Faculty of Engineering and Technology Electrical & Computer Engineering Department

Analog Electronics -ENEE2360-

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Project Name: Automatic Light Controller

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Date: 20 Apr.2021

Abstract

The project is an automatic light control device that aims to use electronic devices to control the lamp with the degree of light that turns on when dark, and turns off during the day automatically Using these electrical devices: transistor, relay, resistors, light sensor, capacitors, diodes, and transformers to do this project using **OrCad** software according to the following methodology, firstly, analysis of the automatic lighting control circuit, then design the circuit using **OrCad** software. Finally, circuit simulation using **OrCad.**

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Theory

It is considered an automatic lighting control unit where the lighting turns on automatically when the lighting turns on automatically. This system uses the transistor as an **on/off** switch the system makes use of the transistor work in the local area and cut off to automatically turn on and off the lights. This system works as a sensor, as it does not require manual control, the system detects light itself. When the light is light or light, the light value will show light and show light automatically. Measure it on a potentiometer (**variable resistor**) to control how dark the light should be. Moreover, the system is designed to avoid common problems such as overload, relay chattering, and also inductive kick back in the relay.

- We will talk about the new elements:

1. **Photocell**:

   It's a sensor, which has the same function of a resistor, but the resistivity of it depends on the spotlight on it. When the light is intense the resistivity of it became too small and vice versa.

2. **Relay**:

   Is a device that open or closes the contacts to cause the operation of the other electric control, it consists of two sections: primary and secondary, the primary section contains the coil, which produced a magnetic field when the current flow through it. The secondary section consists of common, normally closed, and normally opened. The normally opened part in this experiment is connected with the lamp, so when the magnetic field produced by the coil if it strong enough, in this case the common will be connected to the normally opened so, this will turn on the lamp, else the common will still connected to the normally closed and the lamp will be off.

3. **Transistor**:

In this experiment will control the relay, by providing it with the current needed to produce the magnetic field, if the transistor in the cutoff region the relay will deenergized and the switch will be off, so the lamp will be off too. If the transistor in the active region, then the relay will be energized and the switch will close, so the lamp will be on. The region of the transistor depends on the V_{BE} voltage, if V_{BE} is bigger than 0.7, the transistor will be in the active region, and if V_{BE} is smaller than 0.7, the transistor will be in the cut off region.

4. Dc power supply:

The dc power supply here consists of, transformer, which decrease the amplitude of line voltage, then this voltage goes to the full-wave rectifier, which convert it the positive pulsating dc, the next stage is the filter, which smooth the pulsating dc signal by removing the ripple contents, then the output of this power supply is a dc voltage, which become a part of the other circuit, which contains the transistor, the photocell, the relay, and the lamp, and we considered it as input dc voltage to this circuit, to make the analysis of the circuit easier .

Procedure & Discussion

Stage I:

We connected as in Fig2 the center taped transformer with AC source to step dawn it, and we connected the full wave rectifier diode with center tap transformer to convert from AC volt to DC volt, after that we connected a large capacitor (1000 µF) works as a filter to smooth the pulsating wave to decrease the AC ripple, and finally we get DC voltage with 36 V as shown in Fig3.

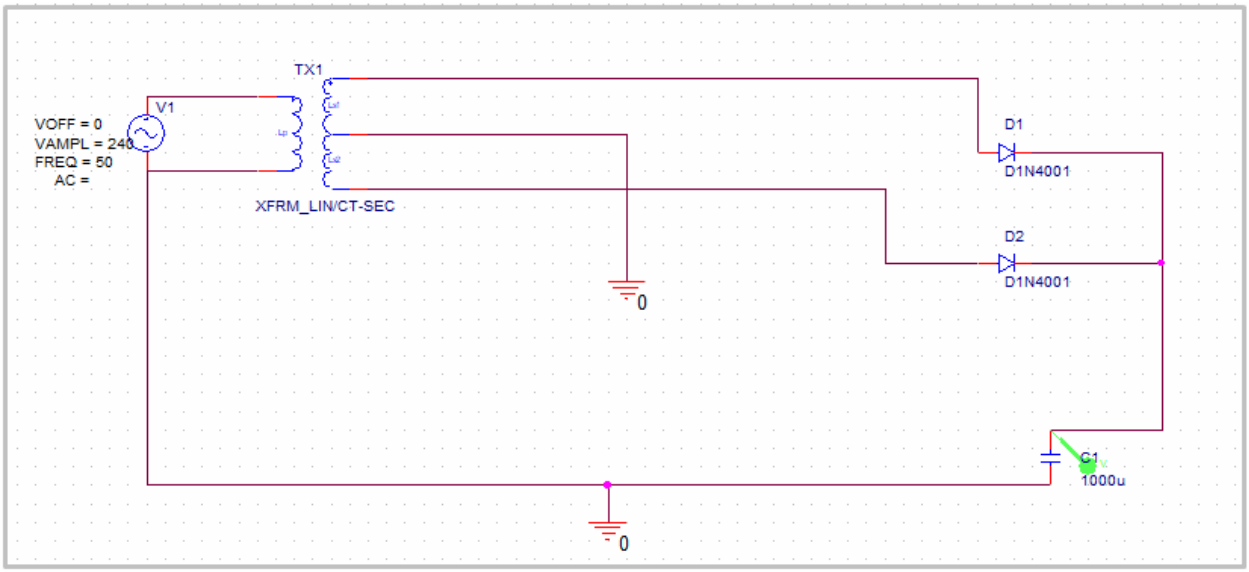

Figure 1: Dc Power Supply

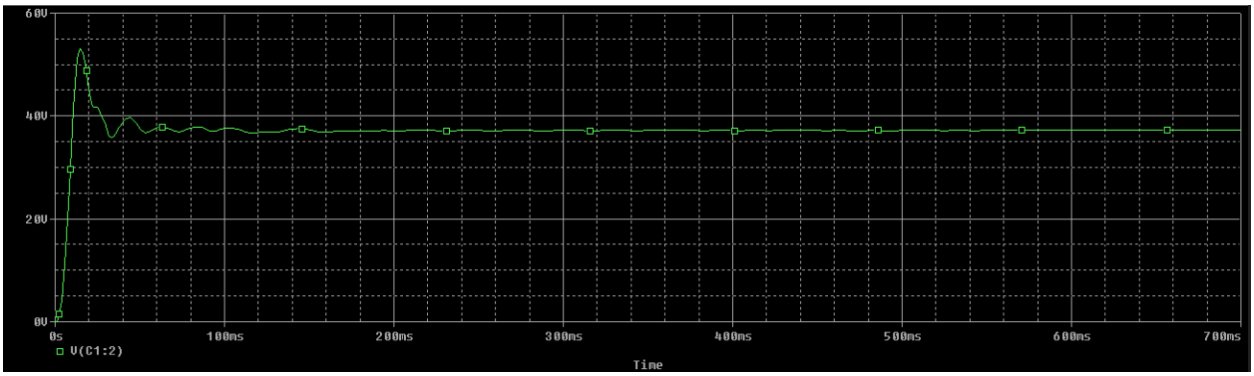

Figure 2: DC Simulation

○ Stage II:

➢ The following figure represents the circuit schematic using OrCad and then a multi-meter was used to measure:

- The value of the sensor resistance at day and night
- The voltage across the capacitor
- The value of the variable resistance

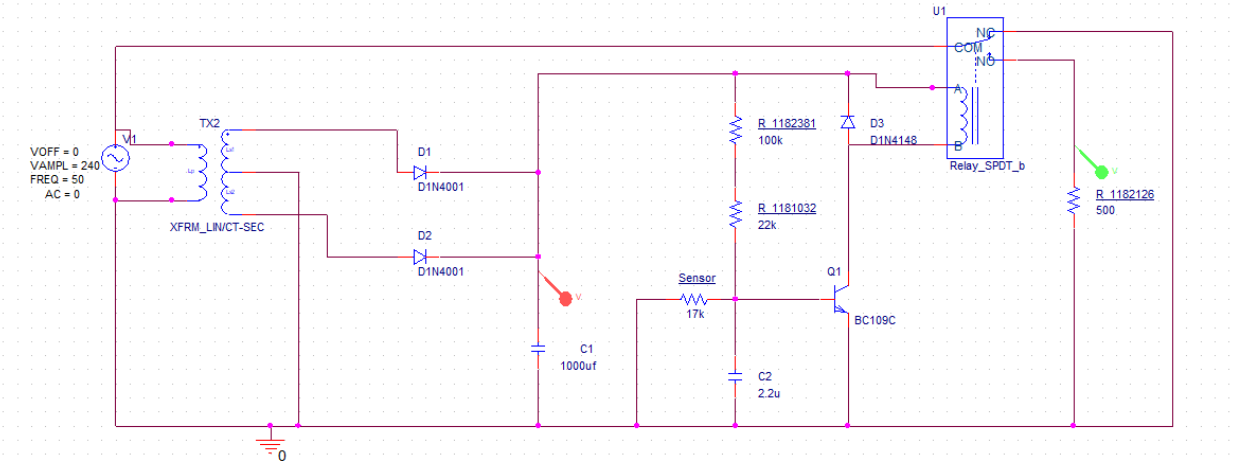

Figure 3: Circut schematic using OrCad

- Vbe = Vth across the sensor (R)

  We put 100k as a value for the variable resistor R(1182381), and we have taken 3 values for R(Sensor).

  We used voltage divider to compute the value of Vth (Vbe) for the 3 values.

➢ When R=2k:

  Vth = Vbe = (2)/(2+22+100) * (36) = 0.58 v.

  Since vth < 0.7 , the transistor is in cut off region

  Diode is on and Rth = 0 .

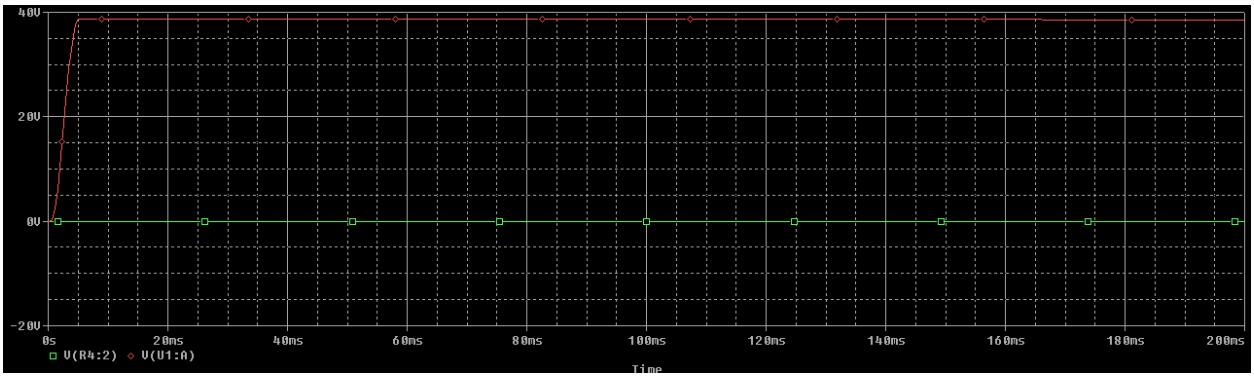

Figure 4: Simulation for (R= 2k)

- ✓ **We notice that the green curve (voltage across the lamp) is equal to zero so there are no current passes through it so the lamp is off (Vbe < 0.7).**

- When R=8K:

  Vth = VRs = (8)/(8+22+100) * (36) = 2.2 v.

  Since vth > 0.7 , the transistor is on

  Diode is of and Rth != 0 .

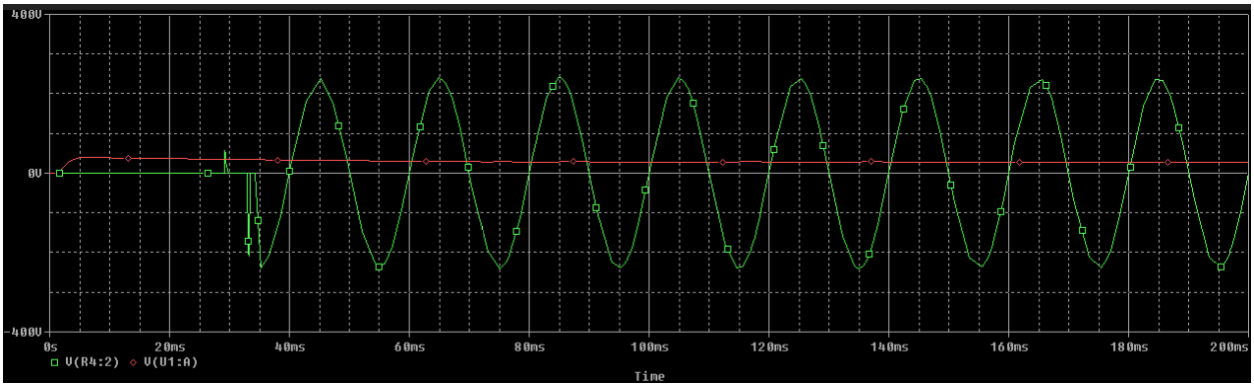

Figure 5: Simulation for (R= 8k)

- ✓ **We notice that the green curve is not equal to zero so there is a current passes through the lamp (lamp is on) (Vbe > 0.7).**

- When R = 12k:

  Vth = VRs = (12)/(12+22+100) * (36) = 3.2 v.

  Since vth > 0.7 , the transistor is on

Diode is of and Rth != 0 .

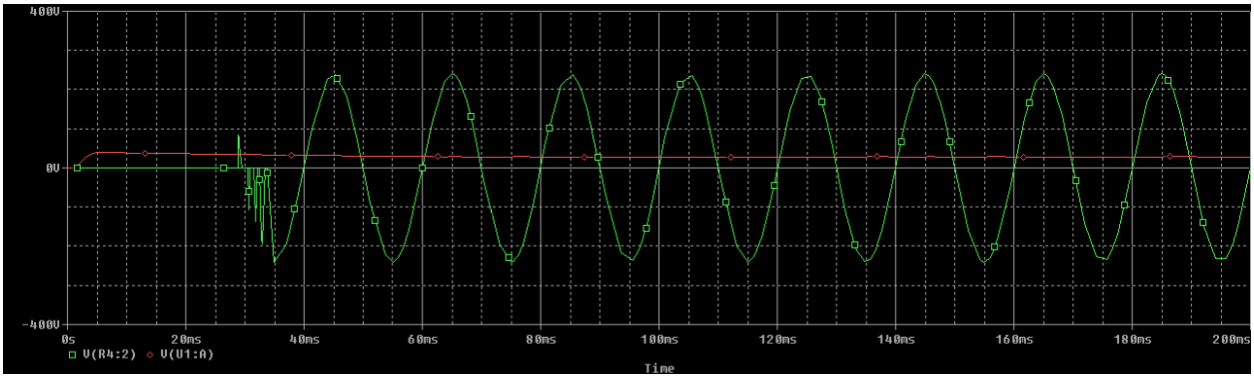

Figure 6: Simulation for (R= 12k)

- ✓ **The green curve represents the voltage across the lamp (500k resistor), we notice that the voltage does not equal zero so the lamp in on, so (Vbe > 0.7) so our calculations is true.**

Conclusion

In this project we have dealt with electronic devices such as transistors and relays, we learned how to use orcad tools to connect them in a circuit and simulate it to get the values that we need. We connected diodes, capacitor and transformer to build a dc power supply. Also we got in touch with the transistors that worked as a switch; when V is less than 0.7 the switch was open and no current passed. But when it more than 0.7 the current passed through E and C. We have seen how to build center tapped full wave rectifier. It was a very useful project, the objectives were successfully achieved. Now we are able to use orcad to build circuits.