Team 8 - Voltage Vanguard
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Practicum Product Design Specification (PDS) Outline Rev 1.1

Short Descriptive Name: PWM Hybrid Analog/Digital Synthesizer with built in display

Executive Summary with Concept of Operations (2 pts)

The PWM synthesizer is a hybrid analog and digital audio processing device in the form factor of a guitar pedal. It functions as a synthesizer with one octave(11 manual inputs). These inputs modulate the synthesizer's analog and digital effects. This device will create the ability for a musician to interact with effects typically found in guitar pedals in a unique way. The synthesizer will connect to a standard 9V power supply that is standard on a pedal board.

An example of how this product would be used: One person can be manipulating the synth, pressing each button/switch to change the frequency that the microcontroller sends to the effects. Either with relays or switches, the microcontroller would be able to control none, one or a combination of effects that turn on, and this output goes to a speaker. The OLED display may show the effects that are turned on, the buttons that are switched on, or any other information that the user would find relevant.

Brief "Market" Analysis (2 pts)

The intended customer demographic for the PWM synth would be entry level music enthusiasts or those looking to get into music production. The competition is a multitude of audio effects companies. Our product is different because it's locally designed and crafted, and creates a combination of effects that are typically uncommon and often do not come on a singular device. Market price for similar products can start at around $100 upwards. To market this product and stay competitive, we could start the price of the synthesizer at $75 for the base model and increase the price as more components are added.

Requirements (4 pts)

Must:

- Must be powered using 9V
- Must have a Guitar pedal form factor
- Must have amplifiers to amplify input signals
- Must have adjustable potentiometers and buttons/switches to change effects
- Must have at least 2 analog effects
- Must have a audio output that a speaker can be connected to
- Must have digital control using a microcontroller, at least one waveform
- Must have a display, OLED or LED

Should:

- Should use a MIDI keyboard to control the synth
- Should have a high quality metal case
- Should have the microcontroller produce multiple waveforms or additional digital effects

May:

- May be battery powered
- May have more than 2 analog effects
- May be cat themed
- May cost less than $75

System Architecture (4 pts)

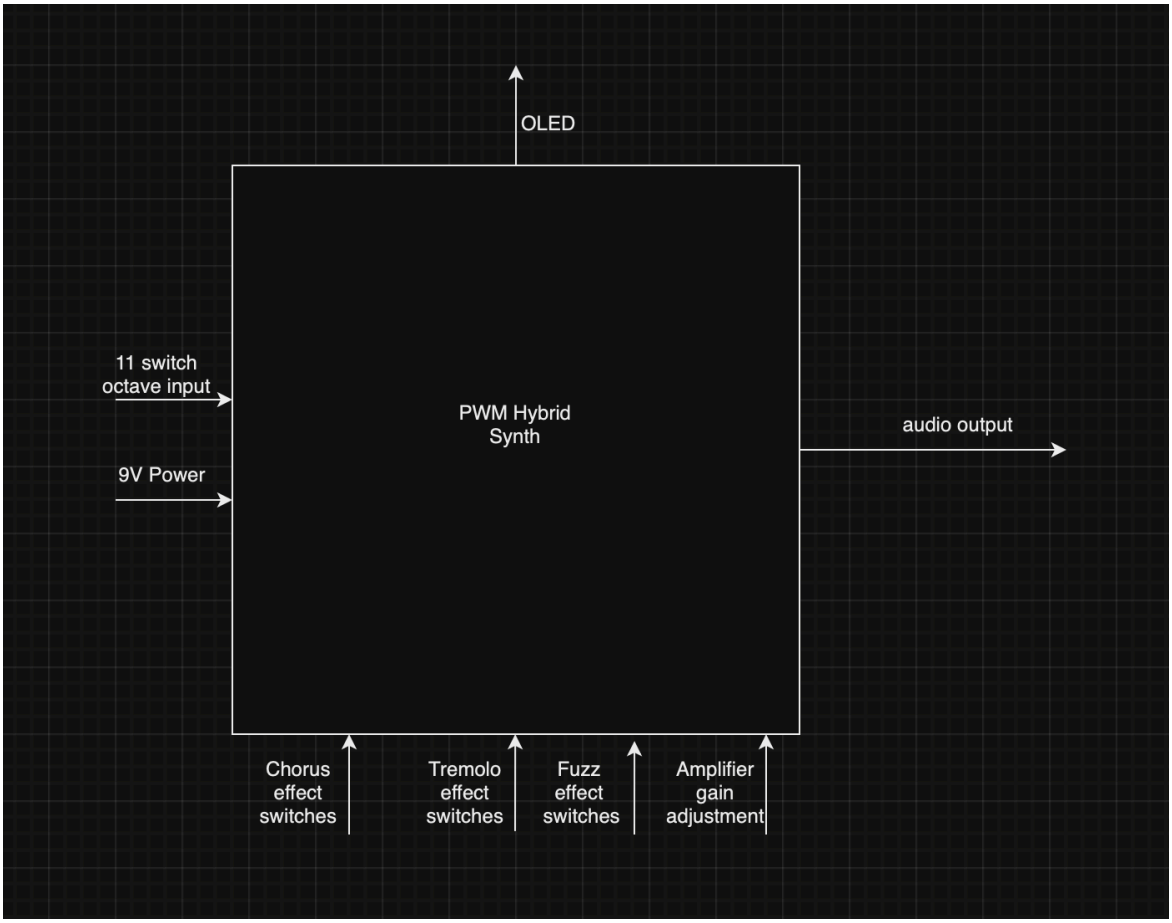

Figure 1: Level 0 block diagram

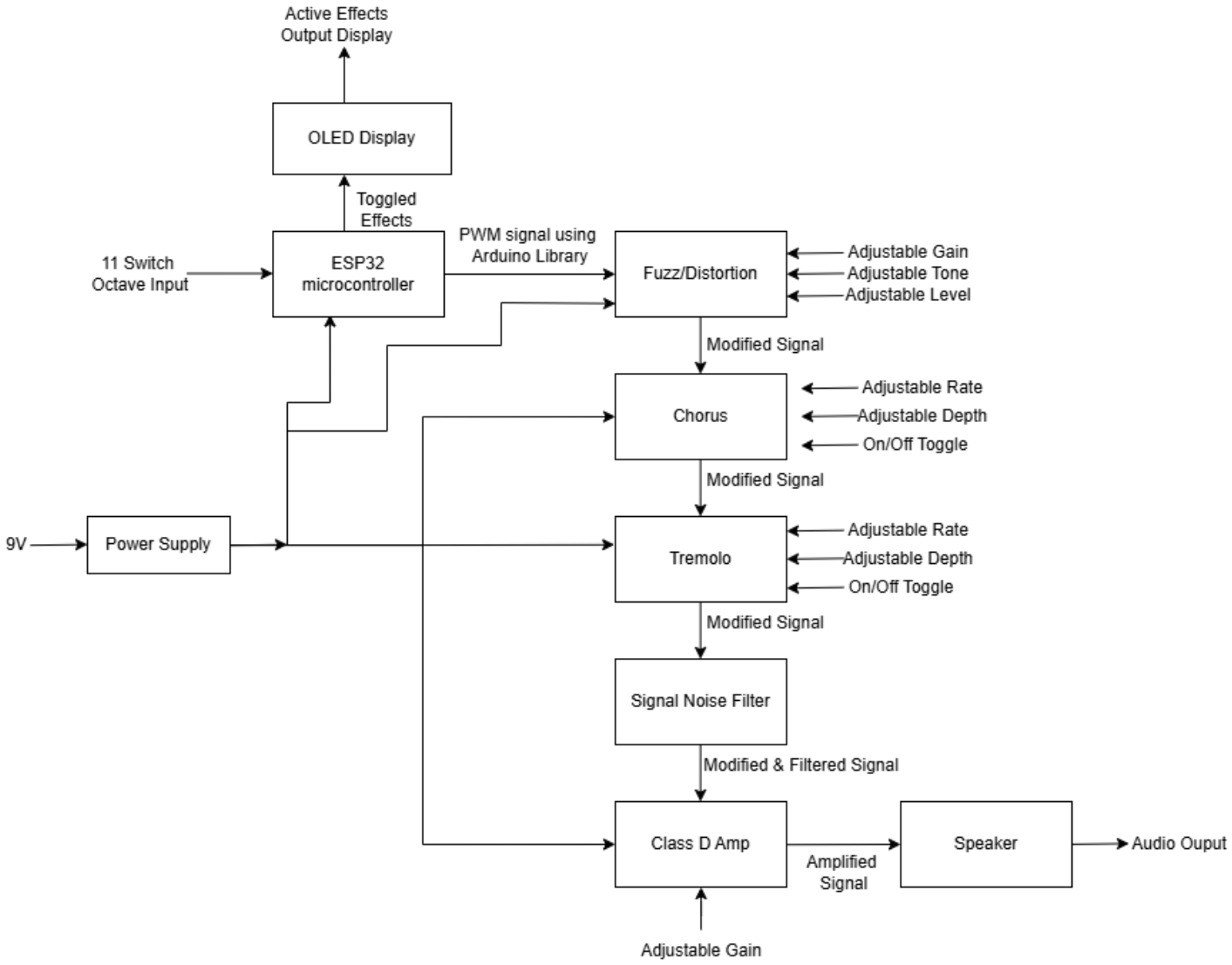

Figure 2: Level 1 block diagram

Design Specification (4 pts)

- Actuators
  - Outputs (speaker amp and line-level audio)
  - Displays
    - OLED or LED (ex: 9x9 Matrix)
- Sensors
  - Human input
    - Potentiometer
    - Buttons
    - Toggle Switches
- Controllers
  - ESP32-S3-WROOM (tentative)
  - Analog discrete logic
  - OP amps (filter, feedback, etc)