Practicum Product Design Specification (PDS)

Team 16

RFID Spotify Record Player

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Version 2

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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:

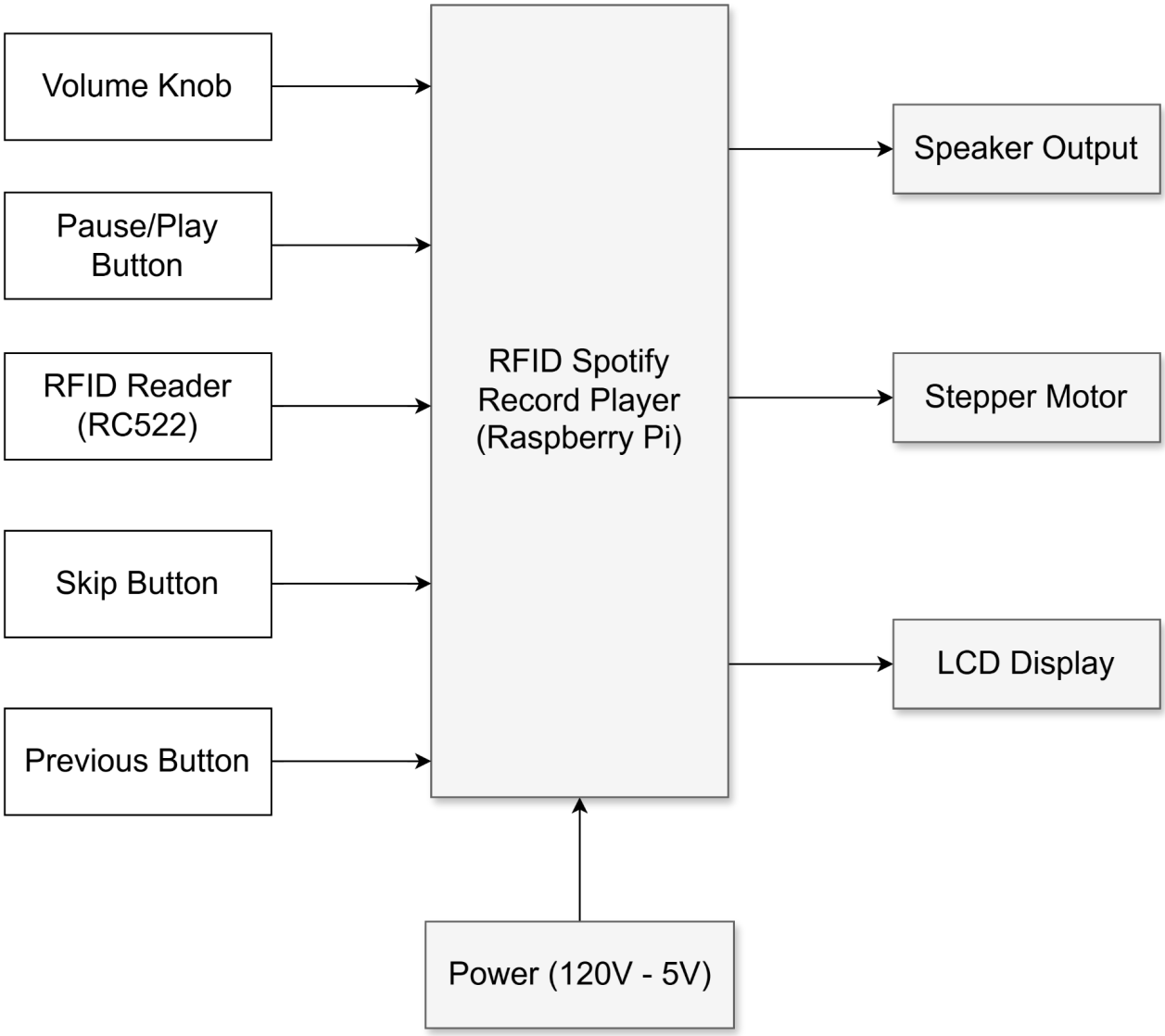
- **Target Users:** Retro tech enthusiasts and individuals who appreciate unique user interfaces for their music experience.
- **Competition:** Competitors may include similar DIY projects combining Raspberry Pi, Spotify, and RFID. However, most of these don’t focus on the retro look and feel of a record 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 $75-$100, keeping it affordable compared to high-end custom audio systems, but competitive for a niche product.

Requirements:

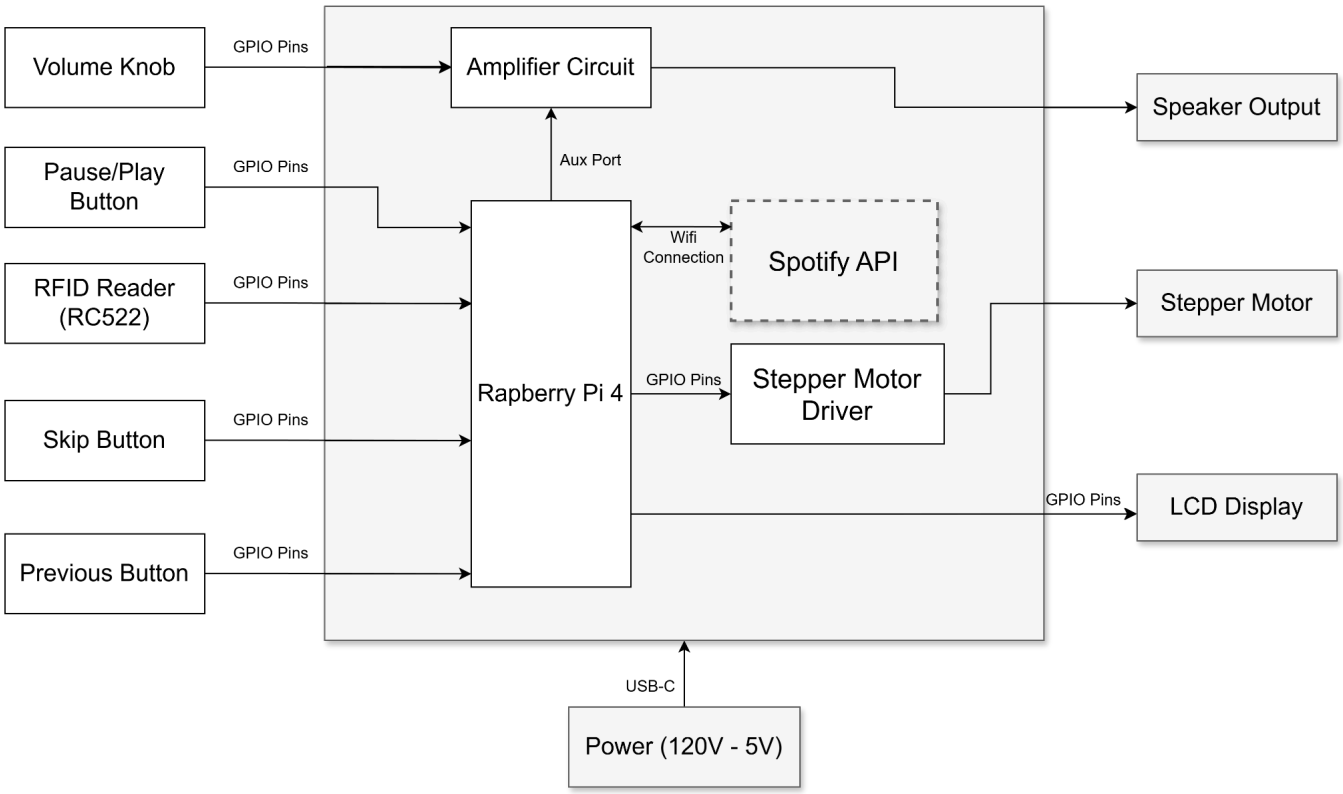
- **Must accurately read RFID tags** within 1-2 seconds.
- **Must connect to Spotify** via a Wi-Fi or Ethernet connection.
- **Must trigger a corresponding song and/or playlist** based on the RFID chip.
- **Must** offer a smooth, lag-free music playing experience.
- **Must not overheat** during extended 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.

System Architecture:

- **Level 0 Block Diagram**:



- **Level 1 Block Diagram**:



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.