VICAI SYSTEM FOR TEACHING COMPUTER ENGINEERING

نظام مرئي ذكي لتعليم هندسة الحاسب

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ملخص البحث ...

نظرا للتقدم السريع في صناعة الحاسبات وتداولها فقد تعدد استخدامها في تطبيقات كثيرة في شتى مجالات الحياة ... ومن اهم هذة التطبيقات استخدام الحاسبات كنظم خبيرة معتمدة على الذكاء الاصطناعي كوسائل تعليمية حديثه تساعد على تعليم المقررات المختلفه ..وحاليا فهناك البعض من هذة النظم ولكن يعيبها ضعف التركيب وقلة المعلومات وعدم استخدام امكانيات الحاسب الحديثة ... هذا بالاضافة الى ان هذة النظم لا يوجد بينها الا نظام واحد لتعليم معمار الحاسب ذاته ...

لذلك كان هذا البحث ..حيث يقدم نظاما جديدا للتعليم الذاتي لمقرر هندسة ومعمار الحاسب ...والنظام يستخدم التكنولوجيا الحديثه في الذكاء والعرض المرئي حيث يتم توليدوعرض ١٤ قائمة رئيسية وفرعية بالاضافة الى ١٥١ شاشة ملونة ومصورة ...ولزيادة سرعة النظام فقد تم التمثيل السطحي والعملي لقاعدة المعرفة باستخدام اسلوبي القواعد والاطارات. وقد تم تقسيم النظام الى ثلاث نظم فرعية ... الاول منها يختص بشرح تفصيلي لدوائر المكونات المادية ومعمار الحاسبات ذو المعالج ٣٨٦... اما النظام الفرعي الثاني فيتضمن شرح للاجهزة الاضافية وملحقات الحاسب ...والنظام الفرعي الثالث فيقوم بتشخيص اعطال الحاسبات ثم تحديد الاسباب ومن خلال حوار بين النظام والمستخدم فيتم تحديد طريقة الاصلاح للتغلب على الاعطال.

ويتميز النظام المقترح بالبساطه وسهولة الاستخدام...وقدتم اختبار النظام والنتائج تؤكد اهمية النظام المقترح حيث أن أسلوبه التعليمي تفاعلي جذاب وكذلك فانه ذو كفاءة عالية .

ABSTRACT

This paper introduces a Visual Intelligent Computer Aided Instruction (VICAI) system It consists of three subsystems, the first concerns with the personal computer hardware and architecture (80386SX processor). The second subsystem is focused on its peripherals. While the third subsystem gives advices for repairing any troubleshooting that might occurs in pesonal computer systems. This is done through a dialogue between the system and the user. For surface and deep representation of knowledge base. The system is designed using both rules and frames. Also, the system is highly use visual display and color graphics which are likely accepted by the user.

KEYWORDS : Expert System, Visual Programming, Computer Hardware, Troubleshooting.

1. INTRODUCTION

Artificial Intelligence (AI) now encompasses a variety of technological areas. An Expert System (ES) is the first true operational application of AI field. Generally, ES tools consist of three components: a knowledge base that has a representation and control structure; an inference engine that has a rules interpreter; and a user interface which determines whether the system asks questions that the user must answer or offers menu of choices. In practic, the difference between the ES and the conventional program is at the types of problems to be solved and the way in which the problems are to be solved. Indeed, ESs are particularly well adapted for the resolution of certion sorts of problems where:

- A great quantity of information is provided.
- The information pieces is not fixed, but progressive.
- The information pieces are rather of the heuristic than algorithmic type.
- The symbolic treatment of the information leads to as numeric treatment.
- A qualitative analysis of the problem and its context has a much, if not more, importance as its quantitative analysis.
- The path taken in order to come to a solution is just as important as the solution itself.

Two essential qualities come out of this; the possibility of a relaxed man-machine conversation, and the system's capacity for intlligible reasoning. These two basic characteristics clearly define the appropriate areas for this application. They are all the areas where an intelligent interactive system is necessary.

There are three main areas of ES applications, these are systems which help [3,4,8,13], problem solving [6], and teaching aids [5-11, 22-30] .

The first application area (systems which help) is divided into two groups; diagnostic aids [4], and design and manufacture aids [3,8,13]. The first group is concerned with system diagnosis while the second contains different fields, such as stractural analysis, architecture, electric circuits, industrial drawings, etc. It is expected to go further than the current CAD/CAM systems by posing solutions to the operator.

While in the second application area, the ES is used as problem solver [6] in the following fields: robotics, recognition forms, games, and automatic demonstration of theorems.

The teaching aids systems are designed for students as eductional services based on Computer Aided Instruction (CAI). The existing computer teaching aid systems [5-11,22-30] are introduced to improve the quality of eduction at low cost in different subjects, such as geography, electrical circuits, internal medicine, mathematics, statics, numbering systems, and computer. Traditional CAI systems have one of the following characteristics; either they are incapable of solving the problem, or they are able to do it. They are mostly closed systems, unable to reply users questions. The ES has knowledge of that which it is teaching. So, we should realize that the traditional CAI form of instruction has become rather old fashioned. Conseqnentaly, ES is used in eductional techniqnes, where the contents and instructional approach take the form of semanticaly related concepts and inference rules which result in a less rigid instructional approach. The most significant aspect of all type of such systems is that a user may interact with the lesson based upon individual needs by choosing his/her own sequence and direction through the material. Most of the systems are experimental and not widely used. It is just that these prototype systems do not have all the qualities required by an ideal system. Moreover, the transfer of expertise from man to machine is neither straightforward not easy.

This paper introduces a Visual Intelligent Computer Aided Instruction (VICAI) system for teaching computer engineering course. The system can also deal with fault diagnosis. It is designed according to some design features to have all the qualities required by an ideal system. Finally, the proposed VICAI system not only a new eductional system but also a new highly visual user interface.

2. VICAI SYSTEM DESIGN

The Visual Intellingt computer-Aided Instruction (VICAI) system is proposed for teaching computer engineering courses (hardware and fault diagnosis). It is developed to overcome the disadvangates of the existing approaches [5-11,22-30]. The proposed VICAI system consists of a collection of intelligent programs; a knowledge base, inference engine, knowledge acquistion, and user interface, as shown in figure (1).

The knowledge base contains a great amount of information. The ways of knowledge representation are rules, frames and semantic nets. The rules are used for surface representation, in terms of facts within statements and relationships between them as objects. While, frames and semantic nets are used for deep representation of structure data (hierarichal) and encoding information, where set of attributes are associoated with each frame .The knowledge about the way in which information should be used is defined as "metaknowledge". For fast execution, the pieces of information are stored in independent modules.

The Function of the inference engine is control structure (reasoning mechanism) by using the stored knowledge in a meaningful way. This task is carried out by a sequence of elementary cycles as shown in figure (2). It has shon that, the inference engine is the key to the system, which examines the facts and executes the applicable rules according to logical interface or control procedures.There are two strategies of demonstration; forward chaining and backward chaining. The proposed system is able to make deduction by means of both forward and backward chaining, to reduce the number of possible combinations, by minimizing the number of returning arcs. The inference engine is based on either propositional logic rules apply directly to the facts, or first-order logic rules that can be applied to a whole class of facts using variables.

User interface is used to handle communication with the user in natural language. False user's reply method is judged to be false by the expert module and if the user used a correct method, then the module decides to ask for more details. It can also, call the expert module for all the information which is connected with this field in order to evaluate the user's reply. The user may intervene in the solving process by guiding the system by strategies.

Knowledge acquistion is used to serve unfamilier users with the implementation and interrelationships of the abstract data types developed for an application domain. Also, it is used to assist with the development of the knowledge base, and check in comming knowledge for possible in consistencies and redundancies.

The proposed VICAI system consists of three subsystems each of which has its own function. Figure(3) gives the proposed VICAI's frames for each subsystem. Using DOS commands and the C's functions, an inference engine is designed to link and control these programs with a help menu. Figure(4) gives a part of the inference engine. It produces the main menu screen of the proposed system as given in Figure(5). If we move the arrow on the help and press the Enter key, the help screens will be appeared as in Figure(6). The three subsystems will be explained in more details as follows.

2.1. *Hardware Subsystem:*

This subsystem describes and explains the personal computer hardware components and architercture of the processor 80386 SX. In this subsystem, the knowledge is represented in a frame scheme and starts by displaying a help menu to guide the user in going through the program, followed by a block diagram of the system mother board as shown in Figures(7) and (8). The keyboard arrow keys are used to enable the user to move through the mother board screen. Details about any particular part of the mother board can be obtained by moving the highlight to that part and press Enter key. Another screen, representing another frame level containing more information for the selected part, is then displayed in a very attractive form. Thee arrow movements are also used to further down frame levels. This resulting in 3 submenus and 49 screens of information, connection diagrams, and pen description of each component. Sample of these screens are given in Figures (9) to (16).

2.2. *Peripherals Subsystem:*

This subsystem can be selected as shown in Figure(17). It describes the computer peripherals which may be connected to it, and gives information about some of them to perform specific task. Names of these peripherals are displayed in screen of Figure(18), and more information is given for the most common used peripherals. The user can select one of them from the menu using arrows and pressing Enter key as in the submenu of Figure(19). There are 2 submenus and 13 screens describe these peripherals in details. Sample of these screens is given in Figure(20). Finally, the user can quite transfer from any screen to another by pressing ESC Key.

2.3. *Diagnosis Subsystem:*

This subsystem enables the user to repair most of the troubleshooting that may occur in the PC set without any external help. The knowledge bases used in the diagnostic subsystem are formed by obtaining information from human experts in the field of personal computer service. It is based on heuristic approach, a rule that tends to get closer to a solution, which is capable of tackling serious hardware problems. The knowledge in this part is represented using both rule-based and frames schemes. Rules are modular "chunks" of Knowledge of the form "IF situation THEN Action". The frames scheme allows a deeper insight into underlying concepts and causal relationships and facilitute the implementation of deeper-level reasoning such as abstraction and analogy. A frame is a record like data structure a form for incoding information on a stereotyped situation, a class of objects, a general concept or a specific instance of any of these. Figure(22) shows a frame representation of a part of the hierarchy of the diagnostic subsystem. The Figure shows one frame representing a particular type of problem (display problems) another, a hole range of problems (start up, run, keyboard, display, other). Associated with each frame is a set of attributes, the descriptions on values of which are contained in slots. Slots can also store other information. the strength of frame-based systems derives from this hierarchical structure which enables frames to inherit attributes from other frames located above them in the hierarchy.

From the diagnostic menu of Figgure(22), the system is transfered to a specific problem. Then, a dialoge between the system and the user is started and continued until the system identifies the fault and gives advises for repairing. There are 8 submenus and 88 screens. Samples of repairing procedure are given in screens of Figures (23) to (29).

3. PROGRAMMING LANGUAGE

Expert system pioneers developed symbolic languages, such as LISP and PROLOG, which are the forerunners of the more natural languages used by expert system tools.From a theoretical point of view we can certainly confirm that a tree type of data structure, which is the basis of LISP and PROLOG, is not the best choice. From the practical point of view the most general first-order Logic inference engines are not often written in LISP.

Recently, more sophisticated expert system tools and simplified versions of symbolic languages have become available that include a control and logic structure, and such features as menus, windows, and frames. Moreover, it has the characteristics which make it easy to read and operate. Therefor, the languages such as PL/1, PASCAL, C, BASIC, and FORTRAN are then the languages which support existing and future expert systems.

However, there is no good reason to invent a new programming language to write the required expert system if one exists that comes close providing the necessary requirements. Also with the availability of graphic workstations has come the increasing influence of visual technology on language environments. For these reasons, the proposed VICAI system is written in Turbo C Language. It seems to be attractive uses in visual and textual technology and includes a control and logic structure with the features of frames, windows and menus.

4. OPERATING REQUIREMENTS:

All files are linked together with the Turbo C functions, so they must be on the same level of directory. These programs can be run using a personal computer PC XT or AT. The minimum configuration is one disk drive (5.25 or 3.5 inch) with at least 640 KB of memory size and 1.2 MB of storage size. The computer must be equiped with Enhanced Color Monitor and Enhanced Graphics Adapter (EGA) card.

5. CONCLUSION

A Visual Intelligent Computer Aided Instruction (VICAI) system is introduced as an eductional expert system based on the visual technology. The user may have a self teaching lessons in the personal computer hardware and its peripherals, and may have a good advice in repairing any trobuleshooting problems. To accelerate the overall system processes, the system is designed using both rules and frames to represent its knowledge base.

As the visual data information and color graphics are most likely accepted by the user, the system is designed in such a way that a novice user can use it through 14 menus and 151 pretty screens and visual block diagrams in very simple and attractive form. In addition the system contains windows and views within the screens.

The system performance is tested by a group of the electronics section's students to teaching computer engineering course. The results of the final exam show that the students, which were use the proposed system, have got the highest degrees.

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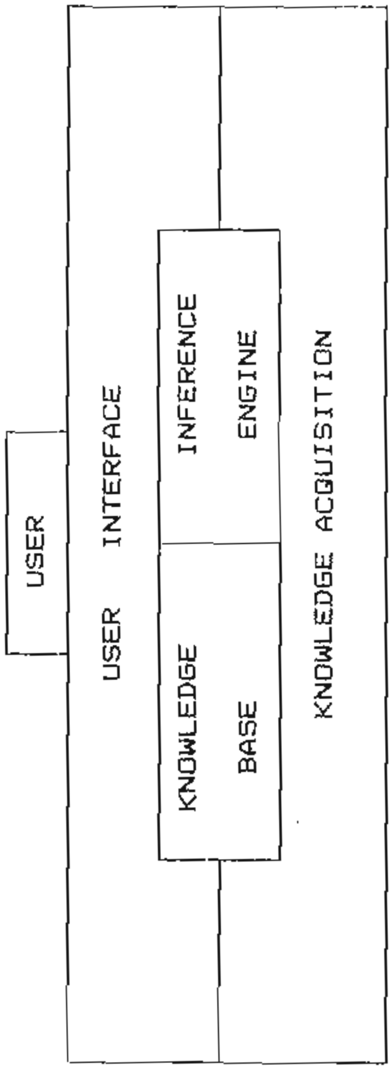

FIGURE (1) : VICAI SYSTEM COMPONENTS

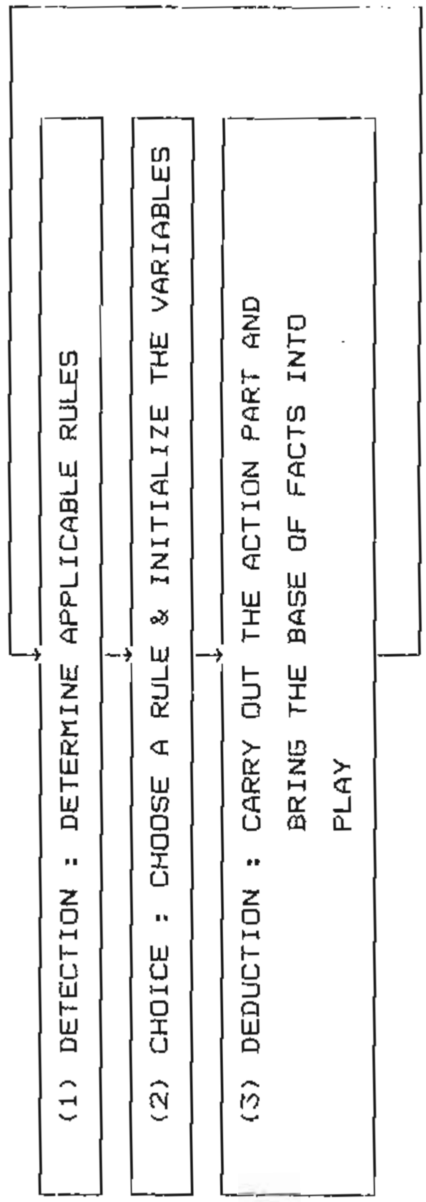

FIGURE (2) : BASE CYCLE OF THE INFERENCE ENGINE

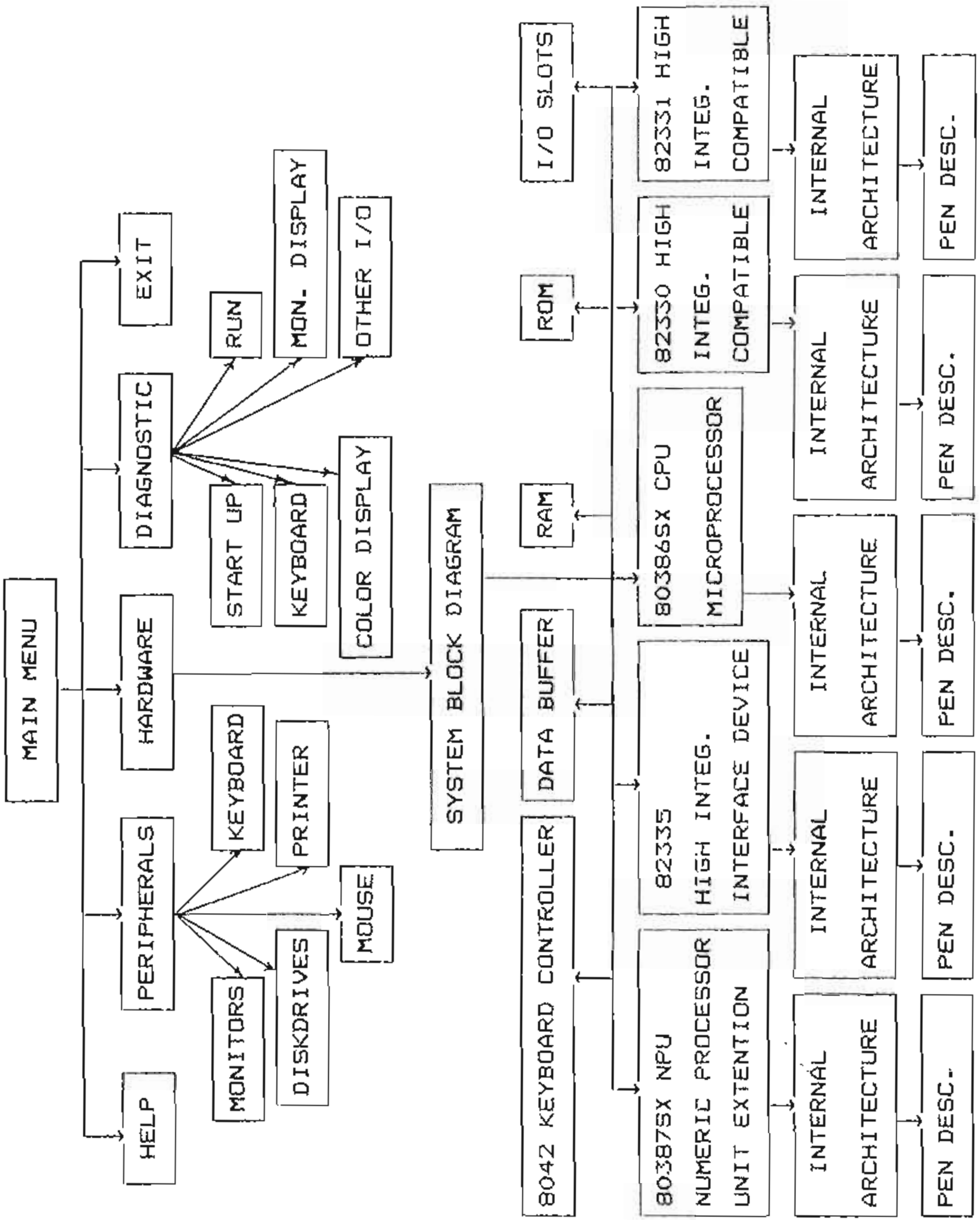

FIGURE (3) : VICAI SYSTEMS'S FRAMES

```
#include <graphics.h>
#include <conio.h>
#include<alloc.h>
#include<process.h>
#include<stdio.h>
void *buffer;
unsigned size;
char *moh[5]={"Hardware","Peripherals","Diagnostic","Help","Exit To Dos"};
int kkey,st=5,s1,y=90;
main ()
{
int mode,driver;
registerbgidriver(EGAVGA_driver);
registerbgifont(triplex_font);
registerbgifont(sansserif_font);
registerbgifont(small_font);
driver=EGA;
mode=EGAHI;
mode=EGAHI;

initgraph(&driver,&mode,"");
mazorah();ebrah();
setvisualpage(1);
ih(0,0);
}
mover(y,st,c,k)
{
setcolor(k);
setfillstyle(1,c);bar(190,y,460,y+30);outtextxy(195,y+8,moh[st]);
}
menu(v)
{
int g,d=5,d1=15,y1,d2=14;
graphdefaults();
setactivepage(1);
y1=90;
cleardevice();setpalette(0,8);setcolor(2);setlinestyle(0,0,3);rectangle(0,0,g;
setfillstyle(1,9);bar(50,30,getmaxx()-50,310);/*setpalette(10,9);*/
setfillstyle(1,0);bar(200,100,495,290);
setfillstyle(1,3);bar(175,75,475,275);setcolor(0);setfillstyle(1,5);
bar3d(180,80,470,270,0,0);/*setfillstyle(1,s);bar3d(185,85,465,265,0,0);*/
settextstyle (1,0,1);flsherl(320,35,200,30,"  MAIN MENU  ",15,4);
setcolor(15);settextstyle(0,0,2);for(g=0;g<5;g++){ if(g==v){d=d1;d2=0;}
mover(y1,g,d,d2);d=st;y1+=35;d2=14;}
setcolor(4);setfillstyle(1,14);bar3d(40,320,getmaxx()-40,345,0,0);settextstyl
outtextxy(45,330,"                 ARROWS                    Enter");
setcolor(0);
outtextxy(45,330,"                             :Motion                  :Selection");

settextstyle(0,0,2);setcolor(15);
/*********************************************************************
***************              CONTROL              ********************/
}
ih(v,i){int g,y1;
if(i==0)help();
setactivepage(1); settextstyle(0,0,2);
a:
kkey=getch();
if(kkey==13){
switch(v){
case 4:{cleardevice();closegraph();exit(0);}break;
case 3:{setvisualpage(0);conhelp();break;}
case 0:{wait(200,130);execl("hard.exe",NULL);break;  }
case 1:{wait(200,170);execl("per.exe",NULL);break;  }
case 2:{wait(200,210);execl("diag.exe",NULL);break;}
}}
if (kkey==0)
{
switch (getch())
{
case 80:
s1=v+1;
if(s1==5){ s1=0;y=90;mover(230,4,st,14); }else{mover(y,v,st,14);y+=35;}
mover(y,s1,15,0); v=s1;break;
case 72:
s1=v-1;if(s1==-1){s1=4;y=230;mover(90,0,st,14);}else{mover(y,v,st,14);y-=35;}
mover(y,s1,15,0);v=s1;
}
}
goto a;
}
/*************************************************************************/

flsherl(x,y,l,w,v,f,c)
char *v;
{
int i;
for(i=1;i<=l;i+=20)  {
setfillstyle(1,f);bar(x-i,y,x+i,y+w);
setlinestyle(0,0,3);
setcolor(c);/*rectangle(x-i+2,y+2,x+i-2,y+w-2);*/
line (x-i+2,y+2,x+i-2,y+2);line(x-i+2,y+w-2,x+i-2,y+w-2);play(i*5,100);
}settextstyle(0,0,2);setcolor(1);outtextxy(x-(l/2),y+8,v);
setlinestyle(0,0,1);
}
play(f,d)
{
sound(f);delay(d);nosound();}
help(){int  t,i,tt;
setactivepage(0);
setcolor(4);setfillstyle(1,9);bar3d(1,1,638,348,1,0);
 t=280;tt=30;
 for(i=1;i<=25;i+=5){setfillstyle(1,0);
                   bar(t+i+2,tt-i-2,t+100-i,tt+25-i);}
setfillstyle(1,12);bar3d(270,30, 390,55,0,0);
setcolor(0);settextstyle(1,0,2); outtextxy(280,32,"  HELP");
setfillstyle(1,0); bar(60,75,600,130);
                   bar(60,150,600,205);
                   bar(60,225,600,280);
setfillstyle(1,14);bar3d(50,70,590,120,0,0);
                 bar3d(50,145,590,195,0,0);
                 bar3d(50,220,590,270,0,0);
setcolor(4);settextstyle(0,0,1);
outtextxy(65,75,"  HARDWARE PROGRAM :");
settextstyle(0,0,1);setcolor(0);
outtextxy(230,75,"It displays the main components of the 386");
outtextxy(57,90,"motherbored and enables the user to get information of any p
outtextxy(57,105,"by moving the HIGHLIGHTED BAR to that part then press ENTER
setcolor(4);
outtextxy(57,150,"  DIAGNOSTIC PROGRAM: ");setcolor(0);
outtextxy(57,150,"                               It helps the user of the PC to repair
outtextxy(57,165,"fault. The user can know the cause of this problem and repar
outtextxy(57,180,"it by the answer of som  questions about that problem.");
setcolor(4);
outtextxy(57,225,"  PERIPHERAL PROGRAM: ");setcolor(0);
```

FIGURE (4)

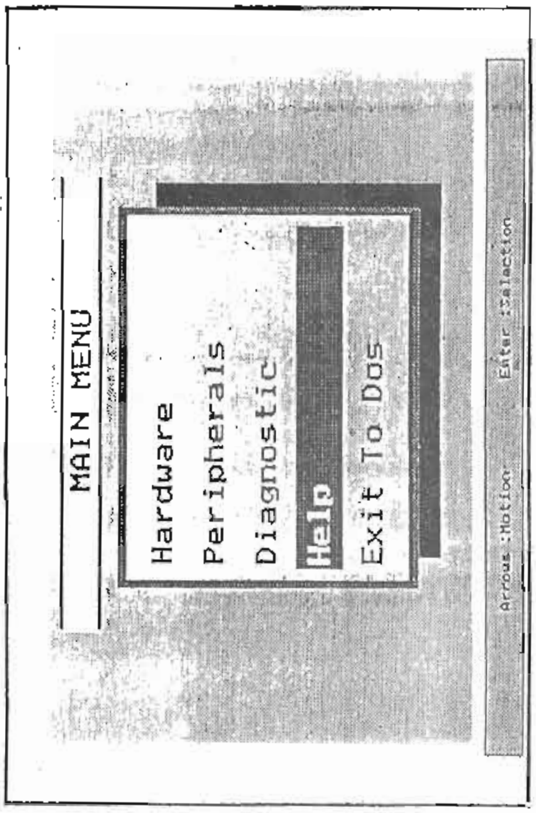

FIGURE (5)

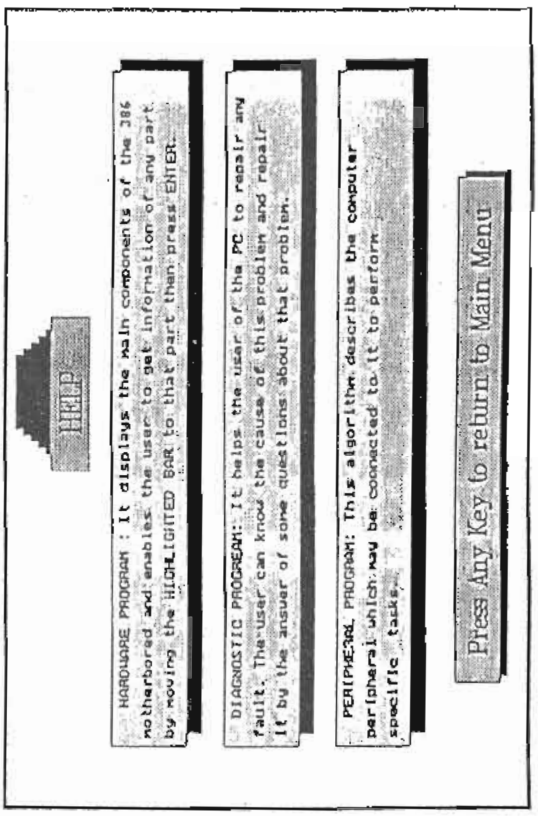

FIGURE (6)

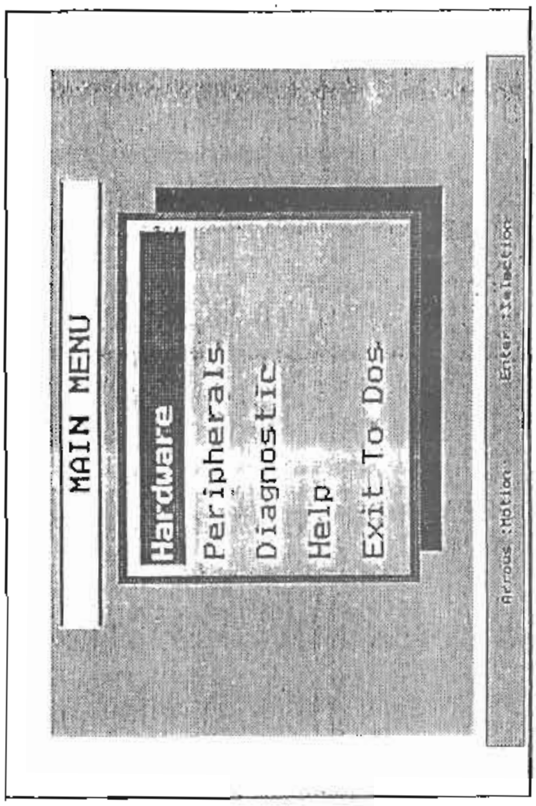

FIGURE (7)

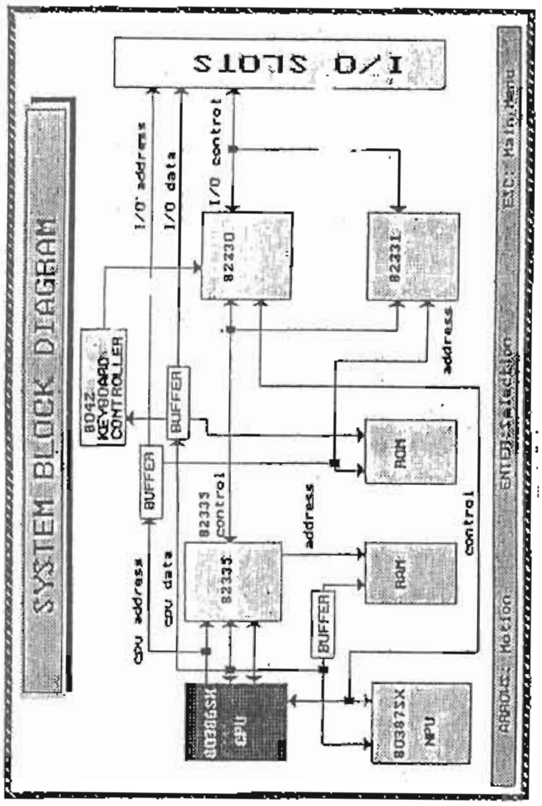

FIGURE (8)

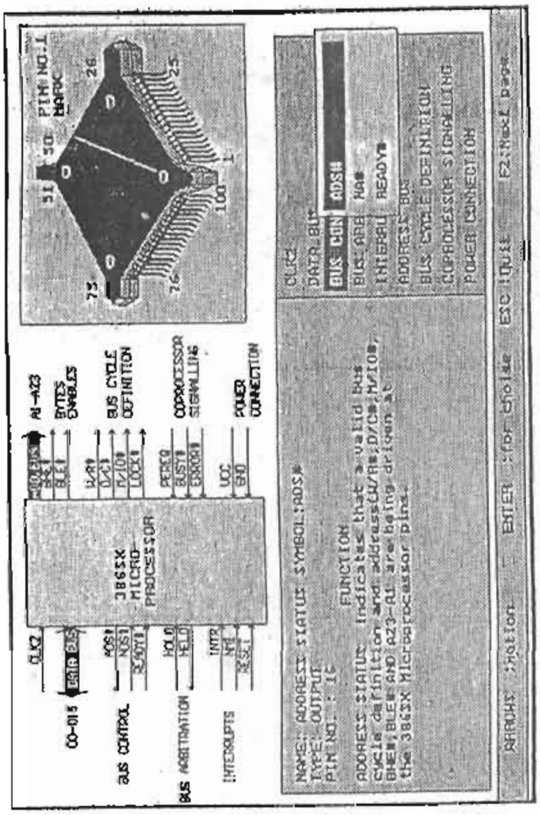

FIGURE (9)

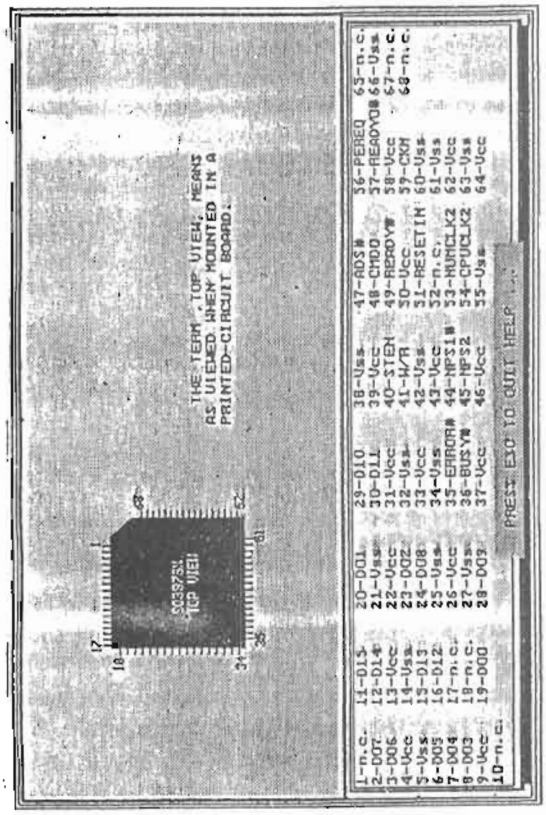

FIGURE (11)

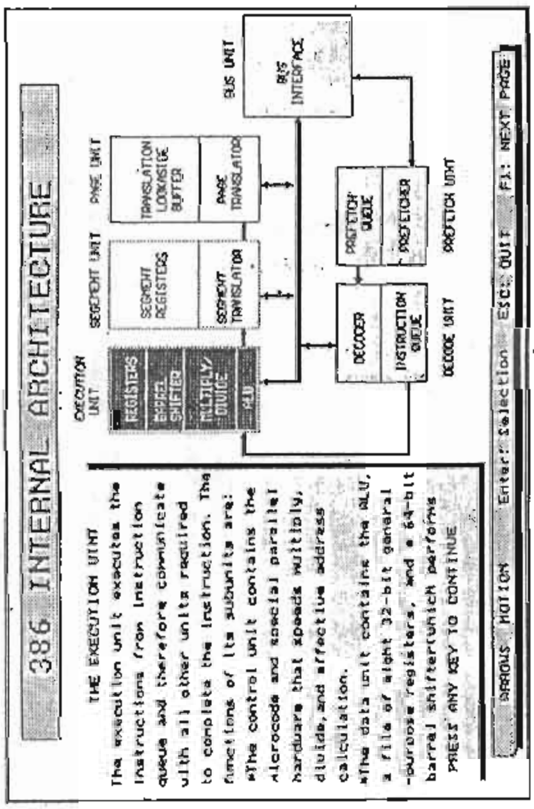

FIGURE (10)

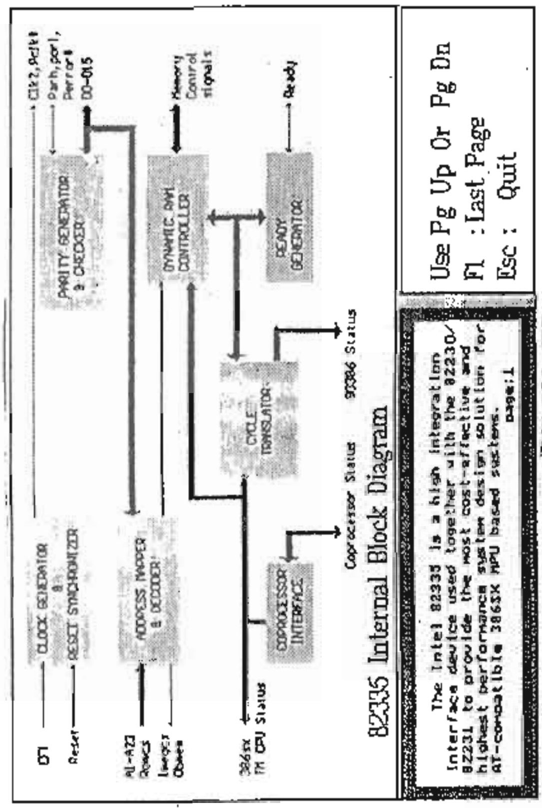

FIGURE (12)

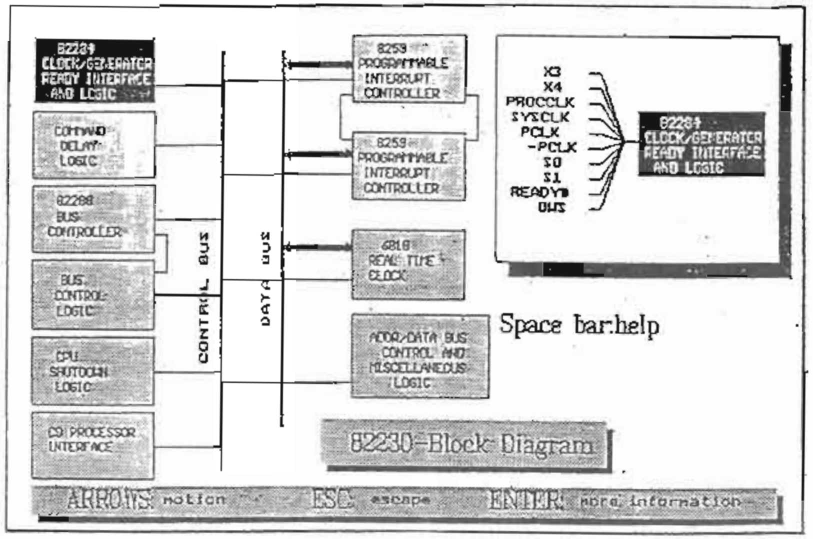

FIGURE (13)

82230 PIN Description

SYMBOL	PIN no	TYPE	DESCRIPTION
X3	26	I	CRYSTAL: inputs used to generate PROCCLK
X4	27	O	and SYSCLK.
PROCCLK	28	O	PERIPHERAL CLOCK INVERTED is the inverse of PCLK.
SYSCLK	54	O	SYSTEM CLOCK is the result of PROCCLK .
PCLK	42	O	PERIPHERAL CLOCK is half the frequency of PROCCLK.
-PCLK	43	O	PERIPHERAL CLOCK INVERTED is the inverse of PCLK .
S0,S1	18,19	I	STATUS input from the CPU.
READY	21	O	READY is an active low output.
OWS	47	I	ZERO WAIT STATE option .

Any key to continue

FIGURE (14)

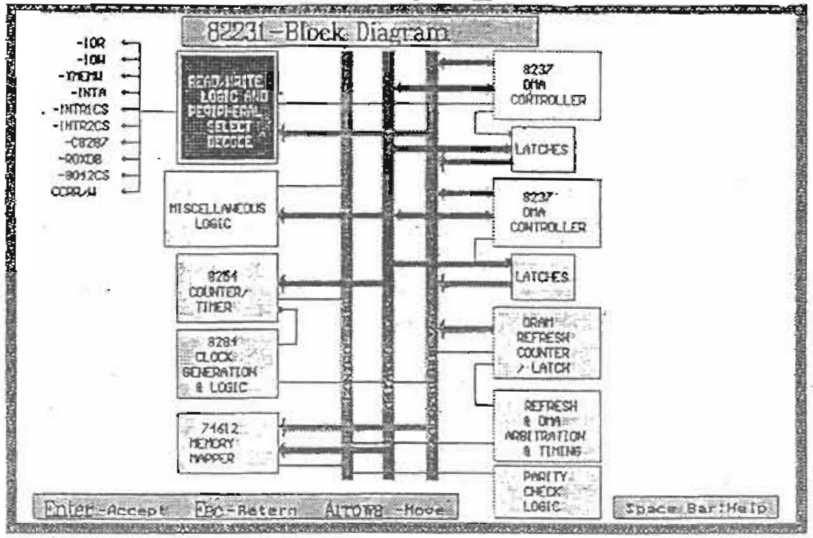

FIGURE (15)

PIN DESCRIPTION

Symbol	Pin No	Type	Description
-IRO	33	I/O	I/O READ signal instructs selected I/O device to drive its data onto the data bus.
-IOW	34	I/O	I/O WRITE signal instructs selected I/O device to read the data on the data bus.
-XMEMW	45	O	MEMORY WRITE signal indicating a DMA write operation to peripheral devices or memory.
-INTA	30	I	INTERRUPT ACKNOWLEDGE instructs an interrupting device that its interrrupt is being acknowledged.
-INTR1CS	28	O	INTERRUPT CONTROLLER 1(MASTER) CHIP SELECT is an used by 82230 to select the interrupt.
-INTR2CS	29	O	INTERRUPT CONTROLLER 2(SLAVE) CHIP SELECT is an used by 82230 to select the interrupt.
-CS287	26	O	CHIP SELECT 287 is used by 82230 to derive the -NPCS signal.
-RDXDB	38	O	READ X-DATA BUS controls the direction of the bidirection buffer between the least significant byte of the 'S' DATA BUS and the 'X' DATA BUS.
-8042CS	63	O	8042 CHIP SELECT is an active low, chip select signal for the Keyboard Controller.
CCRR/W	25	O	CLOCK CALENDER READ/WRITE signal for the real Time clock.

Press any key to continue_

FIGURE (16)

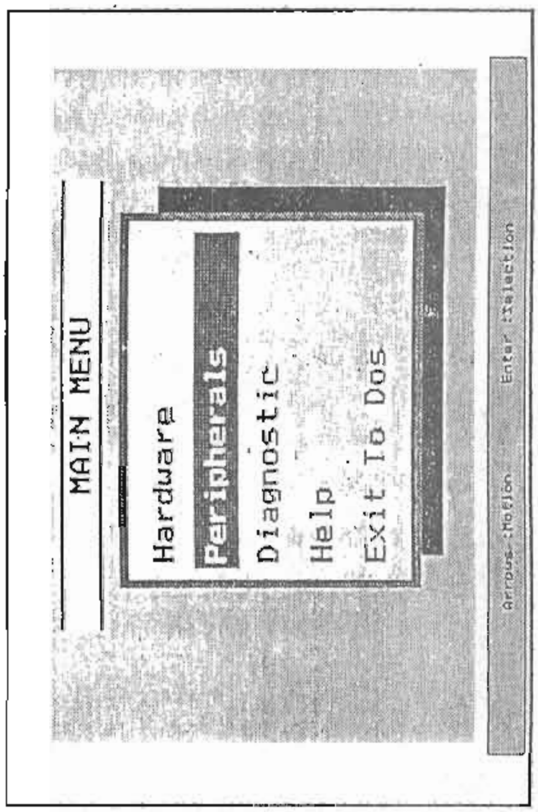

FIGURE (17)

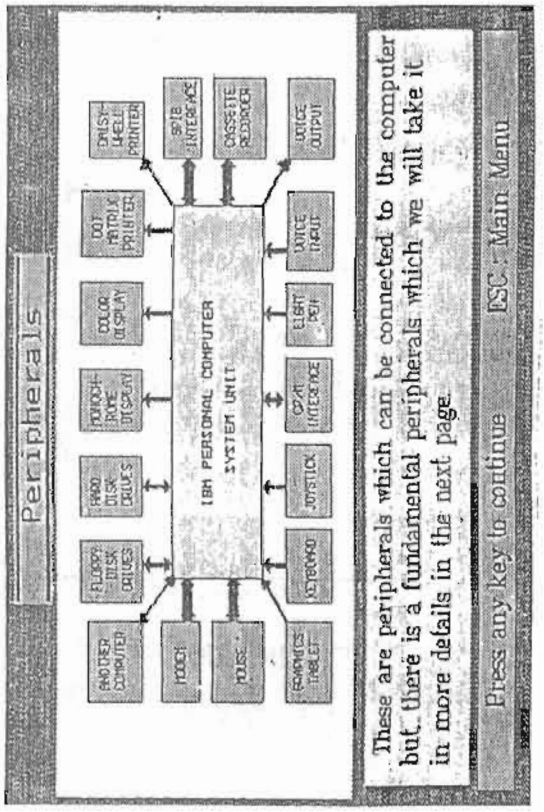

FIGURE (18)

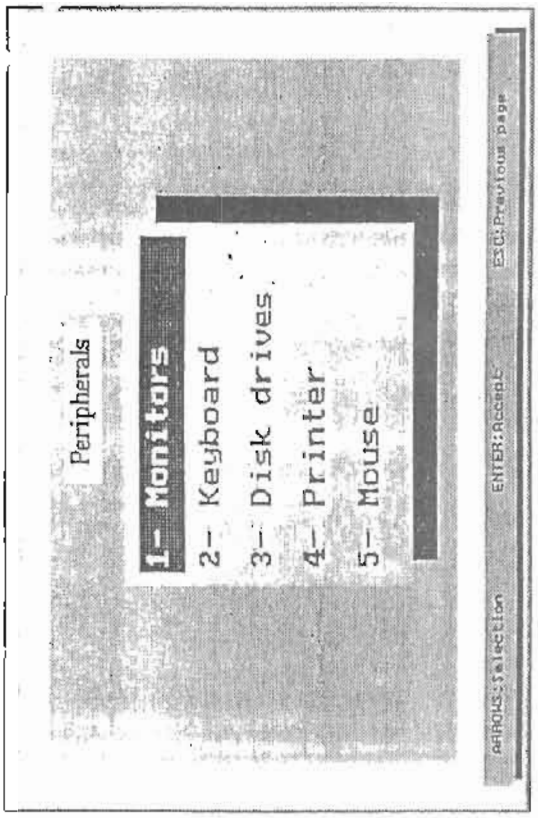

FIGURE (19)

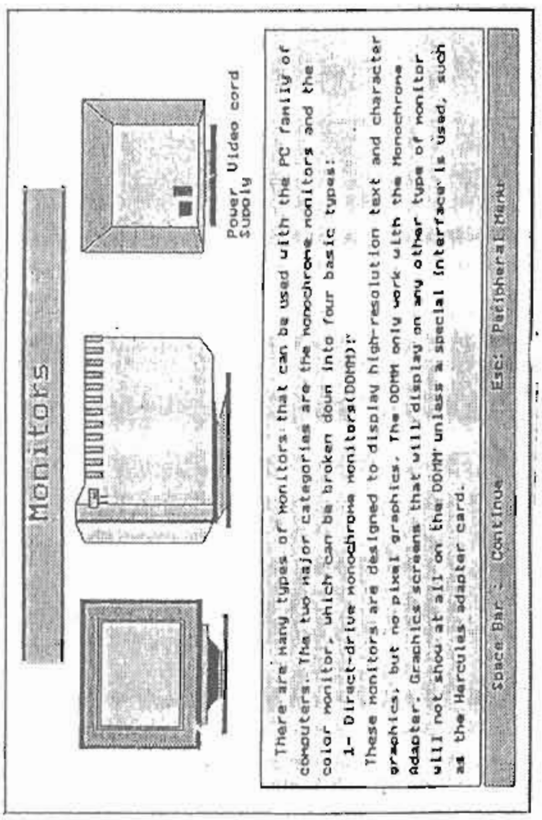

FIGURE (20)

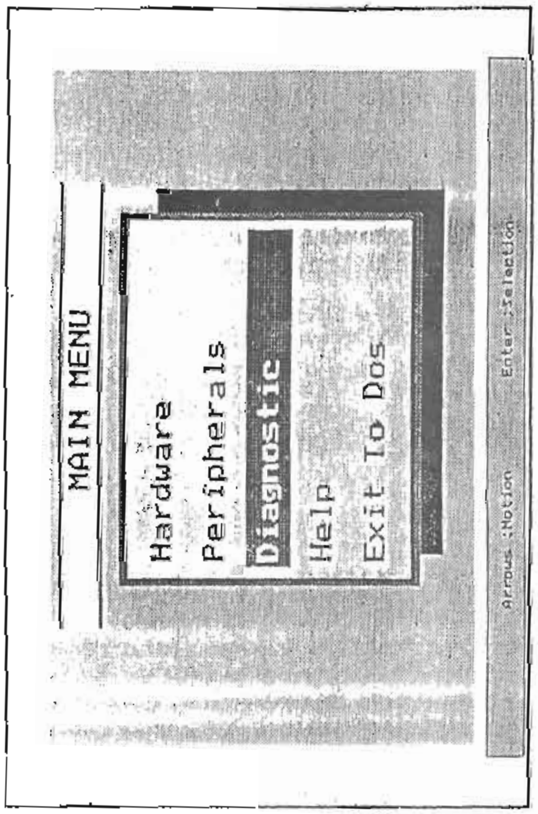

FIGURE (21)

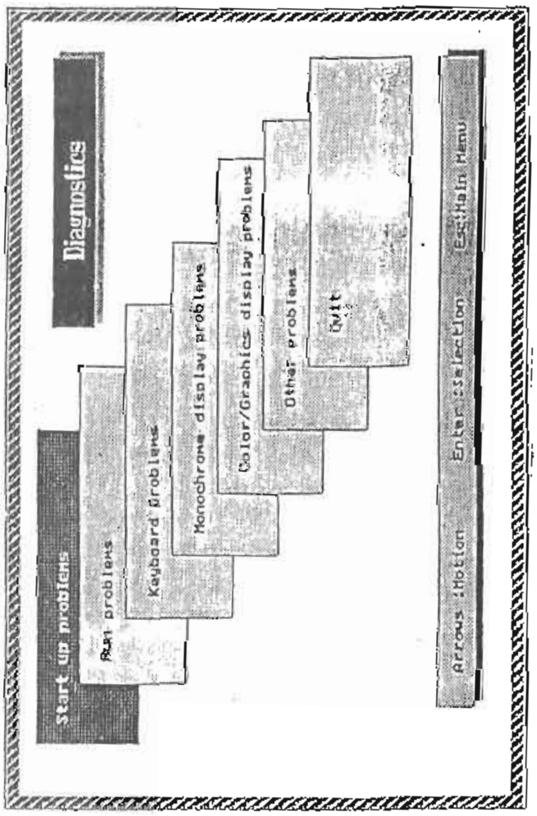

FIGURE (22)

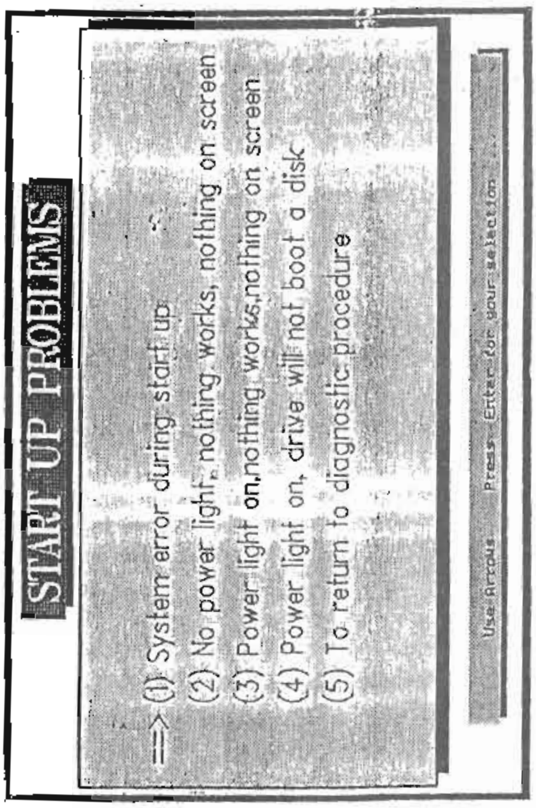

FIGURE (23)

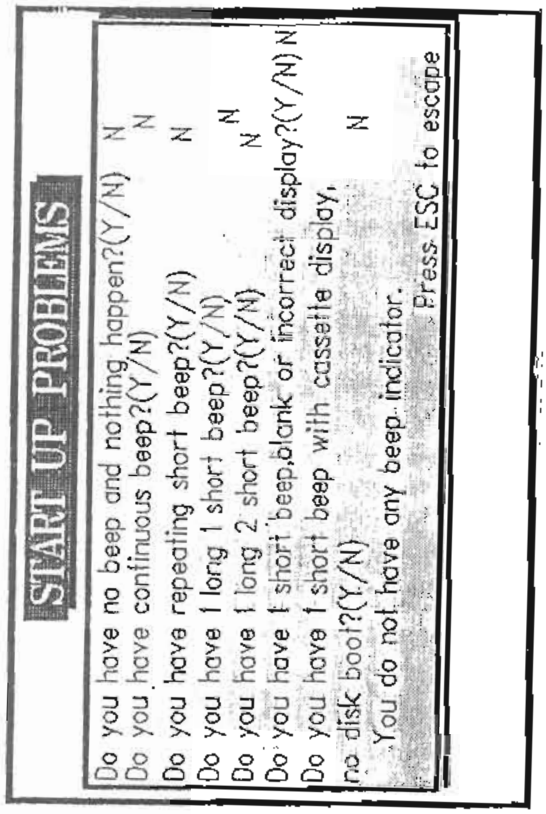

FIGURE (24)

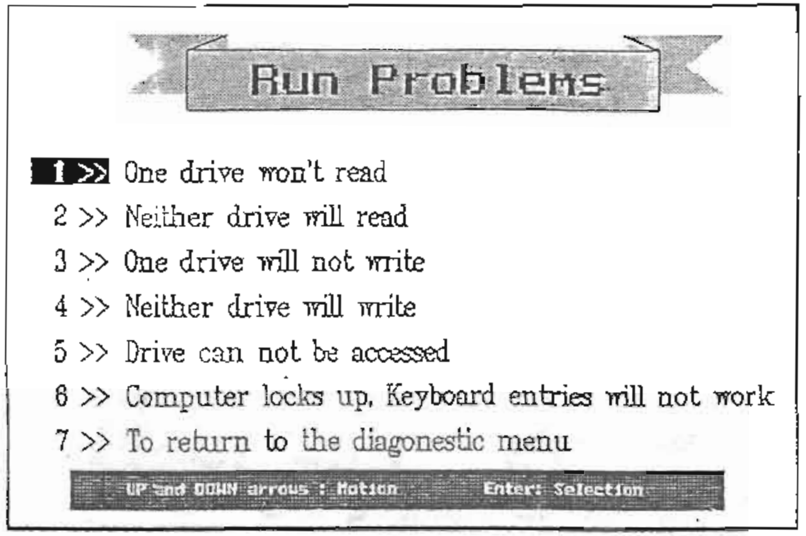

FIGURE (25)

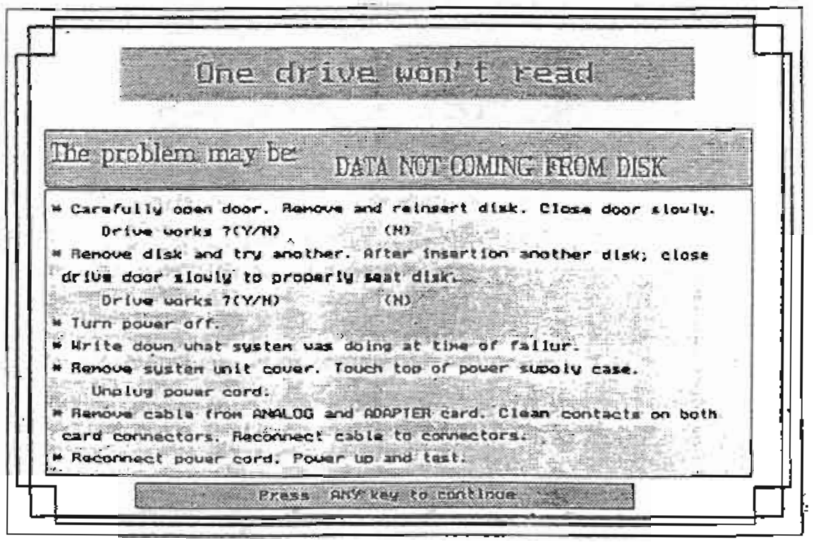

FIGURE (26)

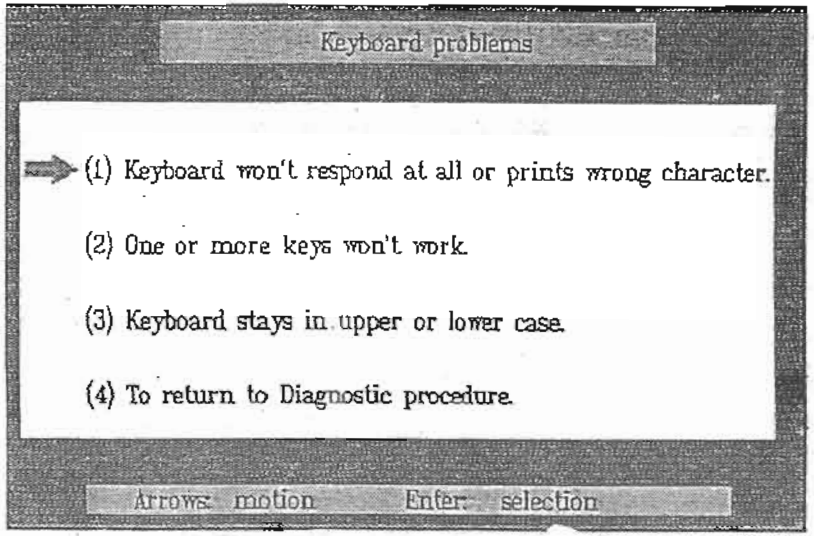

FIGURE (27)

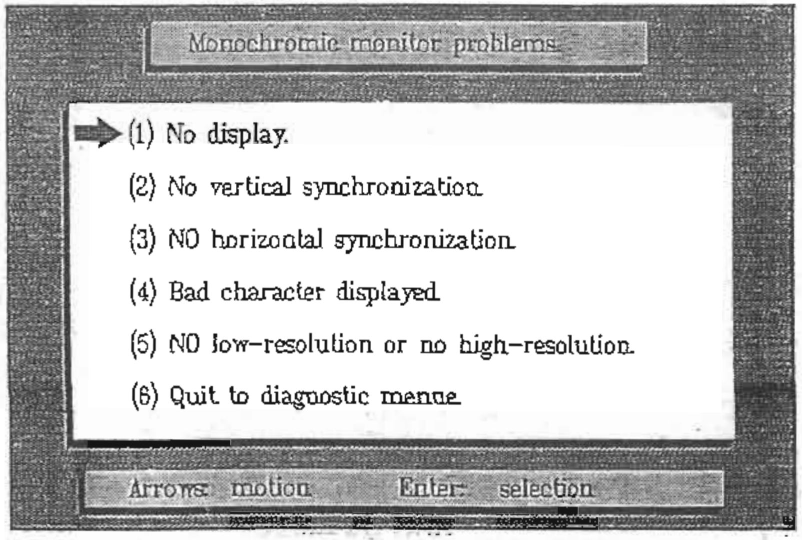

FIGURE (28)