EP317 Project - Audio Spectrum Analyser

By

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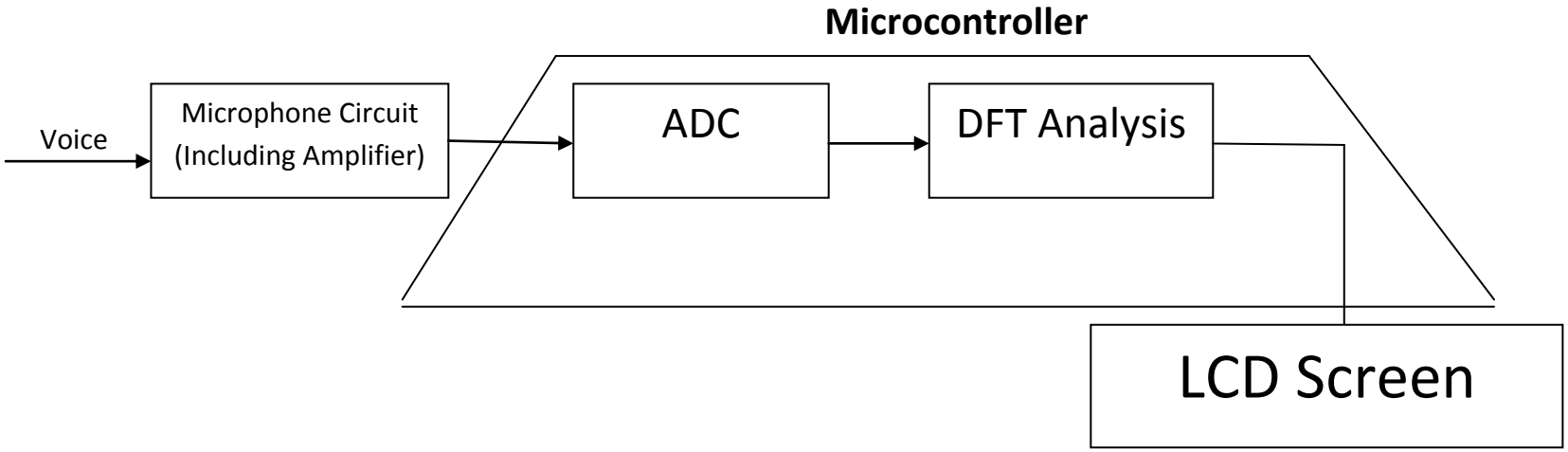


Both of us are responsible for all parts shown above.

Tests

- The mic ckt is verified by directly connecting to the CRO.
- I/P to ADC is given from signal generator at frequency Ω & LCD O/P verified.

Realization:

Microphone Circuit

- Converts a voice signal to an electrical analog signal.
- The signal generated by the mic is only mV strong. We have amplified it 400x to allow us to couple it to the MuP ADC, which accepts I/P between 0 and 5V (V_{ref} = 5V (default) when powered by the USB supply, as we have).
- The mic O/P has a DC offset (of mv) which is also amplified. This suits us because the MuP ADC I/P requires a 0-5V I/P.
- The amplification is realised with an op-amp (LM324).

ADC (MuP internal)

- Converts the input (electrically coded voice in analog form) into digital equivalent at the samples taken. (250 samples/ ≈34ms)
- This allows a resolution of about 50 Hz (order), as found experimentally. (length of f(t) 'observed')
- The bandwidth is from 0 Hz to about 2500Hz (frequency of sampling)

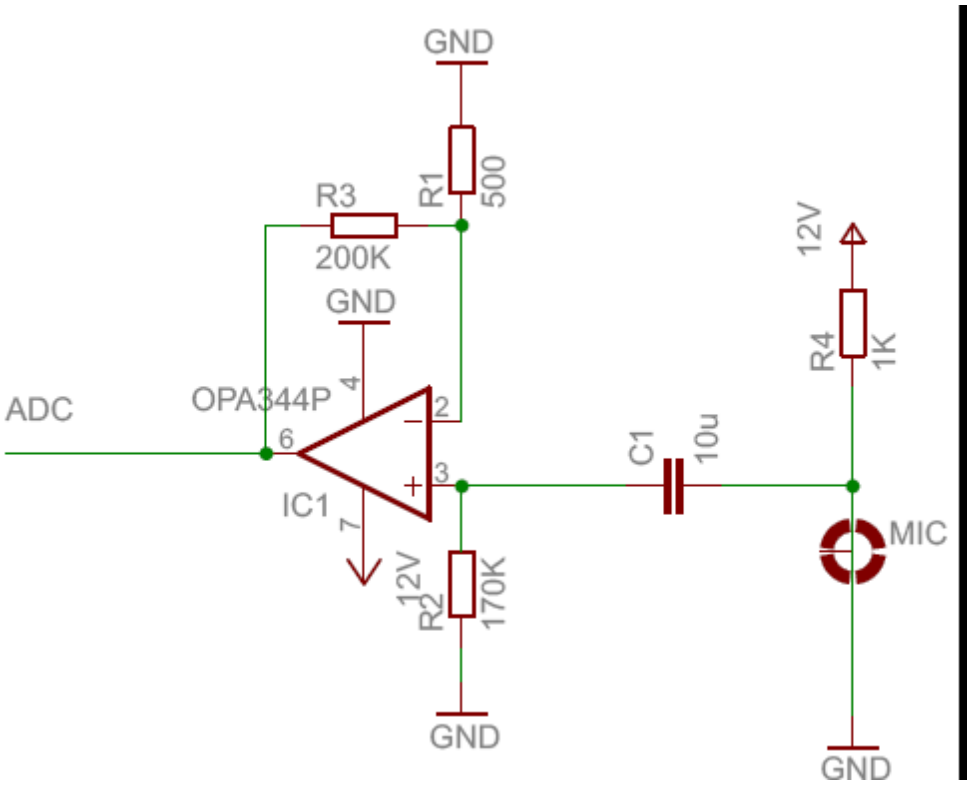
Microcontroller Analysis

- Takes the input samples in digital form and codes the voice signal as a sequence of (N = 250) values
- This sequence is analyzed by the microcontroller to get its DFT by the code written.

LCD Screen

- Displays the normalised DFT output as follows.
  - Each column (8 pixels broad) of the LCD has 16 rows (pixels).
  - Depending on |F(Ω)|, the DFT amplitude at frequency Ω, 1-16 of these rows are filled.
  - This gives a nice visual display of the DFT.

Circuit Diagram



DFT Algorithm

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% F is the Fourier amplitude at frequency 'freq'
% Ts is the sampling interval

Real(F) = 0
Imaginary(F) = 0

for n = 0 to N-1
        Real(F) = Real(F) + f[n] * cos(2πf*n*Ts)
        Imaginary(F) = Imaginary(F) + f[n] * sin(2πf*n*Ts)
end

Modulus(F) = sqrt[Real(F)^2 + Imaginary(F)^2]
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EP315 – Microprocessors Lab
Project – Acoustic Spectrum Analyser

Team Members:

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List of (Major) Components Used:

1) One Electret microphone
2) One polystyrene capacitor (10 µF)
3) One LM324 quad op-amp
4) One 16x2 LCD screen (JHD202C)