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Getting Started

Introduction

The objective of this post is to explain how to upload an Arduino program to the ESP32-2432S028R module, from JCZN .

<http://www.jczn1688.com/filedownload/534855>

The ESP32 WiFi and Bluetooth chip is the latest generation of Espressif products. It has a dual-core 32-bit MCU, which integrates WiFi HT40 and Bluetooth/BLE 4.2 technology inside.

ESP wroom 32 has a significant performance improvement. It is equipped with a high-performance dual-core Tensilica LX6 MCU. One core handles high speed connection and the other for standalone application development. The dual-core MCU has a 240 MHz frequency and a computing power of 600 DMIPS.

In addition, it supports Wi-Fi HT40, Classic Bluetooth/BLE 4.2, and more GPIO resources.

Installing using Arduino IDE

Programming the ESP32

An easy way to get started is by using the familiar Arduino IDE. While this is not necessarily the best environment for working with the ESP32, it has the advantage of being a familiar application, so the learning curve is flattened.

We will be using the Arduino IDE for our experiments.

1, Installing using Arduino IDE

we first need to install version 1.8.19 of the Arduino IDE (or greater),for example, the Arduino installation was in “C/Programs(x86)/Arduino”.

download release link:

<https://downloads.arduino.cc/arduino-1.8.19-windows.exe>

2, This is the way to install Arduino-ESP32 directly from the Arduino IDE.

Add Boards Manager Entry

Here is what you need to do to install the ESP32 boards into the Arduino IDE:

- (1) Open the Arduino IDE.

```
3_4_TFT_Rainbow | Arduino 1.8.19
File Edit Sketch Tools Help
3_4_TFT_Rainbow §

/*
An example showing rainbow colours on a 1.8" TFT LCD screen
and to show a basic example of font use.

Make sure all the display driver and pin connections are correct by
editing the User_Setup.h file in the TFT_eSPI library folder.

Note that yield() or delay(0) must be called in long duration for/while
loops to stop the ESP8266 watchdog triggering.

#####
##### DON'T FORGET TO UPDATE THE User_Setup.h FILE IN THE LIBRARY #####
#####

#include <TFT_eSPI.h> // Graphics and font library for ST7735 driver chip
#include <SPI.h>

TFT_eSPI tft = TFT_eSPI(); // Invoke library, pins defined in User_Setup.h

unsigned long targetTime = 0;
<

Invalid library found in C:\Users\zhang'pei\Documents\Arduino\libraries\Touch_test: no headers files (.h) found in C:\U
Invalid library found in C:\Users\zhang'pei\Documents\Arduino\libraries\Touch_test: no headers files (.h) found in C:\U

ESP32 Dev Module, Disabled, Default 4MB with spiffs (1.2MB APP/1.5MB SPIFFS), 240MHz (WiFi/BT), DIO, 80MHz, 4MB (32Mb), 921600, Core 1, Core 1, None on COM6
```

- (2) Click on the File menu on the top menu bar.
- (3) Click on the Preferences menu item. This will open a Preferences dialog box.

The screenshot shows the Arduino IDE interface with the title bar "3_4_TFT_Rainbow | Arduino 1.8.19". The menu bar includes File, Edit, Sketch, Tools, and Help. A context menu is open over some code, with options like New, Open..., Open Recent, Sketchbook, Examples, Close, Save, Save As..., Page Setup, Print, Preferences (which is highlighted in blue), and Quit. The main code area contains several lines of C++ code related to TFT display operations. At the bottom of the code area, there are two error messages: "Invalid library found in C:\Users\zhang'pei\Documents\Arduino\libraries\Touch_test: no headers files (.h) found in C:\U" repeated twice. The status bar at the bottom right indicates "ESP32 Dev Module, Disabled, Default 4MB with spiffs (1.2MB APP/1.5MB SPIFFS), 240MHz (WiFi/BT), DIO, 80MHz, 4MB (32Mb), 921600, Core 1, Core 1, None on COM6".

```
reen << 5 | blue;
font still works as before
JK);
suit font!");

do not use the .setCursor call, coords are embedded
CK, TFT_BLACK); // Do not plot the background colour

// Overlay the black text on top of the rainbow plot (the advantage of not drawing the backgorund colour!)
tft.drawString("Font size 2", 80, 14, 2); // Draw text centre at position 80, 12 using font 2

//tft.drawString("Font size 2",81,12,2); // Draw text centre at position 80, 12 using font 2

tft.drawString("Font size 4", 80, 30, 4); // Draw text centre at position 80, 24 using font 4

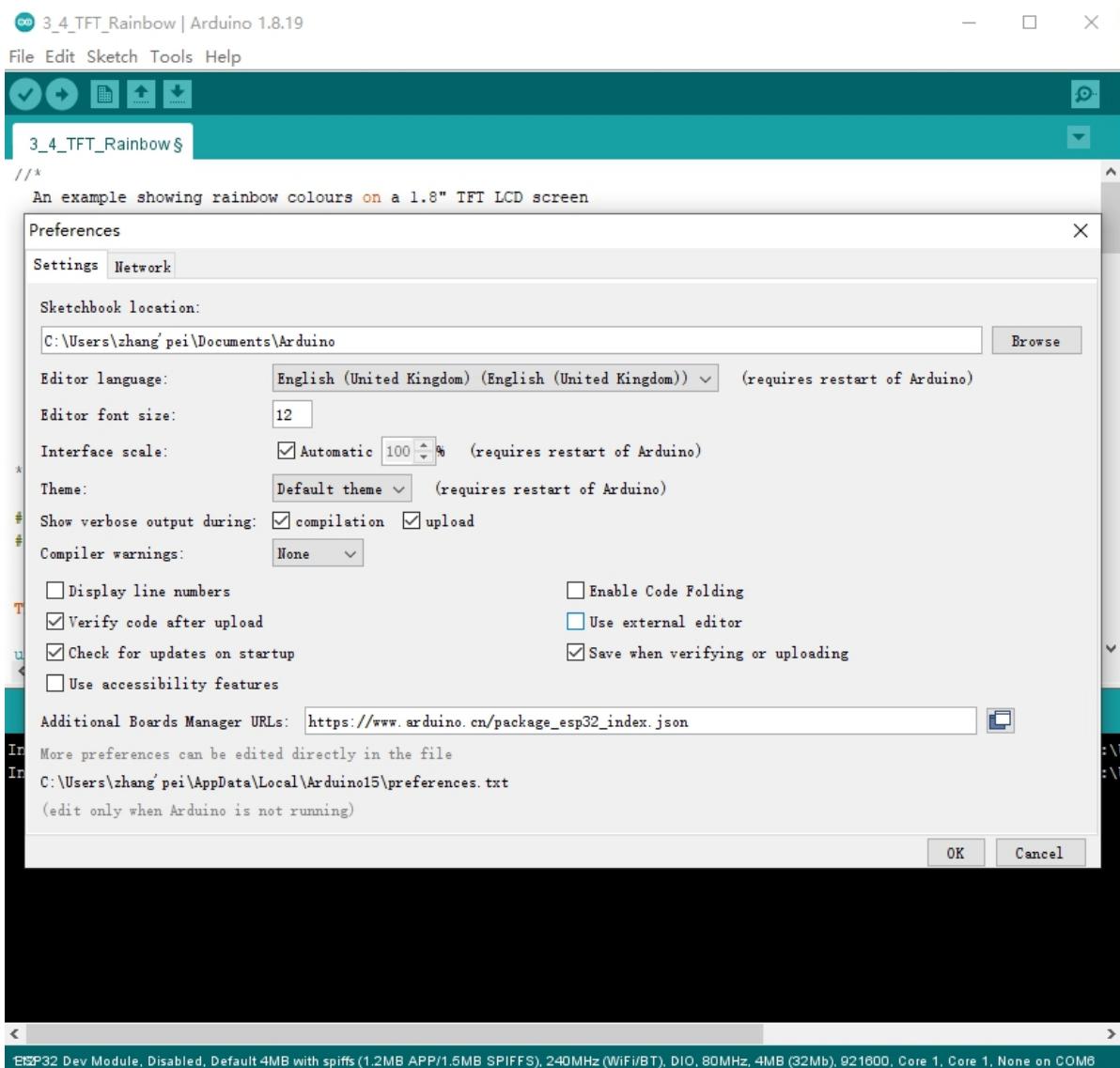
tft.drawString("12.34", 80, 54, 6); // Draw text centre at position 80, 24 using font 6
```

- (4) You should be on the Settings tab in the Preferences dialog box by default.
- (5) Look for the textbox labeled “Additional Boards Manager URLs”.
- (6) If there is already text in this box add a coma at the end of it, then follow the next step.
- (7) Paste the following link into the text box :
Stable release link:
https://raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package_esp32_index.json
Development release link:

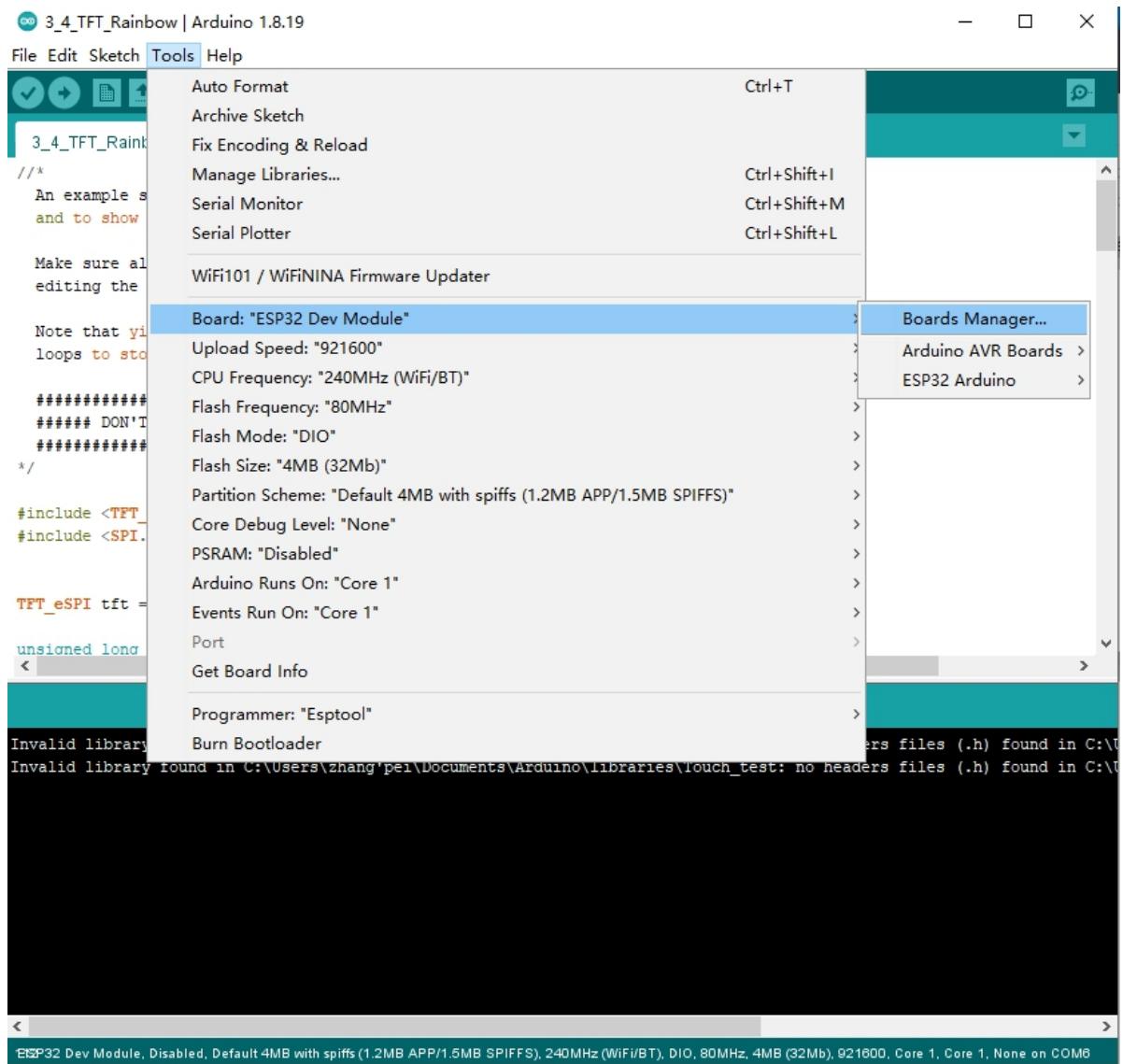
https://raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package_esp32_dev_index.json

- (8) Click the OK button to save the setting.

The textbox with the JSON link in it is illustrated here:

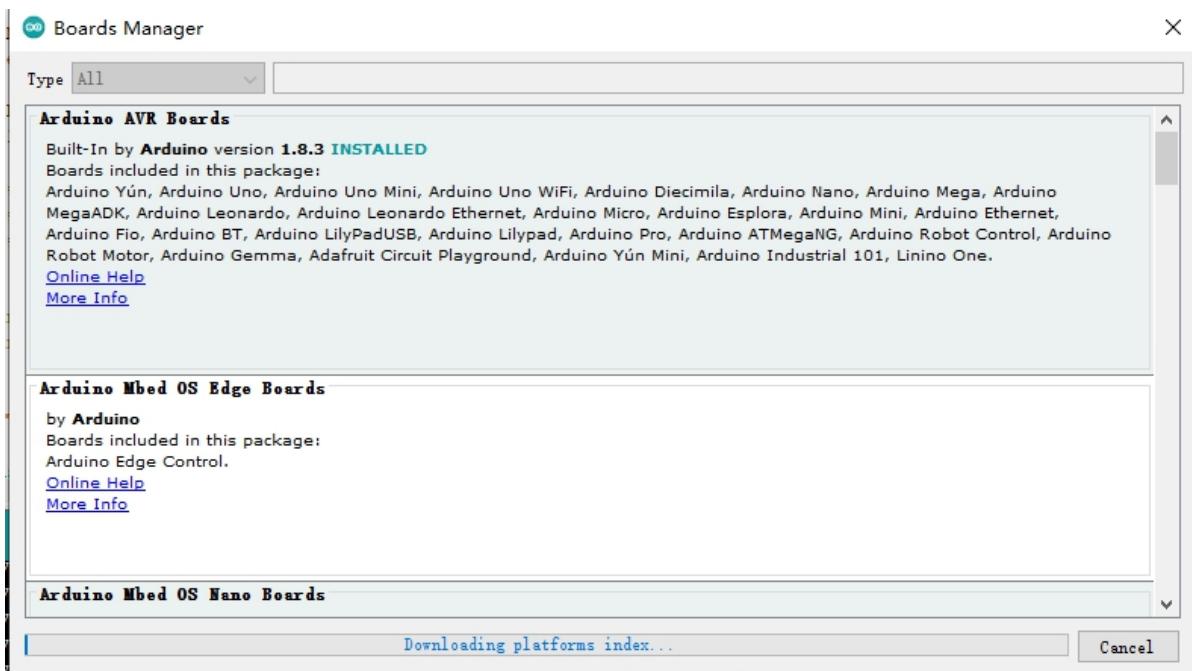


- (9) In the Arduino IDE click on the Tools menu on the top menu bar.
- (10) Scroll down to the Board: entry
- (11) A submenu will open when you highlight the Board: entry.
- (12) At the top of the submenu is Boards Manager. Click on it to open the Boards Manager dialog box.
- (13) In the search box in the Boards Manager enter "esp32".

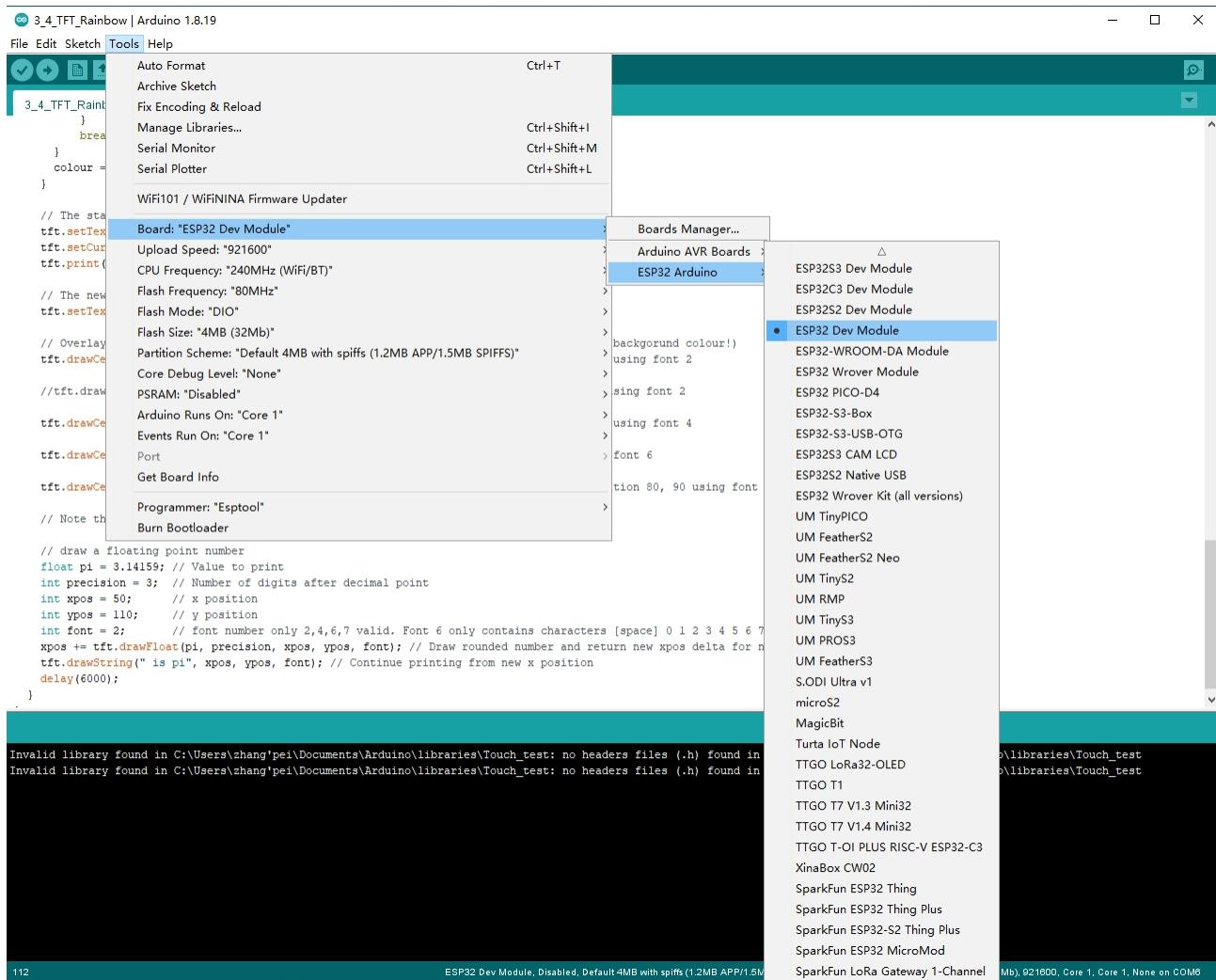


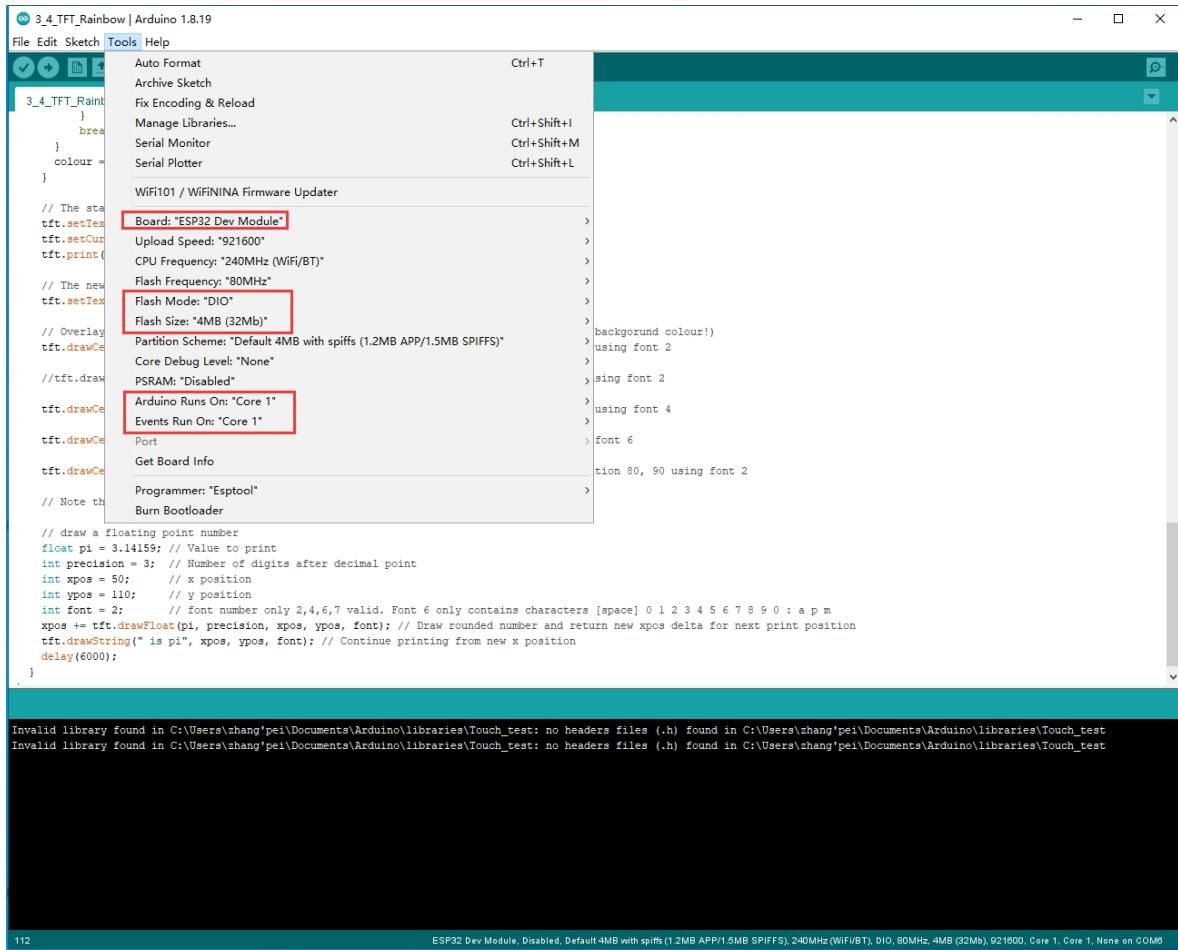
(14) You should see an entry for “esp32 by Espressif Systems”. Highlight this entry and click on the Install button.

This will install the ESP32 boards into your Arduino IDE

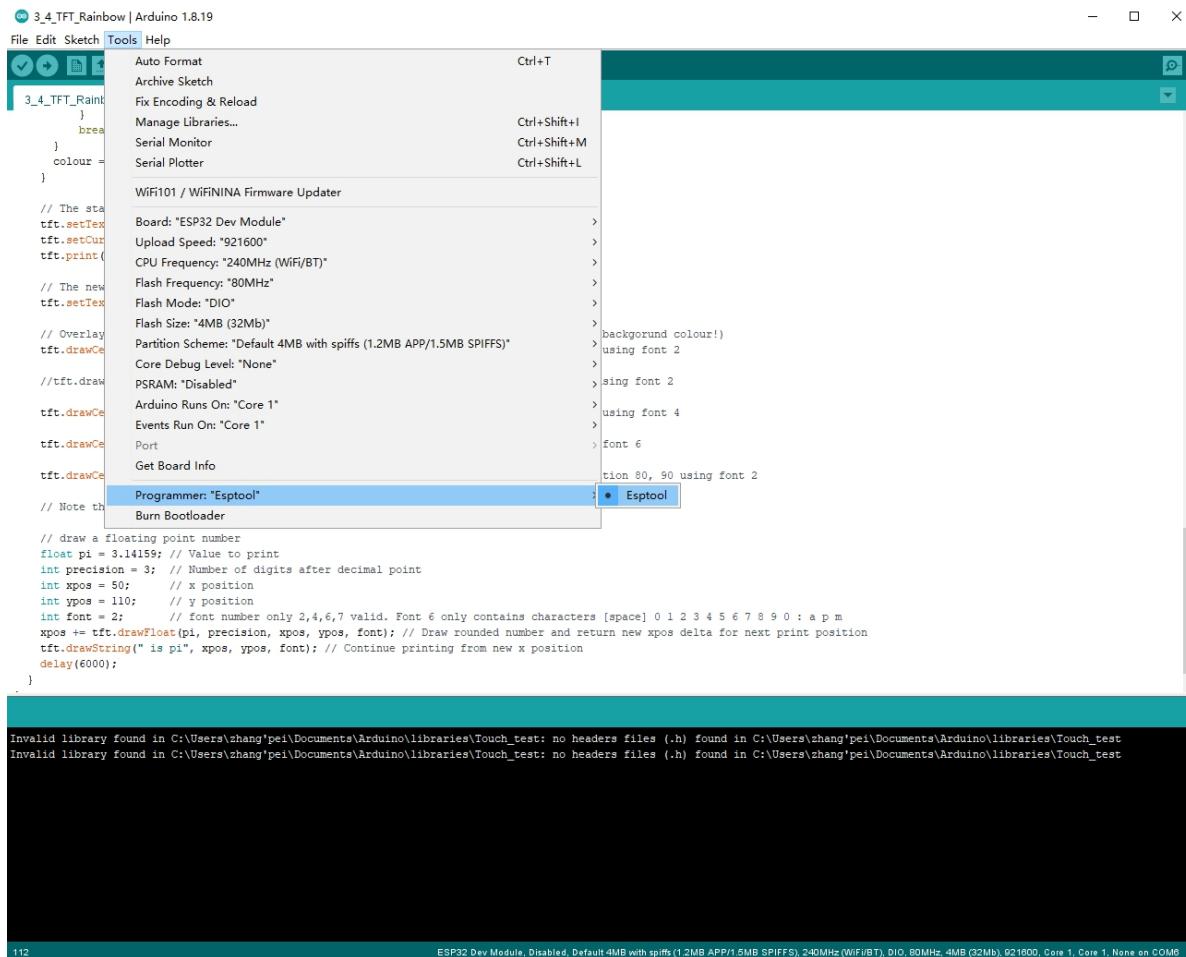


Once the installation completes, we need to select the correct board options for the "ESP32 Arduino" board. In the board type, in the tools tab, we choose "ESP32 Dev Module".





Set and In the programmer entry of the same tab, we choose “esptool”.



It's important to note that after the code is uploaded, the device will start to run it. So, if we want to upload a new program, we need to reset the power of the device, in order to guarantee that it enters flashing mode again.

First program

Since this platform is based on Arduino, we can use many of the usual functions. As an example for the first program, the code below starts the Serial port and prints "hello from ESP32" every second.

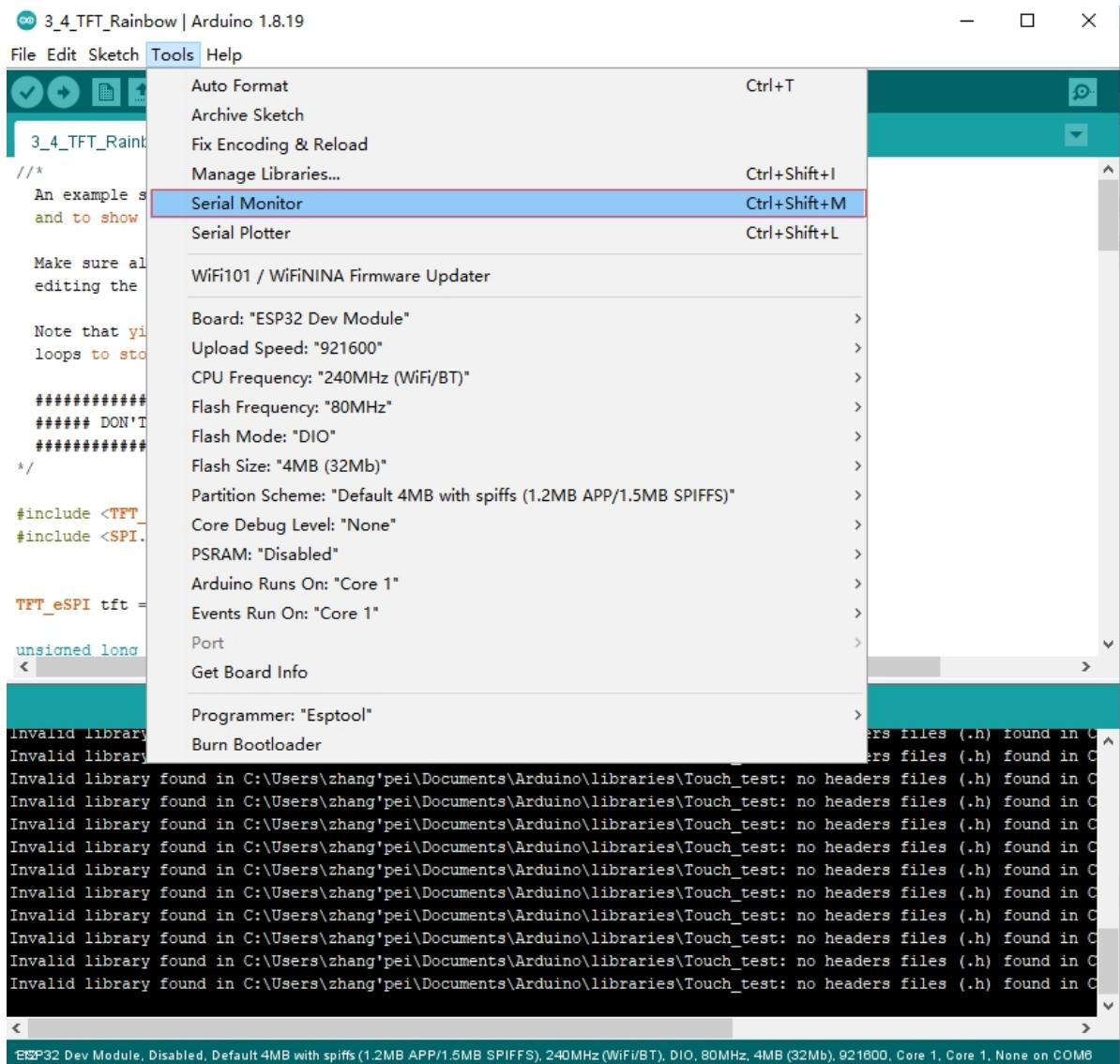
```

void setup() {
    Serial.begin(115200);
}

void loop() {
    Serial.println("hello from ESP32");
    delay(1000);
}

```

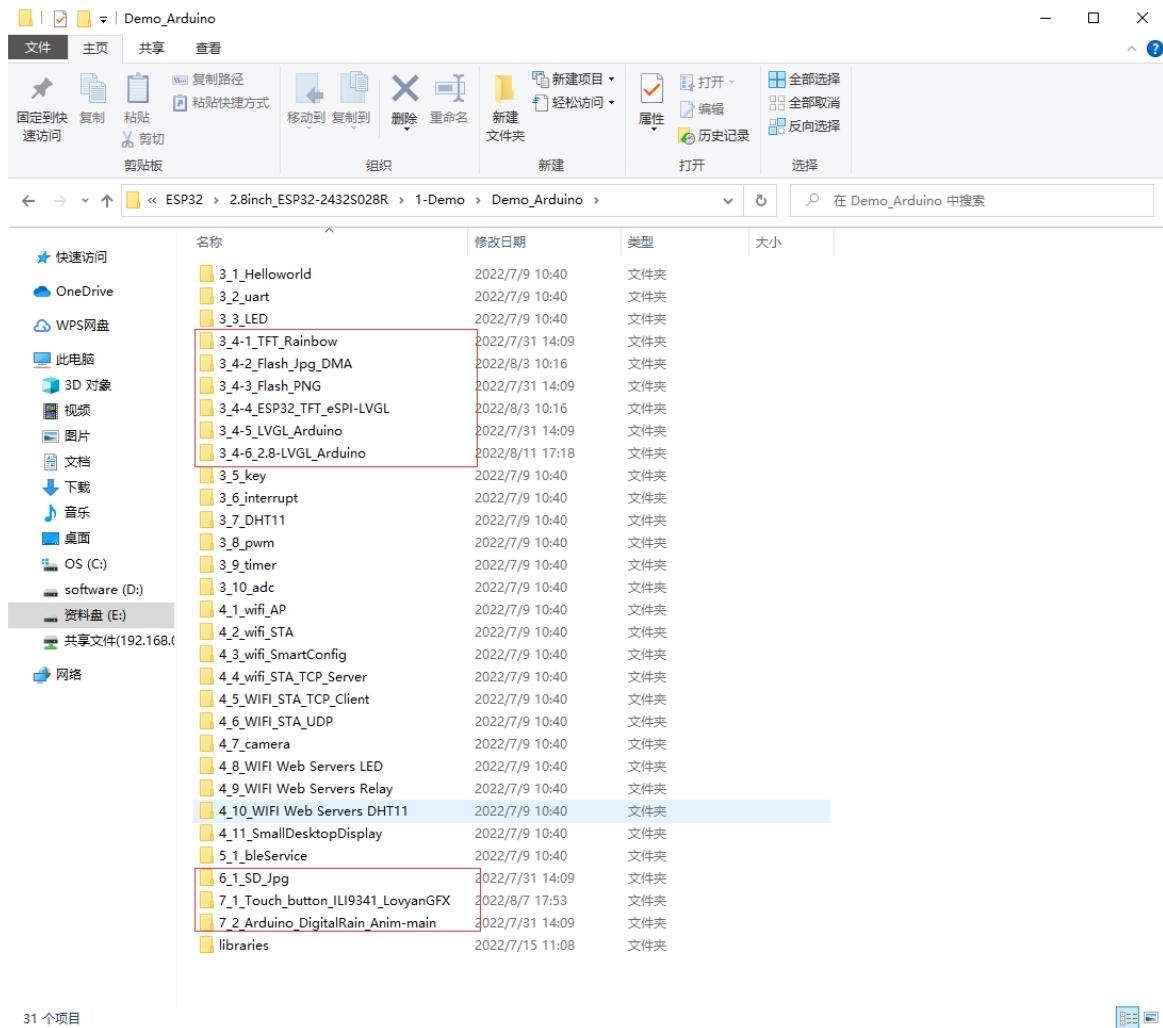
If everything is working fine, we will see the output in the serial console shown.



Again thank you for so much concern.. Hopefully, it's the beginning of a wonderful relationship!

Sample program usage

At present, only a preliminary explanation and introductory use are given to the samples displayed on the screen, and the corresponding examples in the data center are found, as shown in the figure:



The examples in the red circle are all based on the TFT_eSPI library as the basic application. This library supports various commonly used driver chips, such as ST7735, ST7789, ILI9341, etc., and has good compatibility.

TFT_eSPI library file installation:

Open the library manager in Arduino, search for TFT_eSPI, and click instal .

LVGL_Arduino | Arduino 1.8.19

File Edit Sketch Tools Help

Auto Format Ctrl+T
Archive Sketch
Fix Encoding & Reload
Manage Libraries... Ctrl+Shift+I
Serial Monitor Ctrl+Shift+M
Serial Plotter Ctrl+Shift+L
WiFi101 / WiFiNINA Firmware Updater

```
#include <lvgl.h>
#include <TFT_eSPI.h>
#include <ILI9341.h>

/*更改屏幕分辨率
static const uint16_t lv_color = 0x000000;
static const uint16_t lv_bg_color = 0xFFFF00;
```

TFT_eSPI tft = new TFT_eSPI();

```
#if LV_USE_LOG
/* 日志调试 */
void my_print()
{
    Serial.print("Core Run On: "Core 1");
    Serial.print("Events Run On: "Core 1");
}
#endif
//
```

```
void lv_examp
{
    /*要转换的值
    static lv_color_t prop1 = {
```

```
    LV_STYLE_TRANSFORM_WIDTH, LV_STYLE_TRANSFORM_HEIGHT, LV_STYLE_TEXT LETTER_SPACE);

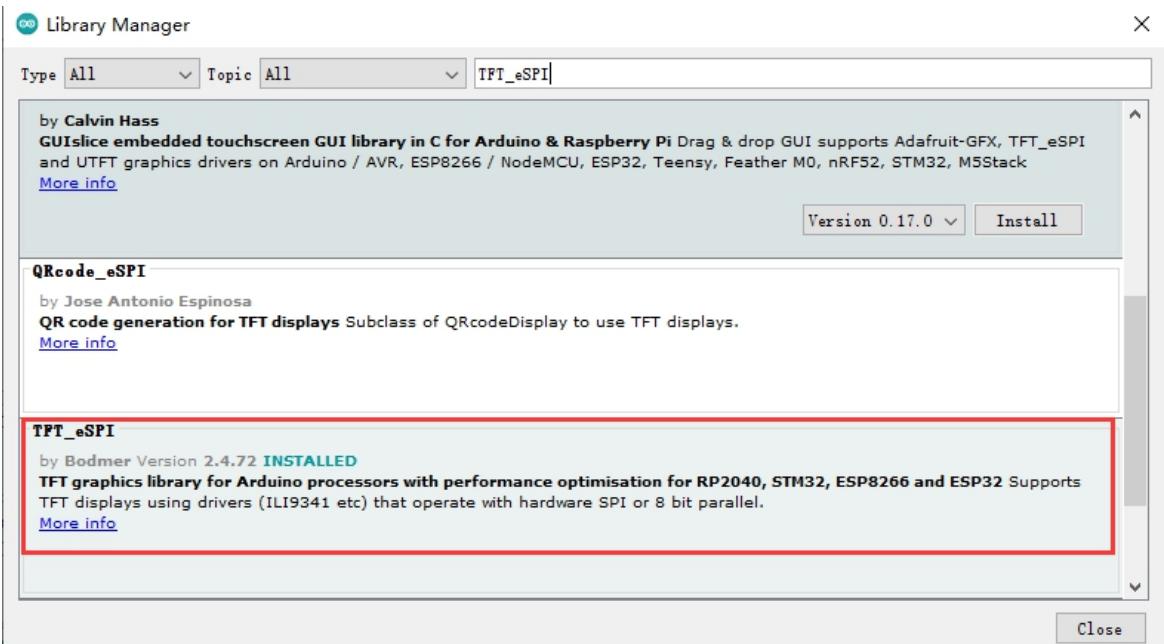
    /*Transition descriptor when going back to the default state.
     *Add some delay to be sure the press transition is visible even if the press was very short*/
    static lv_style_transition_dsc_t transition_dsc_def;
    lv_style_transition_dsc_init(&transition_dsc_def, props, lv_anim_path_overshoot, 250, 100, NULL);

    /*Transition descriptor when going to pressed state.
     *No delay, go to presses state immediately*/
}

Done uploading.

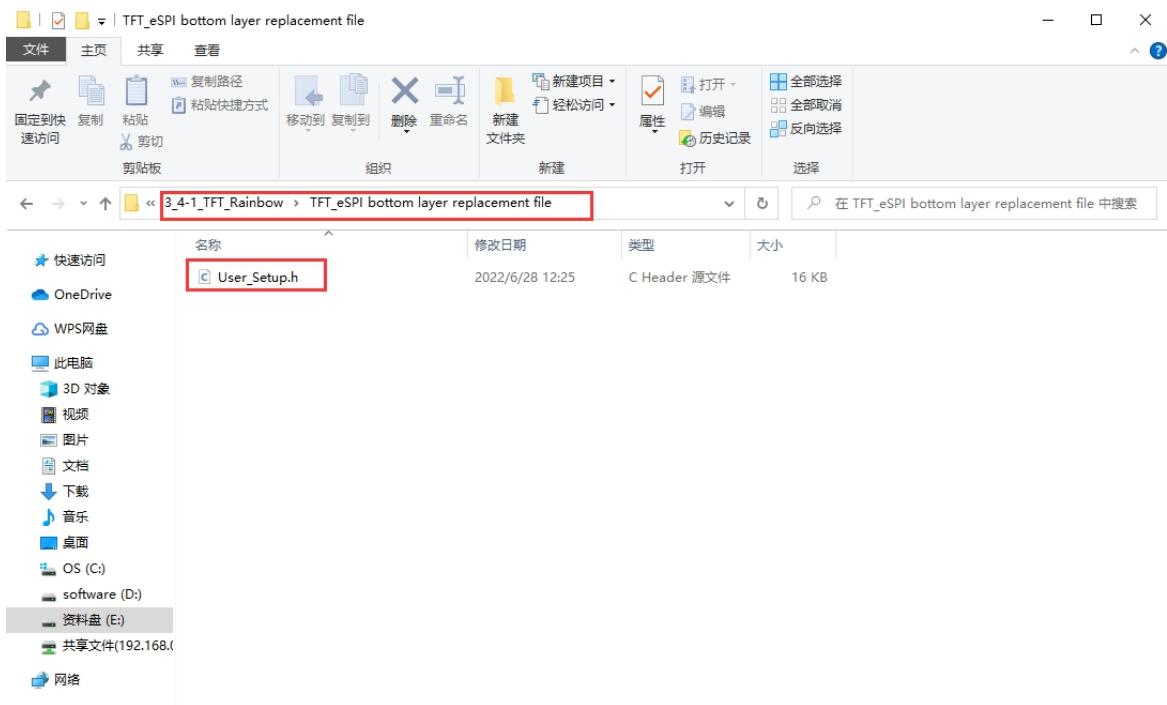
Writing at 0x000721c7... (71 %)
Writing at 0x00077b55... (76 %)
Writing at 0x0007d03b... (80 %)
Writing at 0x00085715... (85 %)
Writing at 0x0008db49... (90 %)
Writing at 0x0009323e... (95 %)
Writing at 0x00099999... (100 %)
Wrote 565088 bytes (331572 compressed) at 0x00010000 in 5.5 seconds (effective 816.4 kbit/s)...  
Hash of data verified.

Leaving...
Hard resetting via RTS pin...
Invalid library found in C:\Users\zhang\pe\Documents\Arduino\libraries\Touch_test: no headers files (.h) found in C:\Users\zhang\pe\Documents\Arduino\libraries\Touch_test
```



Although the TFT_eSPI library has many advantages, it may also have a troublesome place for ordinary users, that is, after the installation

It needs to be configured separately, I already have a configured file, as shown in the figure:

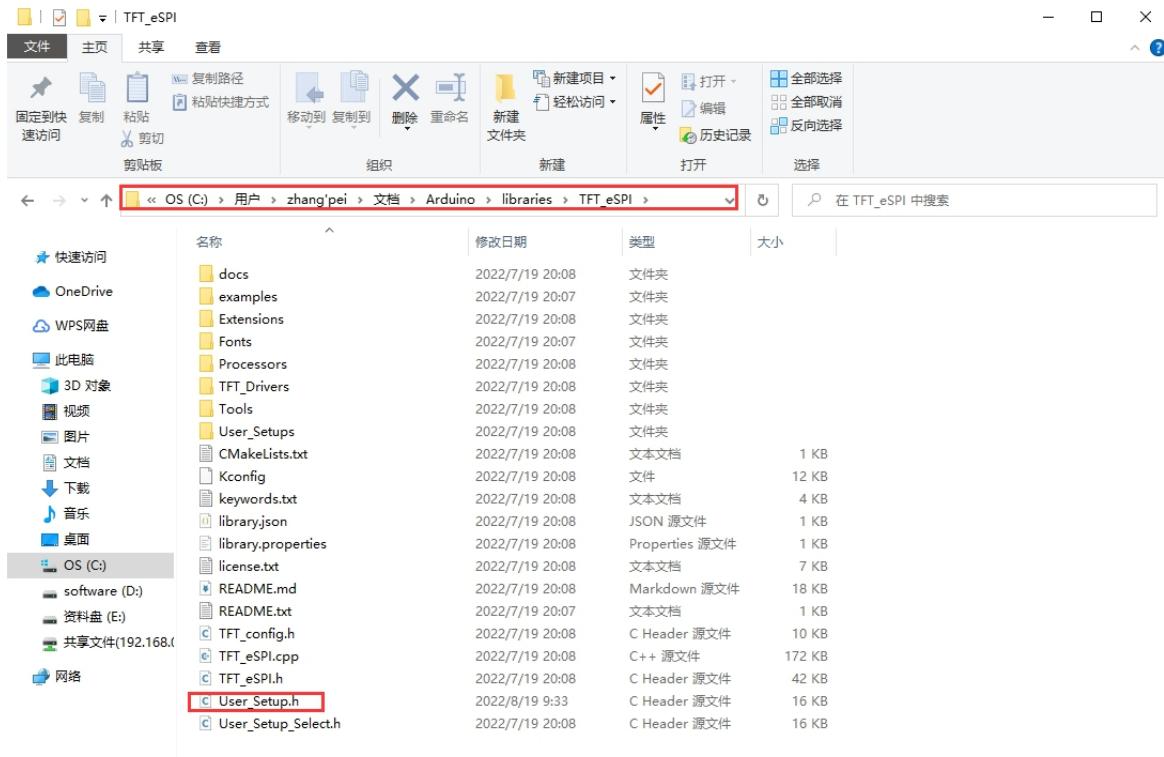


Copy the file and replace User_Setup.h in TFT_eSPI. The library location is generally
C:\Users\<username>\sketchbook\libraries \TFT_eSPI .

If you want to take a closer look at the various setting options, you can follow my tutorial and set it up.
Go to the Arduino library file installation directory and open the location of the TFT_eSPI library. Taking
Windows as an example, the library installation directory is generally:

C:\Users\<username>\ sketchbook\libraries \TFT_eSPI .

As shown:



Then open the User_Setup.h file in the library file directory, and make corresponding settings according to your own screen type and driver chip type. Here is an example of the 2.8-inch ILI9341 TFT LCD color screen I used.

First, we open User_Setup.h.

Step 1: Modify the custom driver file. Among the many driver files, choose the one that suits your screen, and comment out the unused ones.

As shown:

```

38 // Only define one driver, the other ones must be commented out
39 //##define ILI9341_DRIVER // Generic driver for common displays
40 #define ILI9341_2_DRIVER // Alternative ILI9341 driver, see https://github.com/Bodmer/TFT_eSPI/issues/1172
41 //##define ST7735_DRIVER // Define additional parameters below for this display
42 //##define ILI9163_DRIVER // Define additional parameters below for this display
43 //##define S6002A1_DRIVER
44 //##define RPI_ILI9486_DRIVER // 20MHz maximum SPI
45 //##define HX8357D_DRIVER
46 //##define ILI9481_DRIVER
47 //##define ILI9486_DRIVER
48 //##define ILI9488_DRIVER // WARNING: Do not connect ILI9488 display SDO to MISO if other devices share the SPI bus (TFT_SDO does NOT tristate when CS is high)
49 //##define ST7789_DRIVER // Full configuration option, define additional parameters below for this display
50 //##define ST7789_2_DRIVER // Minimal configuration option, define additional parameters below for this display
51 //##define R61981_DRIVER
52 //##define RW68140_DRIVER
53 //##define ST7796_DRIVER
54 //##define SSD1351_DRIVER
55 //##define SSD1351_480_DRIVER
56 //##define SSD1963_800_DRIVER
57 //##define SSD1963_800ALT_DRIVER
58 //##define ILI9225_DRIVER
59 //##define GL9A01_DRIVER
60

```

Set the width and height, for ILI9341, set the width and height.

As shown:

```

76
77 // For ST7789, ST7735, ILI9163 and GC9A01 ONLY, define the pixel width and height in portrait orientation
78 // #define TFT_WIDTH 80
79 // #define TFT_WIDTH 128
80 // #define TFT_WIDTH 128 // ST7789 240 x 240 and 240 x 320
81 #define TFT_WIDTH 240
82 // #define TFT_WIDTH 320
83 // #define TFT_HEIGHT 160
84 // #define TFT_HEIGHT 128
85 // #define TFT_HEIGHT 160 // ST7789 240 x 240
86 #define TFT_HEIGHT 320 // ST7789 240 x 320
87 // #define TFT_HEIGHT 240 // GC9A01 240 x 240 // #define TFT_HEIGHT 480
88 // #define TFT_HEIGHT 480 //
89

```

Step 2: Pin definition, comment out other definitions, define your own pins .

As shown:

```

209 #define TFT_MISO 12
210 #define TFT_MOSI 13 // In some display driver board, it might be written as "SDA" and so on.
211 #define TFT_SCLK 14
212 #define TFT_CS 15 // Chip select control pin
213 #define TFT_DC 2 // Data Command control pin
214 #define TFT_RST -1 // Reset pin (could connect to Arduino RESET pin)
215 #define TFT_BL 21 // LED back-light
216
217 #define TOUCH_CS 33 // Chip select pin (T_CS) of touch screen
218

```

Step 3: Turn on the Backlight Pins .

As shown:

```

125
126 #define TFT_BL 21 // LED back-light control pin
127 #define TFT_BACKLIGHT_ON HIGH // Level to turn ON back-light (HIGH or LOW)
128
129

```

After configuring these, compile the arduino function in 3_4-1_TFT_Rainbow to light up the screen .

About the use of touch and LVGL:

Find the data center 3_4-6_2.8-LVGL_Arduino

As shown:

File Explorer View

	名称	修改日期	类型	大小
快速访问	3_1_Helloworld	2022/7/9 10:40	文件夹	
OneDrive	3_2_uart	2022/7/9 10:40	文件夹	
WPS网盘	3_3_LED	2022/7/9 10:40	文件夹	
此电脑	3_4-1_TFT_Rainbow	2022/7/31 14:09	文件夹	
3D 对象	3_4-2_Flash_Jpg_DMA	2022/8/3 10:16	文件夹	
视频	3_4-3_Flash.PNG	2022/7/31 14:09	文件夹	
图片	3_4-4_ESP32_TFT_eSPI-LVGL	2022/8/3 10:16	文件夹	
文档	3_4-5_LVGL_Arduino	2022/7/31 14:09	文件夹	
下载	3_4-6_2.8-LVGL_Arduino	2022/8/11 17:18	文件夹	
音乐	3_5_key	2022/7/9 10:40	文件夹	
桌面	3_6_interrupt	2022/7/9 10:40	文件夹	
OS (C:)	3_7_DHT11	2022/7/9 10:40	文件夹	
software (D:)	3_8_pwm	2022/7/9 10:40	文件夹	
资料盘 (E:)	3_9_timer	2022/7/9 10:40	文件夹	
共享文件(192.168.0.11)	3_10_adc	2022/7/9 10:40	文件夹	
网络	4_1_wifi_AP	2022/7/9 10:40	文件夹	
	4_2_wifi_STA	2022/7/9 10:40	文件夹	
	4_3_wifi_SmartConfig	2022/7/9 10:40	文件夹	
	4_4_wifi_STA_TCP_Server	2022/7/9 10:40	文件夹	
	4_5_WIFI_STA_TCP_Client	2022/7/9 10:40	文件夹	
	4_6_WIFI_STA_UDP	2022/7/9 10:40	文件夹	
	4_7_camera	2022/7/9 10:40	文件夹	
	4_8_WIFI Web Servers LED	2022/7/9 10:40	文件夹	
	4_9_WIFI Web Servers Relay	2022/7/9 10:40	文件夹	
	4_10_WIFI Web Servers DHT11	2022/7/9 10:40	文件夹	
	4_11_SmallDesktopDisplay	2022/7/9 10:40	文件夹	
	5_1_bleService	2022/7/9 10:40	文件夹	
	6_1_SD_Jpg	2022/7/31 14:09	文件夹	
	7_1_Touch_button_ILI9341_LovyanGFX	2022/8/7 17:53	文件夹	
	7_2_Arduino_DigitalRain_Anim-main	2022/7/31 14:09	文件夹	

Download two library files .

One -TFT_e SPI

Library Manager

Type All Topic All

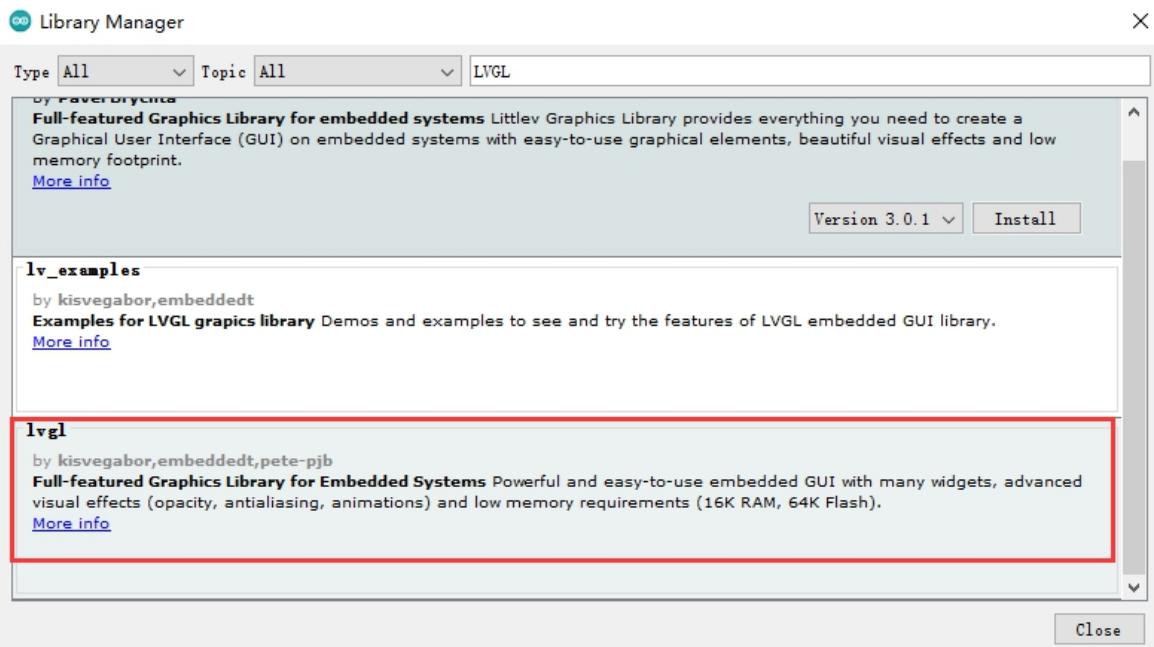
by Calvin Hass
GUIslice embedded touchscreen GUI library in C for Arduino & Raspberry Pi Drag & drop GUI supports Adafruit-GFX, TFT_eSPI and UTFT graphics drivers on Arduino / AVR, ESP8266 / NodeMCU, ESP32, Teensy, Feather M0, nRF52, STM32, M5Stack
[More info](#)

Version 0.17.0

QRcode_eSPI
by Jose Antonio Espinosa
QR code generation for TFT displays Subclass of QRcodeDisplay to use TFT displays.
[More info](#)

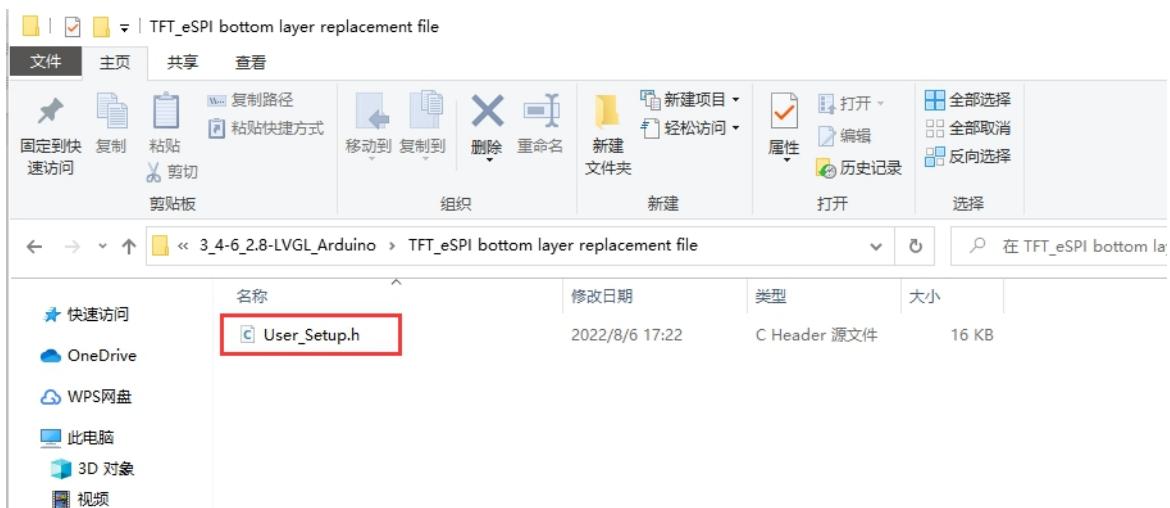
TFT_eSPI
by Bodmer Version 2.4.72 **INSTALLED**
TFT graphics library for Arduino processors with performance optimisation for RP2040, STM32, ESP8266 and ESP32 Supports TFT displays using drivers (ILI9341 etc) that operate with hardware SPI or 8 bit parallel.
[More info](#)

Two -Lvgl



Copy the User_Setup.h of the data center .

As shown:



Replace the corresponding User_Setup.h file in TFT_eSPI with this file .

As shown:

File Explorer showing the contents of the Arduino library directory `TFT_eSPI`:

名称	修改日期	类型	大小
docs	2022/7/19 20:08	文件夹	
examples	2022/7/19 20:07	文件夹	
Extensions	2022/7/19 20:08	文件夹	
Fonts	2022/7/19 20:07	文件夹	
Processors	2022/7/19 20:08	文件夹	
TFT_Drivers	2022/7/19 20:08	文件夹	
Tools	2022/7/19 20:08	文件夹	
User_Setups	2022/7/19 20:08	文件夹	
CMakeLists.txt	2022/7/19 20:08	文本文档	1 KB
Kconfig	2022/7/19 20:08	文件	12 KB
keywords.txt	2022/7/19 20:08	文本文档	4 KB
library.json	2022/7/19 20:08	JSON 源文件	1 KB
library.properties	2022/7/19 20:08	Properties 源文件	1 KB
license.txt	2022/7/19 20:08	文本文档	7 KB
README.md	2022/7/19 20:08	Markdown 源文件	18 KB
README.txt	2022/7/19 20:07	文本文档	1 KB
TFT_config.h	2022/7/19 20:08	C Header 源文件	10 KB
TFT_eSPI.cpp	2022/7/19 20:08	C++ 源文件	172 KB
TFT_eSPI.h	2022/7/19 20:08	C Header 源文件	42 KB
User_Setup.h	2022/8/19 9:33	C Header 源文件	16 KB
User_Setup_Select.h	2022/7/19 20:08	C Header 源文件	16 KB

复制资料中心的 `lv_conf.h`

如图：

File Explorer showing the contents of the Arduino library directory `TFT_eSPI bottom layer replacement file`:

名称	修改日期	类型	大小
lv_conf.h	2022/8/19 17:01	C Header 源文件	24 KB
User_Setup.h	2022/8/6 17:22	C Header 源文件	16 KB

Put this file under the arduino library file, it must be in the same root directory as the library `TFT_eSPI`.

As shown:

此电脑 > OS (C:) > 用户 > zhang'pei > 文档 > Arduino > libraries

在 libraries 中搜索

名称	修改日期	类型	大小
Adafruit_CCS811	2022/6/27 12:06	文件夹	
Adafruit_Unified_Sensor	2022/7/6 9:23	文件夹	
ArduinoJson	2022/6/27 12:06	文件夹	
AsyncTCP	2022/6/28 17:44	文件夹	
Audio	2022/6/27 12:06	文件夹	
DallasTemperature	2022/6/25 10:23	文件夹	
DHT_sensor_library	2022/6/27 12:06	文件夹	
DHT_sensor_library_for_ESPx	2022/6/27 12:06	文件夹	
ESP32Servo	2022/6/27 12:06	文件夹	
ESPAsyncWebServer	2022/6/27 12:06	文件夹	
FastLED	2022/8/9 18:08	文件夹	
GFX_Library_for_Arduino	2022/8/17 10:21	文件夹	
gt911-arduino-main	2022/8/15 15:10	文件夹	
GT911-master	2022/6/27 12:06	文件夹	
IRremote	2022/6/28 13:49	文件夹	
JPEGDecoder	2022/6/27 12:06	文件夹	
LiquidCrystal_I2C	2022/7/31 14:05	文件夹	
LovyanGFX	2022/3/4 10:31	文件夹	
lvgl	2022/6/27 12:06	文件夹	
MFRC522	2022/6/27 12:06	文件夹	
OneWire	2022/6/27 12:06	文件夹	
PNGdec	2022/6/28 10:48	文件夹	
Rtc_by_Makuna	2022/6/27 12:06	文件夹	
TFT_eSPI	2022/8/16 12:46	文件夹	
TFT_Touch-master	2022/8/1 12:16	文件夹	
Time	2022/7/6 9:23	文件夹	
TJpg_Decoder	2022/8/3 14:25	文件夹	
Touch_test	2022/8/1 12:12	文件夹	
TP_Arduino_DigitalRain_Anim-main	2022/7/31 13:13	文件夹	
XPT2046_Touchscreen	2022/7/17 18:09	文件夹	
XT_DAC_Audio	2022/7/2 17:12	文件夹	
lv_arduino.rar	2022/7/21 14:20	360压缩 RAR 文件	6,740 KB
lv_conf.h	2022/8/19 17:01	C Header 源文件	24 KB
readme.txt	2022/6/15 15:12	文本文档	1 KB

After compiling, you can run LVGL and touch normally.

Function introduction

一、Basic settings

1. tft.init(); //Initialization

Initialize the screen, if it is ST7735, you can pass a parameter to it, and see when it is used .

2. tft.fillRect(TFT_BLACK); //fill full screen fill full screen, followed by color values.

tft.fillRect(uint32_t color);

3. Screen rotation

// Set the rotation angle of the screen display, the parameters are: 0, 1, 2, 3

// Represent 0°, 90°, 180°, 270°

void setRotation(uint8_t r);

4. Screen inversion

//Invert display colors i = 1 invert, i = 0 normal

tft.invertDisplay(bool i);

二、Text related API

```
1. tft.setCursor(20, 10, 4); //Set the starting coordinate position and font size of typing  
// Set the text display coordinates. By default, the upper left corner of the text is used as the reference  
point. The reference point can be changed.  
void setCursor(int16_t x, int16_t y);  
// Set the text display coordinates, and the font of the text  
void setCursor(int16_t x, int16_t y, uint8_t font);  
2. tft.setTextColor(2); //Set font color  
// Set text color  
void setTextColor(uint16_t color);  
// Set text color and background color  
void setTextColor(uint16_t fgcolor, uint16_t bgcolor);  
//Setting the background color can effectively prevent numbers from overlapping  
3. tft.setTextSize(2); //Set font size  
Setting the text size can enlarge the display of the font, but the "resolution" of the font will not change  
// Set the text size, the text size range is an integer from 1 to 7  
void setTextSize(uint8_t size);  
4. tft.print("Hello World!");  
// Display font  
tft.print("Hello World!");  
5. tft.printf, tft.println //Display font
```

Special Note: Font 7 is an imitation of a 7-segment digital screen

三、APIs related to drawing text

1. Draw the string (left)

```
int16_t drawString(const String &string, int32_t x, int32_t y)  
int16_t drawString(const char * string, int32_t x, int32_t y)  
int16_t drawString(const String &string, int32_t x, int32_t y, uint8_t font)  
int16_t drawString(const char * string, int32_t x, int32_t y, uint8_t font)
```

2. Draw the string (centered)

```
int16_t drawCentreString(const char * string, int32_t x, int32_t y, uint8_t font)  
int16_t drawCentreString(const String &string, int32_t x, int32_t y, uint8_t font)
```

3. Draw the string (right)

```
int16_t drawRightString(const char * string, int32_t x, int32_t y, uint8_t font)  
int16_t drawRightString(const String &string, int32_t x, int32_t y, uint8_t font)
```

4. Drawing characters

```
int16_t drawChar(uint16_t uniCode, int32_t x, int32_t y)
```

```
int16_t drawChar(uint16_t uniCode, int32_t x, int32_t y, uint8_t font)
void drawChar(int32_t x, int32_t y, uint16_t c, uint32_t color, uint32_t bg, uint8_t size)
```

5. Plot floating point numbers

```
int16_t TFT_eSPI::drawFloat(float floatNumber, uint8_t decimal, int32_t x, int32_t y)
int16_t TFT_eSPI::drawFloat(float floatNumber, uint8_t decimal, int32_t x, int32_t y, uint8_t font)
tft.drawFloat(3.124, 4, 0,0,4);
```

6. Draw the numbers

```
int16_t drawNumber(long intNumber, int32_t x, int32_t y)
int16_t drawNumber(long intNumber, int32_t x, int32_t y, uint8_t font)
```

四、Drawing geometric figures

1. Draw the dots

```
void drawPixel(int32_t x, int32_t y, uint32_t color)
```

2. Draw lines

```
void drawLine(int32_t xs, int32_t ys, int32_t xe, int32_t ye, uint32_t color)
```

3. Draw a horizontal line (quick)

```
void drawFastHLine(int32_t x, int32_t y, int32_t w, uint32_t color)
```

4. Draw a vertical line (quick)

```
void drawFastVLine(int32_t x, int32_t y, int32_t h, uint32_t color)
```

5. Draw the hollow circle

```
tft.drawCircle(100, 100,50,TFT_RED);
```

6. Draw a filled circle

```
void fillCircle(int32_t x, int32_t y, int32_t r, uint32_t color)
```

7. Draw a hollow ellipse

```
tft.drawEllipse(100, 100, 100,60,TFT_GREENYELLOW);
```

8. Draw a solid ellipse

```
void drawRect(int32_t x, int32_t y, int32_t w, int32_t h, uint32_t color)
```

9. Draw a hollow rectangle

```
void drawRect(int32_t x, int32_t y, int32_t w, int32_t h, uint32_t color)
```

10. Draw a solid rectangle

```
void fillRect(int32_t x, int32_t y, int32_t w, int32_t h, uint32_t color)
```

11. Draw a hollow rounded rectangle

```
void drawRoundRect(int32_t x, int32_t y, int32_t w, int32_t h, int32_t radius, uint32_t color)
```

12. Draw a solid rounded rectangle

```
void fillRoundRect(int32_t x, int32_t y, int32_t w, int32_t h, int32_t radius, uint32_t color)
```

13. Draw Hollow Triangles

```
void drawTriangle(int32_t x1, int32_t y1, int32_t x2, int32_t y2, int32_t x3, int32_t y3, uint32_t color)
```

14. Draw Solid Triangles

```
void fillTriangle(int32_t x1, int32_t y1, int32_t x2, int32_t y2, int32_t x3, int32_t y3, uint32_t color)
```

五、Image display related

1. Display BMP picture

```
void drawBitmap(int16_t x, int16_t y, const uint8_t *bitmap, int16_t w, int16_t h, uint16_t fgcolor)
```

```
void drawBitmap(int16_t x, int16_t y, const uint8_t *bitmap, int16_t w, int16_t h, uint16_t fgcolor, uint16_t bgcolor)
```

2. XBM

xmb is a simple two-color image bitmap format, which was widely used in early cgi and is currently used in counters. Here TFT_eSPI recommends an online XBM production tool
xbm is a simple two-color image bitmap format, which was widely used in early cgi and is currently used in counters. Here TFT_eSPI recommends an online XBM production tool

<https://www.online-utility.org/image/convert/to/XBM>

3. Test is very useful

```
void drawXBitmap(int16_t x, int16_t y, const uint8_t *bitmap, int16_t w, int16_t h, uint16_t fgcolor)
```

```
void drawXBitmap(int16_t x, int16_t y, const uint8_t *bitmap, int16_t w, int16_t h, uint16_t fgcolor, uint16_t bgcolor)
```

Display pictures

```
void pushImage(int32_t x, int32_t y, int32_t w, int32_t h, const uint16_t *data) void pushImage(int32_t x, int32_t y, int32_t w, int32_t h, uint16_t *data)
```

```
void pushImage(int32_t x, int32_t y, int32_t w, int32_t h, const uint16_t *data, uint16_t transparent)
```

```
void pushImage(int32_t x, int32_t y, int32_t w, int32_t h, uint16_t *data, uint16_t transparent)
```

```
void pushImage(int32_t x, int32_t y, int32_t w, int32_t h, uint8_t *data, bool bpp8 =
```

```
true, uint16_t *cmap = (uint16_t *)nullptr)
void pushImage(int32_t x, int32_t y, int32_t w, int32_t h, uint8_t *data, uint8_t
transparent, bool bpp8 = true, uint16_t *cmap = (uint16_t *)nullptr)
```