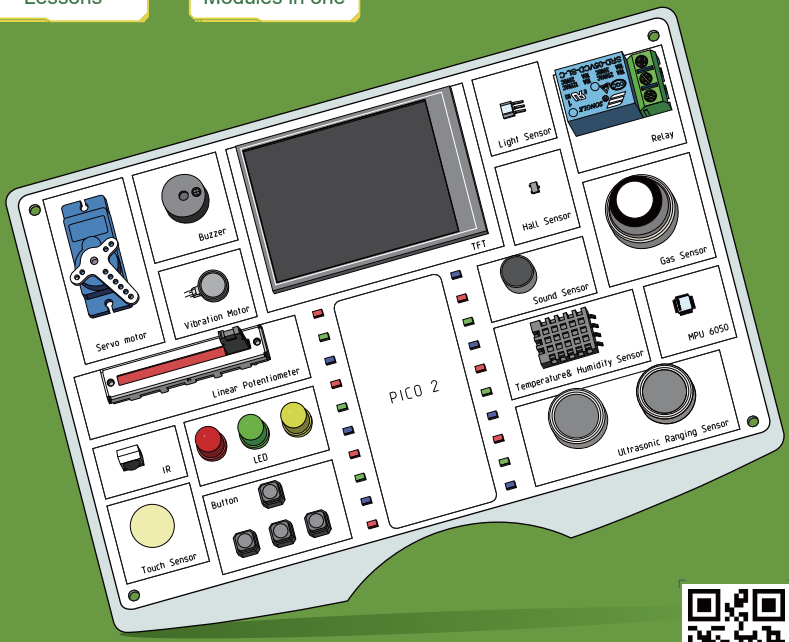
ELECROW

All-in-one Starter Kit for Pico 2 User Manual

- STEAM Education
- Open-source Hardware

20+
Lessons

17
Modules in one



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Introduction

Welcome to the User Manual for the All-in-one Starter Kit for PICO 2. Let's begin our journey into the world of the PICO 2 development board and its sensors.

Rest assured, this development board is equipped with 21 courses that are designed to be progressively challenging, engaging, and thought-provoking. These courses will guide you step-by-step through the essential knowledge. Here, you will become familiar with electronic modules, hone your logical thinking skills, enhance your creative design capabilities, and implement the functionality of these modules through programming.

The learning process starts with understanding how to install the programming software, followed by an introduction to the PICO 2 development board and its various sensors. You will then delve into the programming functions of these sensors and the programming language they utilize, ultimately learning how to apply these sensors in practical applications. Each step is meticulously explained, making it easy for beginners to quickly grasp C/C++ programming.

The All-in-one Starter Kit for PICO 2 includes 17 electronic modules, each with its unique characteristics and functions, specifically designed for beginners and an ideal choice for getting started. For example, the light sensor allows beginners to control real-world lighting devices through programming.

In summary, by working with this development board, you will learn the fundamental knowledge and principles of sensors, understand important concepts such as digital and analog signals, analog-to-digital conversion, and programming logic, and master the use of some complex electronic modules. Most importantly, through PICO 2 programming, you will further enhance your logical thinking skills.

For the programming software, we will utilize the Arduino IDE. Arduino IDE is an easy-to-use open-source platform and one of the best choices for learning programming.

List of Sensors	
• Temperature& Humidity Sensor	x1
• Button	x4
• Ultrasonic Ranging Sensor	x1
• Light Sensor	x1
• Linear Potentiometer	x1
• LED	x3
• Buzzer	x1
• 2.4-inch TFT Display	x1
• Infrared Remote	x1
• Relay	x1
• Servo motor	x1
• Sound Sensor	x1
• Accelerometer & Gyro	x1
• Touch Sensor	x1
• Vibration Motor	x1
• Hall Sensor	x1
• Gas Sensor(MQ2)	x1

Getting Started

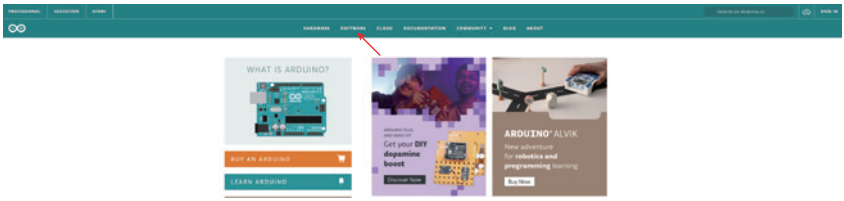
Installing Arduino IDE

Download Arduino in Windows system

STEP 1:

Login to Arduino official website, download Arduino, click **SOFTWARE.**

Arduino official website: https://www.arduino.cc/



STEP 2:

Select your computer's corresponding system to download, such as Window system.

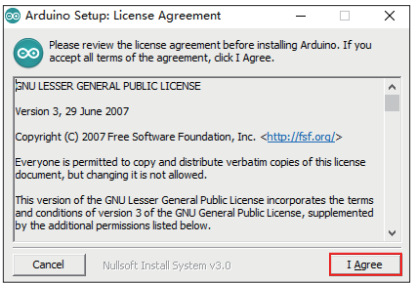
STEP 3:

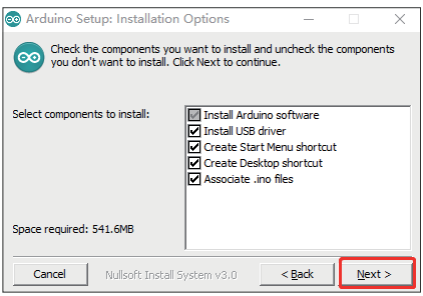
Click JUST DOWNLOAD and select the save location to start the download.

STEP 4:

1.When installing Arduino, please locate the executable file with the .exe extension within the folder where you previously saved, which is the Arduino installation package.

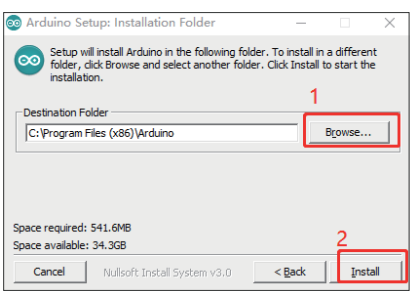
2. After double-clicking the installation package, this page will appear.
Click on "I Agree".

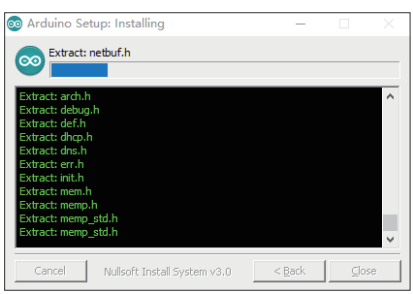




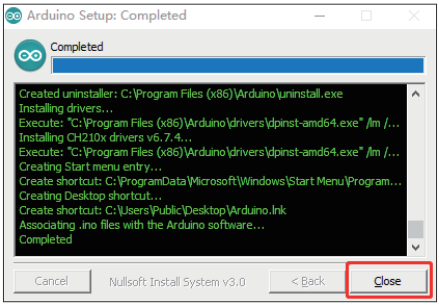
3.Check all options by default and click Next.

4.Click on 'Browse' to select the installation location, it is recommended to install it on any drive other than the C: drive. Then click 'Install'.





5.Installation Complete,click 'Close'.

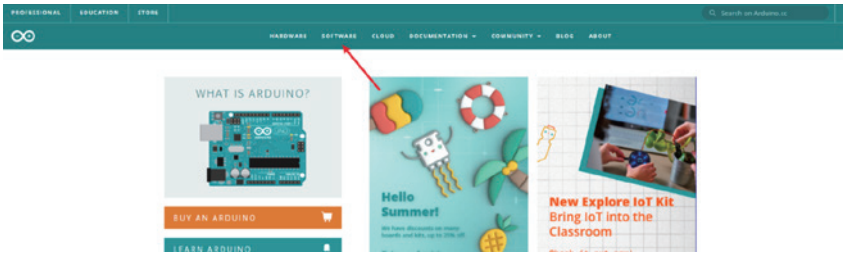


Download Arduino in Linux system

STEP 1:

Login to Arduino official website, download Arduino, click 'SOFTWARE'.

Arduino official website:https://www.arduino.cc/



STEP 2:

Select the version of Linux that corresponds to your computer for download.

STEP 3:

After clicking 'JUST DOWNLOAD', select the save location to begin the download process.

STEP 4:

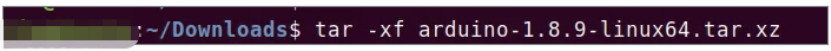
Install Arduino IDE

You are now ready to install the Arduino IDE. Please navigate to the download folder where you saved the Arduino archive (assuming the directory is: /home/username/Downloads). You will need to extract the downloaded Arduino archive. You can do this by launching a terminal using the Ctrl+Alt+T shortcut and then running the following command to change to the Downloads folder:

cd /home/username/Downloads

To extract the archive folder, please run the following command in the terminal:

tar-xf [Compressed-filename]



Then, in the terminal, run the following command to navigate to the newly extracted Arduino folder:

cd [Uncompressed-foldername]

You can try executing the `ls -l` command in the terminal to view the file list in the Arduino folder, and then locate the install.sh installation script that we are about to install.

```
~/Downloads/arduino-1.8.9$ ls -l
total 13704
-rwxr-xr-x  1 tin tin      882 Mar 15 07:16 arduino
-rwxr-xr-x  1 tin tin 13877879 Mar 15 07:16 arduino-builder
-rwxr-xr-x  1 tin tin     5161 Mar 15 07:16 arduino-linux-setup.sh
drwxr-xr-x 13 tin tin     4096 Mar 15 07:15 examples
drwxr-xr-x  4 tin tin     4096 Mar 15 07:16 hardware
-rwxr-xr-x  1 tin tin    10786 Mar 15 07:16 install.sh
drwxr-xr-x  6 tin tin     4096 Oct  6  2018 java
drwxr-xr-x  4 tin tin     4096 Mar 15 07:16 lib
drwxr-xr-x 21 tin tin     4096 Mar 15 07:15 libraries
drwxr-xr-x  6 tin tin     4096 Mar 15 07:15 reference
-rw-r--r--  1 tin tin    88826 Mar 15 07:15 revisions.txt
drwxr-xr-x  4 tin tin     4096 Mar 15 07:16 tools
drwxr-xr-x  4 tin tin     4096 Mar  7 02:10 tools-builder
-rwxr-xr-x  1 tin tin       86 Mar 15 07:16 uninstall.sh
```

We are now ready to install Arduino. Execute the following command in the terminal with sudo privileges to install Arduino:

sudo ./install.sh

Please wait for a period of time until the installation is complete.

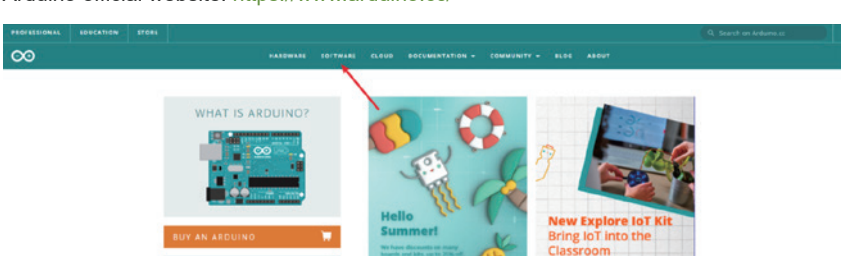
```
:~/Downloads/arduino-1.8.9$ sudo ./install.sh
[sudo] password for tin:
Adding desktop shortcut, menu item and file associations for Arduino IDE...
rm: cannot remove '/usr/local/bin/arduino': No such file or directory
Removing symlink failed. Hope that's OK. If not then rerun as root with sudo.

rm: cannot remove '/usr/local/bin/arduino': No such file or directory
Removing symlink failed. Hope that's OK. If not then rerun as root with sudo.

 done!
```

Download Arduino in MacOS system

STEP 1:

Login to Arduino official website, download Arduino, click 'SOFTWARE'.

Arduino official website: https://www.arduino.cc/

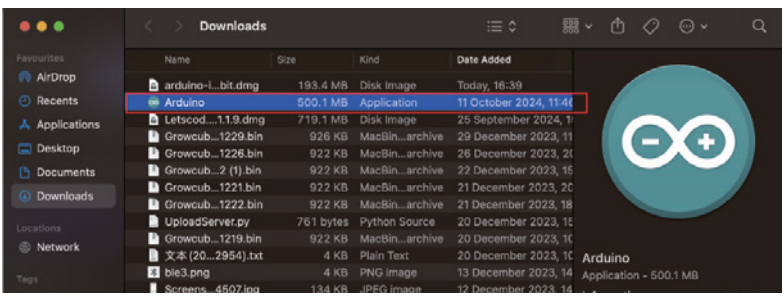


STEP 2:

Select the Mac version of your computer to download.

STEP 3:

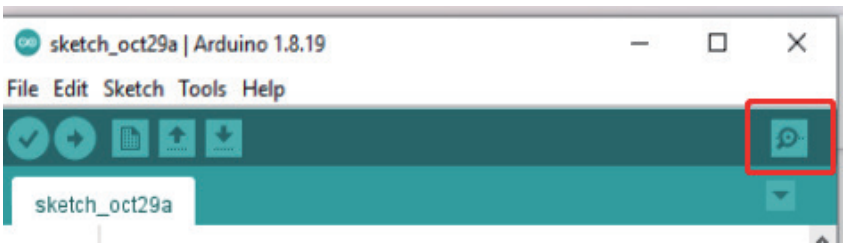
After the download is successful, double-click to install.

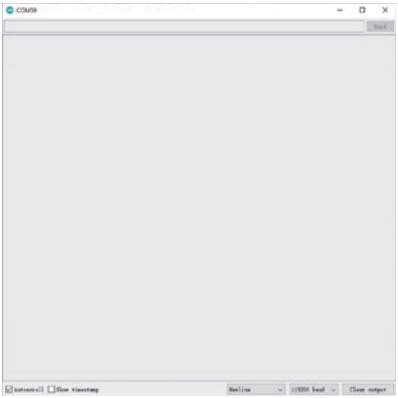


How to Use the Serial Monitor Tool

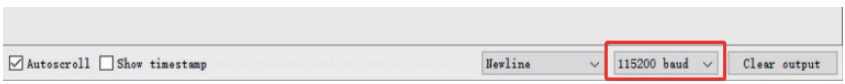
1.Open the Arduino IDE.

2.Click on the "Serial Monitor" button. Note that you need to have a serial device connected to open it; otherwise, the Serial Monitor tool will not be accessible.



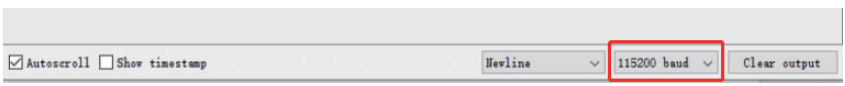


Setting the baud rate.



The baud rate setting should be the same as that initialized by the code to communicate properly.

```
Serial.begin(115200);
```



Course Usage Instructions

How to Access the Courses: After flashing the course firmware, enter the boot interface and click on Course Learning to view the course options.

Click the button below to access the course.

How to Exit the Course and Return to the UI Interface: After entering the course, you can exit the course by touching the Touch Sensor module located at the lower left corner.

Note: Since Course 15 utilizes the Touch Sensor module, the method to exit this course is slightly different. You can exit Course 15 by pressing the left button on the Button Module.

Game Usage Tutorial

Game Tutorials

Game 1: Little Dinosaur Game

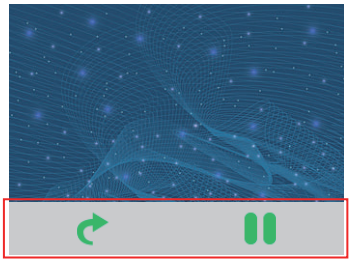
How to Play: Control the little dinosaur to jump and avoid obstacles by tapping the screen.

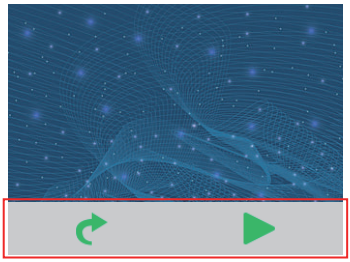
Game 2: Bouncing Ball Game

How to Play: Use the left and right buttons to move the paddle left or right and bounce the ball.

Game 3: Snake Game

How to Play: Use the up, down, left, and right buttons to control the movement of the snake and eat the fruits.





For the above games, swiping up on the screen will bring up the menu.
Clicking the “Return”.

button will exit to the factory UI interface. Clicking the “Start/Stop” button can control the game status. Once the “Start” button is clicked, the menu interface will automatically exit.

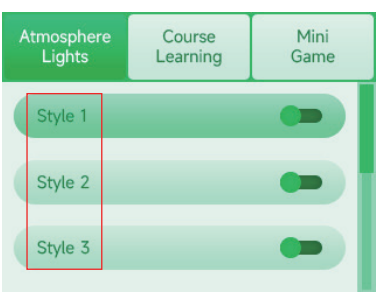
Customizing and Modifying Light Effects Tutorial

Taking the factory code as an example, the code is displayed in the segment from lines 1330 to 1350 below.

```
1330 void RGB_style1() {
1331
1332   digitalWrite(LED_EN, HIGH);
1333
1334   colorWipe(strip.Color(255, 0, 0), 50);  // Red
1335   strip.show();
1336   colorWipe(strip.Color(0, 255, 0), 50);  // Green
1337   strip.show();
1338   colorWipe(strip.Color(0, 0, 255), 50);  // Blue
1339   strip.show();
1340 }
1341 void RGB_style2() {
1342
1343   digitalWrite(LED_EN, HIGH);
1344   whiteOverRainbow(75, 5);
1345 }
```

RGB_style1( )
RGB_style2( )
RGB_style3( )
RGB_style4( )

The functions are the implementation functions for the four types of lighting effects in the UI interface.



By modifying these four functions, you can achieve the goal of customizing the factory-default lighting effects.

Function：digita1Write(LED_EN, HIGH);

The code indicates the activation of the RGB power supply. This step is necessary if you want the RGB to light up.

Function：colorWipe(strip.Color(255, 0, 0), 50);

The code indicates that the RGB LEDs are sequentially illuminated with the color RGB (255, 0, 0), and the interval between the illumination of each RGB LED is 50 milliseconds.

Function：whiteOverRainbow(75, 5);

The code represents the implementation of a rainbow stripe moving effect for RGB LEDs. Here, the value 75 indicates the speed of the rainbow stripe movement, while 5 represents the number of RGB LEDs between each rainbow stripe movement interval.

Function：rainbowFade2White(3, 3);

The code represents the implementation of a rainbow stripe lighting effect for RGB LEDs. The first parameter indicates the interval between frames of the rainbow animation, while the second parameter specifies the duration of the rainbow animation playback.

Function：rainbowCycle(20);

The code represents the implementation of a flickering rainbow stripe lighting effect for RGB LEDs, where 20 indicates the interval time between flickers. By combining the above codes, various lighting effects can be achieved.

Lessons

Lesson 1 - LED Control

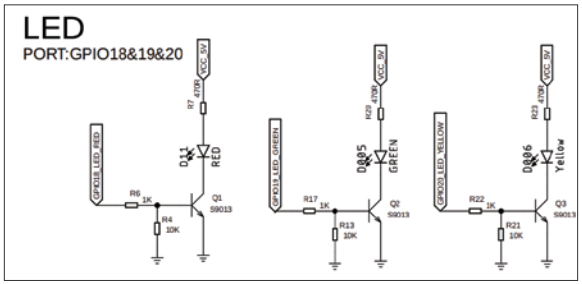
Introduction

In this lesson, we will learn how to control LED lights. By manipulating the code, we can achieve the effect of the LED lights turning on and off at intervals.

Hardware required

• All-in-one-Starter-Kit-for-Pico2 x1
• USB Cable x1

Hardware schematic



What will you see

After starting the course, you will see the LED light up for one second, then turn off for one second, and repeat this cycle. If this process is not observed, please ensure that the program is running correctly.

Lesson 2 - Button Control LED

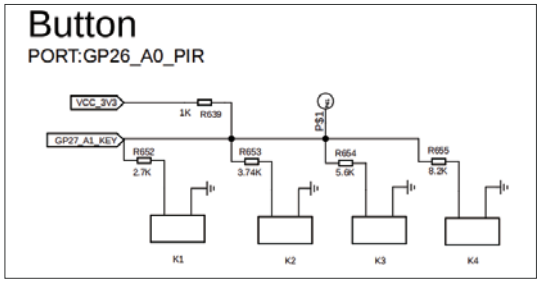
Introduction

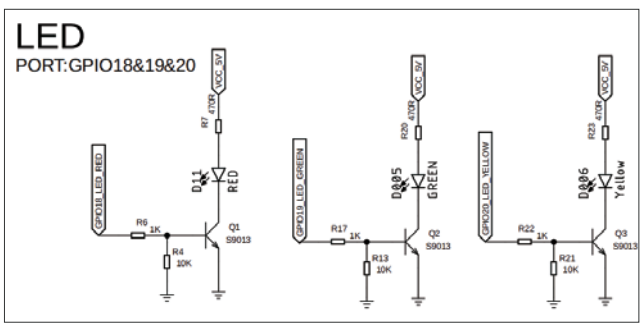
When the button is pressed, it will output a high-level signal. When the button is released, it will output a low-level signal. In this lesson, we will use the button to control the state of the LED: the LED will turn on when the button is pressed, and turn off when the button is released.

Hardware required

• All-in-one-Starter-Kit-for-Pico2 x1
• USB Cable x1

Hardware schematic





What will you see

After the course is launched, when you hold down the “up” button, the LED remains lit continuously. When you release the button, the LED turns off. If the LED does not operate as expected, please ensure that the program is running correctly.

Lesson 3 - Breathing LED

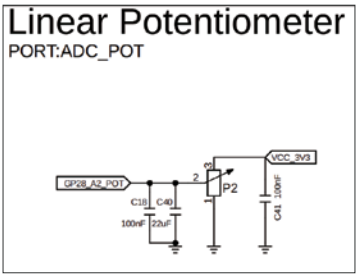
Introduction

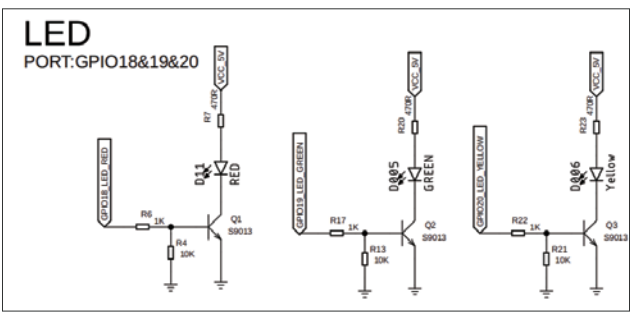
In this lesson, we will use a potentiometer with a maximum resistance of 10kΩ to achieve the breathing effect of the LED. As you slide it from left to right, its output voltage will range from 0V to 5V (VCC). In this session, we will adjust the LED using the potentiometer to create the breathing light effect!

Hardware required

• All-in-one-Starter-Kit-for-Pico2 x1
• USB Cable x1

Hardware schematic





What will you see

After starting the course, the brightness of the LED will change according to the movement of the potentiometer. When you slide it all the way to the right (maximum position), the LED will be at its brightest. When you slide it all the way to the left (minimum position), the LED will turn off. If the LED does not work as expected, please ensure that the program is running correctly.

Lesson 4 - 2.4-inch TFT Display

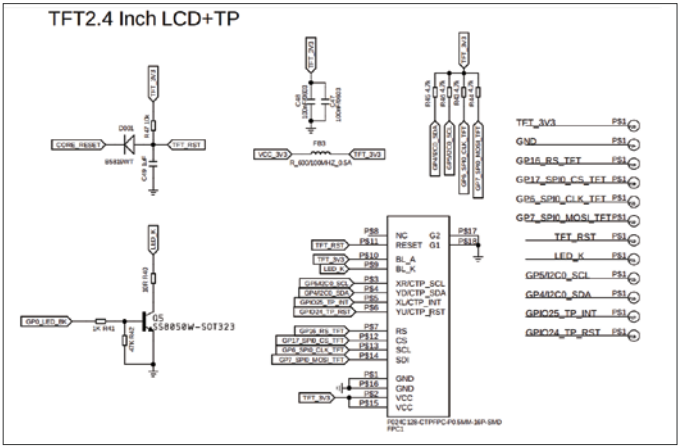
Introduction

In this lesson, we will use the TFT display module from the All-in-One Starter Kit for Pico² to display text. The TFT display module communicates with the development board via SPI. This TFT display module is easy to operate and convenient to use.

Hardware required

• All-in-one-Starter-Kit-for-Pico2 x1
• USB Cable x1

Hardware schematic



What will you see

After the course is initiated, you will see the text “HELLO WORLD!” displayed on the screen. One second later, the text “Bye Bye” will appear on the TFT display. After another second, the display will be cleared, and the screen will turn off. If the TFT display module does not function as expected, please ensure that the program is running correctly.

Lesson 5 - Traffic Light

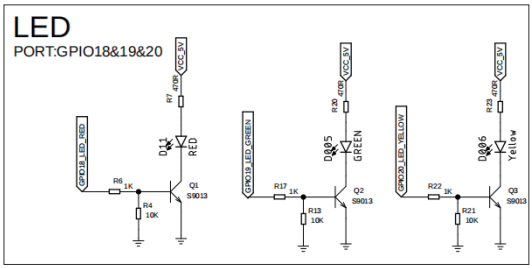
Introduction

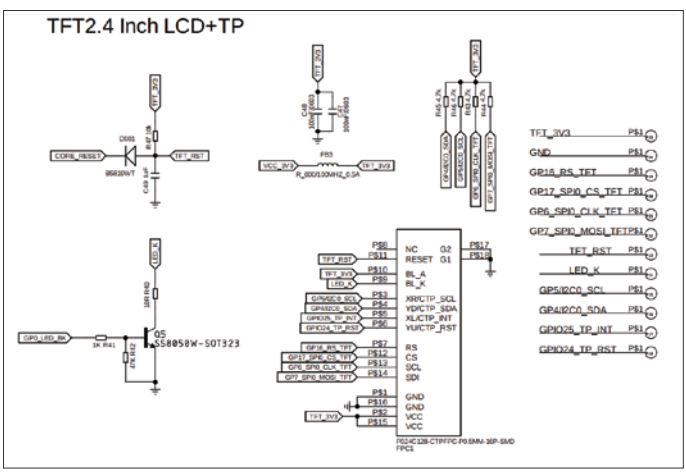
In this lesson, we will use the LED module to simulate a traffic light.

Hardware required

• All-in-one-Starter-Kit-for-Pico2 x1
• USB Cable x1

Hardware schematic





What will you see

After the course is initiated, the green light will turn on first, while the TFT displays "Countdown: 30 seconds" and starts timing. When the countdown reaches the last 5 seconds, the green light will start flashing. After the 30-second green light period ends, the green light will turn off, the yellow light will turn on, and the TFT will display "Countdown: 3 seconds" and start timing. After the 3-second yellow light period ends, the yellow light will turn off, the red light will turn on, and the TFT will display "Countdown: 20 seconds" and start timing. When the countdown reaches the last 5 seconds, the red light will start flashing. After the 20-second red light period ends, the red light will turn off, the green light will turn on again, and the TFT will continue to display the countdown. This cycle will repeat continuously.

Lesson 6 - Intelligent Street Light

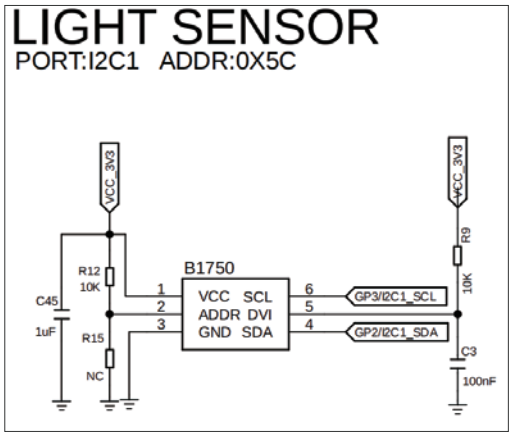
Introduction

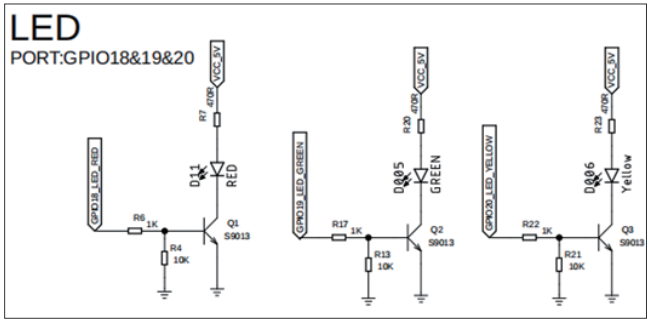
In this lesson, you will learn how to obtain light intensity information from the light sensor module and how to control the LED light based on this data. By determining different levels of brightness, you can achieve intelligent control of the LED's on/off state. This smart control of the LED allows you to avoid unnecessary energy consumption and achieve energy-saving goals.

Hardware required

- All-in-one-Starter-Kit-for-Pico2 x1
- USB Cable x1

Hardware schematic





What will you see

When you cover the top of the light sensor with your hand to simulate a dark environment, you should see the red LED light up. When you remove your hand to simulate a light environment, the red LED should turn off. If this does not happen, please check whether the program has been executed correctly.

Lesson 7 - Ultrasonic Ranging Sensor

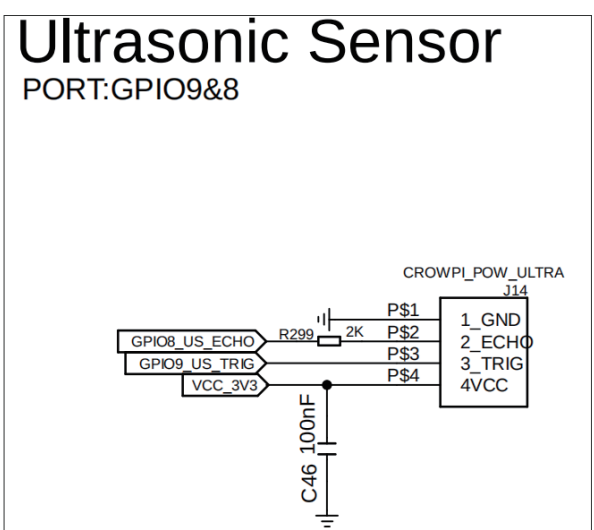
Introduction

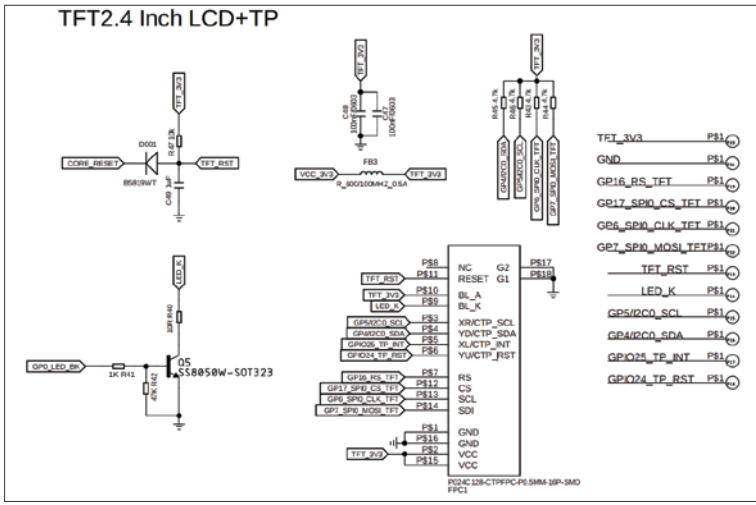
In this lesson, we will learn how to use the ultrasonic sensor module. With this module, we can measure the distance between the module and a flat surface in front of it. We can create an ultrasonic distance meter, and the measured distance will be displayed on the LCD module.

Hardware required

- All-in-one-Starter-Kit-for-Pico2 x1
- USB Cable x1

Hardware schematic





What will you see

After starting the course, you will see the distance data measured by the ultrasonic sensor continuously refreshing on the LCD screen. As the flat surface in front of the ultrasonic module moves, the measured distance values will also change accordingly. If this does not happen, please check whether the program is running correctly.

Lesson 8 - Obstacle Close Range Alarm

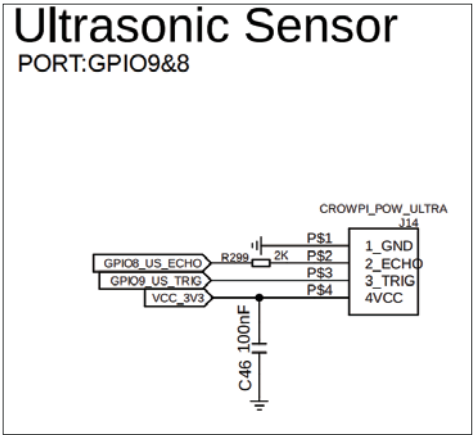
Introduction

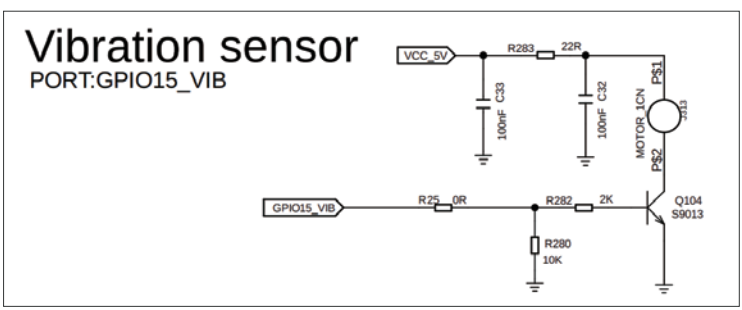
In this lesson, we will delve deeper into the ultrasonic sensor module and learn how to integrate it with other modules. We will use the distance data obtained from the ultrasonic module to control the on/off state of the vibration motor module. In this way, we can achieve the effect of ultrasonic obstacle avoidance.

Hardware required

- All-in-one-Starter-Kit-for-Pico2 x1
- USB Cable x1

Hardware schematic





What will you see

After starting the course, you will observe that as the distance measured by the ultrasonic module changes, the vibration motor will activate when the distance is less than 30 centimeters, indicating that an obstacle has been detected. If the distance reaches or exceeds 30 centimeters, the vibration motor will turn off, indicating that the path is clear and there are no obstacles. If this process does not occur as described, please check whether the program is running correctly.

Lesson 9 - Brightness Display

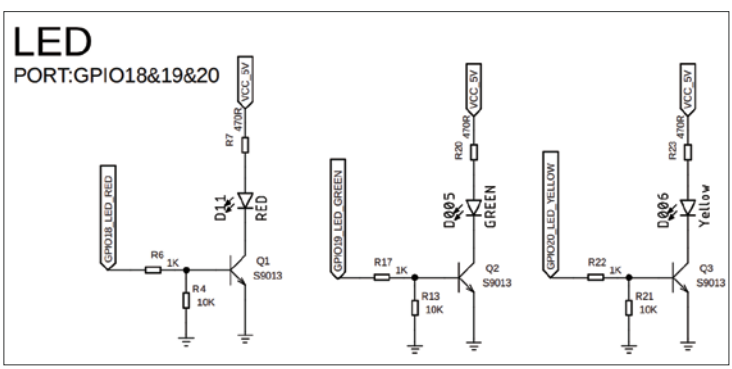
Introduction

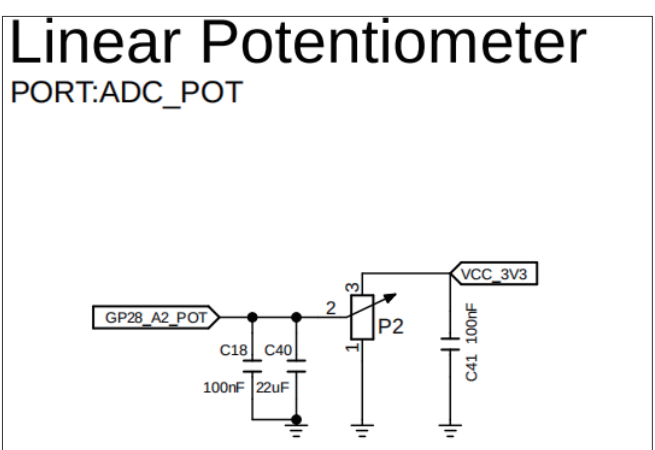
In this lesson, we will learn how to control the brightness of a light using a potentiometer and divide the brightness levels into 10 grades.

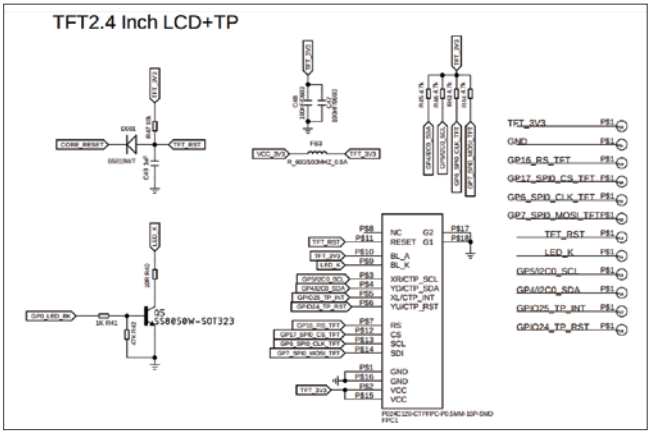
Hardware required

- All-in-one-Starter-Kit-for-Pico2 x1
- USB Cable x1

Hardware schematic







What will you see

After starting the course, you will see that by sliding the potentiometer left or right, you can adjust the brightness level of the light from 0 to 10.

Lesson 10 - Temperature&Humidity Detecting System

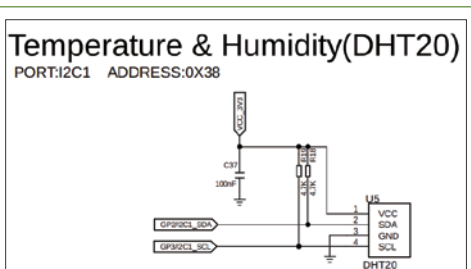
Introduction

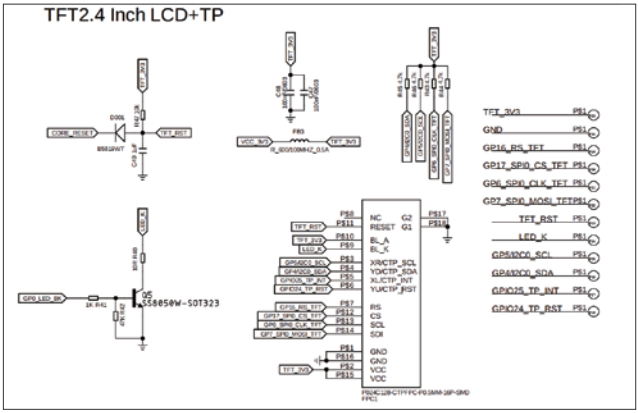
In this lesson, we will learn how to use the temperature and humidity sensor module.

Hardware required

- All-in-one-Starter-Kit-for-Pico2 x1
- USB Cable x1

Hardware schematic





What will you see

After starting the course, in this lesson, you will see the temperature and humidity data obtained from the temperature and humidity sensor displayed on the screen.

Lesson 11 - Servo Control

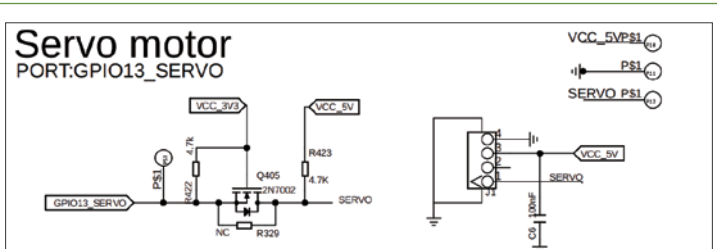
Introduction

In this lesson, we will learn the basic use of a servo motor to achieve left and right swinging of the servo module.

Hardware required

- All-in-one-Starter-Kit-for-Pico2 x1
- USB Cable x1

Hardware schematic



What will you see

After starting the course, you will see the servo rotate from 0 degrees to 180 degrees, and then from 180 degrees back to 0 degrees. If this process does not occur, please check whether the firmware has been correctly flashed and whether the hardware connections are correct.

Lesson 12 - IR Control LED

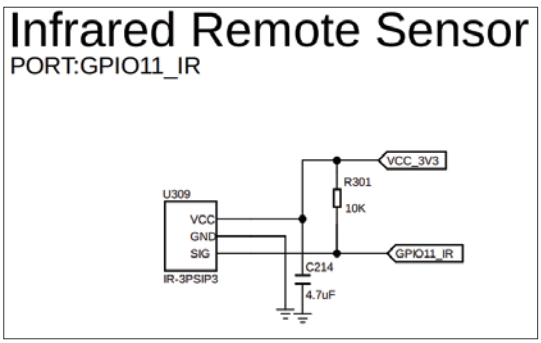
Introduction

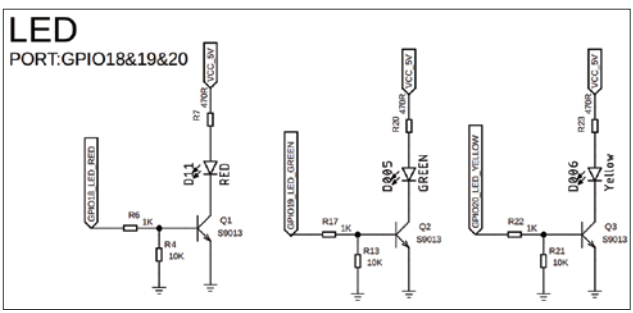
In this lesson, we will learn the basic operation of using an infrared remote control to control an LED.

Hardware required

• All-in-one-Starter-Kit-for-Pico2 x1

Hardware schematic





What will you see

After the course starts, you will observe the following:

- When you press the “1” button on the remote control, the red LED will light up.
- When you press the “2” button on the remote control, the yellow LED will light up.
- When you press the “3” button on the remote control, the green LED will light up.
- When you press the “4” button, all three LEDs (red, yellow, and green) will flash simultaneously.
- When you press the “5” button, the red, yellow, and green LEDs will display a running light effect.
- When you press the “6” button, all the LEDs will turn off.

Lesson 13 - Weather Reminder

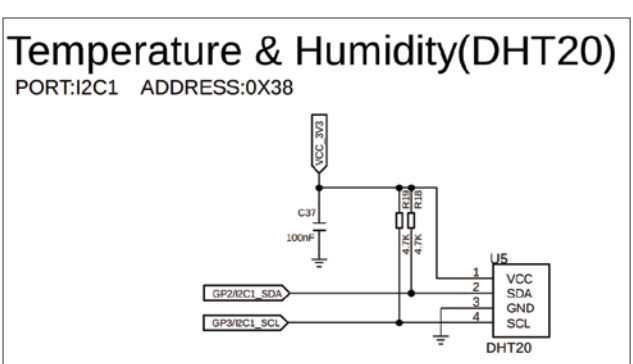
Introduction

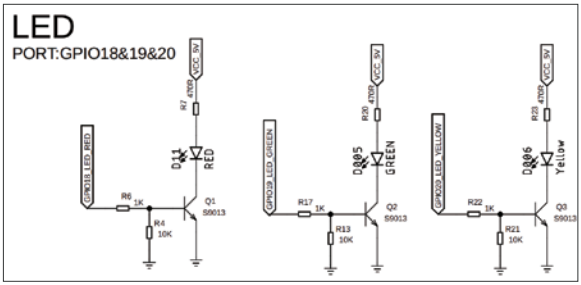
In this lesson, we will explore how to adjust the information displayed on the TTL screen, the on/off state of the TTL display, and the ringing state of the buzzer based on the temperature and humidity data detected by the DHT20 sensor.

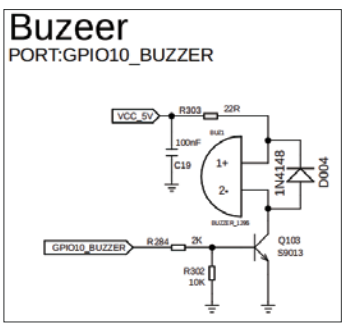
Hardware required

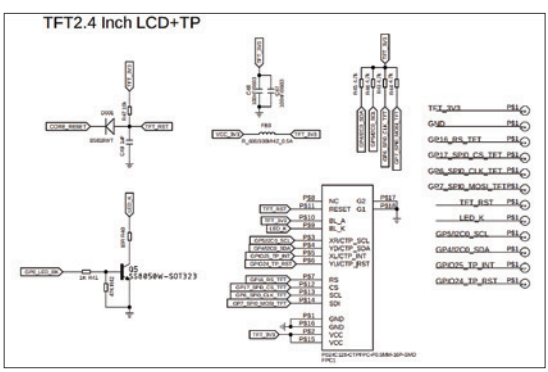
- All-in-one-Starter-Kit-for-Pico2 x1
- USB Cable x1

Hardware schematic









What will you see

After starting the course, you will see the TFT display information about temperature and humidity. If the temperature exceeds 25°C, the yellow light will turn on, and the TFT will display a warning message "Temperature Too High." If the temperature exceeds 30°C, the red light will turn on, and the TFT will display a warning message "Temperature Hot." If the humidity falls below 40%, the buzzer will sound, and the TFT will display a warning message "Air is Dry."

Lesson 14 - Servo Angle Control

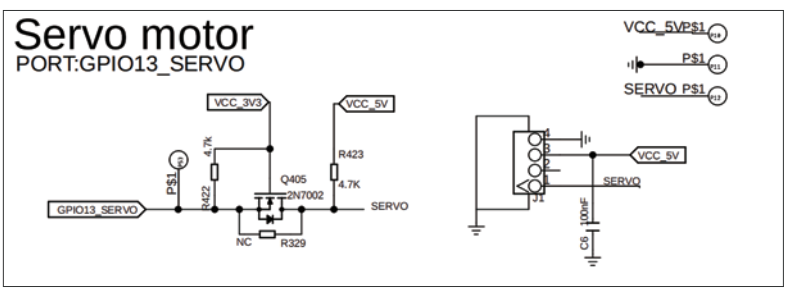
Introduction

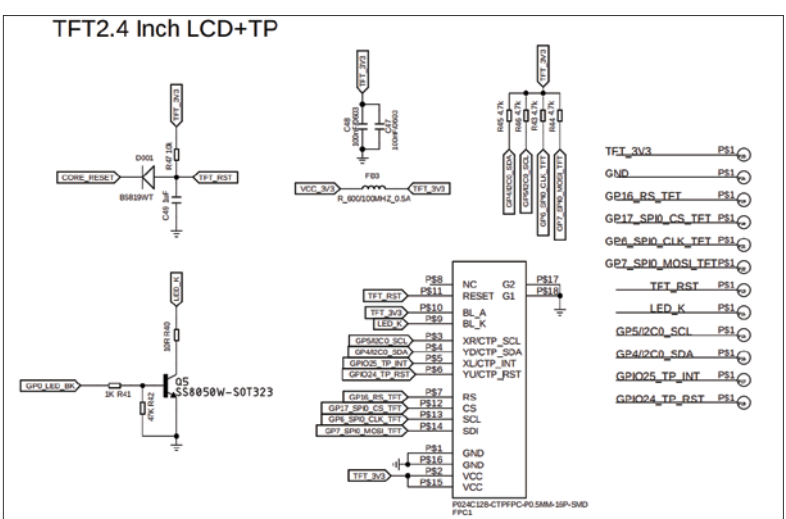
In this lesson, we will learn how to control the rotation angle of a servo motor using an infrared remote control and display the angle on the TFT screen.

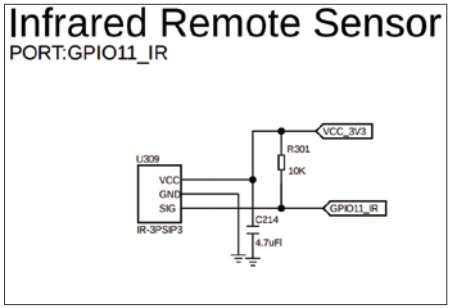
Hardware required

- All-in-one-Starter-Kit-for-Pico2 x1
- USB Cable x1
- Crowtail- IR Emitter x1

Hardware schematic







What will you see

After starting the course, you will see the TFT display the corresponding angle after the remote control inputs the angle. Once the confirmation key is pressed, the servo will rotate to the corresponding angle, and the current angle will be displayed on the LCD screen. When the stop button is pressed, the servo will cease operation; when the start button is pressed, the servo will begin to operate.

Lesson 15 - Polite Automatic Door

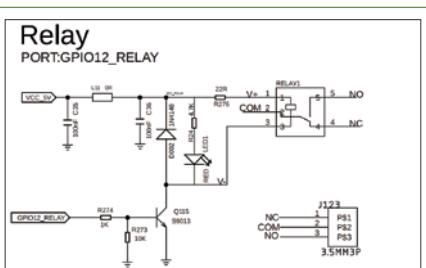
Introduction

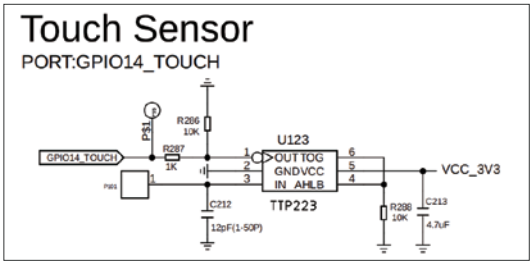
In this lesson, we will learn advanced operations of the servo motor. We will use a touch module to control the relay to turn on and off.

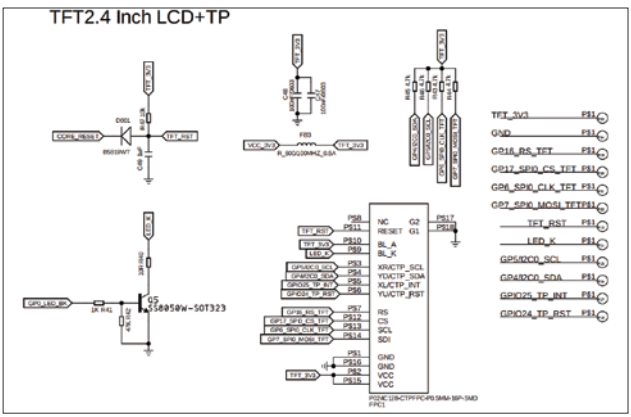
Hardware required

- All-in-one-Starter-Kit-for-Pico2 x1
- USB Cable x1

Hardware schematic







What will you see

After starting the course, the TFT will display "Please Open the Door." When you press the touch button, the relay will close the circuit (open the door), the relay indicator light will turn on, and the TFT will display a welcome message "Welcome." After a 10-second delay, the relay will automatically open the circuit (close the door), the relay indicator light will turn off, and the TFT will display "Please Open the Door" again.

Lesson 16 - Sound Reminder

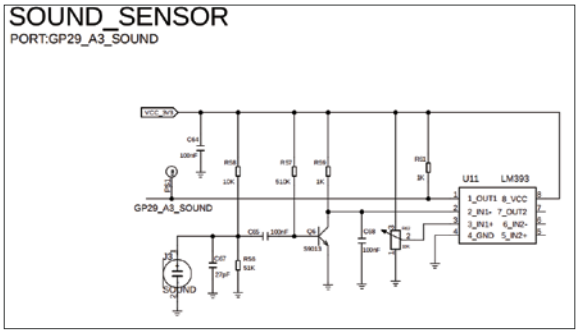
Introduction

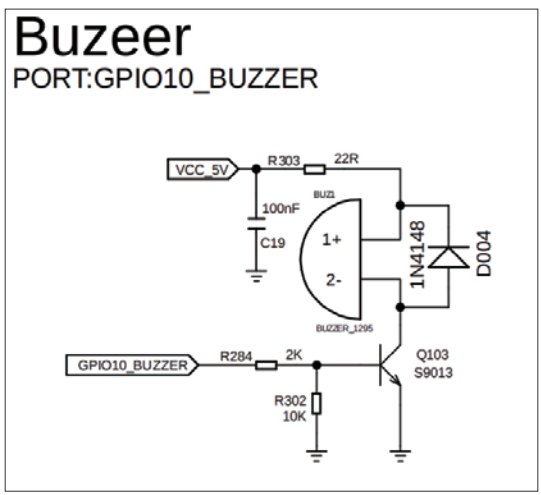
In this lesson, we will learn advanced operations of the sound sensor. We will use the sound sensor to detect the ambient noise in the current environment. When a sound is detected, the buzzer will be triggered to provide an alert.

Hardware required

- All-in-one-Starter-Kit-for-Pico2 x1
- USB Cable x1

Hardware schematic





What will you see

After starting the course, you will see that if the surrounding noise is too loud or you shout at the sound sensor, the buzzer will emit a one-second beep to remind you to lower the volume. If the noise continues to be loud, the buzzer will keep beeping. If there is no sound, the buzzer will stop beeping.

Lesson 17 - Calculation Of Acceleration

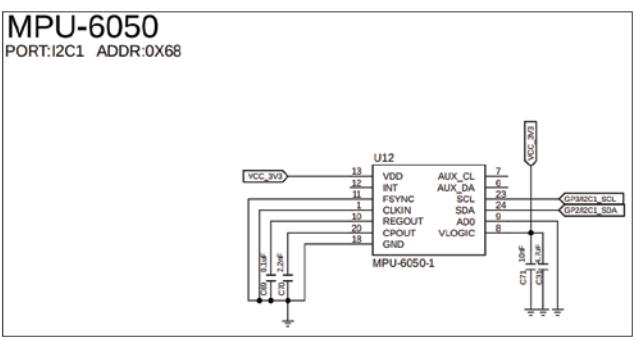
Introduction

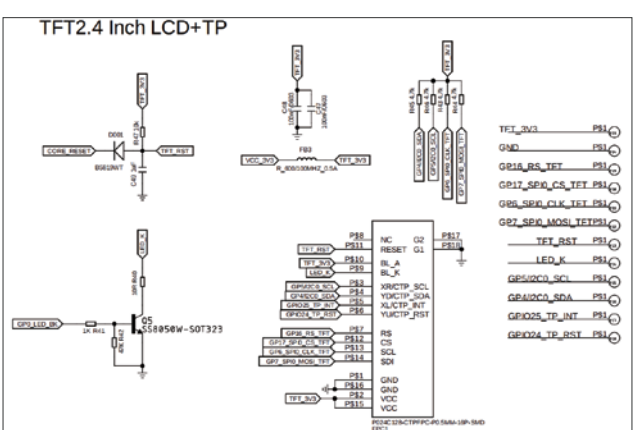
In this lesson, we will learn how to operate the MPU6050 sensor. By moving the board, the MPU6050 sensor will detect and calculate the different accelerations in various directions.

Hardware required

- All-in-one-Starter-Kit-for-Pico2 x1
- USB Cable x1

Hardware schematic





What will you see

After running the program, you will see the TFT display the accelerometer values for the X, Y, and Z axes. When you move the accelerometer quickly along an axis, you will observe that the accelerometer value for that axis changes.

Lesson 18 - Smart Corridor Light

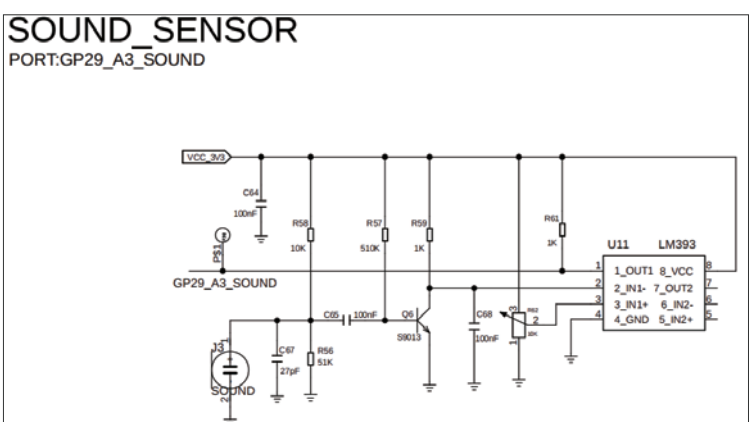
Introduction

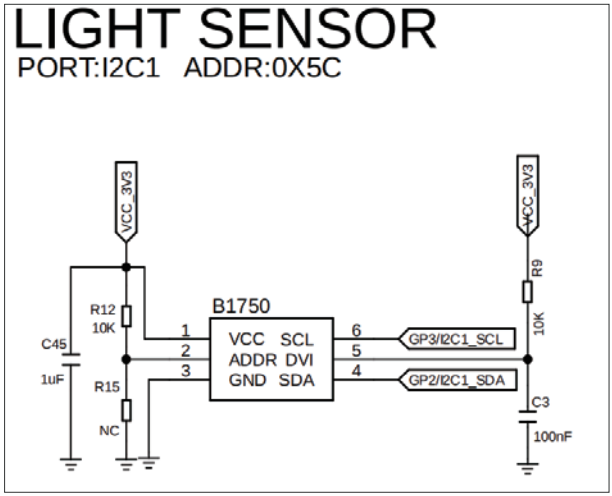
In this lesson, we will learn advanced operations involving the integration of the Sound Sensor, Light Sensor, and LED. By coordinating these sensors, we will achieve the effect of an intelligent corridor light.

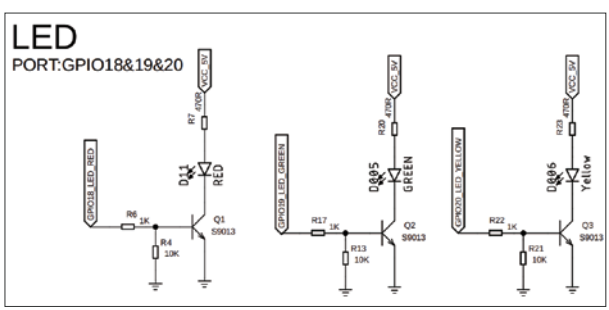
Hardware required

• All-in-one-Starter-Kit-for-Pico2 x1
• USB Cable x1

Hardware schematic







What will you see

After starting the course, when the ambient light is very strong, the LED will not turn on regardless of whether there is any sound. When the ambient light is very dim or when the light sensor is covered by hand, the LED will remain off by default. At this time, if a sound is detected, the LED will turn on for 10 seconds and then turn off. If sounds are detected continuously, the LED will remain on until there is no sound for 10 seconds, after which it will turn off.

Lesson 19 - Simple Calculator

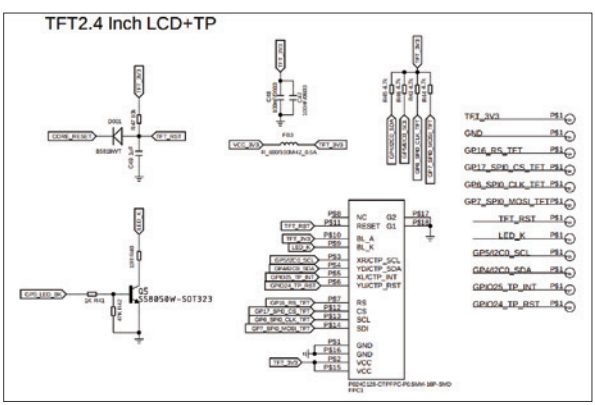
Introduction

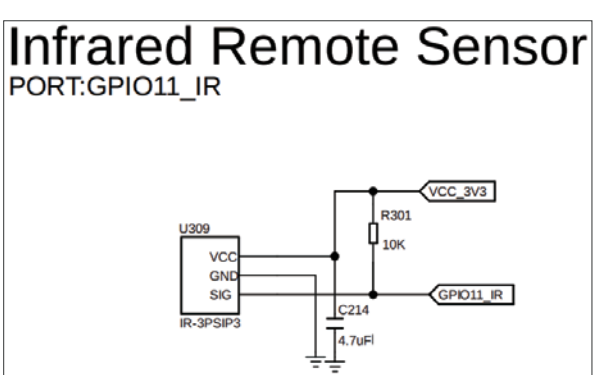
In this lesson, we will learn advanced usage of the IR (Infrared) remote control. We will input numbers and expressions using the IR remote control and display them on the screen. After pressing the confirmation button, the result will be calculated and displayed on the screen.

Hardware required

• All-in-one-Starter-Kit-for-Pico2 x1
• USB Cable x1

Hardware schematic





What will you see

The IR remote control serves as the input device, while the TFT acts as the calculation display. Five non-numeric buttons on the remote control are designated as: “+ (addition), - (subtraction), × (multiplication), ÷ (division), and = (equals).”
Upon running the program, the TFT will display: “Please Enter:”. At this stage, input the numerical values for the calculation, and the TFT will synchronously display the input. After pressing the equals sign (=), the TFT will display the result. If the calculation exceeds the permissible range, it will display “Out of Calculation Range.” If there is an error in the input format, it will display “Error.”

Lesson 20 - Hall Counter

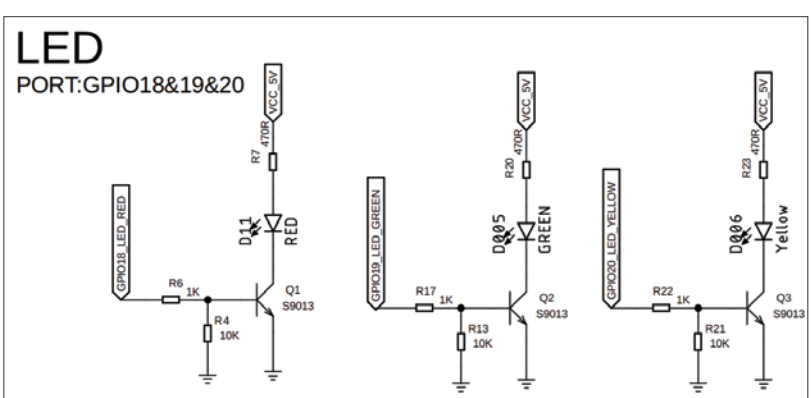
Introduction

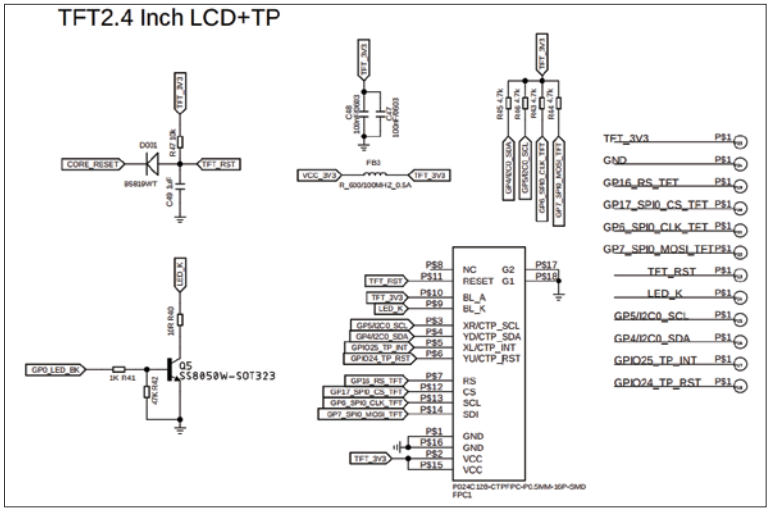
In this lesson, we will learn the basic usage of a Hall effect counter.

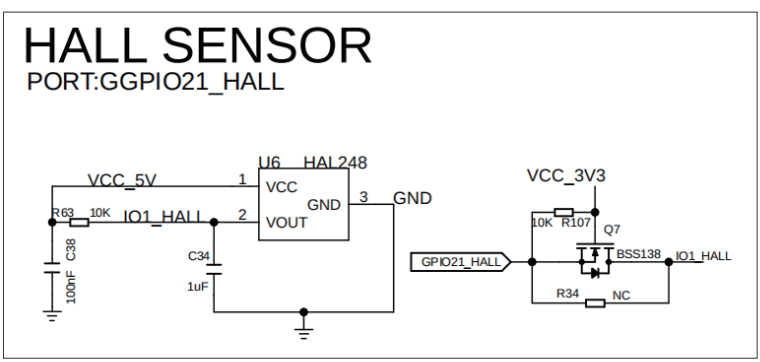
Hardware required

• All-in-one-Starter-Kit-for-Pico2 x1
• USB Cable x1

Hardware schematic







What will you see

After starting the course, the TFT will display “Counter: 0.” Each time you bring a magnet close to the Hall sensor, the red light will turn on once, and the TFT will display the count incremented by 1, and so on.

Lesson 21 - Smoke Alarm

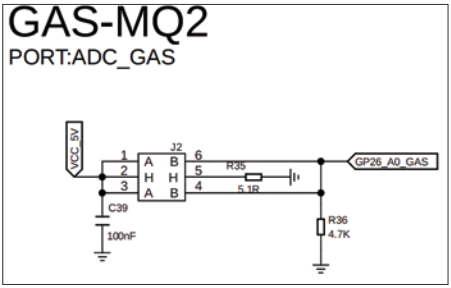
Introduction

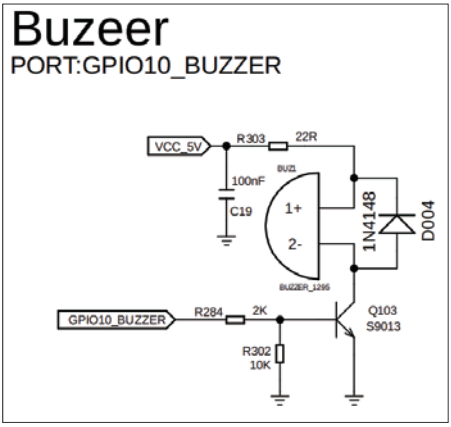
In this chapter, we will learn the basic usage of a smoke detector.

Hardware required

- All-in-one-Starter-Kit-for-Pico2 x1
- USB Cable x1

Hardware schematic





What will you see

After starting the course and running the program, allow the MQ2 sensor to warm up for a few minutes. When smoke (for example, smoke generated from burning and extinguishing a piece of paper; note: exercise caution!) approaches the MQ2 sensor, the buzzer will activate and sound.

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