

UART通信

北京匠牛科技
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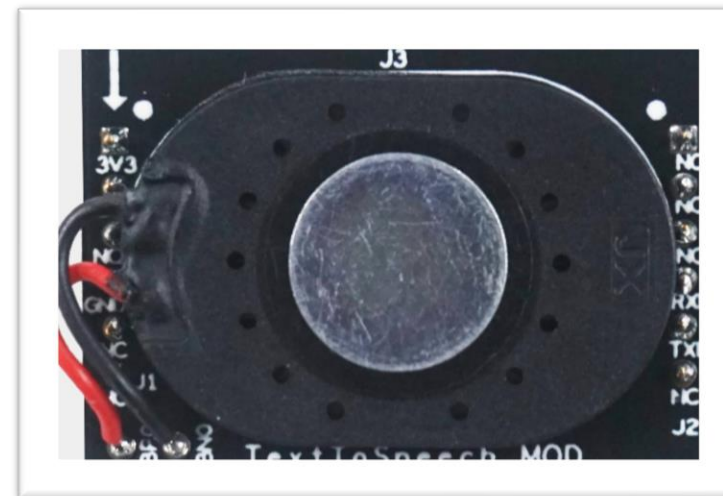
概要

使用语音播报模块播报匠牛社区：

1. 语音播报模块简介
2. UART简介
3. MSP432初始化配置UART功能
4. 代码分析

语音播报模块简介

- 可任意合成播报中文文本、英文字母、数字;
- 支持GB2312、GBK、BIG5和UNICODE内码格式的文本;
- UART通信接口, 支持三种波特率: 9600bps, 19200bps, 38400bps;



语音播报模块

本案例播报内容

帧结构	帧头	数据区 长度	数据区			
			命令字	命令参数	待发送文本	异或校验
数据	0xFD	0x00 0x0B	0x01	0x01	匠牛社区 0xBD 0xB3 0xC5 0xA3 0xC9 0xE7 0xC7 0xF8	0x8E
数据帧	0xFD, 0x00, 0x0B, 0x01, 0x01, 0xBD, 0xB3, 0xC5, 0xA3, 0xC9, 0xE7, 0xC7, 0xF8, 0x8E					
说明	播放文本编码格式为“GBK”的文本“匠牛社区”，不带音乐背景					

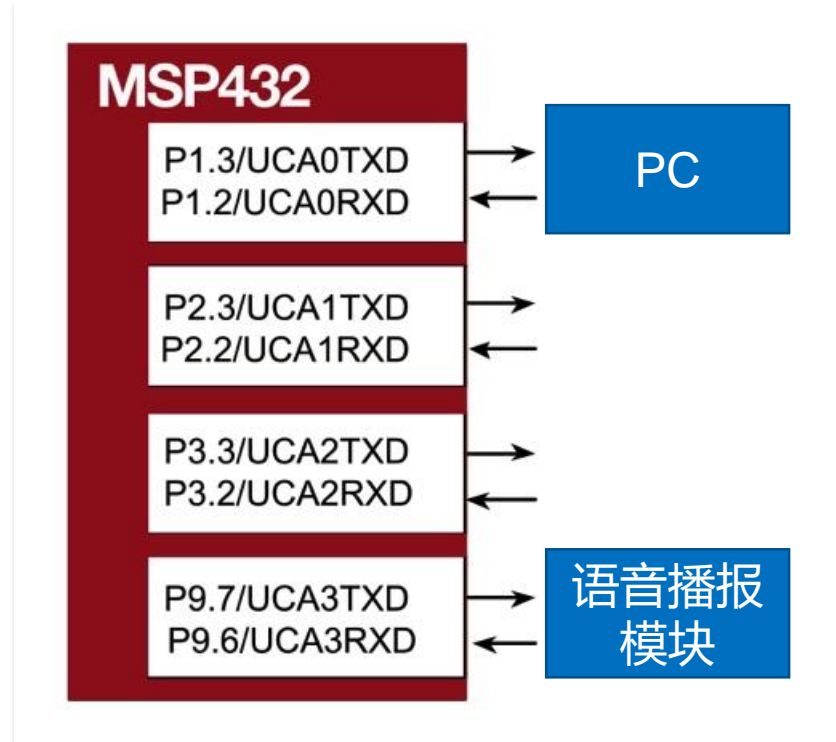
什么是UART?

UART是通用异步收发传输器 (Universal Asynchronous Receiver/Transmitter)的缩写，它是一种通用串行数据总线，用于异步通信。UART通信为双向通信，可以实现全双工传输和接收。

工作原理是将传输数据的每个字符一位接一位地传输。包括起始位、数据位、奇偶校验位、停止位、空闲位。UART传输还有一个参数：波特率，是衡量数据传送速率的指标，表示每秒钟传送的符号数。

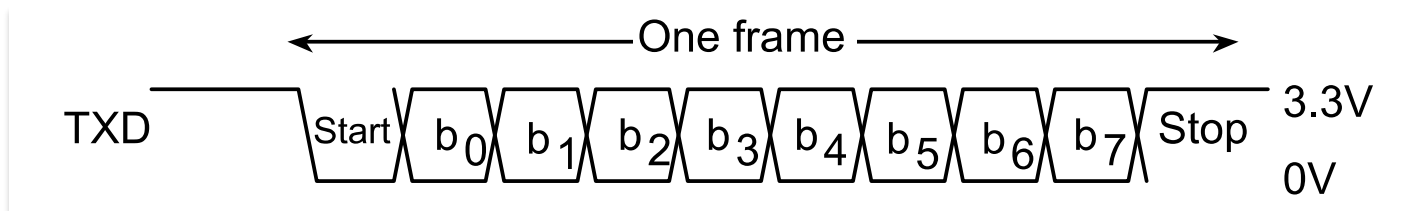
UART通信非常的简单可靠，它只需要三条线，分别为TXD、RXD和GND，TXD用来发送数据，RXD用来接收数据，以及一根接地线GND。

MSP432 UART端口选择



Pin	PxSEL1=0, PxSEL0=1
P1.2	UCA0RXD
P1.3	UCA0TXD
P2.2	UCA1RXD
P2.3	UCA1TXD
P3.2	UCA2RXD
P3.3	UCA2TXD
P9.6	UCA3RXD
P9.7	UCA3TXD

通用异步收发器



- **发送/接收一帧**
 - 1开始(低), 5-8位数据, 1停止(高)
 - 串行方式, 每**bit-time**一个bit
 - 没有发送时钟, 异步, 数据时序
- **波特率**是每单位时间的总比特数
 - 波特率 = $1 / \text{bit-time}$
 - 发送器和接收器都一致并知道波特率
- **带宽**是每单位时间的数据或信息
 - 带宽 = (数据位/帧位)*波特率

MSP432 UART UCAXCTLW0寄存器

Bit	Field	Type	Reset	Description
15	UCPEN	RW	0h	Parity enable 0b = Parity disabled 1b = Parity enabled. Parity bit is generated (UCAXTXD) and expected (UCAXRXD). In address-bit multiprocessor mode, the address bit is included in the parity calculation.
14	UCPAR	RW	0h	Parity select. UCPAR is not used when parity is disabled. 0b = Odd parity 1b = Even parity
13	UCMSB	RW	0h	MSB first select. Controls the direction of the receive and transmit shift register. 0b = LSB first 1b = MSB first
12	UC7BIT	RW	0h	Character length. Selects 7-bit or 8-bit character length. 0b = 8-bit data 1b = 7-bit data
11	UCSPB	RW	0h	Stop bit select. Number of stop bits. 0b = One stop bit 1b = Two stop bits
10-9	UCMODEx	RW	0h	eUSCI_A mode. The UCMODEx bits select the asynchronous mode when UCSYNC = 0. 00b = UART mode 01b = Idle-line multiprocessor mode 10b = Address-bit multiprocessor mode 11b = UART mode with automatic baud-rate detection
8	UCSYNC	RW	0h	Synchronous mode enable 0b = Asynchronous mode 1b = Synchronous mode
7-6	UCSELx	RW	0h	eUSCI_A clock source select. These bits select the BRCLK source clock. 00b = UCLK 01b = ACLK 10b = SMCLK 11b = SMCLK
5	UCRXEIE	RW	0h	Receive erroneous-character interrupt enable 0b = Erroneous characters rejected and UCRXIFG is not set. 1b = Erroneous characters received set UCRXIFG.
4	UCBRKIE	RW	0h	Receive break character interrupt enable 0b = Received break characters do not set UCRXIFG. 1b = Received break characters set UCRXIFG.

备注：见
MSP432P4xx Technical Reference Manual
手册24.4.1章节

MSP432 UART UCxBRW 寄存器

设置UART 波特率寄存器

Table 24-10. UCxBRW Register Description

Bit	Field	Type	Reset	Description
15-0	UCBRx	RW	0h	Clock prescaler setting of the baud-rate generator

备注：见MSP432P4xx Technical Reference Manual 手册24.4.3章节

MSP432初始化配置UART功能 (上)

```
// Initialize the UART3 for 9600 baud rate (assuming 12 MHz SMCLK clock),  
// 8 bit word length, no parity bits, one stop bit
```

```
void UART3_Init(void){  
    EUSCI_A3->CTLW0 = 0x0001; // hold the USCI module in reset mode  
    // bit15=0,          no parity bits  
    // bit14=x,          not used when parity is disabled  
    // bit13=0,          LSB first  
    // bit12=0,          8-bit data length  
    // bit11=0,          1 stop bit  
    // bits10-8=000,     asynchronous UART mode  
    // bits7-6=11,       clock source to SMCLK  
    // bit5=0,           reject erroneous characters and do not set flag  
    // bit4=0,           do not set flag for break characters  
    // bit3=0,           not dormant  
    // bit2=0,           transmit data, not address (not used here)  
    // bit1=0,           do not transmit break (not used here)  
    // bit0=1,           hold logic in reset state while configuring  
    EUSCI_A3->CTLW0 = 0x00C1;
```

MSP432初始化配置UART功能 (下)

```
// set the baud rate
// N = clock/ baud rate = 12,000,000/115,200 = 104.1667
// UCBR = baud rate = int(N) = 1250
EUSCI_A3->BRW = 1250; //1250 -- 9600 //115200 ---104;
EUSCI_A3->MCTLW &= ~0xFFF1; // clear first and second modulation stage bit fields
P9->SEL0 |= 0xC0;
P9->SEL1 &= ~0xC0; // configure P9.7 and P9.6 as primary module function

EUSCI_A3->CTLW0 &= ~0x0001; // enable the USCI module
EUSCI_A3->IE &= ~0x000F; // disable interrupts (transmit ready, start received,
transmit empty, receive full)
}
```

内容小结

1. 熟练使用语音播报模块;
2. 熟悉UART协议, 能够配置MSP432的UART功能;

课后练习&思考&本知识点延伸扩展

课后练习:

1. 使用语音播报模块播放其它内容, 如学校中文名称和英文名称、日期;

思考:

1. 思考UART收发数据的工作原理;

2. 对比思考前面课程中讲到的SPI通信协议和UART通信协议有什么优缺点?

本知识点延伸扩展:

1. 结合语音识别模块和语音播报模块, 实现TI-RSLK机器人的语音交互系统设计;

2. 使用UART通信添加CC3100WIFI模块和CC2650蓝牙模块;

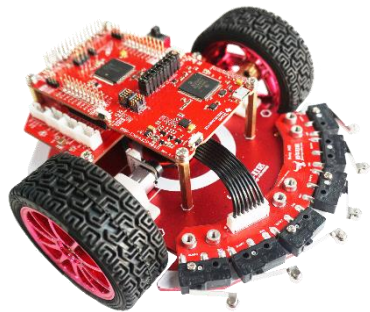
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