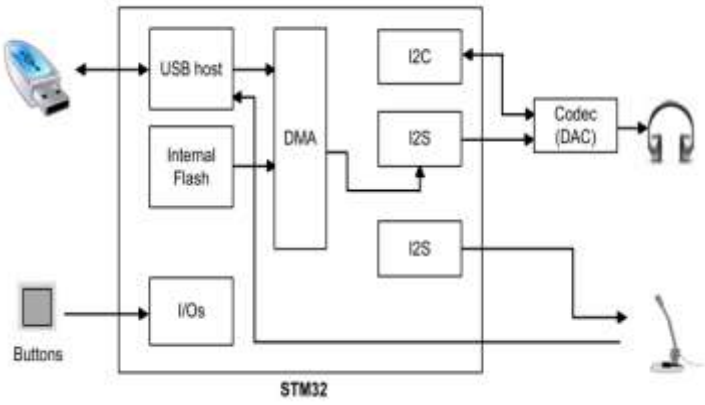
# Building a music player with stm32

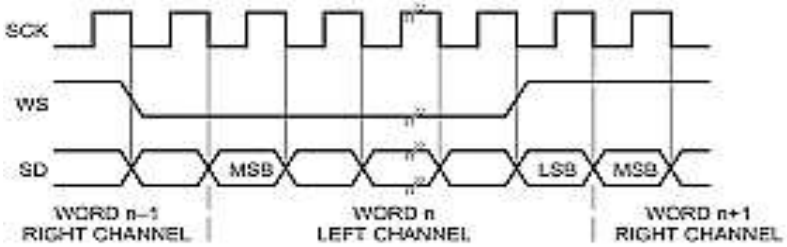
Step into the world of DIY electronics with our mini project – a nifty music player crafted around an STM32 microcontroller. This pocket-sized wonder reads songs from a USB flash drive and packs buttons for easy control. Play, pause, adjust volume, and navigate through songs effortlessly, all displayed on a snazzy LCD screen.

The music player, built around an STM32F407 microcontroller with USB OTG functionality, offers a user-friendly experience with features such as song selection from a connected USB flash drive, seamless play/pause/resume control, a reset function accessible through a prolonged button press, the option to repeat favorite tracks, convenient volume adjustment buttons, an instant mute/unmute capability, and a clear LCD display providing visual feedback on song details and volume levels.

**How does sound come out from the stm32 board ?**




The music player utilizes the I2S (Inter-IC Sound) protocol in conjunction with a Digital-to-Analog Converter (DAC) to deliver high-quality audio. The I2S protocol, known for its efficiency in transmitting digital audio data, facilitates a seamless communication




pathway between the microcontroller and the DAC. The DAC, in turn, converts the digital audio signals into analog signals, ensuring accurate and clear sound reproduction. This combination of I2S and DAC technologies forms the backbone of the music player's sound system, providing a reliable and efficient method for translating digital music data into audible melodies.


Enhancing the audio capabilities, the music player incorporates the CS43L22 chip, functioning as an audio codec. This chip plays a pivotal role in converting digital audio signals from the microcontroller, managed

through the I2S and I2C protocols, into high-quality analog signals for optimal sound output. The CS42L22 contributes to the overall audio fidelity of the music player, ensuring a rich and immersive auditory experience.

**Hardware Implementation:**

To build the music player project, you'll need an STM32 microcontroller board, USB OTG connector, SD card and the usb reader, CS43L22 audio codec chip, momentary push buttons, LCD display, wires, breadboard, resistors, power supply, a programming cable, and relevant documentation for each component.

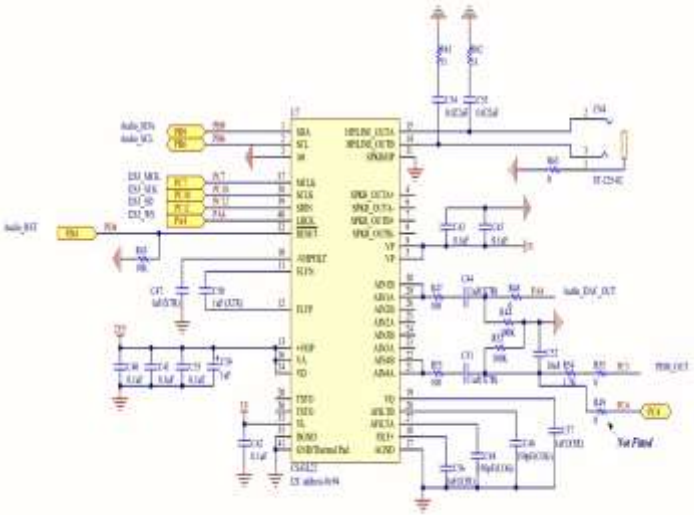
**Software implementation:**

For the microcontroller's configuration, you need stm32cubeid installed on your personal computer.

As far we have it, we need to activate many features:

- USB mass storage so we can be able to read music from the sd card reader.
- I2C for the audio codec.
- I2S for sending the audio data to the audio codec.

Also we need to activate some inputs and outputs for the buttons and lcd display.

Concerning I2S, it should be activated as a half-duplex master transmitter, with a frequency in a range between 20 KHz and 44 KHz.

The main important thing is we need to activate the PD4 pin which is responsible for the audio output (so the audio driver works properly).

Speaking about the code , the code works properly unless there are not these library included in :

AudioI2S.c : this library let the stm32 catch the music data including its frequency so it can be carried to the audio codec through the I2S protocol.

This library gives us the ability to mute, unmute and adjust sound's volume

CS43L22.c: this library is responsible for the analog signal output, without it, it's unable to hear the sound of music.

Waveplayer.c : it lets the user to control the music , including it in the project let us pause , resume and change the song that we want to listen to.

**Some Optimizations:**

To get more performances,

We got to activate DMA (direct memory access) so we optimize the CPU's performances thus we get fast transaction of data to the other components of the stm32 board.

Some difficulties?

One of the difficulties we faced while building the project is the adjustment of the microcontroller's clock , we had to try many times to make it function correctly.

For the first time, we tried to read the music from the sd card reader module; unfortunately, we got bad results: the sound was very slow, and noisy (the used protocol was SPI).

We also had other issues like button debouncing issues , I2S configuration , audio file's extension ( the microcontroller only accept audio files in a wav format.)

**Conclusion :**

In conclusion, the creation of this feature-rich music player, orchestrated around an STM32 microcontroller, USB OTG, and the CS42L22 audio codec, embodies the convergence of hardware and software innovation. With a harmonious blend of user-friendly controls, seamless playback functionalities, and enhanced audio processing, this project not only provides an immersive musical experience but also serves as a testament to the creativity and technical prowess that can be achieved in the realm of embedded systems.