Lab 7: Arduino Resonator

Objective: To investigate the design of a digital resonator based on the Arduino microcontroller.

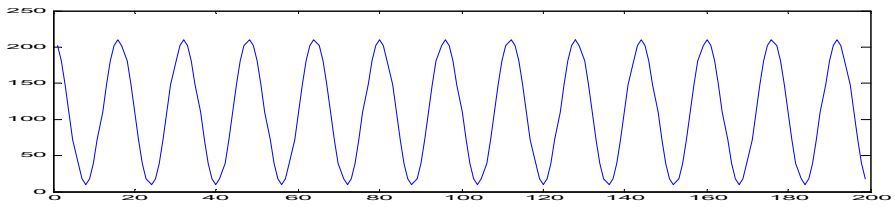
Procedure:

Enter the following code into Matlab:

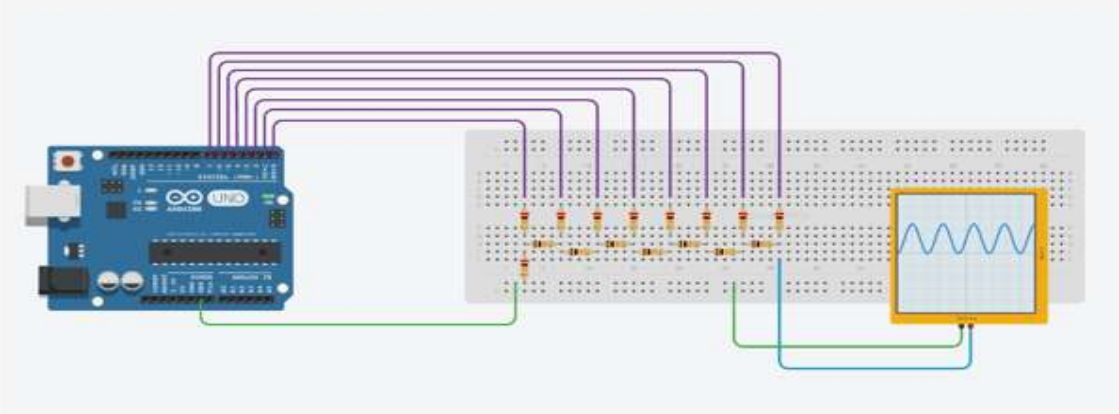
```
%tk_resonator.m
    n=1;
    y=0;
    fs=8000;
    fa=500;
    Q=2*pi*fa/fs;
    a=2*cos(Q);
    ym1=1;
    ym2=cos(Q);

    while(n<200)
        y=a*ym1-ym2;
        ym2=ym1;
        ym1=y;
        yy(n)=y;
        n=n+1;
    end
    yy=yy+1.1;

    yy=yy*100;
    plot(yy)
```



Set up the following system on the Tinkercad website (https://www.tinkercad.com/circuits)
You will need to set up an account and password.



Insert the following code into the system code editor:

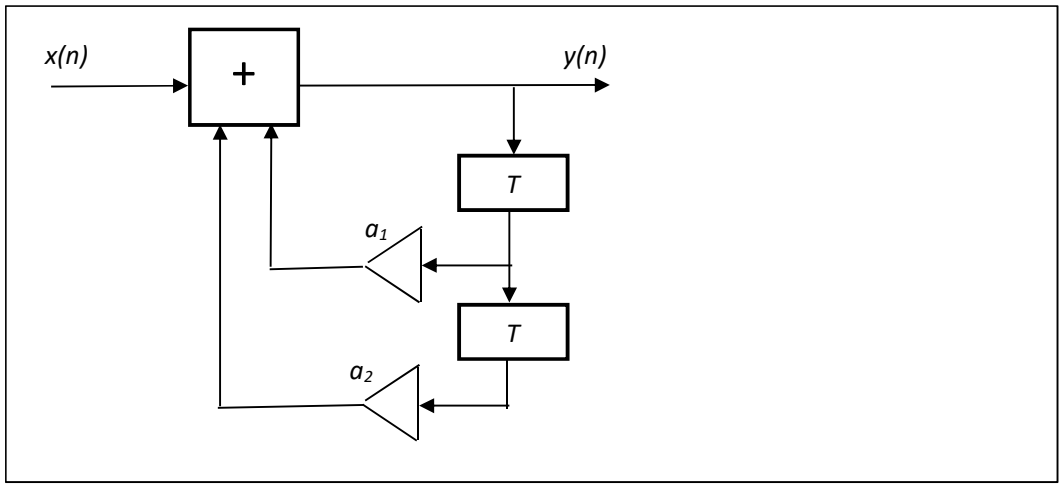
```
// avr-libc library includes
#include <avr/io.h>

//******** Sine wave parameters ********
#define pi 3.1415 // 2*PI saves calculation later

int n=0;
float fs,fa,Q,a,y,ym1,ym2;

void setup()
{
        fs=8000;
        fa=200;
        Q=2*pi*fa/fs;
        a=2*cos(Q);
        y=0;
        ym1=1;
        ym2=cos(Q);
        DDRD = B11111111;  // digital pins 7,6,5,4,3,2,1,0
}

void loop()
{
                y=a*ym1-ym2;
                ym2=ym1;
                ym1=y;
                n++;
                y=y+1.2;
                y=y*100;
                y=(int)y;
        PORTD=y;
}
```



$$y(n) = 2\cos(\theta_0)\, y(n-1) - y(n-2)$$
$$a_1 = 2\cos(\theta_0) \quad a_2 = -1$$

Now set up a real system using an Arduino microcontroller. The top 4 most significant bits are sufficient for testing purposes. Connect an oscilloscope to the R-2R DAC output. Is the correct signal obtained?

Modify the code to produce the sum of 2 signals of frequency 200 Hz and 600 Hz of amplitude 1 V and 0.4 V respectively.