Team 8: Voltage Vanguard ECE 411
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Homework Week 7 - Functional Decomposition

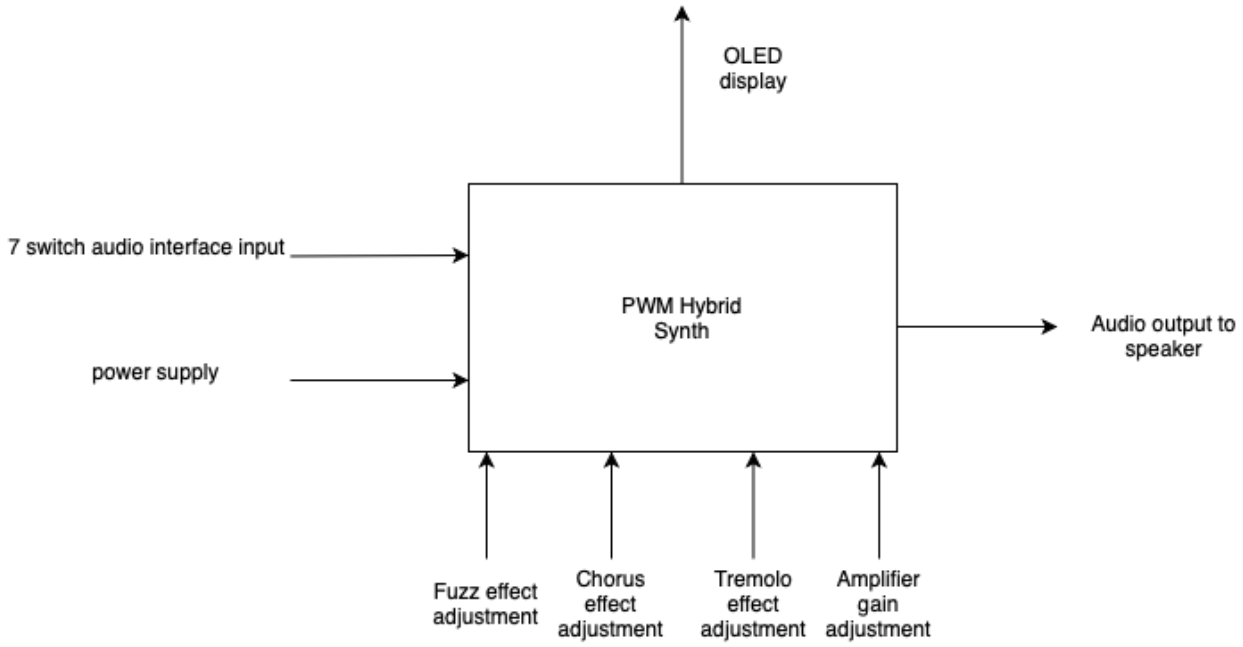

Figure 1: Level 0 diagram

Module	PWM Hybrid Synth
Inputs	- 7 push button switches for user audio input - Power supply - Effect 1 (Fuzz) potentiometer control adjustment - Effect 2 (Chorus) potentiometer control adjustment - Effect 3 (Tremolo) potentiometer control adjustment - Internal amplifier gain adjustment
Outputs	- OLED display - Audio output to be matched with a standard 8 ohm speaker.
Functionality	User pushes one out of seven audio interface input buttons, which sends a signal to the PWM Hybrid Synth. This signal is modulated by internal control to create an audio signal, can be changed with Fuzz/Chorus/Tremolo effects and gain adjustment, and then the signal is sent out to a speaker. Other functionality includes the internal control is programmed to output to the OLED display. The module is powered by 9V.

Table 1: Level 0 Functional Requirement

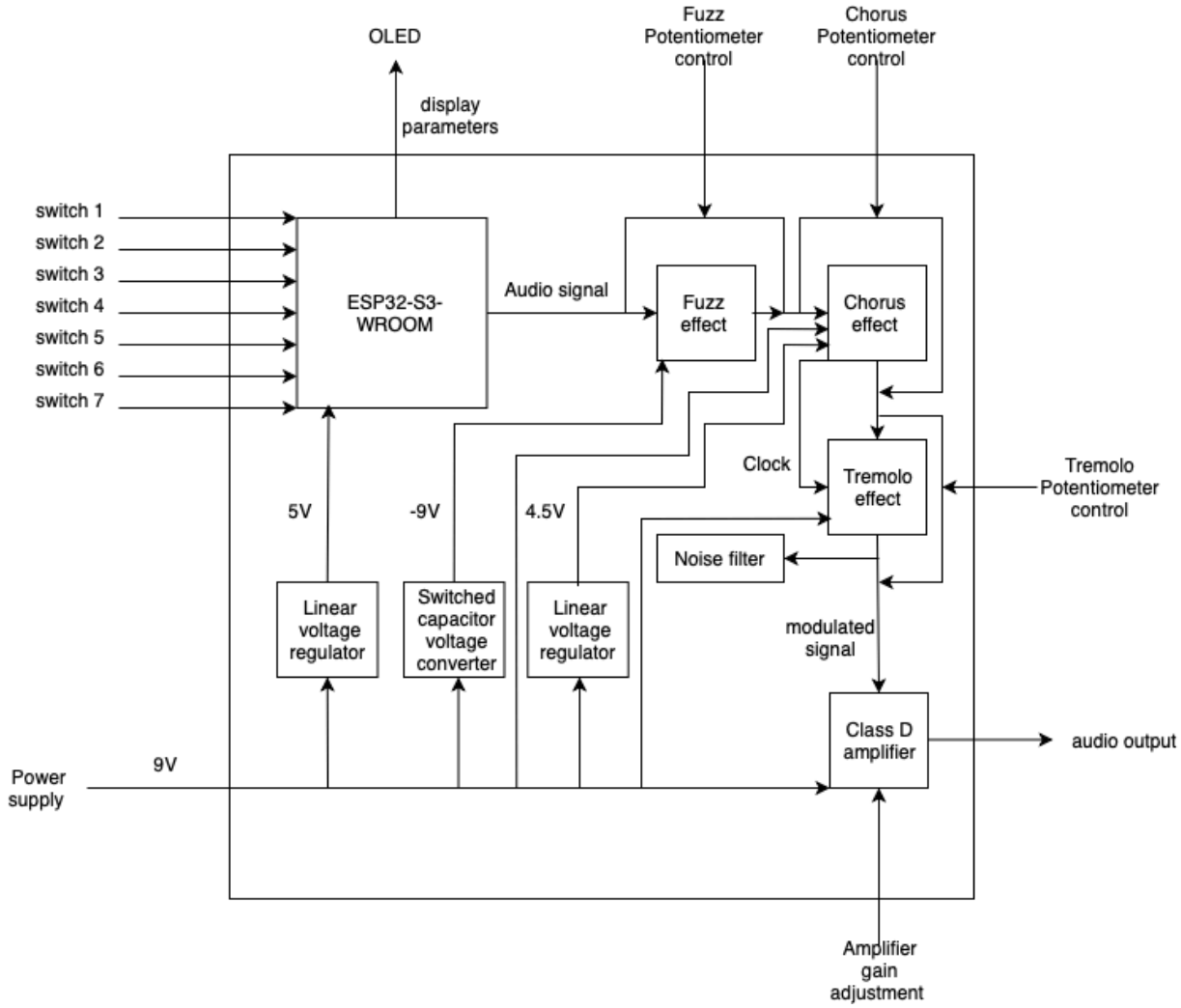

Figure 2: Level 1 diagram

Module	ESP32-S3-WROOM
Inputs	- switch 1 - switch 2 - switch 3 - switch 4 - switch 5 - switch 6 - switch 7 - linear voltage regulator (5V)
Outputs	- OLED - audio signal
Functionality	Takes user input from 7 monophonic push button switches, uses an arduino library to output to the display which button(or note) was pushed. Also uses the arduino library to generate a frequency (note) in the C-major scale, and sends to the effects chain.

Table 2: Level 1 Functional Requirement ESP32-S3-WROOM Module

Module	Linear voltage regulator
Inputs	- 9V power
Outputs	- 5V power
Functionality	Input voltage regulation from 9V to 5V required for microcontroller and OLED

Table 3: Level 1 Functional Requirement Linear Voltage Regulator

Module	Switched capacitor voltage converter
Inputs	- 9V power
Outputs	- 4.5V power
Functionality	Input voltage regulation from 9V to 4.5V required for chorus effect

Table 4: Level 1 Functional Requirement Switched Capacitor Voltage Converter

Module	Linear voltage regulator
Inputs	- 9V power
Outputs	- (-9)V power
Functionality	Input voltage regulation from 9V to -9V required for fuzz effect

Table 5: Level 1 Functional Requirement Linear Voltage Regulator

Module	Fuzz effect
Inputs	- 9V power - Audio signal from μC - Fuzz potentiometer control
Outputs	- Modulated audio signal - Bypassed audio signal from μC
Functionality	“Fuzz” effect takes the audio signal from the μC, modulates the signal by producing a square-wave like output. The signal is sent into saturation by the transistors. This effect will have the ability to be bypassed by the original audio signal.

Table 6: Level 1 Functional Requirement Fuzz Effect

Module	Chorus effect
Inputs	- Modulated signal from Fuzz effect - Audio signal from µC - 4.5V from linear voltage regulator - 9V from power supply - Chorus potentiometer control
Outputs	- Modulated audio signal - Bypassed audio signal from µC - Clock output
Functionality	“Chorus” effect takes the audio signal from either the µC or the Fuzz effect, modulates the signal by duplicating the input signal, creating phase and frequency variations. This effect delays and modulates the pitch of the incoming input signal. This effect will have the ability to be bypassed by the original audio signal. The clock output includes a powered IC that will work as both the clock for this effect and the Tremolo effect.

Table 7: Level 1 Functional Requirement Chorus Effect

Module	Tremolo Effect
Inputs	- Modulated signal from Chorus effect - Audio signal from µC - Clock input - 9V power - Tremolo potentiometer control
Outputs	- Modulated audio signal - Bypassed audio signal from µC - Node to noise filter
Functionality	“Tremolo” effect takes the audio signal from either the µC or the Chorus effect, modulates the signal by varying the amplitude of the input signal. This effect will have the ability to be bypassed by the original audio signal. The clock input is tied to the clock of the Chorus effect.

Table 8: Level 1 Functional Requirement Tremolo Effect

Module	Noise filter
Inputs	- Modulated signal from the Tremolo effect - Audio signal from the μC
Outputs	- To ground
Functionality	This filter is to ensure the output to the amplifier is set at 60 Hz.

Table 9: Level 1 Functional Requirement Noise Filter

Module	Class D Amplifier
Inputs	- Modulated signal from the Tremolo effect - Audio signal from the μC - 9V power - Amplifier gain adjustment
Outputs	- Audio output
Functionality	Adjustable voltage gain to modulate the input audio signal to a PWM signal, then through MOSFETs, to a low pass filter that mirrors the input audio signal to match the standard 8 ohm speaker that the resulting audio signal will be heard.

Table 10: Level 1 Functional Requirement Class D Amplifier