BIRZEIT UNIVERSITY

ENEE2313

Tank Water Level Indicator

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Instructor:

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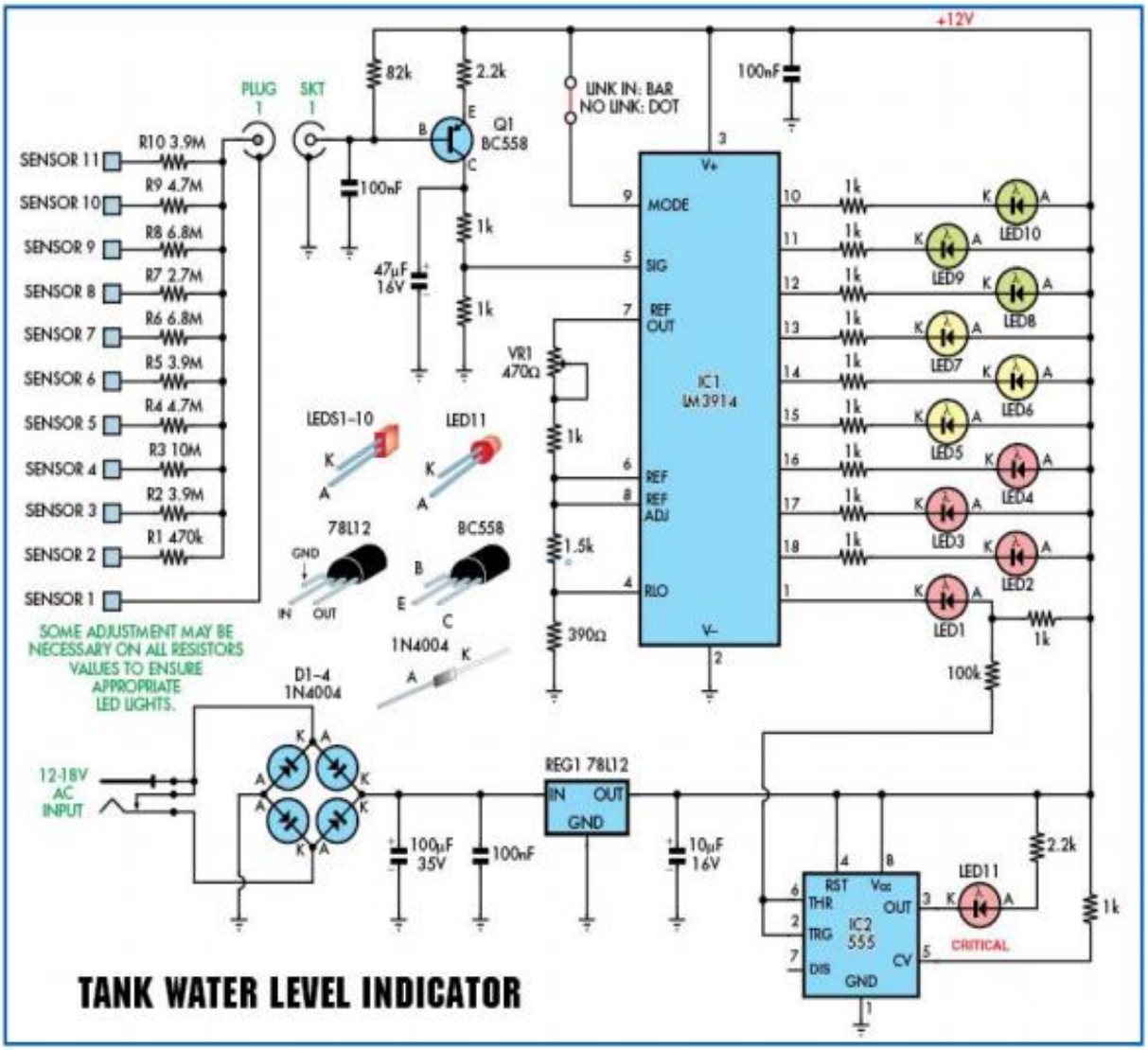
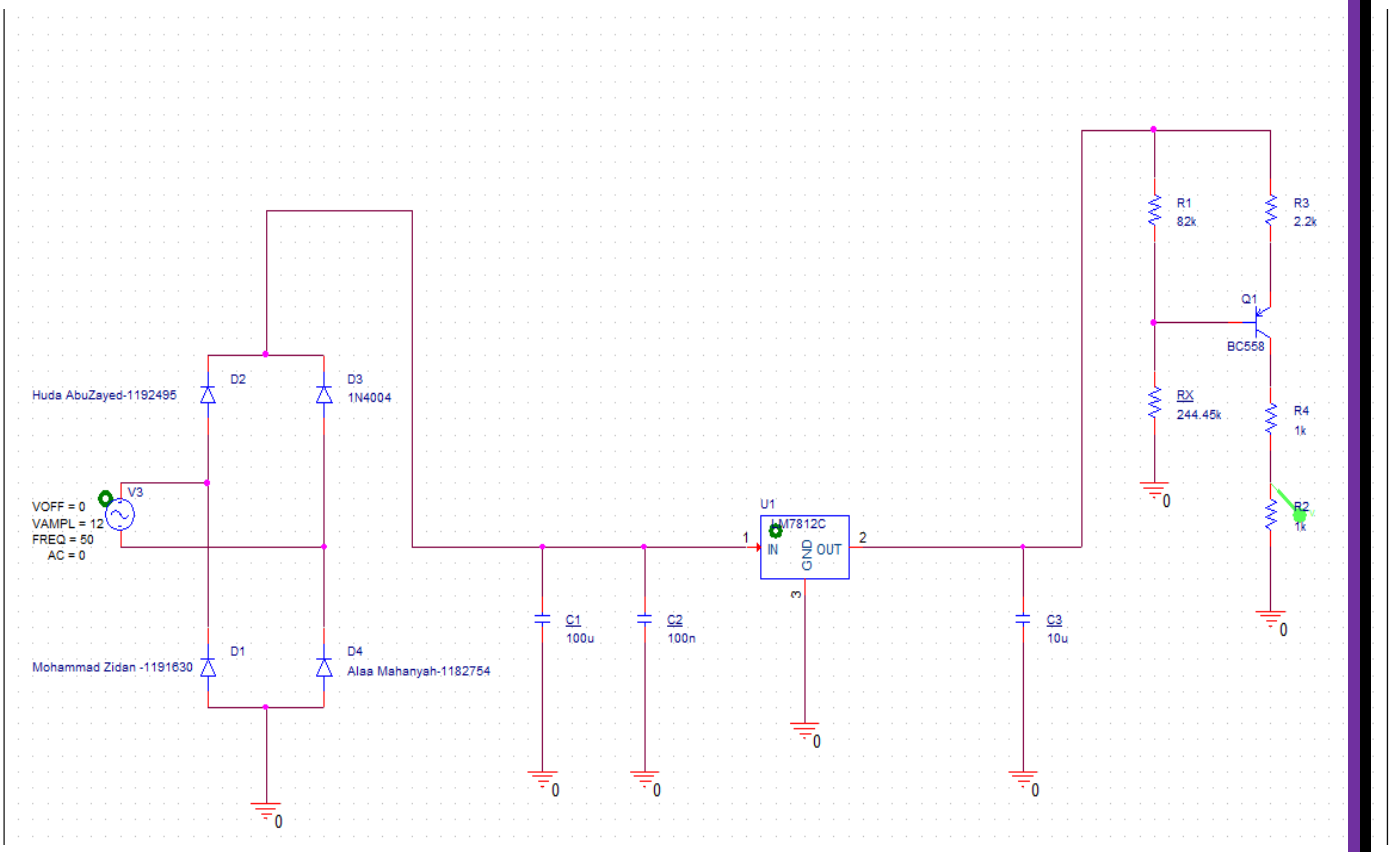
Abstract:

The aim of this project is to design a simple tank water that can indicate to the water level in the tank by using sensors connected with LEDS_ LIGHTS which glowing when the water level increased. That's mean when the water level increases in the tank, then the number of glowing LEDS_ LIGHTS will increase. At this time, the resistor become small and the height of water and the voltage around one 1K ohm will increase.

The Components of the circuit which used to build this project:

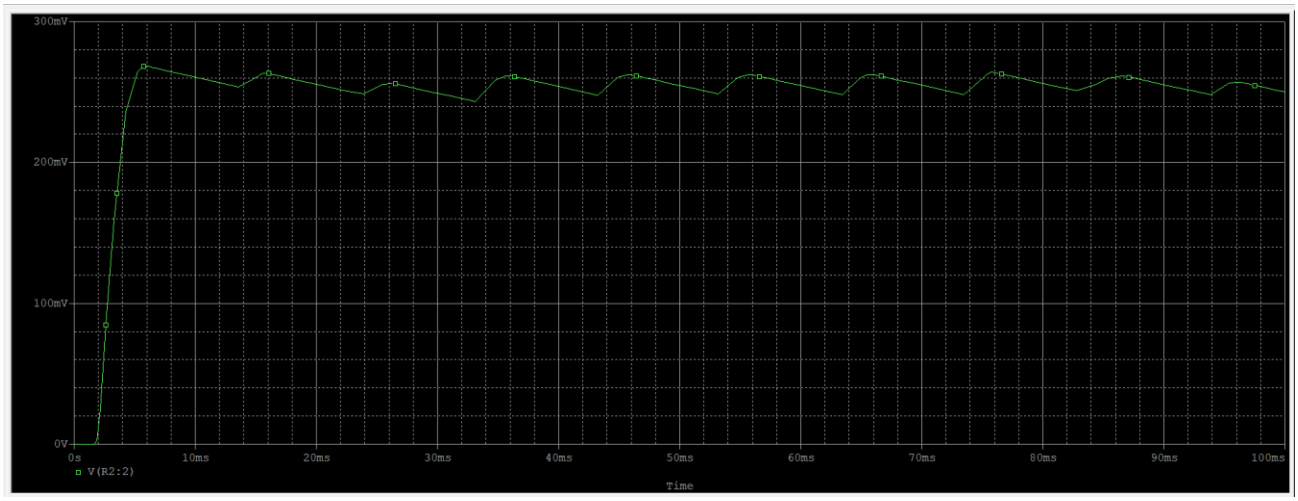
Resistor, Regulator, Ac source, BJT Transistor, Capacitors and Diodes.


+12V
PLUG 1
SKT 1
82k
2.2k
Q1 BC558
LINK IN: BAR
NO LINK: DOT
100nF
SENSOR 11
R10 3.9M
SENSOR 10
R9 4.7M
SENSOR 9
R8 6.8M
SENSOR 8
R7 2.7M
SENSOR 7
R6 6.8M
SENSOR 6
R5 3.9M
SENSOR 5
R4 4.7M
SENSOR 4
R3 10M
SENSOR 3
R2 3.9M
SENSOR 2
R1 470k
SENSOR 1
47µF 16V
1k
VR1 470Ω
1.5k
390Ω
IC1 LM3914
MODE
SIG
REF OUT
REF
REF ADJ
RLO
V+
V-
LED1
LED2
LED3
LED4
LED5
LED6
LED7
LED8
LED9
LED10
LEDS1-10
LED11
78L12
BC558
1N4004
SOME ADJUSTMENT MAY BE NECESSARY ON ALL RESISTORS VALUES TO ENSURE APPROPRIATE LED LIGHTS.
D1-4 1N4004
12-18V AC INPUT
100µF 35V
REG1 78L12
IN OUT GND
10µF 16V
100k
IC2 555
RST
THR
TRG
DIS
Vcc
OUT
CV
GND
CRITICAL
TANK WATER LEVEL INDICATOR

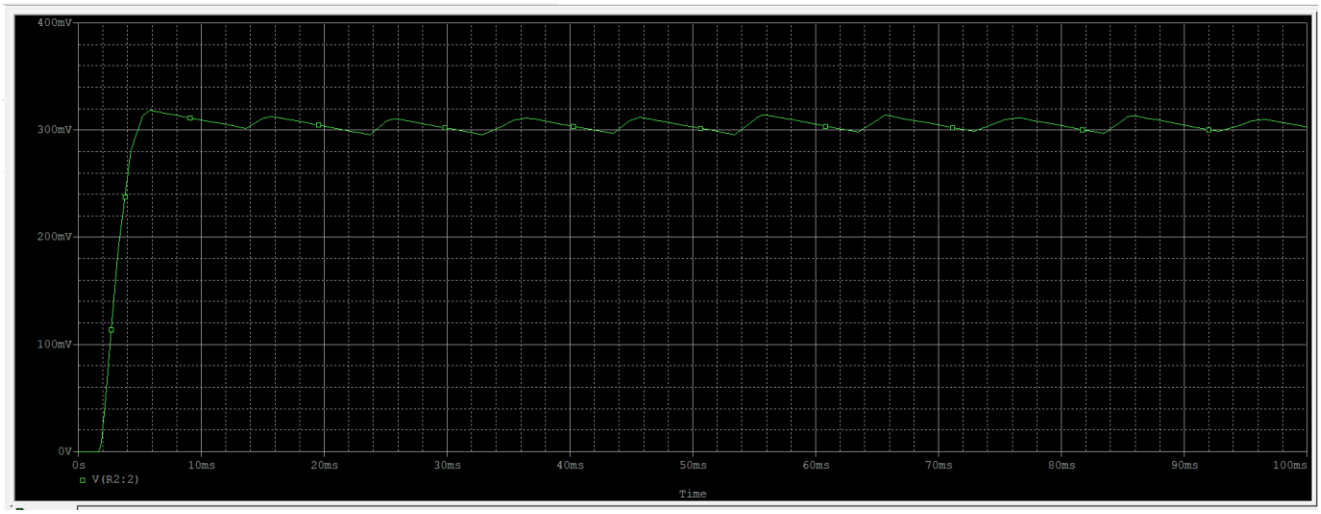


Simulations:

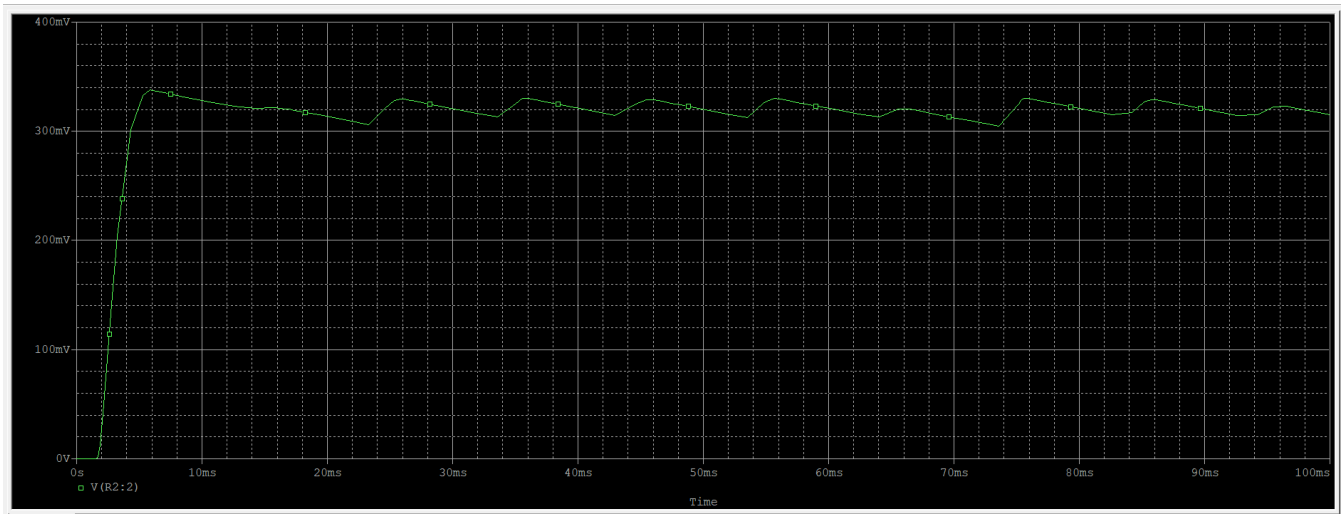
When Rx=470k:



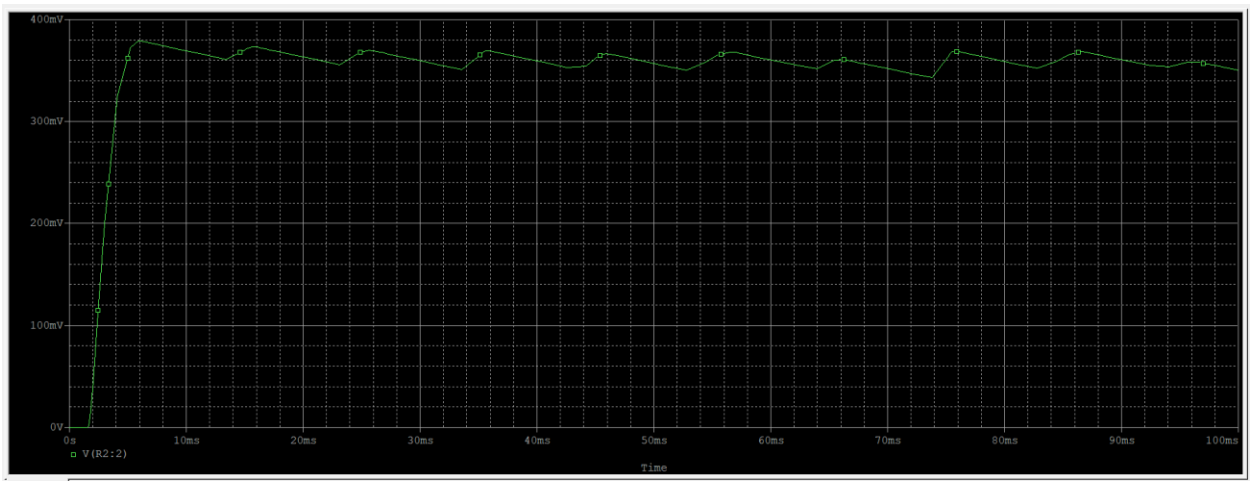
When Rx=419.45k (3.9M parallel with 470k):



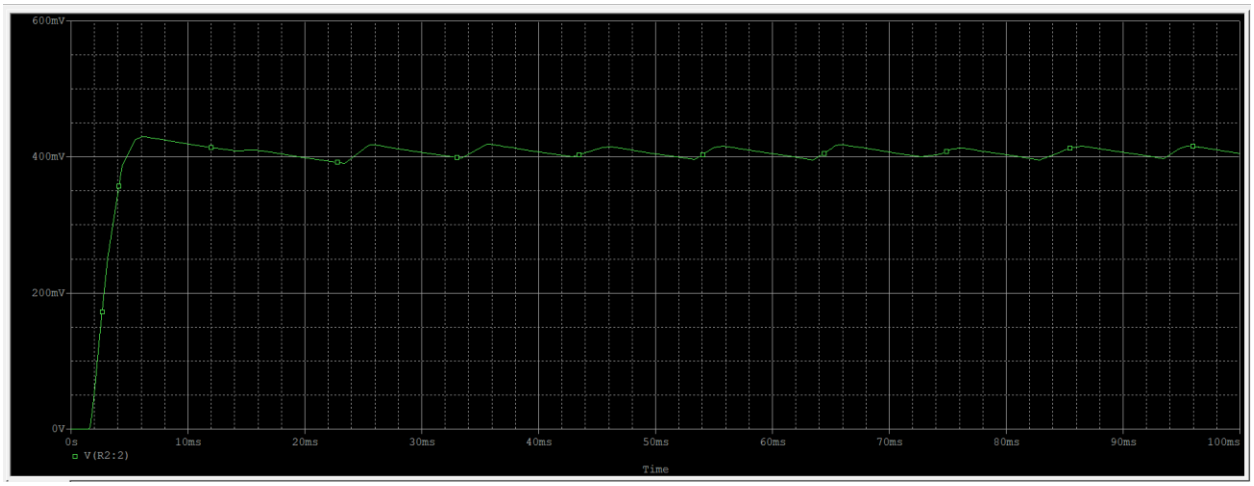
When Rx=402.56k (419.45k parallel with 10M):



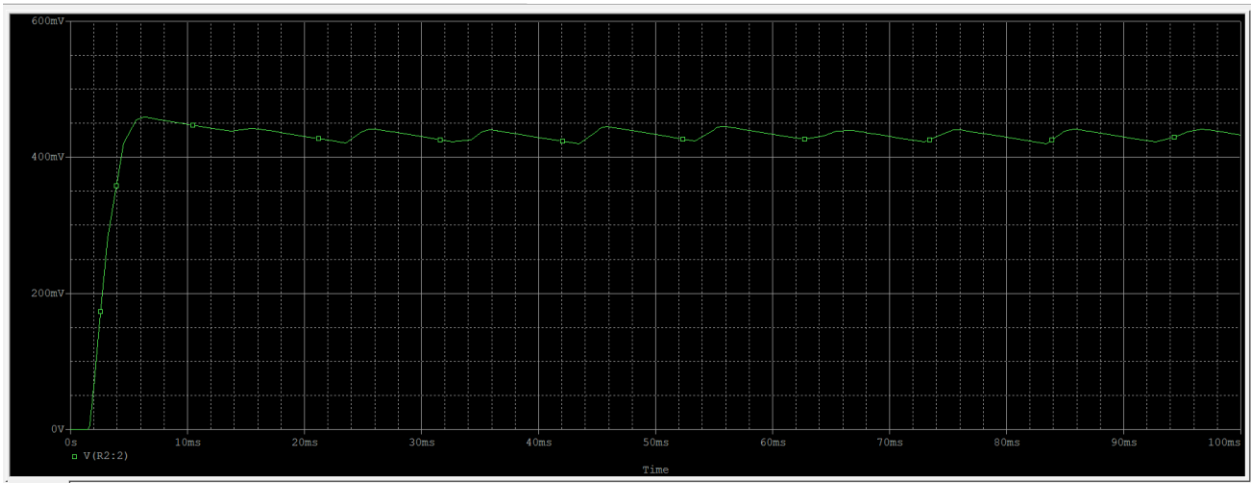
When Rx= 370.80K (402.56K parallel with 4.7M):



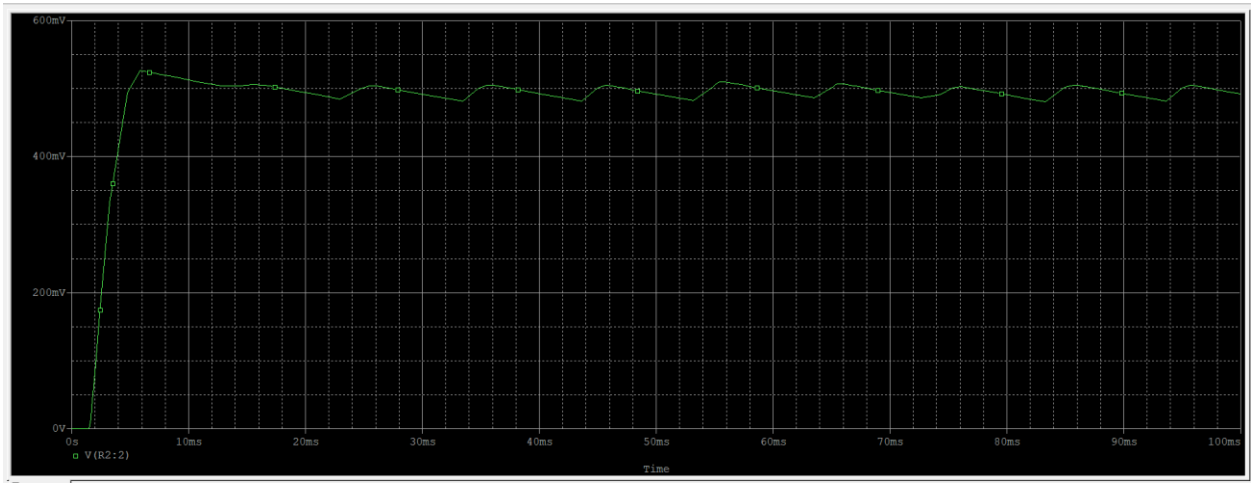
When Rx= 338.6k (370.80k parallel 3.9M):



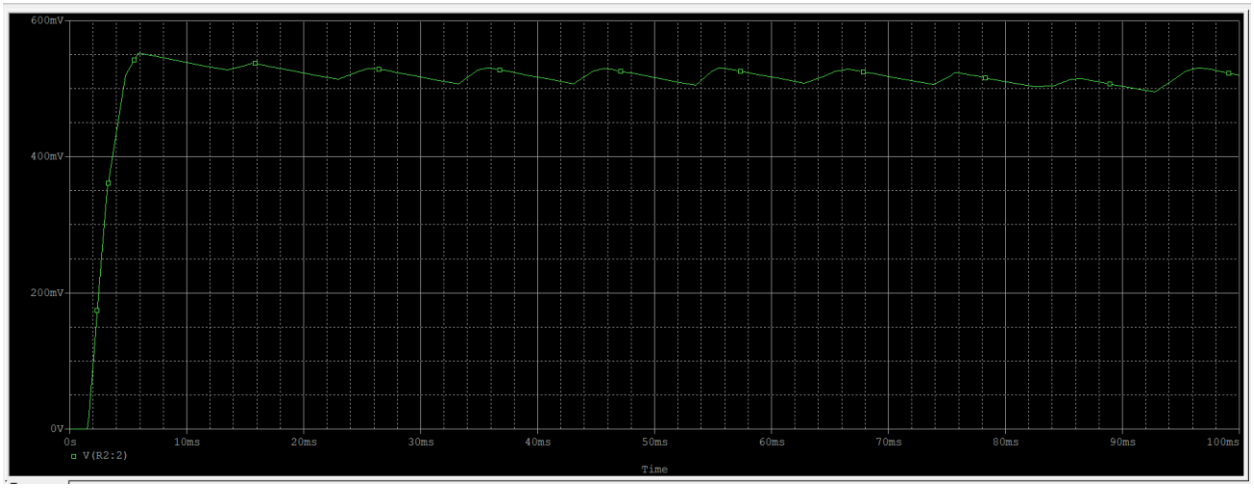
When Rx=322.5K (338.60K Parallel with 6.8M):



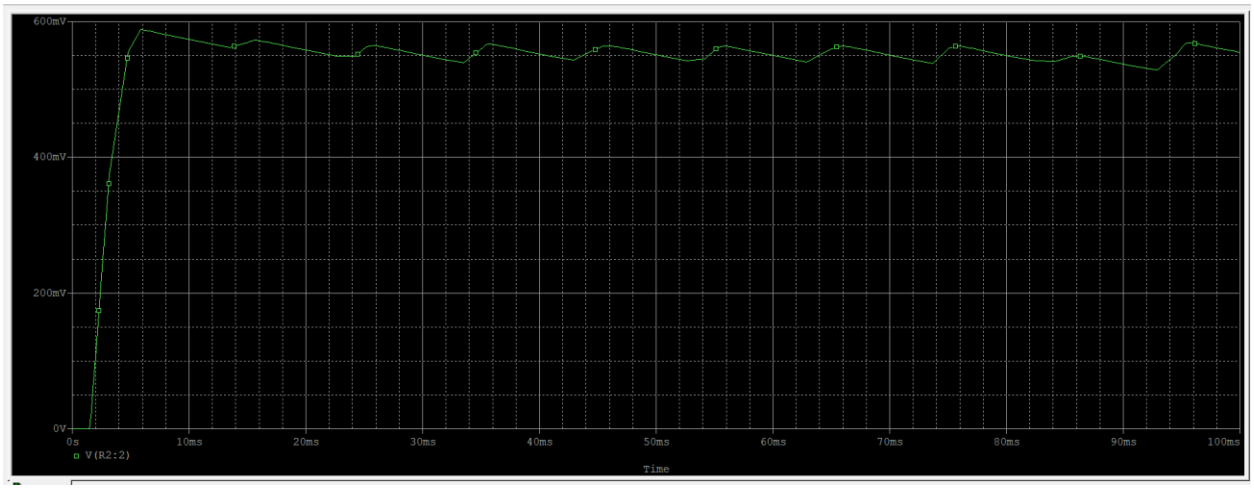
When Rx= 288.08K (322.5k parallel with 2.7M):



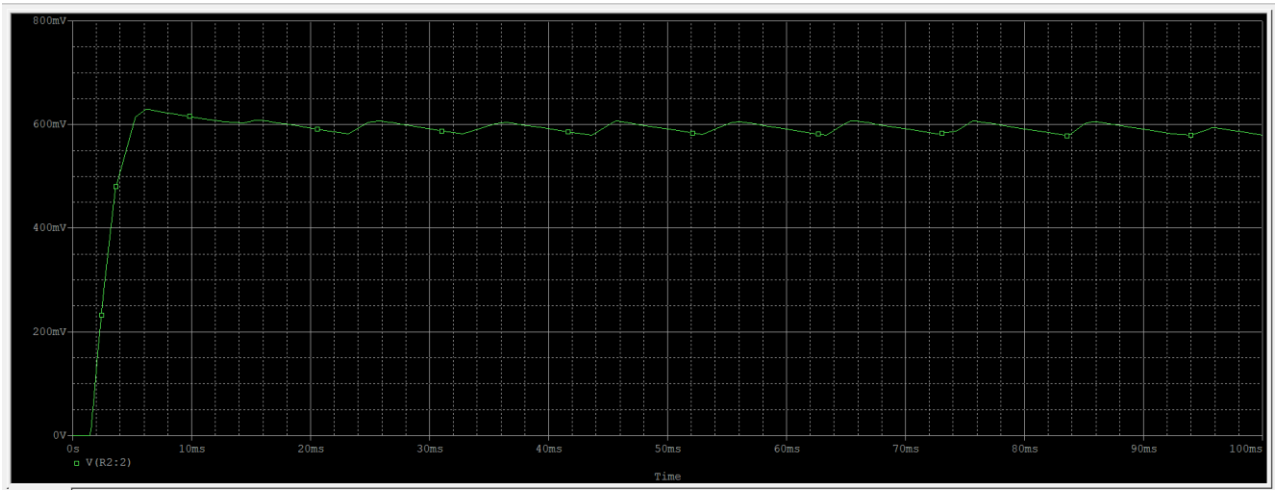
When Rx=276.3K (288.08K Parallel with 6.8M):



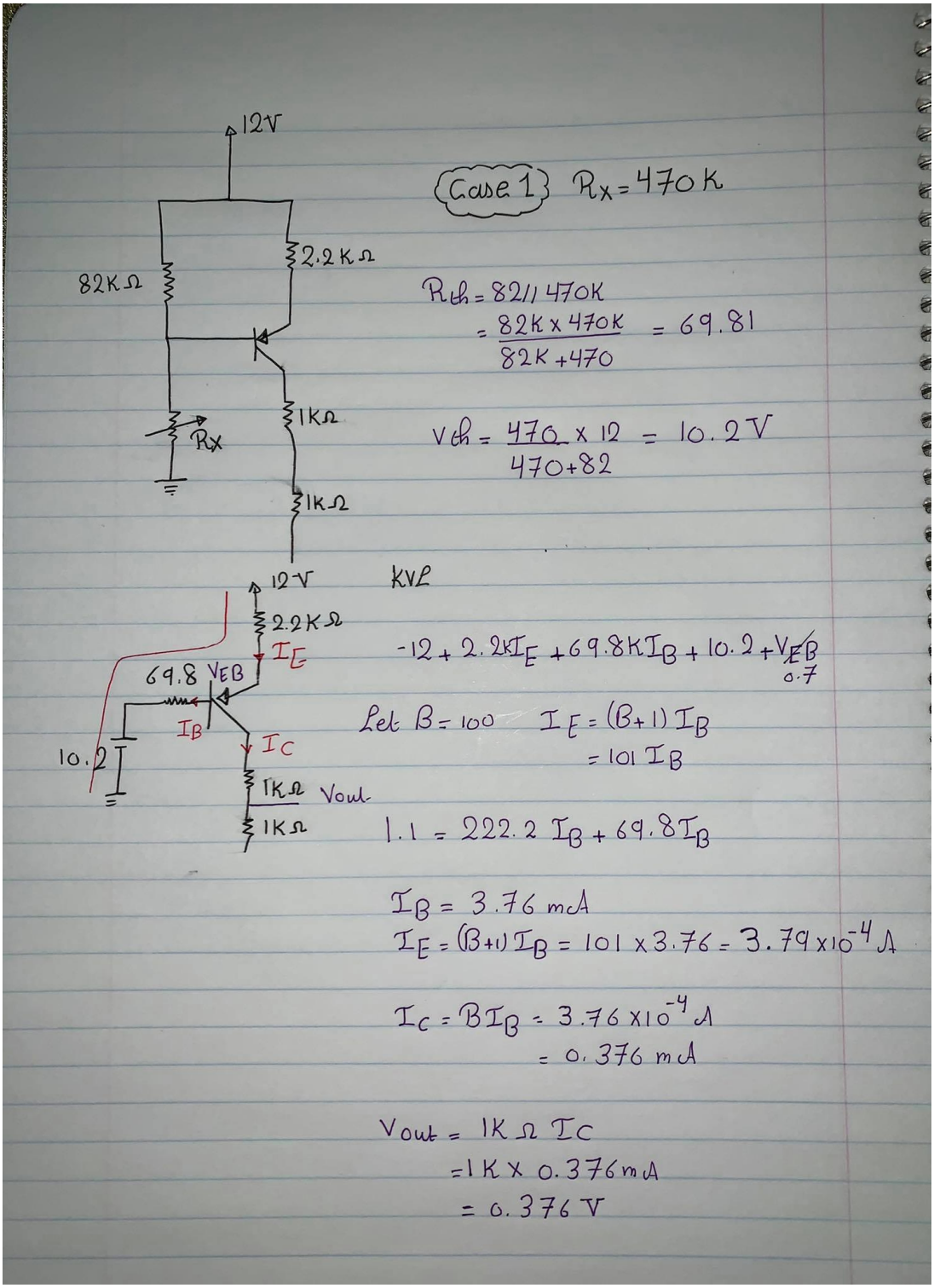
When Rx=260.9K (276.3K Parallel with 4.7M):



When Rx= 244.45K (260.9k Parallel with 3.9M):



Analysis and calculations:



Case 1 $R_x = 470K$

$R_{th} = 82 \parallel 470K$

$= \frac{82K \times 470K}{82K + 470} = 69.81$

$V_{th} = \frac{470}{470+82} \times 12 = 10.2V$

KVL

$-12 + 2.2KI_E + 69.8KI_B + 10.2 + V_{EB}$ (0.7)

Let $\beta = 100$ $I_E = (\beta+1) I_B$

$= 101 I_B$

$1.1 = 222.2 I_B + 69.8 I_B$

$I_B = 3.76 mA$

$I_E = (\beta+1) I_B = 101 \times 3.76 = 3.79 \times 10^{-4} A$

$I_C = \beta I_B = 3.76 \times 10^{-4} A$

$= 0.376 mA$

$V_{out} = 1K\Omega\ I_C$

$= 1K \times 0.376 mA$

$= 0.376 V$

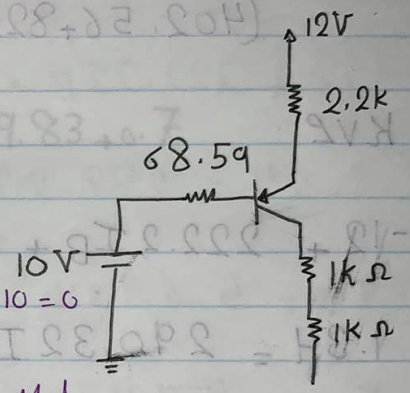
Case 2 $R_x = 3.9M // 470K$

$$R_x = \frac{3.9\times10^6 \times 470\times10^3}{(3.9\times10^6)+(470\times10^3)} = 419.45\ K$$

$R_{th} = 419.45K // 82K$

$= 68.59\ K$

$$V_{th} = \frac{419.45}{419.45+82} \times 12 = 10\ V$$



$-12 + 222.2I_B + 0.7 + 68.59I_B + 10 = 0$

$1.3 = 290.79\ I_B \Rightarrow I_B = 4.47\ MA$

$I_E = 4.51\times10^{-4}\ A$

$I_C = 4.47\times10^{-4}\ A$

$V_{out} = (1K) \times I_C$

$= 1\times10^3 \times 4.47\times10^{-4}$

$= 0.447\ V$

Case 3) $R_x = 419.45k // 10M$

$R_x = 402.56K$

$R_{th} = 402.56K // 82K$

$= 68.12K$

$V_{th} = \frac{402.56K}{(402.56+82)K} \times 12 = 9.96V$

KVL

$-12 + 222.2I_B + 68.12I_B + 9.96 + 0.7 = 0$

$1.34 = 290.32I_B$

$I_B = 4.615 \times 10^{-6} A$

$I_E = 4.66 \times 10^{-4} A$

$I_C = 4.615 \times 10^{-4} A$

$V_{out} = 0.4615 V$

Case 4 $R_X = 402.56K \,||\, 4.7M$

$R_X = 370.80K$

$R_{th} = 370.80K \,||\, 82K$
$= 67.15K$

$V_{th} = \frac{370.80K \times 12}{(370.80+82)K} = 9.83$

$12 = 222.2I_B + 67.15K I_B + 9.83 + 0.7$

$I_B = 5.08 \times 10^{-6}$

$I_E = 5.13 \times 10^{-4}$

$I_C = 5.08 \times 10^{-4}$

$V_{out} = I_C \times 1K = 0.508\ V$

Case 5 $R_x = 370.8K // 3.9M$

$R_x = 338.6K\Omega$

$R_{th} = 338.6 // 82 = 66K\Omega$

$V_{th} = \frac{338.6 \times 10^3}{(338.6+82)\times 10^3} \times 12 = 9.66\ V$

$-12 + 222.2I_B + 66I_B + 9.66 + 0.7 = 0$

$1.64 = 288.2I_B$

$I_B = 5.69 \times 10^{-6} A$

$I_E = 5.747 \times 10^{-4} A$

$I_C = 0.569mA$

$V_{out} = (1K)X(I_C)$
$= 0.569\ V$

Case 6 $R_x = 338.6K // 6.8M$

$R_x = 322.5K\Omega$

$R_{th} = 322.5 // 82 = 65.37K\Omega$

$V_{th} = \frac{322.5 \times 10^3}{(322.5+82)\times 10^3} \times 12 = 9.56\ V$

$-12 + 222.2I_B + 65.37I_B + 0.7 + 9.56$

$I_B = 6.05 \times 10^{-6} A$

$I_E = (\beta+1) I_B$

$= 6.1105 \times 10^{-4} A$

$I_C = 0.6\ mA$

$V_{out} = R I_C$

$= 1 \times 10^3 \times 0.6 \times 10^{-3}$

$= 0.6\ V$

Case 7 $R_x = 322.5K // 2.7M$

$R_x = 288.08$

$R_{th} = 288.08K // 82K = 63.83K$

$V_{th} = \frac{288.08K \times 12}{(288.08+82)K} = 9.34\ V$

$-12 + 2.2 I_E + 63.83K I_B + 0.7 + 9.34$

$I_B = 6.85 \times 10^{-6} A$

$I_E = 6.9185 \times 10^{-4} A$

$I_C = 6.85 \times 10^{-4} A$

$V_{out} = I_C \times 1 \times 10^3$

$= 0.685\ V$

Case 8 $R_x = 288.08K // 6.8M$

$R_x = 276.3K$

$R_{th} = 276.3 // 82 = 63.3K$

$V_{th} = \frac{276.3 \times 10^3 \times 12}{(276.3+82) \times 10^3} = 9.25V$

KVL $\Rightarrow -12 + 222.2 I_B + 63.3 I_B + 9.25 + 0.7$

$2.05 = 285.5 I_B$

$I_B = 7.18 \times 10^{-6} A$

$I_E = 7.252 \times 10^{-4} A$

$I_C = 0.718 mA$

$V_{out} = 1K \times I_C$

$= 0.718V$

Case 9 $R_x = 276.3 // 4.7$

$R_x = 260.9K\Omega$

$R_{th} = 260.9 // 82K = 62.39K\Omega$

$V_{th} = \frac{260.9K}{(260.9+82)K} \times 12 = 9.13V$

$-12 + 222.2 I_B + 62.3 I_B + 0.7 + 9.13$

$I_B = 7.66 \times 10^{-6}$ V

$I_E = 7.739 \times 10^{-4}$ V

$I_C = 0.766$ mA

$V_{out} = I_C \; 1K$

$= 0.766$ V

Case 10 $R_x = 260.9K \| 3.9M$

$R_x = 244.45K$

$R_{th} = 244.45K \| 82K = 61.4K$

$V_{th} = \frac{244.45K}{(244.45+82)K} \times 12 = 8.98$ V

$-12 + 222.2I_B + 61.4I_B + 0.7 + 8.98 = 0$

$2.32 = 283.6 I_B$

$I_B = 8.18 \times 10^{-6}$ A

$I_E = 8.26 \times 10^{-4}$ A

$I_C = 8.1805 \times 10^{-4}$ A

$V_{out} = I_C \times 1 \times 10^3$

$= 0.81805$ V

Conclusion:

The project was very useful, it provided to us more information about how we can analyze, design and build the circuit and make the simulation on OrCad PSpice. The function of this electronic circuit also helped us to learn how we can know the water level in the tank by using LEDs_ lights work with sensors. In addition, through this project we learned new uses for diodes and improved our analysis skills and simplification the complex circuits.