Build Your Own Portable Gaming System

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If you have not already done so:

- Download the pre-requisites instructions and complete all downloads and installations
- http://prereqs.codemash.org/

Slide deck download (PDF):
https://github.com/DigiTorus86/Teensy-R4ge-Pro/tree/master/documents

Session Objectives

Load and run different emulators and games on the hardware.

Learn how to use the hardware peripherals in custom games and other programs.

Troubleshoot and resolve any lingering hardware issues.

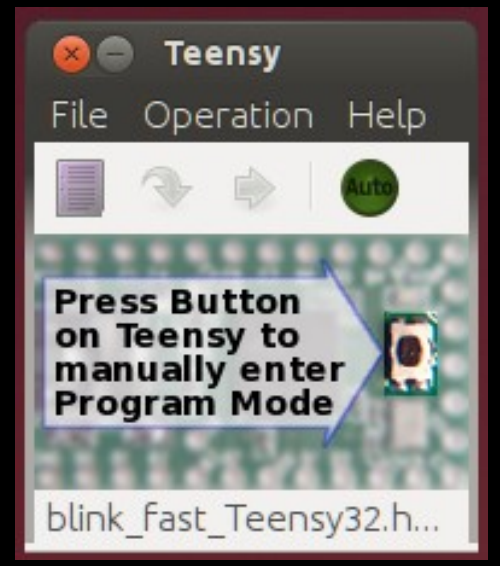
Pre-Requisites

- Working Teensy R4ge Pro with 8MB PSRAM installed
- VS Code with Platformio and Teensy platform
- Arduino IDE with Teensyduino
- Micro SD card formatted for FAT32
- Clone of https://github.com/Jean-MarcHarvengt/MCUME/
- Clone of https://github.com/DigiTorus86/Teensy-R4ge-Pro/

IDE Setup and Verification

Are you ready?

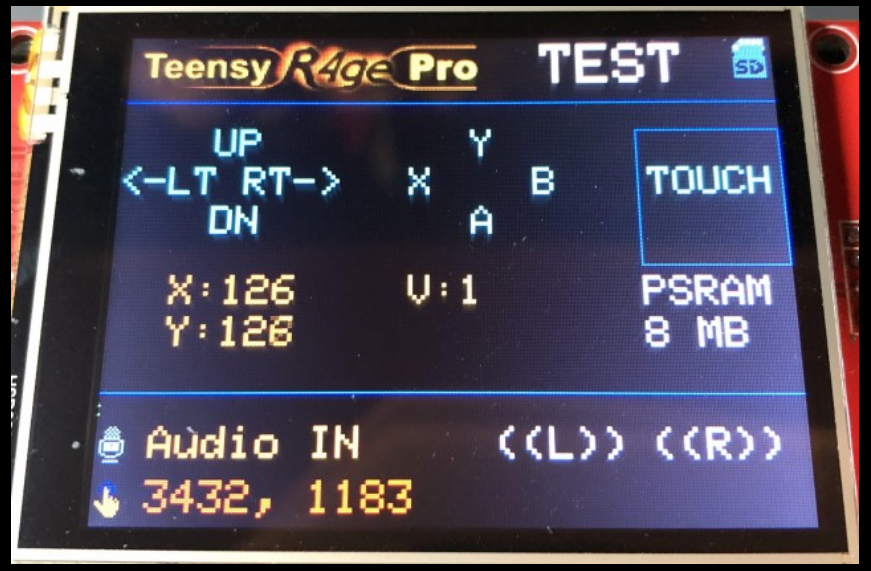
Arduino IDE



1. Ensure Teensy is connected to your laptop via USB
2. Launch the Arduino IDE
3. Open the teensy-r4ge-pro-test sketch
4. Under Tools → Board, select “Teensy4.1”
5. CPU Speed: “600 MHZ”
6. Select the Port that the Teensy is on (this will vary by system and OS)
7. Programmer: “AVR ISP” or “AVR ISP mkII”
8. Go to Sketch → Upload (or click the right arrow button)
9. Should compile and the Teensyduino app should launch

Verification

- Ensure that all peripherals are still working as expected. Use the instructions in the header comments if needed.
- Change line 155 to some other (family-friendly) short word.
- Re-upload and verify that the title text changed accordingly.
- The test app is a good resource for simple example code to use the hardware and peripherals.



Doom

What to do when all hell breaks loose

A Brief History

- Originally released in December 1993
- Source code released in 1997
- Many sequels and spin-offs

Prepare the SD Card

1. Create a local folder named “MCUME-SD”
2. Extract the sd.zip file to it.
3. Copy the DOOM1.WAD file to the data folder.
4. Copy the contents of MCUME-SD to the micro SD card root.
5. Insert the SD card into the Teensy.

Source and Settings

1. Copy the iopins.h and platform_config.h files from the Teensy-R4ge-Pro/MCUME/teensydoom/ to the MCUME/MCUME_teensy41/teensydoom/ folder.
2. In the ArduinoIDE, open the MCUME/MCUME_teensy41/teensydoom folder.
3. Under Tools → Optimize, select “Faster”
4. Upload the sketch to the Teensy.

Doom Modifications – iopins.h

```
#define TFT_CS         10
#define TFT_RST        255

#define PIN_JOY2_A1X   16
#define PIN_JOY2_A2Y   17
#define PIN_JOY2_BTN   25
#define PIN_KEY_USER1  2 // BTN A
#define PIN_KEY_USER2  3 // BTA B
#define PIN_KEY_USER3  4 // BTN X
#define PIN_KEY_USER4  5 // BTN Y
```

```
// Second joystick
#define PIN_JOY1_BTN    24  // Encoder button
#define PIN_JOY1_1      29  // UP
#define PIN_JOY1_2      30  // DOWN
#define PIN_JOY1_3      32  // RIGHT
#define PIN_JOY1_4      31  // LEFT
```

Doom Modifications - platform

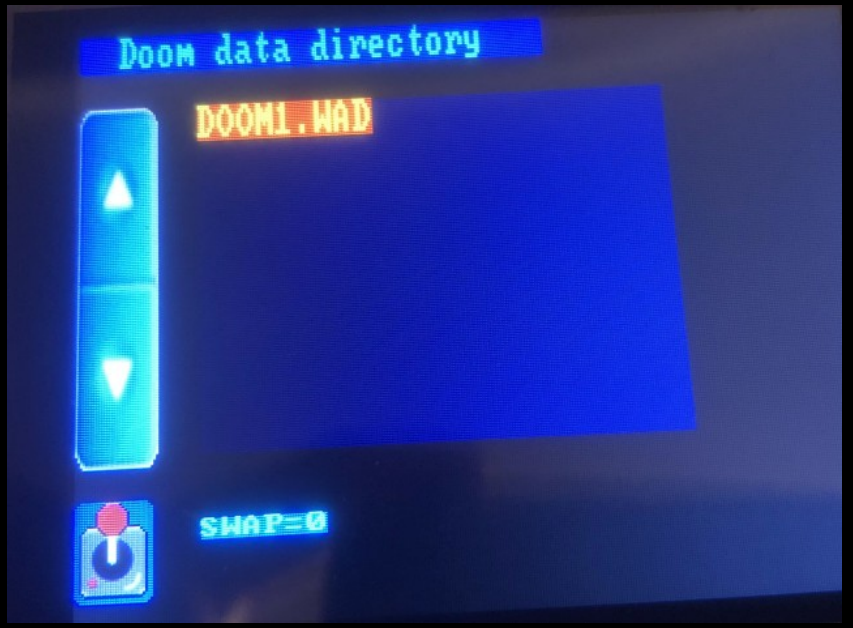
platform_config.h changes:

```
#define INVX        1
#define INVY        1
#define ILI9341     1
```

Running the Emulator

- Use the Up/Down buttons or joystick to change selection.
- Press rotary encoder button to select file.
- Press Y button to reset emulator.

If screen is blank, re-insert SD card and reboot hardware.



Playing Doom

- Change menu selection: Up/Down buttons or joystick
- Select menu, get item: A button
- Fire: Rotary encoder button
- Door/switch: B button

Unfortunately, no sound available.

Other Emulators

Running old systems on new hardware

General Instructions

- Download emulator game files.
- Extract to corresponding emulator folder on SD card.
- Copy the iopins.h and platform_config.h files from the Digitorus86/Teensy-R4ge-Pro/MCUME folder to the MCUME/MCUME_teensy41/ folder.
- Load the emulator into ArduinoIDE.
- Select the appropriate Tools->Optimize setting.
- Upload to the Teensy.

Castaway - Atari ST

1. Save .st game files to “st” folder on SD card.
2. Copy the iopins.h and platform_config.h files from the Teensy-R4ge-Pro/MCUME/teensycastaway41/ to the MCUME/MCUME_teensy41/teensycastaway41/ folder.
3. Load into ArduinoIDE and select “Smallest Code” option.

Castaway - Verified Games

- 1943 (with sound)
- 23 Games
  - Battlezone
  - Joust
- Arkanoid
- Caves of Rigel
- Crossbow
- Defender of the Crown
- Dragon Spirit
- Flying Shark
- Fusion
- Ivanhoe
- Karate King
- Slightly Magic
- Super Sprint
- Twin World

Ultimate Amiga Emulator

1. Save .ADF or .HDF files to “amiga” folder on SD card.
2. Copy the iopins.h and platform_config.h files from the Teensy-R4ge-Pro/MCUME/teensyuae41/ to the MCUME/MCUME_teensy41/teensyuae41/ folder.
3. Load into ArduinoIDE and select “Smallest Code” option.

UAE – Verified Games

- Battle Squadron
- Elite
- SturmTruppen
- Turrican
- Turrican 3

Nofrendo - NES

1. Save files to “nes” folder on SD card.
2. Copy the iopins.h and platform_config.h files from the Teensy-R4ge-Pro/MCUME/teensynofrendo/ to the MCUME/MCUME_teensy/teensynofrendo/ folder.
3. Load into ArduinoIDE and select “Faster” option.

Nofrendo – Verified Games

- Super Mario Brothers
- Tetris
- Donkey Kong
- Donkey Kong Jr.
- Elevator Action
- Galaga
- Faxanadu
- Ms. Pac Man
- Q*Bert
- Xevious

Custom Sketches

Creative DIY Hackery

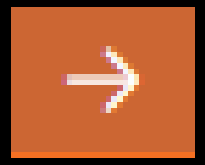
VS Code + PlatformIO

If you plan to do any custom development, VS Code + PlatformIO is **STRONGLY** recommended!

- Modern IDE
- Much better developer experience
- Excellent industry support

VS Code + PlatformIO

1. Launch VS Code.
2. File → Open folder:
   Teensy-R4ge-Pro/PlatformIO/teensy-r4ge-pro-test
3. Make sure the Teensy is connected.
4. Click the upload button in the
   bottom toolbar.

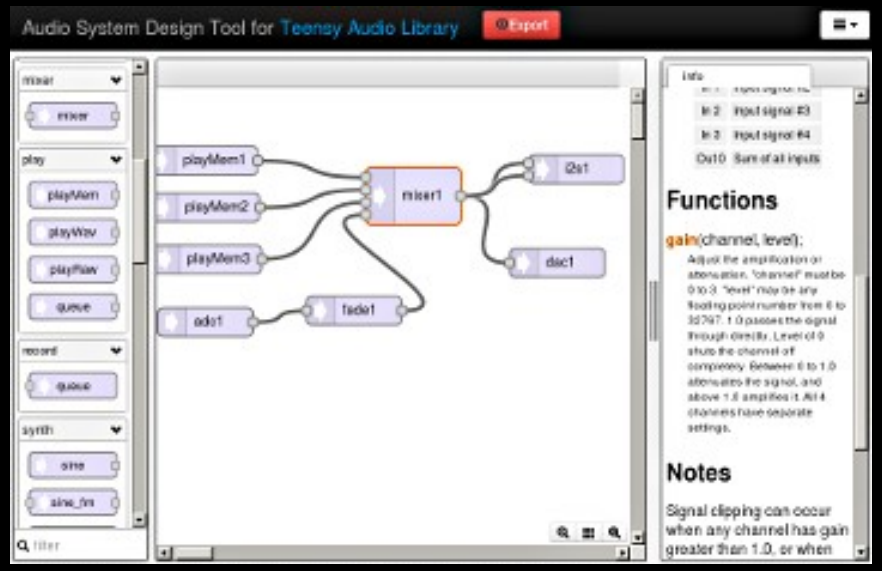


Teensy Audio

Teensy 4.1 is capable of sophisticated, high-quality audio generation, capture, and processing.

Online Audio Design GUI
https://www.pjrc.com/teensy/gui/

Imports and exports C code



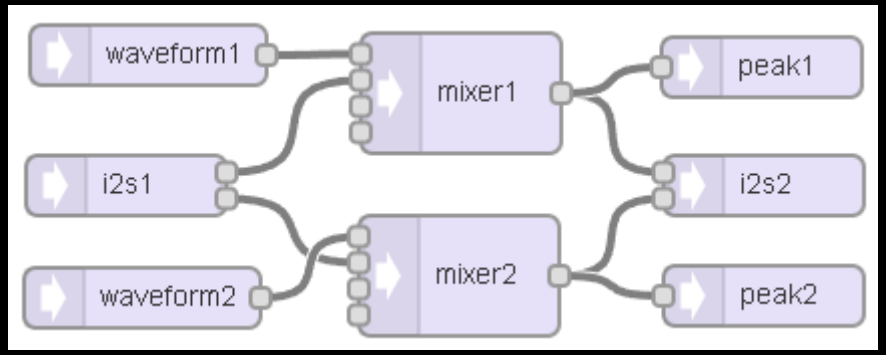
Teensy Audio Network

Basic Structure:

Source(s) → Effects/Filters/Mixers → Output

Teensy Audio - Import

1) Launch Teensy Audio GUI in browser:
   https://www.pjrc.com/teensy/gui/?info=AudioMixer4
2) Copy the code between the //GUItool comments
3) Click IMPORT on the Audio GUI and paste into the textbox



Teensy Graphics

- Use the Teensy-specific (xxx_t3) graphic libraries for most applications.
- Use the direct memory access (DMA) libraries for situations where fastest performance is required.
  https://github.com/KurtE/ILI9341_t3n
- Graphics performance limited by speed of SPI bus between Teensy and the display.

Teensy Graphics – Demo

- Load the sketch:
  Teensy-R4ge-Pro/PlatformIO/teensy-r4ge-pro-shooter-demo
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