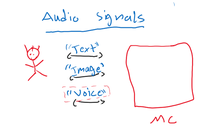
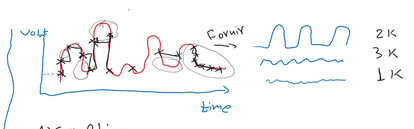
DAC and R2R

Audio signals



original vs convert

1) sampling Error
2) Quantazation Error

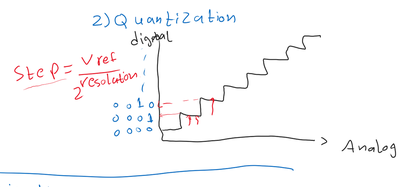


1) Sampling

sampling Rate ↑ Accuracy ↑ Memory consumption ↑

Nyquest Law sampling Rate ≥ 2x max Freq

2) Quantization



Audiable signals

Human Audiabl signal => 20 HZ → 20 KHZ

Human voice → male 150 HZ to 3.5 KHZ
→ female 250 HZ to 4 KHZ

150 HZ to 4 KHZ

min sampling rate = 8 KHZ

At min sampling rate
8000 sample/second
assume every sample = 8 bit (ADC Resolution)

Every 1 second consume 8 KB memory

Allowed in flash = 40k

max lenght = 40K / 8K = 5 sec

Code idea

u8 song[5000] = { - - - - - - }

sample → DAC → 🔊

1. using systick Interrupt

8000 sample per second

```
i = 0
systick_handler()
{
  pac_send(song[i])
  i++;
  if(i == 5000)
    i = 0
}
```

→ 50 Msec

stk_period(125 Msec)

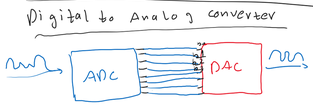
200 Msec

Frequency changer

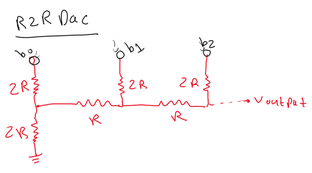
2. using OS

Task → periodicty 125 Msec

Digital to Analog convertor



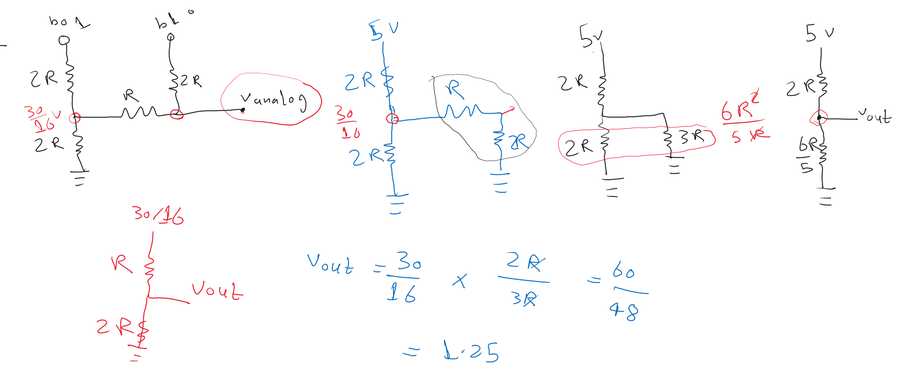
R2R Dac



example
2 Bit R2R dac
Ref voltage 5 V
Step = 5/2^2 = 1.25

Digital	Analog
0 0	0
0 1	1.25
1 0	2.5
1 1	3.75

R2R



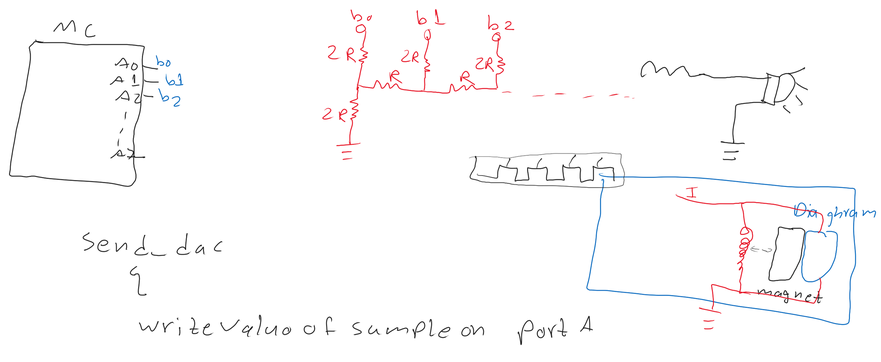
Voltage divider
$V_o = V_{in} \times \frac{R_2}{R_1 + R_2}$

$\frac{5 \times \frac{6}{5} R}{\frac{16}{5} R} = \frac{30}{16} V$

$V_{out} = \frac{30}{16} \times \frac{2R}{3R} = \frac{60}{48}$

$= 1.25$

circuit definition.




```
send_dac
{
  write value of sample on port A
}
```

* Summary

Audio file → Audacity → raw file → xxd → Dac C project → GPIO → R2R Dac → speaker

raw file → specif part (5 sec)
→ sampling rate 8K
sample size 8bit

xxd -i song_name.raw song.h

#include

Timer every 125 Msec
Send 1 sample to the dac

oscillscope