NPTEL-Analog Circuits and Applications Lab
Automatic Water pumping system

G M Harini,Anoushka Tembhurne

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CONTENTS:

1 Aim of the Project

To design a circuit which can turn on and off water pump automatically.The conditions are when water is less than 20 percent then motor will start automatically and fill tank until it reaches 90 and motor turns off automatically and remains off until again the water reaches 20percent .This process is repeated.

2 Apparatus

BJT-BC557,Resistors-1Kohm,1.7kohm,1.2kohm,Bread board,Connecting wires,Power supply,DMM

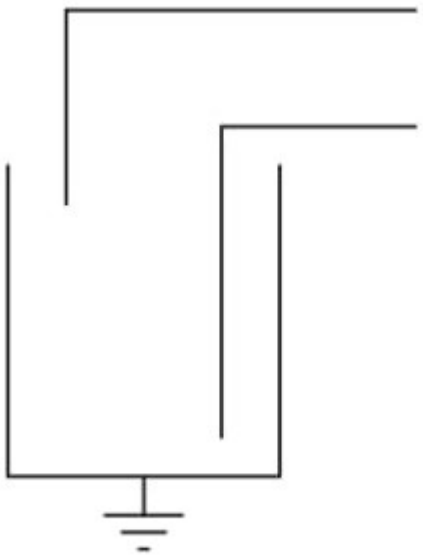
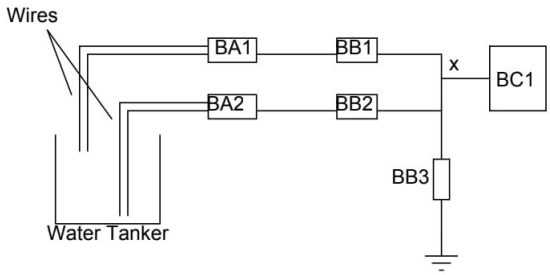


Figure 1: NOTE:Water is grounded

3 Design

BLOCK DIAGRAM From block diagram here we are using pnp transistors as



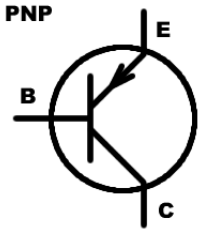
BA1 and BA2 blocks to drive current forward and BB1,BB2,BB3 to divide input voltages create voltage at Vx such that depending on Vx value the block BC1 makes decision to switch on or off.

SELECTION OF BJT OVER MOSFETS:

Here we are using pnp transistors at BA1 and BA2 blocks

As BJTs are current controlled current sources,here we need to measure driven current so we use BJTs over mosfets. Initially we use two PNP transistors for detecting the level of water

PNP Transistors : PNP junction transistor is a current controlled device in which both the collector and emitter currents are controlled by the base current.A PNP transistor is "on" when the base is at a lower potential than the emitter (forward-biased base-emitter junction).It is "off" when the base is not sufficiently negative compared to the emitter (reverse-biased base-emitter junction).



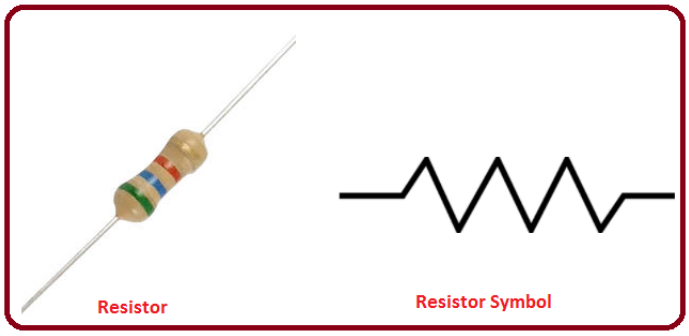
Why not NPN ?

When base is grounded the transistor gets open circuited as no base current flows so there is no flow of current from emitter to collector.So we use pnp over npn.

Resistor:

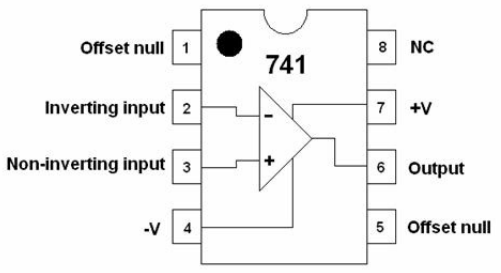
Using resistors to divide voltages

A resistor is a two-terminal electrical component that provides electrical resistance.Here we are using 1kohm,7.7kohm,1.2kohm to divide voltages.Here we are dividing voltages at Vx.



OP AMP-LM741

Here we are using op amp to create schmitt Trigger circuit to create hysteresis loop to satisfy the given conditions.Other than schmitt trigger we can use gates and comparator but we dont get desired output .



this circuit acts as decision making which gives hysteresis loop

4 Circuit

Explanation We require motor to turn on when water is below 20percent and between 20 to 90 percent and off at 90 percent and remain off until decreases to 20 percent .To satisfy these conditions we are designing circuit at different cases like : we design schmitt trigger circuit to on or off the motor depending on the voltage at Vx which is 0,2.5,3.3.

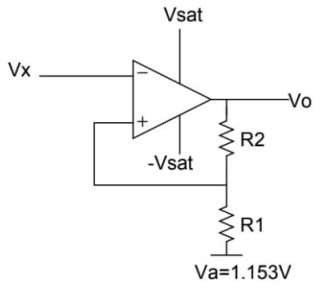


Figure 2: Schmitt trigger

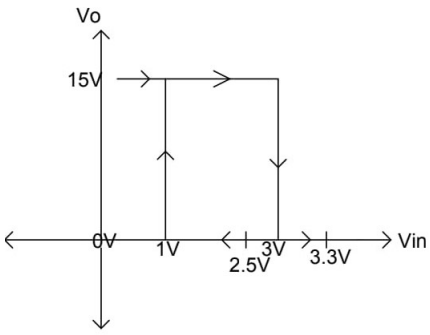


Figure 3: Schmitt trigger

Click on this link to see calculations of the design of schmitt trigger :Design of schmitt trigger ckt

When water is below 20percent : Both the base terminals(B1,B2) are left open the collector and emitter terminals of Q1 and Q2 gets open and no currents flows across R3 and R4 and creates voltage at Vx=0 the schmitt trigger vo=15v motor is on .

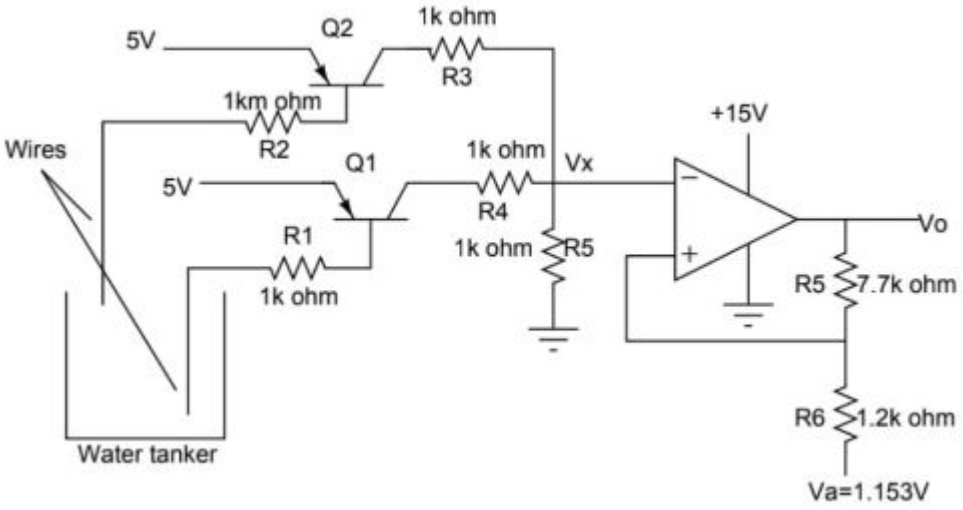


Figure 4: Automatic water pumping system

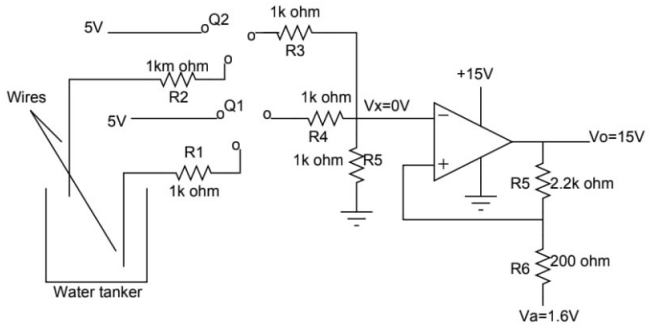


Figure 5: Water is below 20 percent

Water is at 20percent

The base if Q1 is grounded and and Q2 is open, Vx is 2.5v then the output Vo is 15v (motor is on).

$$((5 - Vx)/1K) + ((0 - Vx)/1K) = 0$$

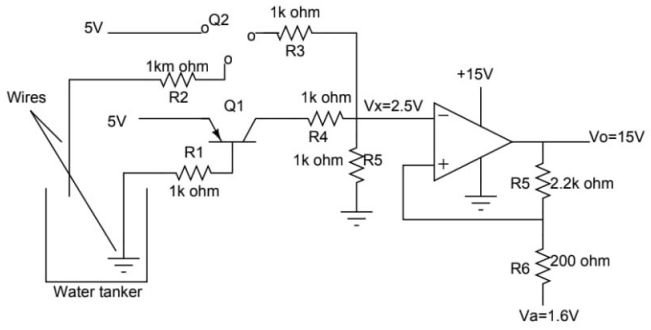
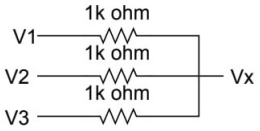


Figure 6: water at 20 percent

(1)

$$Vx = 2.5v$$

(2) **Water reaches 90 percent** Both Q1 and Q2 is on Vx=3.3v and creates voltage Vout=15v(motor is on) V1 and V2 are 5v then Vx=3.3V



$$2((5 - Vx)/1K) + ((0 - Vx)/1K) = 0$$

(3)

$$Vx = 3.3v$$

(4)

Water decresing from 90-20 percent Now Q2 is off and Q1 is on .Then vo=0v (motor is off).

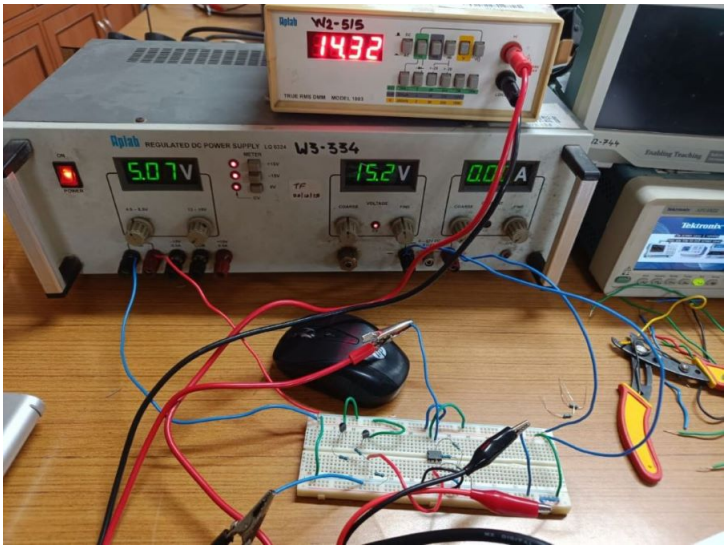


Figure 7: Water level at below 20percent

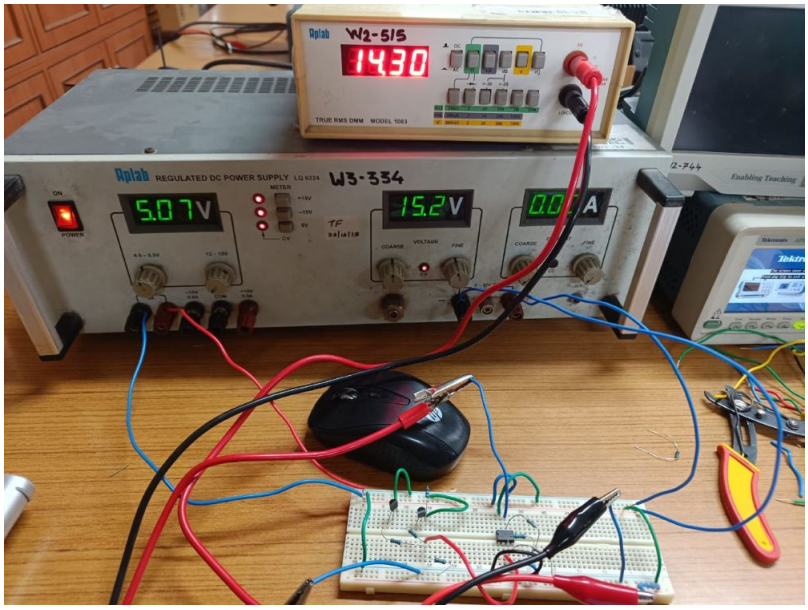


Figure 8: Water level reaches 90percent

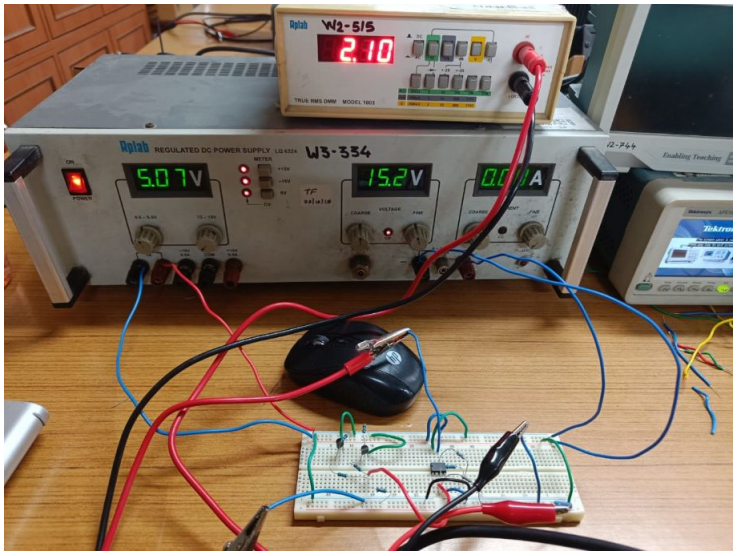


Figure 9: Water level at 90percent

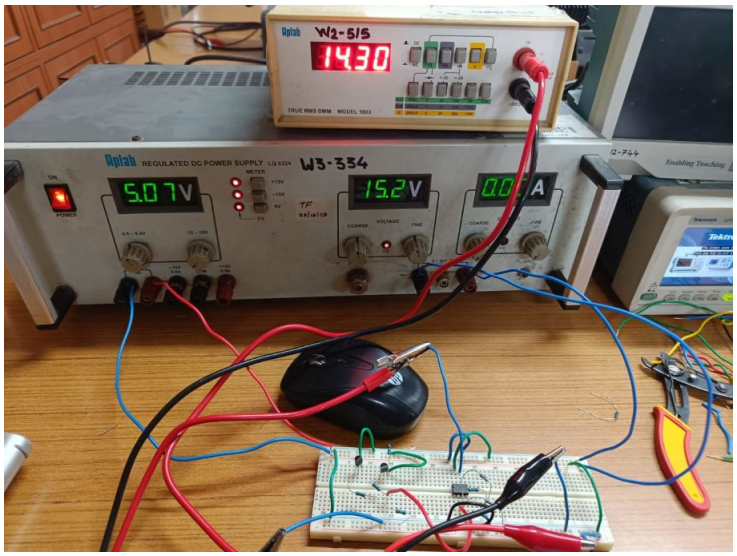


Figure 10: Water level decreases 90-20percent

5 Experimental results

6 Inference and Conclusions:

We have designed Automatic water pumping system using BJTs and op amp and resistors that satisfies all conditions .From successful implentation and

operation of this project Inferences made are:
1.Efficiency improvement.
2.Economy benefits
3.Practical and beneficial addition to water management practices.