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

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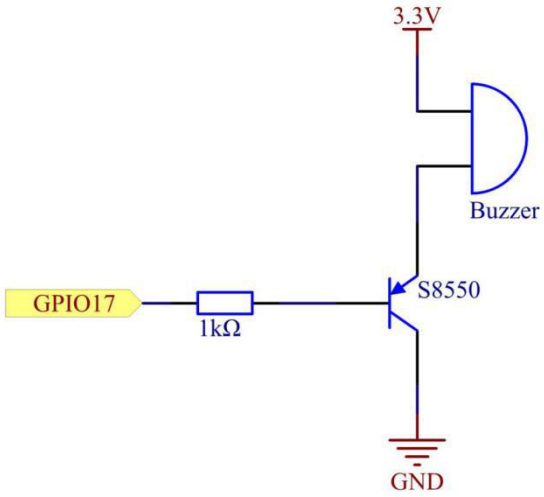
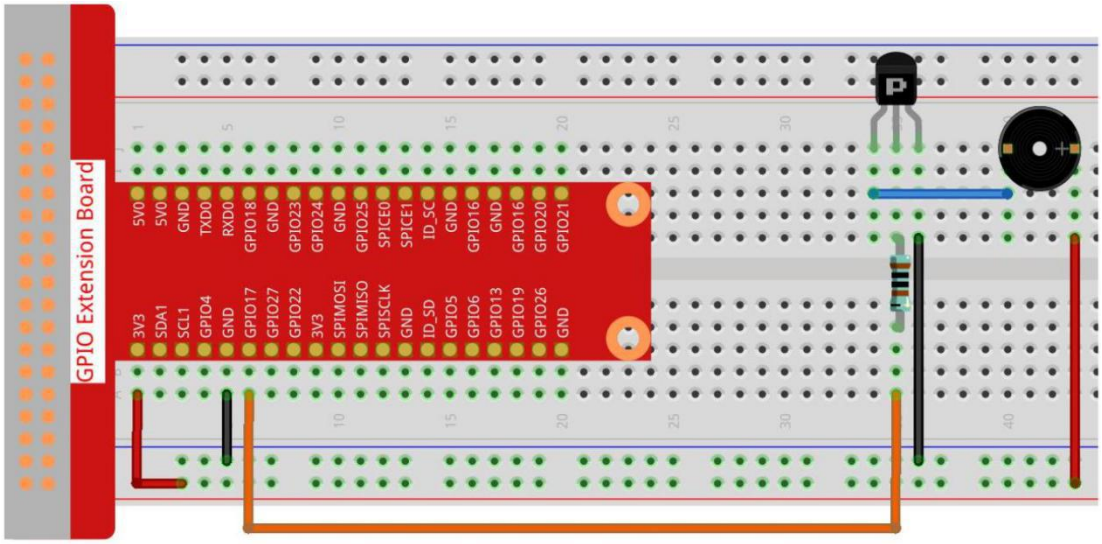


Experimental Procedures

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
```

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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
```

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```
#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,CM5,CM2,CM3,CM3,CL6,CL6,CL6,CM1,CM2,CM3,CM2,CL7,CL6,CM1,CL
5};

int beat_1[] = {1,1,3,1,1,3,1,1,1,1,1,1,1,3,1,1,3,1,1,1,1,1,1,2,1,1,1,1,1,1,1,3};

int song_2[] =
{CM1,CM1,CM1,CL5,CM3,CM3,CM3,CM1,CM1,CM3,CM5,CM5,CM4,CM3,CM2,
CM2,CM3,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
…
```

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.

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```
int song_1[] =
{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,CL7,CM2,CM1};

int beat_1[] = {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_1)/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

The code here is for Python3, if you need for Python2, please open the code with the suffix py2 in the attachment.

```
#!/usr/bin/env python3
#-----------------------------------------------
#
#    This is a program for Passive Buzzer Module
#          It will play simple songs.
#    You could try to make songs by youselves!
#
#          Passive buzzer                    Pi
#                VCC ----------------- 3.3V
#                GND ------------------ GND
#                SIG ----------------- Pin 11
#
#-----------------------------------------------

import RPi.GPIO as GPIO
import time
```

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```
Buzzer = 11

CL = [0, 131, 147, 165, 175, 196, 211, 248]          # Frequency of Low C notes

CM = [0, 262, 294, 330, 350, 393, 441, 495]          # Frequency of Middle C notes

CH = [0, 525, 589, 661, 700, 786, 882, 990]          # Frequency of High C notes

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 beats
             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 beats
             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 ration


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 child program
destroy() will be  executed.
        destory()
```

Code Explanation

```
CL = [0, 131, 147, 165, 175, 196, 211, 248]        # Frequency of Low C notes
CM = [0, 262, 294, 330, 350, 393, 441, 495]        # Frequency of Middle C notes
CH = [0, 525, 589, 661, 700, 786, 882, 990]        # Frequency of High C notes
```

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], # 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]     ]
```

These arrays are the notes of a song.

```
beat_2 = [    1, 1, 2, 2, 1, 1, 2, 2,          # Beats of song 2, 1 means 1/8 beats
              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%.

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

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