program modules were tested with these data until found satisfactory.

The entire program was thoroughly tested with all modules incorporated which was eventually found successful.

4.3.3 Debugging

The elimination of errors (bugs) from a program is known as debugging. A bug is either a syntax error (violation of one of those rules for writing instructions) or a logic error.

The test-data were judiciously compiled so that all programs and validation routines are tested. The second stage of system testing was done with live - data by several of the people who will eventually use the system. The exercise provided an extra level of assurance that the system will work satisfactorily.

4.4 CHANGE-OVER PROCEDURE

Finally, after every aspect of the system was checked and verified to ensure its operational accuracy and solid results were obtained from the use of test data and live data; the entire system was re-initialized to handle 'live' data.

Since not much of paper work is required to run the new system, it is more economical and safer to adopt parallel method of changeover.

Therefore, the parallel method is recommended and adopted whereby the new system runs concurrently with the old system, processing exactly the same data and producing identical results. This procedure continued until the user is satisfied and feels comfortable with the new system.

4.5 OPERATION MANUAL

The operating manual is a guide on the operation of the new system. It gives step-wise refinement of how to use the new system.

4.1 Establishing contact with the computer

First remove the computer cover and the peripherals covers (if applicable). Then switch on the power from the mains, and switch on power protector (UPS) and wait for some seconds. Then switch on the system unit and finally the monitor (ie. Visual Display Unit).

Your computer should now be activating. If it is successful, you will see a blinking cursor at the DOS prompt or the message:

Current date is 07-15-97

Enter new date [mm-dd-yy] _ press ENTER key

Current time is 07:10:29

Enter new time [hh:mm:ss] _ press ENTER key

By now you should have the DOS prompt displayed thus C:\>_

4.2 Running the Program

After establishing contact with the computer, type at the OS prompt the following sequence of commands to activate the rogram (MSYS) :

C:\>CD\DBASE and press Enter key

C:\DBASE>DBASE and press Enter key

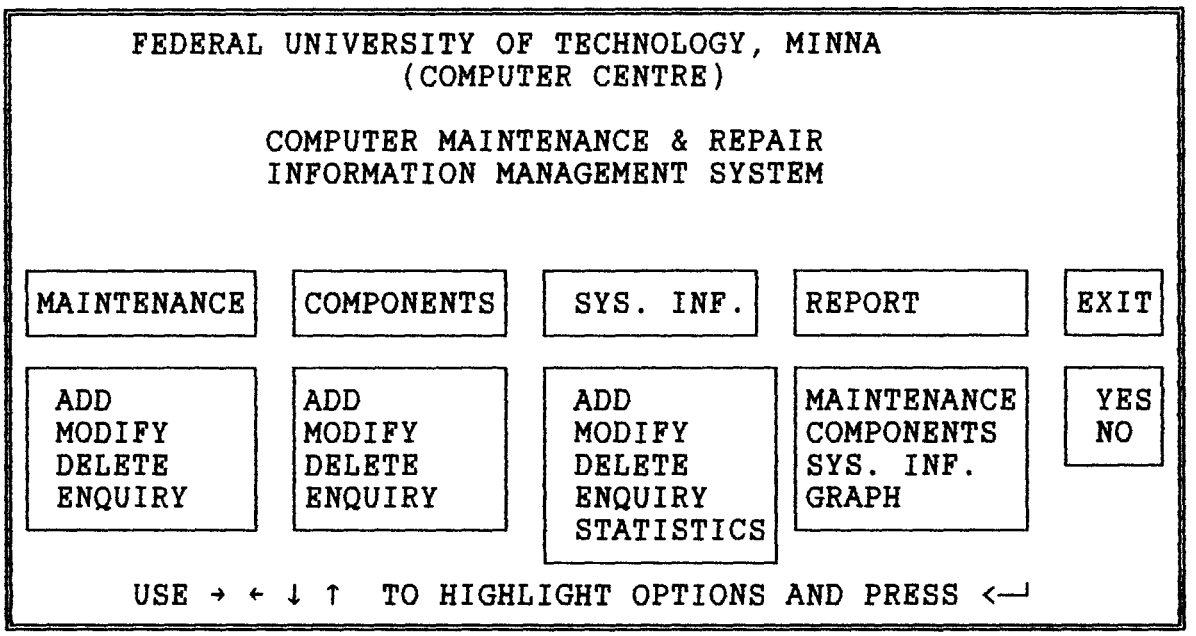
With the dBASE IV activated, press the [Esc] key and then etter Y

Now, type at DOT prompt of dBASE IV the following command.

.DO MSYS and press Enter key

Security test must be passed before the user can proceed. The system will request the user to supply or enter password. If the correct password is entered, it proceeds by displaying boldly the name of the writer. Just press any key at this point to continue.

Once a key is pressed, the system Main Menu will be displayed as shown below :



DEVELOPED BY : ZUBAYR EMIMARU (PGD/MCS/121/96)
J U L Y, 1 9 9 7

4.5.3 Adding records to database

Move the pointer to the option desired, highlight APPEND and press Enter key. Press [DOWN] arrow key and letter Y. Now enter new data. Ensure to press Enter key at the last field of the last record entered.

Note that forms for APPEND, MODIFY, DELETE and ENQUIRY are usually super-imposed on the system main-menu using window. This does not cause any problem to the system but rather an exploration of window facilities provided by dBASE IV.

4.5.4 Modifying records in the database

Move the pointer to the option desired, highlight MODIFY and press Enter key. Then move the pointer through the file until record to be modified is found. Effect appropriate changes on the record and press Esc key when you finished.

4.5.5 Deleting records from the database

Move the pointer to the option desired, highlight DELETE and press Enter key. Then move the pointer through the file to the record to be deleted and press Esc key to select the record. The message **Delete the highlighted record ? (Y/N)** will appear. Press Y if the record is to be deleted or N to leave it intact.

4.5.6 Enquiring from the database

Move the pointer to the option desired, highlight ENQUIRY and press Enter key. Then use [UP] and [DOWN] arrow keys to move the pointer through the file until the information required is found. Press Esc key to exit.

4.5.7 Computing Maintenance & Repair statistics

Move the pointer to SYSTEM INF, highlight STATISTICS and press Enter key. The system will commence the computation immediately. Once the computation is completed, press Y to print the results (if printer is connected to the computer) or N to exit.

Note that this exercise (computation of maintenance and repair statistics) simply updates the existing statistics based on the current data.

4.5.8 Plotting Graph (based on maintenance & repair statistics)

Move the pointer to REPORTS, highlight GRAPH using [DOWN] arrow key and press Enter key. The system takes over by plotting a bar chart (graph) on the screen based on the current statistics.

Note: To obtain the latest (up-to-date) graph, first compute the statistics of maintenance and repair (see 4.5.7). Press the [PrtSc] key to produce a hard copy of the graph plotted on the screen if printer is connected to the computer or any other key to exit.

4.5.9 Printing Reports

Move the pointer to REPORTS, highlight the desired option and press Enter key. The message **Is the Printer READY ? (Y/N)** will appear on the screen below. To start printing, press Y or N to exit.

4.5.10 Signing Off

To end the program run or terminate the session (ie. close down the system), move the pointer to the EXIT, highlight YES and press Enter key, or highlight NO and press Enter key to resume work.

Note: Switch off the monitor, the system unit, the peripherals and cover them up when closing finally for the day to protect the computer from effect of dust, water, insects etc. on the circuitry.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

Computer hardware maintenance is almost always performed under contract by engineers working either for the equipment manufacturer or retailers, or from specialist maintenance companies or service department like the Computer Centre, Federal University of Technology, Minna - Nigeria. Their function is divided between breakdown repairs, for which they must be on call, and preventive maintenance carried out on a regular basis.

Reliability of a system (computer) is freedom from failure. Unfortunately every man-made object is subject to failure in operation, either as a result of component failing or as a consequence of something else happening outside the system. Things suddenly fail at random, and things eventually wear out. Operations without failure are of interest to every computer user and totally essential to real-time and life-support systems. Thus reliability has to be sought and engineered into computer systems both in their original manufacture and during their use, hence the aim of this project.

In reliability engineering, reliable hardware can be sought in the following ways :

i) using good-quality and well tested components;

ii) good design that eliminates potential areas of failure, e.g moving parts, friction, stress, heat etc.

iii) providing extra capacity that can be used to check the

correctness of an operation.

iv) providing spare units which can continue in use if the first unit fails.

It is through a combination of these methods that a small group of computer manufacturers are able to offer "*non stop*" computer systems. Although non-stop systems will experience failures internally, these failures will not stop the system working - such systems are called "fault - tolerant" systems.

5.2 RECOMMENDATIONS

Since most hardware wears out with use and age, the most essential precaution is testing hardware regularly either in time or by use, and replacing defective parts. This is known as preventive maintenance, and should reduce random or wear-out failures to a minimum, the effect of which can be further controlled by holding spares and by arranging a rapid and guaranteeable repair service.

With modern electronic solid-state technology, the greater number of failures are likely to be caused by errors in software, so that reliable software and similar software maintenance procedures are equally essential, both for application and for system software.

Ultimately, and perhaps unfortunately, all computer systems rely on electrical power. The power supply to business premises, schools, homes is from time to time, affected by situations outside our control - total failure, a planned shut-off for

repairs. It is therefore necessary to provide back-up power supply - either a battery which provides enough life to enable a computer system to close down in an orderly fashion; or in extreme, a standby generator which is immediately switched into use when a failure of the mains supply is detected.

Similarly, physical security measures should be mounted to prevent access and use of computers by unauthorised personnel, by means of :

i) restricted access - locking rooms when not in use;

ii) restricted use - use only by authorised names;

iii) precautions against theft or sabotage with burglar and other anti-theft devices;

iv) precautions against fire should be anticipated by installing sprinkler systems or inert gas emitters.

Finally, this work can be improved upon by introducing an automatic circuit fault detection device, with the computer software program developed in this project serving as a knowledge-based system to the device; from which description of faults detected and actions to be taken to correct the problems can be obtained.

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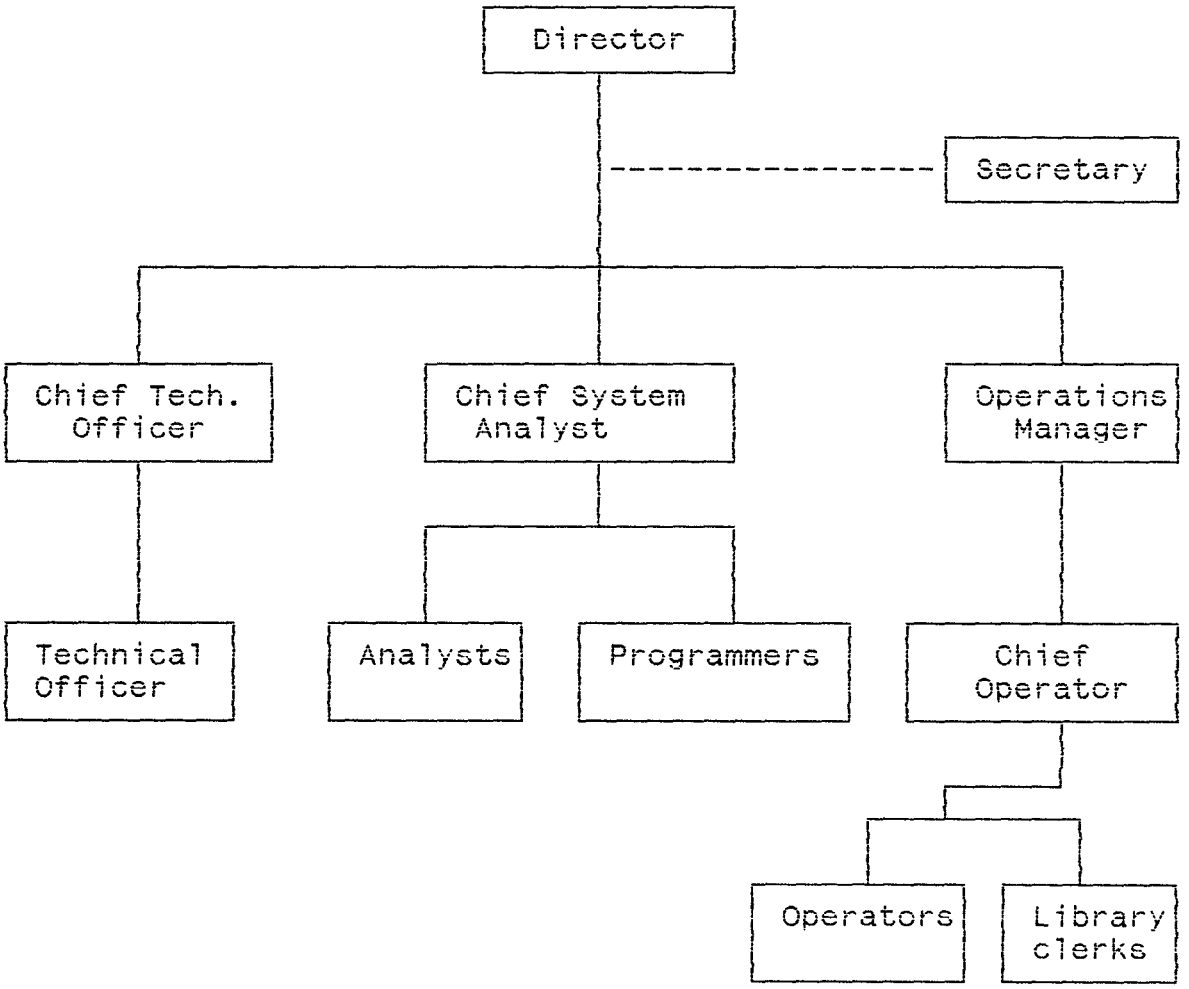
A P P E N D I X I

Organisation Structure of the Computer Centre, F.U.T. Minna



A P P E N D I X II

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
(COMPUTER CENTRE)
COMPUTER MAINTENANCE & REPAIR
INFORMATION MANAGEMENT SYSTEM

MAINTENANCE DATA COMPONENTS DATA SYSTEM INF REPORTS EXIT

APPEND

COMPCODE	COMPNAME	FREQUENCY	PERCENTAGE	REG_DA
IBM	IBM PC AT 286	1	6.7	02/01/
PRECISION	PC AT 386	5	33.3	17/04/
COMPAQ	PC AT 486	2	13.3	05/12/
KINGTECH	PC AT 80286	2	13.3	01/09/
ROYALE	PC AT 80386	3	20.0	13/05/
GULIP	PC AT 80286	2	13.3	12/08/

Press [Esc] key when you finish...
Display computer information.

COMPUTER MAINTENANCE & REPAIR
MAINTENANCE REPORT

puter code	F a u l t	A c t i o n
PAQ	DRIVE A NOT FUNCTIONING	DRIVE A CLEANED/LUBRICATED
PAQ	NOT BOOTING FROM DRIVE C	SYSTEM FILES INSTALLED ONTO C
IP	SYSTEM BOOT FAILURE	SYSTEM FILES TRANSFERRED TO C
IP	IT DOES NOT BOOT FROM DRIVE A	BOOT RECORD CLEARED & REINST
	NO POWER	POWER CABLE REPLACED
GTECH	NO POWER	POWER UNIT FUSE REPLACED
GTECH	CONTROLLER CARD FAILURE	HD CABLE REFIXED
CISION	DRIVE C NOT ACCESSIBLE	SETUP PROGRAM USED TO INSTAL
CISION	KEYBOARD BAD	KEYBOARD SERVICED
CISION	SCREEN REMAINS BLANK	MONITOR CABLE WAS ADJUSTED
CISION	DISK DRIVE B REQUIRED	DRIVE B INSTALLED
CISION	KEYBOARD NOT WORKING	KB INTERFACE CABLE REPLACED
ALE	SCREEN IS BLANK	COMMUNICATION CABLE ADJUSTED
ALE	CONTROLLER CARD FAILURE	CONTACT CLEANED & FIRMLY FIX
ALE	ERROR READING DRIVE A	DISK DRIVE A REPLACED

100
90
80
70
60
50
40
30
20
10
0

ELECTRONIC COMPONENTS INFORMATION
ELECTRONIC COMPONENTS REPORT

Component code	Component Number	Replacement
IC	SN7400N	FJH131
IC	SN7401N	FJH231
IC	SN7402N	FJH221
IC	SN7403N	FJH291
IC	SN7404N	FJH241
IC	SN7405N	FJH251
IC	SN7410N	FJH121
IC	SN7420N	FJH111
IC	SN7430N	FJH101
IC	SN7440N	FJH141
IC	SN7441N	FJL101
IC	SN76210	TBA500
IC	SN76540	TAA700
TX	AC121	AC128
TX	AC153	AC128
TX	AC172	AC127
TX	BC108C	BC108C
TX	BC112	BC146
TX	BC120	2N2218
TX	BSX51A	BC107A
DD	1N3893	BYX30/400
DD	1N447	1N446
DD	1N4448	1N4448
DD	1N4449	1N4449
DD	1N41449	1N4148
DD	1N4837B	BZX61
DD	1N4838B	BZX61
DD	1N4839B	BZX61
DD	1N4840B	BZX61
DD	1N4841B	BZX61
DD	1N4842B	BZX61

A P P E N D I X III

```
*********************************************************
*                                                       *
*  Computer Maintenance and Repair                      *
*  Information Management System                        *
*  Program developed by :-                              *
*         Name :    Zubayr Emimaru                      *
*         Reg. No.  PGD/MCS/121/96                      *
*         Dept.     Mathematics/Computer Science        *
*         School:   Post-Graduate Studies               *
*         Date :    July, 1997                          *
*                                                       *
*  Purpose :                                            *
*            In partial fulfilment for the award of     *
*            Post-Graduate Diploma in Computer Science  *
*            of the Federal University of Tech., Minna.*
*********************************************************
 Defi  Wind  maintwin  From  10,2  To  22,77  Doub  color
gr+/b,gr+/gb,gb+/b

**********    Important Notice  ************
*                                           *
*   This program must never be copied in    *
*   part  or whole by any  means without    *
*   the prior  permission of the writer.    *
*   All rights reserved.  (c) 1997          *
*                                           *
*********************************************
Defi Wind errwin From 13,10 To 16,70 Doub colo w+/r+

set talk off
   set echo off
    set stat off
     set safe off
      set scor off
       set colo to
on error do errproc
Defi Wind pwin From 8,10 To 15,70 Doub colo w+/b
do pword

Note  Knowledge-based System on Computer Maintenance

public p,q,r,s,t,u,v,a,b,c,d
store space(40) to p,q,r,s,t,u,v,a,b,c,d
do disp
Defi Wind graphwin From 0,1 To 24,79 Doub colo w+/b
Do while .t.
  clear
  do header
  set colo to rg+/rg+
  @3,10 clea to 18,68
   set colo to w+/b
```

```
    @1,5 clea to 18,78
     @6,8 clea to 16,76
      @6,7 fill to 16,76 color w/gb+
       @1,25 say p
        @2,25 SAY q
         @3,25 say r
          @4,25 say s
           set colo to gr+/b
            set colo to w+/r+
             @18,17 SAY t
              @18,25 SAY CHR(26)
              @18,27 SAY CHR(27)
             @18,29 SAY CHR(25)
            @18,31 SAY CHR(24)
         @18,63 SAY CHR(17)+CHR(196)+CHR(217)
        set colo to w+/b
       @20,17 say u
      @21,17 say v
     set colo to w/n
    set colo of high to w+/gb+
   set colo of info to W*/b
  set colo of mess to gr+/b

  do cmrmenu
  acti menu main pad maint
  on sele popup ext exit
Enddo
set colo to
clear all
clear
retu


**********************
Proc repairs
        k    = space(1)
        store 0 to row
        ? chr(7)
        @22,20 say 'Is the printer READY ?  (Y/N)' get k pict "!"
        read
        if upper(k)='N'
           @22,20 say space(40)
           return
        endif
        use MAINT.DAT

        row = 60
        sort on compcode to temp
        use temp
        set devi to print

        Do while .not. eof()
          if row > 56
            @3,18 say A
            @4,18 say '              MAINTENANCE REPORT'
            @6,1 say repl(chr(196),75)
```

```
            @7,1 say 'Computer code'
            @7,20 say 'F a u l t'
            @7,50 say 'A c t i o n'
            @8,1 say repl(chr(196),75)
            row=9
          endif
          @row,1 say compcode
          @row,20 say Fault
          @row,50 say Action
          row=row+1
          skip
         Enddo


    close data
    eject
    set devi to scre
    @23,15 say 'End of report,   press any key to exit.'
    set cons off
    wait""
   set cons on
   @22,20 say space(40)
retu


**********************
Proc compnts

        k    = space(1)
        store 0 to row
        ? chr(7)
        @22,20 say 'Is the printer READY ?  (Y/N)' get k pict "!"
        read
        if upper(k)='N'
           @22,20 say space(40)
           retu
        endif
        use COMPNTS.DAT
        row = 60
        set devi to print

        Do while .not. eof()
          if row > 56
            @3,18 say B
            @4,18 say '         ELECTRONIC COMPONENTS REPORT'
            @6,1 say repl(chr(196),75)
            @7,1 say 'Component code'
            @7,20 say 'Component Number'
            @7,50 say 'Replacement'
            @8,1 say repl(chr(196),75)
            row=9
          endif
          @row,1 say compcode
          @row,20 say comp_numb
          @row,50 say replcmt
          row=row+1
```

```
          skip
         Enddo


     close data
     eject
     set devi to scre
     @23,15 say 'End of report,   press any key to exit.'
     set cons off
     wait""
     set cons on
     @22,20 say space(40)
retu


**********************
Proc table

        k    = space(1)
        store 0 to row
        ? chr(7)
        @22,20 say 'Is the printer READY ?  (Y/N)' get k pict "!"
        read
        if upper(k)='N'
           @22,20 say space(40)
           return
        endif
        use REFERENC.DAT
        row = 60
        set devi to print


        Do while .not. eof()
          if row > 56
            @3,18 say C
            @4,18 say '            COMPUTER LIST REPORT'
            @6,1 say repl(chr(196),75)
            @7,1 say 'Computer code'
            @7,20 say 'Computer name'
            @7,60 say 'Date registered'
            @8,1 say repl(chr(196),75)
            row=9
          endif
          @row,1 say compcode
          @row,20 say name
          @row,50 say frequency
          @row,60 say reg_date
          row=row+1
          skip
         Enddo
         close data
         eject
         set devi to scre
         @23,15 say 'End of report,   press any key to exit.'
         set cons off
         wait""
```

```
         set cons on
        @22,20 say space(40)
retu


**********************
Proc stat

        k    = space(1)
        store 0 to row
        ? chr(7)
        @22,20 say 'Computing statistics, wait...'
        sele 1
        use maint.dat
        sele 2
        use referenc.dat
        code=space(15)
        mfreq=0
        mpfreq=0.0
        mtot=0


        ***  computations ***

        Do while .not. eof()
          code=compcode
          sele 1
          count for compcode=code to mfreq
          sele 2
          repl frequency with mfreq
          skip
        Enddo
        sele 2
        sum frequency to mtot
        go top
        Do while .not. eof()
          mfreq=frequency
          mpfreq=mfreq/mtot*100
          repl percentage with mpfreq
          skip
        Enddo


        ? chr(7)
        @22,20 say 'Is the printer READY ?  (Y/N)' get k pict "!"
        read
        if upper(k)='N'
           @22,20 say space(40)
           close data
           return
        endif
        sele 2
        row = 60
        set devi to print
```

```
        Do while .not. eof()
          if row > 56
            @3,18 say C
            @4,18 say '  MAINTENANCE & REPAIR STATISTICS'
            @6,1 say repl(chr(196),75)
            @7,1 say 'Computer code'
            @7,15 say 'Computer name'
            @7,50 say 'Freq. of break-down'
            @7,70 say '% estimate'
            @8,1 say repl(chr(196),75)
            row=9
          endif
          @row,1 say compcode
          @row,15 say name
          @row,50 say frequency
          @row,72 say percentage
          row=row+1
          skip
         Enddo



         close data
         eject
         set devi to scre
         @23,15 say 'End of report,   press any key to exit.'
         set cons off
         wait""
         set cons on
         @22,20 say space(40)
retu


************************* Main menu

Procedure cmrmenu

defi menu main
defi pad  maint of main prompt "MAINTENANCE DATA" AT 7,10
defi pad  comp  of main prompt "COMPONENTS DATA" AT 7,28
defi pad  ref   of main prompt "SYSTEM INF"AT 7,46
defi pad  rep   of main prompt "REPORTS" AT 7,60
defi pad  ext   of main prompt "EXIT" AT 7,70


defi popup maint from 8,10 to 13,26
defi bar 1 of maint prompt "  APPEND" mess 'Add new records.'
defi bar 2 of maint prompt "   MODIFY" mess 'Update existing
records.'
defi bar 3 of maint prompt "   DELETE" mess 'Delete existing
records.'
defi bar 4 of maint prompt "  ENQUIRY" mess 'Display records on
repairs file.'


defi popup comp from 8,28 to 13,44
```

```
defi bar 1 of comp prompt "  APPEND" mess 'Add new components to
data bank.'
defi bar 2 of comp prompt "  MODIFY" mess 'Update components
data.'
defi bar 3 of comp prompt "  DELETE" mess 'Delete components
data.'
defi bar 4 of comp prompt "  ENQUIRY" mess 'Display records of
components.'


defi popup ref from 8,46 to 14,57
defi bar 1 of ref prompt "APPEND" mess 'Add new computer
information.'
defi bar 2 of ref prompt "MODIFY" mess 'Update computer
information.'
defi bar 3 of ref prompt "DELETE" mess 'Delete computer record.'
defi bar 4 of ref prompt "ENQUIRY" mess 'Display computer
information.'
defi bar 5 of ref prompt "STATISTICS" mess 'Compute/Print Maint.
Statistics.'


defi popup rep from 8,58 to 13,69
defi bar 1 of rep prompt "REPAIRS" mess 'Print Maintenance &
Repair data.'
defi bar 2 of rep prompt "DATA BANK" mess 'Print Electronic
Components data.'
defi bar 3 of rep prompt "SYSTEM INF" mess 'Print Computer
Information.'
defi bar 4 of rep prompt "GRAPH" mess 'Plot graph for computer
reliability.'


defi popup ext from 8,70 to 11,74
defi bar 1 of ext prompt "YES" mess 'Terminate session.'
defi bar 2 of ext prompt "NO" mess 'Resume work.'



on pad maint of main acti popup maint
on pad comp  of main acti popup comp
on pad ref   of main acti popup ref
on pad rep   of main acti popup rep
on pad ext   of main acti popup ext

on sele popup maint do maint
on sele popup comp do comp
on sele popup ref do ref
on sele popup rep do rep
on sele popup ext do ext
    ***

procedure ext
do case
   case bar() = 1
    set colo to
```

```
    clear
    quit
   case bar() = 2
    deact menu
endcase
return


procedure maint
 do case
    case bar() = 1
     do madd
    case bar() = 2
     do mmod
    case bar() = 3
     do mdel
    case bar() = 4
     do mqry
 endcase

procedure comp
 do case
    case bar() = 1
     do cadd
    case bar() = 2
     do cmod
    case bar() = 3
     do cdel
    case bar() = 4
     do cqry
 endcase


procedure ref
 do case
    case bar() = 1
     do radd
    case bar() = 2
     do rmod
    case bar() = 3
     do rdel
    case bar() = 4
     do rqry
    case bar() = 5
     do stat
endcase


procedure rep
 do case
    case bar() = 1
     do repairs
    case bar() = 2
     do compnts
    case bar() = 3
     do table
```

```
    case bar() = 4
     do plot
 endcase



Procedure madd
    sele 1
  Use referenc.dat
    sele 2
  Use maint.dat
store space(15) to mcode
 @23,25 say 'Press [Esc] key when you finish...'
  acti wind maintwin
   go bott
    brow nodelete noedit noinit
   mcode=compcode
  deact wind maintwin
if mcode=space(15)
   dele
   pack
Endif
   sele 1
   go top
   locate for compcode = mcode
   if eof()
      ? chr(7)
      acti wind errwin
      @1,3 say 'Invalid computer code;  entry will not be saved.'
      wait "   Press any key..."
      sele 2
      dele
      pack
      deact wind errwin
   endif
@23,15 say space(60)
close data
retu



Procedure mmod
Use maint.dat
@23,25 say 'Press [Esc] key when you finish...'
acti wind maintwin
brows noappend nodelete noinit
deact wind maintwin
@23,25 say space(50)
close data
retu


Procedure mdel
Use maint.dat
ze=space(1)
@23,25 say 'Press [Esc] key to select...'
```

```
acti wind maintwin
brows noappend noedit noinit
acti wind errwin
@1,5 say 'Delete the highlighted record ? (Y/N)' get ze
read
if upper(ze)='Y'
   dele
   pack
endif
deact wind errwin
deact wind maintwin
@23,25 say space(60)
close data
retu


Procedure cqry
Use compnts.dat
@23,25 say 'Press [Esc] key when you finish...'
acti wind maintwin
brows noappend noedit nodelete noinit
deact wind maintwin
@23,25 say space(50)
close data
retu



Procedure radd
Use referenc.dat
@23,25 say 'Press [Esc] key when you finish...'
acti wind maintwin
brows nodelete noedit noinit FIELDS compcode,compname,reg_date
deact wind maintwin
@23,25 say space(50)
close data
retu



Procedure rmod
Use referenc.dat
@23,25 say 'Press [Esc] key when you finish...'
acti wind maintwin
brows noappend nodelete noinit FIELDS compcode,compname,reg_date
deact wind maintwin
@23,25 say space(50)
close data
retu



Procedure rdel
Use referenc.dat
ze=space(1)
@23,25 say 'Press [Esc] key to select...'
```

```
   acti wind errwin
   @1,3 say 'An Error has occured, please check or'
   @2,3 say 'Do you want to terminate session ? (Y/N)' get k pict
"!"
   read
   deact wind errwin
   if k='Y'
      clear all
      set colo to
      clear
      quit
    endif
    return


*****************
Proc plot
*****************
acti wind graphwin

Note v-scale

clear
inv=0.0
p=100
x=10
y=0
do while y <= 20
@y,x say chr(179)
if mod(y,2) = 0
   @y,x say chr(180)
   @y,x-3 say ltrim(str(p))
   p=p-10
endif
y=y+1
enddo


Note h-scale

y=20
x=11
c=1
@y,10 say chr(192)
do while x <= 64
@y,x say chr(196)
if mod(x,4) = 0
   @y,x say chr(194)
   @21,x say ltrim(str(c))
   c=c+1
endif
x=x+1
enddo

use referenc.dat
@1,20 say "GRAPH SHOWING COMPUTER HARDWARE RELIABILITY"
```

```
@2,20 say "   (Y-axis ==> percentage reliability)"
percent=0
n=0
x=12

do while .not. eof()
  y=19
  percent=percentage
  if percent > 0
     reliab=(1/percent)*100
     Note inv=abs(inv)
     c=0
     do while c <= reliab
        @y,x say chr(219)
        c=c+1
        y=y-1
     enddo
     x=x+4
     n=n+1
   Endif
skip
Enddo

@5,62 say "X-axis"
@6,62 say repl(chr(196),4)
c=1
x=62
y=7
go top
Do while c <= n
   if percentage > 0
      @y,x say ltrim(str(c))+' - '+compcode
      c=c+1
      y=y+1
   endif
   skip
Enddo
close data
@21,20 say ""
wait + "          Press [PrtSc] to print  or  any other key to
exit..."
deact wind graphwin
return


********* end of program profile *******
```

```
acti wind maintwin
brows noappend noedit noinit
acti wind errwin
@1,5 say 'Delete the highlighted record ? (Y/N)' get ze
read
if upper(ze)='Y'
   dele
   pack
endif
deact wind errwin
deact wind maintwin
@23,25 say space(60)
close data
retu



Procedure mqry
Use maint.dat
@23,25 say 'Press [Esc] key when you finish...'
acti wind maintwin
brows noappend noedit nodelete noinit
deact wind maintwin
@23,25 say space(50)
close data
retu

Procedure cadd
Use compnts.dat
@23,25 say 'Press [Esc] key when you finish...'
acti wind maintwin
brows nodelete noedit noinit
deact wind maintwin
@23,25 say space(50)
close data
retu



Procedure cmod
Use compnts.dat
@23,25 say 'Press [Esc] key when you finish...'
acti wind maintwin
brows noappend nodelete noinit
deact wind maintwin
@23,25 say space(50)
close data
retu



Procedure cdel
Use compnts.dat
ze=space(1)
@23,25 say 'Press [Esc] key to select...'
```

```
acti wind maintwin
brows noappend noedit noinit
acti wind errwin
@1,5 say 'Delete the highlighted record ? (Y/N)' get ze
read
if upper(ze)='Y'
   dele
   pack
endif
deact wind errwin
deact wind maintwin
@23,25 say space(60)
close data
retu



Procedure rqry
Use referenc.dat
@23,25 say 'Press [Esc] key when you finish...'
acti wind maintwin
brows noappend noedit nodelete noinit
deact wind maintwin
@23,25 say space(50)
close data
retu


Procedure header

*******************************************

a="    COMPUTER MAINTENANCE & REPAIR      "
b="    ELECTRONIC COMPONENTS INFORMATION  "
c="    COMPUTERS INFORMATION SYSTEM       "
d="    MAINTENANCE & REPAIRS STATISTICS   "

*******************************************


*******************************************
p="FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA"
q="         (COMPUTER CENTRE)"
r="    COMPUTER MAINTENANCE & REPAIR      "
s="    INFORMATION MANAGEMENT SYSTEM      "
t="USE THE         TO HIGHLIGHT OPTION AND PRESS   "
u=" DEVELOPED BY :  ZUBAYR EMIMARU (PGD/MCS/121/96)"
v="                 J U L Y,   1 9 9 7             "


    ***


*********************
Proc errproc
   k=space(1)
```