DESIGN AND CONSTRUCTION OF AUTOMATIC WATER SPRINKLER

BY

BASHEER IBRAHIM SHA'ABAN
H/EET/08/10884

NOVEMBER 2010

DESIGN AND CONSTRUCTION OF AUTOMATIC WATER SPRINKLER

BY

BASHEER IBRAHIM SHA'ABAN

H/EET/08/10334

NOVEMBER, 2010.

DECLARATION

I hereby declare that this project Report was written by me and is a record of my own project work. It has not been presented before in previous application for a higher national Diploma Reference made to published literature has been duly acknowledged.

BAHEER IBRAHIM SHA'ABAN

Student

Sign ..... Date 03/12/10

The above declaration is confirmed by:

Lecturer Auwal Aliyu

Supervisor

....

Signature Date

APPROVAL

This is to certify that the project report entitled **"Testing and construction of automatic water sprinkler"** by Basheer Ibrahim Sha'aban meet the regulations governing the award of higher National Diploma in Electrical/Electronics Engineering, Nuhu Bamalli Polytechnic Zaria and is approved for its contribution to knowledge and literary.

Student
Name: Basheer Ibrahim Sha'aban
Signature.....
Date.....03/12/20.....

Project supervisor
Name: Engr. Auwal Aliyu
Signature.....
Date.....9/12/20.....

Project co'ordinator
Name: Mallam Mahmud panti
Signature.....
Date.....

Head of Department (HOD)
Name: Engr. Muhammad Garba
Signature.....
Date.....

DEDICATION

I personally dedicate this project to my late parents Alhaji Ibrahim Sha'aban and his wife that's my mother who trained me morally, financial support, patience, encouragement, advice, sacrifices and prayers from child-hood up to the end of their lives, had led me to the successful completion of my study, may their gentle soul rest in perfect peace Ameen.

ACKNOWLEDGEMENT

First and foremost I will give my endless gratitude to Almighty Allah who makes one glorious gives dignity, all praise be to him, lord of majesty and bounty the honourer, the just, the maintainer, the originator the sublime, the generous, the most strong, the creator of death, the giver of life, and the master of the day of resurrection, for making my research work a successful one. I wish to thank my project supervisor Engr.Auwal Aliyu for his official assistance and untiring effort, excellent suggestion, correction and advice throughout the course of this project.

I am indebted to my brothers and sisters Nafisatu, zainab, shamsuddeen and shamsiya,and to the members of family uncle A.k and uncle Albashir, Also my regards and appreciation goes to my colleagues , Umar Waziri, Abubakar ragraga, yahaya O_2, Aminu Turaku. Also my gratitude goes to my Rabi'u Salanke, Yusufa Chayo,shamsudden Adamu, Hafizu Rector, Ahmad sabo, Nasiru Shehu, Umar Isah, mafee, mega. I will be unfair if I fail to extend to my appreciation to my ladies on campus especially Aishatu S. Abubakar campus Queen, Nafisatu yusuf a lady with dignity, Maryam iliyasu my only sister, Khadija sani my lady, Aishatu Abubakar my sweety, shamsiya Ibrahim Balarabiya, Flexy G, Juliet Obi Nwosu my hot cake and Miriam Michael. Thanks to you All.

TABLE OF CONTENT

ABSTRACT/SUMMARY

The construction of this project is carried out so as to be able to sprinkle within the surroundings or to water flowers when the sensor senses dryness on the ground. When the ground is wet there will be no sprinkle of water.

LISTS OF FIGURES

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

With rapid urbanization our style of living are fast changing. Along with these changes is the type of accommodation we all aspire for.

Although Electrical Engineering has made living very comfortable it still strives to make living better. Thus this project is a demonstration of one of the many ways Engineering can help simplify chores in the household.

This project looked into ways of eliminating or reducing to the bearest minimum waste of water in the irrigation environment as water is very essential to our existence.

1.2 OBJECTIVES OF THE PROJECT

The objective of this project is to construct a circuit that will switch on an AC water sprinkler machine of 220V when dryness is sense from thew ground.

1.3 THE SCOPE OF THE STUDY

This project is constructed to operate as automatic water sprinkler either to provide sounding plants with water.

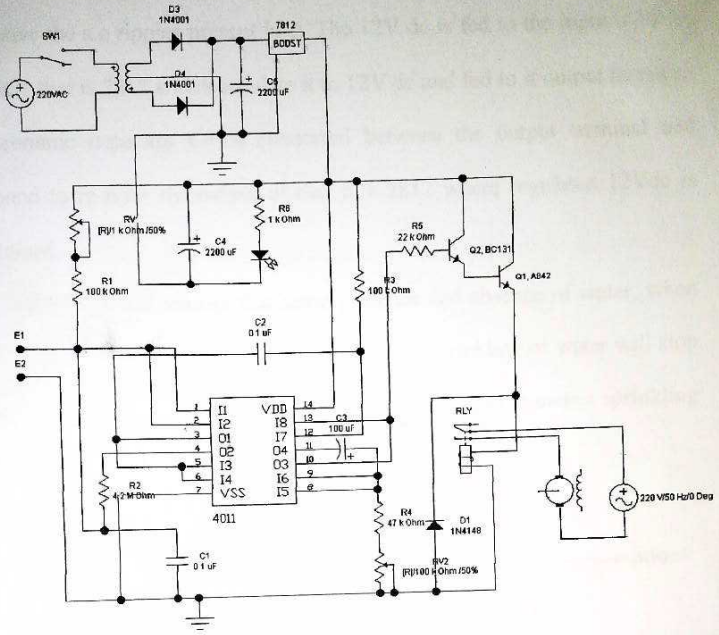


Fig.1.1 complete circuit diagram

1.4 PRINCIPLE OF OPERATION

Refer to fig.1.4 above, this circuit uses 12V, 500mA step-down center-tapped transformer, which transform the input voltage of 220Vac into 12Vac. The generated 18Vac is rectified to 12Vac with help of the rectifier circuit (full-wave). Capacitor C5 is used to smooth the dc voltage in order to

remove the a.c ripples present in it. The 12V dc is fed to the input terminal of IC1 that is 7812 which regulate it to 12V dc and fed to it output terminal. A ceramic capacitor C4 is connected between the output terminal and ground to re-filter the output of that IC1 7812 where regulated 12Vdc is obtained.

E1 and E2 are the sensors that sense presence and absence of water, when E1 and E2 are separated it means no water and sprinkling of water will stop and when shorted that E1 and E2 are immerse in water it means sprinkling of water will start.

1.5 PROJECT LIMITATION

The system is designed to work successfully under the following conditions:

- AC power input = 220V ac – 240V ac
- Input current = 500mA
- Input frequency = 50Hz
- Current output = 200mA
- Regulated output voltages dc = 12V
- Operating temperature = 0°C to 75°C

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter consist of the generals description of the construction of the four stage regulated power supply. The descriptions involved are from the input voltage of the transformer to the output voltages, which are obtained, in form of regulated dc voltage.

2.2 REGULATED POWER SUPPLY

Most electrical equipment requires a source of power supply that can provide the necessary dc operating voltage and current. Majority of equipments require power supply while some portable equipment such as transistor radio receivers are battery operated so as to provide the energy required capable of providing a nearly constant dc output voltage even when there are variations in load or input voltage.

Source of regulated dc power. The basic power supply consists of the following stages:

i. Voltage transformation
ii. Voltage rectification
iii. Voltage filtration
iv. regulation

The necessary requirement for conversion from AC to DC is a transformer; rectifier, filter and a regulator are refinement of a dc power supply.

Some characteristics to be noted when constructing a power supply circuit are shown below:

i. Maximum and minimum voltage demand of the load
ii. Maximum and minimum current demand by the load
iii. Percentage regulation
iv. The ripple factors
v. The efficiency
vi. Circuit

Power supply unit can be classified into two categories these are;

i. Unregulated supply: this is a supply in which the output voltage varies with the variation of input voltage.
ii. Regulated supply: this is the supply that output voltage remains constant even when the input voltages vary.

The basic elements of unregulated power supply are:

i. The transformer
ii. The rectifier
iii. The filter

While for the regulated supply is:

i. Voltage regulator

2.3 REVIEW OF PREVIOUS POWER SUPPLY PROJECTS

In constructing this project, past project carried out by some students, electronics journal and Internet web-sites were visited and the literature review was done.

Abdullahi 2006, in his project titled 'testing and construction of automatic water pumping and level control system', the project is constructed in such a way that, when the Reservoir tank is full and the overheads tank that is upper and lower level are empty, the system will generate a signal that will automatically switch on the electric pumping machine.

However, when the overhead tank is full that is upper and lower level probes are immerse in water then pumping will automatically stop,

Even if the overhead tank is empty. When the reservoir tank is empty the machine will be in the "off" position.

However, in this project the testing and construction of automatic water sprinkler, whenever dryness is sense by the sensor its enable the system to automatically sprinkle water and stop when enough water has been sprinkle.

Aniwen 2004, another project reviewed, titled 'design and construction of water level control system'. The project is design in such a way that the sensing circuits, which are made-up of good conductors, sense the present or absent of water in the overhead or underground tank. The present or absent of water enable the output of the AND logic gate of the logic circuit to go High or Low which in turn trigger the power latch ON or OFF and at the same-time switches the electric pumping machine ON or OFF. When the pumping switches ON, water will be pump from the underground to overhead tank.

The AND logic gate output will be HIGH if the two inputs are HIGH.

Indicators are included to indicate the present or absent of water either in the overhead or underground tank.

Hence, with this innovation the pumping of water from underground to the overhead tank is controlled and it is automatic.

However, in this project the testing and construction of automatic water sprinkler, whenever dryness is sense by the sensor its enable the system to automatically sprinkle water and stop when enough water has been sprinkle.

CHAPTER THREE

3.20 LOGIC CIRCUIT

The logic gate used is NAND gate type CD4011BCGoing through data books the NAND gate chosen is either 7400 or CD4011BC.

The NAND gate has the following characteristics:

VDD = 3V – 15V

Operating temperature = -55°C to +125°C

PD Dual in line = 700mW, Small outline = 500mW

Storage temperature (TS) = -65°C to +150°C

Input tr.; tf = 20ns

CL = 50pF

RL = 200kΩ

In designing this project the two NAND gates are label N1 andN2 are connected together and the sensor.

N1 has two inputs, which are A and B

N2 has two inputs, which are C and D

Input B of N1 is connected to output Y of N2.

Input C of N2 is connected to output X of N1

Hence, X = C and Y = B

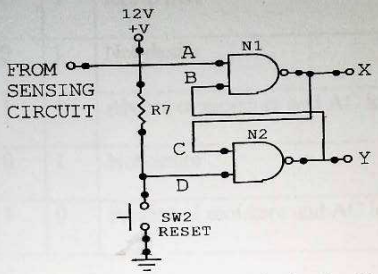


Fig. 3.20 the logic circuit

Table 2 truth table of inputs A and B of N1

A	B	X	REMARK
0	0	1	Not desired
0	1	1	Present of moisture and alarm switch ON
1	0	1	Not desired
1	1	0	Absent of moisture and alarm switch OFF

Table 3 truth table of inputs C and D of N2

C	D	Y	REMARK
0	0	1	Not desire
0	1	1	Absent of moisture and AC load switch ON
1	0	1	Not desire
1	1	0	Present of moisture and AC load switch OFF

The combine output of N1 and N2 form the truth table below.

Table 4

X	Y	Z	REMARK
0	0	0	After RESET
0	1	1	Not desire
1	0	1	Desire condition to ON alarm and OFF LOAD
1	1	0	To RESET

For the power latches to be trigger ON the logic circuit output must be:

X = 1 to switch ON alarm

Y = 1 to switch ON AC load

Where: 1 = High, 0 = low.

The output X of N1 is connected to the power latche1 and alarm circuit.

The output Y of N2 is connected to the power latch2 and to AC load

However, when push button SW2 (RESET) is push ON, the flip – flop

RESET

When SW2 is closed, VCC = 0 + I4R4 then Vd = 0

From APPENDIX 2

Iin = ID = 0.000001(at VCC = 15)

R4 =Vcc/I4

R4 = 12/0.000001

R4 = 1.2MΩ

The input terminal A is connected to the collector of Q1 while the input

Terminal D is connected to R4 via Vcc.

3.30 POWER LATCHES

The circuit consists of two latches.

Power latch 1 enable the RLY1 to switch ON or OFF the AC load whenever the present or absent of moisture is detected.

Power latch 2 enables the RLY2 to switch ON or OFF the alarm circuit Whenever the present or absent of moisture is detected.

3.31 POWER LATCH 1

This circuit enables the RLY1 to switch ON OR OFF when a High or

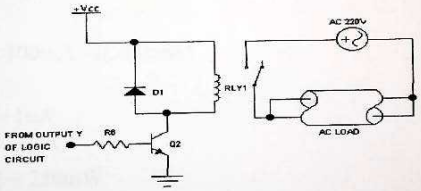


Fig.3.31

Low is received from the logic output Y.

Q1 = Q2 =Q3, they are the same they have the same characteristic.

Assume Y = 1 = High note Vy is VoH from Appendix 2 and this is 9.95V

$Vy = I6R6 + Vbe$

$Vy = 9.95V$ when input voltage is 10V and IoH which is $I6 = 2.25mA$ at 25°C refer to Appendix 1

$9.95V = I6R6 + Vbe$

$R6 = (9.95 - 0.7) / 0.00225$

$R6 = 4111\Omega$ (preferred value is 4.2K Ω)

D2 is a freewheeling diode it has the function of protecting Q3 from any excessive current from the relay. D2 was chosen to be IN4001 and it has the following characteristics:

$VR(max) = 25V$

$If(max) = 100mA = ILed(max)$

$IR(max) = 1uA$

$Ptot(max) = 250mW$

At the collector circuit of Q3

$Vcc = IL1Rr1 + Vce3$

$Vce3 = 1/3$ of Vcc

$Vcc = 12V$

$Vce3 = 4V$

Rr = Relay resistance

IL1 = collector current

12 = IL1Rr1 + 4

8V = IL1Rr1

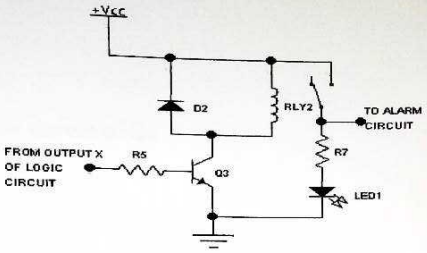
IL1 = 0.1A this is the maximum collector current Q3

Rr1 = 8/0.1

Rr1 = 80Ω (preferred value is 100Ω)

Hence, the Relay JZC-20F with 12V DC, 10A-and100Ω characteristic was chosen.

The AC load is any equipment that is capable 0f handling AC 220V-240V.



3.32 POWER LATCH 2

Fig.3.332

Power latch 2 switch ON or OFF the alarm circuit whenever the present or absent of moisture is detected.

$Vx = I5R5 + Vbe$

$Vx = 9.95V$ from DC electrical characteristics of 4011 refer to Appendix 1

$9.95V = I5R5$ and $IoH = I5 = 2.25mA$

$R5 = (9.95 - 0.7)/(0.00225)$

$R5 = 4111\Omega$ (preferred value $4.2K\Omega$)

D3 and D2 are the same and the serve similar purpose.

At the collector circuit of Q4

$Vce4 = 1/3$ of Vcc

Vce4 = 12/3, Vcc = 12V

Vce4 = 4V

IL2 = collector current of Q4

Rr2 = Relay resistance

Vcc = IL2 Rr2 + Vce4

Vcc = 100IL2 + 4

8 = IL2Rr2

IL2 = 0.1A from characteristics

Rr2 = 8/0.1

Rr2 = 80Ω (preferred value is 100Ω)

Hence, the relay chosen is JZC-20F.

The LED is to indicate whenever the alarm is ON.

It has the following characteristics

Forward voltage VF = 2 = Vdd

Reverse voltage Vr = 5v

Forward current If = 15mA = ILed(max)

Vcc = IfR7 +Vf

Therefore, R7 =(Vcc – Vf) / If

$$R7 = \frac{12 - 2}{0.015}$$

R7 = 666.6666Ω (preferred value 700Ω)

3.4.0 ASTABLE MULTIVIBRATOR

The astable multivibrator is designed using the IC timer connected in the astable mode. NE 555 was chosen for this project considering the Characteristics below:

V_{CC} supply voltage V_{CC} = 18v

Input voltage (continuous, RESET, THRESHOLD, TRIG.) = V_{CC}

Output current = 225mA (approx.)

Operating free-air temp range = 0°c - 70°c

The astable stages are divided into two.

Stage 1- low freq. stage

Stage 2 – High freq. Stag

3.5.2 RECTIFIER

Model 980 – 1500

It has four terminals

Terminals = pins

$V+ = 1$

$A_{C1} = 2$

$A_{C2} = 3$

$V- = 4$

$Vrms = 15V$

$Vmax = \sqrt{2} \times Vrms$

$Vmax = \sqrt{2} \times 15$

$Vmax = 21.21V$

$Vdc = 21.21 \times 0.636$

$Vdc = 13.49V$

$Vd`c = Vdc - 2(0.7)$

$= 13.49 - 1.4$

$= 12.09V$

3.5.3. FILTER

Capacitors C_1 should have the capability to filter all ripples voltages

Hence, $\gamma = 1/ (4\sqrt{3}RLFC1)$

Where;

RL = Load resistance = 30Ω

F = frequency = 50Hz

C1 = capacitor

γ =5% = 0.05 = 1/ (4√3 x 30 x50 xC1

C1 =1.9245mf = 1924.5uf

C1 = 2200uf

3.5.4. REGULATOR

Model – 7812

Vcc = 12v

Vrms = 15V

Vmax =√2 x Vrms

Vrms = √2 x 15

Vrms = 21.21V

Vdc = 21.21 x 0.636

Vdc = 13.49V

Vd`c = Vdc – 2(0.7)

= 13.49 – 1.4

= 12.09V

Max circuit current = 1A

Therefore 7812 is chosen to provide regulated 12v as Vcc at maximum current of 1A.

CHAPTER THREE

CONSTRUCTION

3.1 INTRODUCTION

Construction was conducted in order to put together all the components discussed in the previous chapters to form a single four-stage regulated power supply.

3.2 COMPONENTS USED FOR CONTRUCTION

The following components were used in the construction of this project:

1. Transformer 12V centre-taped 1
2. Capacitor 2200uf,25V 2, ceramic 1nf 4
3. Regulator 78125 1
4. Resistor 1KΩ 2
5. Diode (bridge rectifier) 1 IN4001 3
6. LED Red 1 Green 1
7. Variable resistor 2
8. CD4011 1
9. Relay 1

3.3 CONSTRUCTION MATERIALS

The materials used while constructing a five- stage regulated power supply include, test board, vero board, soldering iron, lead wire, sucker and flexible wires i.e. jumpers.

VERO BOARD – is made up of a thin sheet limited insulating material manufactured with regular spaced holes permit mounting of electronics used as a permanent board on which the circuit was constructed.

TEST BOARD – is a special board made for testing the circuit before mounting the component onto a vero board for construction and soldering. The components were not soldered on the test board but rather tighten holes conductors are used to provide easiness of connection.

SOLDERING IRON – is the material used to heat the lead wire between the conductors and connecting point on the vero board.

LEAD WIRE – this is the material used as means of connection between conductor and the board buy applying heated soldering iron.

SUCKER – is a material used to removed excess lead wire at the soldered joint or when removing component i.e. to suck out the lead

Wire away from the terminal.

FLEXIBLE WIRE – these wires that are used when connecting two or more terminals of the component together.

3.4 CONSTRUCTION PROCEDURE

A test board was initially used to test whether all the components arranged could perform the expected function. The construction procedures are as follow:

1. All the required components, was tested using digital multi-meter so as to confirm its functionality before taken to the circuit for soldering.
2. The components were plug in vertically in the position specified in the circuit connection and vero board conductor's arrangement, also flexible wires used where necessary.
3. The components were soldered on the board using soldering iron and lead wire.
4. The soldered connections were tested using multimeter and other equipment's to ensure efficient soldering

12

5. Incase of any partial contact or line short circuit, the joint should be re-soldered if partial contact or line short circuit, the joint should be re-soldered if partial contacts are sucked out to clear the short circuit.

3.5 CONSTRUCTION OF THE CASING

The control circuit casing was bought in the market already made in plastic form although before it was purchase the dimensions were calculated as shown below:

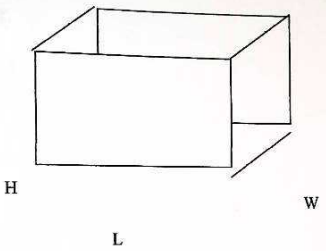


Fig. 3.1 the casing of the project

Where H = 5.5cm = height

W = 15 cm = width

L = 15cm = Length

13

The cuboid was used to determined surface area and volume

Surface Area (A) =2(LW +LH +HW)

$=2\{(15 \times 15) + (15 \times 5.5) + (5.5 \times 15)\}$

$=2\{225+ 82.5 +82.5\}$

$=780cm^2$

Total Volume (V) = LWH

$=15 \times 15 \times 5.5$

$= 1{,}237.5cm^3$

CHAPTER FOUR

TESTING AND RESULT

4.1 TESTING MATERIALS

Testing material are materials that can be used to measure the functionality of the component or the entire circuit. The material used for these purpose is digital multi-meter.

DIGITAL MULTIMETER – This is an instrument that combines in one case the basic instruments for the measurement of voltage, current, resistance and other related quantities.

4.2 TESTING PROCEDURE

The measurement of performance for individual component and the entire circuit were taken by using multimeter, breadboard. The following steps were taken during the test.

1. The signal applied at the input port was measured.
2. The output voltage was noticed and recorded using multimeter.

4.3 SAFETY PRECAUTION

1. The circuit should not be connected while the power supply is ON.
2. Make sure that all connections are properly made before the power supply is connected the power supply.
3. All circuits' connections and components were checked for any fault.

4.4 RESULTS

All the components were put in there respective places and were all coupled together to function as one unit. After switching ON the system The construction of this project is carried out successfully it was able to sprinkle water within the surroundings or for irrigation purposes also to water flowers when the sensor senses dryness on the ground and when the ground is wet there will be no sprinkle of water.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

In this chapter, the summary and achievement of the constructed project were explained inform of conclusion and recommendation.

5.2 CONCLUSION

The construction of automatic water sprinkler was successful. Hence, we say the aims and objectives of the project have been achieved. The project can be concluded as the project uses an AC input voltage that undergone so many process, so as to produce a 12V DC regulated output the of the project was achieved.

5.3 RECOMMENDATIONS.

Since the electronic equipment are virtually useful in every sphere where efficiency and comfort is needed, the recommendations were suggested as below:

1. There is need to improve the input voltage so as to obtain a large number of the dc output for testing wider environment.

2. Other types of protection such as fuse, relay, circuit breakers e.t.c. suppose to be employed together with switching transistors, so as to avoid the electronics systems from being damage by short circuit e.t.c.

3. This circuit can be design and constructed using micro-controller.

REFERENCES

1. Aniwen, E. A. **Design and construction of water level control system** Dept. of Electrical Engineering BUK 2004.

2. Sharma, M. C. **Practical Electronics power supply;** First edition BPB Publishers, New Delhi India 2004.

3. Abdullahi, B. **Testing and construction of automating water pumping control system** Department of Electrical/Electronics Engineering Technology Kano State Polytechnic, 2006.

4. Theraja, BL and AK **A textbook of Electrical Technology;** Revised edition S. Chand and company. New Delhi India.

5. Fairchild, semiconductor **Discrete power and signal Technology;** www.Digchip.com 2004.

6. Robert B. and Nashelky L. **Eectronics devices and circuits theory;** Third edition; prentice hall, USA 1982.

7. Dave Johnson, P. E. **Stabilised power; circuit idea** www.Electronicsforu.com 2004.