

Music Inventory Machine

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ABSTRACT

UPDATED—18 March 2022. This paper describes the Music Inventory Machine project done in the course INFO 4320 at Cornell University. The goal for this project is to develop a machine for storing music in physical IDs with NFC technology, so that users can play the music they want. The machine gives the user the right card by having them interact with a scanner, and the user can then scan the card to play the song.

Author Keywords

Rotators; Motors; Interfaces; Music; Scanner; Arduino; Stepper; NFC; Spotify; API.

ACM Classification Keywords

•Hardware~Electronic design automation~Physical design (EDA)~Placement

INTRODUCTION

The machine will use NFC cards to store music information in a rotating turntable with a box that also serves as a container. Users can request specific music by scanning the corresponding barcode. Our machine will identify and connect the signal to the right card and pop it to the user. The user can then scan the music card to play it on their device.

The goal of this project is to provide music lovers with physical interaction through a machine that uses the latest technology and yet bonds back through the times of cassette and CDs, echoing the wave of new-retro culture in contemporary society.

The make-up of our music inventory machine is similar to a turntable so that users will immediately associate between the two. It is structured for people to see through the inside that has the main objects - the music cards. The scanner on the top of this machine communicates with the Spotify API. Buttons and scanners follow a minimalist design approach so that the functionalities around scanning barcodes and operating the machine would be simple for users to understand and creates an effortless workflow.

RELATED WORK

1. Fascinating Vintage 20 Cassette Carousel from 1972 : Panasonic RS-296US

<https://www.youtube.com/watch?v=RJo13FP4UpI&t=96s>

This cassette carousel gives the general inspiration for our music inventory machine in terms of the logic behind the rotator mechanism. Instead of cassettes, we want to use NFC cards instead which connect to the barcode technology that is seen commonly in our current daily life.

2. How to use Spotify API on ESP32 with NFC Reader to control Echo Dot

<https://www.youtube.com/watch?v=RMtRH-3sTR4>

The link above is an example of how to use an arduino kit and nfc readers to play music using the spotify API. Our machine will use similar technology to play the music, but also hopefully use the NFC reader to help store the information of the card location within the machine.

3. The CyrosBox

<https://create.arduino.cc/projecthub/cyros/the-cyrosbox-3147ed>

Similar to above, but this machine uses RFID and a raspberry pi. A useful thing to learn from the work is whether it would be better to use RFID or NFC for the cards.

4. Juuke is an Arduino-powered RFID music player for the elderly

<https://blog.arduino.cc/2020/08/01/juuke-is-an-arduino-powered-rfid-music-player-for-the-elderly/>

This work used RFID like the previous, but an interesting feature this work has is a volume button, something we hadn't considered but should perhaps consider for the interface depending on implementation difficulty.

5. Arduino RFID Simulating Simple Access Control System

<https://create.arduino.cc/projecthub/KABAKA/arduino-rfid-simulating-simple-access-control-system-798927>

This system builds a connection between audio signaling and RFID as well as a digital screen to show the status of the machine. It gives us a great reference on building simulations between an RFID scanner and digital output. Although we might not want to necessarily include an interactive screen, we do want to build a machine that has bigger capacity in terms of the number of NFC cards compared to this work.

6. Graphic LCD 84x48 - Nokia 5110

<https://www.sparkfun.com/products/10168>

This is a dot matrix display without backlight, like the old school Nokia phone screen, low refresh rate, complex wiring, could be useful to display play status and time seek bar or menu items.

7. SparkFun Qwiic OLED Display (0.91 in, 128x32)

<https://www.sparkfun.com/products/17153>

An OLED display with awesome backlight but limited tiny size, could be useful to display barcode information.

8. SparkFun 20x4 SerLCD - RGB Backlight (Qwiic)

<https://www.sparkfun.com/products/16398>

The most easy one LCD with normal backlight, 20x4 dot matrix display uses I2C communication, very suitable for displaying songs' ID3 tag information.

9. Arduino MIDI Stepper Synth

https://create.arduino.cc/projecthub/JonJonKayne/arduino-midi-stepper-synth-d291ae?ref=tag&ref_id=music&offset=6

I really like the musical aspect of this example. As opposed to ours that uses a rotator to display and provide storage of music, it uses parts that rotate to visually illustrate the rhythm of the music. However, our machine does a better job in terms of constructing a complete structure in terms of functionality and aesthetics.

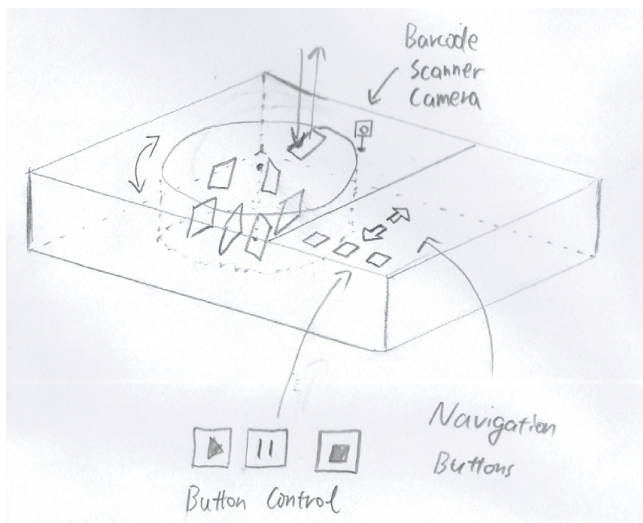
10. Smart Rack Inventory System with RFID and Arduino

<https://www.youtube.com/watch?v=2GclXDMdZng>

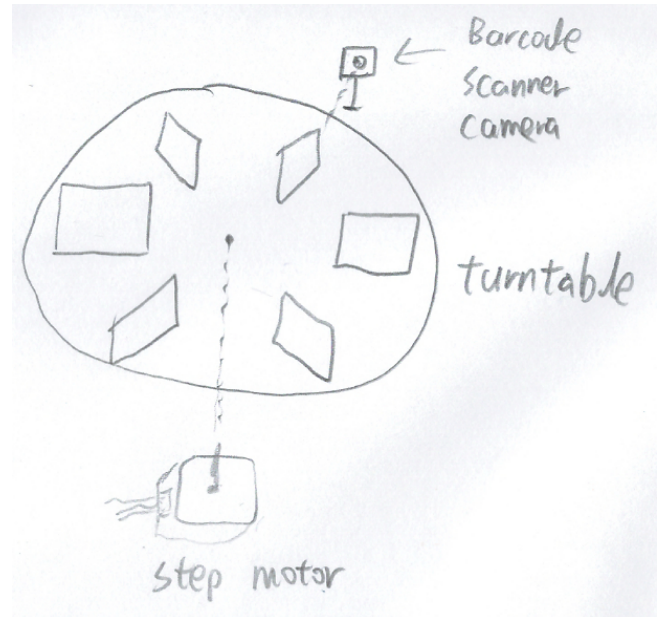
This work nicely demonstrates how to build the connection between RFID and Arduino. What we want to improve upon would be to hide the wires that are used as much as possible so that the risk of the machine being interrupted in the process of running would be lower.

INITIAL DESIGN

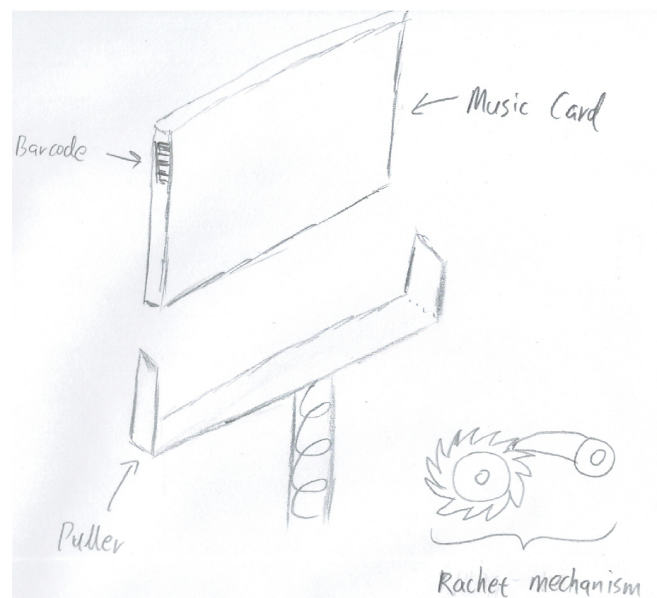
Below is the main machine box, a turntable inside on the left, maintaining a series music card, there is an open notch at the top to let the music card insert/eject. Right side there are four buttons, the bottom three buttons control play/pause/stop, two arrow buttons are used for music card selection.



Here are the details of the turntable, a barcode scanner camera fixed inside the machine, every new music card insert or eject an existing music card, the camera will scan the barcode on the music card and pass this information to the controller, in case for tracking a list of songs. A stepper motor is used to make this round table turn.



Below is the mechanism part for the music card puller/locker. The U-shape arm can grab or pop up a music card.



Feature Sketch

The initial sketch of this machine is a rectangular box from the outside, containing several music cards inside, the user can insert a music card to an empty slot, then use navigation buttons on the right side to pick one of the cards to play.

Music card storage will be on a turntable that is inside the machine, every slot has a puller with a spring inside, we plan to use a spring-ratchet mechanism to lock/eject music cards on the turntable.

For each music card, there is a barcode on the side, when a new music card has been inserted, the internal camera inside the machine will scan the barcode and read the song's information, remember the position of the turntable, and store this information into the onboard memory.

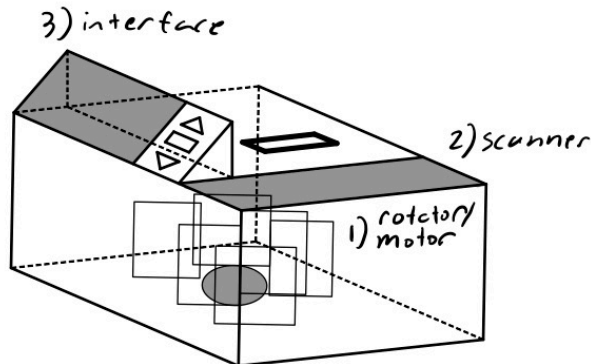
Priority Ranking

Basic implementation: Turntable rotation using stepper motor, outside box, puller/eject mechanism, barcode camera.

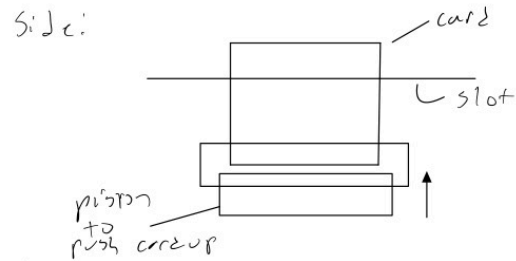
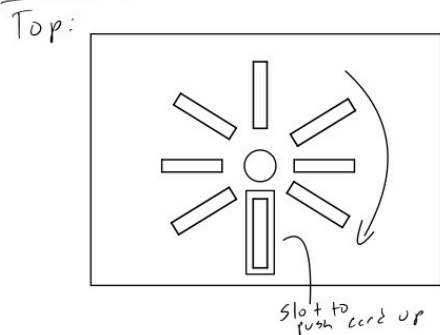
Optional: Use RFID instead of camera (since camera is sensitive to lights), a display shows currently playing information.

DESIGN ITERATION

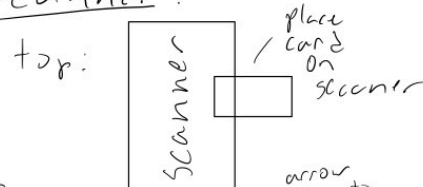
The final design iteration has a sketch of the complete machine, top and side views of the storage system, top view of the scanner, and a view of the user interface.



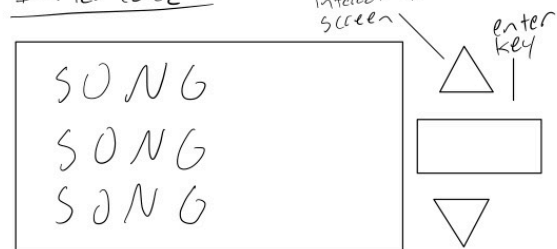
Motor / Rotator



Scanner:



Interface:



Feature Description

Overview: The machine will have three distinct parts; the rotator/motor/storage, user-storage interface, and the music player/scanner.

For the storage system, cards will be stored in a circle pattern, as seen from the top view in the motor/rotator sketch. The motor will move depending on where the card the user requested is. The card storage structures will have little pistons to push the card up through the top of the box so the user can retrieve it, as depicted by the side view of the motor/rotator.

For the interface, there will be a simple screen which will display song names with physical buttons next to it, to scroll up or down, and to select the song, as the interface sketch shows..

For the scanner, there will be an NFC scanner which interacts with the Spotify API to play music, as indicated by the scanner top view..

Priority Ranking

Basic implementation: scanning (RFID), turntable rotation and grabbing/popping music cards out, container for music cards

Optional: Interactive physical screen or dot matrix screen.