TRƯỜNG ĐẠI HỌC BÁCH KHOA HÀ NỘI

Embedded System Report

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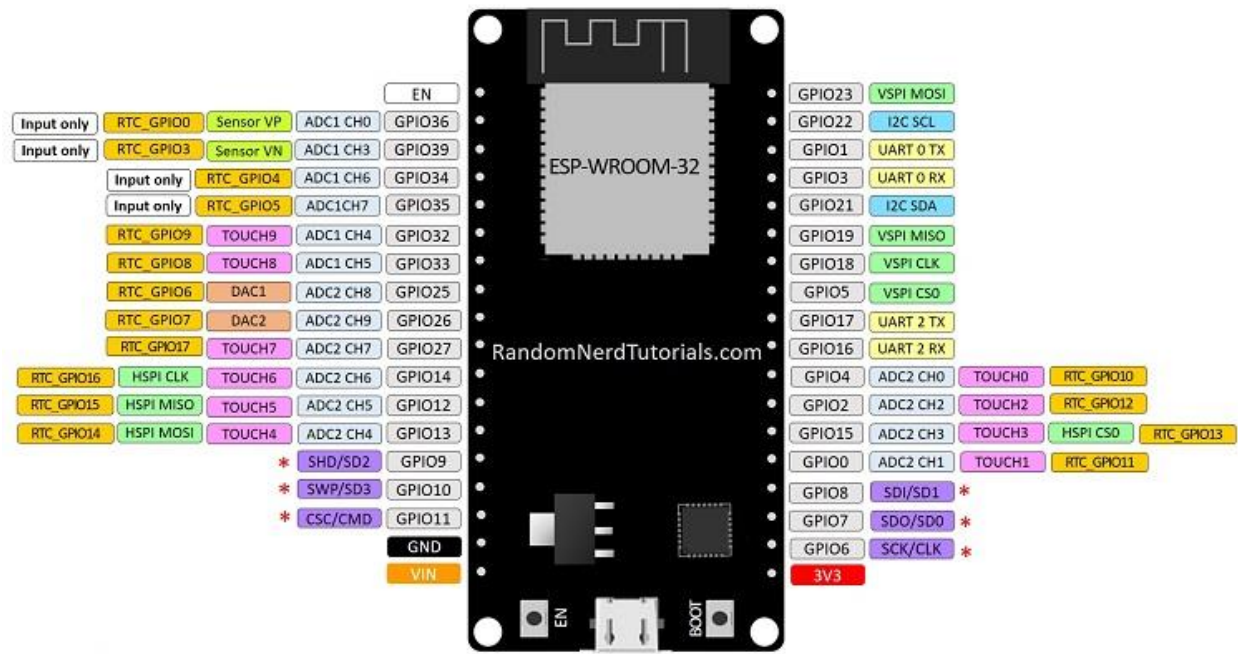
Hà Nội, 07-2024

1 COMPONENTS

- **ESP32 DEV Module:**
  The ESP32 Dev Module is a powerful and versatile microcontroller platform developed by Espressif Systems. It's designed for a wide range of applications due to its high performance, low power consumption, and integrated wireless capabilities.


ESP32 DEVKIT V1 – DOIT
version with 36 GPIOs

* Pins SCK/CLK, SDO/SD0, SDI/SD1, SHD/SD2, SWP/SD3 and SCS/CMD, namely, GPIO6 to GPIO11 are connected to the integrated SPI flash integrated on ESP-WROOM-32 and are not recommended for other uses.

- **DFPlayer Mini:**
  The DFPlayer Mini is a compact and low-cost MP3 player module designed for integration with microcontroller-based projects. It is widely used in applications where audio playback is required due to its simplicity, ease of use, and versatile features.
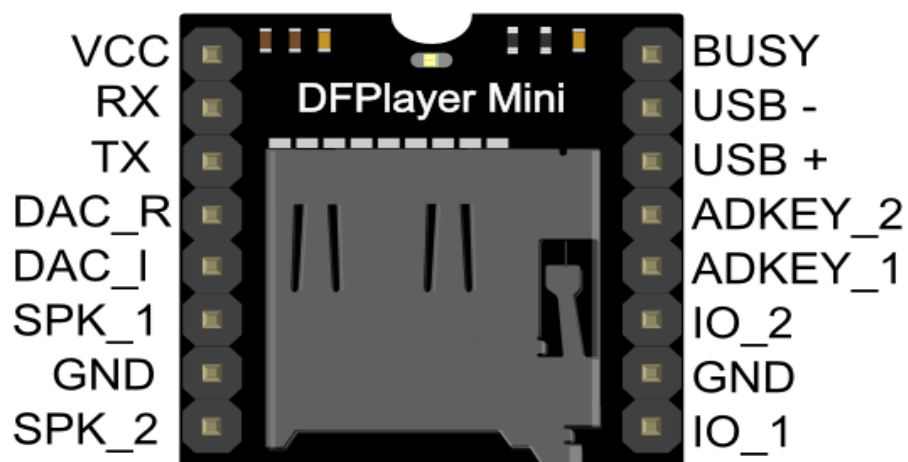
Pin	Description	Note
VCC	Input Voltage	DC3.2~5.0V;Type: DC4.2V
RX	UART serial input	
TX	UART serial output	
DAC_R	Audio output right channel	Drive earphone and amplifier
DAC_L	Audio output left channel	Drive earphone and amplifier
SPK2	Speaker-	Drive speaker less than 3W
GND	Ground	Power GND
SPK1	Speaker+	Drive speaker less than 3W
IO1	Trigger port 1	Short press to play previous（long press to decrease volume）
GND	Ground	Power GND
IO2	Trigger port 2	Short press to play next（long press to increase volume）
ADKEY1	AD Port 1	Trigger play first segment
ADKEY2	AD Port 2	Trigger play fifth segment
USB+	USB+ DP	USB Port
USB-	USB- DM	USB Port
BUSY	Playing Status	Low means playing \High means no

- **TFT Shield ST7735 128x128 1.44":**
The TFT Shield ST7735 128x128 1.44" is a small, colorful display module commonly used in embedded systems and microcontroller projects. It features a 1.44-inch TFT LCD with a resolution of 128x128 pixels and is controlled by the ST7735 driver. This module is ideal for projects that require graphical displays, such as showing sensor data, user interfaces, or small animations.
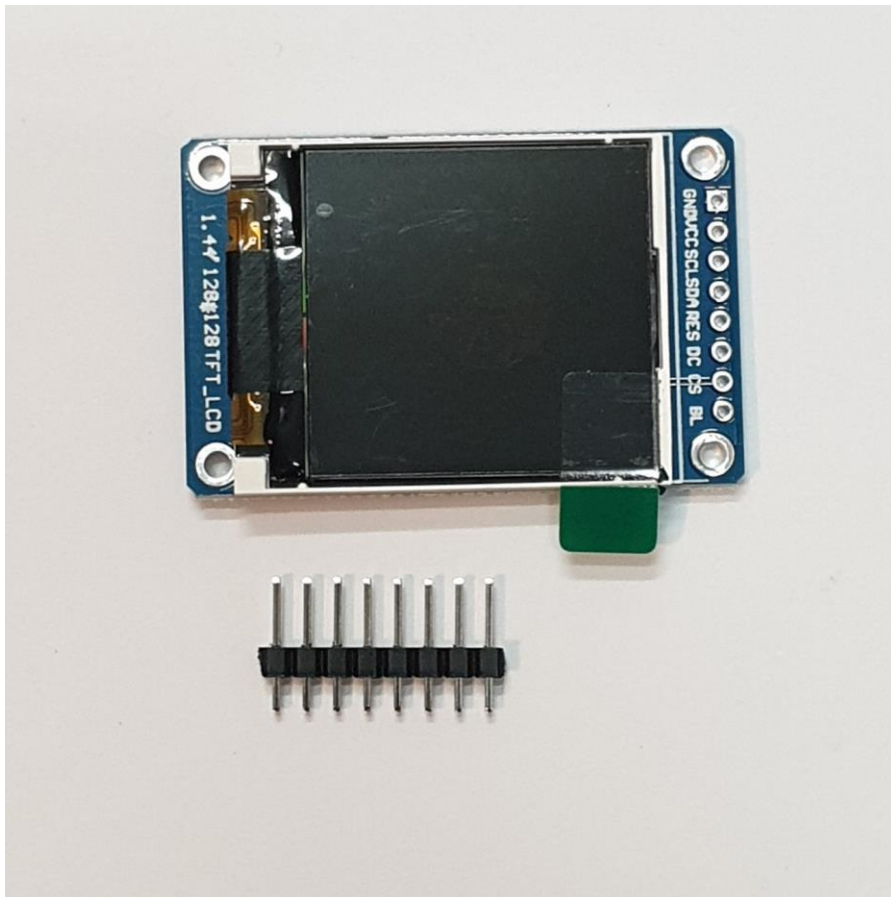
To control a TFT shield with SPI, you'll need a microcontroller (like an Arduino) and a library that supports the specific TFT shield you are using.

Steps to Control TFT Shield with SPI:
Connect the TFT Shield to the Microcontroller:

Typically, the TFT shield is designed to plug directly onto the microcontroller board. Ensure the SPI pins (MISO, SCK, CS) of the TFT shield are connected to the corresponding pins on the microcontroller.

Install Necessary Libraries:
Libaries required: Adafruit BusIO, Adafruit GFX, Adafruit ST7735 and ST7789.
You can install these libraries through the Arduino Library Manager.

- **PAM8403 Class D:**
The PAM8403 is a low-power, high-efficiency Class D audio amplifier IC capable of delivering 3 watts of output power per channel into a 4-ohm load. It is commonly used in portable and battery-powered audio applications due to its small size and low power consumption.
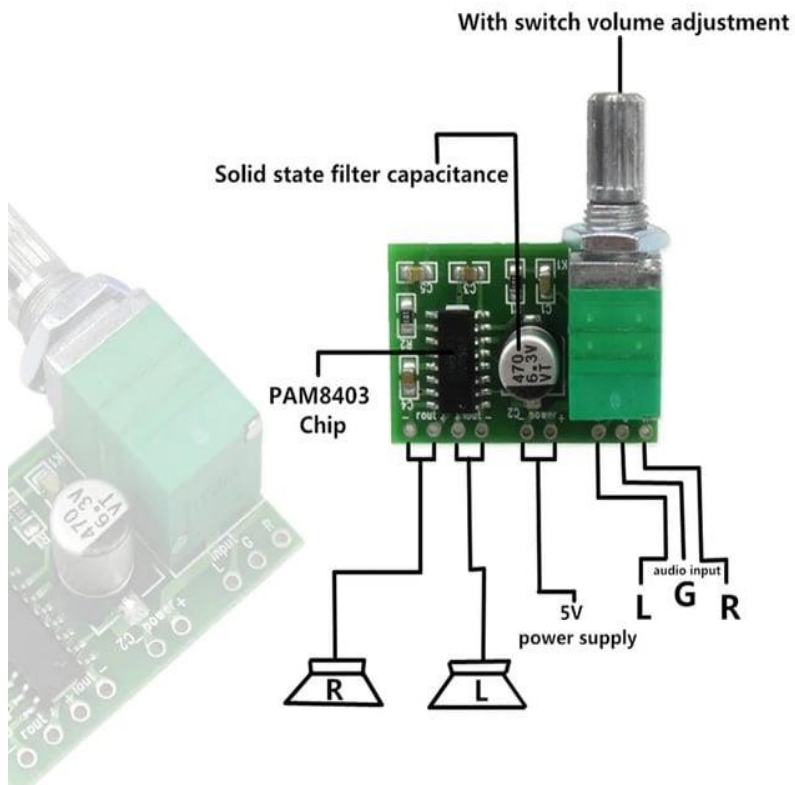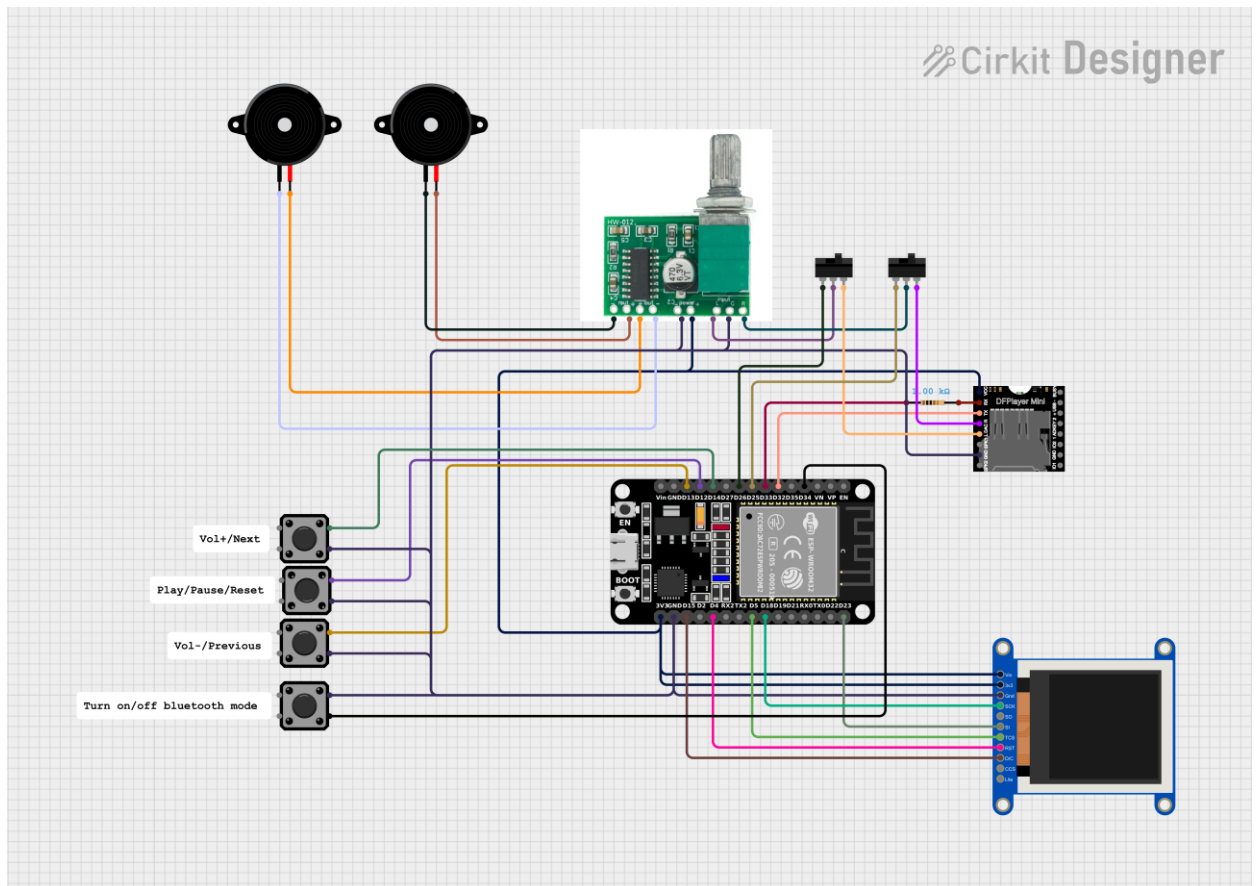
2 FUNCTIONS

- Read data from SD card.
- Broadcast audio and stereo sound.
- Increase and decrease volume.
- Use button to change playing song.
- Display status and volume of the song, update the index of the song that is playing.
- Press and hold the middle button will reset the player.

3 DETAILED DESIGN AND OPERATION
a. Hardware design.

- **ESP32:** Receive commands from button and serial to control DF Player and control the screen via SPI. Connect to Bluetooth devices and play audio through the internal DAC pins 25 and 26 using the ESP32-A2DP library by Phil Schatzmann.
- **PAM4103:** amplify sound signal generated, convert left and right analog signal to be source of the 2 speakers, additionally control the volume with a potentio meter.
- **Speaker:** generate sound.
- **DFPlayer Mini:** uses DFRobot library to control DFPlayer Mini, Pin RX is the serial pin that is used to receive data, Pin TX is used to send data to ESP32. DAC_R and DAC_L send analog signals to PAM4103, which then is used to produce stereo audio.
- **Button**: control the DFPlayer Mini and the device
- **TFT Shield ST7735:** uses SPI protocol to display information of the song playing.
- Switch: to change between the audio output from the DFPlayer and Bluetooth.

b. The system's operation:

- SD card player:
- This system can display current volume, track number, and total number of tracks.
- Update the Play/Pause symbol, and blink Next/Previous symbol according to the user's action.
- 4 button control:
  1. Bluetooth control button: enable other buttons to either control the SD player or the Bluetooth source. Hold to disconnect from Bluetooth.
  2. Volume down button: click to lower volume, double click to go to the previous track, hold to continuously lower volume.
  3. Play button: click to play or pause a song, hold to reset the DFPlayer Mini.
  4. Volume up button: click to raise volume, double click to go to the next track, hold to continuously raise volume.

- Bluetooth audio player:
- This receiver system can use buttons to control the audio playing on the source device.
- Display song name and author of the current song on the LCD display.
- 4 button control:
  1. Bluetooth control button: enable other buttons to either control the SD player or the Bluetooth source. Hold to disconnect from Bluetooth.
  2. Volume down button: click to lower volume, double click to go to the previous track, hold to continuously lower volume.
  3. Play button: click to play or pause a song.
  4. Volume up button: click to raise volume, double click to go to the next track, hold to

continuously raise volume.

4 SPECIFIC TASK ASSIGNMENT

Tùng: prepare hardware, design hardware architectures, software design and refining.
Hiếu: software design and prepare report.

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