5.Passive_Buzzer

Introduction

In this lesson, we will learn how to make a passive buzzer play music

Hardware Required

- ✓ 1 * Raspberry Pi
- ✓ 1 * T-Extension Board
- ✓ 1 * Passive Buzzer
- ✓ 1 * 40-pin Cable
- ✓ 1 * S8050 PNP Transistor
- ✓ Several Jumper Wires
- ✓ 1 * Breadboard
- ✓ 1 * Resistor(1kΩ)

Principle

Passive Buzzer

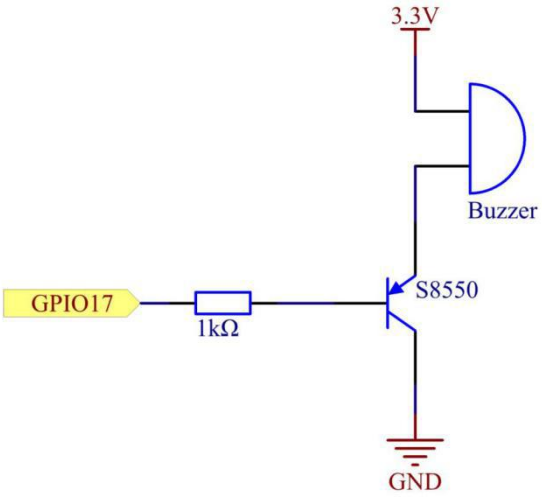
a passive buzzer does not have such source, so it will not beep if DC signals are used; instead, you need to use square waves whose frequency is between 2K and 5K to drive it. The active buzzer is often more expensive than the passive one because of multiple built-in oscillating circuits.

Schematic Diagram

In this experiment, a passive buzzer, a PNP transistor and a 1k resistor are used between the base of the transistor and GPIO to protect the transistor.

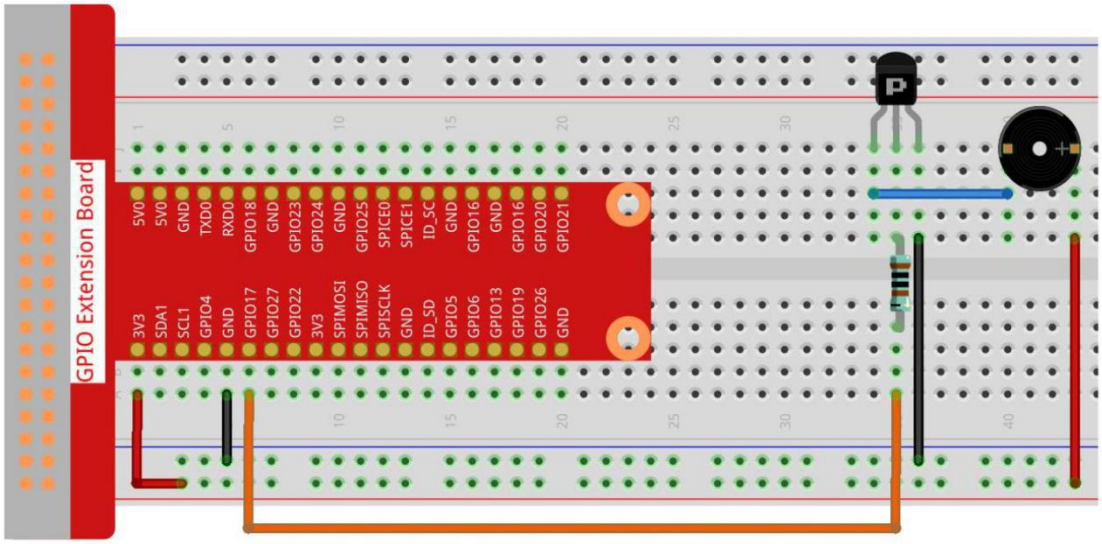
When GPIO17 is given different frequencies, the passive buzzer will emit different sounds; in this way, the buzzer plays music.

T-Board Name	physical	wiringPi	BCM
GPIO17	Pin 11	0	17



Experimental Procedures

Step 1: Build the circuit.



For C Language Users

Step 2: Change directory.

```
cd /home/pi/REXQualis_Raspberry_Pi_Complete_Starter_Kit/C/5.Passive_Buzzer
```

Step 3: Compile the code.

```
gcc 5.Passive_Buzzer.c -o Passive_Buzzer.out -lwiringPi
```

Step 4: Run the executable file above.

```
sudo ./Passive_Buzzer.out
```

The code run, the buzzer plays a piece of music.

Code

```
#include <wiringPi.h>
#include <softTone.h>
#include <stdio.h>
#define BuzPin      0
#define CL1   131
#define CL2   147
#define CL3   165
#define CL4   175
#define CL5   196
#define CL6   221
#define CL7   248
#define CM1   262
#define CM2   294
#define CM3   330
#define CM4   350
#define CM5   393
#define CM6   441
#define CM7   495
#define CH1   525
#define CH2   589
#define CH3   661
#define CH4   700
#define CH5   786
#define CH6   882
#define CH7   990
int song_1[] =
{CM3,CM5,CM6,CM3,CM2,CM3,CM5,CM6,CH1,CM6,CM5,CM1,CM3,CM2,CM2,CM3,C
M5,CM2,CM3,CM3,CL6,CL6,CL6,CM1,CM2,CM3,CM2,CL7,CL6,CM1,CL5};
```

```
int beat_1[] = {1,1,3,1,1,3,1,1,1,1,1,1,1,1,3,1,1,3,1,1,1,1,1,1,1,2,1,1,1,1,1,1,1,3};
int song_2[] =
{CM1,CM1,CM1,CL5,CM3,CM3,CM3,CM1,CM1,CM3,CM5,CM5,CM4,CM3,CM2,CM2,C
M3,CM4,CM4,CM3,CM2,CM3,CM1,CM1,CM3,CM2,CL5,CL7,CM2,CM1};
int beat_2[] = {1,1,1,3,1,1,1,3,1,1,1,1,1,1,3,1,1,1,2,1,1,1,3,1,1,1,3,3,2,3};
int main(void)
{
    int i, j;
    if(wiringPiSetup() == -1){ //when initialize wiring failed,print message to screen
        printf("setup wiringPi failed !");
        return 1;
    }
    if(softToneCreate(BuzPin) == -1){
        printf("setup softTone failed !");
        return 1;
    }
    while(1){
        printf("music is being played...\n");
        for(i=0;i<sizeof(song_1)/4;i++){
            softToneWrite(BuzPin, song_1[i]);
            delay(beat_1[i] * 500);
        }
        for(i=0;i<sizeof(song_2)/4;i++){
        softToneWrite(BuzPin, song_2[i]);
            delay(beat_2[i] * 500);
        }
    }
    return 0;
}
```

Code Explanation

```
#define CL1    131
#define CL2    147
#define CL3    165
#define CL4    175
#define CL5    196
#define CL6    221
#define CL7    248
#define CM1    262
#define CM2    294
…
```

These frequencies of each note are as shown. CL refers to low note, CM middle note, CH high note, 1-7 correspond to the notes C, D, E, F, G, A, B.

```
int song_2[] =
{CM1,CM1,CM1,CL5,CM3,CM3,CM3,CM1,CM1,CM3,CM5,CM5,CM4,CM3,CM2,
                    CM2,CM3,CM4,CM4,CM3,CM2,CM3,CM1,CM1,CM3,CM2,CL5,CL
                    7,CM2,CM1};
int beat_2[] = {1,1,1,3,1,1,1,3,1,1,1,1,1,1,3,1,1,1,2,1,1,1,3,1,1,1,3,3,2,3}
```

The array, song_1[] stores a musical score of a song in which beat_1[] refers to the beat of each note in the song (0.5s for each beat).

```
    if(softToneCreate(BuzPin) == -1){
        printf("setup softTone failed !");
        return 1;
```

This creates a software controlled tone pin. You can use any GPIO pin and the pin numbering will be that of the wiringPiSetup() function you used. The return value is 0 for success. Anything else and you should check the global errnovariable to see what went wrong.

```
        for(i=0;i<sizeof(song_2)/4;i++){
softToneWrite(BuzPin, song_2[i]);
            delay(beat_2[i] * 500);
        }
```

Employ a for statement to play song_1.

In the judgment condition, i<sizeof(song_1)/4，“devide by 4” is used because the array song_1[] is an array of the data type of integer, and each element takes up four bytes. The number of elements in song_1 (the number of musical notes) is gotten by deviding sizeof(song_4) by 4.

To enable each note to play for beat * 500ms, the function delay(beat_1[i] * 500) is called.

The prototype of softToneWrite(BuzPin, song_1[i])：

```
void softToneWrite (int pin, int freq);
```

This updates the tone frequency value on the given pin. The tone does not stop playing until you set the frequency to 0.

For Python Language Users

Step 2: Change directory.

```
cd /home/pi/REXQualis_Raspberry_Pi_Complete_Starter_Kit/Python
```

Step 3: Run.

```
sudo python3 5.Passive_Buzzer.py
```

The code run, the buzzer plays a piece of music.

Code

```
import RPi.GPIO as GPIO
import time
Buzzer = 11
CL = [0, 131, 147, 165, 175, 196, 211, 248]      # Frequency of Bass tone in C major
CM = [0, 262, 294, 330, 350, 393, 441, 495]    # Frequency of Midrange tone in C major
CH = [0, 525, 589, 661, 700, 786, 882, 990]     # Frequency of Treble tone in C major
```

```
song_1 = [  CM[3], CM[5], CM[6], CM[3], CM[2], CM[3], CM[5], CM[6], # Notes of song1
            CH[1], CM[6], CM[5], CM[1], CM[3], CM[2], CM[2], CM[3],
            CM[5], CM[2], CM[3], CM[3], CL[6], CL[6], CL[6], CM[1],
            CM[2], CM[3], CM[2], CL[7], CL[6], CM[1], CL[5] ]
beat_1 = [  1, 1, 3, 1, 1, 3, 1, 1,                  # Beats of song 1, 1 means 1/8 beat
            1, 1, 1, 1, 1, 1, 3, 1,
            1, 3, 1, 1, 1, 1, 1, 1,
            1, 2, 1, 1, 1, 1, 1, 1,
            1, 1, 3 ]
song_2 = [  CM[1], CM[1], CM[1], CL[5], CM[3], CM[3], CM[3], CM[1], # Notes of song2
            CM[1], CM[3], CM[5], CM[5], CM[4], CM[3], CM[2], CM[2],
            CM[3], CM[4], CM[4], CM[3], CM[2], CM[3], CM[1], CM[1],
            CM[3], CM[2], CL[5], CL[7], CM[2], CM[1]      ]
beat_2 = [  1, 1, 2, 2, 1, 1, 2, 2,                  # Beats of song 2, 1 means 1/8 beat
            1, 1, 2, 2, 1, 1, 3, 1,
            1, 2, 2, 1, 1, 2, 2, 1,
            1, 2, 2, 1, 1, 3 ]
def setup():
    GPIO.setmode(GPIO.BOARD)          # Numbers GPIOs by physical location
    GPIO.setup(Buzzer, GPIO.OUT)      # Set pins' mode is output
    global Buzz                       # Assign a global variable to replace GPIO.PWM
    Buzz = GPIO.PWM(Buzzer, 440)      # 440 is initial frequency.
    Buzz.start(50)                    # Start Buzzer pin with 50% duty cycle
def loop():
    while True:
        print ('\n    Playing song 1...')
        for i in range(1, len(song_1)):       # Play song 1
        Buzz.ChangeFrequency(song_1[i]) # Change the frequency along the song
note
        time.sleep(beat_1[i] * 0.5)       # delay a note for beat * 0.5s
```

```
            time.sleep(1)                                   # Wait a second for next song.
            print ('\n\n       Playing song 2...')
            for i in range(1, len(song_2)):          # Play song 1
            Buzz.ChangeFrequency(song_2[i])   # Change the frequency along the song
note
            time.sleep(beat_2[i] * 0.5)          # delay a note for beat * 0.5s
def destory():
      Buzz.stop()                          # Stop the buzzer
      GPIO.output(Buzzer, 1)          # Set Buzzer pin to High
      GPIO.cleanup()                       # Release resource
if __name__ == '__main__':          # Program start from here
      setup()
      try:
            loop()
except KeyboardInterrupt:    # When 'Ctrl+C' is pressed, the program destroy() will be
executed.
        destory()
```

Code Explanation

```
CL = [0, 131, 147, 165, 175, 196, 211, 248]        # Frequency of Bass tone in C major
CM = [0, 262, 294, 330, 350, 393, 441, 495]     # Frequency of Midrange tone in C major
CH = [0, 525, 589, 661, 700, 786, 882, 990]       # Frequency of Treble tone in C major
```

These are the frequencies of each note. The first 0 is to skip CL[0] so that the number 1-7 corresponds to the CDEFGAB of the tone.

```
song_1 = [    CM[3], CM[5], CM[6], CM[3], CM[2], CM[3], CM[5], CM[6],
                  CH[1], CM[6], CM[5], CM[1], CM[3], CM[2], CM[2], CM[3],
                  CM[5], CM[2], CM[3], CM[3], CL[6], CL[6], CL[6], CM[1],
                  CM[2], CM[3], CM[2], CL[7], CL[6], CM[1], CL[5] ]
```

These arrays are the notes of a song.

```
beat_2 = [   1, 1, 2, 2, 1, 1, 2, 2,1, 1, 2, 2, 1, 1, 3, 1,1, 2, 2, 1, 1, 2, 2, 1,1, 2, 2, 1, 1, 3 ]
```

Every sound beat (each number) represents the ⅛ beat, or 0.5s

```
Buzz = GPIO.PWM(Buzzer, 440)
Buzz.start(50)
```

Define pin Buzzer as PWM pin, then set its frequency to 440 and Buzz.start(50) is used to run PWM. What's more, set the duty cycle to 50%.

```
        for i in range(1, len(song_1)):
            Buzz.ChangeFrequency(song_1[i])
            time.sleep(beat_1[i] * 0.5)
```

Run a for loop, then the buzzer will play the notes in the array song_1[] with the beats in the beat_1[] array, .

Now you can hear the passive buzzer playing music.

Phenomenon Picture