Pong Game - Introduction to ESP32

A fun pong game for the TTGO T-Display with sound effects. Choose your sound module:

- **DFPlayer Mini** — full MP3 playback from SD card, one track per event
- **ISD1820** — simple record-and-play chip, one recorded sound triggered on paddle hit or score lost

readme-banner.jpg

The board

esp-pong.jpg

What You'll Learn

https://www.youtube.com/embed/jyTEXo0oIZs

- How to upload code to an ESP32
- How to wire a sound module (DFPlayer Mini or ISD1820) and trigger it from code
- How software controls hardware through GPIO pins
- Serial communication between devices (DFPlayer)
- How edge-triggered signals work (ISD1820)

What You Need

Hardware

- **TTGO T-Display** (ESP32 with built-in screen)
- **USB-C cable** to connect to your computer
- **Small speaker** (3W 8ohm recommended)
- **Jumper wires** to connect things

Choose one sound module:

Module	Pros	Cons
DFPlayer Mini	Different sound per event, SD card holds many tracks	Needs SD card and MP3 files
ISD1820	No SD card needed, record your own voice/sound	Only one sound, no volume control

Software

- VS Code with PlatformIO extension
- Start your project with the demo code - https://github.com/impressto/tdisplay-pong

How to Play

Onboard Buttons

1. **Left Button (GPIO 0)** - Move paddle LEFT
2. **Right Button (GPIO 35)** - Move paddle RIGHT

External Buttons (Optional)

You can add your own buttons for a better gaming experience!

- **GPIO 25** - External button to move paddle LEFT
- **GPIO 13** - External button to move paddle RIGHT

Wiring external buttons:

```
Button leg 1 -----> GPIO pin (25 or 13)
Button leg 2 -----> GND
```

No resistor needed - the ESP32 has internal pull-up resistors!

Gameplay

- Hit the ball with your paddle to score points!

- The ball appears to **roll** as it moves - watch it spin!
- If you miss, you lose a point

Getting Started

Step 1: Upload the Code

1. Connect your T-Display to your computer with a USB cable
2. Open this folder in VS Code
3. Click the **PlatformIO: Upload** button (→ arrow at the bottom)
4. Wait for it to finish - the game will start automatically!

Step 2: Play the Game First!

Before wiring anything, play the game to understand when events happen:

- Ball bounces off walls
- Ball hits your paddle
- You score a point
- You miss the ball

Wiring Up Sound!

Pick **one** sound module and follow its wiring guide below. Then set the matching option in `config.h` .

Option A: DFPlayer Mini

The DFPlayer Mini plays MP3 files from a micro SD card. You can assign a different sound to each game event.

Wiring

```
T-Display          DFPlayer Mini
---------          -------------
GPIO 17 (TX) ----> RX  (through 1K resistor recommended)
```

```
GPIO 21 (RX) <---- TX
GPIO 22      <---- BUSY  (optional — detects when playing)
GND          ----> GND
5V           ----> VCC
                   SPK1 ----> Speaker (+)
                   SPK2 ----> Speaker (-)
```

Note: Use 5V for louder output. The 1K resistor on TX protects the DFPlayer's RX pin.

Setting Up Sound Files

1. Format a micro SD card as FAT32
2. Create a folder named `mp3` in the root
3. Name your sound files: `0001.mp3`, `0002.mp3`, `0003.mp3`, etc.
4. Insert the SD card into the DFPlayer

Recommended sound files:

File	Event
`0001.mp3`	Score milestone award (every 5 points by default)
`0002.mp3`	Paddle hit (regular)
`0003.mp3`	Score lost

Enable in config.h

```
#define DFPLAYER_ENABLED   1    // Enable DFPlayer
#define ISD1820_ENABLED    0    // Disable ISD1820
```

Option B: ISD1820 Voice Record Playback Module

The ISD1820 is the simplest way to add sound. It stores **one recorded sound** directly on the chip — no SD card, no MP3 files. Just record your voice or a sound effect by holding the REC button, and the ESP32 will trigger it during the game.

Recording Your Sound

1. Power the ISD1820 (3.3V or 5V)
2. **Hold the REC button** on the module and speak or make a sound into the microphone
3. **Release REC** when done — the sound is saved permanently, even without power
4. Press the PLAY button on the module to hear it back before wiring to the ESP32

Wiring

```
T-Display          ISD1820
---------          -------
GPIO 15      ----> P-E  (Play Edge-triggered)
GND          ----> GND
3.3V or 5V   ----> VCC
                   SP+  ----> Speaker (+)
                   SP-  ----> Speaker (-)
```

Important: Connect to the **P-E** pin (Play Edge), NOT the P-L pin. P-E plays the sound once when the pin goes HIGH, which is what we want.

Enable in config.h

```
#define DFPLAYER_ENABLED            0    // Disable DFPlayer
#define ISD1820_ENABLED             1    // Enable ISD1820
#define ISD1820_TRIGGER_PADDLE_HIT  1    // Play on paddle hit (1=yes, 0=no)
#define ISD1820_TRIGGER_SCORE_LOST  1    // Play on score lost (1=yes, 0=no)
```

No Sound Module?

That's fine too — just disable both in `config.h`:

```
#define DFPLAYER_ENABLED   0
#define ISD1820_ENABLED    0
```

The game runs perfectly without any sound hardware attached.

Game Events

Event	When Does It Trigger?	DFPlayer	ISD1820
Wall Bounce	Ball bounces off any wall	□	□
Paddle Hit	Ball hits your paddle	□ regular sound	□ (configurable)
Score Milestone	Score reaches a multiple of 5	□ award sound	□
Score Lost	You miss the ball	□	□ (configurable)

Customizing the Game

Open `src/config.h` to change settings:

```
// ---- DFPlayer ----
#define DFPLAYER_ENABLED   1     // 1 = enable, 0 = disable
#define DFPLAYER_TX_PIN    17
#define DFPLAYER_RX_PIN    21
#define DFPLAYER_VOLUME    10    // 0-30
#define TRACK_AWARD        1     // 0001.mp3 - plays at score milestones
#define TRACK_PADDLE_HIT   2     // 0002.mp3 - plays on regular paddle hit
#define TRACK_SCORE_LOST   3     // 0003.mp3 - plays on score lost
#define SCORE_MILESTONE_INTERVAL  5   // Award sound fires at 5, 10, 15, 20...

// ---- ISD1820 ----
#define ISD1820_ENABLED             0    // 1 = enable, 0 = disable
#define ISD1820_PLAY_PIN            15   // GPIO connected to P-E pin
#define ISD1820_TRIGGER_PADDLE_HIT  1    // 1 = trigger on paddle hit
#define ISD1820_TRIGGER_SCORE_LOST  1    // 1 = trigger on score lost
```

Other Fun Settings to Try

```
#define PADDLE_WIDTH     15    // Make paddle bigger = easier game
#define BALL_SPEED_START  3    // Higher number = slower ball
#define PADDLE_SPEED      2    // How fast paddle moves

// External button pins (set to -1 to disable)
#define EXT_BUTTON_DOWN  25    // External button - paddle left
#define EXT_BUTTON_UP    13    // External button - paddle right
```

Adding Your Own Event Code!

Want to customize what happens when game events occur? You can add your own custom code!

Where to Put Your Code

Open `src/events.cpp` - this is where all the event magic happens!

The file has 4 event functions you can modify:

```
void onWallBounce() {
  // This runs when the ball hits a wall
}

void onPaddleHit() {
  // This runs when you hit the ball
}

void onScoreGained() {
  // This runs when you score a point
}

void onScoreLost() {
  // This runs when you miss the ball
}
```

Project Files Overview

File	What's Inside
`src/main.cpp`	The game code (paddle, ball, score)
`src/config.h`	Settings you can change (pins, speeds, sizes)
`src/events.h`	List of event functions (don't change this)
`src/events.cpp`	**Your code goes here!** Event implementations

T-Display Pinout

Here are the GPIO pins used in this project:

Pin	Usage	Notes
0	Left button	Onboard button
13	External button	Default: External LEFT button
15	ISD1820 P-E	Trigger pin (when ISD1820 enabled)
17	DFPlayer TX	Serial TX to DFPlayer RX (when DFPlayer enabled)
21	DFPlayer RX	Serial RX from DFPlayer TX (when DFPlayer enabled)
22	DFPlayer BUSY	Optional: detect when DFPlayer is playing
25	External button	Default: External RIGHT button
26	Event pin	Ball wall bounce
27	Event pin	Ball paddle hit
32	Event pin	Score gained
33	Event pin	Score lost
35	Right button	Onboard button (input only)

Troubleshooting

No sound from DFPlayer

- Check wiring: TX to RX, RX to TX (they cross over!)
- Make sure the SD card is formatted as FAT32
- Verify sound files are in an `mp3` folder and named `0001.mp3`, `0002.mp3`, etc.
- Try a different speaker
- Check the DFPlayer is getting power (5V recommended for reliable operation)
- Open the Serial Monitor — the game prints `[DFPlayer] OK!` or a wiring error on startup

No sound from ISD1820

- Make sure you have recorded a sound first (hold REC button, speak, release)
- Check you are connected to the **P-E** pin, not P-L
- Test the sound by pressing the PLAY button on the module itself
- Check `ISD1820_ENABLED 1` is set in `config.h`
- Verify the GPIO pin number matches `ISD1820_PLAY_PIN` in `config.h`

Code won't upload

- Try pressing the RESET button on the T-Display
- Make sure the USB cable supports data (some only charge)
- Try a different USB port

Game runs but no sound

- Open the Serial Monitor — startup messages show which module is active and whether it initialised successfully

Want to Learn More?

- Change the ball to a different image! (Look at `kim-jong-un.h`)
- Add your own background image! (Look at `background.h`)
- Create new events for different game situations
- Adjust the ball rotation speed in `main.cpp` (`BALL_ROTATION_SPEED`)

Features

- □□ Custom ball sprite with rolling animation
- □□ Background image support
- □□ Onboard + external button control
- □□ DFPlayer Mini sound effects (multiple tracks, SD card)
- □□ ISD1820 voice module support (record your own sound, no SD card needed)
- □□ Increasing difficulty as you score

Have fun learning electronics! □□

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