Music NFC Box

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EN v1.0 using LaTeX

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1 Introduction

The project, called Music NFC-Box, takes inspiration from turntables and recreates some of their features in an original way.
The Music NFC-Box allows you to play a music album by scanning a specially coded NFC card that represents the album displayed in the printed image.

For its creation, some Logitech speakers were recycled, the Z150 model, composed of 2 drivers 2 inches each, a 3W RMS x2 audio amplification circuit with 2 audio inputs and a 5V DC power supply, perfect for an Arduino controller which I will talk about on the next page.

- Logitech Z150 speakers (before)

- Prototype Music NFC-Box and NFC cards (v1.0)

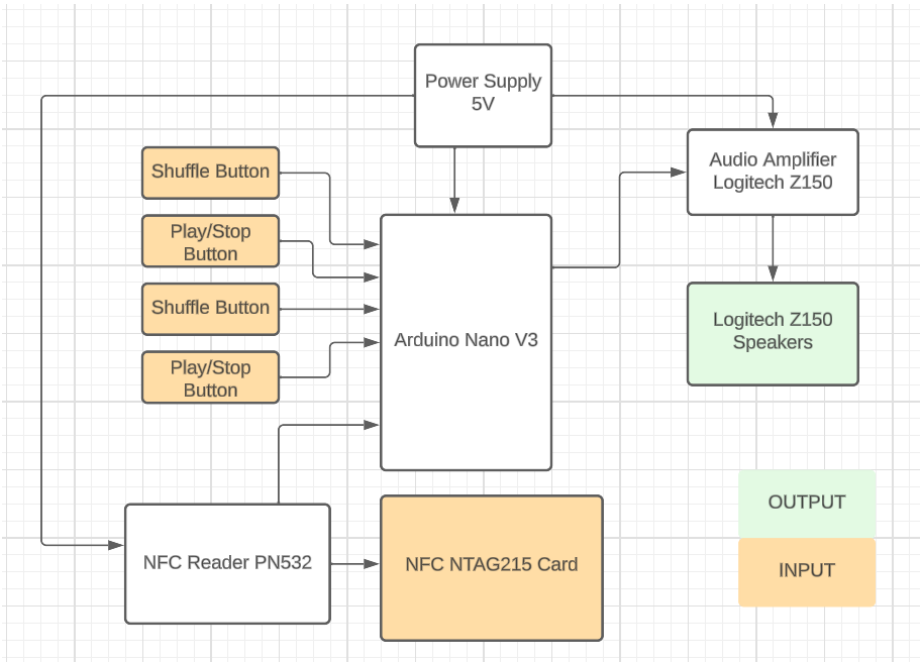
2 Prototype

The first step to create a good product is certainly a prototyping phase consisting of definition and design, testing of the main functions and creation of the basic case/accommodation.

The components used are the following:
- Arduino Nano V3
- PN532 NFC reader module from NXP
- NTAG215 NFC cards from NXP
- DFPlayer Mini MP3 module
- Logitech Z150 Audio amplifier 2.0 3W RMS e 2x 2" Audio drivers
- 2GB Micro SD
- 5VDC-800mA Power Supply

Arduino Nano will communicate with the various modules, NFC reader and MP3 module, and will analyze the reading of the NFC cards presented, verifying that the content is suitable for interaction with the system; if the content is actually suitable, Arduino will save the identification code of the album to be started and will communicate to the MP3 module to initialize the execution of the specified album.

Music albums are saved locally on a Micro SD Card of up to 32GB and are sorted into folders and songs in folders following a well-defined folder and file naming format: folders named with 2 digits filled with zeros (e.g. "01" album n°1) and files named with 3 digits filled with zeros (e.g. "002" song n°2).



- Conceptual scheme of the project

2.1 Project

Respecting the specifications of the datasheets, the communication between Arduino and the MP3 module takes place via UART at 9600 baud rate while between Arduino and the NFC reader module I2C is chosen at 115200 baud rate.

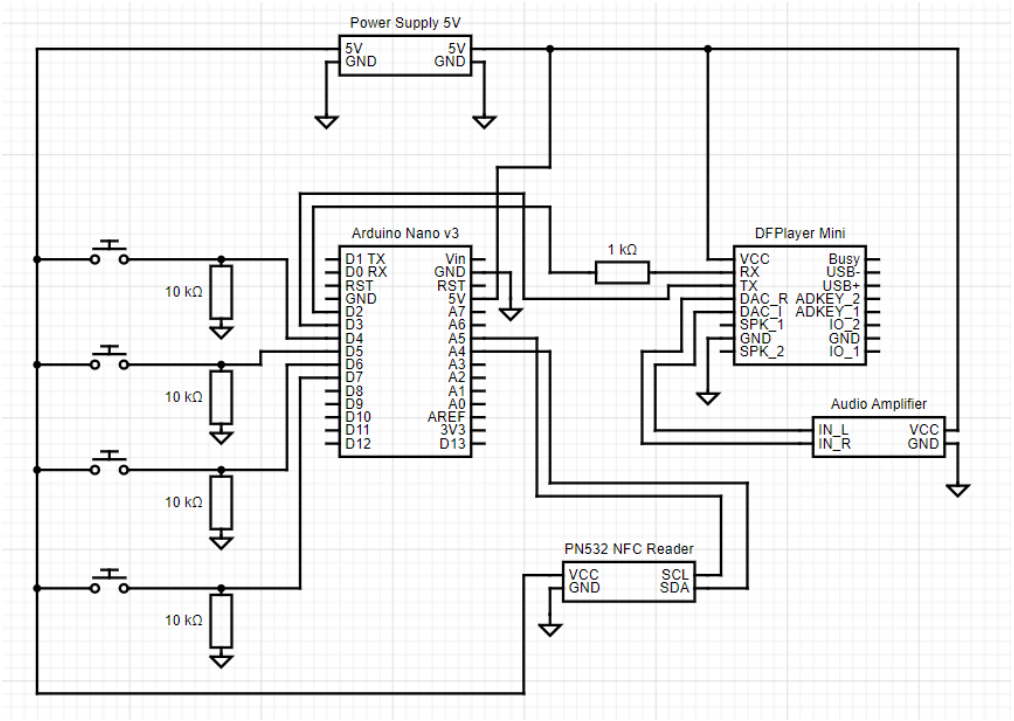
The buttons have the role of random playback, pause/play, next song and previous song and are connected with a pulldown resistor to pins D4-D5-D6-D7.
SDA and SCL of devices communicating in I2C protocol are connected to pins A4 and A5 and in this case we have the PN532 NFC reader module.

The DFPlayer Mini MP3 module is connected in serial software UART communication to pins D2-D3 and following the manufacturer's advice in the datasheets, insert a 1kOhm resistor in series between the TX of the Arduino and the RX of the module as the communication may not work without it.

4.1 Serial Communication Connect

Module's serial port is 3.3V TTL level, so the default interface level is 3.3V. If the MCU system is 5V. It is recommended connect a 1K resistor in series.

- DFPlayer Mini datasheet extract

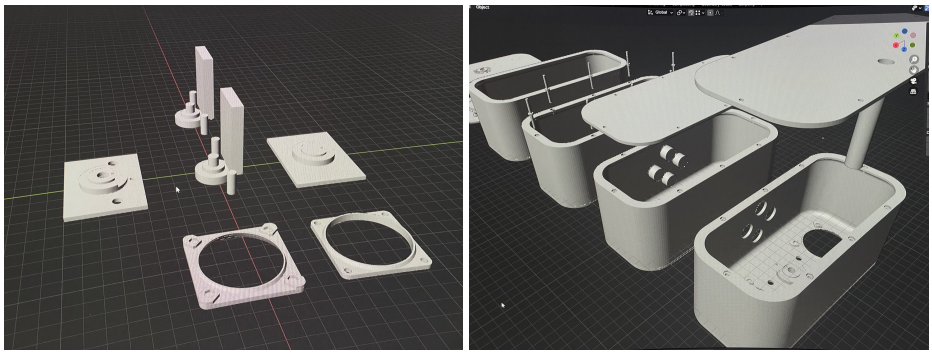


- Connection circuit diagram

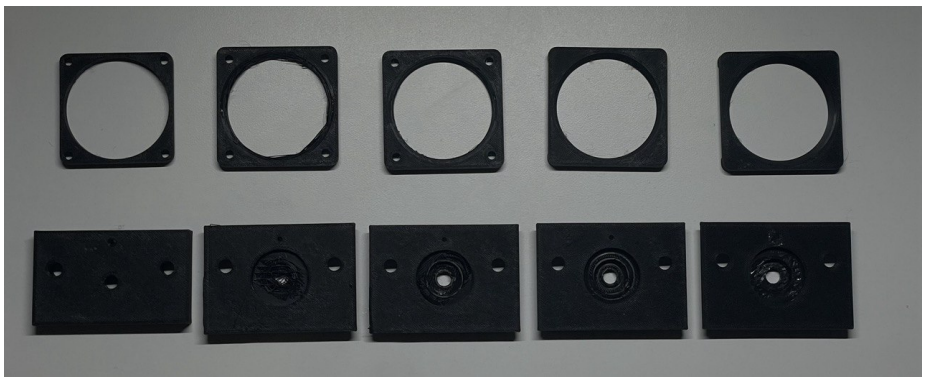
2.2 Enclosure

The housing of the circuitry, the audio drivers and the buttons will be printed in 3D creating a very accurate and precise case in detail: to achieve this you must initially measure the dimensions of each part and create a three-dimensional model using 3D drawing software such as in my case Blender3D.

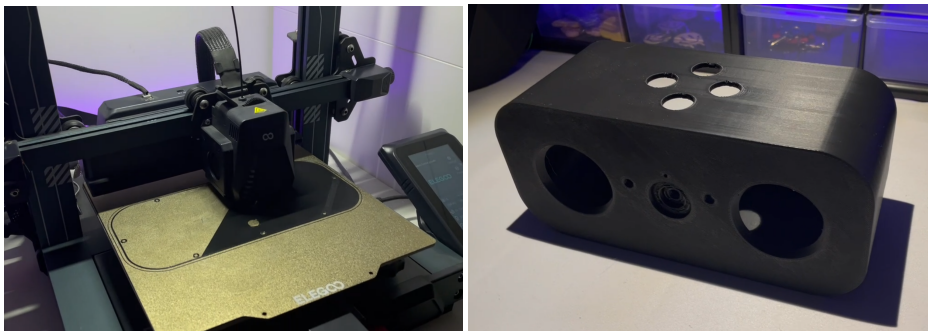
3D printing is well known for its fast prototyping characteristics compared to traditional techniques for creating plastic objects but to further reduce production times and waste it is decided to first print small pieces to check the correct housing and the correct measurement of the circuitry and audio drivers in order to easily correct possible errors and not make them on a 6/7 hour print which is the final case.



- 3D designs of the small test pieces (left) and the enclosure complete with back cover (right)



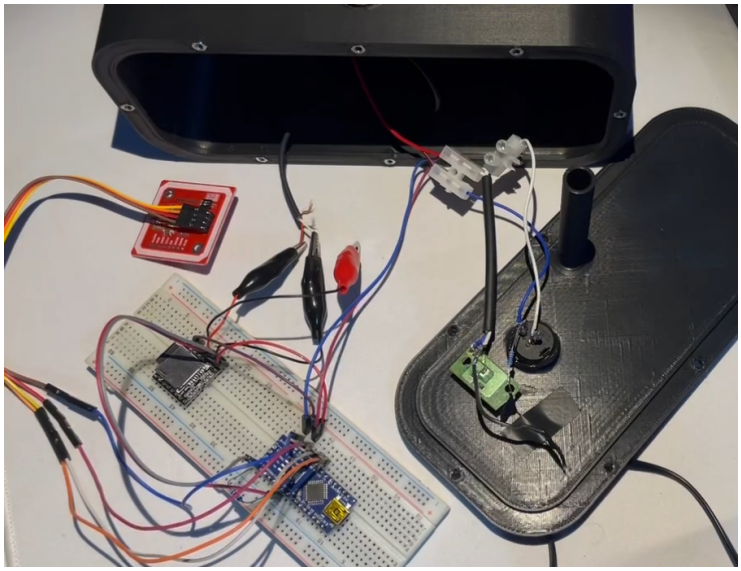
- Various test pieces



- Printing of the first complete prototype

2.3 Assembly

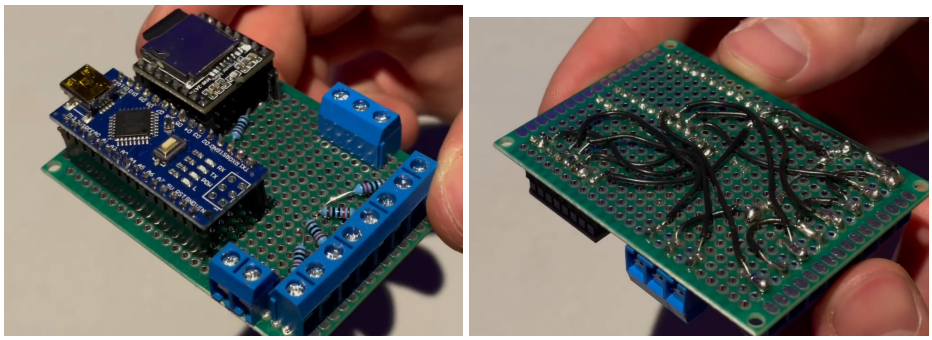
Once the case has been printed and checked that each cavity has correct dimensions, the audio drivers and the audio amplification circuit can be inserted and fixed inside.
The previously established circuit is assembled on a test platform, a breadboard, to start writing code for Arduino and finally join the various parts of the project.



- First complete test

The next step is to compress the circuitry on the test bench onto a significantly smaller base to insert everything inside the case.

It is therefore necessary to create an ad hoc circuit for this system with tin soldering using other components not mentioned before such as a millefora base, terminal blocks, copper cable; We opted to use pin connector headers so as not to solder the modules and Arduino permanently on the board and if it were necessary later to have the possibility of removing them from the board.



- Circuit soldered on the base on which the Arduino and DFPlayer are housed

Note that the audio amplification circuit is fixed to the front part of the speaker, the NFC reader module is screwed from the inside onto the right wall of the speaker, the Arduino and DFPlayer modules are fixed on the electronic board created specifically and placed on the back of the speaker a simple activation button with the socket for the 5VDC power cable.
After having connected and inserted the main board inside, all that remains is to close the case and check the functionality as a closed prototype.

2.4 Conclusions

As the first prototype it is perfect from the point of view of the functions planned at the beginning, the missing aspects to be reviewed soon concern the audio quality and the aesthetics but the result obtained with this attempt is decidedly satisfactory.