DESIGN AND CONSTRUCTION OF A COMPUTER - AIDED AUTOMATIC SWITCH (CAAS)

By

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A PROJECT REPORT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING (B.ENG) DEGREE IN THE

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September, 2003

DECLARATION

I, **ABDUL ADENIYI OLUGBENGA**, hereby declare that this project is an original concept and work of mine, was designed, constructed and tested by me, under the supervision and guidance of Dr Y.A. Adediran.

The project has not been presented in any form for the award of diploma or degree certificate. The information extracted and derived from published and unpublished work has been acknowledge

SIGN: ....

NAME: Abdul Adeniyi O

REG. NO: 97/5878EE

DATE: 22nd Sep. 2003

CERTIFICATION

This is to certify that Abdul Adeniyi Olugbenga carried out this project titled "Design and Construction of a Computer – Aided Automatic Switch" under the supervision of Dr Y.A. Adediran.

And submitted to the Electrical and Computer Engineering Department, Federal University of Technology, Minna in fulfillment of the requirements for the award of Bachelor of Engineering of Engineering (B. Eng) degree in Electrical and Computer Engineering.

Dr Y.A Adediran ....

Project Supervisor Signature

Engr.M.N. Nwohu. 2/4/04 ....

Head of Department Signature

External Supervisor ....

Signature

DEDICATION

I dedicate this project to the Almighty God, the beginning and the end. And also to my late Stepmother, Mrs. O.O.Abdul, whose love, care, and sacrifice has brought me to the Top.

ACKNOWLEDGEMENT

I am very grateful to Almighty God, for his guidance through thick and thin of my academic pursuit. I wish to acknowledge the immeasurable love, constant moral, financial and parental care of my parent, especially my mum.

My thanks also go to my supervisor, Dr.Y.A.Adediran and the head of Electrical and Computer Engineering Department, for his constructive advises and to have spent his precious time going to my manuscript. I also wish to mention my friends, Mr. Fafemi Taiwo, Mr. Adi tarngu, Mr. kaase Gbakon, Pst. Adeshina Adejare and the last but not the least my dearest person Miss. Asaolu Lola, for all their supports during the course of study in F.U.T, Minna.

I cann't forget my love ones; Muyiwa Oduleye, Nike Abdul, Tunde Abdul and my lovely pet Busola Abdul for their support and love.

ABSTRACT

This project was the design and construction of a Computer – Aided Automatic Switch, which is a device that is capable of switching on and off of electronic appliances.

The appliance of top – down design approach was used. The system was broken down into simpler functional blocks. MSI devices used in the implementation of the system design were used in functional block elements, and therefore no emphasis was laid on their internal circuitries but rather on how they function as a whole the processing power of computer was also utilized in converting the binary outputs of the analog – to – digital converter to decimal, graduating the reading of the instrument and finally to send control signal to external peripherals appropriately.

The successful practical implementation of the project involved careful plan and layout of the circuit components such that troubleshooting and repair can carried out without much disruption to the circuit arrangement.

In order to obtain higher degree of accuracy, a linear temperature integrated circuit (IC) was used instead of the non- linear thermistor.

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CHAPTER ONE

GENERAL INTRODUCTION

1.1 INTRODUCTION

Automation, system of designed to extend the capacity of machines to perform certain task formerly done by human and to control sequence of operation without human intervention. The term automation has also been used to describe non manufacturing system in which programmed or automatic devices can operate independently or near independently of human control. In the field of communications, aviation, agriculture for example devices as automated guidance, automatic incubator and etc. are used to perform various operation much faster and accurate than could be accomplished by human being. In spite of this, **CAAS** has been design to help control devices in order to regulate their temperature, light intensity and switching of devices base on timely purpose.

Temperature is a measure of the average kinetic energy of molecules. The concept of temperature stems from the idea of measuring relative hotness and coldness.

Light is electromagnetic radiation with wavelength capable of causing the sensation of object.

There are conditions at home, hospital, offices, industries and laboratories when the knowledge of these quantities becomes so important than can be over looked. Temperature and light plays an important part in determining the condition in which living things can survive. For example, an incubator must be within a very narrow range of temperature to keep prematurely born or usually weak child worm. Therefore there exist a great need to design instruments that can help a great extent in measuring and maintaining the temperature.

Computer Aided Automatic switch is one of the devices that can be used in doing these effectively. The advantages of **CAAS** are too numerous than what can be exhausted in this report.

The principle of modular design using discrete components and medium scale integration (MSI) integrated circuit (ISC) was adopted in building the **CAAS**.

1.2 LITERATURE REVIEW

The phenomenon of temperature is natural to human beings as one of the fundamental senses, but it was realized as early as the time of *Galileo* (1610) that for scientific purpose the human skin is not sufficiently accurate as a thermometer. The draw backs of this crude thermometer are that certain amount of heat must be transferred to the skin before the sensation is felt and only a limited range of temperature between those that numb and those that burn the skin, can be measured (The New Illustrated science and invention Encyclopedia Vol.21 1987).

The earliest temperature indicators were made just before 1600 by *Galileo* and others, the important step of attaching scale to make a thermometer was taken by *Santorio* ten years later. These early instruments were essentially barometers using water in the tube, and so they respond to changes in pressure as well as temperature. *By 654 the Grand duke of Tuskany, Ferdinand II*, had invented the familiar sealed glass tube thermometer with the fluid contained in a bulb. In the basic pattern of all liquid-in – glass thermometers, the fluid being used was contained in a glass tube with a narrow tube or capillary. The principle on which they work was that the volume of the liquid increases with its temperature. Temperature can be measured on any of the following scales, Kelvin or Absolute scale, Fahrenheit scale, Celsius or Centigrade Scale and Ranking scale.

(the New Illustrated Science an Invention Encyclopedia Vol.21 1987).

Light is an instrument for measuring light intensity, illumination, or luminance. Light meters used in photography to determine proper camera setting are called exposure meters. The first light meter was actinometer (devised by *J.B.F Soleil in 1840*) with these instruments; camera exposure was monitored by measuring the time it took for a photosensitive paper to darken to a standard tint. Extinction light metes (*C.F Albinus, 1844*) have been used to observe the scene being photographed through a wedge of graduated density and to note the step through which the scene details remained just visible. Exposure photometer (*J.F. Taylor, 1866*) has been used to compare a target illuminated by a standard light source with another target illuminated by the scene (The Encyclopedia American vol.17 1983).

Most light meters now are photoelectric instruments with photovoltaic or photoconductive cell as the light sensitive element. The photovoltaic cell, typically as selenium cell, generates an electric current when light falls on the cell. The photoconductive cell, typically a cadmium sulfide (CdS) cell, a battery provides a current through the cell, and this current increases as the light intensity on the cell increases. (The Encyclopedia American Vol.17 1983)

1.3 PROJECT OBJECTIVE AND MOTIVATION

The design and construction of the computer-Aided Automatic switch was meant to achieve various objectives. During the course of study in the department of Electrical and Computer Engineering, various courses had been taught, such as Electronics, Control theory and Microcomputer Hardware programming. This project involves the application of all the fundamental ideas and principles that had been acquired.

During the period of studies, students went through lots of practical classes where they make use of different electrical component such as light dependent resistors, thermistor, resistors, capacitors, diodes, transformers, fuses and integrated circuits, which were used together with others instruments to build different circuits like half wave rectifier circuit, full wave rectifier circuit , house wiring and so on. Hence, the objective of the project is to use the knowledge acquired to design and construct a more complex circuit that can use in the society.

1.4 PROJECT OUTLINE

The **CAAS** is an essential appliance that can be used to switch any appliance in the house, office or anywhere with or without the effort of human being base on the setting on the computer.

This thesis outlines the design procedures, skills and techniques involved in the design, construction and testing of the **CAAS**.

Chapter one provides the general introduction to the project as a whole; it gives first hand description of the project. The chapter also introduce **CAAS** literature review and the objectives, which the project is meant to achieve.

Chapter two discusses the steps involved in the system design. It gives information about the operating principle of the **CAAS** and different modules that make up the **CAAS**.

Chapter three covers the detail involved in the construction and testing of the project. It explains how various components were soldered on the Vero board and how the devices were tested. It also gives the troubleshooting and the result obtained at the end of the object.

Lastly, chapter four contain the conclusion obtained and recommendation given.

CHAPTER TWO

SYSTEM ANALYSIS AND DESGIN

2.1 PRINCIPLES OF OPERATION CAAS

The **CAAS** makes use of electrical transducers (light – dependence resistor (LDR) and a temperature sensor) to convert the quantities of interest (light intensity and temperature) to electrical signal. The electrical signal (voltage) is supplied to the input of an ADC via a multiplexer. The ADC converts the analog signal to a digital signal. The digital output of the ADC is fed to the microprocessor or the microcomputer through the input/output (I/O) port, with the aid of a well structured control program written in **Visual Basic** the data would be read and corresponding temperature or light intensity would be displayed on the monitor appropriately.

The control program is also used to control various appliance connected to **CAAS** based on the user setting.

The inputs of the multiplexer are obtained from a voltage divider circuit and a temperature sensor. The voltage divider circuit contains one sensor and a fixed resistor as show in fig 2.1

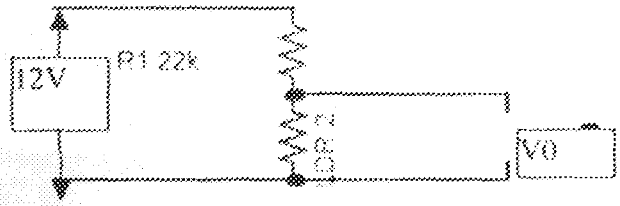


fig2.1

The resistance of light dependent resistor and the temperature sensor decrease as the light intensity and temperature increase respectively. When the light intensity increases, the current in fig2-1 increases and therefore the voltage drop (V_0) across the LDR increases. In this project LM35 temperature sensor IC was used because it has a linear relation between the temperature sensed and output voltage or output current.

The multiplexer select either of the two sensors base on the signal or binary inputs at its select pins and sending the corresponding voltage to the ADC.

When the LDR is selected, the voltage across is resistance which is proportional to the light intensity, is input to the ADC and the corresponding decimal value is displayed on the monitor, the control program now make comparison between the inputted voltage which has been convert to a corresponding light intensity in "lux" is compare with the user setting, if there is any variation the program either switches on or switches off the appliance connected to the control pins.

Also this applies to the temperature sensor, when it's selected the voltage is send into ADC and the corresponding decimal value is displayed on the monitor after it has been converted back to Celsius by the control program. The control program also compare the converted temperature which is now in Celsius with the user setting, and if there is any variation in the temperature, the control program either switches on or switches off the appliance connected to the control pins.

The appliances are connected to the control pins through some external circuits within the **CAAS**.

2.2 THE CONCEPT OF TRANSDUCER

Measurement by direct comparison with reference standard having the same characteristic as those of the quantity measured are called direct measurement, but most measurements yield result in more indirect way.

They are based on the knowledge of the relationship between the quantity to be measured and the response of the measuring instrument of system influenced by it.

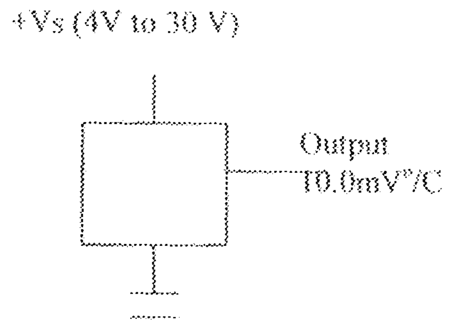
The Instrument society of America (ISA) defines a transducer as a device, which provides a usable output in response to a specified measured. The measurand is a physical quantity, property or condition, which is measured.

The output is electrical quantity produced by the transducer which is a function of the applied measurand.

A transducer can also be defines as a devices that is able to convert one form of energy into another. Since what is required is electrical signal, the transducers of specific interest are those that can convert light intensity and temperature which are physical quantities into their equivalent electrical signals.

2.2.1 TEMPERATURE SENSOR

The temperature sensor used in **CAAS** is LM35DZ temperature sensor IC. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in degrees Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of +/-1/4 degrees C at room temperature and +/-3/4 degrees C over a full -55 to +150 degrees C temperature range. The LM35 is rated to operate over a -55 degrees to +150 degrees C temperature range, while the LM35C is rated for a -40 degrees to +110 degrees C range (-10 degrees with improved accuracy) The encapsulation is a plastic TO92 package, connection details given below.

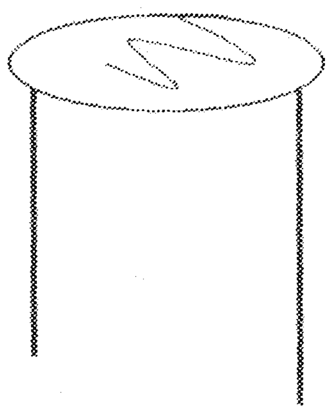


Basic Centigrade Temperature Sensor

2.2.2 LIGHT- DEPENDENT RESISTOR (LDR)

Light – dependent resistor is polycrystalline film or bulk single crystal material which contained between two conductive electrodes, act as light sensitive resistor whose resistance decrease as incident illumination increase. Cadmium Sulphide (CdS) and Cadmium Selenide (CdSe) are the most popular because of their spectral response, which peaks in the visible light region .

These cells are not electrically self generating; however, a battery or power supply modular must be employed to supply current through them.



2.3 THE ANALOG-TO-DIGITAL CONVERTER

An analog- to – digital converter is required to convert the analog signals from the sensors to digital equivalent. The ADC 0804, which is an 8-bit analog – to – digital converter IC, was used in this project. The ADC 0804 is a CMOS 8 – bit, successive approximation A/D converter which use a modified potentiometric ladder and are designed to operate with the 8080A control bus via three state outputs. This converter appears to the processor as memory location or I/O ports and hence no interfacing logic is required.

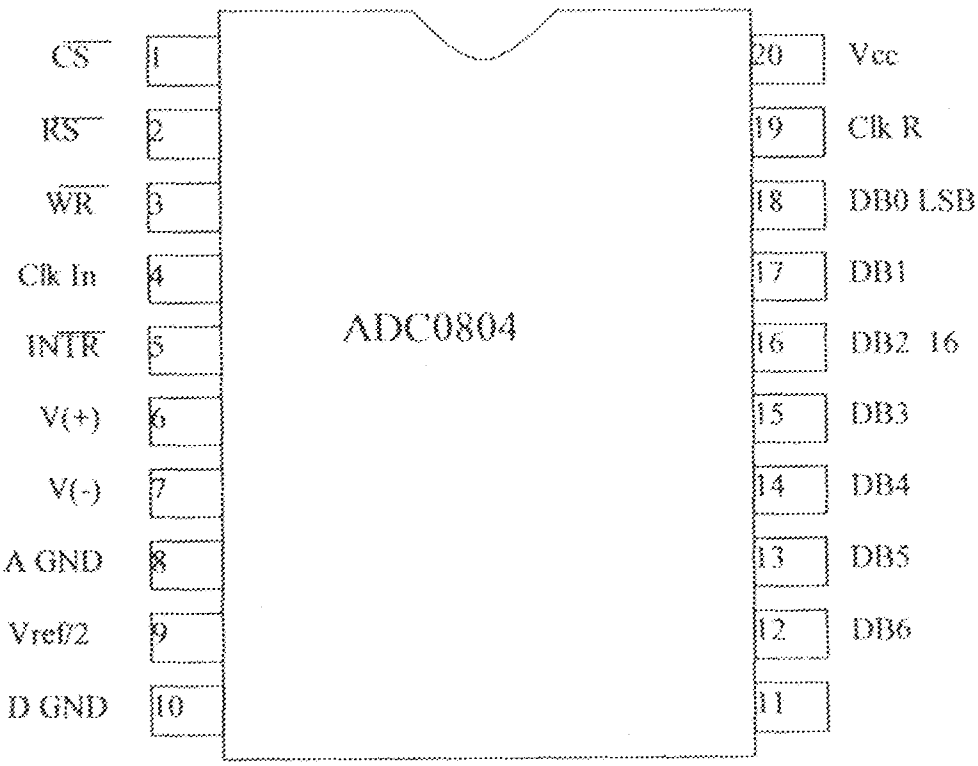


Fig2.3a ADC 0804 A/D CONVERTER IC PIN DIAGRAM

The name and function of each pin on the ADC 0804 IC are shown in the table below.

Pin No	Symbol	Input/Output	Description
1	$\overline{CS}$	Input	Chip select line from µP control
2	$\overline{RD}$	Input	Write line from µP control
3	$\overline{WR}$	Input	Write line from µP control
4	CLK IN	Input	Clock
5	$\overline{INTR}$	Output	Interrupt line
6	Vin(+)	Input	Analog voltage (positive input)
7	Vin(-)	Input	Analog voltage (negative input)
8	A GND	Power	Analog ground
9	Vref/2	Input	Alternate voltage reference (+)
10	D GND	Power	Digital ground

11	DB_7	Output	MSB data output
12	DB_6	Output	Data output
13	DB_5	Output	Data output
14	DB_4	Output	Data output
15	DB_3	Output	Data output
16	DB_2	Output	Data output
17	DB_1	Output	Data output
18	DB_0	Output	LSB Data output
19	CLKR	Input	Connect external resistor for clock
20	Vcc(ref)	Power	Positive of 5V power supply and primary reference voltage.

Table 2.1 ADC 0804 A/D converter IC Pin Label and Function

The ADC 0804 has binary outputs, and features a short conversion time of only 100µNs. Its inputs and outputs are both CMOS and TTL compatible. It has an on chip clock generator. The on-chip generator does need two external components (resistor and capacitor) to operate. The ADC 0804 IC operates on a standard +5V DC power supply and can encode input analog voltage ranging from 0 to 5V but it is possible to scale the input to any smaller range, still retaining the full 8 bit resolution. This is achieved by programming pin 9 with a reference voltage equal to half the input voltage range. For the purpose of this project, the ADC is scaled to have analogue voltage of 2.76V. As a result of this a voltage equal to 1.38V was established at pin 9, by means of a potential divider.

A low – to – high transition of the clock signal at the $\overline{WR}$ input start the A/D conversion process. When the conversion is finished, the binary output is updated, and the $\overline{INTR}$ output emits a negative pulse. The ADC 0804 can perform about 5000 to 10000 conversions per second. The conversion rate of the ADC is high because it uses successive- approximation technique in the conversion process.

For example, if the digital output voltage is in this binary bit 001110102, the MS character is decimal 3 and the LS character is decimal 10, so

$$V_s = \left(\frac{MS}{16} + \frac{LS}{256}\right)(V_{ref})*2$$

2.3.1 ADC RESOLUTION

The resolution of an A/D converter is given as the number of bits at output fir a binary – type unit. For decimal – output A/D converter (used in DMMs), the resolution is given as the number of the readout (such as 3.5 or 4.5). Typical A/D converters with binary output have resolution of 4, 6, 8, 10, 12, 14 and 16 bits.

The sight errors that occur due to the use of discrete binary steps to represent a continuous analog voltages called quantizing errors. For instance, each step in a 4- bit A/D converter would be one – fifteenth (2^4-1=15) of the input voltage. This would be a resolution of 6.7 percent (1/15*100=6.7%). Therefore a 16 bit A/D converter is more "accurate" than a 4- bit because it divides the input or reference voltage into smaller discrete step.

2.3.2 ADC ACCURACY

The resolution of an A/D converter can be thought of as the inherent "digital" error due to the discrete steps available at the output of the IC. Another source of error in A/D converter might be the resistor network. The overall precision of the A/D converter is called the accuracy of the A/D converter IC.

The accuracy of an A/D converter IC with binary output ranges from ± 0.5 to ±2 LSB. The accuracy of an A/D converter IC with decimal output might range from 0.01 to 0.05 percent.

2.3.3 ADC CONVERSION TIME

The conversion time is another important specification of an A/D converter. It is the time it take for the IC to convert the analog input voltage to binary (or decimal) data outputs. Typically conversion times ranges from 0.05 to 10000μs for A/D converter ICs with binary output. Conversion time for A/D converters with decimal outputs is somewhat longer and might typically be 200 to 400ms.

2.4 DATA FLIP – FLOP ANALYSIS

Logic circuits may be classified into two large categories. The first group is combinational logic circuits, which are composed of gates. The second group is sequential logic circuit, which include devices called flip – flops. Flip – flops are interconnected to form sequential logic circuit for data storage, timing, counting, and sequencing. Flip – flops have extremely valuable memory characteristics. A flip – flop will "remember" its outputs even after the inputs are removed.

The logic symbol shows two input labeled for D (for Data) and ck (for clock). Flip – flops usually have complementary output labeled Q and $\overline{Q}$ (not Q). the > on the $\overline{ck}$ inputs of the D logic symbol denotes that this flip – flops transfers data from the input to the output on the positive going edge(↑) of the clock pulse.

The modes of operation for the D flip flop are show in the table below. To set the flip – flop means to load a 1 at the D input and pulsing the ck (clock) input one causes output Q to be set to 1. The second line shows the flip – flop being reset. To reset means to clear the Q output to 0. to hold means to store the output data. When the flip – flop is in the hold mode, changes in logic state at the data input will cause no change in the outputs. The hold condition illustrates the memory characteristic of the D flip – flop.

In a 8 bit D register, if all the 8 inputs are set at once the outputs will be logic 1 and this appears in parallel.

Mode of Operation	INPUTS		OUTPUTS	
	$\overline{D}$	CK	Q	$\overline{Q}$
Set ↑	1		1	0
Reset ↑	0		0	1
Hold	X	No ck	Same as before	

O = Low   1=High   X=Irrelevant

↑ = Low to high transition of the clock pulse

Table 2.4 Mode Truth Table for D flip – flop

For the project work, D flip flop employed fir its operation is the 74hct375 which has 8 data inputs and 8 data output. The "pin outs" of the D register is shown below.fig2.4

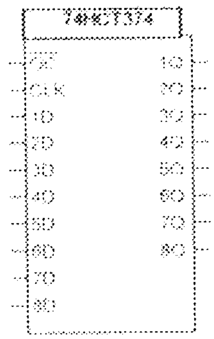


Fig 2.4 OCTAL D –TYPE FLIP – FLOP 74HCT374

2.5 TRANSISTOR CIRCUIT ANALYSIS

A transistor is a 3 terminal device available in two flavors (npn and pnp), with properties that meet the following rules for npn transistors.

1). the collector must be more positive than the emitter

2). the base – emitter and base – collector circuit behave like diodes. Normally the base – emitter diode is conducting and the base – collector diode is reverse biased, i.e the applied diode is in the opposite directory to easy current flow.

3). any given transistor has maximum values of I_c, I_b and V_{ce} that must not be exceeded.

When all the rules are strictly obeyed, I_c is roughly proportional to I_b and can be written as

$$I_c = h_{fe}I_b = \beta I_b$$

Where h_{fe}, the current gain is typically about 100.

2.5.1 TRANSISTOR SWITCH

In this project work the transistors were used as a switch. In a application, in which a small control current enable a much larger current to flow in another circuit is called transistor switch.

The output of the data flip – flop is about 5V, biases the transistor through the base resistor R.

To determine the value of $R_o - R_2$

The output Q is about 5V and the biases the transistor. The current through the resistor $R_o - R_2$

$$R_o - R_2 = \frac{5}{11X10^{(-3)}} = 450ohms$$

Using a single transistor to switch the relay was not too effective because the driving current is low. To current this hitch, Darlington transistor configuration is used.

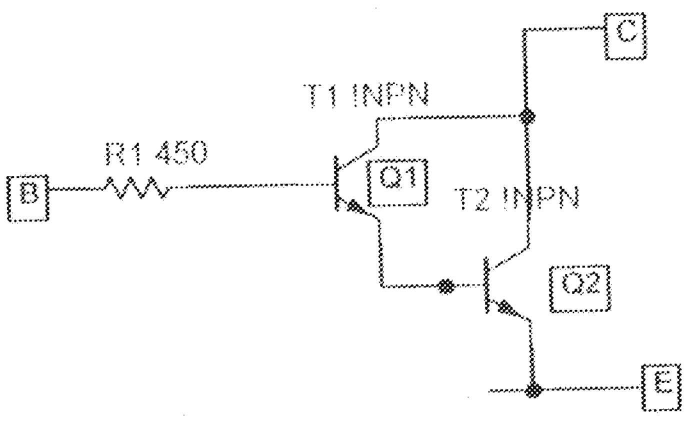


Fig2.5 Darlington Transistor configuration.

With the transistor configuration show as above, the result behaves like a single transistor with beta equal to the product of the two transistor betas.

For a Darlington transistor the base – emitter drop is twice normal and saturation voltage is at least one diode drop. Also, the combination tends to act like a rather slow transistor because Q_1 cannot turn off Q_2 quickly. This problem is taken care of by including a resistor from base to emitter of Q_2.

R also prevent leakage current through Q_1 form biasing Q_2 into conduction, it values is chosen so that Q_1's leakage current (nanoamperes for small signal transistors, as much as hundreds of microamps for power transistors) produce less than a diode drop across R and so that R doesn't sink a large proportion of Q_2's base current when it has a diode drop across it.

Typical R might be a few hundred ohms in a power transistor Darlington, or a few thousand ohms for a small signal Darlington.

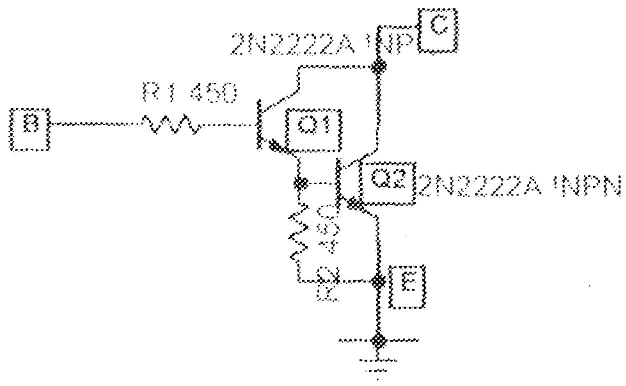


Fig 2.6 Darlington Transistor configuration.

2.6 RELAY CIRCUIT ANALYSIS

Relays are electrically controlled switch. In the usual type which is used in this project, a coil pulls in an armature when sufficient coil current flows.

The transistor circuit drives the relay i.e. through the action of the transistor circuit the relay is either energized or otherwise. Whenever the relay is energized contact is initiated at the relay output causing the electrical appliance to be turn on.

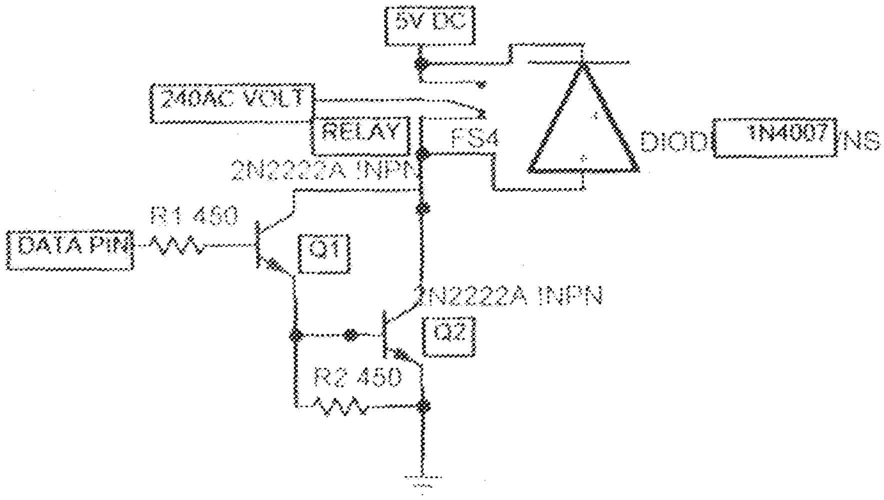


Fig2.6

As show in the figure2.7 above the circuit need external power supply which has the output voltage which is right for controlling the relay(12V in this case). The transistor does the switching of current and the diode prevents spikes form the relay coil form damaging the computer and the transistor.

Since coils (solenoids and relay coils) have a large amount of inductance, when the current is cut off they generate a very large voltage spike.

2.7 MICROCOMPUTER UNIT

A microcomputer is a computer whose central processing unit (CPU) is constructed from just a few LSI (large scale integration) circuits; the CPU chip (or chip set) constitute a microprocessor.

Microcomputer is required for interfacing object. It house the parallel port needed for this interfacing project. The control program (source code) and the window graphics for the user are realized with the microcomputer.

An interface generally is a shared boundary between two or more devices which involves sharing information. The parallel port is essentially for interfacing projects.

A PC parallel port (printer port) is an inexpensive and yet powerful platform for implementing projects dealing with the control of real world peripheral. The parallel port provides eight TTL outputs five inputs and four bi-directional leads and it provides a very simply means to use the PC interrupt back of PC as a D type 25 pin female connector. The CPU parallel port is subdivided into 3 types: The status port, the control port, the data port. The parallel port is software enhanced, so as to make the data port bi- directional. Each port has its own unique addresses. All the ports used in this project. The data port has a port address of value 3BC or 378 in hexadecimal, while the decimal equivalent is 76,888 or 632. The status port has address 3BD or379 or 278 in hexadecimal or 957 or in decimal.

Below is a diagram illustrating the port address, the pin numbers and the way the signals are arranged in a register like this format.

Bit 7	Bit 6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Pin 9	Pin 8	Pin 7	Pin 6	Pin 5	Pin 4	Pin 3	Pin 2
Data 7	Data 6	Data 5	Data 4	Data 3	Data 2	Data 1	Data 0

Table 2.3a Data Port of the Parallel Port

Port	Address
Hex	Dec
3BC	956
378	888
278	632

Table 6.2 Status ports of the parallel port

Table 6.2 Status ports of the parallel port

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Pin 11	Pin 10	Pin 12	Pin 13	Pin 15	Res'd	Res'd	Res'd
Busy	Acknowledge	Paper out	Select in	Error	Not used	Not used	Not used

Note: Res'd mean reserved

Port Address

Hex	Dec
3BD	957
379	889
278	633

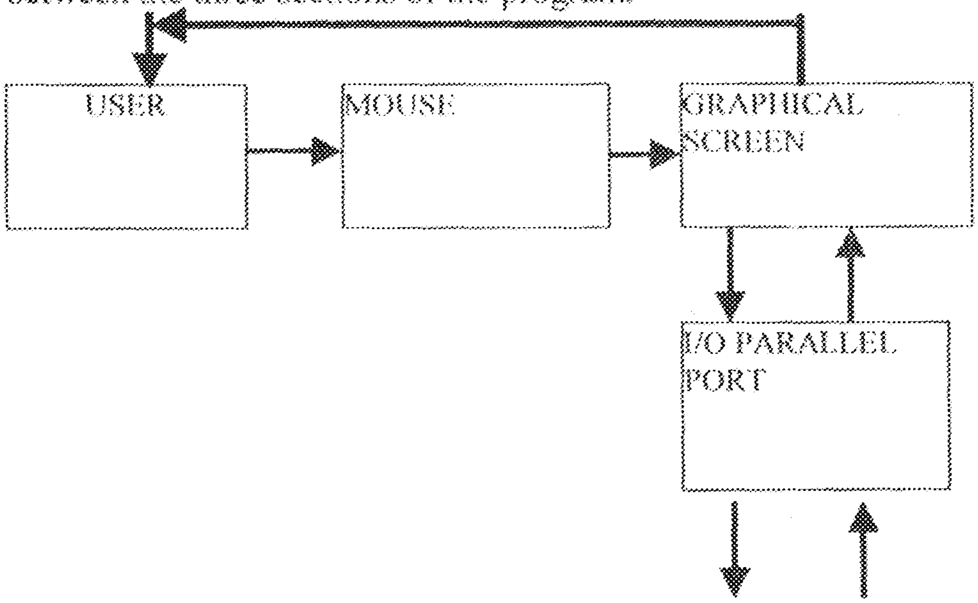
Table2.6 Control Port of the Parallel Port

Bit 7	Bit 6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Res'd	Res'd	Res'd	Res'd	Pin 17	Pin 16	Pin 14	Pin 1
Not used	Not used	Not used	Not used	Select printer	Initialized printer	Auto line feed	Strobe

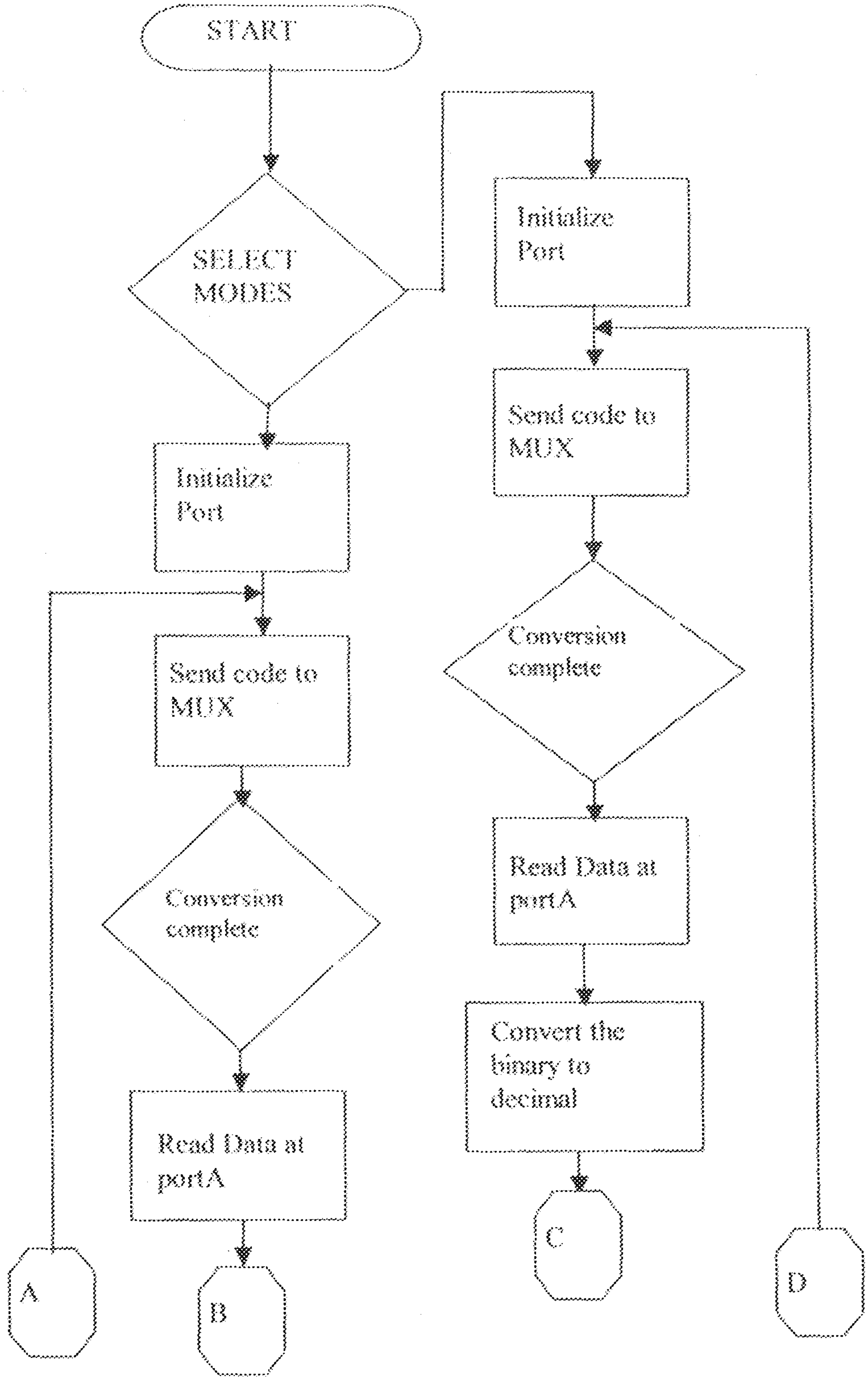
Port	Address
Hex	Dec
37A	958
3BE	890
27A	63A

2.8 SOFTWARE DESIGN

The software design aspect of CAAS consists basically of three parts. The mouse interface, the graphical interface and keyboard routine and the input – output routine. The user interact with the graphical through the mouse and the keyboard, the graphical will then interface with I/O routine through the parallel port. The fig below gives a clear illustration of the interaction between the three sections of the program.



The most important of these sections is the I/O routine that forms the major part of the monitor program is described using the flow chart below. Figure 2.8a shows the flow chart for temperature and intensity control. Figure 2.8a shows the flow chart for time control.


START
SELECT MODES
Initialize Port
Send code to MUX
Conversion complete
Read Data at portA
A
B
Initialize Port
Send code to MUX
Conversion complete
Read Data at portA
Convert the binary to decimal
C
D

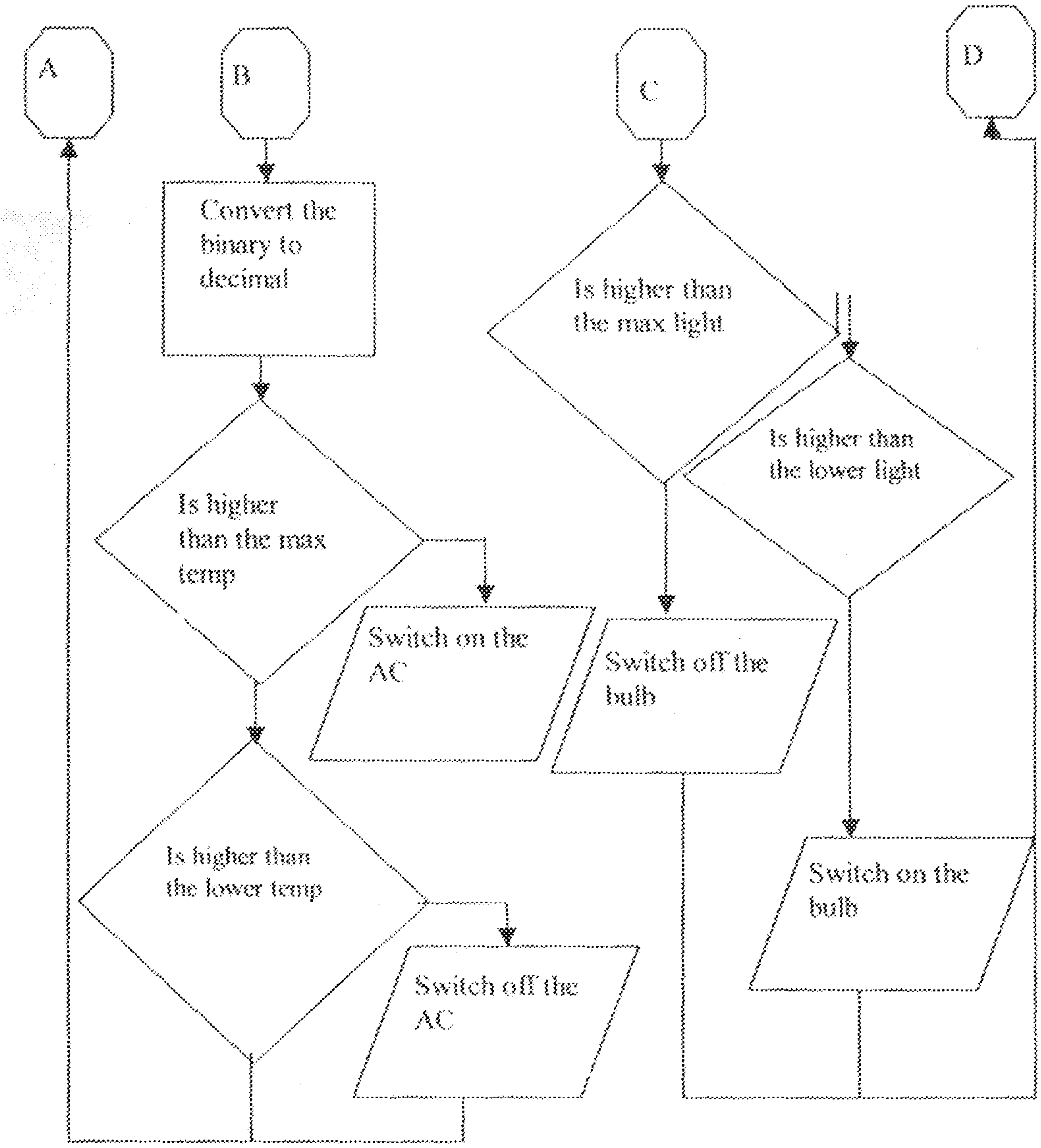

A
B
C
D
Convert the binary to decimal
Is higher than the max light
Is higher than the lower light
Is higher than the max temp
Switch on the AC
Switch off the bulb
Is higher than the lower temp
Switch on the bulb
Switch off the AC

Fig2.8a

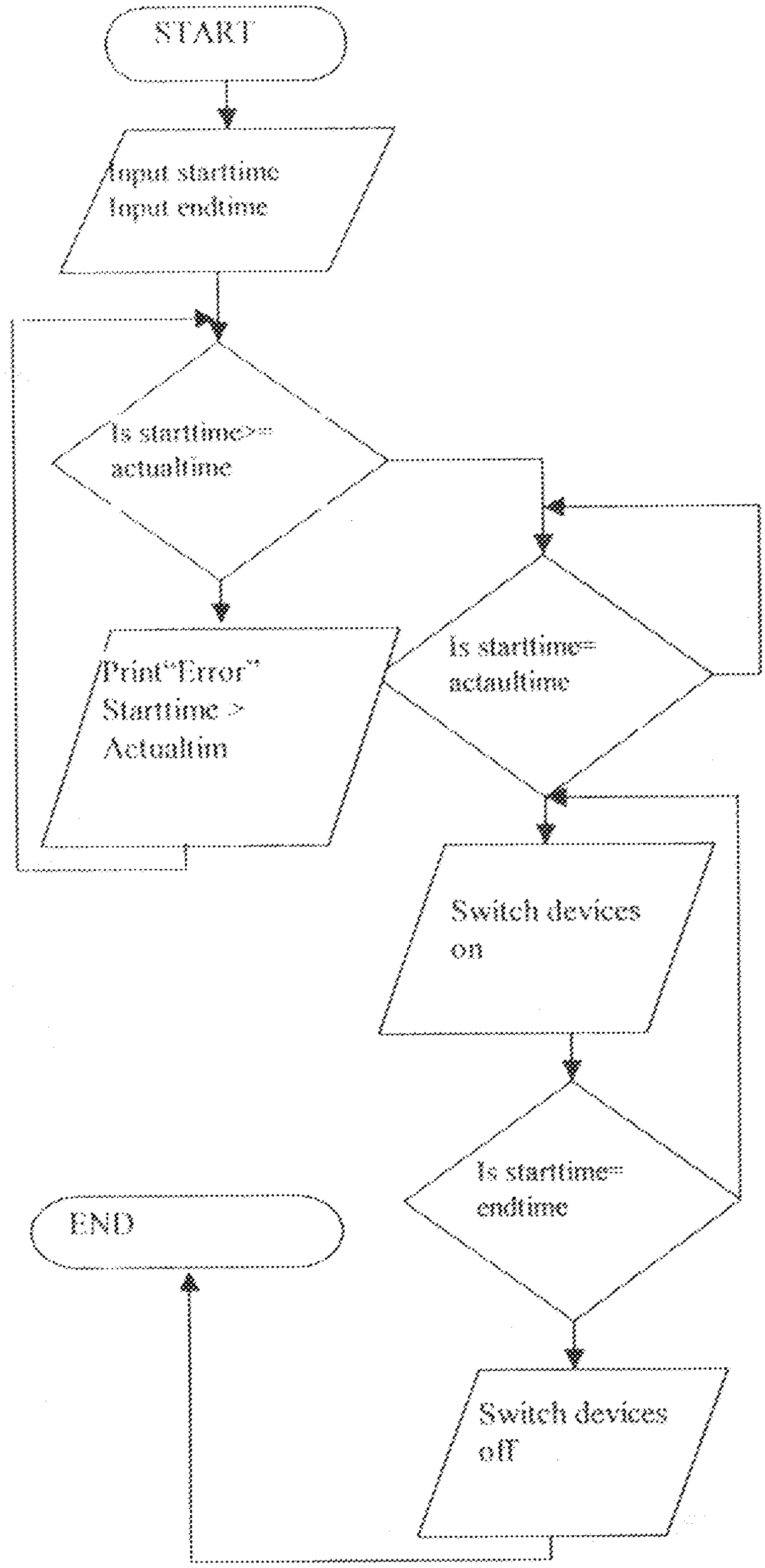

START
Input starttime
Input endtime
Is starttime>=
actualtime
Print"Error"
Starttime >
Actualtim
Is starttime=
actaultime
Switch devices
on
Is starttime=
endtime
Switch devices
off
END

Fig2.8b

2.9 POWER SUPPLY UNIT

The **CAAS** and almost all electronic circuits require a direct current (D.C) voltage source for operation. For portable low power systems, batteries may be used. More frequently, a circuit, which converts the readily available A.C waveform of the power sources to direct voltage of constant amplitude.

The circuit employs in the AC – to – DC conversion is called rectifier, this employs one or more diodes. The rectifier is preceded by a transformer which either set – up or (mostly) set down the alternating current (A.C) supply to suit the requirement of the providing electrical isolation between the A.C. supply and the rest of the circuit. Filter is required to remove the fluctuation (called ripples) present in the output voltage supplied by the rectifier. Since the input voltage is not regulated, thus a voltage regulator is used to overcome this drawback. The block diagram of fig2.8a illustrates the stages of the supply.

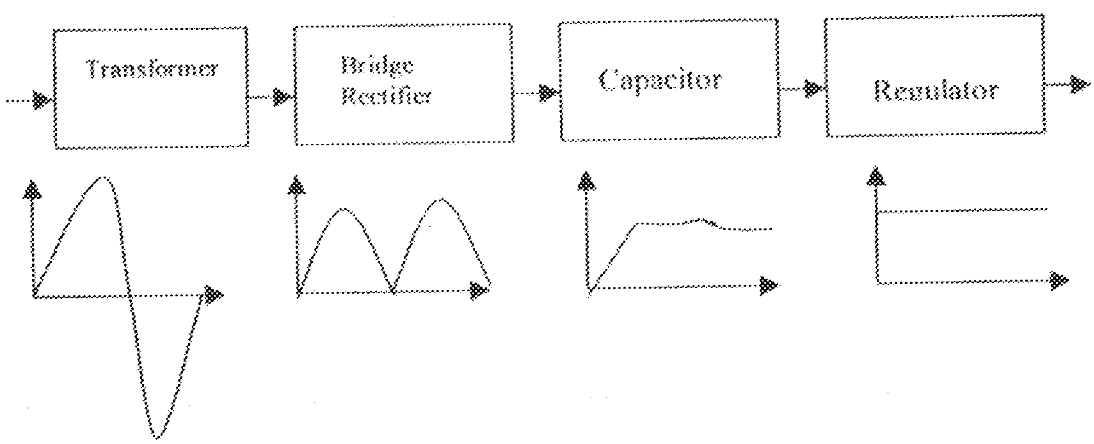


Fig2.9 Block Diagram of the Power Supply Unit.

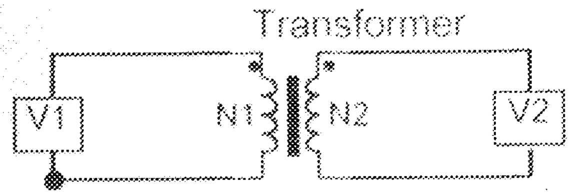
2.9.1 THE TRANSFORMER

The first stage of a power supply is the transformation stage, the transformer steps down the input A.C voltage to the desired level. It also isolates the load from the A.C power supply.

The physical basis of a transformer is a mutual inductance between two circuit linked by a common magnetic flux. It consists of two inclusive the coils, which are electrically separated but magnetically linked. The coil connected to the A.C source is called the primary (input) of the transformer and the other side is called secondary (output) of the transformer. The ratio of the primary voltage V_1, to that of the of the secondary voltageV_2, is directly proportional to the ratio of the number of turns in the primary winding n_1, and the number of turns in the secondary winding n_2.

$$\frac{V_1}{V_2} = \frac{n_1}{n_2}$$

Transformer can simply represented as shown in fig2.9.a

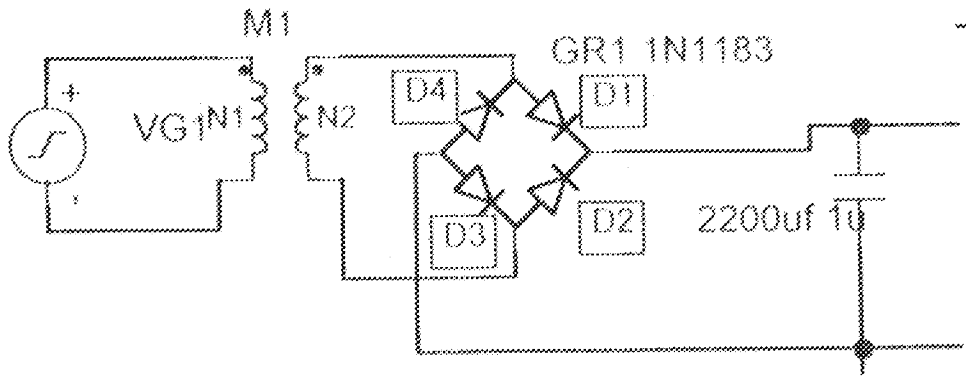


2.9.2 RECTIFIER

Rectifier employs one or more diodes to convert A.C voltage into pulsating direct voltage and the process is referred to as Rectification.

Full – wave bridge rectifier is used for rectification in the power supply unit of the project. Full wave rectifier uses four diodes for its operation and it makes use of both the positive and negative half cycles of the A.C supply.

A typical bridge rectifier is shown in fig2.9b



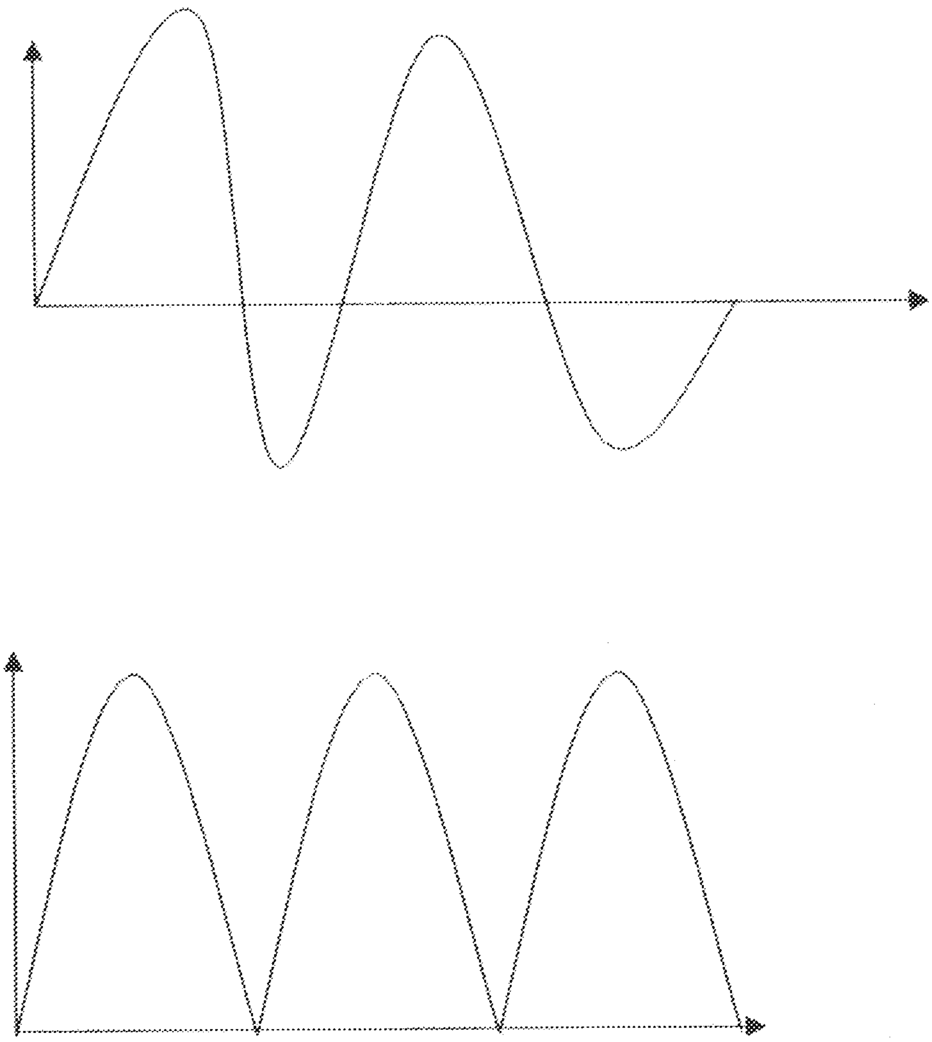


Fig2.9c

During the positive half – cycle, diodes D_1 and D_3 are forward diode biased and conduct, similarly during the negative half cycle, the diodes D_2 and D_4 are forward biased and conduct. Consequently, the wave form show in fig 2.9c is obtained at the output of the rectifier.

The average D.C voltage of the output voltage is given as

$$Vdc = \frac{2Vp}{\Pi} = \frac{(2(2)^{(0.5)})Vs}{\Pi}$$

Where V_p and V_s are the r.m.s and peak value of the rectifier input voltage.

2.9.3 THE FILTER (SMOOTHING) CIRCUIT

The output voltage of the full wave bridge rectifier consists of ripples(harmonics), which is not good for the operation of sophisticated electronic circuits. Thus a filter circuit is employed to get rid of these A.C components in order to obtain a pure D.C.

In this case, capacitor filter circuit is adopted to smoothen out the pulsations in the output, since capacitor is capable of opposing change in voltage across it, an appropriate capacitor is therefore connected across the output of the rectifier. The capacitor charges up during the diodes conduction period to the peak value and when the rectifier voltage falls below this, the capacitor discharge through the load, so that the load receives almost steady current fig2.9.3 show the load voltage obtained from a full wave rectifier with a capacitor filter.

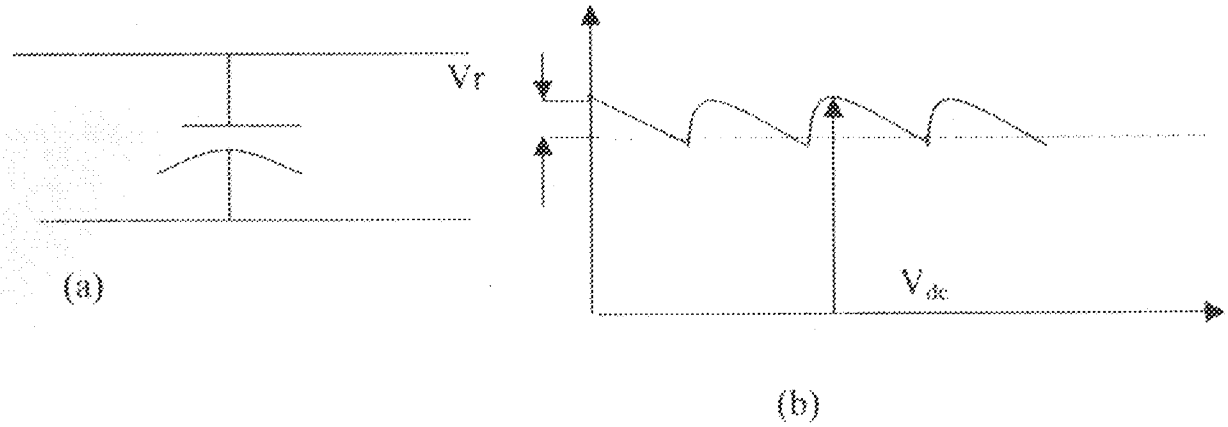


Fig 2.9.3 (a) Filter circuit

(b)Waveform illustration the filter Action of the capacitor

2.9.4 THE REGULATOR

The output voltage of the filter capacitor varies when the load current or the input voltage varies. This effect is also undesirable for efficient operation of electronic circuits that require regulated supply. Normally the output voltage should remain constant, therefore the aim of a regulator is to keep the variation to zero, or bearest minimum value.

In this project design, a monolithic voltage regulation IC chip was used to obtain the required and acceptable voltage stability. The voltage regulator IC used is the three terminal, positive, fixed voltage regulator. These regulators are available in the 7800 series. Since all the ICs used can operate effectively at 5V, a 5V regulator (7805) was used. A capacitor of low value is always connected across the output terminal of the regulator to improve the transient response as shown in fig 2.9.4a

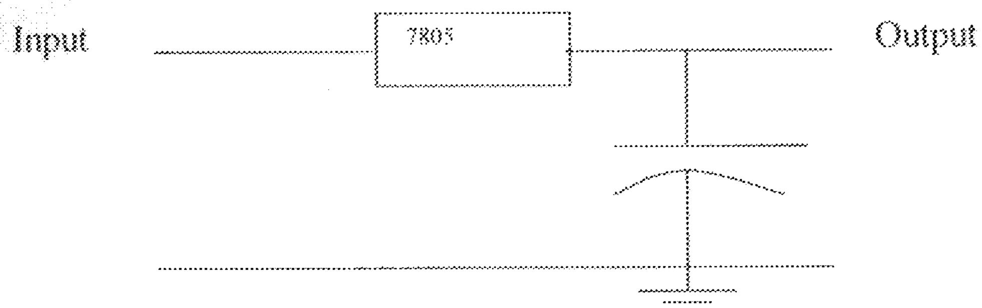


Fig2.9.4a The 7805 used as a fixed 5V output voltage regulator

2.9.5 DESIGN SEQUENCE OF THE POWER SUPPLY UNIT

The object of the power supply unit is to provide a regulated DC voltage that will power the discrete IC chips used in the project. Therefore a 5V power supply that can deliver 500mA is suitable for the purpose and also 12V power supply was used to supply voltage to the relay.

The transformer voltage rating can be calculated by considering the voltage drop across the diodes of the rectifier and connecting leads. Transformer voltage is chosen to be 12V (secondary).

$$V_{r.m.s} = \frac{V_{peak}}{\sqrt{2}}$$

$V_{peak} = 12V$

$$V_{r.m.s} = \frac{12}{\sqrt{2}} = 9V$$

Hence, a 220/9V step down transformer was used.

The transformer and possibly the rest of the circuit, the input and output power transformer must be considered.

Power input = Power Output

$I_1V_1 = I_2V_2$

$V_{1(r.m.s)} = 220V, \quad I_2 = 1A, \quad V_2 = 9V$

$$I_1 = \frac{I_2V_2}{V} = \frac{1 X 9}{220} = 40.91mA$$

Thus, at full load, a current of 41mA flows in the primary of the transformer.

For the capacitor filter, the ripple voltage of the rectifier output was estimated to be about 5V.

V = ripple voltage

V = 5V

The time between peaks of the rectified input waveform to the capacitor filter is given by $\triangle t$

$$\triangle t = \frac{1}{2f} \quad f = \text{frequency of the mains} = 50hz$$

$$\triangle t = \frac{1}{2X50} = 10ms$$

$$I = \frac{C\triangle V}{\triangle t} \qquad I = 1A$$

$$C = \frac{1A \, X \, 0.01}{5v} = 0.002F$$

However, a filter capacitor of value greater than 1μf was used. The voltage rating of the capacitor of the filter capacitor was chosen to twice the peak of

Vpeak; hence a filter capacitor of 200 μf and 25V was used. An IC regulator with an output of 5V at 1A was used.

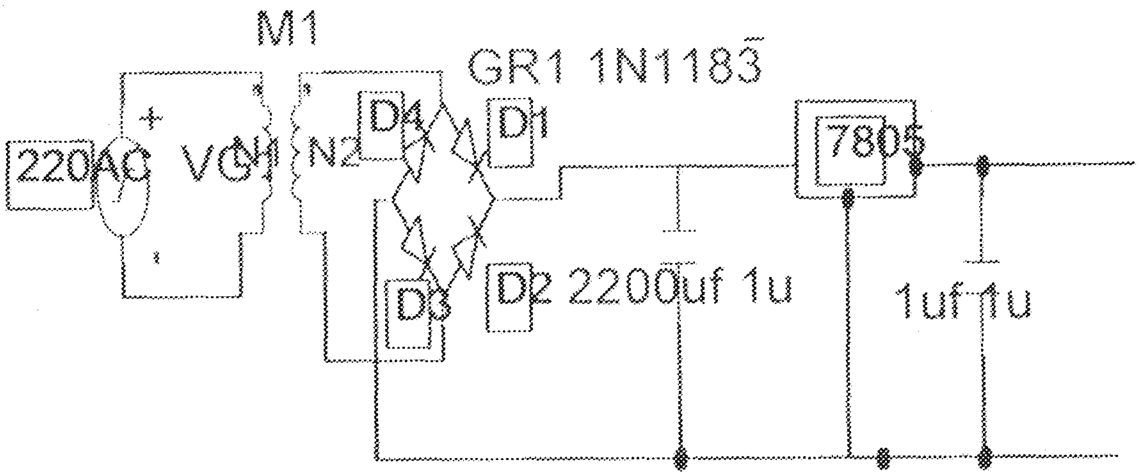


fig2.9.5 The Complete Circuit Diagram of the Power Supply Unit

CHAPTER THREE

CONSTRUCTION, TESTING AND RESULT

3.1 CONSTRUCTION TOOLS AND EQUIPMENT

During the construction of CAAS designed in this project, some electronics tools and equipment were used. These tools are briefly discussed in this section.

Soldering iron: A modular soldering iron with 30watts heating element was used for the project. Any higher wattage may damage the electronic component especially the sensors.

Soldering stand: This was used for keeping the soldering iron in a safe, upright position. The stand use is made up of metal and it is constructed so that the bit of the soldering iron does not touch any metallic or plastic parts.

Solder: Flux – core solder type was used for the soldering of the various electronic components.

Sponge: this was used for occasional cleaning of the soldering bit during use. The sponge was always kept damp and used to wipe the soldering bit.

Lead – sucker: This was used for sucking up molten solder. It also served to a great extent in removing bad components out of Vero board.

Wire cutters: Cutters were used to cut wires to required length and to rip off the excess leg of electronic components after soldering.

Strippers: Wire strippers were used to strip off the insulation from solid or stranded hookup wires.

Wire and connectors: Wire is the link that connects all the parts of the circuit together. For this project, solid wire was used because it is easy soldered and unsolder.

Digital multimeter: This was used for quite a number of functions. It was used to test the continuity of electronics links, to test logic level, to measure resistance, capacitance and voltage in various part of the circuit.

Vero Board: This allows permanent prototyping of an electronic design. The Vero board was pre – etched, therefore the various electronic components were simply soldered in place, using connector wires and blade to make continuity respectively between them, wherever necessary.

3.2 CONSTRUCTION DETAILS

Careful planning of the circuit layout simplifies wiring, minimizes errors and made troubleshooting easier. Overall circuit layout was made parallel so as to conform to the orderly schematic diagram of circuit. All ICs used in the design were position in the same direction for a logical signal flow and this also made it easy to keep track of pin numbers during wire and troubleshooting. The continuity on the Vero board was always cut with the aid razor blade as demanded.

3.2.1 CONSTRUCTION OF THE POWER SUPPLY UNIT

The Vero board was scratched to provide a clean surface for good soldering. The secondary of the transformer, the four diode were soldered in a way to form a bridge rectifier, 222uf capacitor, the 5V regulator and the 1uf was later conned. The output of the unit was then connected to a long continuous line of the vero board where it would be trapped to any desired point.

3.2.2 CONSTRUCTION OF INPUT CIRCUIT

The light – dependent resistor, temperature, capacitor and the switch were carefully soldered to the vero board. The supply was obtained from the power supply unit. The output of voltage divider was V0 was sent to input of analog multiplexer and also the output of the temperature sensor was fed into the multiplexer. The output of the multiplexer was now fed in the ADC for conversion to digital output so that the microprocessor could process with the data supplied. The input of switches was then connected to the control pins of the via a transistor and octal buffer.

3.5 CONSTRUCTION OF THE ANALOG – TO – DIGITAL CONVERTER CIRCUIT

The 20 pins IC socket was used to hold the ADC 0804 so that the temperature of the soldering iron will not damage it. The V(+) in was connected to output of the multiplexer while the V(-) was grounded. The output of the Clock oscillator was connected to the clock input (WR) of the ADC 0804. The 10kohms resistor and150pf capacitor were soldered.

3.6 CONSTRUCTION OF THE HARDWARE INTERFACE

The outputs of ADC 0804 were fed through the data pins of the parallel port to the microprocessor. And the octal D flip-flop inputs were connected to the status pins of the parallel port and the select inputs of the multiplexer were connected to the control pins of the parallel port. The each output of the octal buffer (D flip – flop) was used to control an external device via a transistor acting as switch.

3.5 PROJECT CASING

Wooden material (ply wood) was chosen for the construction of the casing of this project because of its desirable properties. Such low heat conductivity, lightness and resistance to corrosion. This is a cuboid of dimension (25X18X16) was used. The picture of the casing and convenient location for switches, light dependent resistor, temperature sensors and the parallel port on the casing.

CHAPTER FOUR

CONCLUSION AND RECOMMENDATIONS

3.5 CONCLUSION

The main purpose of the project was to make students more familiar with electronic components and also to enhance the skills and techniques in handling construction tools and equipments, and this was achieved. The principle of Top – Down Design was adopted in the design and construction of this project.

The Computer – Aided Automatic Switch will be of great use to engineers, doctors, agriculturist, scientist, photographers, technologists, and so many people.

4.2 RECOMMENDATION

In order to obtain higher degree of accuracy in reading the light intensity, an optical sensor should be used because of its faster response.

And also a tyristor should be instead of relay when it want to used in gas industry or when the power of the appliance is of higher power.

3.4 TESTING AND TROUBLESHOOTING

The final stage of the project construction was the coupling stage, when different unit of the project was coupled together and test.

When the circuit was powered software was used to control the devices it was discovered there was no control basically because the computer was not reading any value from the parallel port and this is result that some components fail to power. The circuit was troubleshooted by using a multimeter was used to check the voltage at each of the pins feeding the parallel port. And when the necessary corrections were made, the circuit was powered again and the readings were displayed on the monitor and with this I was able to control the appliances.

3.5 RESULT

The CAAS designed and constructed was able to measure temperature to a very high degree of accuracy. When the temperature was increased with the help of soldering iron, the thermometer read 450C and the CAAS reed 46.5oC. Also, the software responses were very fantastic and it was used to control all the appliances connected it.

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APPENDIX

CONTROL PROGRAM FOR COMPUTER AIDED AUTOMATIC SWITCH

```
 Dim endtime As Date, starttime As Date, currenttime As Date, county As Long
 Dim timerresult As Long, jj As String, jjj As String
 Public aa As Long, bb As Long
 Private Sub cmdcroom_Click()
End Sub
Private Sub cmdfan_Click()
Dim jj As Long, jjj As Long
If txtmaxt(o).Text <> "" And txtmint.Text <> " " Then
jj = CLng(txtmaxt(0).Text)
jjj = CLng(txtmint.Text)
Call Timer7_Timer
Else
MsgBox "you can't leave it blank"
End If
End Sub
Private Sub cmdheat_Click()
Dialog.Show
End Sub
Private Sub cmdlight_Click()
Call Timer6_Timer
End Sub
Private Sub cmdexit_Click()
Unload Me
Load frmwel
frmwel.Show
End Sub
Private Sub cmdother_Click()
If txtend.Text <> "" And txtstart.Text <> "" Then
If IsDate(txtend.Text) = True And IsDate(txtstart.Text) = True Then
endtime = CDate(txtend.Text)
starttime = CDate(txtstart.Text)
currenttime = CDate(txtcurrent.Text)
 If txtcurrent.Text > txtstart.Text Then
```

```
 MsgBox " the starting time has past,check the Actualtime and determine
your starting time", vbOKOnly, "wrong entry"
 txtstart.Text = ""
 txtstart.SetFocus
 Exit Sub
 ElseIf currenttime < starttime Then
 Timer2.Enabled = True
 Timer2_Timer
 End If
Else
MsgBox " Enter valid time", vbOKOnly, "Enter time"
txtstart.Text = ""
txtstart.SetFocus
txtend.Text = ""
txtend.SetFocus
End If
Else
If txtstart.Text = "" Then
MsgBox "you can't leave it blank", vbOKOnly, "enter time"
txtstart.SetFocus
Exit Sub
End If
If txtend.Text = "" Then
MsgBox "you can't leave it blank", vbOKOnly, "enter time"
txtend.SetFocus
Exit Sub
End If
txtstart.SetFocus
txtend.Text = ""
txtend.SetFocus
End If
End Sub
Private Sub Command1_Click()
End Sub
 Private Sub Form_Initialize()
'Timer1.Enabled = True
Call Timer1_Timer
txtend.Text = ""
```

```
End Sub
Private Sub Form_KeyPress(KeyAscii As Integer)
If KeyAscii = 32 Then
Timer7.Enabled = False
ElseIf KeyAscii = 84 Then
Timer6.Enabled = False
ElseIf KeyAscii = 76 Then
Timer5.Enabled = False
End If
End Sub
Private Sub Form_Load()
Out &H37A, 1
aa = Inp(&H378)
Out &H37A, 0
bb = Inp(&H378)
lblnotlight.Caption = CStr(aa)
lblnottemp(1).Caption = CStr(bb)
'txtstart.Text = ""
End Sub
Private Sub Form_Paint()
frmcroom.ScaleTop = screentop
frmcroom.ScaleLeft = screenleft
'frmcroom.Height = screenheight
'frmcroom.Width = screenwidth
cmdother.Top = cmdheat.Top
cmdother.Left = cmdlight.Left
cmdother.Width = cmdlight.Width
cmdother.Height = cmdlight.Height
txtcurrent.Top = Label5.Top
txtcurrent.Left = Label5.Left + Label5.Width
cmdexit.Top = cmdother.Top + 600
cmdexit.Left = cmdheat.Left
cmdexit.Width = cmdother.Width * 4.6944
cmdexit.Height = cmdother.Height
End Sub
Public Sub Timer1_Timer()
Timer1.Interval = 500
txtcurrent.Text = Format(Time, "long time")
```

```
txtmint.SetFocus
Exit Sub
Else
End If
End Sub
Private Sub txtstart_keypress(KeyAscii As Integer)
If (KeyAscii < 48 Or KeyAscii > 58) And KeyAscii <> 97 And KeyAscii <>
80 And KeyAscii <> 48 And KeyAscii <> 58 And KeyAscii <> 77 And
KeyAscii <> 109 And KeyAscii <> 8 And KeyAscii <> 112 And KeyAscii
<> 65 Then
Beep
KeyAscii = 0
MsgBox "please you can't enter letters", vbCritical, (warning)
txtstart.Text = ""
txtstart.SetFocus
Exit Sub
Else
End If
End Sub
Private Sub txtend_keypress(KeyAscii As Integer)
If (KeyAscii < 48 Or KeyAscii > 58) And KeyAscii <> 97 And KeyAscii <>
80 And KeyAscii <> 48 And KeyAscii <> 58 And KeyAscii <> 77 And
KeyAscii <> 109 And KeyAscii <> 8 And KeyAscii <> 112 And KeyAscii
<> 65 Then
Beep
KeyAscii = 0
MsgBox "please you can't enter letters", vbCritical, (warning)
txtend.Text = ""
txtend.SetFocus
Exit Sub
Else
End If
End Sub
Private Sub timer3_timer()
Out &H3BD, 20
Timer3.Interval = 62.5
endtime = CDate(txtend.Text)
starttime = CDate(txtstart.Text)
currenttime = CDate(txtcurrent.Text)
```

```
End Sub
 Private Sub Timer2_Timer()
 cmdother.Enabled = False
 Dim b As Long
Timer2.Interval = 62.5
currenttime = CDate(txtcurrent.Text)
county = DateDiff("s", currenttime, starttime)
countd.Caption = county
For b = county To 0
If currenttime = starttime Then
Timer3.Enabled = True
timer3_timer
Timer2.Enabled = False
End If
Next b
End Sub
Public Sub Timer6_Timer()
Out &H37A, 0
If txtmaxt(1).Text <> "" And txtmaxt(1).Text <> " " Then
jj = CLng(txtmaxt(1).Text)
jjj = CLng(txtmaxt(2).Text)
Timer6.Enabled = True
Timer6.Interval = 62.5
'Call calculate
'Call timeread_time
bb = Inp(&H378)
lblnotlight.Caption = CStr(bb)
If jj > bb And bb > jjj Then
Out &H3BD, 0
ElseIf bb > jj Then
Out &H3BD, 0
Else
Out &H3BD, 1
End If
Else
MsgBox "you can't leave it blank", vbOKOnly
End If
```

```
End Sub
Public Sub Timer7_Timer()
Out &H37A, 1
Timer7.Enabled = True
Timer7.Interval = 62.5
'Call timetemp_time
yy = Inp(&H378)
lblnottemp(1) = CStr(yy)
If jj > yy And bb > yyy Then
Out &H3BD, 40
ElseIf yy > jj Then
Out &H3BD, 0
Else
Out &H3BD, 40
End If
End Sub
Private Sub txtmaxt_KeyPress(Index As Integer, KeyAscii As Integer)
If (KeyAscii < 48 Or KeyAscii > 58) And KeyAscii <> 97 And KeyAscii <>
80 And KeyAscii <> 48 And KeyAscii <> 58 And KeyAscii <> 77 And
KeyAscii <> 109 And KeyAscii <> 8 And KeyAscii <> 112 And KeyAscii
<> 65 Then
Beep
KeyAscii = 0
MsgBox "please you can't enter letters", vbCritical, (warning)
txtmaxt(j).Text = ""
txtmaxt(j).SetFocus
Exit Sub
Else
End If
End Sub
Private Sub txtmint_KeyPress(KeyAscii As Integer)
If (KeyAscii < 48 Or KeyAscii > 58) And KeyAscii <> 97 And KeyAscii <>
80 And KeyAscii <> 48 And KeyAscii <> 58 And KeyAscii <> 77 And
KeyAscii <> 109 And KeyAscii <> 8 And KeyAscii <> 112 And KeyAscii
<> 65 Then
Beep
KeyAscii = 0
MsgBox "please you can't enter letters", vbCritical, (warning)
txtmint.Text = ""
```

```
notme = DateDiff("s", currenttime, endtime)
lblnotme(0).Caption = DateDiff("s", currenttime, endtime)
For b = notme To 0
Out &H3BD, 0
txtend.Text = CStr(0)
cmdother.Enabled = True
Timer3.Enabled = False
txtstart.Text = 0
txtstart.Text = 0
txtstart.SetFocus
txtend.SetFocus
Exit Sub
Next


End Sub
```

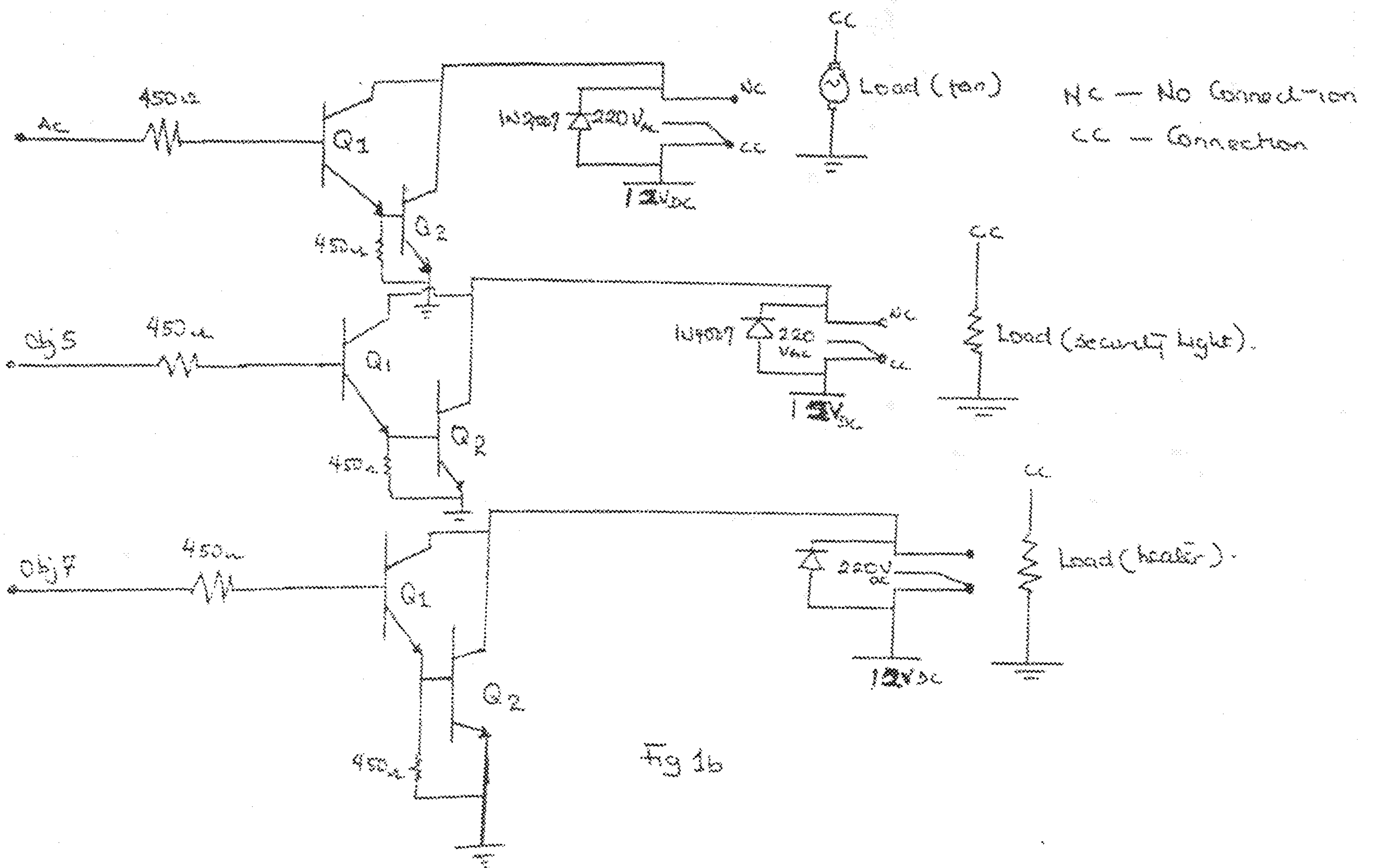
Ac
450Ω
Q1
Q2
1N4007
220 Vac
12Vdc
Nc
cc
Load (fan)
NC — No Connection
CC — Connection
Obj S
Load (security light).
Obj F
220Vac
Load (heater).

Fig 1b

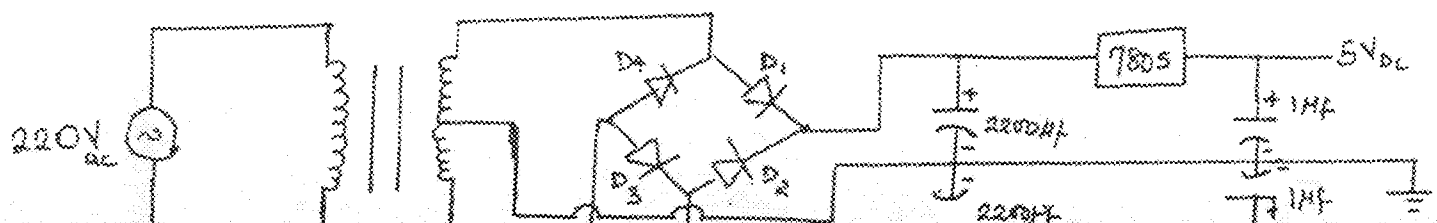
220Vac
D1
D2
D3
D4
7805
2200uF
1uF
5Vdc

Fig 1c

CIRCUIT DIAGRAM FOR COMPUTER AIDED AUTOMATIC SWITCH

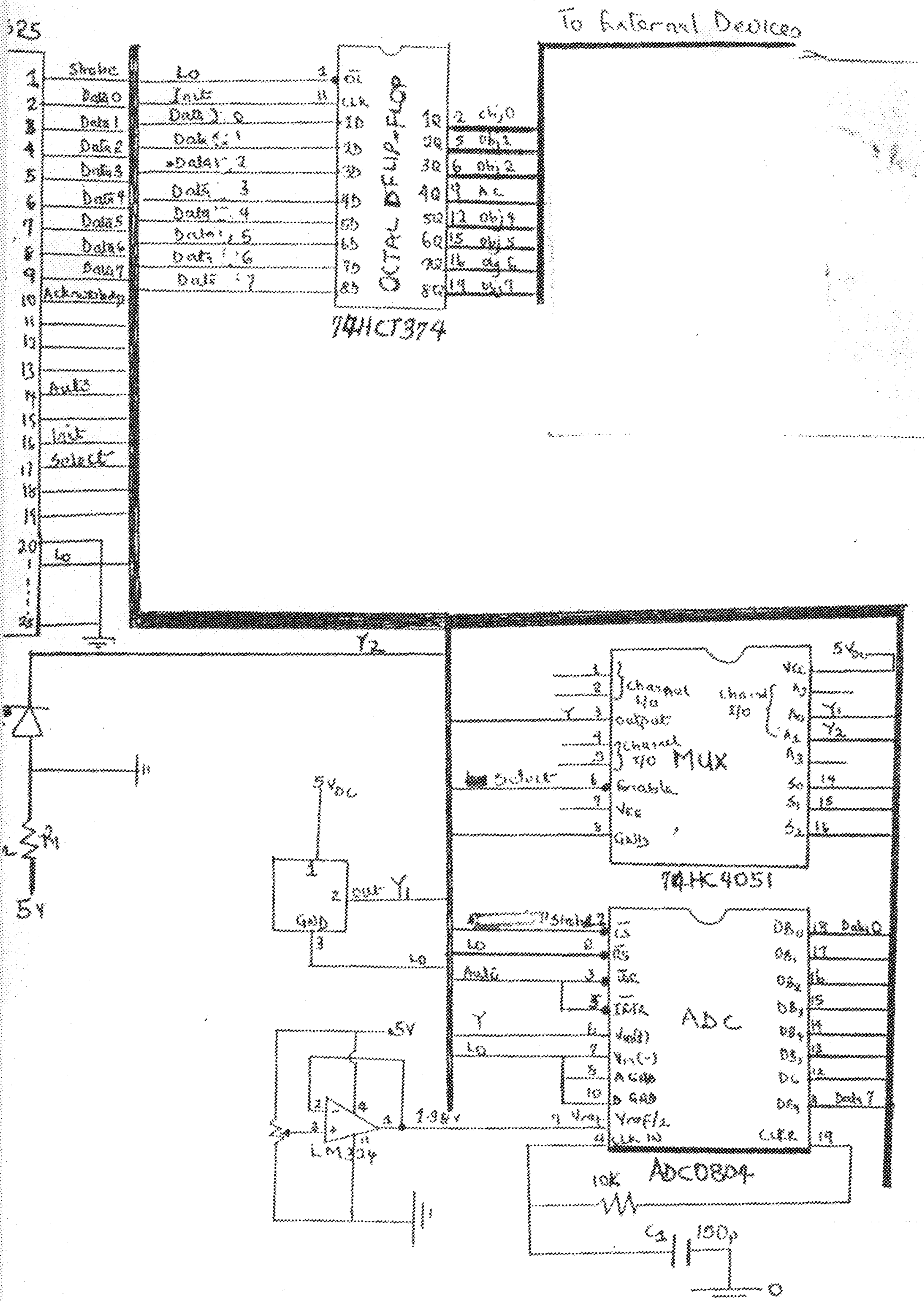

Fig 1a