Dwight Look College of
ENGINEERING
TEXAS A&M UNIVERSITY

Project name: Guitar Entertainment System

Team members: Rawan Ibraheem, Rishabh Ruikar, Monte Martin

Problem Statement

- Problem statement: Current guitar amplification and sound modification systems lack the integration of modern technology and user-friendly control methods for those with limited experience.

Solution Proposal

- Solution proposal: Develop a high-tech guitar sound system with an amp, pedals, and a bluetooth app, to allow to the user to more seamlessly integrate and customize the sound system to their liking.

Bluetooth™

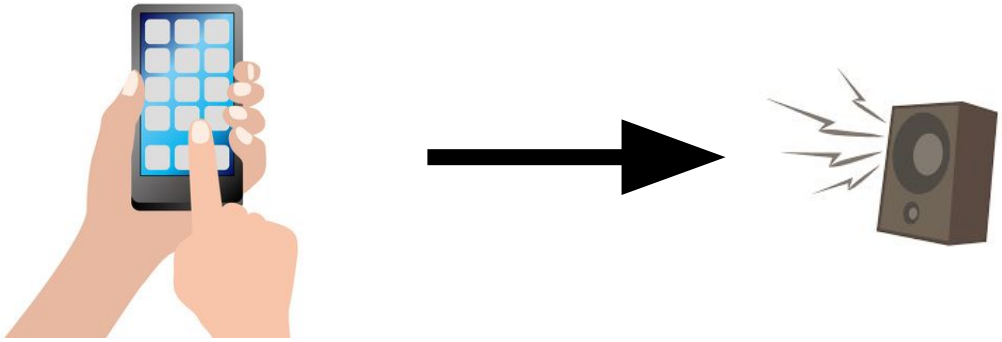
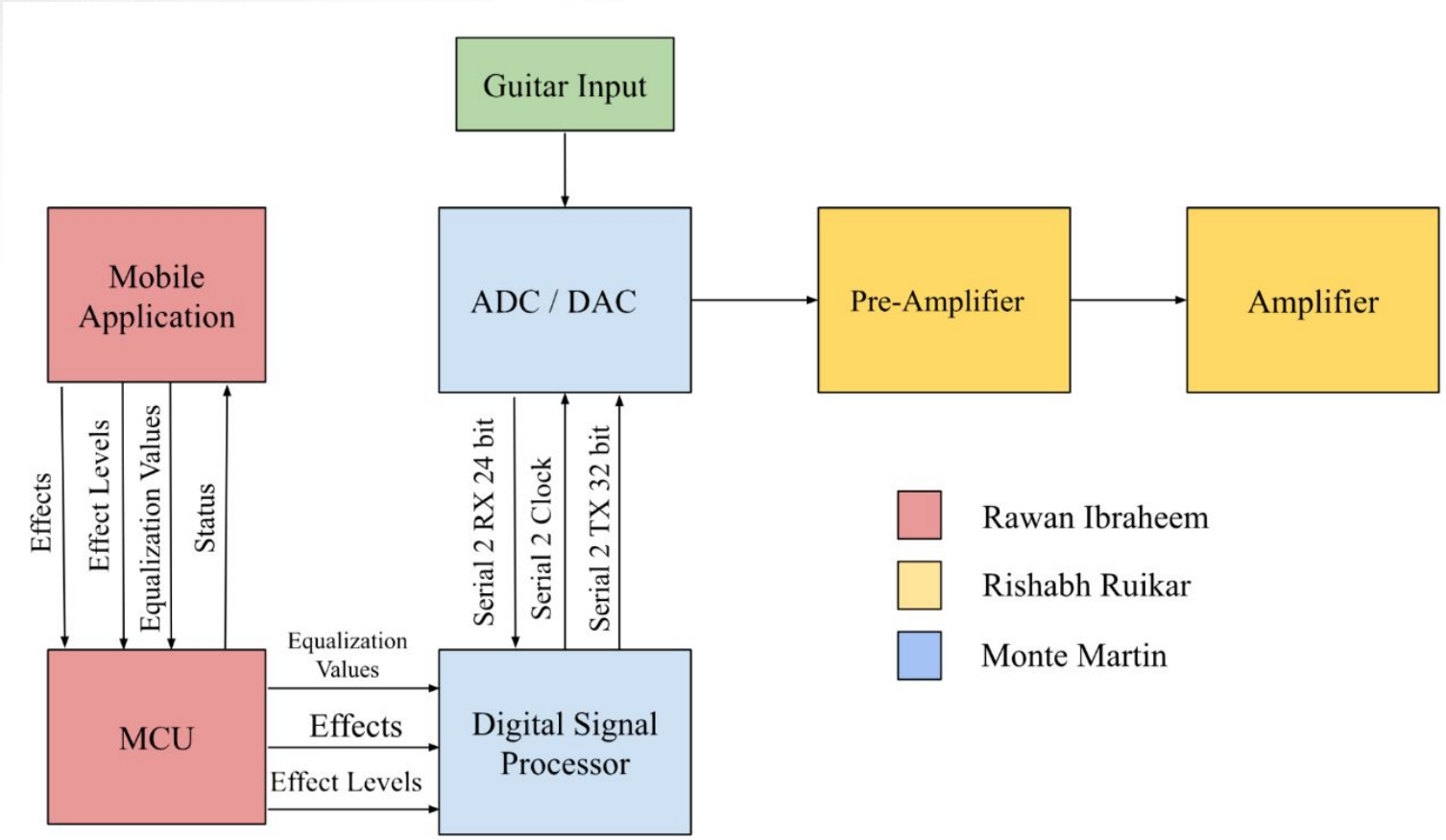


Diagram of subsystems and interface



Task partition

- Rawan: Design and implement android application that can send and receive signals from MCU
- Rishabh: Design and build a pre-amp and amp system to process and amplify signals from the pedals
- Monte: Create a sound processor that is controlled by the MCU to implement effects.

Amplifier Subsystem Overview

- Will contain 3 “sub-components”
  - Pre-amp
    - Amplify low-level signals, matches impedances between source and mixing device, minimizes noise
  - Amplifier
    - Boosts the power of the “conditioned” signal to be able to drive speakers to sufficient volume while maintaining clarity at high output levels.
  - Speaker
    - Converts the amplified signal into audible sound waves
- Receive signals from pedal system via ¼ inch Tip sleeve

Amplifier Progress

- Currently finalizing circuits that can be used
  - Will be using TL072 op-amps
- Simulating in Multisim this week
  - Circuit must have a gain between 30-60 dB

Pedal Subsystem Overview

- The pedal system is comprised of 4 subsystems:
  - Analog Practical Filter
    - Prevents signal contamination from aliased noise
  - Analog to Digital Converter
    - Takes in filtered analog signal and converts it into a digital signal
  - Digital Signal Processor + effects
    - Can implement effects through transform functions
  - Digital to Analog Converter + filtering
    - Takes transformed digital signal, does some final filtering, and then converts it back to analog

Pedal System Progress

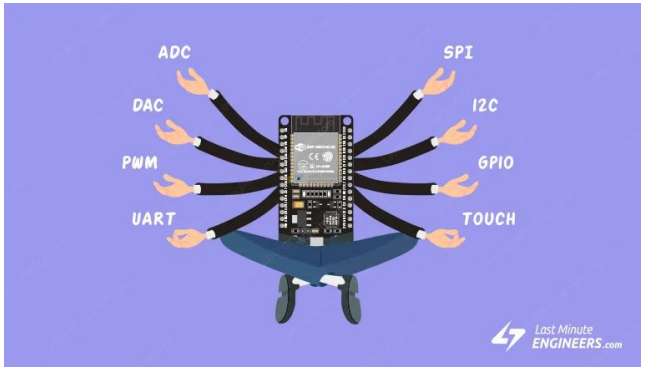
	A	B	C
1	**Component**	**ADC**	**DAC**
2	**Manufacture**	TI	TI
3	**Name**	PCM4220	PCM5142
4	**Sample Rate(kHz)**	216	384
5	**Signal to Noise Ratio(dB)**	123	112
6	**Digital Audio Interface**	I2S, L, TDM	-
7	**Control Interface**	H/W	H/W, I2C, SPI
8	**Resolution(Bits)**	24	32
9	**Package Type**	TQFP(PFB)	TSSOP
10	**Number of Pins**	48	28
11	**Area**	81mm 9 x 9	62.08mm 9.7 x 6.4

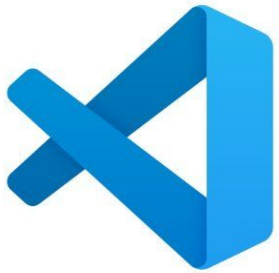
Pedals Progress Continued

D	E
	DSP
Manufacturer	STM
Name	STM32H747IGT6
Data Bus Width	32 bits
Maximum Clock Frequenc	240 MHz, 480 MHz
Program Memory Size	1 MB
Number of I/O	119
Data RAM size	1 MB
Interface Type	GPIO, I2C, SAI, SDIO, SPI USART USB
Package Type	LQFP
Number of Pins	176

MCU & Application

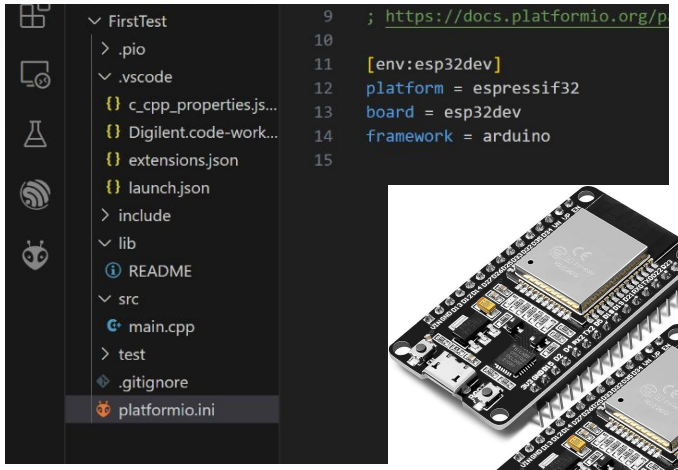
- The microcontroller unit will send signals to the ADC and DAC, as well as send and receive signals from an android mobile application
- The application will allow for users to adjust sound effects and save presets for different contexts
- The microcontroller will be an ESP32, which has bluetooth connectivity and consumes low energy
- The application will be created in Android Studio
- The microcontroller will be coded in Visual Studio Code using the PlatformIO extension

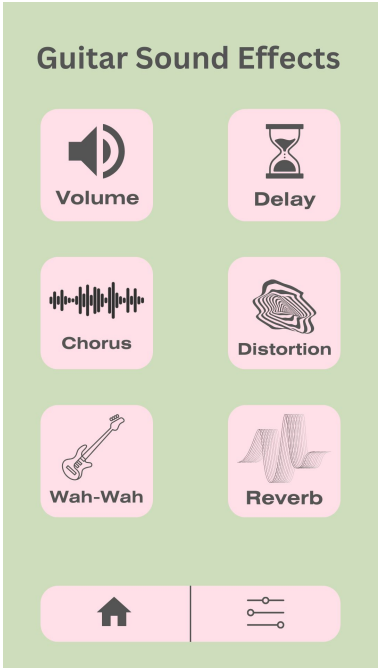


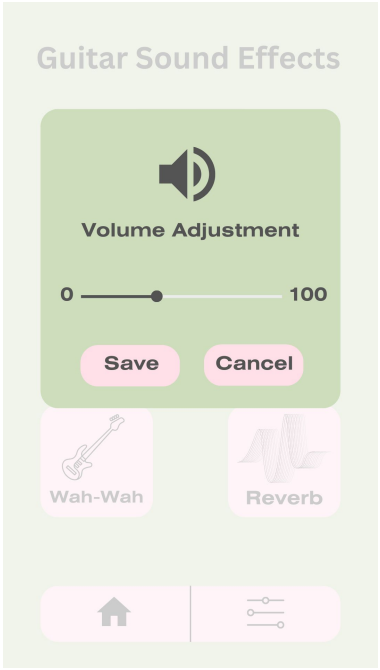


MCU & Application

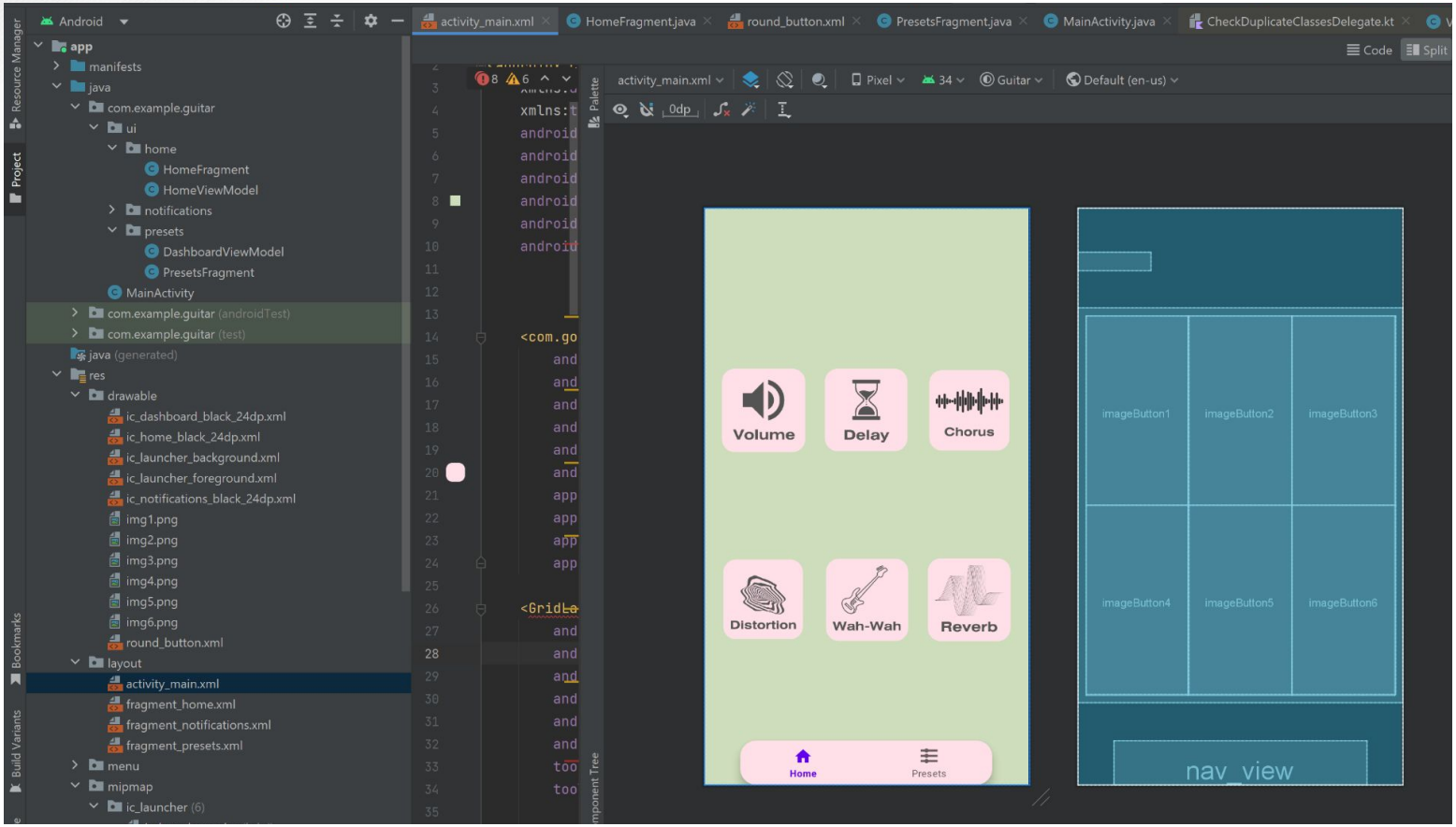
Development board and breadboard ordered to begin programming.







MCU & Application



Execution plan

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**Task**	**Owner**	**9/25**	**10/2**	**10/9**	**10/16**	**10/23**	**10/30**	**11/6**	**11/13**	**11/20**	**11/27**	**12/4**
2	Assign members to specific subsystems.	All											
3	**Subsystem - Mobile Application & MCU**												
4	Design mobile app's user interface (UI).	Rawan											
5	Familiarize self with ESP32's IDF.	Rawan											
6	Develop features that allow users to adjust and customize effects.	Rawan											
7	Implement Bluetooth communication modules into app.	Rawan											
8	Create functionality for users to save and recall preset sound profiles.	Rawan											
9	Test the app on a variety of Android devices to ensure compatibility.	Rawan											
10	Integrate app-related instructions and guides into comprehensive user manual.	Rawan											
11	**Subsystem - ADC/DAC, DSP**												
12	Design Layout	Monte											
13	Decide on Parts	Monte											
14	Order Parts	Monte											
15	Design Practical Filter(Analog Filter PreADC)	Monte											
16	Write Code for Effects	Monte											
17	Code for Digital Filters	Monte											
18	Build mock system	Monte											
19	Load code onto actual components	Monte											
20	testing	Monte											
21	Create PCB	Monte											
22	Solder PCB	Monte											
23	**Subsystem - Pre-amplifier, Amplifier**												
24	Create detailed circuit schematics for the preamplifier and amplifier stages	Rishabh											
25	Choose components op-amps, transistors, capacitors, and resistors	Rishabh											
26	Design a prototype PCB for the preamplifier and amplifier stages.	Rishabh											
27	Assemble and solder components onto PCB.	Rishabh											
28	Conduct tests to validate performance of preamplifier and amplifier stages.	Rishabh											

Not Started
In Progress
Completed
Behind schedule

Validation Plan

	A	B	C	D
1	**Subsystem**	**Deliverable**	**Methodology**	**Owner**
2	MCU & Application	Application is able to run on emulator	Run application in Android Studio on Pixel 2	Rawan
3	MCU & Application	Application is able to run on mobile device	Run application on Samsung S20	Rawan
4	MCU & Application	Establish connection between application and ESP32 within 5 seconds	Use timer to measure time it takes to connect send signal to MCU	Rawan
5	MCU & Application	Application and MCU have a bluetooth connectivity range of at least 10 meters	Measure distance of signal meter by meter using measuring tape	Rawan
6	MCU & Application	Ensure MCU can send volume adjusting signal to DSP	Measure the output of the DSP sine wave uszing oscilliscope	Rawan
7	ADC/DAC, DSP	Have less than 10 dB of noise between analog input and output	Use oscilloscope to provide an input signal and the output signal	Monte
8	ADC/DAC, DSP	All effects work as intended, with outputs within 5 dB of calculated values	Use oscilloscope to provide an input signal and the output signal	Monte
9	ADC/DAC, DSP	have less than 10 ns of delay between signal input and output	Use an oscilloscope to measure delay between input and output signals	Monte
10	ADC/DAC, DSP	The delay function can create up to 2 seconds of delay without loss of signal quality	Use a timer and oscilloscope to measure delay and signal quality	Monte
11	Amplifier	Preamp circuit will be able to receive an input signal	Simulate the preamp circuit in Multisim	Rishabh
12	Amplifier	Preamp circuit will be able to receive a signal from the pedals	Simulated via a digital medium (not finalized yet)	Rishabh
13	Amplifier	Preamp is able to pass this signal on to the amplifier	Use an oscilloscope to measure output signal	Rishabh
14	Amplifier	Amplifier is able to process this signal and "amplify" it	Test amplifier signal in Multisim	Rishabh
15	Amplifier	Speaker is able to receive audio signal and output it at at least 95 dB	Use an oscilloscope to measure input and output signal	Rishabh

Thank you,
Any questions?