Product Design Specification

Manual Hole Disk Player

Version 1.02

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1 - Introduction

This document describes the design of the Manual Hole Disk Player (MHD-Player).

2 - Executive Summary

2.1 Manual Hole Disk Player (MHD-Player) Summary

The Manual Hole Disk Player is a device that plays music that is decoded from a Manual Hole Disk (MHD). Its purpose is to create music/tones from a disk whose data was physically set by someone. The intended use for this device is to play music and for it to be a potential teaching tool for binary or digital decoding.

To use the MHD-Player, the user must first turn it on. Then they may insert an MHD and press the play button. At any time, they can pause/play the disk, speed the player up/down, and turn the volume up/down. After use, the user may turn off the MHD-Player.

2.2 Manual Hole Disk (MHD) Summary

The Manual Hole Disk is a physical disk with holes dispersed in straight lines that travel from the center to the edge of the disk. These holes can be covered or not by flaps that are part of the disks. Each hole represents a bit (covered = 0, not-covered = 1), and each row of bits (4 per row) can be decoded into a specific tone or lack of a tone. Users can set the data of this disk with their hands by flipping the flaps and listen to the music it makes when inserted into an MHD-Player.

3 – Brief Market Analysis

This device is intended for children as a toy or for teachers to use as an interactive example of binary/digital decoding.

Competition against this device would be other education tools/toys for digital coding. While toys such as “Rami the Binary Teacher” and the “STEM Binary Puzzle” teach basics of binary, neither use electronic components for feedback based on the input.

The closest design to the Binary Disk Player is from “Series Toys: Teaching the Binary Number System” (DOI:10.1145/2325296.2325358), which provides visual feedback to learners, but does not provide any audio feedback.

Looking at other educational toys (many with no electronics) with the goal of teaching something similar to our product, our price range is $30-$50.

4 – Requirements

4.1 MHD-Player Requirements

Must be able to:

- Play an MHD
- Use batteries
- Play sound
- Be able to change volume
- Be able to change speed of audio (tempo)

Should be able to:

- Display volume level
- Display playback speed
- Be able to pause/play at any time

May be able to:

- Display battery level.

4.2 MHD Requirements

Must have at least 32 rows of bits for tones (A song can play 32 tones before looping). Must have rows all be 4-bits long. Must be decodable be the MHD-Player. May have an extra bit for each row to indicate the start of the disk.

5 – System Architecture (MHD-Player)

5.1 Block Diagram

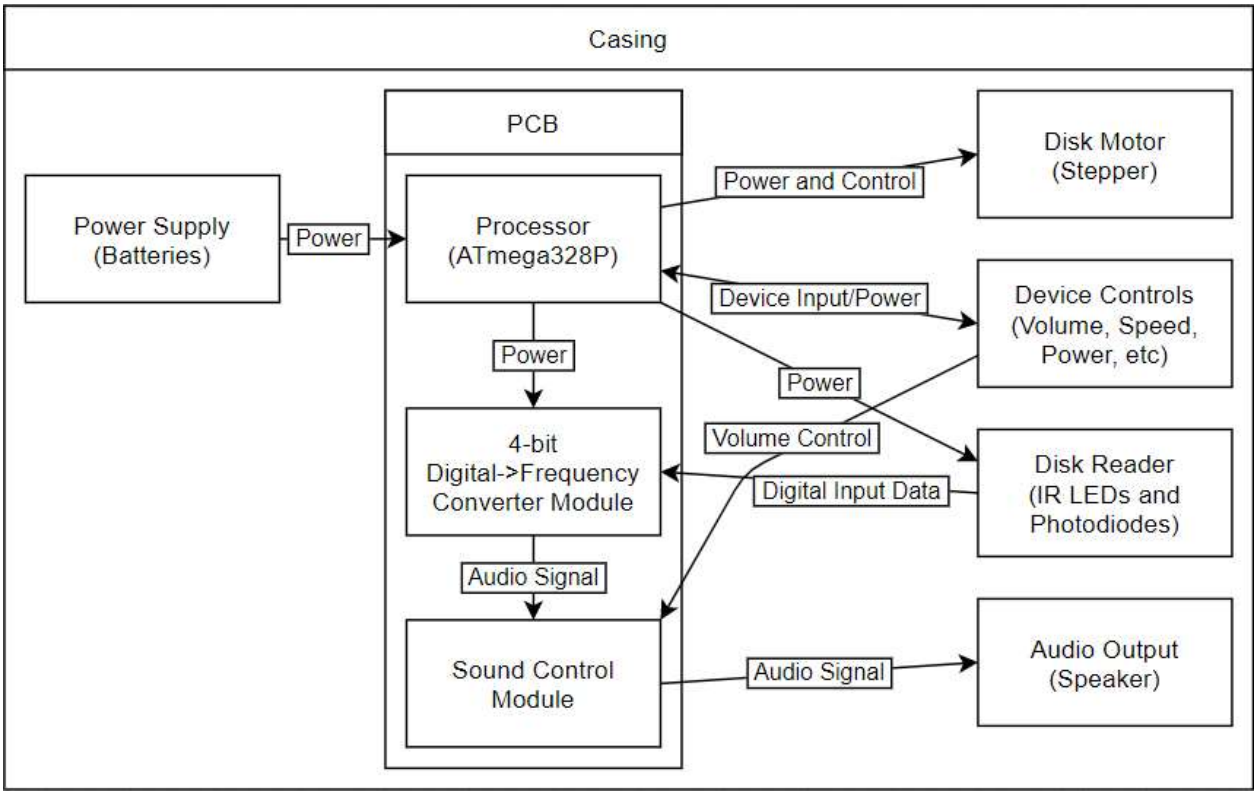

Figure 5.1: Level 1 System Block Diagram

5.2 System Block Roles

Casing: Holds all components of the device.

Power Supply: Supplies power to the processor/PCB.

Processor: Controls power to Disk Motor, Disk Reader, and Digital->Frequency Converter Module. Sends control signals to Disk Motor and receives input from Device Controls.

Digital->Frequency Converter Module: Receives power from Processor and input from Disk Reader. Outputs audio signal to Sound Control Module.

Sound Control Module: Receives audio signal from Digital->Frequency Converter Module and input from Device Controls. Outputs modified audio signal to Speaker.
Disk Motor: Receives power and input from Processor to spin disk.

Device Controls: Gives input to Processor and Sound Control Module.

Disk Reader: Reads disk and sends digital input data to Digital->Frequency Converter Module.

Audio Output: A speaker that receives an audio signal from the Sound Control Module.

6 – Design Specification

Processor: ATmega328P

Sensors: Photodiodes and IR LEDs for capturing data from disk. Switches/Buttons/Knobs for controlling power, speed, and volume.

Actuators: A stepper motor to spin the disk.