M487通过DAC播放音效

NuMicro® 32 位系列微控制器范例代码介绍

文件信息

应用简述	本范例使用 M487 MCU 通过 DAC 播放 SD 卡里 WAV 文件音效
BSP 版本	M480_BSP_CMSIS_V3.05.003
开发平台	NuMaker-PFM-M487 V3.0

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1 概述

本范例使用M487 MCU通过DAC播放SD卡里WAV文件音效。

1.1 原理

使用M487 MCU打开SD卡上的WAV（PCM格式）文件，读出数据将16-bit singed数据转成12-bit unsigned数据再用timer触发PDMA将数据搬运到DAC，接耳机时，不需要外接其它电路，通过DAC可直接驱动。而接喇叭时，需要外接功放模块，本范例代码测试时使用的是HEROIC的HT8693单声道音频功放模块，HT8693是一款具有D类和AB类两种工作模式的音频功率放大器，D类模式下最大供电电压可达9V，AB类模式下最大供电电压可达到8.4V。

音频源需要是单声道的16-bit PCM格式，WAV文件。

1.2 执行结果

程序运行打印信息如下图所示：

```
+------------------------------------------------------------------------+
|          Example of playing WAV file on SD card through DAC            |
+------------------------------------------------------------------------+
***** card insert !
Done..
```

图 1-1 SD 卡插入并成功播放 WAV 文件程序运行打印结果

```
+------------------------------------------------------------------------+
|          Example of playing WAV file on SD card through DAC            |
+------------------------------------------------------------------------+
SD initial fail!!
Open file error!
```

图 1-2 SD 卡未插入程序运行打印结果

2 代码介绍

SD 卡里 WAV 文件名定义为 test.wav,并打开该文件。

```
res = f_open(&wavFileObject, "0:\\test.wav", FA_OPEN_EXISTING | FA_READ);
```

读取采样率，设置 timer 触发时间。

```
// read sampling rate from WAV header
memset(aWavHeader, 0, sizeof(aWavHeader));
f_read(&wavFileObject, aWavHeader, 44, &ReturnSize);
u32WavSamplingRate = aWavHeader[6];

u8PCMBufferPlayIdx = 0;
PDMA_Init(u32WavSamplingRate);
```

读出数据将 16-bit singed 数据转成 12-bit unsigned 数据。

```
while (1)
{
    if (u8PCMBuffer_Alt)
    {
        u8PCMBuffer_Alt = 0;

        res = f_read(&wavFileObject, (uint8_t *)&aPCMBuffer[2][0], PCM_BUFFER_SIZE
                          * 4, &ReturnSize);
        pPCMSrcBuffer = (uint16_t *)&aPCMBuffer[2][0];

        for (i = 0; i < PCM_BUFFER_SIZE * 2; i++)
        {
            if (pPCMSrcBuffer[i] & 0x8000)
            //signed 16-bit data convert to unsigned 12-bit data
            {
                pPCMSrcBuffer[i] = ~(pPCMSrcBuffer[i] - 1);
                pPCMSrcBuffer[i] =   0x800 - (pPCMSrcBuffer[i] >> 4);
            }
            else
            {
                pPCMSrcBuffer[i] = (pPCMSrcBuffer[i] >> 4) + 0x800;
            }
        }
        if (u8PCMBufferPlayIdx == 1)
        {
```

```
                pPCMDesBuffer = (uint16_t *)&aPCMBuffer[0][0];

                for (i = 0; i < PCM_BUFFER_SIZE * 2; i++)
                pPCMDesBuffer[i] = pPCMSrcBuffer[i];

            }
            else
            {
                pPCMDesBuffer = (uint16_t *)&aPCMBuffer[1][0];

                for (i = 0; i < PCM_BUFFER_SIZE * 2; i++)
                    pPCMDesBuffer[i] = pPCMSrcBuffer[i];
            }

            if (f_eof(&wavFileObject))
                break;

        }
    }
```

3 软件与硬件需求

3.1 软件需求

- BSP 版本
  - M480 Series BSP CMSIS V3.05.003
- IDE 版本
  - Keil uVersion 5.35

3.2 硬件需求

- 电路组件
  - NuMaker-PFM-M487 V3.0
  - 单声道音频功放模块 (HT8693)
  - 15W、8 欧姆喇叭
- 示意图

通过 DAC 输出音效有两种方案，如下连线图是耳机输出方案：

	DAC0_OUT(PB.12)	→	左声道/右声道	
	GND	↔	GND	
	NuMaker-PFM-M487		耳机	

图 3-1 M487 与耳机连接图

以下连线图是 DAC 输出外加 HT8693 功放模块和喇叭方案：

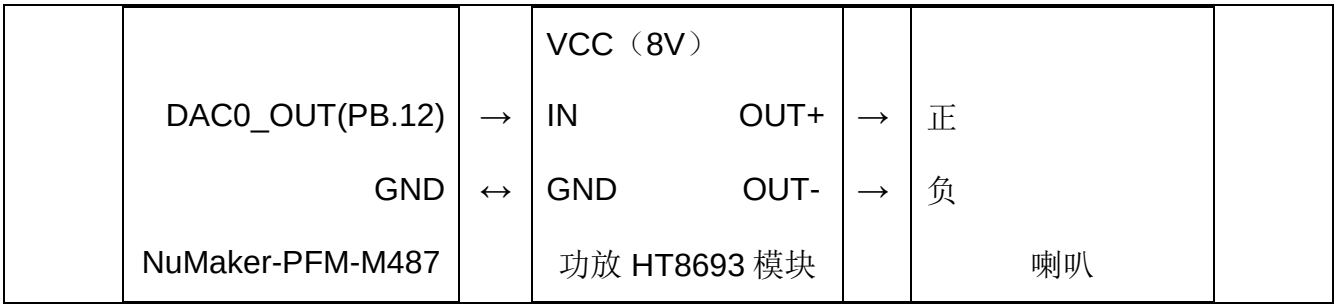

图 3-2 M487 与 HT8693 和喇叭连接图

4 目录信息

EC_M487_DAC_Wavplayer_V1.00	
Library	Sample code header and source files
CMSIS	Cortex® Microcontroller Software Interface Standard (CMSIS) by Arm® Corp.
Device	CMSIS compliant device header file
StdDriver	All peripheral driver header and source files
SampleCode	
ExampleCode	Source file of example code
ThirdParty	
FatFs	A generic FAT file system module for small embedded systems. Its official website is: http://elm-chan.org/fsw/ff/00index_e.html.

图 4-1 目录信息

5 范例程序执行

1. 根据目录信息章节进入 ExampleCode 路径中的 KEIL 文件夹，双击 DAC_Wavplayer.uvproj。
2. 进入编译模式界面
   a. 编译
   b. 下载代码至内存
   c. 进入 / 离开仿真模式
3. 进入仿真模式界面
   a. 执行代码

6 修订纪录

Date	Revision	Description
2022.03.22	1.00	1. 初始发布.

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