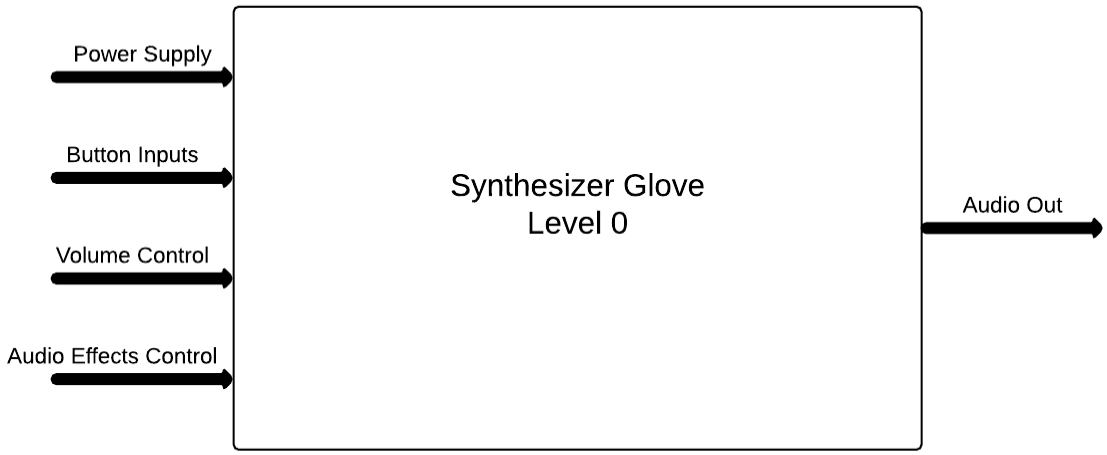
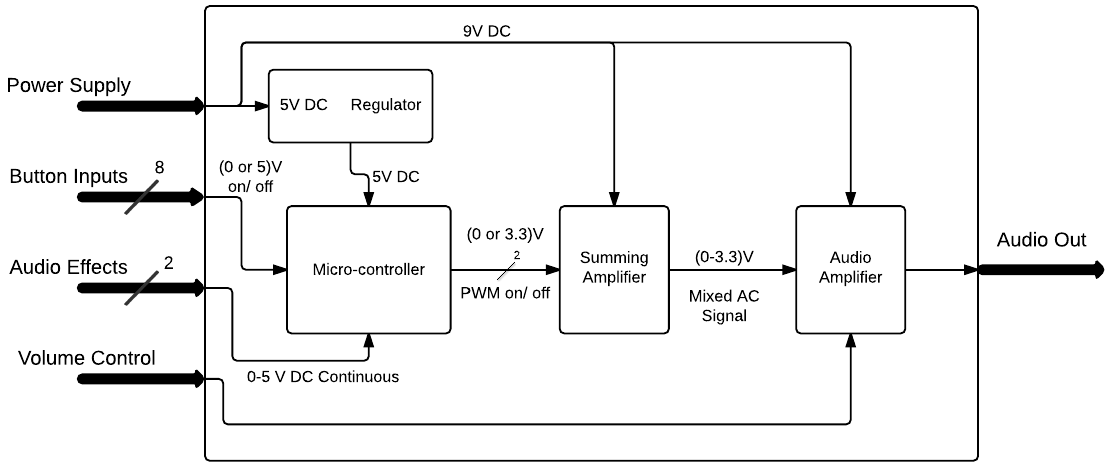
Entire System: Level 0 Design Diagram



Level 0 Synthesizer Glove Design

Module: ● Synthesizer Glove
Inputs: ● **Power:** 9V DC battery ● **Button inputs:** Normally open momentary contact switches ● **Volume control:** Variable volume control ● **Pitch/ tone** Variable pitch and tone control
Output: ● **Audio output:** 0-9V audio signal
Functionality: ● Produce audio tones based on button and volume/pitch/tone control. ● Tones should be variable based on button status and audio quality should be variable on volume/pitch/tone control status.

Entire System: Level 1 Design Diagram



Level 1 Synthesizer Glove Design

Module: 5V DC Regulator	

Inputs:

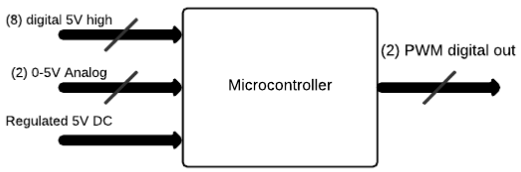
- **Power Supply:** 9V battery

Output:

- **DC Out:** Regulated 5V DC signal

Functionality:

- The input signal enters a 9 to 5 V linear DC to DC voltage regulator.
- The signal is then smoothed using a capacitor >= 10μF.
- The signal is then filtered through a passive RC low-pass filter.

Module: Microcontroller	

Inputs:

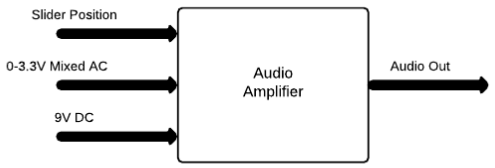
- **Digital 5V High:** 8 total digital signals with a 5V logic high. 3 signals from the vambrace control unit, and 5 signals from the push buttons in the glove.
- **0-5V Analog:** 2 analog signals ranging from 0 to 5 volts from the vambrace control unit.
- **Regulated 5V DC:** Regulated 5V DC voltage from the voltage regulator block for power.

Output:

- **PWM Digital Out:** 5 total pulse width modulated signals outputting to the summing amplifier.

Functionality:

- Produce one or two simultaneous pulse width modulated tones (PWM) based on programmed glove button pushes.
- Shift tones to the next scale up or down, programmatically assigned to the buttons on vambrace unit.
- Read two individual analog voltages based on a two axis joystick. One voltage will shift the programmed PWM tones up and down by pitch, and the other by tone.

Module: Audio Amplifier	

Inputs:

- **Slider Position:** The output of a slider potentiometer controlling the output gain of the amplifier.
- **0-3.3V Mixed AC:** The 0-3.3V mixed AC output of the summing amplifier.
- **9V DC:** 9V DC output of the battery for power.

Output:

- **Audio Out:** An amplified 0-3.3V PWM mixed AC signal.

Functionality:

- Amplifies the 0-3.3 V PWM tones produced by the microcontroller and added together by the summing amp based on the position of the slider potentiometer.

Module: Summing Amplifier	

Inputs:

- **9V DC:** 9V DC output of the battery for power.
- **PWM 0-3.3V Digital:** up to six 0-3.3V PWM tones generated by the microcontroller.

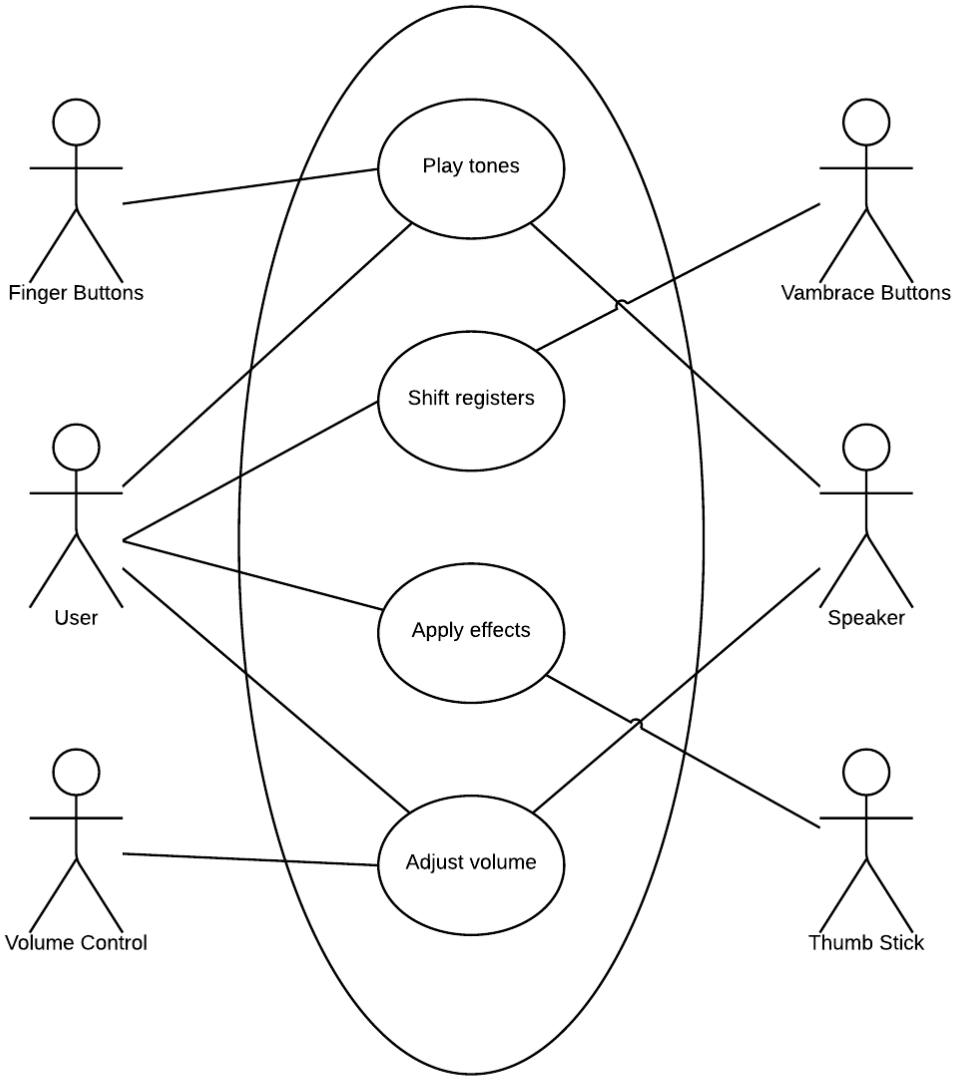
Output:

- **0-3.3V Mixed AC:** 0-3.3V mix of two PWM tones.

Functionality:

- Outputs the sum of the first two generated PWM tones produced by the microcontroller. Only two tones can be played simultaneously.

Entire system: Use Case



Synthesizer Glove Use Case Diagram

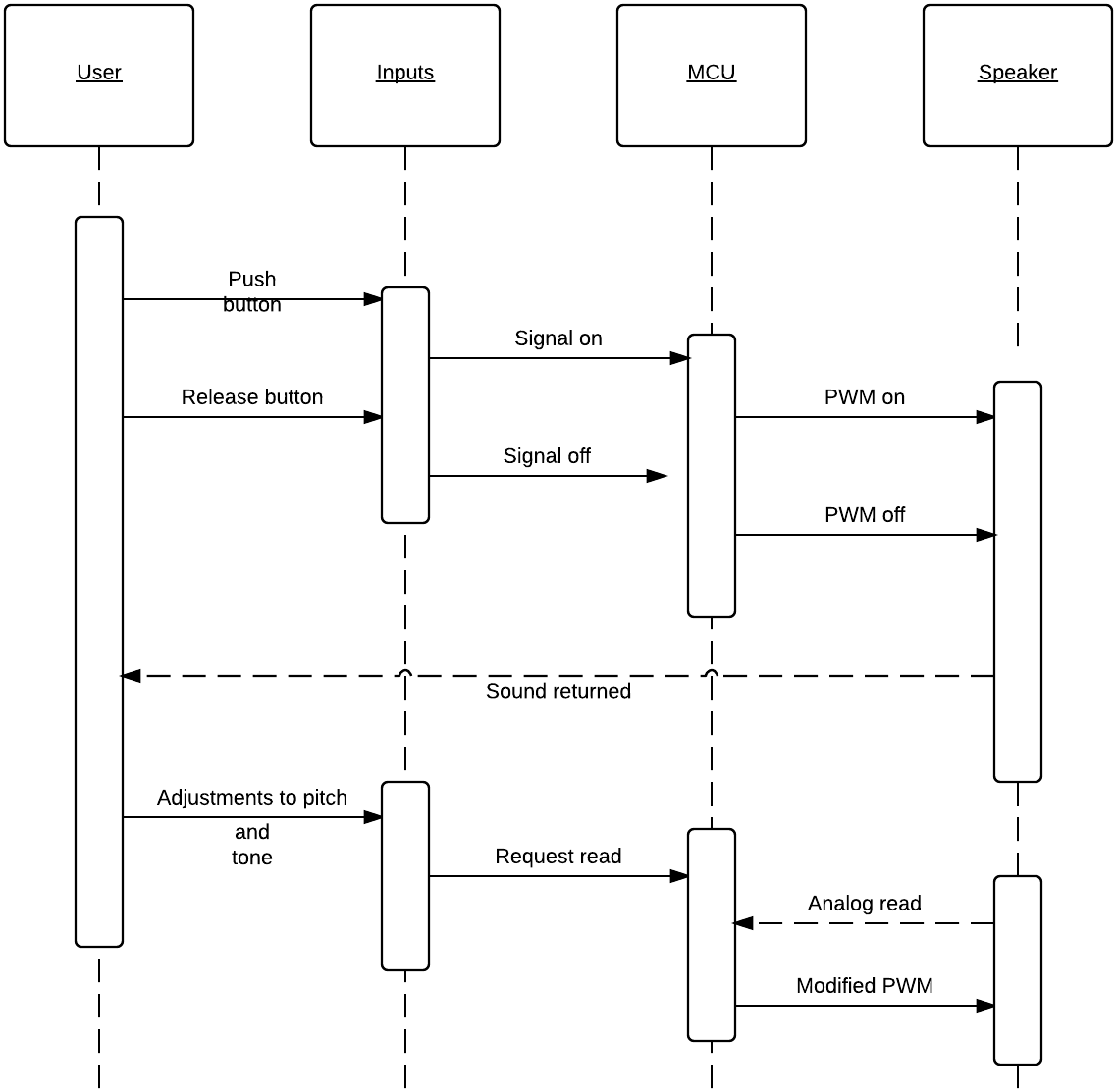
Use Case:	Play Tones
Actors:	User, Finger Buttons, Speaker
Description:	User makes music with right hand playing “piano” style, in glove.
Stimulus:	User presses finger(s) onto a hard surface, forcing momentary switch at finger tip to make contact.
Response:	Speaker produces multiple, scaled, PWM tones in real time corresponding to button pushes and ends tone in real time corresponding to button release.

Use Case:	Shift Registers
Actors:	User, Vambrace Buttons
Description:	User moves current scale (pre-programed notes at fingers) up or down to the next register (continuing the scale in that direction).
Stimulus:	User presses up ,or down, button on surface of Vambrace.
Response:	New base tones are loaded from the tone index into the main program.

Use Case:	Apply Effects
Actors:	User, Thumbstick
Description:	User applies pitchbend and changes tone by moving a small 2 axis joystick located on vambrace.
Stimulus:	Analog voltage applied to pins in micro-controller has shifted do to positional of joystick attached to potentiometers.
Response:	Output response counter is increased or decreased by up to ± 12% for one axis, and duty cycle of PWM is varied from 20-80% (centered at 50) in response to the other axis.

Use Case:	Adjust Volume
Actors:	User, Volume Control
Description:	User changes the audible level of the outputted sounds by changing the position of the volume control potentiometer.
Stimulus:	Resistance in the feedback loop of the final amplifier changes.
Response:	Gain is changed according to $V_{out} = \frac{R_{feedback}}{R_{in}} (V_{in})$

Entire System: Sequence Diagram



Micro-controller: State Space Diagram