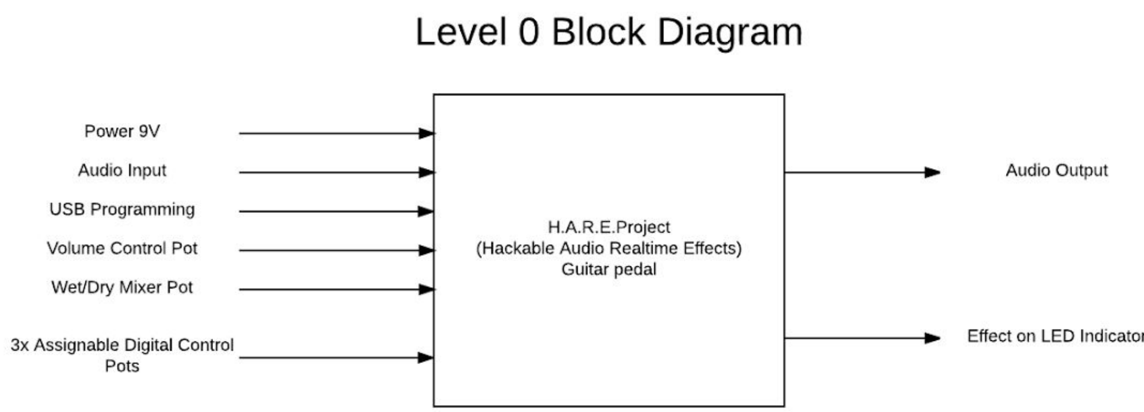
Homework #5 **Team 13**

System Design: Functional Decomposition

HARE Project

Adam Oester
Abram Morphew
Zachary Clark-Williams
Ryan Fallis

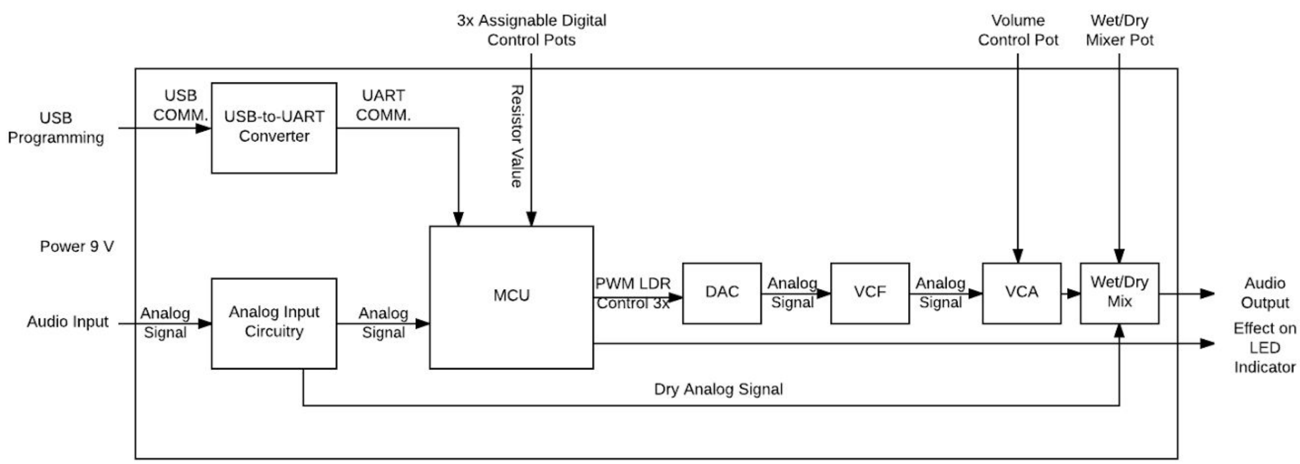
High-Level Block Diagram:



Module	H.A.R.E Project
Inputs	Audio Input, Power (9V), USB Programming, Volume Control Pot, Wet/Dry Mixer Pot, and 3x Assignable Digital Control Pots
Outputs	Audio Output, Effect ON LED Indicator
Functionality	Apply desired effect to audio input signal and output modified signal

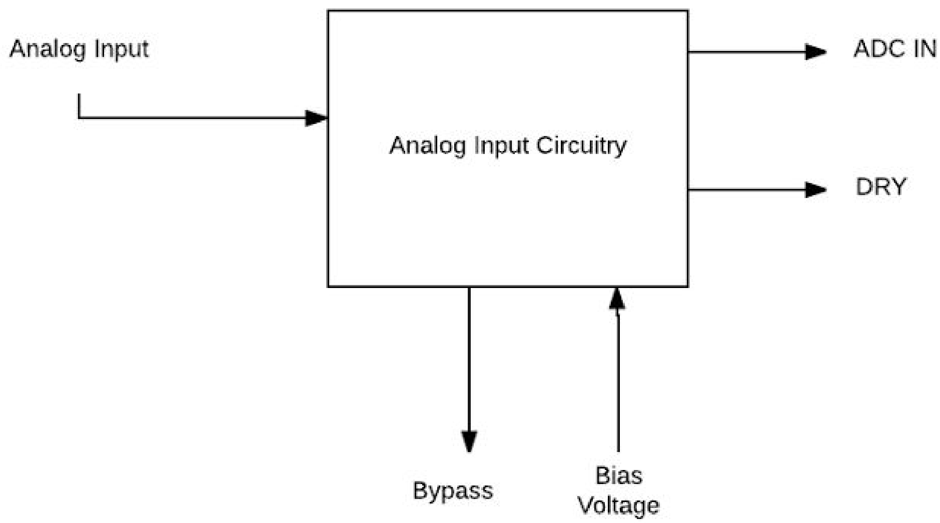
Next-Level Block Diagram:

Level 1 Block Diagram



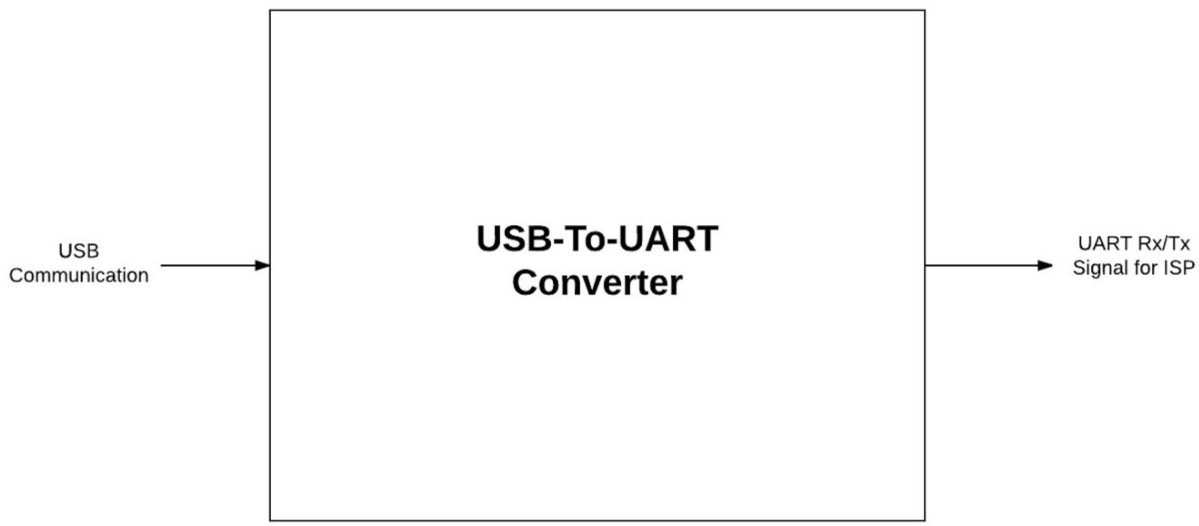
Top-Level Module Diagrams:

Top-Level Analog Input Circuitry



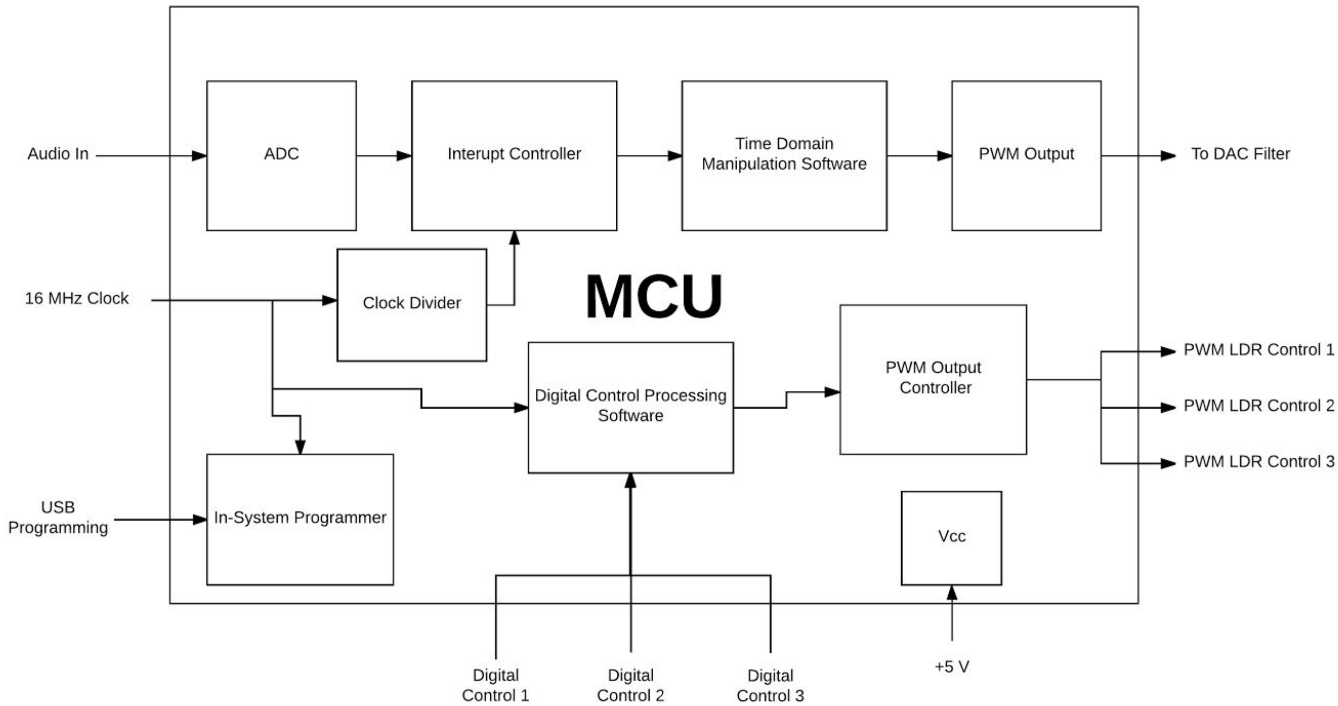
Module	Analog Input Circuitry
Inputs	Analog Input: Input signal from musical instrument Bias Voltage: Biases the gain stage op-amp
Outputs	ADC IN: Signal going to analog-digital converter of MCU DRY: Dry signal sent to Analog Output Bypass: Allows for circuit to be bypassed
Functionality	Takes analog input through gain stage and splits output between MCU ADC and Dry to analog out

Top-Level USB-to-UART Diagram



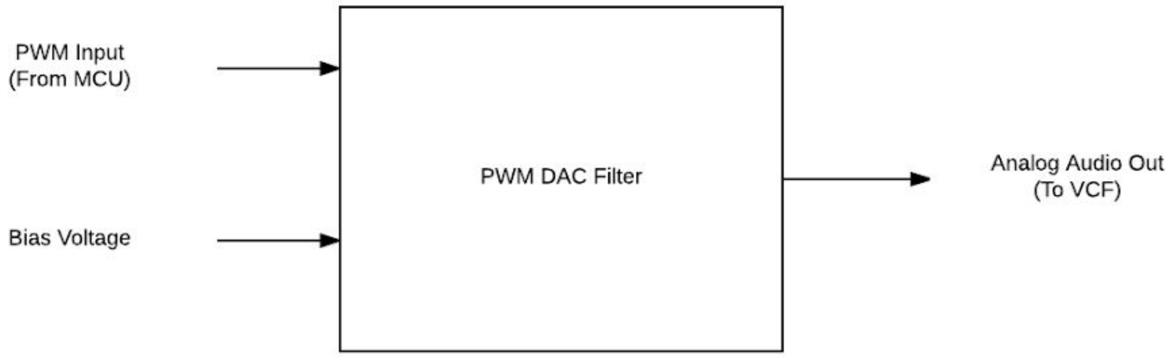
Input	USB signal from a personal computer.
Output	UART Signal for communication with the in-system programmer (ISP) on the ATMega328P MCU.
Functionality	Allows for user programming capability of the ATMega328P from an integrated development environment (IDE).

Top-Level MCU Diagram



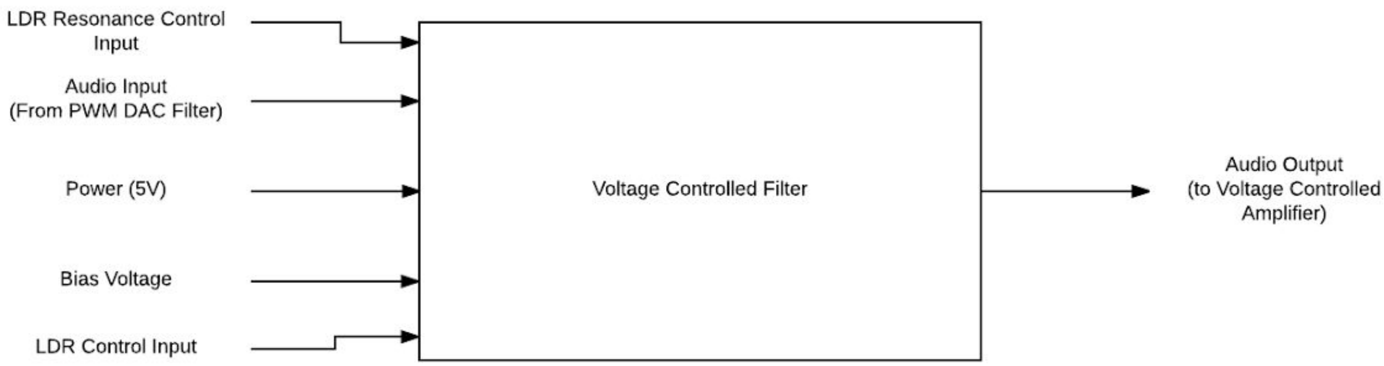
Inputs	Audio input: Samples incoming audio signal MCU Clock: 16 MHz crystal oscillator. Assignable 3x Digital Controls 5V Regulated Power USB Programming Input
Outputs	PWM DAC Audio output signal 3x PWM signals (LDR Control)
Functionality	An analog audio signal is passed to the ADC of the MCU. A clock divider sets the incoming audio sample rate (~62 kHz). Manipulation of the audio signal is then performed during the interupt function called at the given sample rate and then passed out as a PWM signal to the next stage. The USB programming input allows for programming of the ATMega328P. The Digital Controls are values captured on additional ADC ports and then translated to a PWM output attached to an LED. These LEDs are used in conjunction with an LDR to create a control voltage signal for the analog VCF and VCA stages. The PWM LDR controls effectively reduce noise from the MCU in the analog stages.

Top-Level PWM DAC Filter Diagram



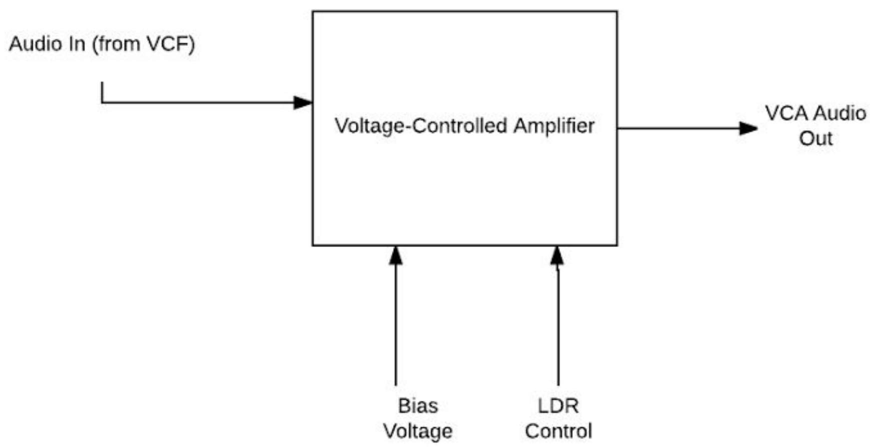
Module	PWM DAC Filter
Inputs	PWM Input (From MCU), Bias Voltage
Outputs	Analog Audio Out (16Bit)
Functionality	Takes the PWM Output from the MCU and filters out the digital noise based bias voltage

Top-Level Voltage Controlled Filter Diagram



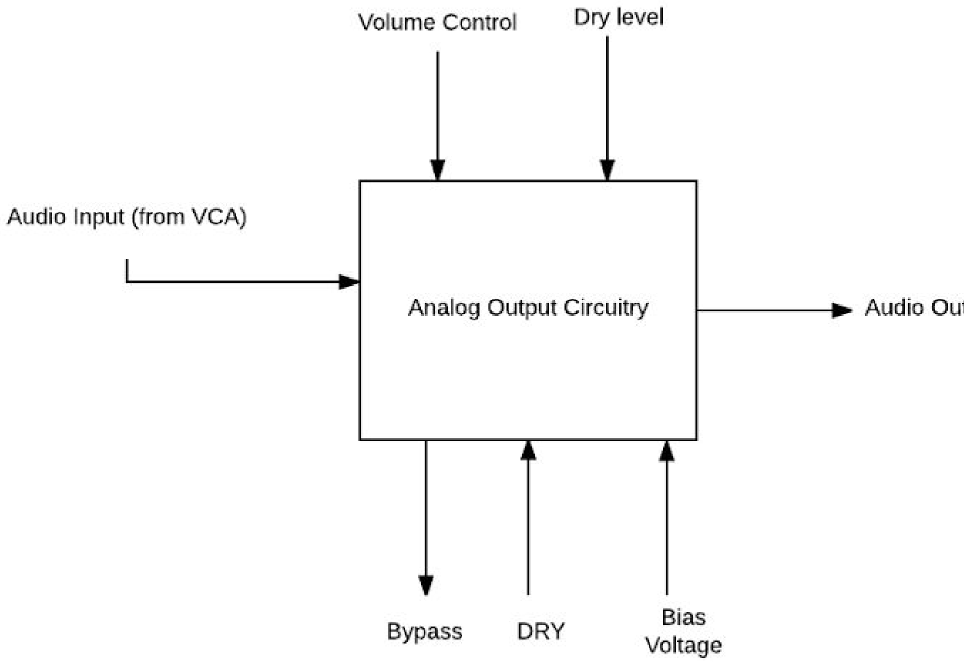
Module	Voltage Controlled Filter
Inputs	Audio Input (From MCU), Power (5V), Bias Voltage
Outputs	Audio Output (to Voltge Controlled Amplifier)
Functionality	Take an audio input singal and adjust the frequency of the output signal based on the Bias Voltage, and LDR's resistance value which is controlled by the MCU's PWM outupt.

Top-Level Voltage-Controlled Amplifier Diagram



Module	Voltage Controlled Amplifier
Inputs	Audio In: Audio utput from Voltage-Controlled Filter stage Bias Voltage: Biases the gain stage op-amp LDR Control: Amplifier control voltage via PWM to LDR
Outputs	VCA Audio Out: Passes the output signal from VCA to Analog Output Circuitry stage
Functionality	Controls voltage of audio signal via PWM controled LDR. Enables tremolo effect.

Top-Level Analog Output Circuitry Diagram



Module	Analog Output Circuitry
Inputs	Audio Input: Input signal from VCA output Bias Voltage: Biases the gain stage op-amp DRY: Dry Analog signal from Analog Input Circuitry stage Dry Level: Potentiometer controls level of dry signal from input stage mixed with audio output Volume Control: Potentiometer controls volume level of audio output
Outputs	Audio Out: Audio signal output Bypass: Allows for circuit to be bypassed
Functionality	Added gain stage, volume control, dry signal mix capabilities, and bypass for audio out