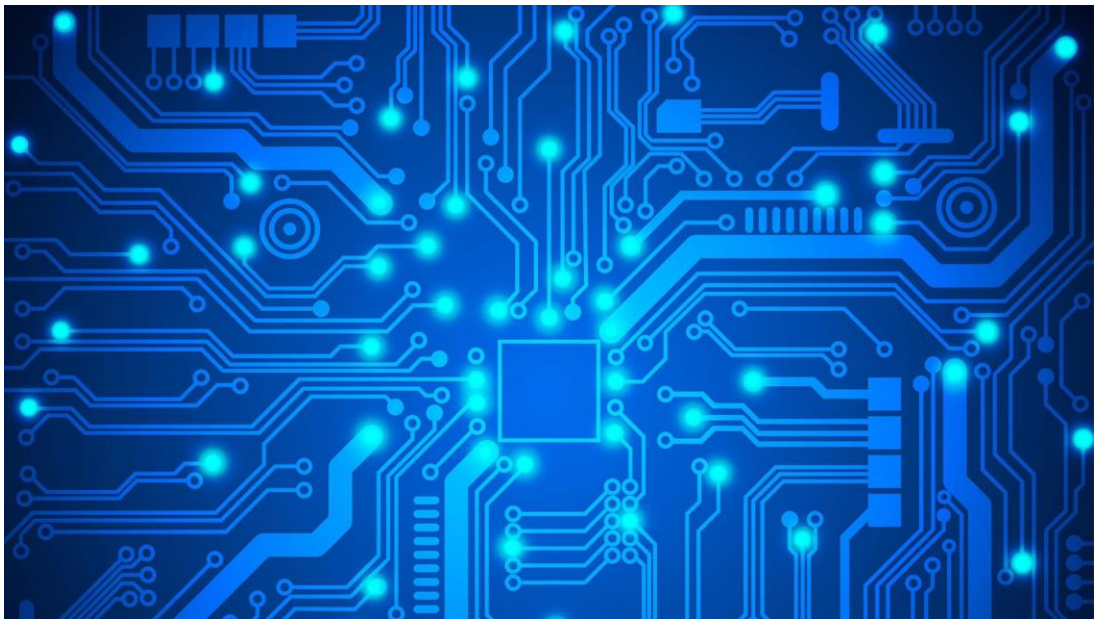
ENEE2313

ELECTRONICS 1



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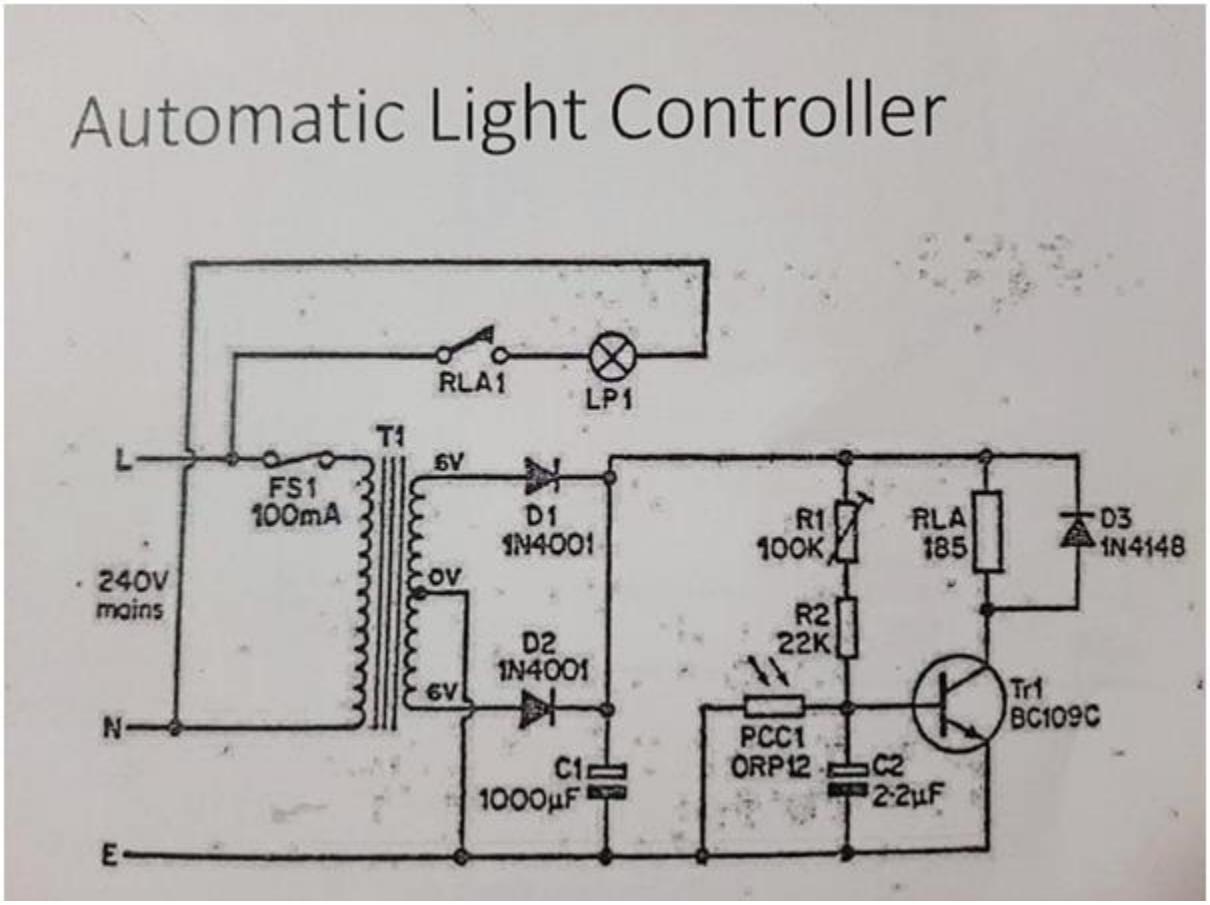
Date: 10-8-2021

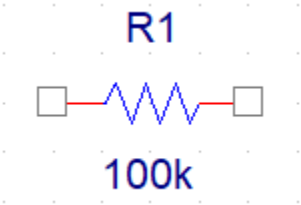
Abstract:

The aim of this project is to design and build a simple Automatic Light Controller by using a sensor to sense the surrounding light intensity which is inversely proportional to an external lighting. In addition to the sensor, we use a simple power supply which contains a lot of components such as diode, filter, center tapped transformer full wave rectifier and capacitors. Then we connect them with another component like, relay, BJT transformer and resistors.



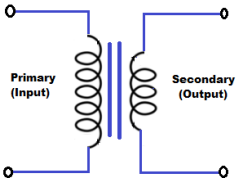
The Components:

Resistor:



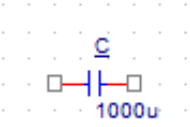
An electrical circuit that used to reduce the current flow. The resistor's ability to reduce the current is called resistance and it measured in units of ohms.

Transformer:



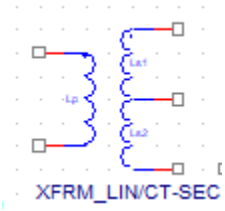
A passive electrical device that uses to increase or decrease the amplitude of the line voltage.

Capacitor:



Is an electronic component consisting of two conducting plates separated by an electrical insulator, it stores an electric charge and release it when required, in this project we connected a large capacitor (1000u) to work as a filter to smooth the pulsating wave to decrease the Ac ripple.

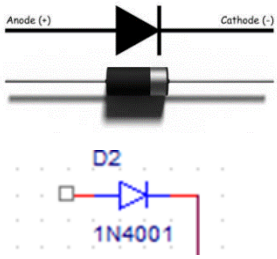
Center Tapped Transformer:



Is designed to provide two separated secondary voltages, V_A and V_B with a common connection. This type produces a two-phase and three wire supply.

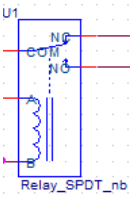
We use it in this project to convert Ac Volt to DC Volt.

Diode:



It is an electronic device with a single p-n junction and it is use to conduct the current in one direction.

Relay:



Is a form of electrical switch. A relatively small current is used to create a magnetic field in a coil within a magnetic core and this is used to operate a switch that can control a much larger current.

The light sensor: Is an electrical component which the main job is to sense the surrounding light whose resistance is proportional inversely with the intensity of the light. When the surrounding light intensity is large then the voltage across the sensor will be small because the resistance of the light becomes small and its current is large, then the value of VBE< 0.7 v, hence the transistor becomes in the cut off region and the relay is deenergized, so the switch is open (the lamp is off). While the resistance at night becomes large and its current is small and the value of VBE has greater than 0.7, hence the transistor is on and becomes in the active region and the relay is energized, so the switch is close (the lamp is on).

Theory:

Our project consists a lot of electrical parts that used to convert the Ac small signal into DC signal using DC power supply (Center Tapped Transformer which used to convert Ac Volt (Zero avg value) to DC Volt, transformer to decrease the amplitude of the line voltage. And the capacitor is used as a filter to smooth the pulsating wave to

decrease the Ac ripple.

The main component that our project is based on is the sensor. The sensor senses the surrounding light around it according to the resistance of the light sensor, the

voltage will change, when (Vth < 0.7) The

transistor which was used as a switch will be in the cut off region, so the current can't pass through the relay (the lamp is off).

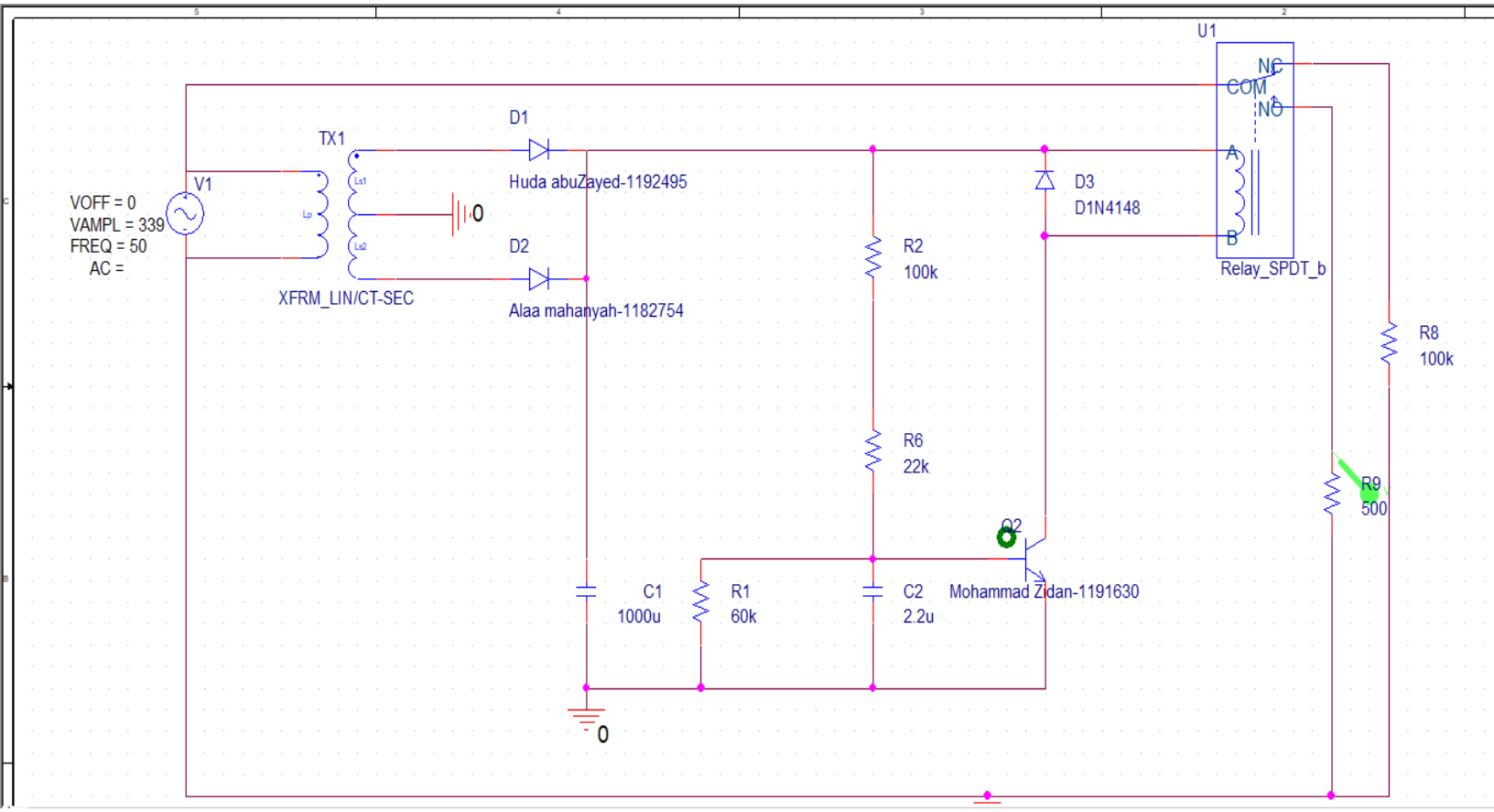
At night:

Its resistance is small, so it allows the current to pass, the value of

vth > 0.7 and the transistor is in the active region and we can calculate vth through the following equation:

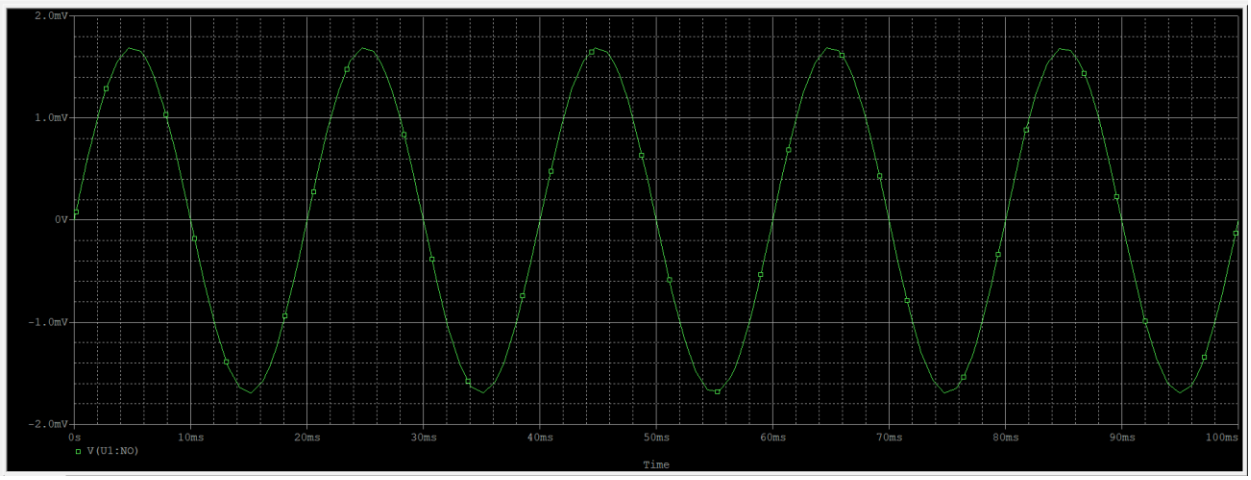
Vth=(R(sensor)*Vcc) \(R(sensor)+R+R(variable resistor).

Simulation:

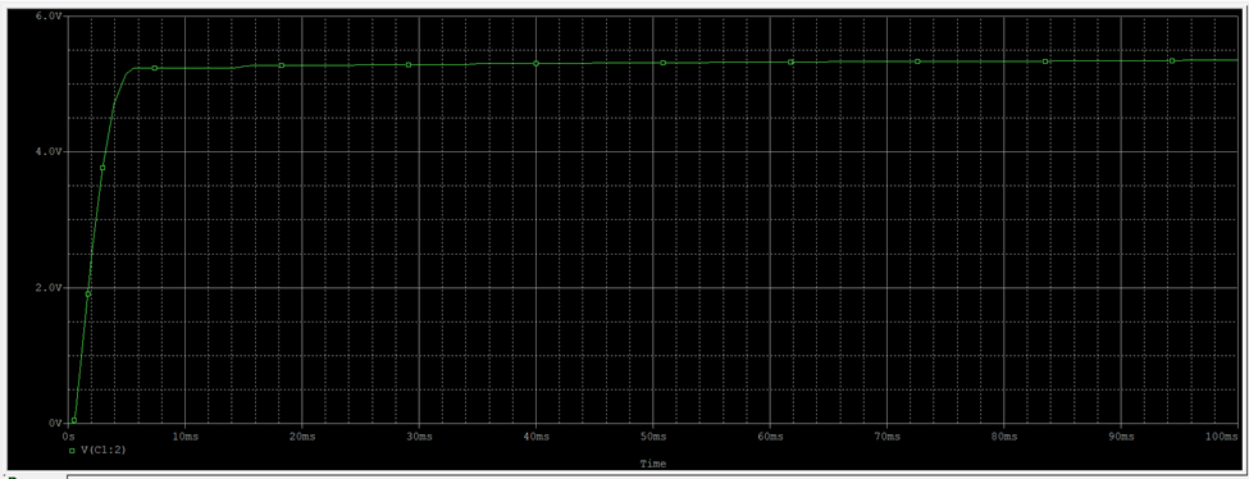

U1
NC
COM
NO
A
B
Relay_SPDT_b
D1
Huda abuZayed-1192495
D2
Alaa mahanyah-1182754
TX1
XFRM_LIN/CT-SEC
V1
VOFF = 0
VAMPL = 339
FREQ = 50
AC =
0
D3
D1N4148
R2
100k
R6
22k
R8
100k
R9
500
Q2
C1
1000u
R1
60k
C2
2.2u
Mohammad Zidan-1191630
0

When R=1k:

R is small, so that VBE < 0.7 v, hence the transistor becomes in the cut off region and the relay is deenergized, so the switch is open (the lamp is off).

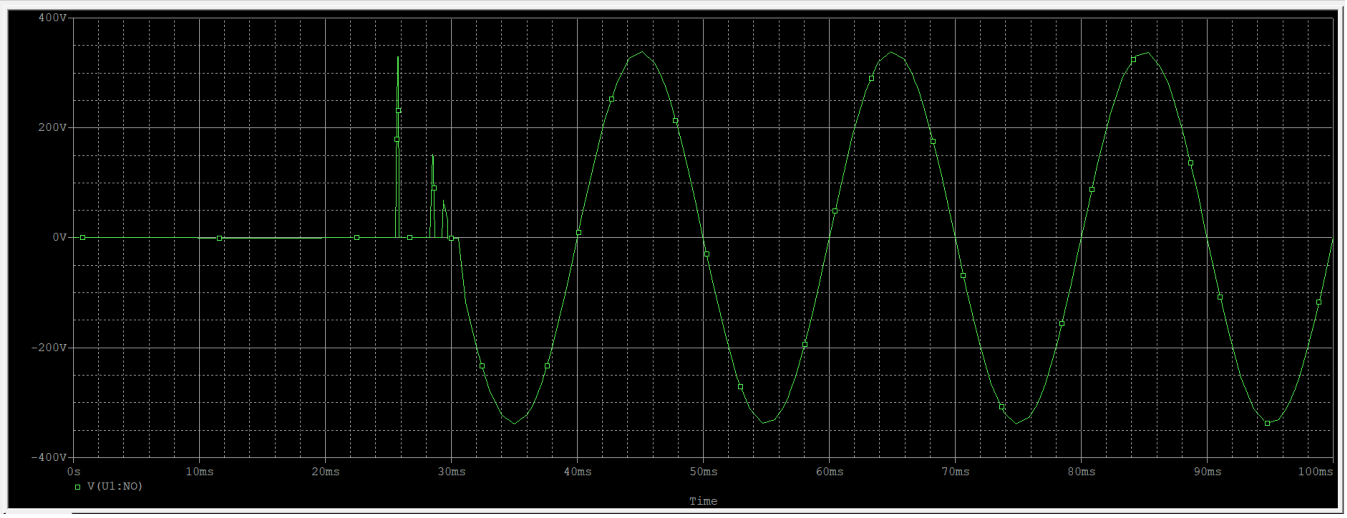


And this is the simulation of the voltage around the capacitor (works as a filter) when the lamp is off.

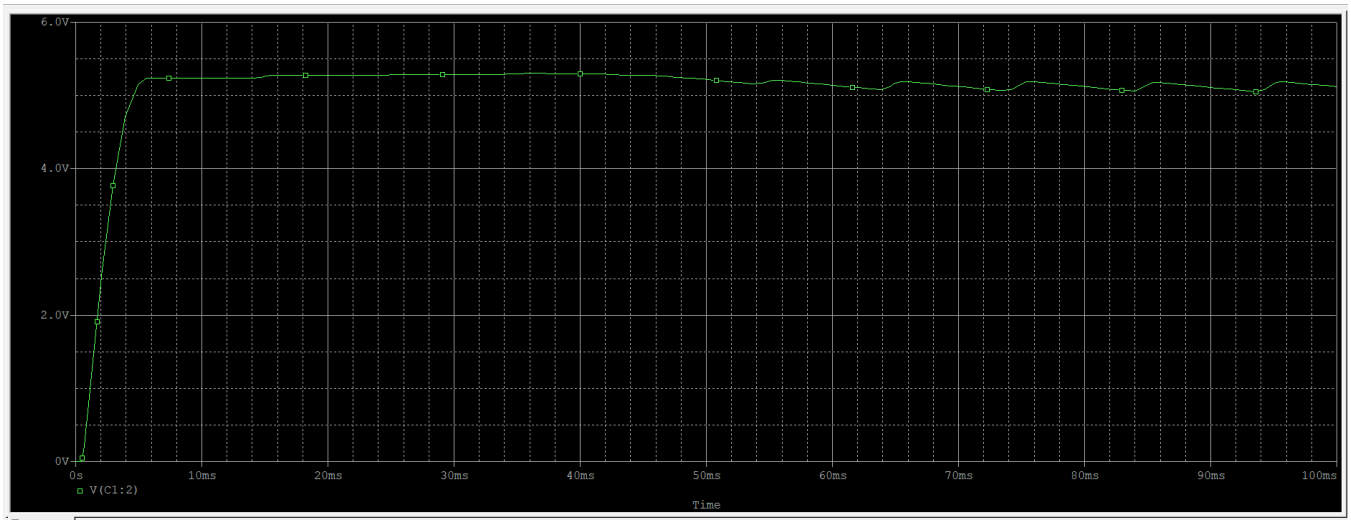


When R=60k:

R is large, so that VBE has voltage greater than 0.7, hence the transistor is on and becomes in the active region and the relay is energized, so the switch is close (The lamp is on).

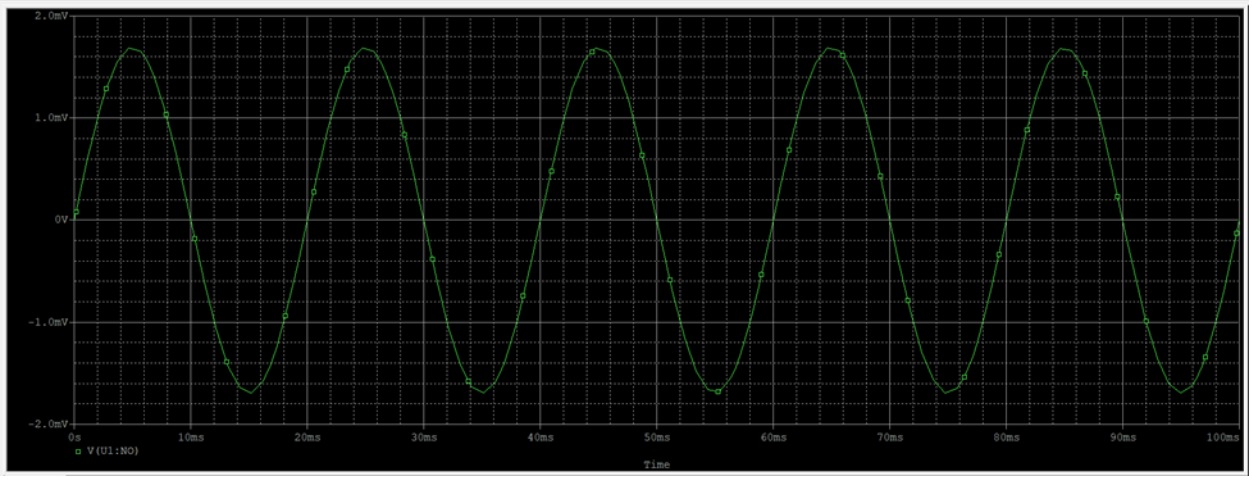


And this is the simulation of the voltage around the capacitor (works as a filter) when the lamp is on.

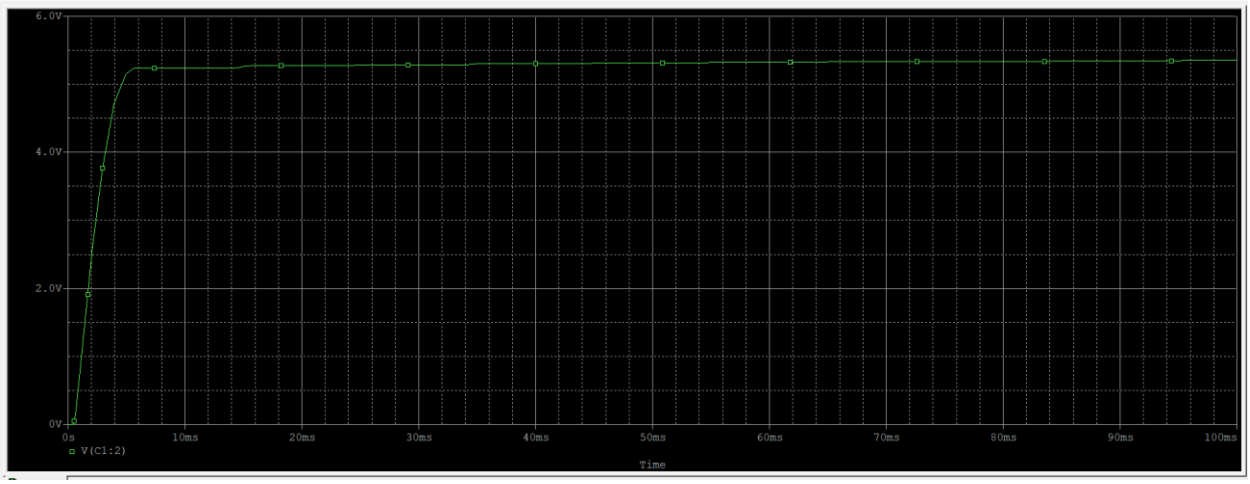


When R=5k:

The transistor is in the cutoff region (The lamp is off).



And this is the simulation of the voltage around the capacitor (works as a filter) when the lamp is off.



Data and Calculations:

The value of Vcc we got = 5.22V.

Note: VBE=Vth

1. In daytime:

The value of R1 at night is = 1kΩ.

VBE = (R1/ R1 + R2+ R6) Vcc

= (1/1+100+22) *5.22= 0.042

The value of R1 in daytime is = 5kΩ.

VBE = (R1/ R1 + R2+ R6) Vcc

= (5/5+100+22) *5.22 = 0.205v

R1 is small, so that VBE < 0.7 Volt and we conclude that:

***The Transistor is in the cut-off region**

*** Relay resistance equal zero.**

***The Switch is open.**

***Lamp is off.**

2. At night:

The value of R1 in daytime is = 60 kΩ.

VBE = (R1/ R1 + R1+ R2) *Vcc

= (60/60+100+22) * 5.22 = 1.720v

R1 is large, so that VBE > 0.7 volt and we conclude that:

***The Transistor in active region.**

***Relay Resistance not equal zero.**

***The Switch is close.**

*** Lamp is on.**

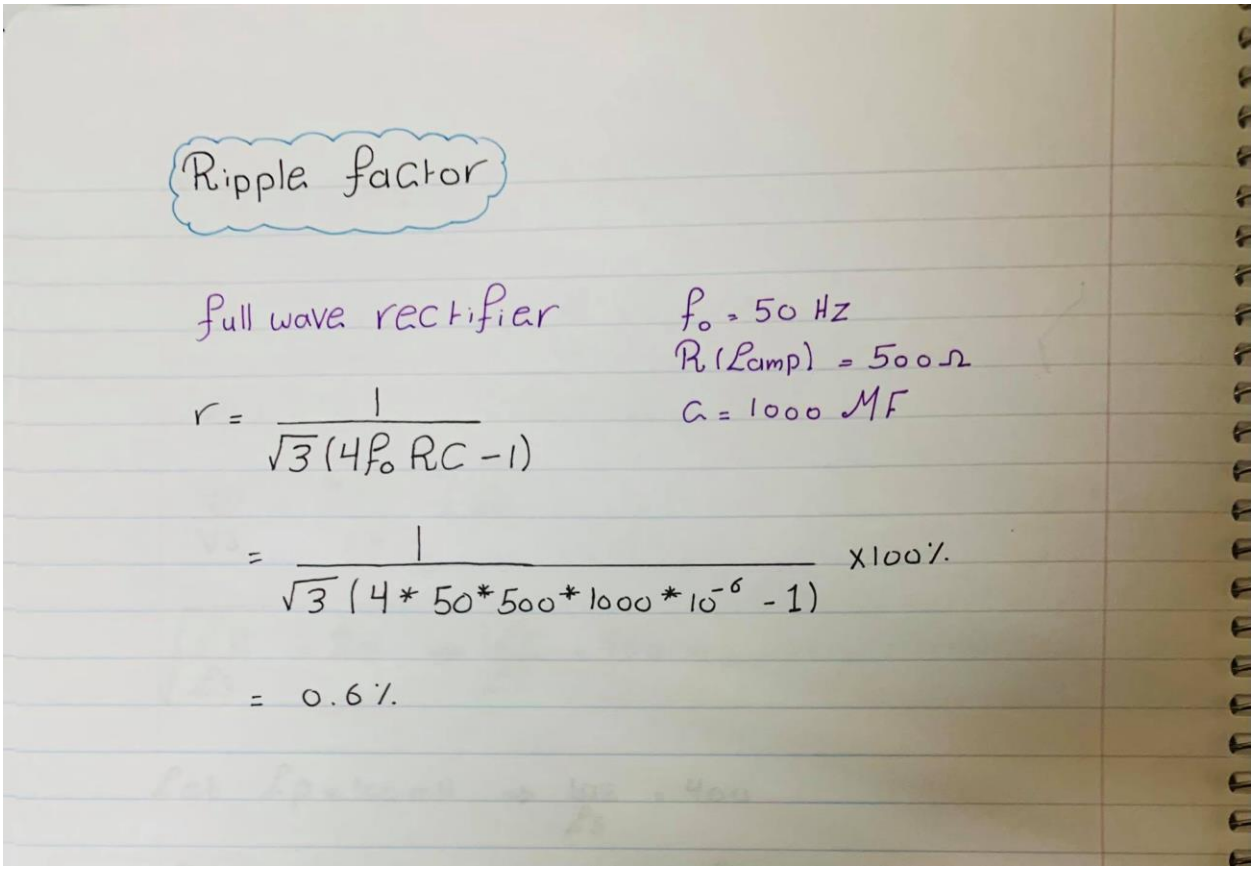
We took three values of resistors:

R = 60k➡lamp is on

R = 1k➡lamp is off

R =5k➡ lamp is off

Ripple Factor:



Center Tapped Transformer:

$V_S = 12\ rms = 12 \times \sqrt{2} = 17\ peak$

$V_P = 240\ rms = 240 \times \sqrt{2} \approx 339$

$$\frac{V_P}{V_S} = \frac{339}{17} \approx 20$$

$$\sqrt{\frac{L_P}{L_S}} = 20 \Rightarrow \frac{L_P}{L_S} = 400$$

Let $L_P = 100\ mH \Rightarrow \frac{100}{L_S} = 400$

$L_S = 0.25\ mH \quad L_{S1} = L_{S2} = \frac{L_S}{2} = \frac{0.25}{2}$

$= 0.125\ mH$

Conclusion:

In this project, we dealt with new elements such as relays and sensors, and we concluded a lot of things from them:

1) when the relay activates, the switch is still open and the lamp is off, in this case we used a small resistance with VBE less than 0.7 V to make the transistor to be in the cutoff region.

2)When the switch is closed, the lamp is immediately on, in this case we used a resistance to make VBE equals 0.7 V.

3)When The relay was activated, the resistor of the sensor is very high, so that VBE is greater than 0.7 and the transistor is on subsequently the light is on.

our opinion about this project:

The project was very useful because it helps us to learn how to design and build the circuit and make the simulation on OrCad PSpice .

In addition, it helps us to imagine how the electronic device such as the diode is working in the different region "cut off region and active region". The transistor is working in the active region when the voltage is greater than 0.7, in this case the value of sensor's resistor is small which allow the big amount of current to pass hence, the lamp will light. On the other hand, when the voltage is less than 0.7 the transistor is working in the cut off region and the value of sensor's resistor is large, as a result of that, the lamp won't light.