DESIGN AND CONSTRUCTION OF AN AUTOMATIC AC VARIABLE ELECTRONIC TIMER

By

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A PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF ENGINEERING (B. ENG.) DEGREE

IN THE

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERRING,
SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY,
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.
NIGERIA

DECEMBER, 2000

CERTIFICATION

I have hereby certified that this work has been supervised, read and approved as meeting the requirement for the award of the degree of Bachelor of Engineering in the Department of Electrical and Computer Engineering, Federal university of Technology, Minna, Niger State.

Engr. M. S. Ahmed
(Project Supervisor)

Date

Dr. Y. A. Adediran
(Head of Department)

14/1/07
Date

External Examiner

17/1/07
Date

DECLARATION

I hereby declare that the project work was solely and wholly conducted by me Ityungu L. Ahungwa; under the supervision of Engr. Ahmed M. S. of Electrical and Computer Engineering Department, Federal University of Technology, Minna.

Ityungu Ahungwa Lincoln

12/01/2001
Date

DEDICATION

This project is dedicated to the almighty God, my late father, Mr. Ityungu Gbinde, my dear mother Mrs Ityungu kumamiyol, Mr. Silas Mac Ikpah and my elder brother, Mr Iorundu Ityungu.

ACKNOWLEDGEMENT

I especially acknowledge the unalloyed efforts, motivation and guidance granted me during my work on this project by my supervisor M. S. Ahmed, without whom the project would have not been an accomplished dream. I am also grateful to Mr. Benjamin Akile Bende for his assistance. I greatly acknowledge the efforts of student Engr. Hon kator. Also I must greatly acknowledge the support and motivation that kept me going, from my sister, Miss Martha Udam. I am very grateful to you all.

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CHAPTER ONE

GENERAL INTRODUCTION

The electronic timer is a safety device used for protecting electrical and electronic appliances. The timer can be used for timing for duration of microseconds through hours. The design avoids as much as possible the use of discrete components in order to raise its reliability level and avoid overcrowding on the vero board and reduce the overall size of the timer. The overall cost is also minimized as a result; together with the overall power consumption.

The timer is very useful especially for students who, after a day's stressful academic work, plugs a heater to prepare something and relaxes only to sleep off; Or goes to a friends room only to engage in arguments and forget that his heater is at work. Thus, the timer saves serious impending disasters. Also, one can select a time after which his device can start operating this is very useful especially in recording from a TV program or radio program in events that you may not be around when the program starts. You think of the applications.
The timing period is a function R and C.

The timer's working principle is that after a selected time duration has elapsed, the timer automatically disengages the supply from the appliance through the relay which triggers off and engages the electric bell which picks up ringing, which serves as an alarm.

1.2 AIMS AND OBJECTIVES OF THE PROJECT

The main aims and objectives of the project are

1. To produce a protective device which incorporates an alarm which will serve a protective purpose for appliances (Electrical and Electronic).
2. To familiarize myself with the practicality of theoretical knowledge.
3. To provide a means of switching on a device after a desired time interval.
4. To fulfil the partial requirement for the award of a B. Eng. In the Department of Electrical and Computer Engineering at the Federal University of Technology, Minna.

1.3 METHODOLOGY

For ease of maintenance and increased system reliability, the numbers of components used greatly were minimized. This also helps a lot in the area of troubleshooting. This was achieved, especially by the use of the 555 timer for the timing circuit. This also reduced system cost to the barest minimum.

1.4 LITERATURE REVIEW

In the past, timers were normally mechanically operated for example the popular fan type. This was a good development but had its disadvantages. The most common of which was degraded reliability (which is an in-built characteristic of all mechanically operated systems) in terms of wear and tear.

The invention of the electronic timer to replace the mechanical timer was a welcome idea. The later is being more effective.

This particular project incorporates an alarm unit, which is set in operation at the end the timing duration selected. The involvement of an IC in the design raises the reliability level of the entire system.

1.5 PROJECT OUTLINE

This write up is divided into four chapters.

Chapter one is concerned with the introduction.

Chapter two deals with the design of the timer. This chapter deals with the projects three major units namely the power supply unit, the timing unit and the alarm unit.

Chapter three treats the testing and results produced by the Automatic variable electronic timer;

And finally the last chapter, chapter four forms the conclusion and recommendations of this project.

2.3 THE TIMING CIRCUIT DESIGN

The 555 timer based timing circuit is a highly stable controller capable of producing accurate time delays, or oscillation. One external resistor and capacitor precisely control the times. It is connected in a monostable mode of operation (Legs of pin 6 and pin 7 are connected together and grounded).

The voltage across the timing capacitor is given as:

$Vc = Vcc\,(1 - e^{-t/RC})$

At Vc = 2/3 Vcc, it follows that,

$2/3\,Vcc = Vcc\,(1 - e^{-t/RC})$

Or $T = RC \ln(1/3), \quad (t = T)$

$\Rightarrow T = 1.1RC$ (secs).

For this design R and C are selected to be 250KΩ and 3300uF respectively.

R is actually split into R_1 and VR_2. Where R_2 is a variable resistor used in varying the timing duration. The selected value for VR_2 here is 244.5KΩ. hence, the minimum timing duration for the timer is $T_{min} = 1.1 \times 5.5 \times 10^3 \times 3300 \times 10^{-6}$

$T_{min} = 20$ secs.

The maximum timing duration occurs when VR_2 is tuned to its maximum resistance of approximately 244.5KΩ in series with 5.5KΩ resistor.

Therefore $T_{max} = 1.1 \times 250 \times 10^3 \times 3300 \times 10^{-6}$

$= 15.125$mins.

Therefore the maximum timing duration for this construction is 15.125 mins.

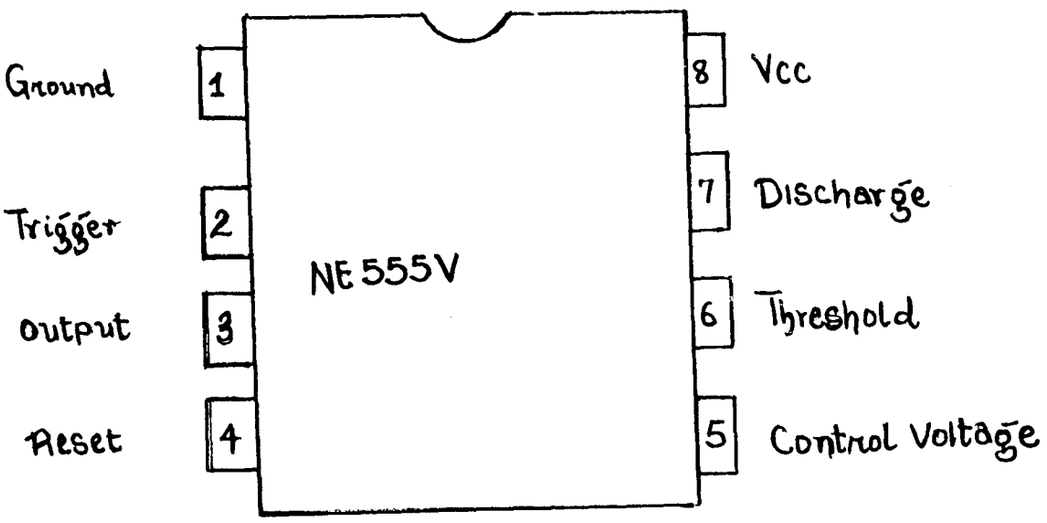


Fig.2.2 Pin diagram arrangement of NE555V

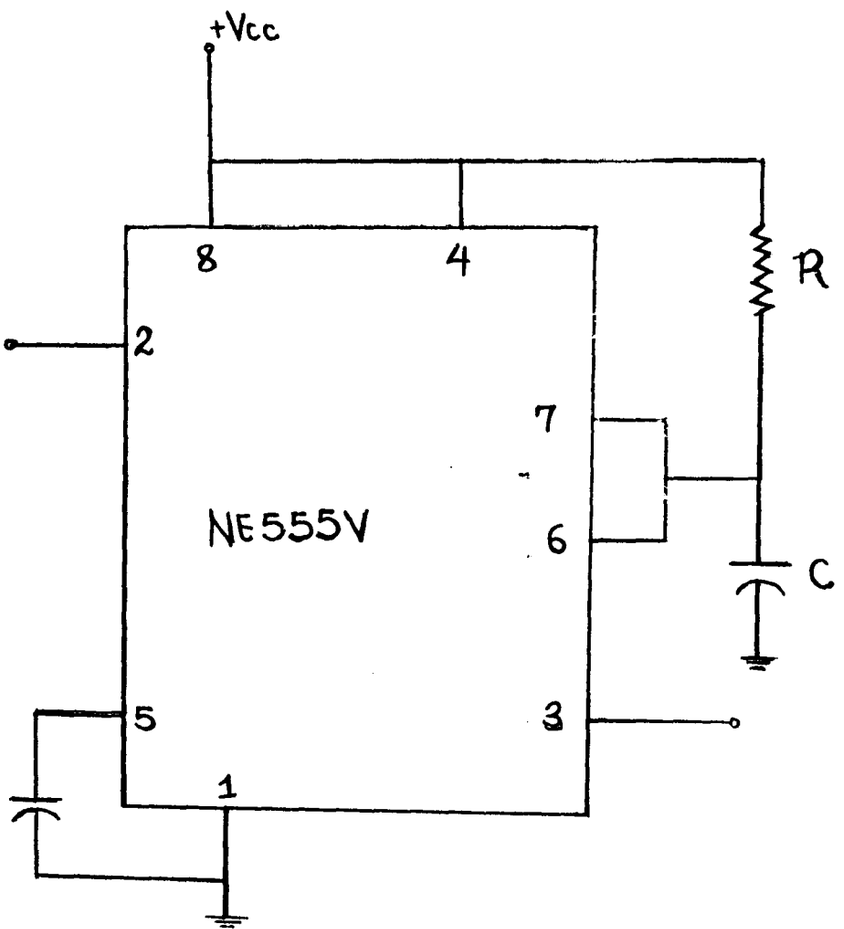


Fig.2.3 Monostable Pin arrangement

2.5 **RELAY**

Is an electromagnetic switch with an attached movable spring armature that is mounted above the core of the electromagnet. When the core is energized, i.e. current flows through it, the armature is altered and the contact points change position such as the normal close. When the current is removed, the action of the incorporated spring brings the entire relay system to normal open and close.

The ratings of the relay are:

10A, 12VDC

Coil resistance 418Ω

Therefore relay consumes 12V/418Ω = 28.7mA

By variation of supply voltage directly across the terminals of the inductor coil, it was observed that 9.6V could be the minimum switching voltage

Therefore Minimum current needed is 9.6V/418Ω = 23mA.

Therefore current limiting resistance is 12 – 9.6/23mA = 104.3Ω

Resistance used here is approximately 102Ω.

2.7 PRINCIPLE OF OPERATION OF THE MAIN CIRCUIT

From the connections of fig.3-1 pole B of the relay, which is the movable pole, is connected to the live from the supply. The other two poles are connected to the two sockets labeled A and B as shown.

When the main switch is put on and the IC is triggered, the current flowing out of pin 3 energizes the relay and the movable pole B is attracted to pole C. This completes the live and neutral arrangement for socket A and an appliance connected to this socket automatically commences operation. After the selected time has elapsed, the output of pin 3 goes low and no current flows into the coils of the relay, as a result of which the force of attraction is lost. The action of the incorporated spring brings the movable pole back to its original position (NC). This action disengages the supply from reaching the appliance on socket A. Simultaneously; socket B whose neutral point is already intact is supplied with live from the pole of the relay. This also applies to the electric bell. The bell, if switched on, starts ringing. The appliance on socket B also commences work. Thus, an appliance connected to socket B is made to come on after a desired time delay.

CHAPTER THREE

CONSTRUCTION, TESTING AND RESULTS

3.1 CONSTRUCTION

The project's complete circuit diagram is shown at the end of this chapter. The components were appropriately combined and soldered after giving a satisfactory working.

The choice of wooden material for the casing serves to prevent accidental shocks to users, wood being a very good insulator. It's relatively cheap cost, easy to work on, lightweight is also considered advantageous.

The relationship between angle turned and resistance measured on the variable resistor is exploited in calibrating the timing periods selectable.

Soldering was carefully done to avoid the problem of short circuit.

3.2 TESTING

The multi-meter was used for testing the various stages after the integrated circuits and discrete components. The power unit was first tested and it yielded an output of approximately 12V dc. The output of the timer or timing circuit was checked including the output of the discrete components of the timer circuit.

The variable resistor variation gave different timing results or intervals.

The complete circuit was finally tested, and it worked satisfactorily.

3.3 RESULTS

The results were in very close agreement with the formula t = 1.1RC. Varying the resistance value produced varying time delays, which are recorded and presented in the table below. A graph of resistance against time is thus plotted against time.

TEST NO	RESISTANCE (KΩ)	TIME INETRVAL (S)
1	5.52	20
2	24.79	90
3	49.58	180
4	99.20	360
5	148.76	540
6	198.35	720
7	247.93	900

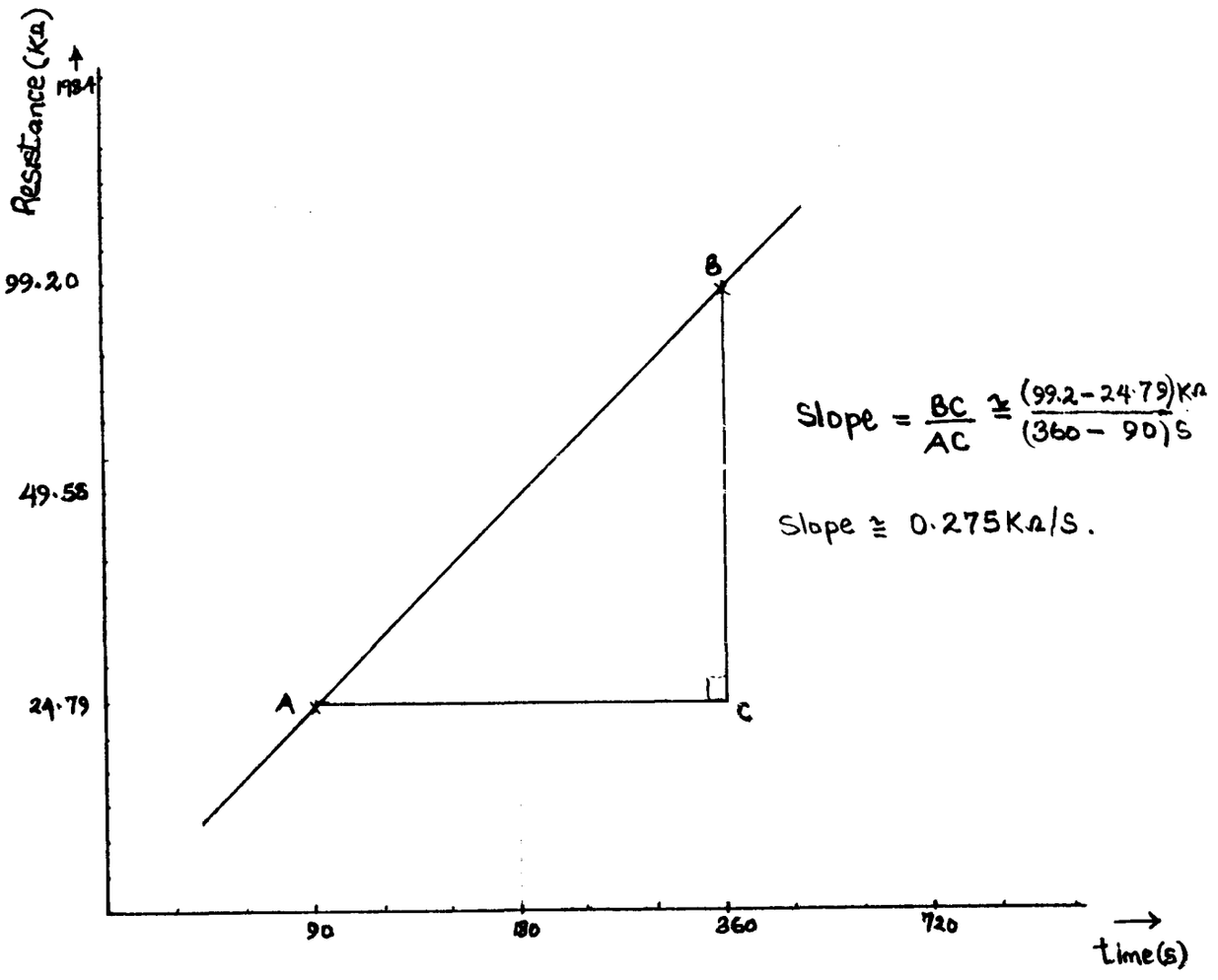


Fig.2.7 A plot of resistance against time.

3.4 DISCUSSION OF RESULTS

It can be observed that the time delay is dependent upon the resistance value. And the time delay is appreciably in agreement with the relationship t = 1.1Rc.

The slope of the graph was 0.275KΩ/s and indicates the rate of variation of resistance with time. The linear graph indicates that the variation of circuit resistance with time delay is direct.

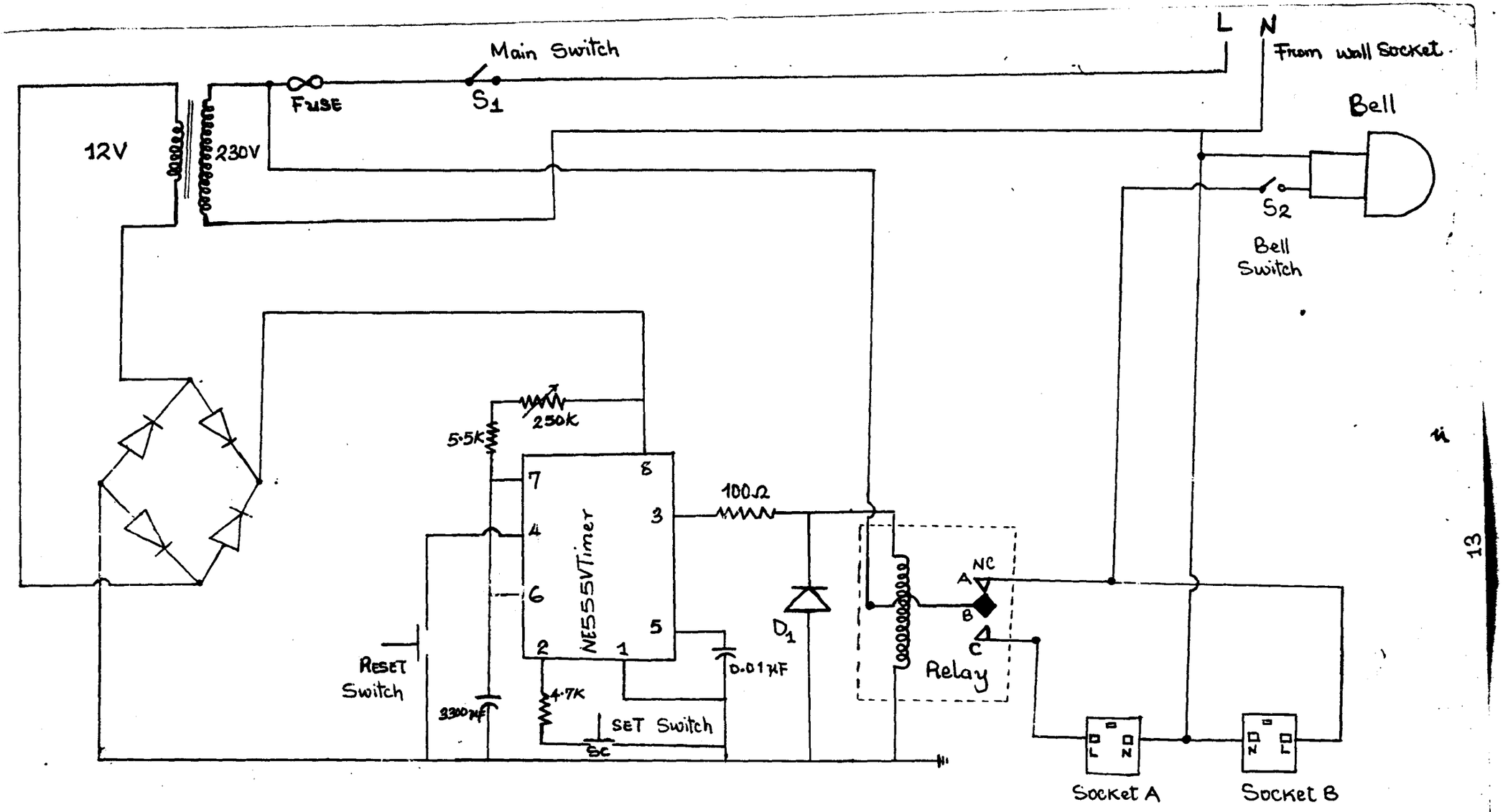
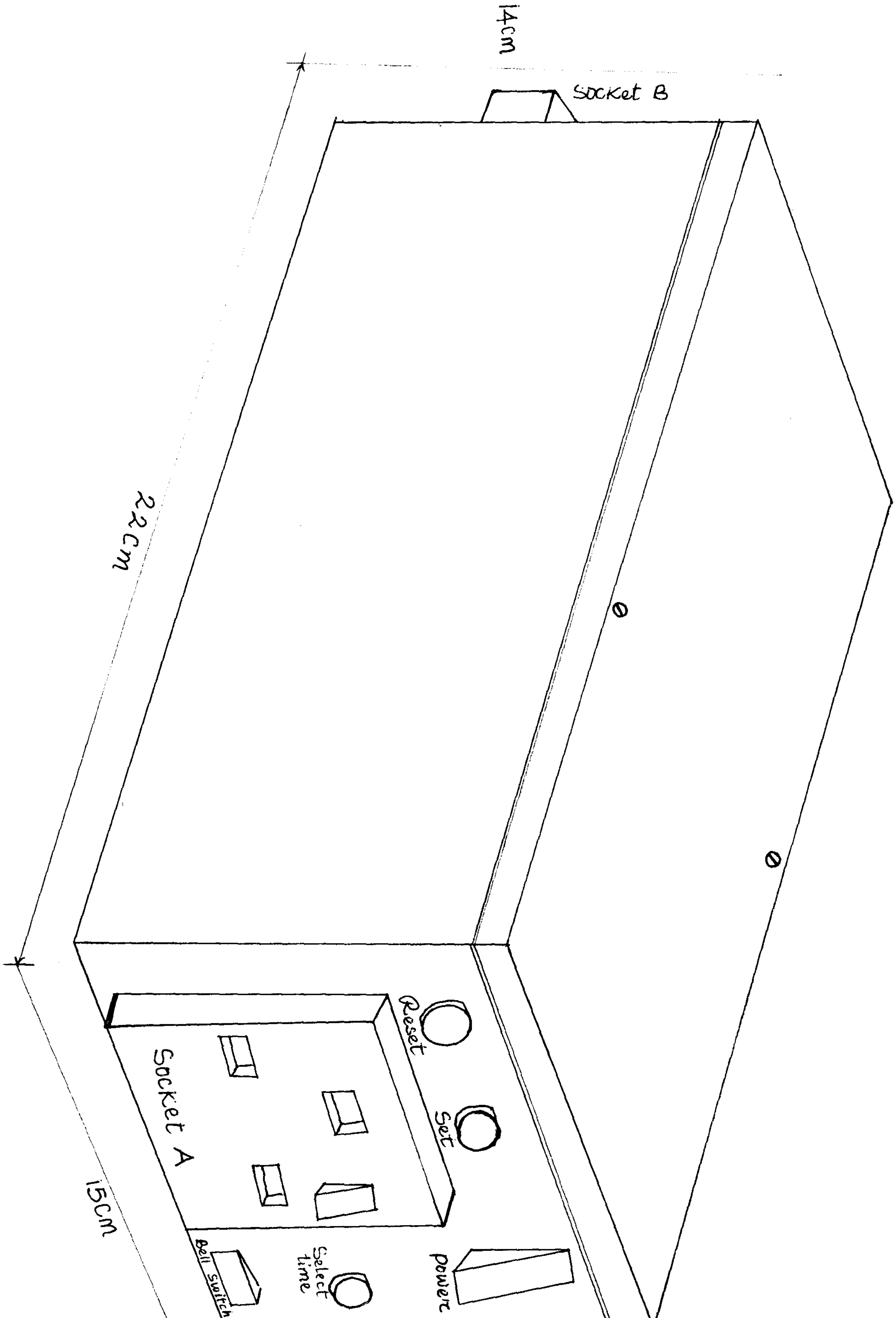


Fig.3.1. Main circuit diagram of the Automatic AC variable electronic timer.


14cm
Socket B
22cm
15cm
Socket A
Reset
Set
Select time
power
Bell switch

CHAPTER FOUR

CONCLUSION AND RECOMMENDATION

As an improved version of the electronic timer, it uses an alarm unit to call the users attention when the timing period is over. This is optional, as some situations might not be convenient to allow the alarm to perform its intended duty. This has made it necessary to use a two-way switch so that the alarm can be silenced as the situation demands. For example when you feel like relaxing and taking some small time off your mind. In such situations the sound produced might be noise to you.

The need for a minimum time taken to delay the timer was seriously addressed here in this project.

I would like to recommend those textbooks on design and construction of electronics circuits is made available to the department to aid students in their design work. Since the absence of which has seriously placed a block in our path of research.

Also, the department computers should be repaired to ease the burden on final year projects. And if possible, additional ones should be made available.

Finally, I would recommend anyone working on this project to receive it to think of how to automatically switch off equipment connected to socket B after a desired time period. As a hint, he or she should think of another monostable to switch on socket B.

REFERENCES

1. Yinusa A. Adediran, (2000), Applied Electricity, Finom Associates,Minna, Nigeria.

2. Theraja B. L., (1979) A Text Book On Electrical Technology, S. Chand & Company Ltd., Ram Nagar, New Delhi.

3. Fisher J. And Gatland B, (1976) Electronic Technology From Theory Into Practice, Second Edition, Robert Maxwellm. C. Britain.

4. Millman J. And Grabel A. (1997) Microelectronic, Second Edition, Mc Graw Hill, Singapore.

5. Ritcher, H. W. (1977) Electrical & Electronic Drafting, John Willey And Sons.