GCSE COURSEWORK

DATA LOGGING AND CONTROL

GREENHOUSES

INFORMATION COMMUNICATION TECHNOLOGY

GCSE - ICT Project
Data Logging and Control

A gardener called Georgina, who works on a large estate owned by a lord, wants an automatically controlled greenhouse.

The reason Georgina needs the greenhouse is because she plans to grow some exotic flowers. She wants to use these flowers to put into a flowerbed at the front of the estate and also for decoration during many functions in the manor house throughout the year.

Although Georgina can get to the greenhouse once a day, she would prefer this to be only to do a spot check to make sure everything is working.

Design an automatically controlled system for the greenhouse, taking into account the environmental conditions, which might be needed to regulate such a greenhouse.

IDENTIFY

IDENTIFICATION

PROBLEM

Georgina is a person who works for a lord who wants an automatically controlled greenhouse. The greenhouse is planned to be used for growing exotic flowers. It is extremely important that the plants have the best possible conditions to grow as they are going to be used for many different functions that will take place in the manor house throughout the year. Georgina will therefore like an automatically controlled greenhouse where she will only need to go and check that everything is alright and running well and she would not like to do any work manually.

MAIN PROBLEM AREAS IDENTIFIED INCLUDING SUB-PROBLEMS

• **Time constraints**; At the moment Georgina has to manually check the greenhouse which takes up a lot of unnecessary time. She could devote this extra time to doing something else.
• She also has to manually check that the plants are getting the right amount of sunlight and that they are getting sufficient amount of water etc and this is very tiring but if she does not do this then the plants will die and so she will be losing money. There are certain different conditions which affect the way plants grow and these are:
• **Amount of water plants receive;** Different plants need different amounts of water to grow and after a long day she can easily make mistakes.
•**Temperature;** If the temperature gets too cold then she needs to switch on the heaters to heat up the greenhouse but if the tempurature gets too hot then she has to switch on the ventilators to cool the tempurature down.
• **Humidity of the air;** If there if too much cold air entering the greenhouse then she needs to switch on the heaters but if the air becomes too moist she has to open the windows or put the ventilators on so that some fresh air can enter the room.
• **Amount of sunlight the plants receive;** Depending on the day whether it is too sunny or cloudy, Georgina needs to conrol this by using artificial lightings so that the plants get the right amount of light they need. However, if the plants are getting access to too much light then she will need to pull the blinds down to stop the light entering.
• **Sound and pressure;** These are a big problem as she can't always be aware of whether there is a break in or not as the greenhouse does not have an alarm system activated or set up.

POSSIBLE SOLUTIONS AND THEIR SUITABILITY

SOLUTION 1
• USE COMMERCIAL SYSTEMS
Georgina can use many different commercial systems such as:
• Lightings
• Watering
• Alarm systems
• Ventilations
• Heating
• Moisture

It is not very suitable for Georgina to use commercial systems as they cost too much money and the money can be used for something else.

SOLUTION 2

• HIRE MORE STAFF TO WORK IN THE GREENHOUSE

This is not a very practical solution as again hiring more staff will cost a lot of money and so they won't be making any profits and they will also need to be trained so that they know exactly how the greenhouse operates and this will be very time consuming. Also, they may make mistakes and then the plants might die and so this will lose Georgina even more money. Also, at nights the greenhouse will need to be checked to make sure that the plants are growing in the right conditions and some workers are not going to be willing to work at night.

SOLUTION 3

• PUT TIMERS ON HEATERS

By having timers put on the heaters, Georgina will not have to go into the greenhouse and switch the heaters on and off manually. The heaters will come on automatically depending on the set time of the timer. However, this is not a very suitable solution. The heater will not be able to tell when it is too cold for the plants or when it is too hot so Georgina will still have to stay in the greenhouse to make sure that the plants and the greenhouse have the correct conditions in order for the plants to grow properly.

SOLUTION 4

• PUT TIMERS ON THE WATER SPRINKLERS

Georgina can put timers on the water sprinklers. The sprinklers would have a set time where they will sprinkle water onto the plants and Georgina will not need to do this manually. She will not have to go to the greenhouse as much to check if the soil of the plants either dry or moist. However, again this is not a suitable solution because in some cases the plants may not be dry and they might be moist and if the sprinklers water the plants when they are moist this may mean that the plants have too much water and this could ruin the plants and so money will be lost and less profits will be made.

SOLUTION 5

• PUT TIMERS ON THE FANS

Georgina can put timers on the fans and the fans will come on automatically according to the set time and Georgina will not have to switch the fans on herself. However, this again is not a suitable solution as the fans may switch on when it is not necessary, for example, in winter the fans will not need to be used because of the cold weather. However, if the fans do turn on, this may affect the conditions of the greenhouses which will in turn affect the growth of the plants.

SOLUTION

The best possible solution, which I have found to the problem, is to use a computer controlled system, which is a computerised system, which has many advantages, and also it solves nearly all the problems encountered when running the greenhouse manually as it is much faster to set up and it also saves a lot of time. Data logging means capturing and storing information automatically by the use of sensors. Also, the system meets all the user requirements. The advantages of data logging are:

- Information can be recorded in remote or hostile situations- outer space, bottom of the sea or inside nuclear reactors.
- Data can be collected over very long or short periods of time.
- More accurate intervals can be set, for example, read data every 10 seconds. No one needs to be there.
- Data is often collected more accurately without human error.

USER REQUIREMENTS:

- The system should allow you to collect data over a long or short period of time.
- The system should allow you to record data over a certain length of time.
- The system should be user friendly and easy to use and must be able to transfer data into graphs on Excel.
- The system should give accurate and precise readings of data that has been collected.
- The system should be able to run after it has been set up without the need of anyone being there.

ANALYSE

ANALYSIS

HARDWARE

WHAT I WILL BE USING THROUGHOUT THIS PROJECT:

- **MOUSE**

This is an input device that makes the cursor move on the screen. Underneath the mouse is a ball, which rotates as the mouse, is being moved around on the screen and the sensors pick up this movement. A mouse usually has 2 buttons to make selections on the screen. It is useful for very simple drawing. I will be using the mouse to make selections on the screen.

- **KEYBOARD**

This is another input device. I will need to use a keyboard in order to type in the procedures.

- **VDU OR MONITOR**

This is an output device. It is ideal for showing the results of what you have done with no print out needed.

- **PRINTER**

This is another output device. It is used to print out your data on paper. I will be using it to print out some of my procedures.

- **CPU (CENTRAL PROCESSING UNIT)**

I will be using the CPU as this part of the computer contains all the software's of the computer and all the main information. From the CPU I will be able to use Smart Move and it will also allow me to save all my procedures. The CPU controls signals and performs arithmetic and logic operations and it also carries out instructions within the software.

- **FLOPPY DRIVE**

The data that I collect from the data control can be saved onto the floppy drive and then I can open up this data in Excel and I can convert it into graphs.

The hardware that I am going to use is a monitor or VDU (Visual Display Unit) V500, and also a keyboard and desk-pro, which was produced by Compaq. I will also be using a laser printer (brother HL- 2060) to print some of the procedures for measuring light and sound etc.

The system, which I am going to use for the whole of this task, is Compaq desk-pro. The processor is Pentium (R) III, which is 500 MHz. The system also has a Random Access Memory (RAM), which is 128 megabytes. The disk space is 10 GB, and in this I can store some of the procedures that I type up. There is also a CD-ROM drive, which will allow me to research anything I want.

- **SMART BOX**

This is the interface between the computer and the output devices. The Smart Box takes the different readings from the different input devices and then transports it to the computer.

- **HUMIDITY SENSOR**

This will sense the humidity of the air. If the humidity is not right then the humidity sensor will sense this and it will then be able to switch on any devices to make that the the humidity of the air inside the greenhouse is correct. If the air is too moist then the windows will be opened and if the condition is very

dry then the mist will be switched on and when the humidity of the air is correct it will automatically be switched off.

- **HEAT SENSOR**

This will sense the amount of heat present in the greenhouse so that it can then be made sure that the plants are growing at the correct temperatures. If it is too hot in the greenhouse the fan will be switched on and will automatically switch off when it reaches a certain temperature in the greenhouse. However, if it is too cold then the heaters will be turned on and they will also turn off automatically when the greenhouse reaches a certain temperature.

- **MOISTURE SENSOR**

For this the sensor will need to be placed inside the soil of the the plants so that readings can be taken of exactly how moist the soil is. If the soil is not moist enough then the sprinklers will be turned on and they will sprinkle water onto the plants but if the soil is too moist then it will be switched off.

- **LIGHT SENSOR**

This will sense whether there is too much light entering the greenhouse or too little so that the right amount of light can be fixed so that the plants don't die. If there is too much light entering the greenhouse then the lamps will be switched off and the blinds will be pulled down. However, if there is too little light entering the greenhouse then the blinds will be opened and the lamp will be switched on but this will only really be necessary during winter.

- **WATER SPRINKLERS**

This will be controlled by the moisture and humidity sensors and will be switched on when necessary.

- **MOTORS**

This will be controlled by the heat and humidity sensors and they will control the motor for the windows.

- **LAMP**

This will be controlled by the light sensors. The plants will need some source of light during the night or else the plants will start to die and so artificial lights will be used.

- **MIST**

This will be controlled by the humidity sensors.

- **HEATER**

The heater will be controlled by the heat sensors.

- **FAN**

This will be controlled by the heat sensor.

DIAGRAM OF COMPUTER:

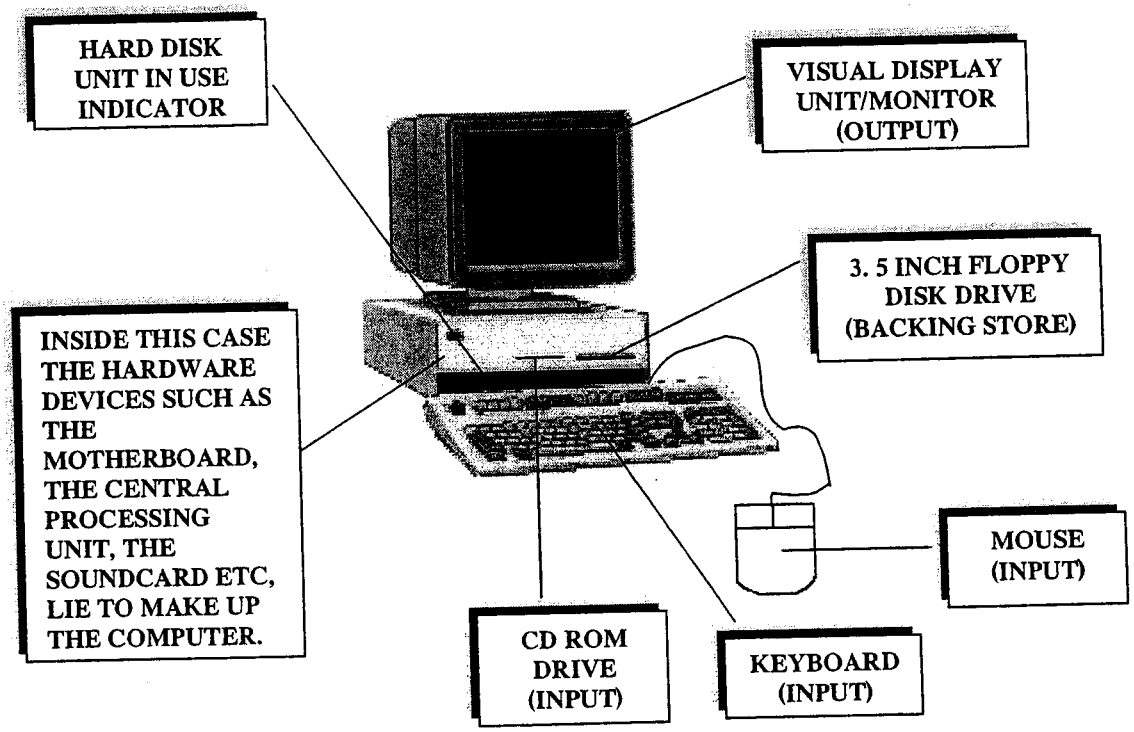
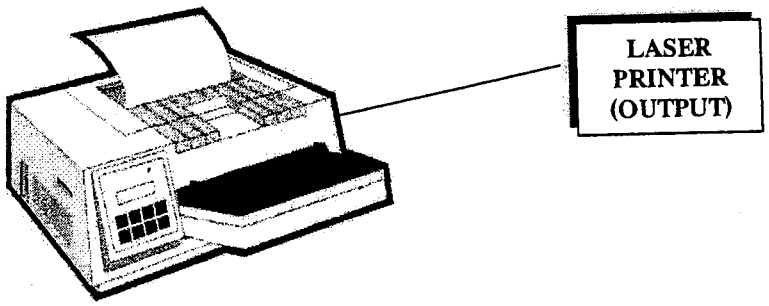


DIAGRAM OF A LASER PRINTER:



SOFTWARE

The computer controlled software that I am going to use is Smart Move. This is a data logging software. Data Logging is the automatic capture of data and storage of data which can be logged over a very short or very long period of time. Smart Move allows me to make procedures which will control the running of the greenhouse. This software package can also store a vast amount of data. Also, the Smart box allows me to use different devices such as sensors and motors in order for me to measure the environmental conditions. I am also going to using Microsoft Excel to produce graphs for the data that I collect which can later be analysed. I am also going to be using Paint, as it manipulates screen dumps which I will be needing for the design section of this project.

Using Smart Move will save a lot of time and it will also be very accurate in its readings that it records e.g light readings, and I will also be able to meet all my user requirements (See Identification, pg 5).

FLOW OF DATA

1= ALARM
2= LAMP
3= SPRINKLER
4= HEATER
5= MIST
6= FAN
7= MOTOR

INPUT	PROCESS	OUTPUT
HUMIDITY SENSOR	If humidity is <13	Then switch on 5
	If humidity is >45	Then switch on 7
	If humidity is >55	Then switch on 6
SOUND SENSOR	If sound is > 26	Then switch on 1
LIGHT SENSOR	If light is > 34	Then switch on 2
MOISTURE SENSOR	If moisture is < 14	Then switch on 3
LIGHT SENSOR	If light is > 37	Then switch on 2
TEMPERATURE SENSOR	If temperature is < 12	Then switch on 4
	If temperature is > 40	Then switch on 6
	If temperature is > 35	Then switch on 7

INPUT

The input for this project are the sensors. Each sensor will be given a procedure and they will work by those procedures. These procedures are set so that the condition of the greenhouse is always correct and so this will ensure that the plants will grow in the right conditions and that they will be of a good standard. The input devices that I will be using are:

- Moisture Sensor
- Sound Sensor
- Humidity Sensor
- Temperature Sensor
- Light Sensor

PROCESS

The sensors will take different readings for the different data and then they will pass it along to the output devices.

OUTPUT

The output devices will switch on automatically counting on the readings that were taken. The readings that are going to be recorded are also outputs which will later be layed out in tables and graphs will be drawn up on Excel to analyse the data. The output devices that I will be using are:

- Heater
- Lamp
- Mist
- Fan
- Water Sprinkler
- Alarm

BACKING UP STORAGE:

In case something happens, either by accident such as a fire or an explosion, or some form of criminal activity such as hacking, it is very useful to have backup copies of your work. So, then if you do happen to lose your work you can easily get it back. The most common backing up storage that is used is a floppy disk or a tape. You could also consider using one of the on-line Internet back up sites. The data is uploaded to a server somewhere else and can be regained if necessary. You should keep your disk or tape safely in a disaster-proof place off site, so that your work is recoverable, because if you don't then you'll lose all your work altogether. You can also save your work on a zip disk if the data is too big or a CD rom. I will be saving all my procedures onto a floppy disk.

COMMON WAYS OF LOSING YOUR WORK:

HACKING:

Hacking is the unauthorized access to files. Damage can be done deliberately so it is always useful to have a backup of your data.

VIRUSES:

A virus is when a program copies itself, repeatedly. It is initially written to damage a computers software. Some viruses are designed to damage files and disk drives. A virus can vitiate a computers system in many ways and some of these are:

- Downloading software from the Internet
- Using pirate software which may be unreliable
- An attachment to an e-mail

SECURITY:

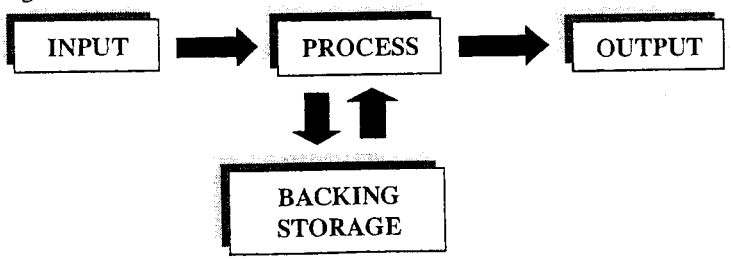
Important data must be taken care of. The loss of an important piece of work can mean that you have to do it again which is really a waste of time. This is why back-up copies of your work are important. You will need to keep backups somewhere off-site so that no one can access them, except yourself. And, always remember to save your work frequently on the hard drive and also on a disk.

DATA PROTECTION ACT:

The Data Protection Act, 1998, was set up to take account of the increasing amount of personal data being held on computers and the potential misuse of that data. The Data Protection Act is a statutory code of data protection good practice designed to protect individuals whose personal data is held on computerised records by organisations. It requires companies to register with the Data Protection Commissioner and restricts the data they can hold. Individuals have a right to see the data held on them and have to have it corrected if inaccurate. In addition, the new Act gives individuals the right to know who is processing data and why, and prevents data users using the data for direct marketing. Companies holding computerised data have a duty under the law to ensure that the data remains confidential and must also ensure that information is not disclosed, however, innocently.

VARIOUS WAYS OF PREVENTING AND DEALING WITH MALICIOUS ACTS:

- Do not open suspicious e-mails
- Use up to date virus scanning software consistently
- Use filtering software to prevent downloads of computer programs
- Keep your password a secret and change it regularly
- Data encryption- this scrambles the data to make it unreadable to anyone without the key. Only the authorized person has the key.
- Activity log- a log of activities will show you who has been using a system and when.



DESIGN

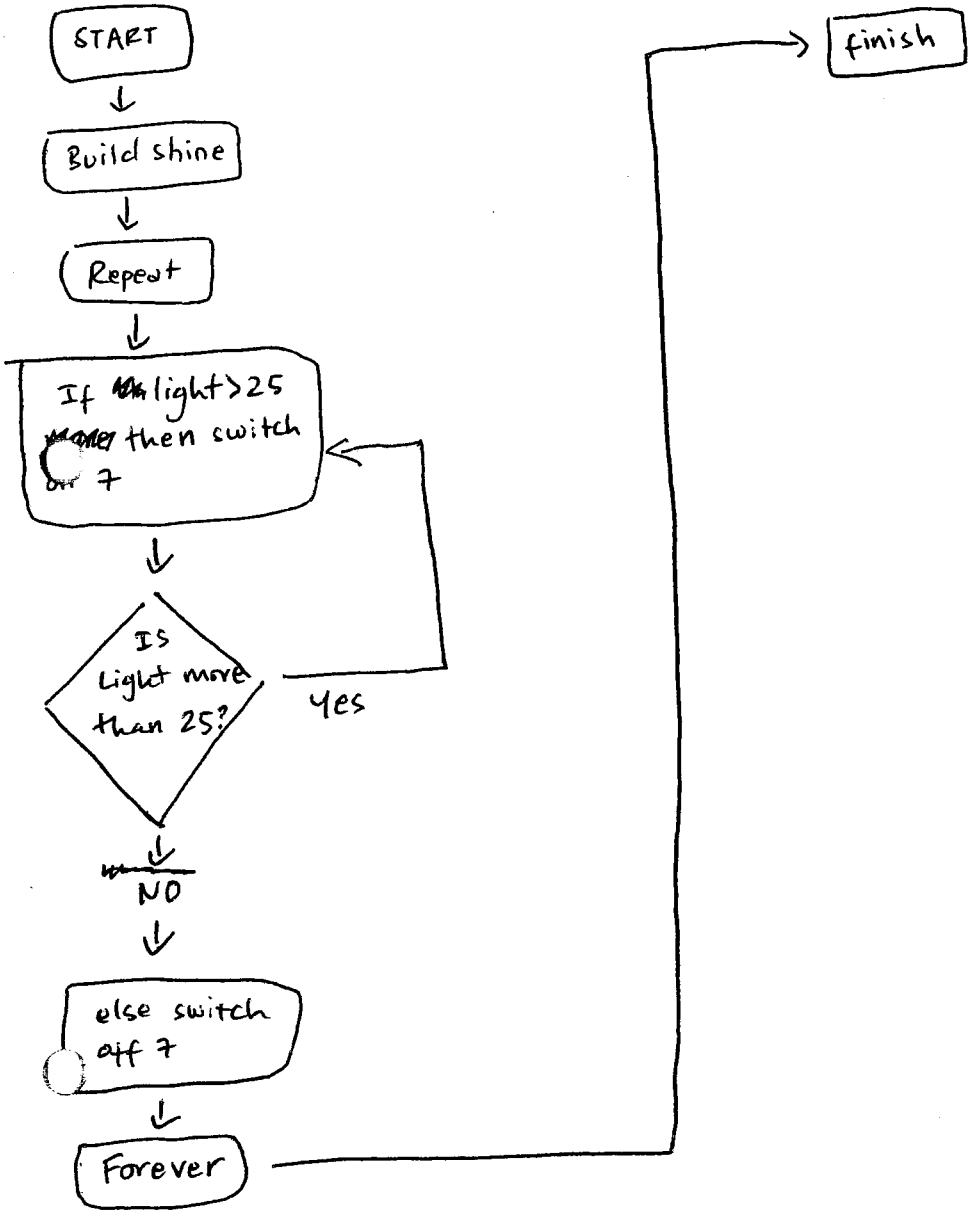
DESIGN

LIGHT

REPEAT

IF LIGHT > 25 THEN SWITCH ON 7 ELSE SWITCH OFF 7

FOREVER



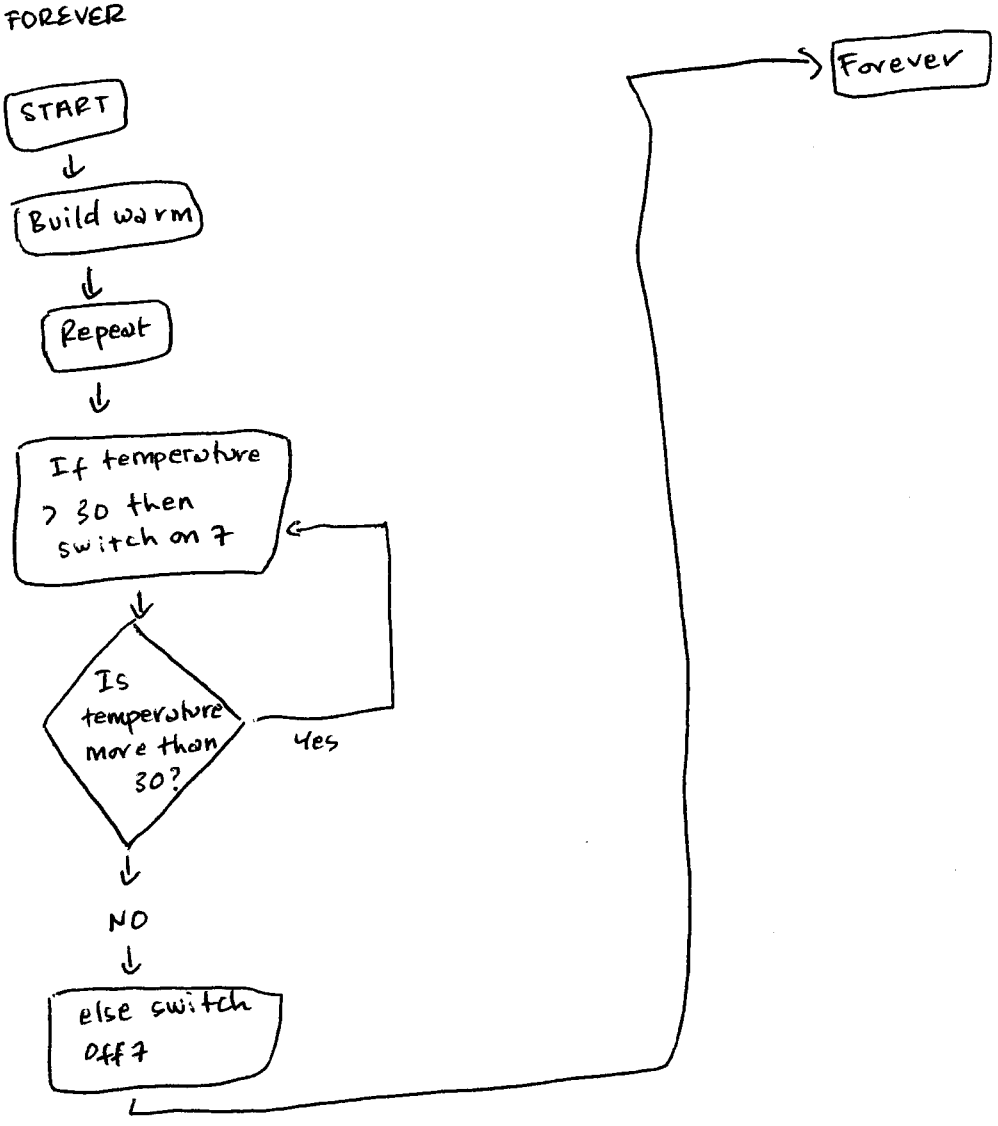
TO CONVERT ALL MY READINGS INTO GRAPHS I WILL NEED TO DO ANOTHER PROCEDURE AS SHOWN BELOW:

LIGHT - COLLECTLIGHT

```
RESET CLOCK
FILE 1, "A:DATA"
START CLOCK
REPEAT
STORE 1, SENSOR 0
WAIT 3
UNTIL TIME >: 30:00
CLOSE
```

TEMPERATURE

```
REPEAT
IF TEMPERATURE 730 THEN SWITCH ON 7 ELSE SWITCH OFF 7
FOREVER
```



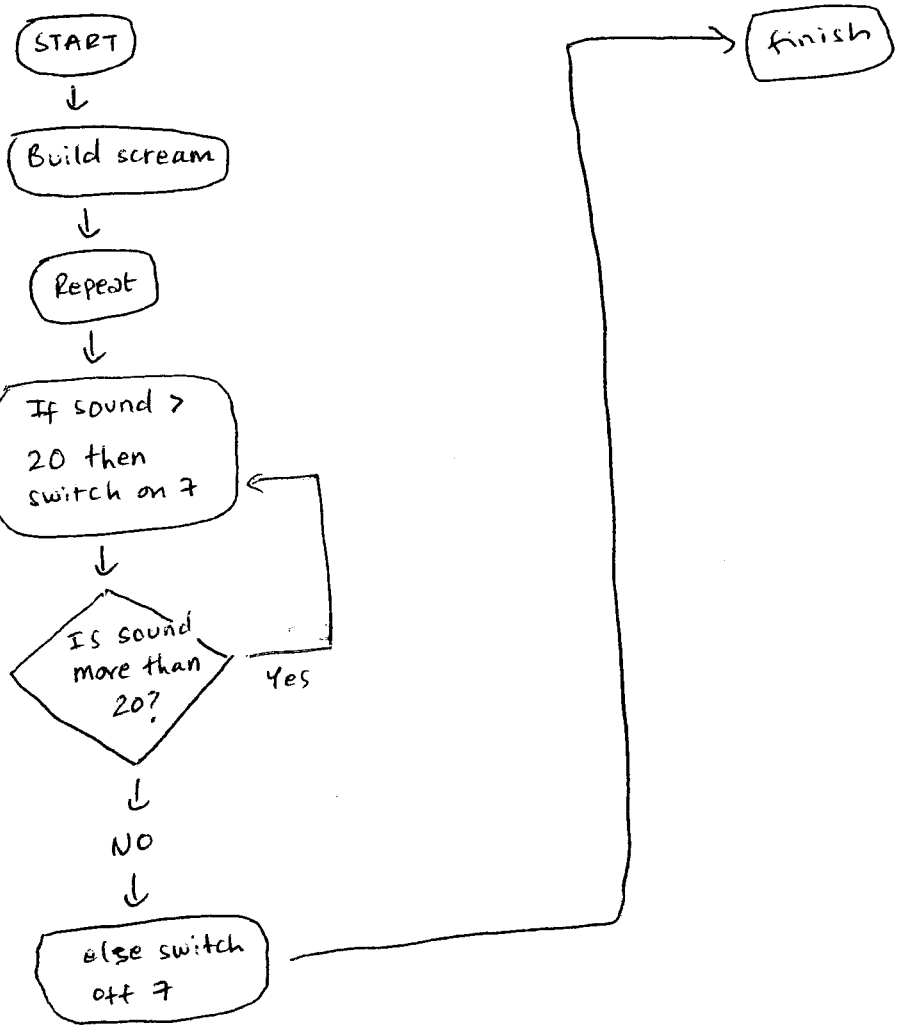
TO CONVERT ALL MY READINGS INTO GRAPHS I WILL NEED TO DO ANOTHER PROCEDURE AS SHOWN BELOW:

TEMPERATURE - COLLECT TEMP

```
RESET CLOCK
FILE 1, "A:DATA"
REPEAT
STORE 1, SENSOR D
WAIT 2
UNTIL TIME > 30:00
CLOSE 1
```

SOUND

```
REPEAT
IF SOUND > 20 THEN SWITCH ON 7 ELSE SWITCH OFF 7
FOREVER
```

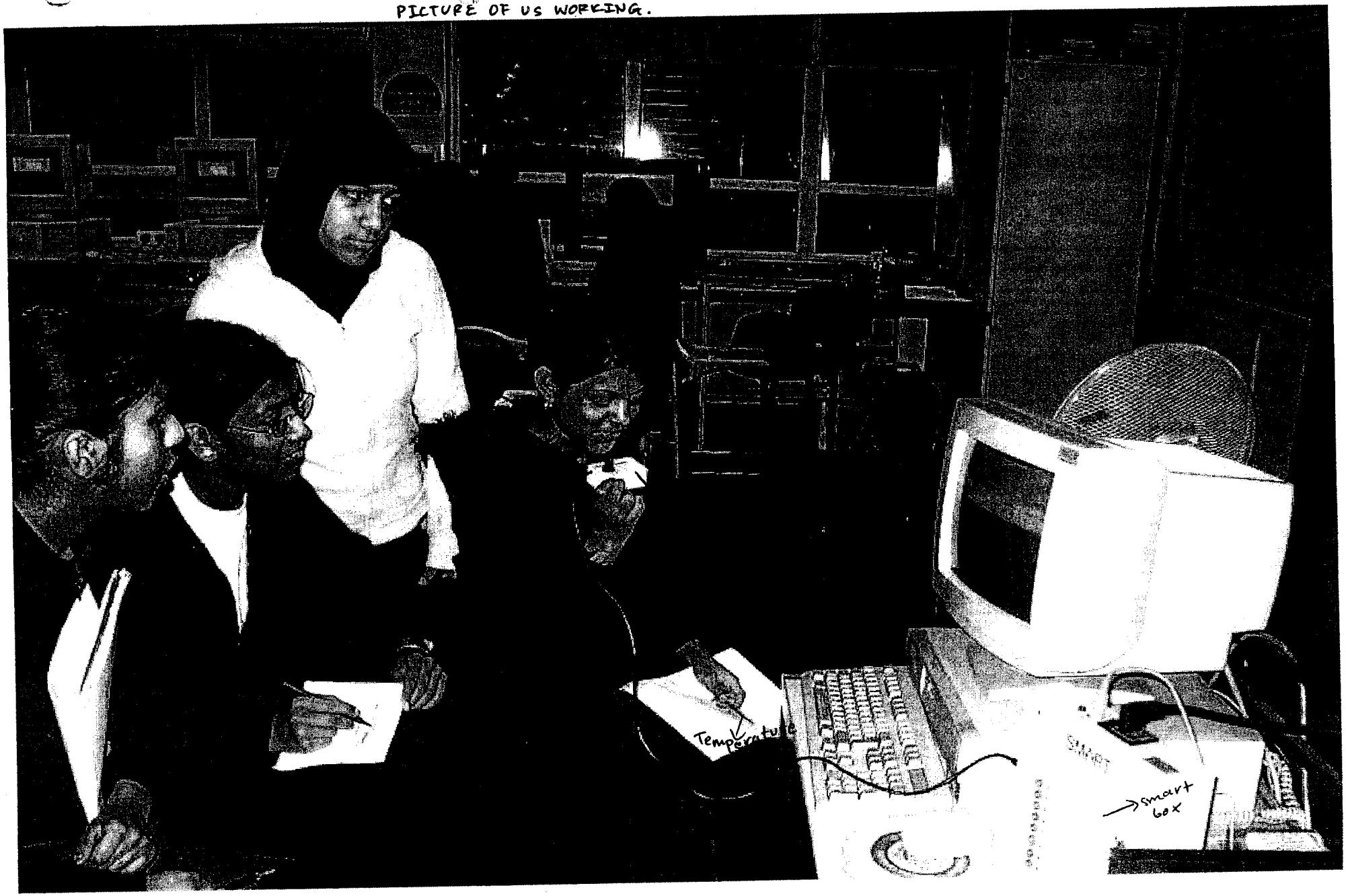


TO CONVERT ALL MY READINGS INTO GRAPHS I WILL NEED TO DO ANOTHER PROCEDURE AS SHOWN BELOW;

SOUND- COLLECT SOUND

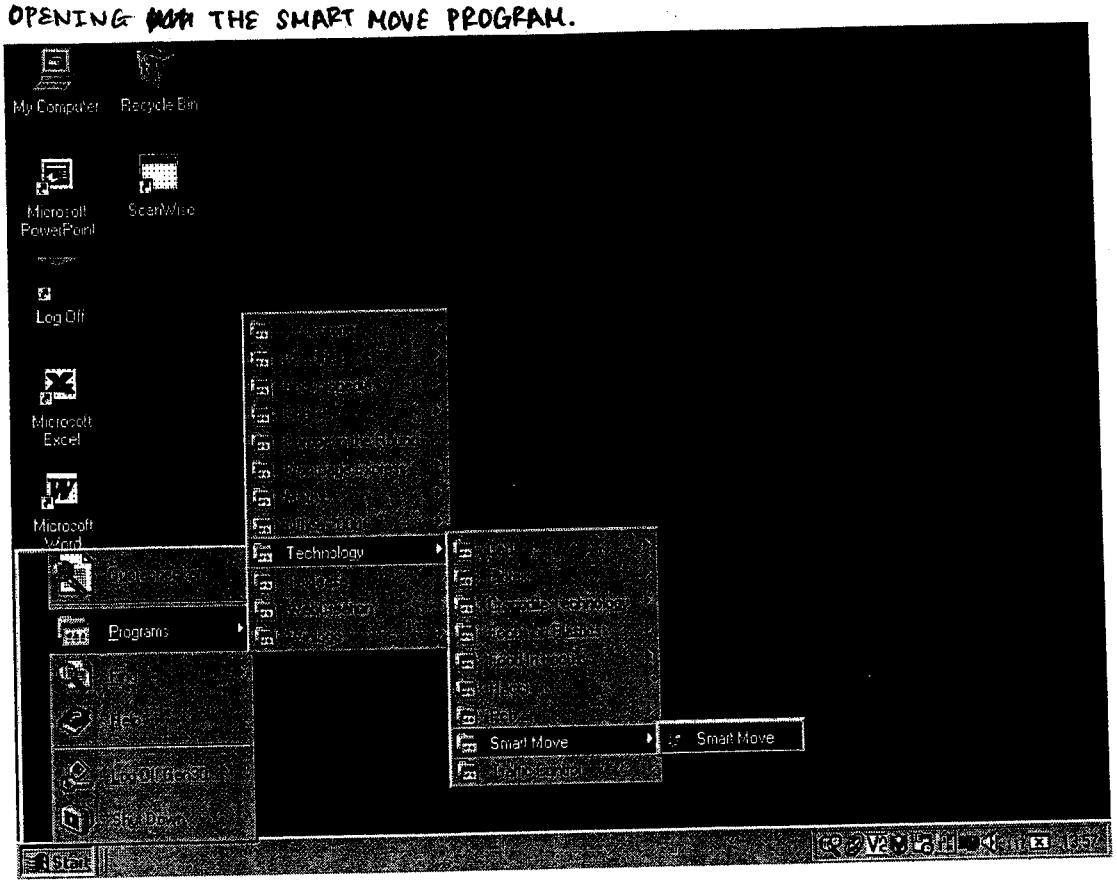
```
RESET CLOCK
FILE 1, "A:DATA"
START CLOCK
REPEAT
STORE 1, SENSOR D
WAIT 2
UNTIL TIME>:30:00
CLOSE 1
```

PICTURE OF US WORKING.

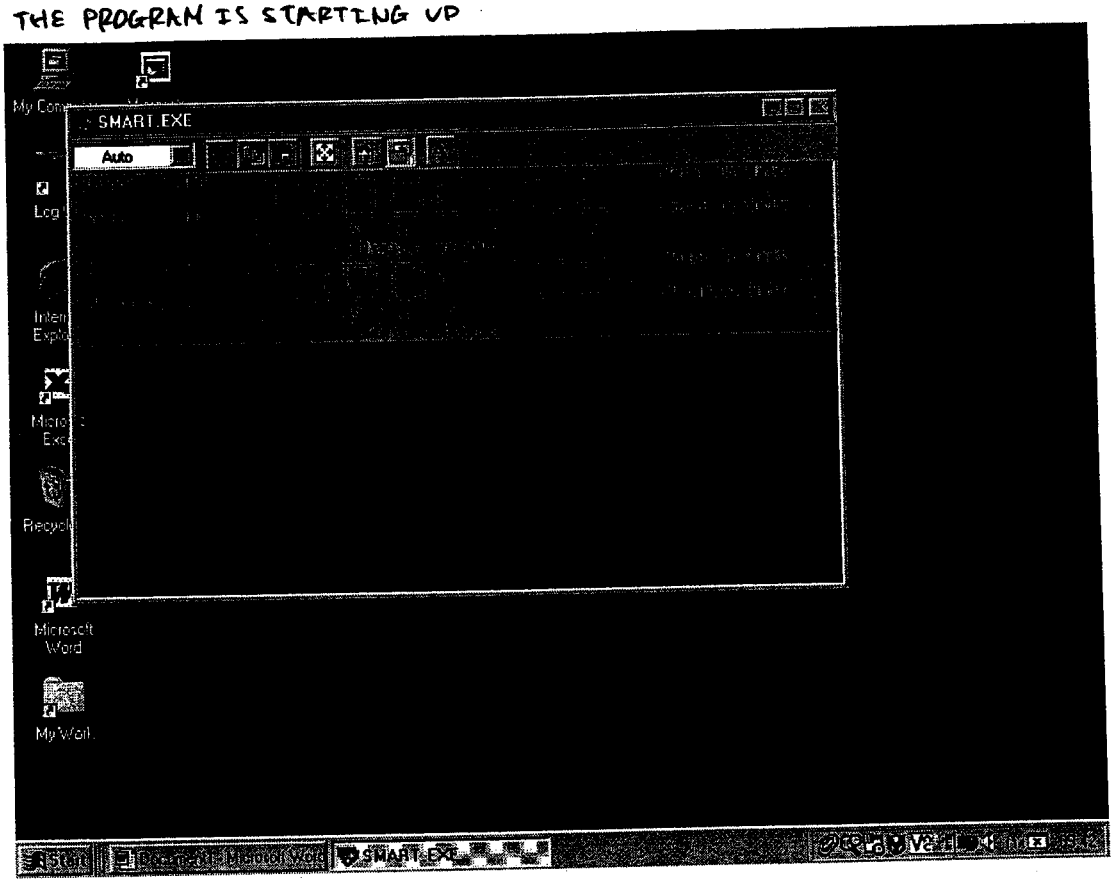


IMPLEMENTATION

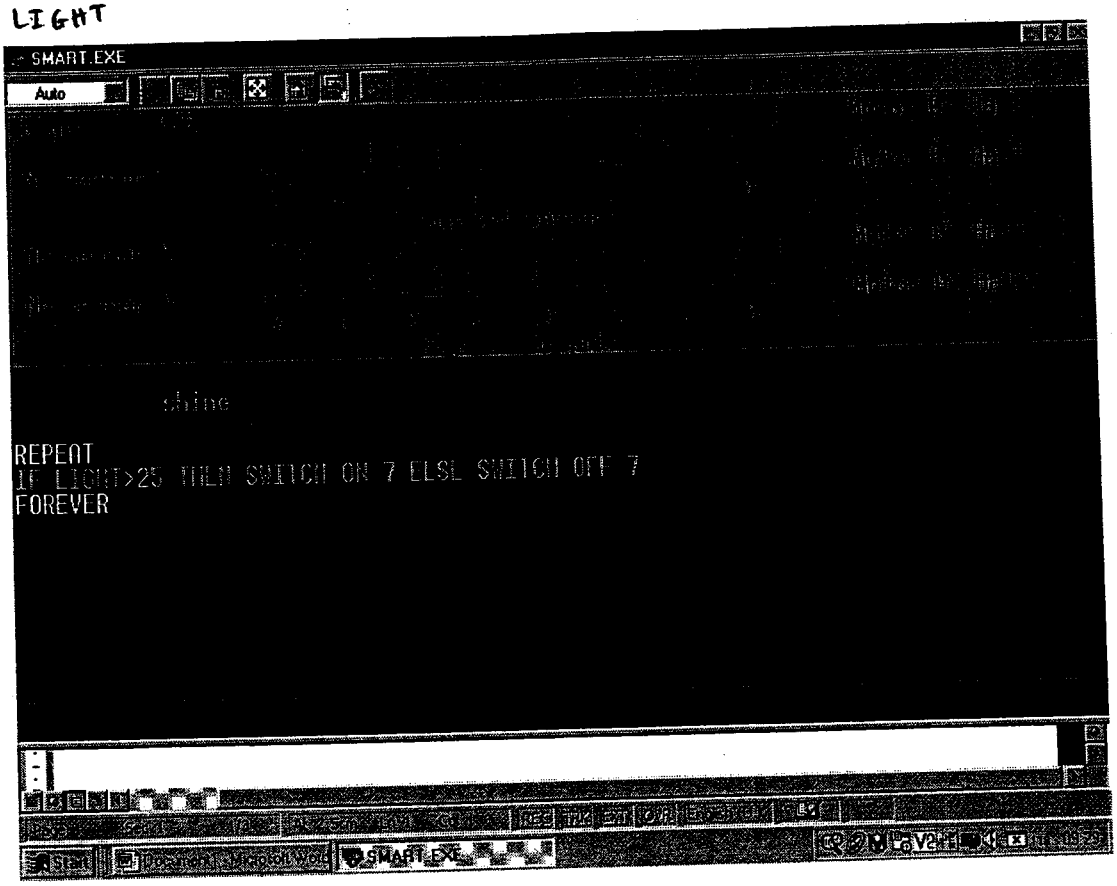
OPENING ~~FROM~~ THE SMART MOVE PROGRAM.

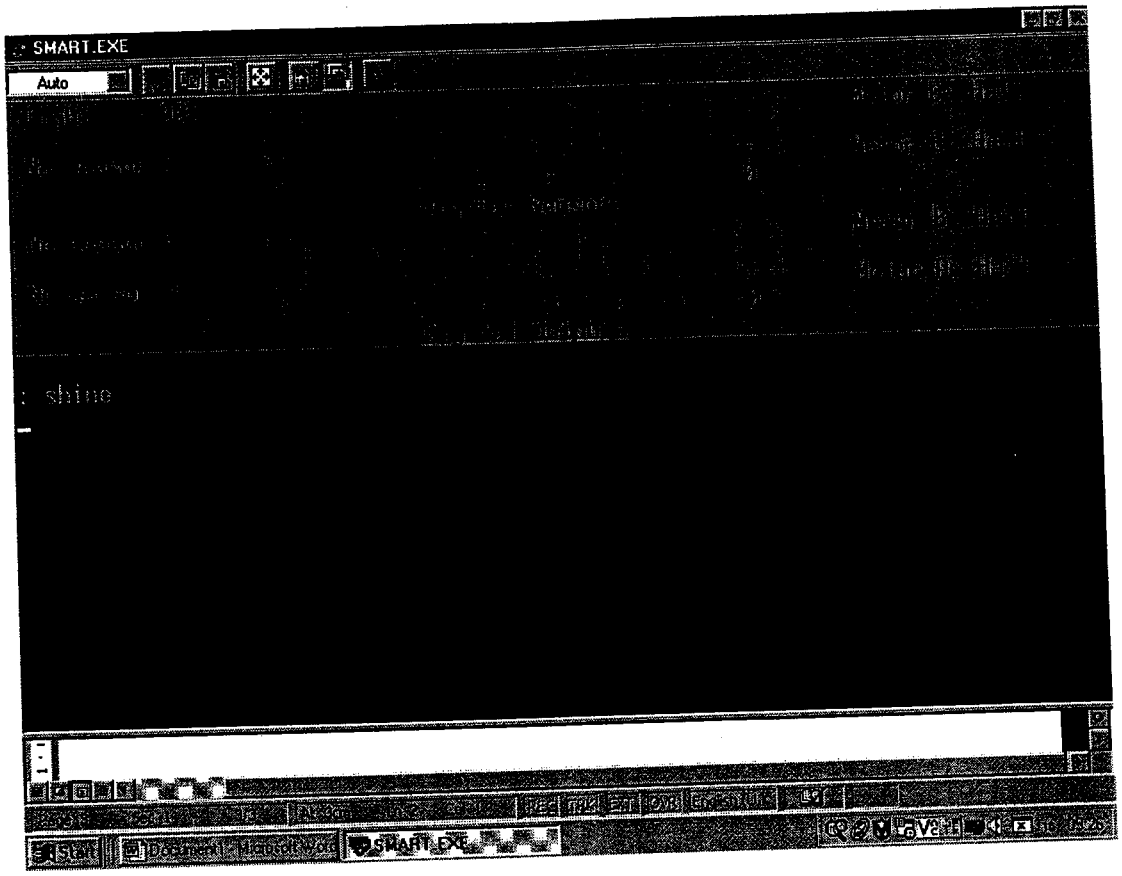


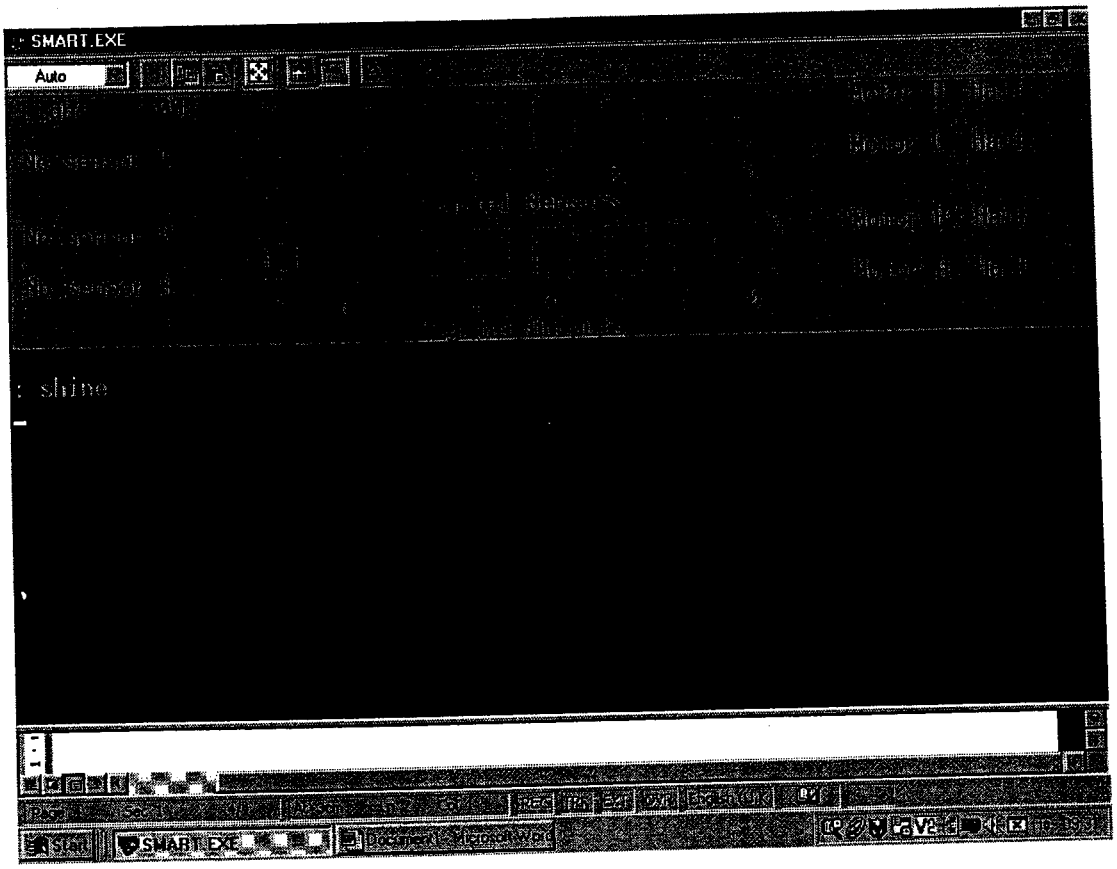
THE PROGRAM IS STARTING UP



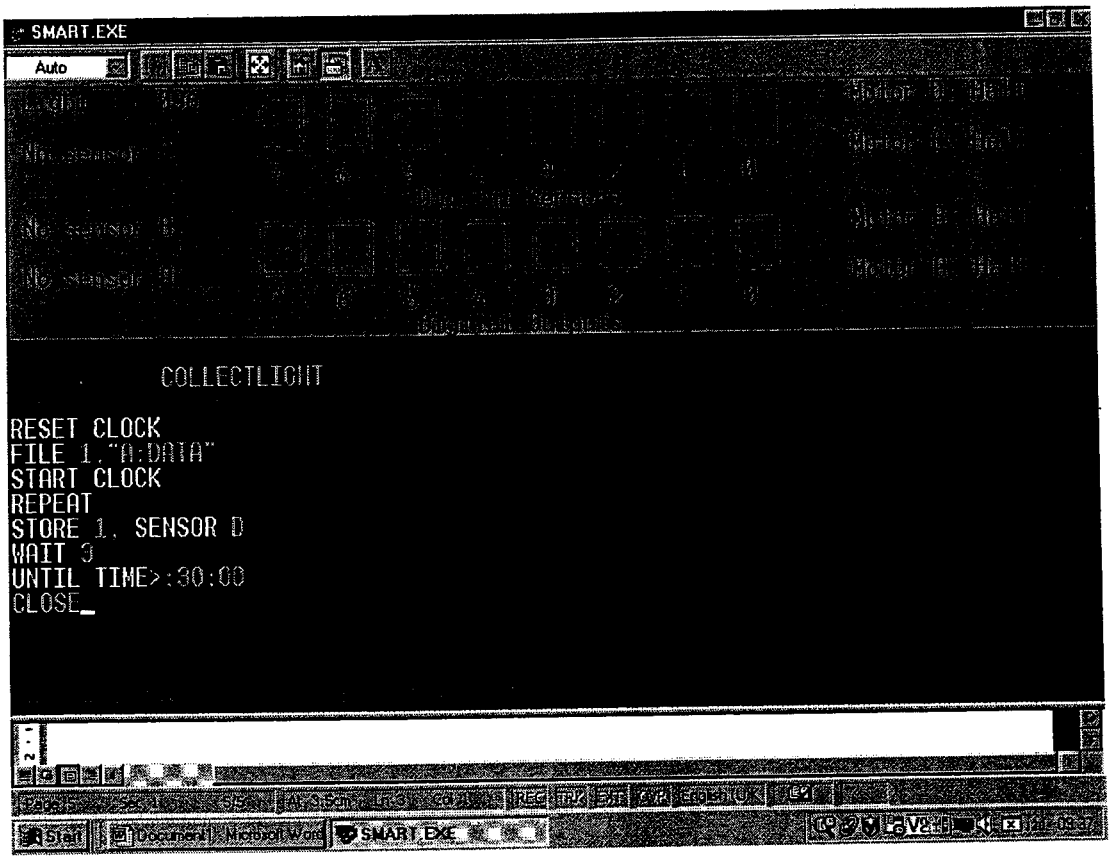
LIGHT


SMART.EXE
Auto
REPEAT
IF LIGHT>25 THEN SWITCH ON 7 ELSE SWITCH OFF 7
FOREVER

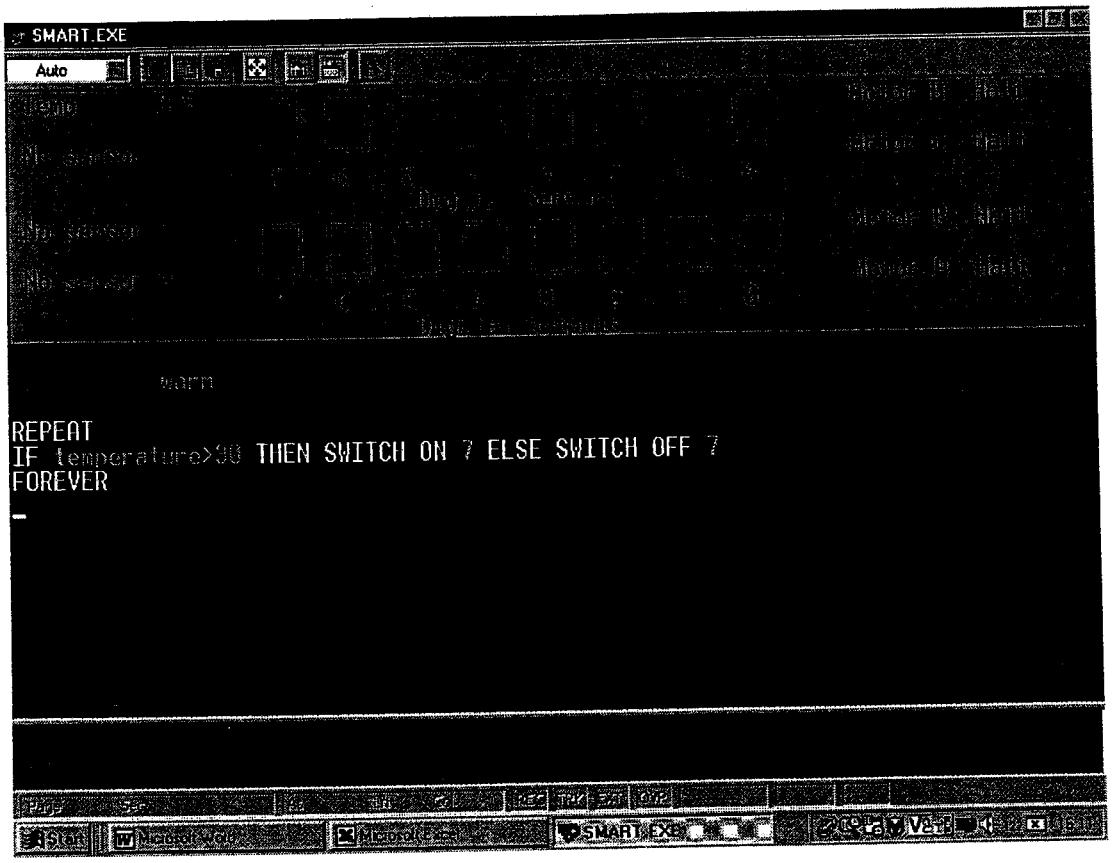

SMART.EXE
Auto
: shine

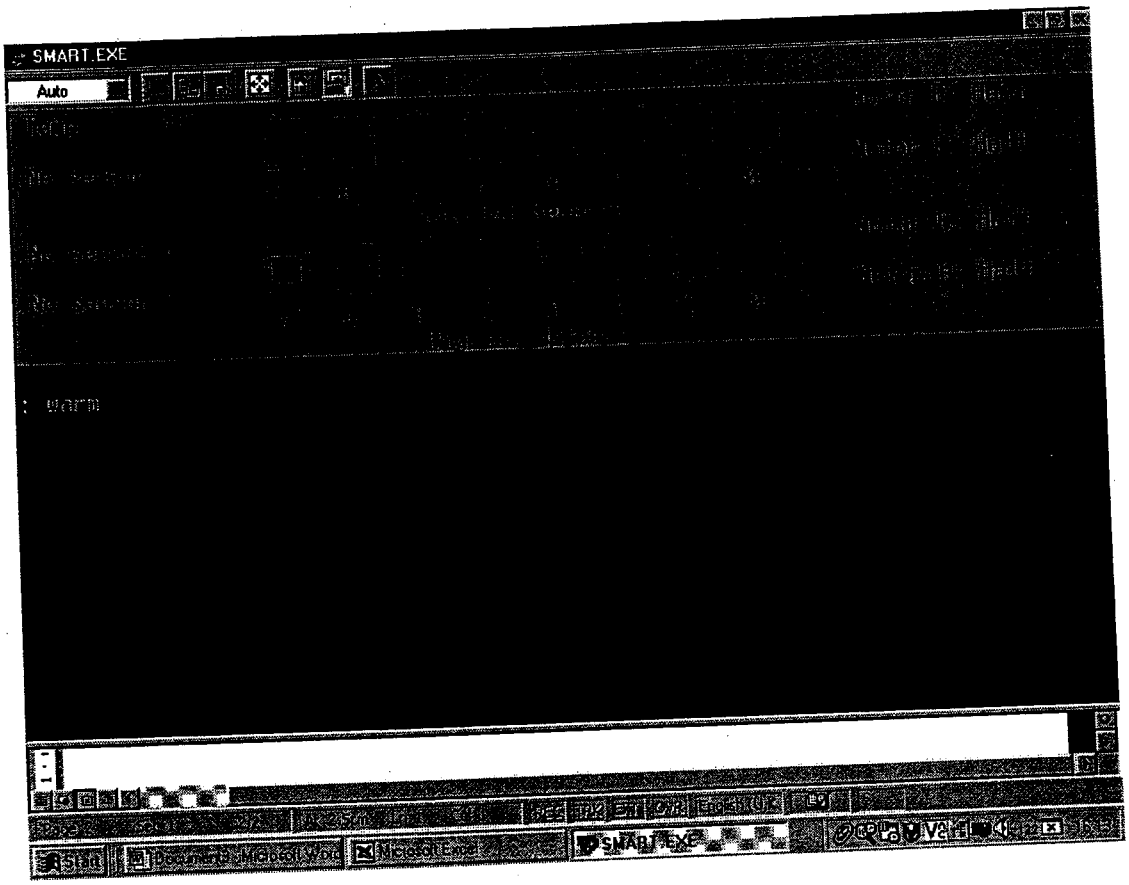

SMART.EXE
Auto
: shine
SMART.EXE

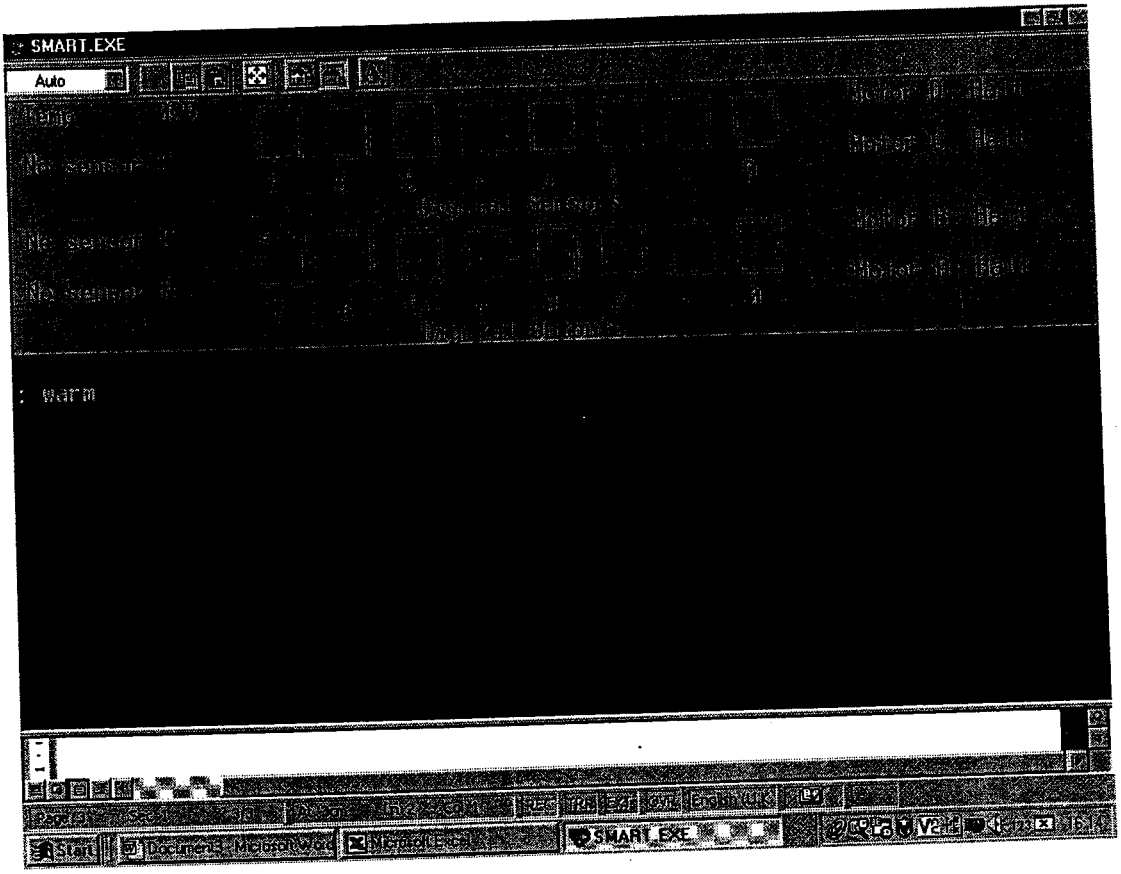
LIGHT

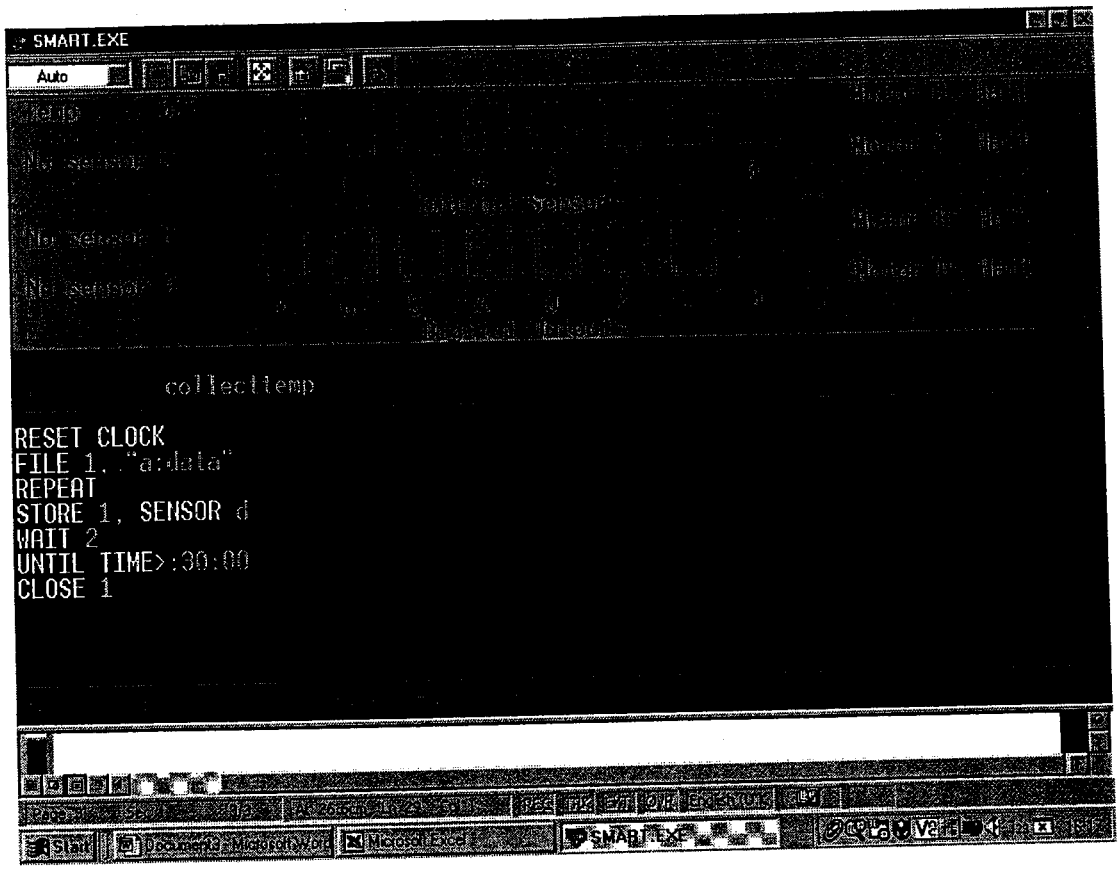

SMART.EXE
Auto
COLLECTLIGHT
RESET CLOCK
FILE 1,"A:DATA"
START CLOCK
REPEAT
STORE 1, SENSOR 0
WAIT 9
UNTIL TIME>:30:00
CLOSE_
Start
SMART.EXE

TEMPERATURE

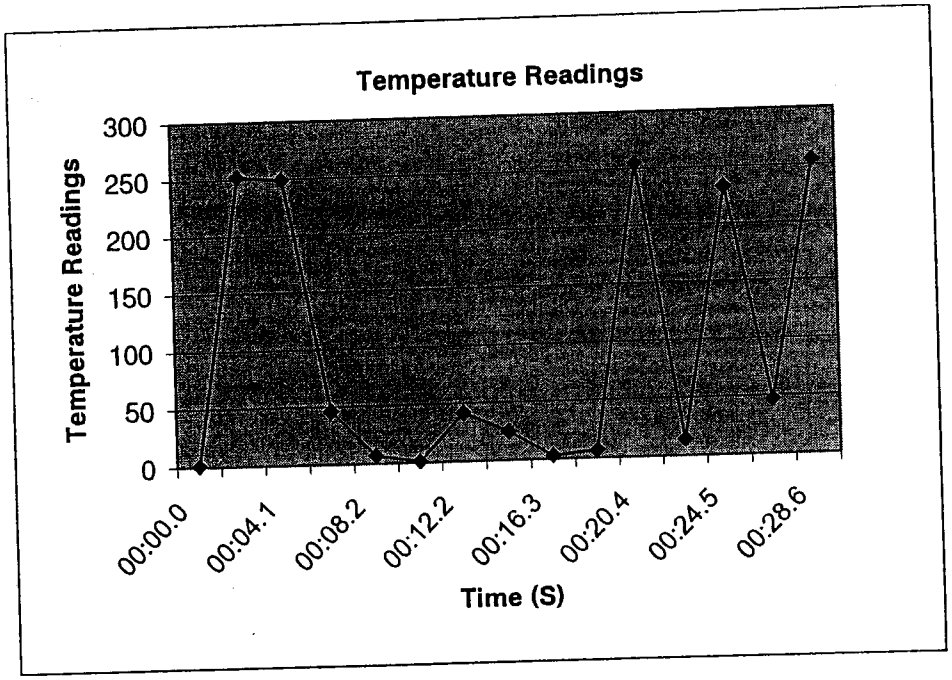



SMART.EXE
Auto
: warm

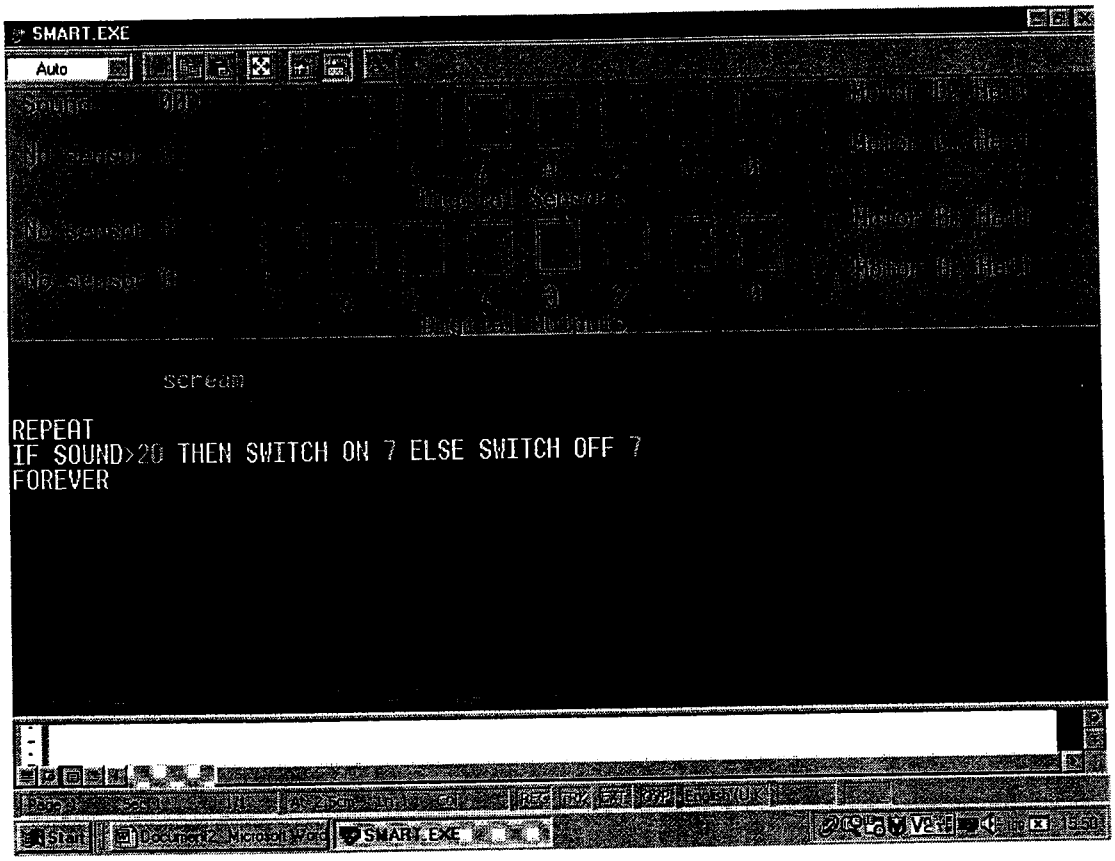

SMART.EXE
Auto
: warm

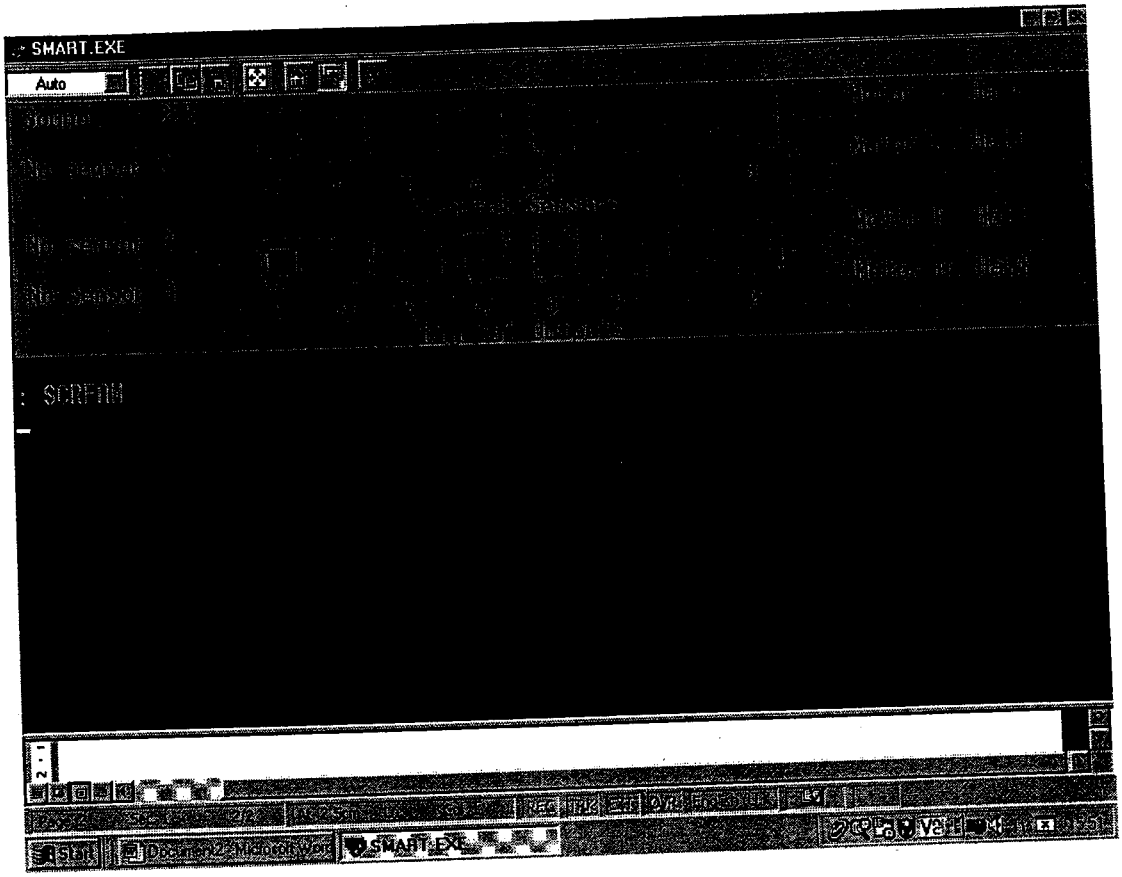

SMART.EXE
Auto
collectTemp
RESET CLOCK
FILE 1, "a:data"
REPEAT
STORE 1, SENSOR 0
WAIT 2
UNTIL TIME>:30:00
CLOSE 1

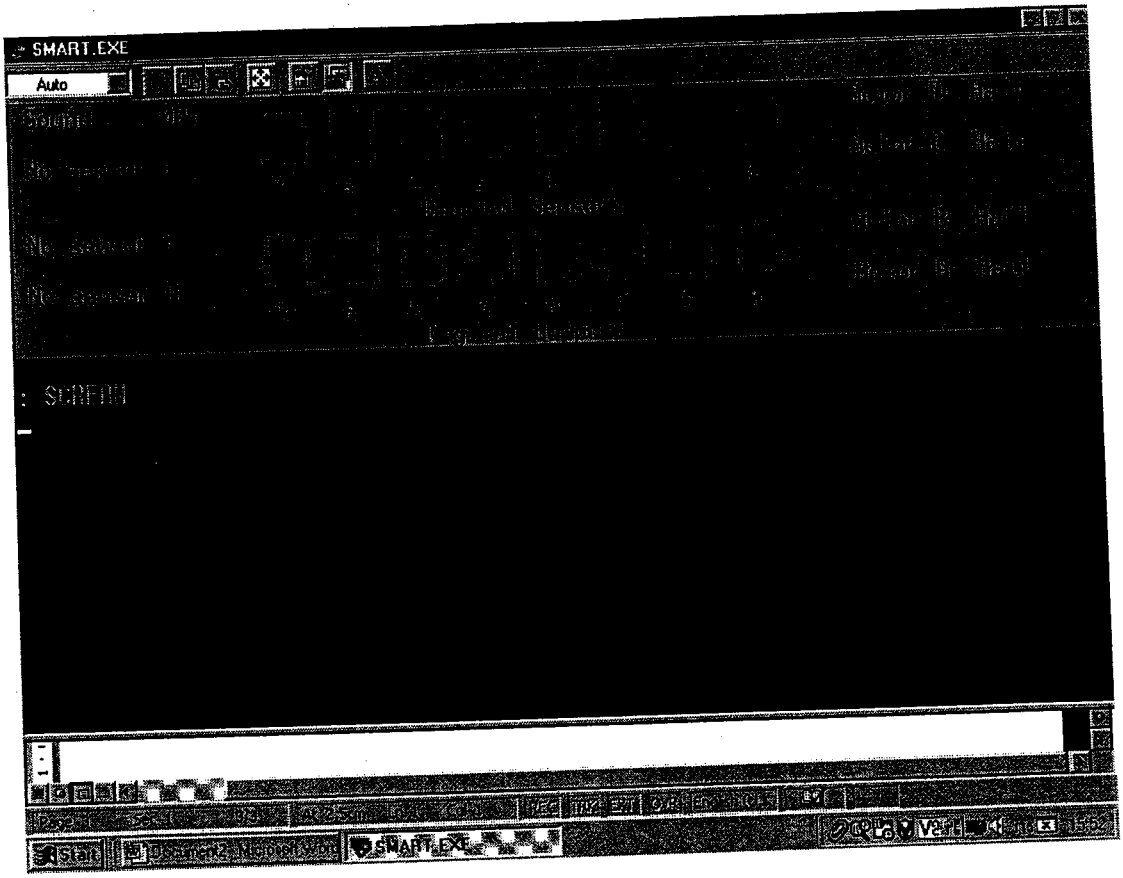
Time (S)	Temperature Readings
00:00.0	1
00:02.0	252
00:04.1	249
00:06.1	46
00:08.2	7
00:10.2	1
00:12.2	42
00:14.3	25
00:16.3	3
00:18.4	7
00:20.4	255
00:22.5	14
00:24.5	233
00:26.6	47
00:28.6	255



SOUND

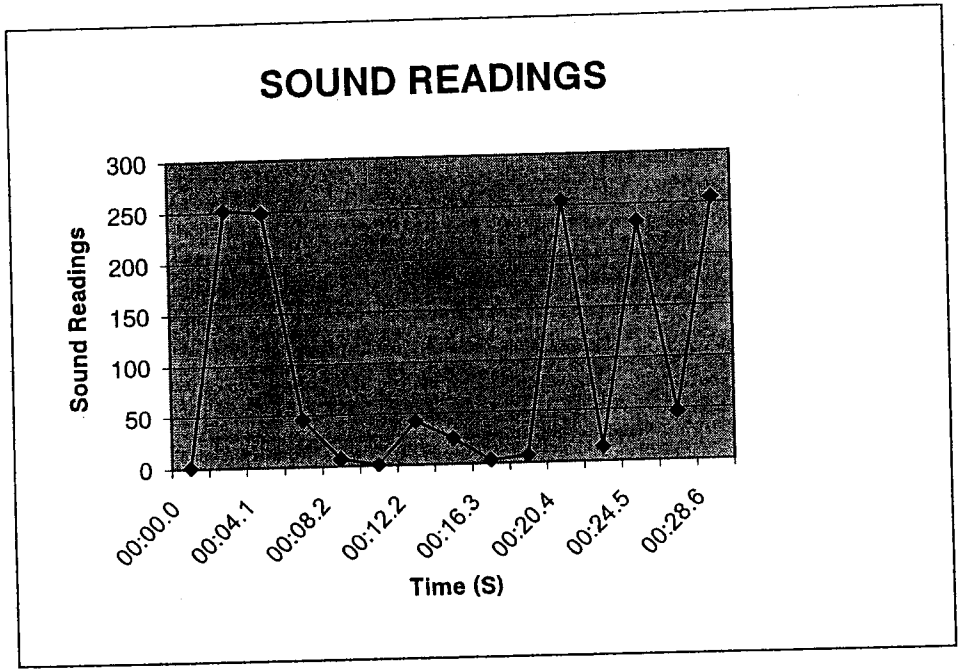

SMART.EXE
Auto
scream
REPEAT
IF SOUND>20 THEN SWITCH ON 7 ELSE SWITCH OFF 7
FOREVER
Start
SMART.EXE


SMART.EXE
Auto
SCRIPT1M


SMART.EXE
Auto
Start
SMART.EXE


SMART.EXE
Auto
COLLECTSOUND
RESET CLOCK
FILE 1, "a:data"
START CLOCK
REPEAT
STORE 1, SENSOR 4
WAIT 2
UNTIL TIME>:00:00
CLOSE 1
Start
SMART.EXE

Time (S)	Sound Readings
00:00.0	1
00:02.0	252
00:04.1	249
00:06.1	46
00:08.2	7
00:10.2	1
00:12.2	42
00:14.3	25
00:16.3	3
00:18.4	7
00:20.4	255
00:22.5	14
00:24.5	233
00:26.6	47
00:28.6	255



EVALUATION

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This project was both challenging and rewarding. By doing this project I was able to explore Smart Move for the first time as I have never used this software package before. Also, by working on this project I was able to learn how Smart Box operates which is very good, as later if I need to do anything like this again I will be able to use the program and will already know how it works.

The aim of this project was to design a greenhouse that would work automatically without the need of a person always being there so that they can get on with other jobs. The way in which I chose to solve this problem was by building a greenhouse, which was going to be controlled by a computer.

The computer controls everything but procedures need to be set up first to make sure that the greenhouse has the best growing conditions for the plants. I managed to solve all the problems that were identified at the beginning of the project and I also met all my user requirements. Georgina no longer needs to work manually now in the greenhouse and she just needs to go in once a day to check that everything is running smoothly.

The computer will also be able to read and record data more accurately than Georgina will be able to. The computer sends a signal to the output devices and they make the different things come on e.g. the heaters will turn on when the temperature of the greenhouse is too low and will turn off when it is too high and then the fans will come on to cool the temperature down.

Data from the computer can also be printed from the system. The readings that are taken from the input sensors can also be turned into graphs on Excel and then they can be printed out. The outputs that come on in the greenhouse can be viewed on the computer, so Georgina will be able to see what is happening in the greenhouse from her house and will not need to actually get up and go there.

This was a very sucessful solution and it helped Georgina to get on with other things she needed to do and it helped her organize her time better. I did not really face any problems when I was doing the experiments just slight problems such as not switching the Smart Box on and making spelling mistakes when entering a procedure on to the computer.

In school we didn't have many sensors and so not all the tests could be carried out but I am pretty certain it would have worked as the procedures for the different sensors are very similar to each other. If I had more time then I would have done some more research on different types of greenhouses to see how they are controlled.