DESIGN AND CONSTRUCTION OF A MICROCONTROLLER-BASED ALTERNATING CURRENT TIMER

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2005/22084EE

A Project Submitted to the Department of Electrical and Computer Engineering

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DEDICATION

I dedicate this work to my parents, Mr. and Mrs. Otaru as well as my siblings for always being there for me.

Certification?

DECLARATION

I, **OTARU MUHAMMED O.** with Matriculation Number 2005/22084EE declare that this work was done by me under the supervision of Mr. Nathaniel Salawu and has never been presented elsewhere for the award of degree. I also relinquish the copyright to the Federal University of Technology, Minna.

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All glory is to God, the most powerful and merciful, all honour is to him, whose infinite protection throughout my stay in the university kept me going. May the Lord Almighty Continue to show forth this mercy and protect us for the rest of our lives.

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ABSTRACT

The Circuit is designed to set the timing to appliances that use alternating current supply. The circuit comprises basically of a microcontroller and other peripheral devices. It is used with applications that have high risk of usage (i.e. appliances that could lead to a serious disaster if not properly monitored of operated) such as electric cooker, microwaves, ovens and so on. A microcontroller was programmed using assembly language. The time can be set for a device within any timing range between one (1) minute and twenty-four (4) hours.

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CHAPTER ONE

INTRODUCTION

1.1 Expository Introduction

In our environment, you will notice all the household appliances that requires a start time and finish time for it to operate. On like Alternative Current Timer (A.C Timers) is not any form of technology that is new, it has been in existence before now. Other products once activated, switch on, on and after a period of time. Before now time up of devices is very important to applied to household appliance, e.g. microwave ovens, gas cooker, electric heater e.t.c. this type of timers has an advantage because it affects human life in one way or the other.

These are various applications where the use of A.C timer is very useful, but the use of micro-computer to control timing of this appliance is not economical. Before now micro-controllers are being used, because things become simple with use of micro-controllers. Micro-controllers are mostly suitable for application where large data's are to be processed or where timing is needed.

A micro-controller (often abbreviated MCU) is normally used for the purpose of controlling, that implements a programme (use), it is also a single chip (integrated circuit). A micro-controller is usually found in devices such as micro wave oven, CD players, VCR, Security System, timing and attendance clocks e.t.c. The program (user) that sometimes runs on the MCU is normally contain either second chip called EPROM or with in the some chip of the MCU itself.

The micro-controller are use in devices that require some amount of computing power but don't require power as that provided by a complex (and expensive) 486 or 586 systems. Micro-computer based systems are basically smaller, more trustable and cheaper. They are ideal for the types of application described above where costs and unit sizes are very important consideration.

The project has various sectors which includes the power supply unit, the control unit and the display unit etc. The display unit is described to display the figures that have preset by the user terminals. The user terminal has three (3) switches.

i. The first of the switches indicate the timing mode of the device i.e. may be the user intends to set the timing of the device.

ii. The second switch is the increase switch,

iii. The third switch is the decrease switch.

The relay unit is described to offset the MCU for the aim of timing, while the power supply unit is used in powering the various parts of the devices from the MCU which needs 5V for full operation to the relay that need 12V for full operation.

1.2 Project Objectives

1. To introduce the student to the design process so that they can checkmate the real problems and look for the solution. Secondly, to introduce the student the principles of timing and timing period can be changed by the simple calculation.
2. It make student to familiar with use of micro-controller as well as achieving very sound programming concepts during the course of project.
3. It make student to get the principles behind the use of electronic components and their functions.
4. It makes us to understand the use of prototyping techniques such as bread board, and computer circuit simulating programme.
5. Opportunity for a student to make their own PCB (Print Circuit Board) and improve on their soldering skill.

1.2.1 Methodology

The modular/ unit design approach was adopted in the design of this project. The Circuitry was discretely designed in different modules (Units) and then assembled to form a complete Microcontroller-based Alternating Current Timer Device.

1.4 Limitations

The limitations of this project are very dangerous such that, an A.C timer is a very deterministic device, i.e. events are not being missed out during counting of the device. They include;

1. If their timing characteristic is faulted, it could lead to a fire outbreak;
2. It would have been a more compacted project if the device was designed incorporated with any appliance for safety

1.5 Advantages

The advantages are;

1. If timing characteristic is maintained, the appliance could be protected from fire.
2. The easy regulation of switching on and off of appliance.

1.6 Scope of the Project

This project comprises of four (4) chapters. Chapter one of the project comprises of the introduction as well as the aims and the objectives. Chapter two comprises of the project's literature review chapter three comprises of the design calculation leading to the exact value being used. Chapter four talks more about the problems encountered during the course of the construction as well as the recommendations. Fig 1.0 as shown the block diagram of the entire project

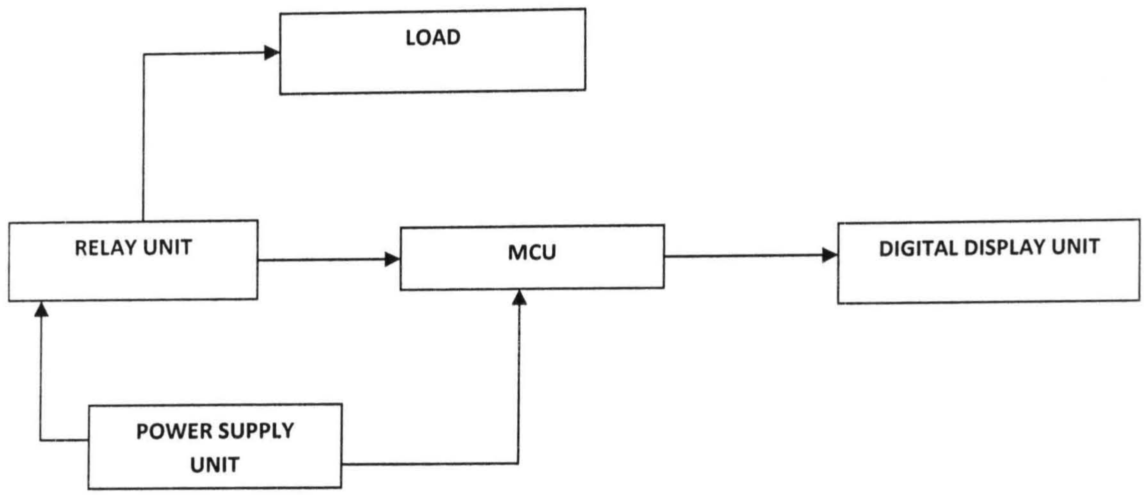

Fig. 1.0 Block Diagram

1.7 Source of Materials

Materials that assisted me in the successful design, construction and report of this work were sourced from various means such as textbooks, internet, and lecture notes and in consultation with lecturers, technicians and colleagues who offer useful suggestion.

CHAPTER TWO

LITERATURE REVIEW

To apply or remove power to or from an attached load during a timing intervals by a timer that is meant for such purpose. During the timing intervals the selection switch determines whether the appliance is on or off. The period of the timing interval is determines by the adjustment of some buttons and other control elements and the timing interval is initiated by the pressing of a momentary contact switch. Standard electrical interfaces are provided to allow the devices to be interface to a standard receptacle and to provide a similar receptacle to the attached appliances.

2.1 Background of Invention

Some electrical appliances which come in little sizes are now equipped with integrals automatic shut off timer which automatically interrupts the power to the appliance after a predetermined time interval after activation. And examples of such appliances are cloth iron, coffee, pots, and cooking appliances they all employed these timing devices in order to reduce the risk of burns injuries and fire outbreak. These fires and injuries in most cases can occur when users forget to turn these appliances off.

U.S Pat. No. 6,140,620 to Aldridge and Stewart describes a device for disconnecting electrical power from a heating element of an electric range after the device timing interval has elapsed. The device utilized a manually operated switch for determining the length of the timing interval. The power is applied to the heating element for a interval equal to the number of time the switch is closed multiplied by a predetermined interval.

U.S Pat. No. 4,494,012 to Coker describes a device that is designed to replace a standard wall mounted light switch which when activated applied power to a load for a predetermine interval of time. The devices can also be used as a standard on-off switch. The cooker circuit employed a mechanical switch in series with the timing circuit and the load. When power is applied to the circuit it turns on for an interval of time and then turns itself off.

Some known mechanical countdown timers also exist that are used for controlling load. These devices are use to turn on a load for a period of time determined by the number of turns that a mechanical clock is wound but they (devices) these devices do not provide for ability to turn a load on or off during a timing interval or a period of time. Furthermore, this device requires a user to set the amount of time that they are on each time they are use; they do not retain a preset time daily.

In addition, this design does not provide for selection of whether the attached load has power applied or removed during the timing intervals. Furthermore, the Aldridge and Stewart devices does not provide for continuous adjustment of the length of the timing interval; it requires the users to choose finite time steps.

The cooker device also is design to provide itself off when its timing interval completes or as elapses. This limits the methods by which the timing interval can be initiated. Power must be removed from the device and then replied to it before the timing interval can restart. This means that the user must switch the device off and then switch must be able to carry the full load current of the devices and the attached load. In addition, the cooker devices does not provide for selection of whether the attached load has power applied or removed during the timing intervals.

2.2 Summary of the Research

The project, henceforth known as an automatic A.C timer is a devices for applying or removing power to or from an attached load during a timing interval. The length of the timing intervals is linearly adjustable between a minimum and a maximum allowable time setting of 24 hours by pressing the required control button. In addition, there is a switch which allows the user to select whether the power is applied or removed during the timing interval. The timing interval of the timing device is initiated by the user by actuating a control such as a momentary contact switch. The timing device is designed to plug into a standard electrical receptacle and provide a similar receptacle for the attached load. The power to the timing device's receptacle is applied or removed by the circuit or mechanism contained within the timing device.

The timing device is useful is any application were power needs to be applied or removed from an attached load during a timing interval of predetermined length. Loads that a user might want to apply power to for a predetermined amount of time and then automatically remove power from are soldering irons, coffee pots and small electrical appliances with heating element which can be hazardous if left on unintentionally. Loads such as these frequently cause fire and burnt when unintentionally left on. Use of these novel devices will also result in energy savings and conservation of natural resources. The energy savings is accomplish by suing the timing devices to remove power from loads such as light and irrigation pumps after a predetermine time interval. A novel use of this timing device is when it is configured to remove power during its timing interval and then reapply it after the timing interval has completed. An example of this mode of usage is removing power from an aquarium water filtration system pump during the feeding of the fish so that the fish food is not ingested by the filtration system. The timing device then reapplies the power automatically after the feeding period has ended. The use of the timing device for this application prevent the user from forgetting to turn on the filtration pump after feeding the fish that can result in stress to, or death of the fish.

CHAPTER THREE

DESIGN AND IMPLEMENTATION

The design of this microcontroller-based alternating current timer comprises of the following sub-units:

I. Power Supply Unit

II. Microcontroller Unit

III. Load Switch Unit

3.1 Power Supply

A regulated 5-Volts was required for the systems full operation therefore, a power supply capable of supplying the required voltage at the required current is needed.

A 12V, 0.5A Transformer was wired to a full wave bridge rectifier. Fig. 3.10 shows how this was achieved.

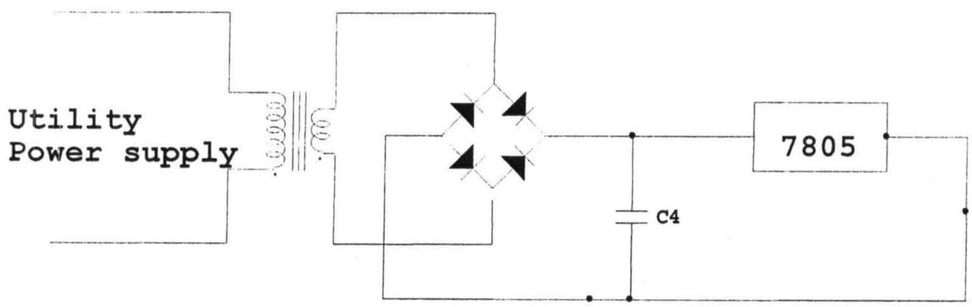

Fig 3.1: Power Supply with rectified output

The rectified DC voltage has a peak value of

$$V_{peak} = Vr.m.s \sqrt{2} \times \quad (3.1)$$

$$= 12 + \sqrt{2}$$

$$= 16.97V$$

But since the output is taken between two diodes, the actual peak voltages are gotten by subtracting the voltage drop across each of the two diodes. Since the voltage across one diode is 0.7V, the total voltage drop across two diodes is given as, $2 \times 0.7 = 1.4$.

Therefore,

$$V_{peak}\ (Actual) = VPeak \times \sqrt{2}\ -1.4$$

$$, = 16.96 - 1.4$$

Therefore, the actual peak voltage is given as,

$$V_{peak}\ (Actual) = 15.57V$$

The A.C. Input to the transformer is being rectified by the bridge rectifier. The process on how this is being done is explained thus below; this process is known as rectification. A rectifier changes a.c. to d.c. this is one of the simplest and most important application of diodes (diodes are sometimes called rectifiers). A.C. Symbol represents a source of A.C. Voltage in electronic circuits. It is usually provided by a transformer powered from the a.c. power line for a sine wave input that is much larger than the forward drop (about 0.7V for silicon diode, the usual type). In the course of this project, rectified d.c. power output was smoothened by 25V, 2200μf capacitor. The smoothing effect is explained below.

project, rectified d.c. power output was smoothened by 25V, 2200μf capacitor. The smoothing effect is explained below.

A very small resistor is used to limit the peak rectifier current because the diodes prevent flow of current back out of the capacitor, which are serving more as energy storage device than as part of a classic low pass filter. The energy stored in the capacitor is $U = ICV^2$ for C in Farads and V in Volts, U comes out M^2 Joules (Watts-Seconds).

From the construction, the value of which was estimated based on the maximum allowable A.C. ripple on the unit, the mains frequency at the maximum load current.

$$Q = CV = It \qquad (3.2)$$

Therefore, $$CV = It \qquad (3.3)$$

Making C the subject of the formula, we have

$$C = \frac{It}{V} \qquad (3.4)$$

WHERE I = Current rating of the transformer = 0.5A; v = DC Output voltage i.e. 15.57, the we have

$$C = \frac{90.5 \times (\frac{1}{2} \times 50)}{15.57}$$

$$C = 321\mu f \text{ (Approximate)}$$

A 2200 ! capacitor was used for a better performance. The required 5V was realized by regulating the 15.5V Peak down +5V using a 7805 Regulator as shown in Fig. 3.2

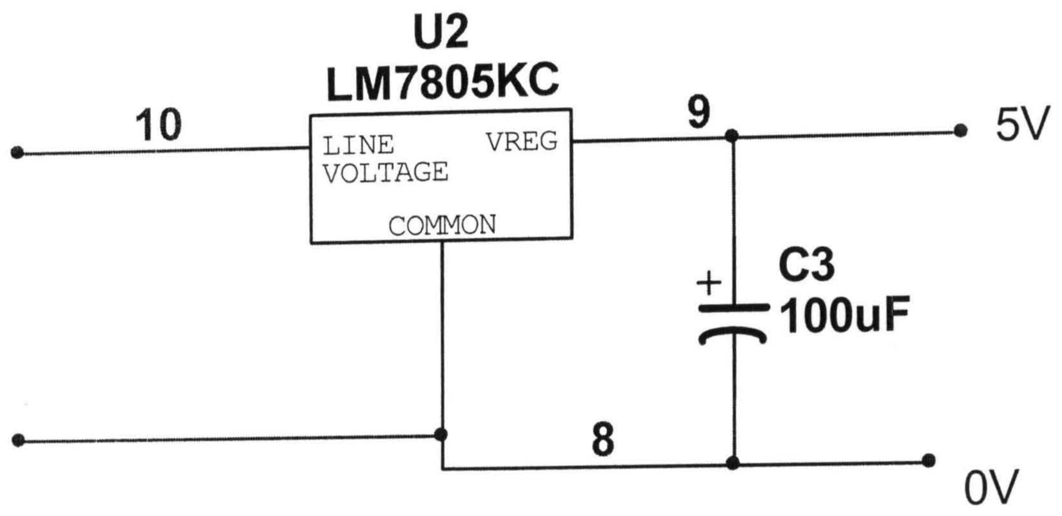

Fig 3.2: Regulated 5Volts d.c. output

The regulation done above is illustrated below. In cases of regulations sufficiently large capacitor are chosen, the ripple voltage can be reduced to any desired level. This brake force approach has two disadvantages;

i) The required capacitor may be bulky and expensive.

ii) Even with the ripple reduces to a negligible level, you will still have a variation of output voltage due to other causes, e.g. the d.c. output voltage will be roughly proportional to the a.c. input voltage, giving rise to fluctuations caused by input line voltage variations. In addition, changes in good current will cause the output voltage to change because of the finite internal resistances of the transformer, diode,

etc. in other words, the Thevenin evening equivalent circuit of the d.c. power supply has $R > 0$.

A better approach to power supply design is to use enough capacitance to reduce ripple to low levels (perhaps 10% of the d.c. voltage), use an active feedback circuit to eliminate the remaining ripple such a feedback circuit "looks at" the output, malconing changes in a controllable series resistor (a transistor) as necessary to keep the output constant. This voltage regulates are used almost universally as power supplies for electronic ciecuits. A power supply built with a voltage regulator can be easily adjustable and self-protecting (against short circuits, overheating, etc) with excellent property as a voltage source. From the Project construction, the 5V regulated output was stabilized bt a 16V, $220\mu F$ Capacitance and fed into the circuit.

3.2 Microcontroller Unit

An 89C51 microcontroller was used for system control function.The 89C52 is an 8-bit device/ machine with 120 bytes of RAM and 4KB of flash ROM programmable and erasable. The controller was run on 12MHz crystal for time keeping purposes. The four normally open push were connected to the inputs (P3.0, P3.1, P3.2, P3.3, and P3.4). An RC reset network made from a 10µf capacitor was connected to the reset input as shown in figure 3.3

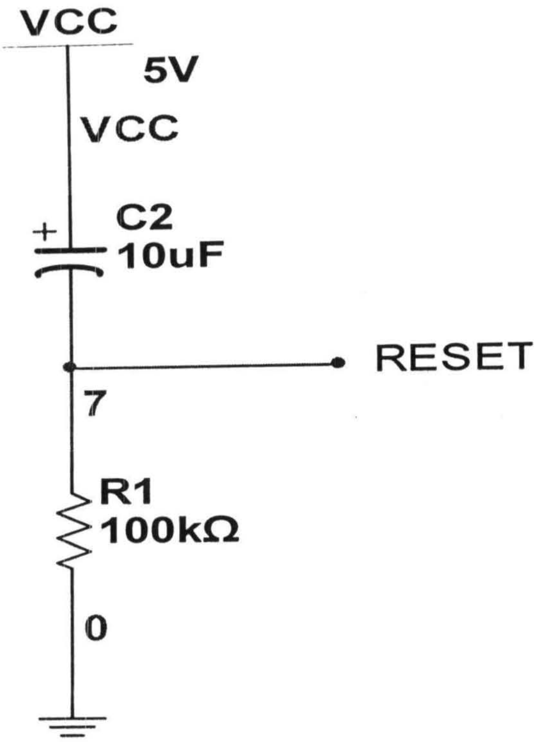

Fig 3.3: R-C Reset Network

The reset circuit produced a rest signal of duration

$$T - RC\ (10 \times 10^{-6} \times 10^{5}) \qquad (3.5)$$

$$T \quad = 10 \times 10^{-1}$$

$$= 10/10 = 1s$$

This controller is held reset for 1 second after the controller was

I Controls the switching operation

Ii Multiplexing the 4 – digit – 7 – segment LED Display

3.3 Load Switching

The Load connected to the system is powered on/off software control via PNP transistor on P3.7. The transistor drives a 6V 10A relay with contacts wired in series with the Voltage to the load depicted in Fig. 3.4 relay resistances;

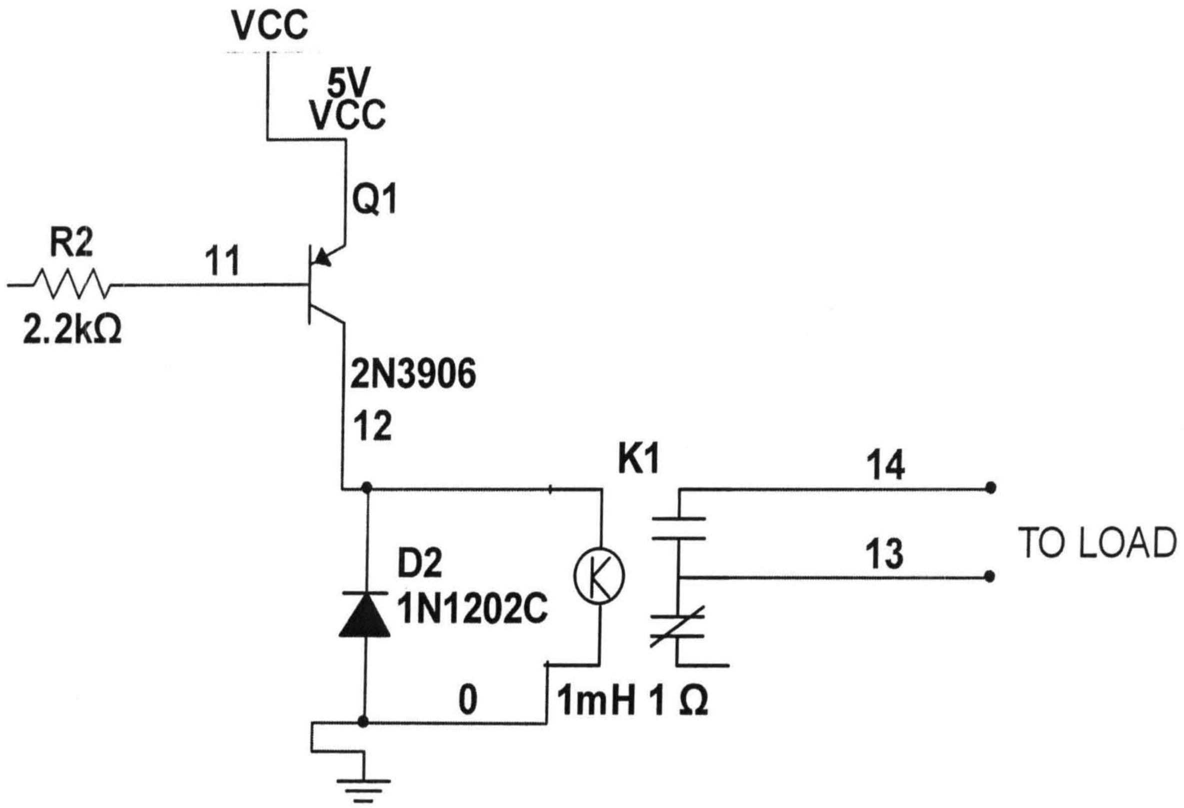

Fig 3.4 Load power switching

400Ω, Coil Voltage; 6V

Delay actuating current, t = $\frac{V}{R}$ (3.6)

$$= \frac{6}{400} = 15mA.$$

Since the relay is connected in the collector circuit from the expression,

$I_C = I_{relay} = 15mA.$

THE 25a11015 GR Transistor has a gain (β) of 200

Calculating for I_B

From the expression,

$I_C = BI_B$

Dividing both sides by β, we have

$$= \frac{\beta IB}{IB} = \beta \quad (3.7)$$

$$I_B = \frac{IC}{\beta} \quad (3.8)$$

Since $I_C = 15mA$. And $\beta = 200$

$$I_B = \frac{15mA}{200} = 0.75 \times 10^{-4} = 75 \text{ "}$$

The value of the base resistance needed to cause a 15mA flow in the collector await of the transistor was calculated from;

$$Rb = V_{cc} - V_{be} - Vol_{(micro)} \quad (3.9)$$

3.4 Display unit

A liquid crystal display [LCD] is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of column of liquid crystal molecules suspended between two transparent electrodes, and two polarized filters, the axis of polarity of which are perpendicular to each other. Without the liquid crystal between them, light passing through one will be licked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other. Many microcontroller devices use "smart LCD" display to output visual information.LCD display designed around Hitachi's LCD hd44780 module, are inexpensive, easy to use, and it is even possible to produce a readout using the 8×80 pixels of the display. They have a standard ASCII set of characters and mathematical symbols.

For an 8-bit data bus, the display requires a +5 supply plus 11 I/O lines .For a 4 bit data bus it only requires the supply lines plus seven extra lines. When the LCD display is enabled, data lines are tri-state and they do not interfere with the operation of the microcontroller. Data can be place at any location on the LCD. Table 3.0 shows the address location of the 16×2 LCD,

Table 3.0: Address location for a 2×16 line LCD

First Line	80	81	82	83	84	85	86	Through 8F
Second Line	C0	C1	C2	C3	C4	C5	C6	Through CF

3.4.1 SIGNALS TO THE LCD

LCD also requires 3 control lines from the microcontroller.

1) **Enable Line (E)**

This line allows access to the display through R/W and RS Lines. When this line is low, the LCD is disabled and ignores signal from R/W and RS. When E

2) **Read/ Write Line (R/W)**

This line determines the direction of data between the LCD and microcontroller. When it is low, data is written to the LCD. When it is high, data is read from the LCD.

3) **Register Select Line (RS)**

With the help of this line, the LCD interprets the type of data on the data lines. When it is low an instruction is being written to the LCD. When it is high, a character is being written to the LCD.

3.4.2 Logic Status on Control Lines

- E – 0 Access to the LCD disabled.
  - 1 Access to LCD enabled
- R/W – 0 Writing data to LCD
  - 1 reading data from LCD
- RS – 0 Instructions

- 1 character

3.4.3 Writing and Reading the data from the LCD

Writing data to the LCD is dine in several steps.

1) Set R/W bit to low
2) Set RS bit to logic 0 or 1 (instruction or character)
3) Set data to data lines (if it is writing)
4) Set E line to high
5) Set E line to low

Read data from data line (if it is reading)

1) Set R/W bit to high
2) Set RS bit to logic 0 or 1 (instruction or character)
3) Set data to data lines (If it is writing)
4) Set E line to high
5) Set E line to low

3.4.4 PIN DESCRIPTION

Most LCDs with one controller has 14 pins and LCDs with 2 controller has 16 pins (2 pins are extra in both for backlight LED connection) Fig 3.6 Described the pin diagram of 2x16 line LCD and Table 3.1 shows the pin description of the LCD. Figure 3.7 shows the complete circuit diagram of the project.

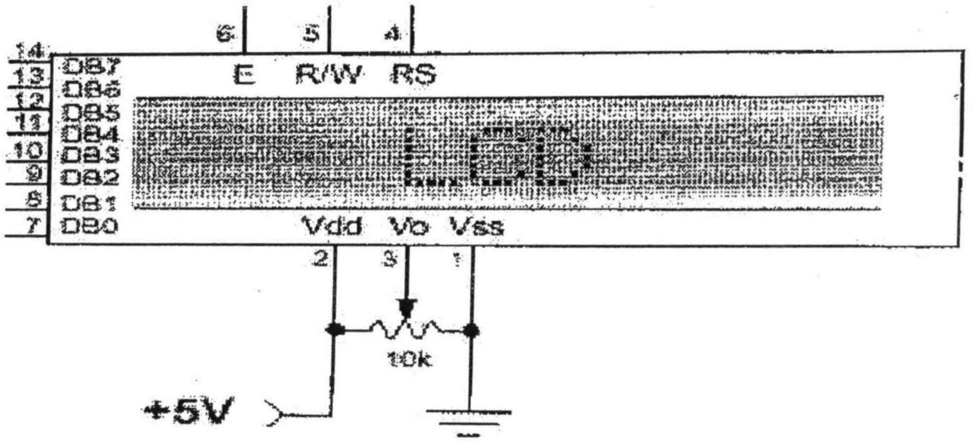

Fig. 3.5 pin diagram of the LCD

Table 3.1 Pin discription of the LCD

Pin No.	Name	Description
Pin no. 1	VSS	Power supply (GND)
Pin no. 2	VCC	Power supply (+5V)
Pin no. 3	VEE	Contrast adjust
Pin no. 4	RS	0 = Instruction input 1 = Data input
Pin no. 5	R/W	0 = Write to LCD module 1 = Read from LCD module
Pin no. 6	EN	Enable signal
Pin no. 7	D0	Data bus line 0 (LSB)
Pin no. 8	D1	Data bus line 1
Pin no. 9	D2	Data bus line 2
Pin no. 10	D3	Data bus line 3
Pin no. 11	D4	Data bus line 4
Pin no. 12	D5	Data bus line 5
Pin no. 13	D6	Data bus line 6
Pin no. 14	D7	Data bus line 7 (MSB)

3.5 Complete Circuit Diagram

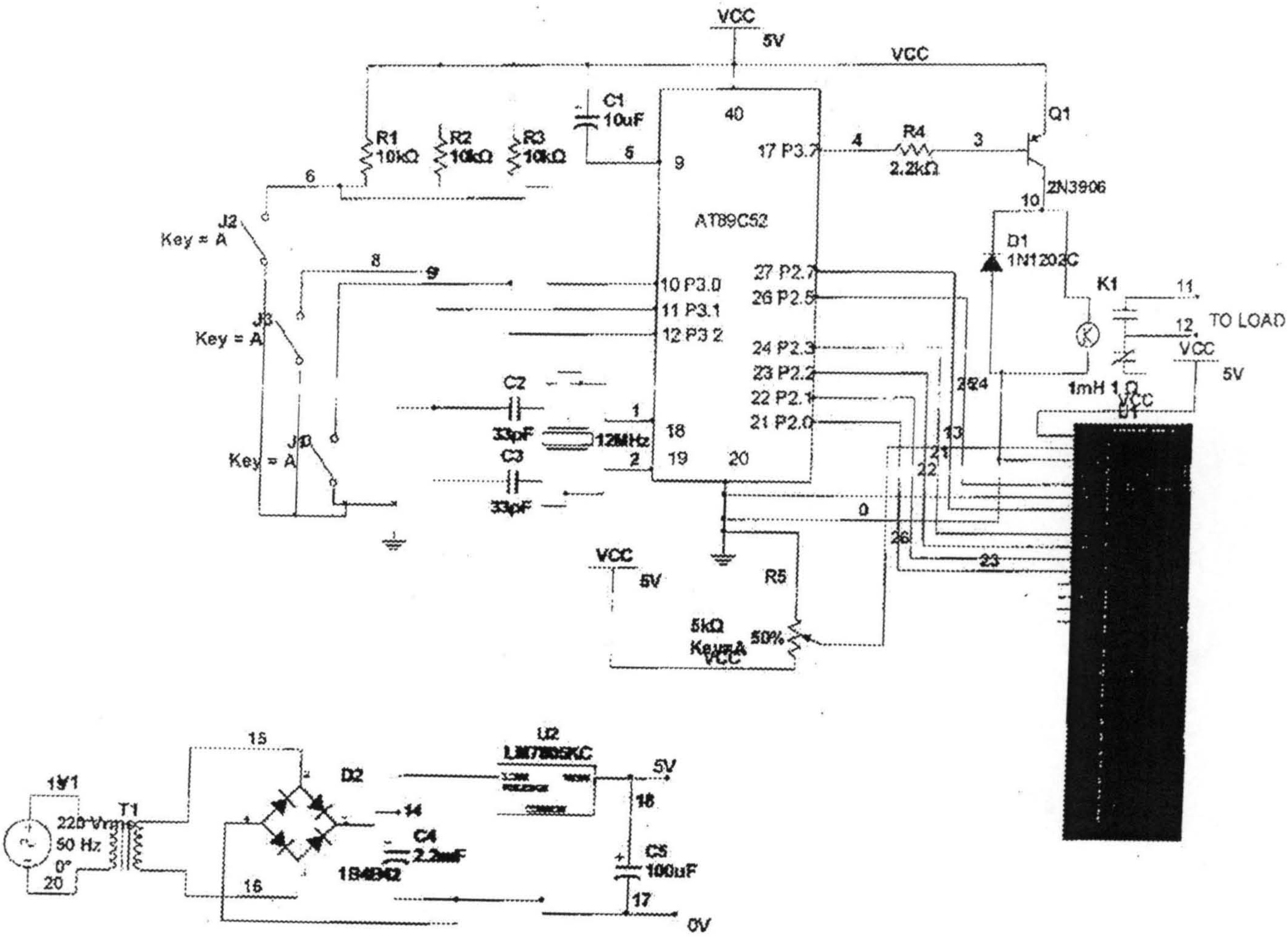

Fig. 3.6 circuit diagram for alternating current timer

Chapter Four

Testing, Discussion of Results and Problem Encounter

4.1 Project Casing Construction

Casing is the material that is used for the outer covering that may also be referred to as the container for the construction of the work. For this project work, a light wooden material was used for the construction of the casing and covered a clear glass cover considering the size and shape of the project work on the veroboard. Dimensioning of the casing was done properly to give the required shape and size. With a view to improving the aesthetic feature of the casing, finishing was also done on the casing. Fig 4.1 is a diagram of the final casing that was achieved;

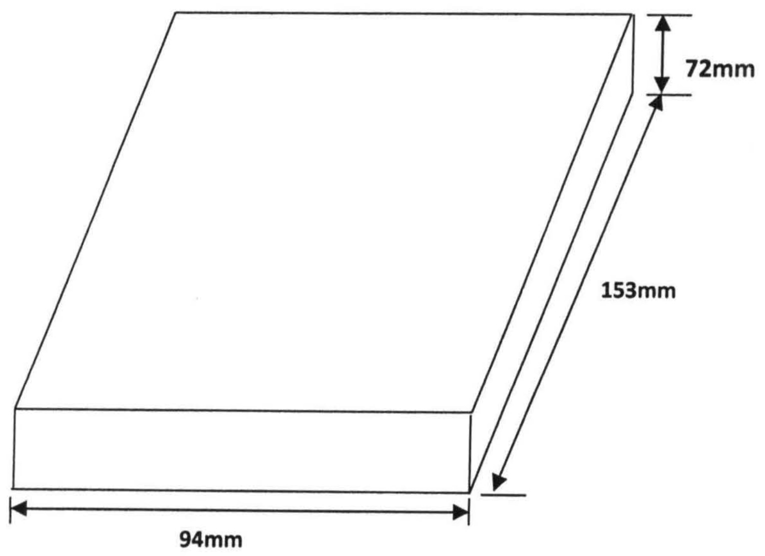

Fig. 4.1: Project Casing with dimensions

4.2 Testing

At every point during the project works, testing of virtually all the components as done. The test that was carried out was done repeatedly to ascertain the strength of the components. The final tests being carried on in order to check the timing characteristics device relative to software embedded in the microcontroller

4.3 Results and Discussion

The timer produced a characteristic that has the ability to regulate the switching off the electronic appliance. During the course of the project, from my measured calculation I found out that the output voltage was 16.97v.But instead the actual measured values was less than required 16.97v due to the voltage drop across the diodes where the output was tapped from. When timing on the devices is set using appropriate measures, the devices is switched off after the time elapsed. The timing characteristic of this device makes its usefulness very unique.

4.4 Troubleshooting Guide

1) If the Power fails to energize or as it were, trigger the circuit, the plug and the Rectifiers should be checked properly. If any is found faulty, then replace them.
2) If the LCD Display is not duly obtained, check the connection of the Display and the LCD itself. If any is found faulty, then replace them.

5.2 Problems Encountered

3) The problem encountered during the course of my project stated thus below;

4) The problem of short circuit due to connecting wires touching themselves on the circuit board, Some of the ICs got burnt due to excessive heat while soldering. Problem of trying to burn the software on the microcontroller due system fault.

5) If the functioning of the device is not properly coordinated due to lack of trigger to the microprocessor, check the rectified output to see if it remains regulated at 5V. If it is not, check the entire power unit properly.

6) If the troubleshooting guide 1) above is performed and the circuit is still not energized, check if the protective diodes (D1, D2, D3 and D4) have been damaged due to fault in the step-down transformer, T1. If so, replace them.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

The objective of this project is mainly to design and construct a prototype that can time a particular occurrence and then activate a relay when the timing has fully elapsed. Ass indicated by the results of the tests, these objectives were fully achieved. The project provides four choices of adjustment and it actually required no special skills in operating and installation. The system is suitable for both domestic and industrial use.

5.3 Recommendations

To actually achieve a very efficient and reliable system, the following recommendations are required. The use of PCB (Printed Circuit Board) to facilitate the construction process will be of an advantage. The department should try and provide more texts so that projects of this nature could be carried out more conveniently done and research would be made easier.

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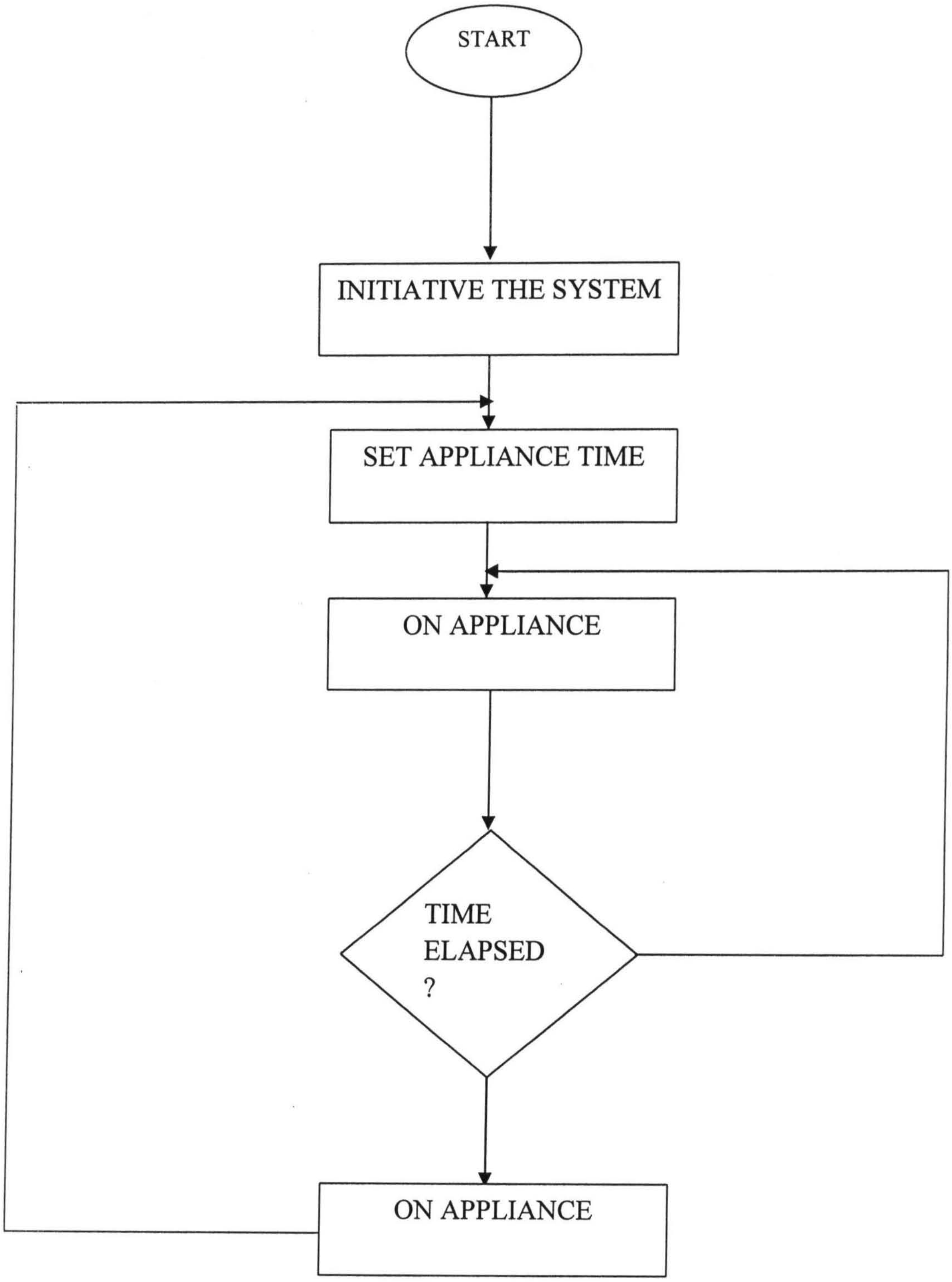
Appendix A

Flow chart



Appendix B:

Source Code

```
#include <intrins.h>

#include <otaruport.h>

unsignedint x;

bit_8  code *val[]={"0","1","2","3","4","5","6","7","8","9","10","11","12"};          // digit array

bit_8  hh,hmin,lmin,hsec,lsec,thh,thmin,tlmin;

sbit load = P3^7;

bit flag;


void main()

  {

          //ENABLE_INT

                DISABLE_INT

          LCD_INI();

                LCD_command(0x80);

                data_in("Welcome");

                for(x= 0; x < 6; x++)

                sec1();

                LCD_command(0x01);


                sel_param=1;

        chg_param_inc=1;

        chg_param_dec=1;

                hh = 0;

                hmin = 0;

                lmin = 0;

                hsec = 0;

                lsec = 0;
```

```
set_clock();
load = 0;
start_time();
load = 1;
LCD_command(0x01);
send_string("time out");
LCD_command(0x01);
send_string("load off");

}
voidstart_time()
{
for(thh = hh; thh>= 0; thh--)
{
bdata_in(thh,0x84);
for(thmin = hmin; thmin>= 0; thmin--)
{
LCD_command(0x86);
data_in(":");
LCD_command(0x87);
data_in(val[thmin]);
for(tlmin = lmin; tlmin>= 0; tlmin--)
{
LCD_command(0x88);
data_in(val[tlmin]);
for(hsec=0;hsec<=5;hsec++)
{

for(lsec=0;lsec<=9;lsec++)
{
```

```
sec1();

if(flag)

set_clock();

}

}

}

}

}

}

voidset_clock()

{

//bit_8 temp;

DISABLE_INT

LCD_command(0x01);

LCD_command(0x80);

send_string("set time");

sec1();

sec1();

sec1();

LCD_command(0x01);

bdata_in(hh,0x84);

data_in(":");

LCD_command(0x87);

data_in(val[hmin]);

LCD_command(0x88);
```

```
                data_in(val[lmin]);
up3:    while(chg_param_inc!=0&&chg_param_dec!=0&&sel_param!=0);
                if(chg_param_inc==0)
                  {
                        hh++;
                        if(hh==25)
                                hh=1;
                        bdata_in(hh,0x84);
                        LCD_command(0x84);
                        delay();
                        goto up3;

                        }
                if(chg_param_dec == 0)
                  {
                        hh--;
                        if(hh==0)
                                hh=24;
                                bdata_in(hh,0x84);
                                LCD_command(0x84);
                        delay();
                        goto up3;
                        }
                while(sel_param==0);
                LCD_command(0x88);
                delay();
up4:    while(chg_param_inc!=0&&chg_param_dec!=0&&sel_param!=0);
if(chg_param_inc==0)
                  {
                        lmin++;
```

```
            if(lmin==10)
              {
                    lmin=0;
                    hmin++;
                    if(hmin==6)
                            hmin=0;
              }
                    LCD_command(0x88);
                    data_in(val[hmin]);
            data_in(val[lmin]);
                    delay();
                    goto up4;
            }
    if(chg_param_dec==0)
      {
            lmin--;
            if(lmin==-1)
              {
                    lmin=9;
                    hmin--;
                    if(hmin==-1)
                            hmin=5;
              }
                    LCD_command(0x88);
                    data_in(val[hmin]);
            data_in(val[lmin]);
                    delay();
                    goto up4;
        }
        delay();
```

```
                    while(sel_param == 0);
                LCD_INI();
                    LCD_command(0x01);
            bdata_in(hh,0x84);
            data_in(":");
            LCD_command(0x87);
            data_in(val[hmin]);
            LCD_command(0x88);
            data_in(val[lmin]);
                flag = 0;


    }


void sec1()
  {
        /*unsigned int i;
            for(i = 0; i < 33000; i++);*/
      bit_8i,j;
      TMOD=0x11;
      for(i=0;i<75;i++)
            _nop_();
      for(i=0;i<7;i++)
      {
            TH1=0;
            TH0=1;
            TL1=0;
            TL0=0;
```

```
TR1=1;
for(j=0;j<119;j++)
        _nop_();
while(TF1!=1)
{
        for(j=0;j<255;j++);
                _nop_();
}
TF1=0;
TR0=1;
TR1=0;
while(TF0!=1)
{
        for(j=0;j<120;j++)
                _nop_();
}
TF0=0;
TR0=0;
    }
    }
voidbdata_in(bit_8 a, bit_8 addr)
{
        bit_8 j;
        j=a/10;
        LCD_command(addr);
        data_in(val[j]);
        j=a%10;
        data_in(val[j]);
}
```

```
void delay(void)
{
        bit_8i,j;
        TMOD=0x11;
        for(i=0;i<2;i++)
        {
                TH1=0;
                TH0=1;
                TL1=0;
                TL0=0;
                TR1=1;
                while(TF1!=1)
                {
                        for(j=0;j<20;j++);
                }
                TF1=0;
                TR0=1;
                TR1=0;
                while(TF0!=1)
                {}
                TF0=0;
                TR0=0;
        }
}
```