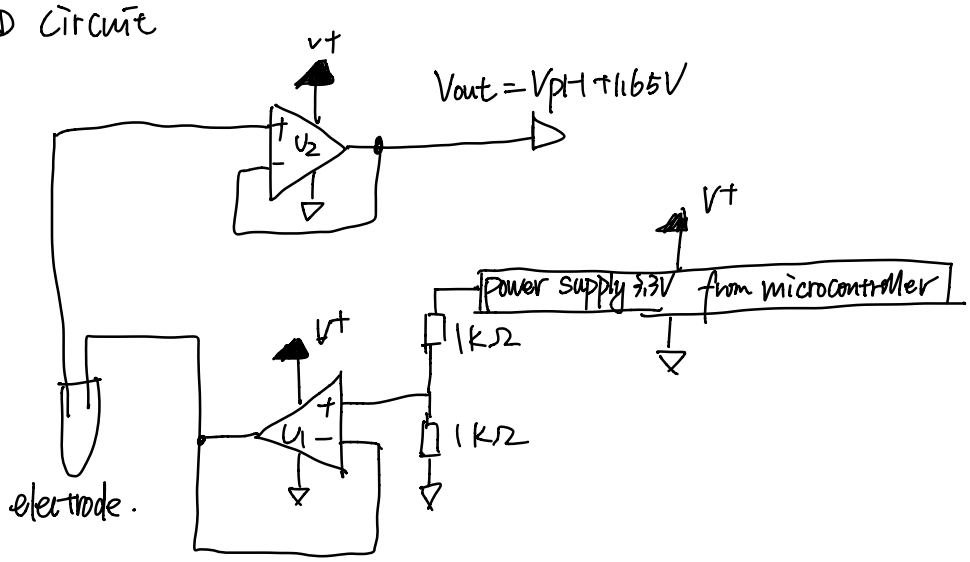
Aim: to measure the pH value of solution and make it stay in an optimum range

System introduction:

pH value probe → amplifier → A/D conversion → digital display.

1. Measure the PH value.

① Circuit



Power supply to op-amp is from microcontroller 5V

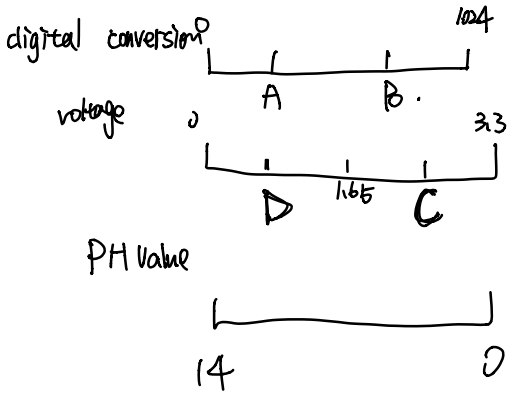
potential divider: $\frac{3.3}{2} = 1.65V$

U1: adds offset directly to the pH-reference electrode ⇒ stay constant.
(because the PH value sensor has a large Input impedance).

U2: adds its individual offset voltage to the output of PH-measuring electrode

(because voltage signal provided by the PH value sensor is too small)

transfer function of PH electrode:



T is temperature of solution in K

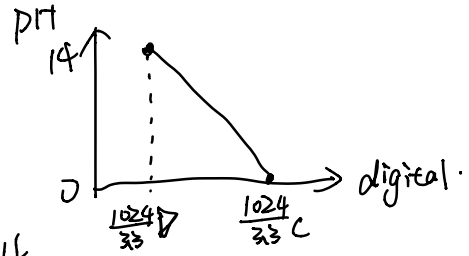
$D = 1.65 - 0.001386T$

$C = 1.65 + 0.001386T$

$\frac{D-0}{3.3} = \frac{A-0}{1024}$ $A = \frac{1024}{3.3}D$

$\frac{C-0}{3.3} = \frac{B-0}{1024}$ $B = \frac{1024}{3.3}C$

range $A-B \Rightarrow$ range of PH



$(\frac{1024}{3.3}C, 0)$

$(\frac{1024}{3.3}D, 14)$

$m = \frac{0-14}{\frac{1024}{3.3}C - \frac{1024}{3.3}D}$

$y = mx + b$

$b = -\frac{1024}{3.3}cm.$

$y = mx + b$ $y \Rightarrow PH$ $X \Rightarrow digital$

2. motor

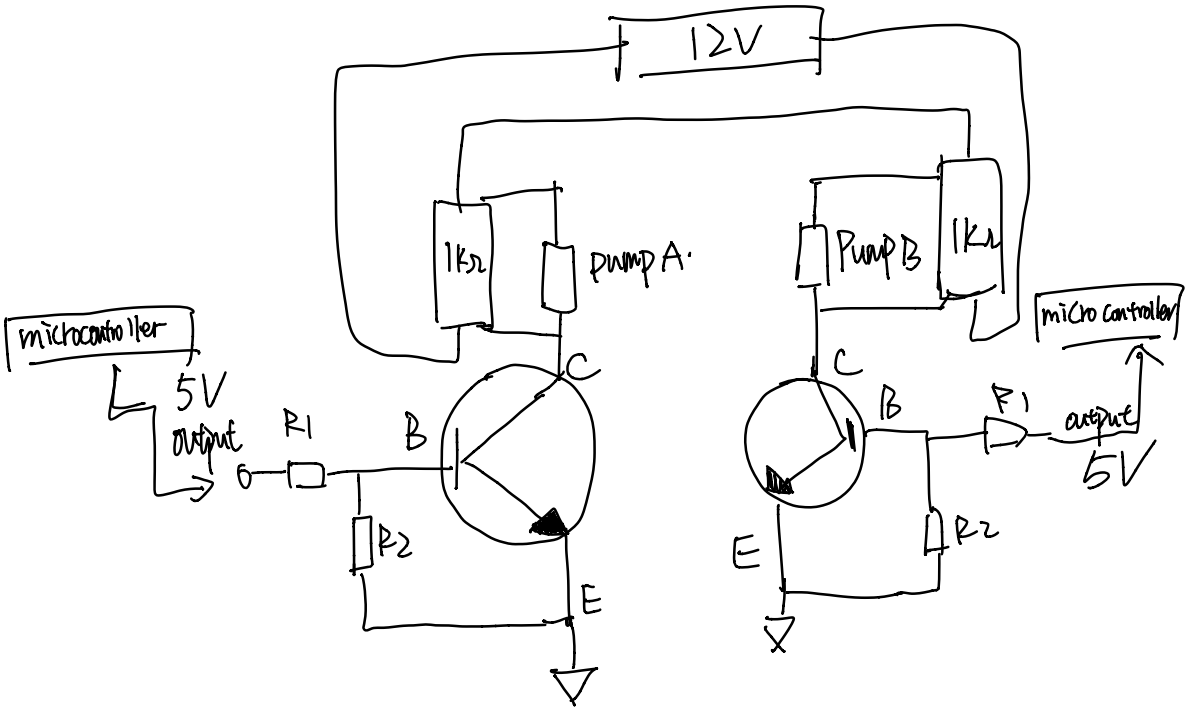
① If the pH < 4.5, pump on. to add base, microcontroller output 5V, transistor 'on' so pump on,

If pH = 5, pump stop, microcontroller output 0V. transistor 'off', so pump off.

① If the pH > 5.5, pump on. to add acid, microcontroller output 5V, transistor 'on' so pump on,

If pH = 5, pump stop, microcontroller output 0V. transistor 'off', so pump off.

Circuit : transistor : NPN BJT (2N2450)



R1: limit the current.

R2: prevent the Transistor working because of the bias current. (noise).

Vcc × R2

$V_b = \frac{\quad}{R_1 + R_2}$ $V_b = 5V$ $V_{CC} = 6V$

$R_1 = 1K\Omega$ $R_2 = 5K\Omega$