Practicum Product Design Specification (PDS)

Team 16

RFID Spotify Record Player

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Version 3

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Executive Summary with Concept of Operations:
The RFID Spotify Record Player bridges the nostalgic experience of using a record player with the convenience of digital music streaming. Instead of vinyl records, RFID chips embedded in custom made mini-records will trigger specific Spotify songs via a Raspberry Pi. The system mimics the action of placing a record on a turntable, offering both a visual spinning effect and the vast music library of Spotify.

How it works:

- The user places an RFID-embedded "record" on the player.
- The RFID reader detects the tag.
- The Raspberry Pi processes this input, sends a command to Spotify to play a specific song, and simultaneously activates a DC motor to spin the mini-record for a visual effect.

Users:
Music enthusiasts who enjoy a blend of old-school vinyl aesthetics with modern music streaming.


Market Analysis:

- **Target Users:** Retro tech enthusiasts and individuals who appreciate unique user interfaces for their music experience.
- **Competition:** Competitors may include similar DIY projects combining Raspberry Pi, Spotify, and RFID. However, most of these don't focus on the retro look and feel of a record player combined with Spotify.
- **Unique Selling Point (USP):** The product stands out for offering a visually satisfying, tactile experience with the practical convenience of Spotify's music library.
- **Price Estimation:** The expected price for parts and assembly would be around $100-$150, keeping it affordable compared to high-end custom audio systems, but competitive for a niche product.

Requirements:

- **Must accurately read RFID tags** within 1-2 seconds.
- **Must connect to Spotify** via a Wi-Fi or Ethernet connection.
- **Must trigger a corresponding song and/or playlist** based on the RFID chip.
- **Must** offer a smooth, lag-free music playing experience.
- **Must not overheat** during extended use.
- **Should include a visual** spinning effect of the mini-record.
- **Should include an LCD** displaying the song playing.
- **Should** be portable and powered (ex. standard AC adapter / rechargeable battery)
- **Should** have action buttons/RFID tags to control pause, play, skip, and reverse.
- **Should be easy to set up** with minimal configuration needed by the user.
- **Should have a "shuffle" mode** for random song playback.
- **Should include a time display** or countdown of the song playing.
- **Should have adjustable volume control** via buttons or a rotary knob.
- **Should include support for multiple user profiles**, allowing different users to have personalized playlists or settings.
- **Should have a low-power mode** to conserve battery when not in active use.
- **Should offer a sleep timer** that gradually lowers volume and shuts off after a set time.
- **Should have a "favorite" button** that lets users save the current track to a playlist.
- **Should provide an adjustable motor speed** to create different visual effects for the spinning disc.
- **Should provide a visual notification for low signal strength** if the Wi-Fi connection is weak.
- **Should include a mute button to instantly stop sound output** without turning off the device.
- **Should** provide an option to adjust the brightness of the LCD display.
- **Should** offer a feature to create playlists from RFID tags based on user preferences.
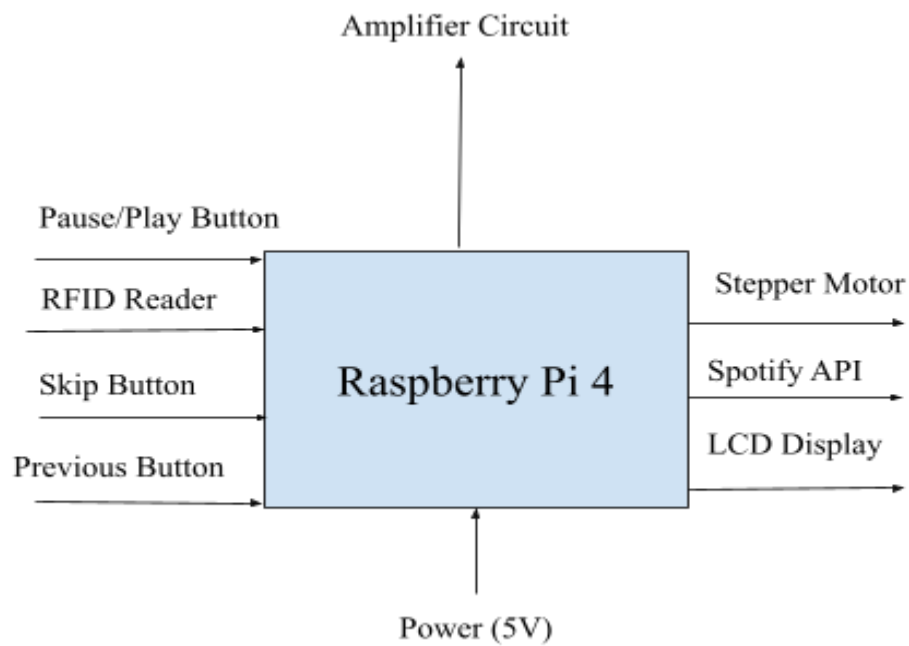
System Architecture:

- **Level 0 Block Diagram**:
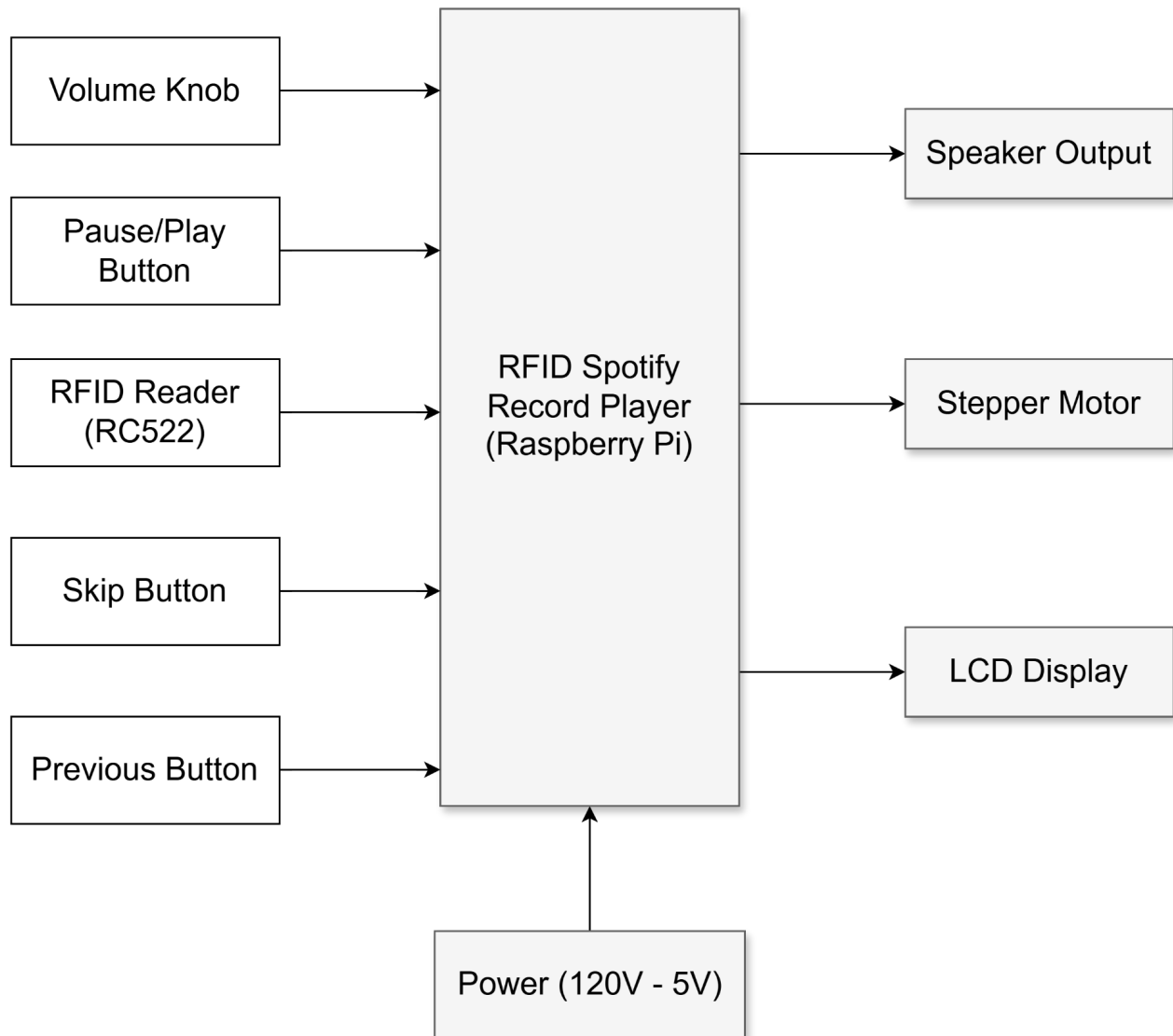
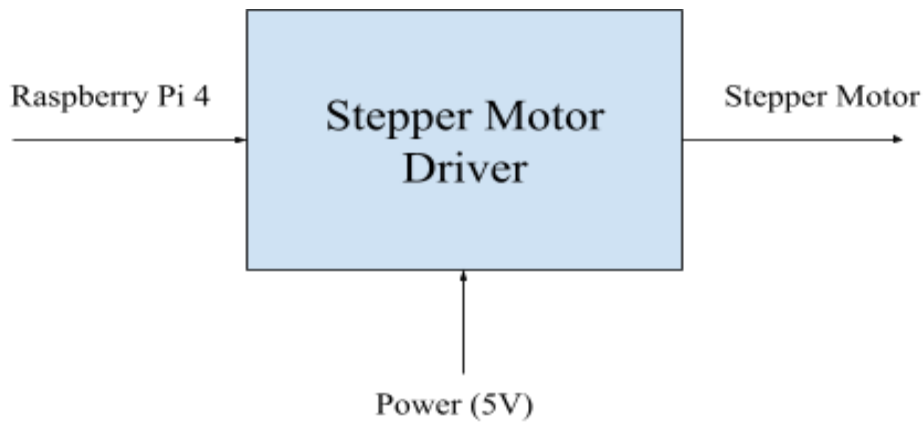| Module	RFID Spotify Record Player (Raspberry Pi)
Input	Volume knob Pause/play button RFID reader(RC522) Skip button Previous button Power(wall outlet 120V to input 5V)
Output	Speaker output Stepper motor LCD display
Functionality	Receive signal from RFID tag and process it to link with Spotify playlist and output the playlist.

● **Level 1 Block Diagram**:
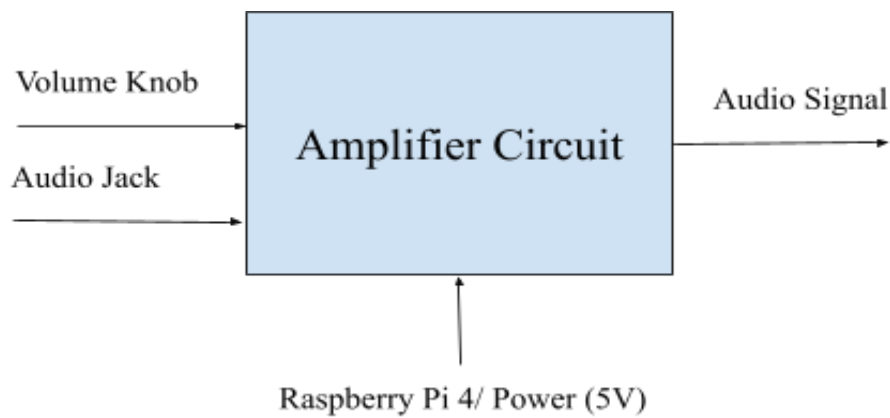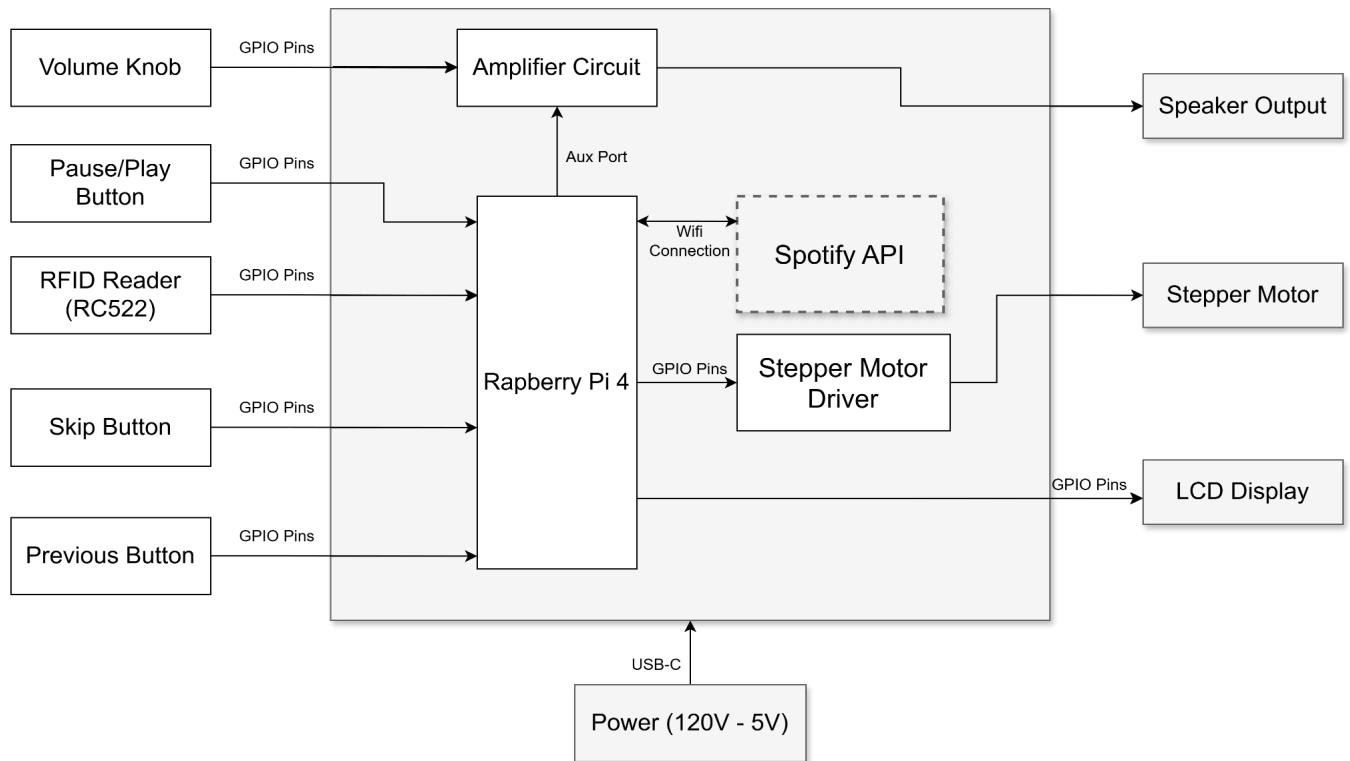
| Module	Amplifier Circuit
Input	Volume knob Raspberry Pi 4 audio jack Power: 5V
Output	Audio signal speaker output
Functionality	Provides a voltage gain to amplify audio signals from the

	Raspberry Pi to a higher volume for the speaker.

Amplifier Circuit

Pause/Play Button

RFID Reader

Skip Button

Previous Button

Raspberry Pi 4

Stepper Motor

Spotify API

LCD Display

Power (5V)

Module	Raspberry Pi 4
Input	Pause/play button RFID reader Skip button Previous button Power: 5V
Output	Stepper motor Spotify API LCD display
Functionality	Reads RFID tags, communicates with Spotify API to play corresponding songs, controls playback functions, and sends data to the LCD Display and stepper motor.

Module	Stepper Motor Driver
Input	Raspberry Pi 4 Power: 5V
Output	Stepper motor
Functionality	Controls the rate of rotation of the stepper motor to spin the mini-record player, simulating a traditional record player effect.
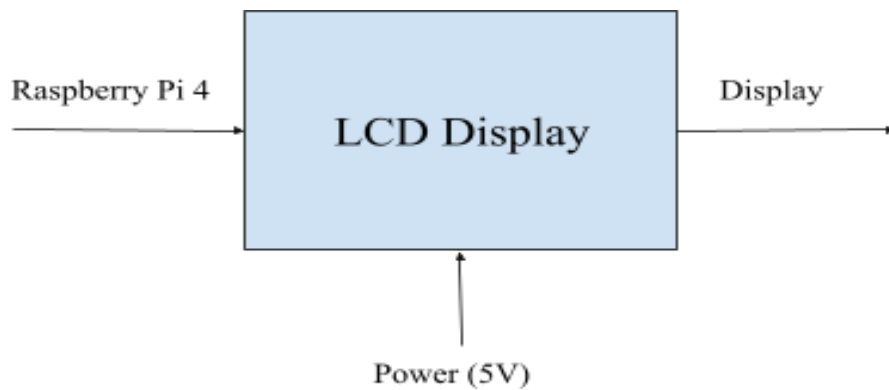
Module	LCD Display
Input	Raspberry Pi 4 Power: 5V
Output	LCD display
Functionality	Display the song title, playback control performed, or errors in playing a song.

Design Specification:

- **Sensor:** RFID reader (RC522 module).
- **Processor:** Raspberry Pi 4 (handles RFID reading, Spotify API interaction, and motor control).
- **Actuator:** Small DC motor to spin the mini-record.
- **Power Supply:** 5V, 2.5A power supply for Raspberry Pi; 5V motor driver (same power connection).
- **Software:** Python scripts for RFID reading and interfacing with Spotify's API; Motor control via GPIO.
- **Mechanical Design:** Mini-record platter driven by a DC motor and audio jack connected speaker.
- **Firmware/Development Environment:** Raspberry Pi OS, Python, Spotify API.