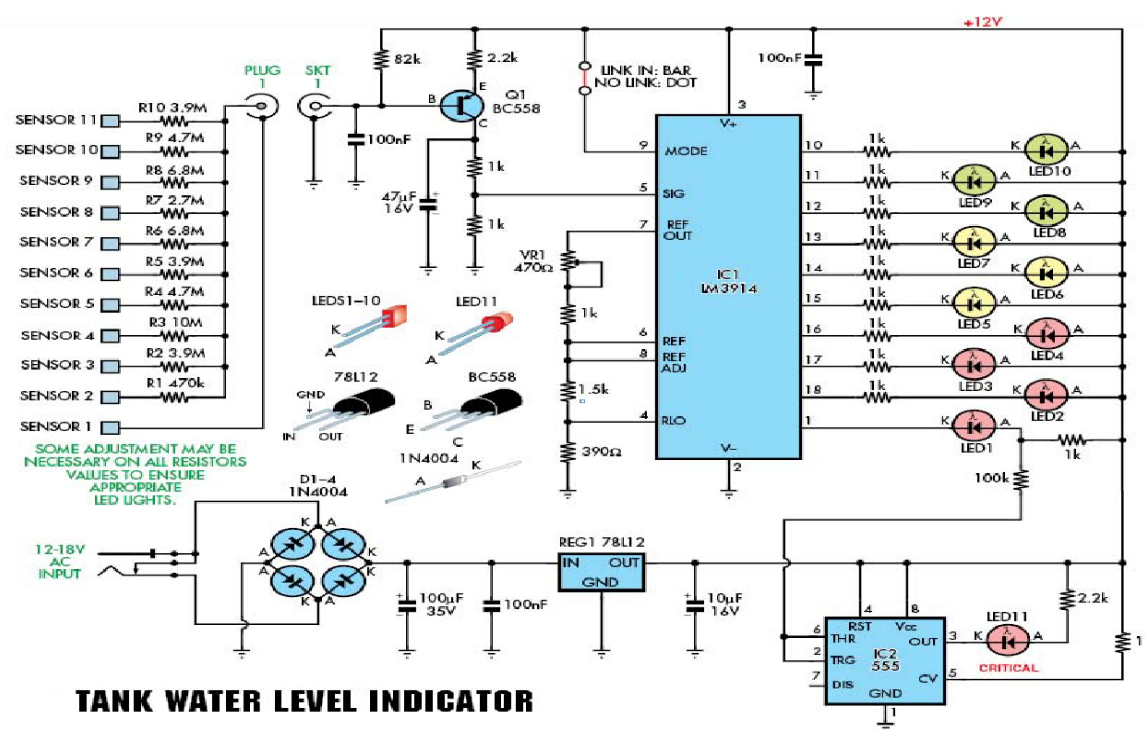
● **Abstract**:

The aim of this project is to construct a circuit that can detect the water level inside a water tank. As the water level increases from the base of the tank the number of glowing LEDS-lights- increases subsequently. Using various components assigned below, and the circuit diagram is also shown.

- Components of the circuit:
  - Linear dot/bar driver IC1
  - Timer IC2
  - PNP transistor
  - Regulator
  - Diodes
  - LEDs
  - Capacitors
  - Resistors

- Circuit’s diagram:



- **Theory:**

First of all, AC power was transformed to DC power by constructing DC power supply using the following components:

Transformer, which was used to step down the value of the AC voltage, then, the diode bridge rectifier worked on converting the AC voltage into full wave pulsating DC. And to get rid of the AC ripple and allow the DC component of the signal to pass, a filter (Capacitor), was involved.

After the previous stages, DC voltage was delivered to the rest of the circuit. The circuit is based on an LM3914 linear LED dot/bar display driver (IC1) which drives ten LEDs. Keep in mind that the more LEDs that light, the higher the water in the tank. the display should be in bargragh mode, hence, Pin 9 of the LM3914 is tied high.

The full-scale range of the bargraph depends on the voltage on pin 6. This voltage can be varied using VR1 from about 1.61V to 2.36V. After taking into account the voltage across the 390Ω resistor on pin 4, this gives a full-scale range that can be varied (using VR1) between about 1.1V (VR1 set to 0Ω) and 2V (VR1 set to 470Ω).

*Note: IC1 has an internal voltage reference that maintains 1.25V between pins 7 & 8. This enables the calculation of the current through VR1 and its series 1kΩ resistor and since this same current also flows through the series 1.5kΩ and 390Ω resistors, the voltages on pins 6 and 4 can be calculated.

As well as setting the full-scale range of the bargraph, the brightness of LEDs 1-10 is also adjusted by VR1 over a small range.

IC1's outputs directly drive LEDs 1-10 via 1kΩ current limiting resistors. While its input signal is formed by an assembly of 11 sensors located in the water tank, one of them is connected to the ground, while the other 10 sensors are connected in parallel to PNP transistor (which functions as an inverting buffer) via ten resistors. According to how many sensors are covered by water, the collector voltage is changed.

LEDs are all off whenever the level of water is below the second sensor, since the transistor is off, hence, no signal is applied to IC1. On the other hand, if the water covers sensor2, the transistor will turn on, and a voltage will be applied to IC1, which leads pin1 to switch low and hence, the first LED will light. Each additional sensor will cause the transistor base to be pulled lower and lower, as a result, more LEDs will turn on.

LED11 is derived by a 555 timer(IC2, which is wired as a threshold detector) in order to give a warning when the water level falls below sensor2.

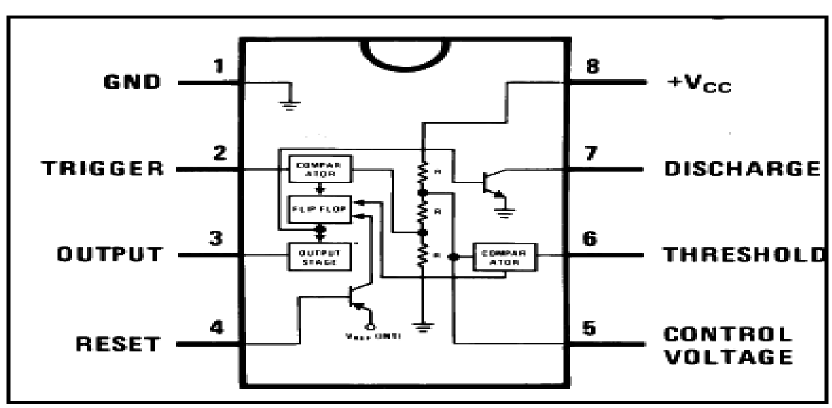
❖Some of the used components:

- **Diode bridge:** Is an arrangement of four (or more) diodes connected in a closed loop "bridge" configuration, and it is a full wave rectifier which produces an output voltage or current which is purely DC or has some specified DC component. Its essential feature is that the polarity of the output is the same regardless of the polarity at the input.

- **Voltage regulator:** It generates a fixed output voltage of a preset magnitude that remains constant regardless of changes to its input voltage or load conditions.

- **Timer IC:** It can be used for triggering applications. And also as a square wave generator. However, the 555 timer application can be broadly classified into two types; astable multivibrator and monostable multivibrator. The IC 555 is available in the form of an 8 pins DIP.

pin configuration:



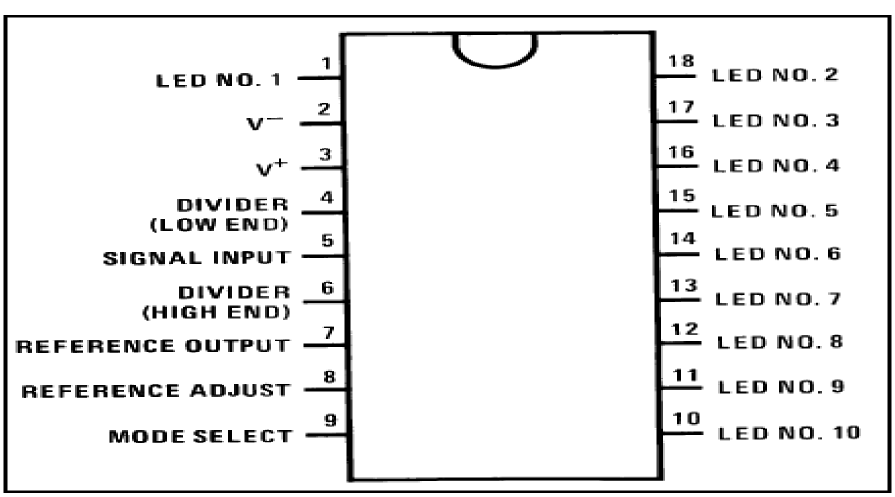
- **The LM3914 linear dot/bar driver (IC1):** is a monolithic integrated circuit that senses analog voltage levels and drives 10 LEDs, providing a linear analog display. A single pin changes the display from a moving dot to a bar graph. Current drive to the LEDs is regulated and programmable, eliminating the need for resistors.

The circuit contains its own adjustable reference and accurate 10-step voltage divider. The low-bias-current input buffer accepts signals down to ground, or V−, yet needs no protection against inputs of 35V above or below ground. The buffer drives 10 individual comparators referenced to the precision divider. Indication non-linearity can thus be held typically to 1⁄2%, even over a wide temperature range. Versatility was designed into the LM3914 so that controller, visual alarm, and expanded scale functions are easily added on to the display system. The circuit can drive LEDs of many colors, or low-current incandescent lamps.

Both ends of the voltage divider are externally available so that 2 drivers can be made into a zero-center meter.

A 1.2V full-scale meter requires only 1 resistor and a single 3V to 15V supply in addition to the 10 display LEDs. If the 1 resistor is a pot, it becomes the LED brightness control.

When in the dot mode, there is a small amount of overlap or “fade” (about 1 mV) between segments. This assures that at no time will all LEDs be “OFF”, and thus any ambiguous display is avoided.



❖ Data and calculation :

1-R=470k

The equation of KVL :

$V1=R4(IE)+VEB+R1(IB)+Vth$

Vth=10.2 VOLT

$12=2.2k(IE)+0.7+69.8k(IB)+10.2$

$IB=3.76*10^{-6}$ A

Ic=0.376m A

V=1k(0.376m)=0.376 v.

2- R=419.45k ____ (470k||3.9M)

The equation of KVL :

$V1=R4(IE)+VEB+R1(IB)+Vth$

V th =10 volt.

$12=2.2K(IE)+0.7+68.6k(IB)+10$

$IB=4.47*10^{-6}$ A

Ic=0.447m A

V=1K(0.447m) = 0.447 v

3- R=402.56k____ (419.45k||10M)

V1=R4(IE)+VEB+R1(IB)+Vth

Vth =9.96 volt .

The equation of KVL :

12=2.2K(IE)+0.7+68.1k(IB)+9.96

IB=4.6*10^-6 A

Ic=0.46m A

V=1k(0.46 m)=0.46 v

4- R=370.8k____ (402.56k||4.7M)

V1=R4(IE)+VEB+R1(IB)+Vth

Vth =9.83 volt .

The equation of KVL :

12=2.2K(IE)+0.7+67.2k(IB)+9.83

IB=5.07*10^-6 A

Ic=0.507m A

V=1K(0.507m)=0.507 v

5- R=338.6k____(370.8k||3.9M)

The equation of KVL :

V1=R4(IE)+VEB+R1(IB)+Vth

Vth=9.66 volt .

12=2.2K(IE)+0.7+66k(IB)+9.66

IB=5.69*10^-6 A

Ic=0.569m A

V=1k(0.569m)=0.569v

6- R=322.5k_____(338.6k||6.8M)

The equation of KVL :

V1=R4(IE)+VEB+R1(IB)+Vth

Vth =9.56 volt .

12=2.2K(IE)+0.7+65.4k(IB)+9.56

IB=6.05*10^-6 A

Ic=0.6 m a

V=1k(0.6m)=0.6 v

7- R=288k_____(322.5k||2.7M)

The equation of KVL :

V1=R4(IE)+VEB+R1(IB)+Vth

Vth =9.34 volt .

12=2.2K(IE)+0.7+63.8k(IB)+9.34

IB=6.85*10^-6 A

Ic=0.685 m A

V=1k(0.685m)=0.685 v

8- R=276.2k_____(288k||6.8M)

The equation of KVL :

V1=R4(IE)+VEB+R1(IB)+Vth

Vth=9.25 volt .

12=2.2K(IE)+0.7+63.3k(IB)+9.25

IB=7.18*10^-6 A

Ic=0.718m A

V=1k(0.718m)=0.718 v

9- R=183.45k___(276.2k||4.7M)

The equation of KVL :

V1=R4(IE)+VEB+R1(IB)+Vth

Vth =8.29 volt .

12=2.2K(IE)+0.7+56.67k(IB)+8.29

IB=0.01m A

Ic=1.07m A

V=1k(1.07m)=1.07 v

10- R=175.2____(183.45k||3.9M)

V1=R4(IE)+VEB+R1(IB)+Vth

Vth =8.17 volt.

The equation of KVL :

12=2.2K(IE)+0.7+55.8k(IB)+8.17

IB=0.011m A

Ic=1.125m A

V=1k(1.125m)= 1.125

- ## Conclusion:

Comparing the results gotten from practical work with the ones gotten from hand calculations, it is obvious that they are slightly different due to many reasons, but both lead up to similar outcome. To sum up, varying the tank resistor (having different water levels), will lead different number of LEDs to light.

In addition to the scientific product, we have to say that it was kind of hard to finally finish this project. But in spite of all the difficulties, it was such a useful experience. Finally, we are done of this project but the information it added to us will not leave our minds.