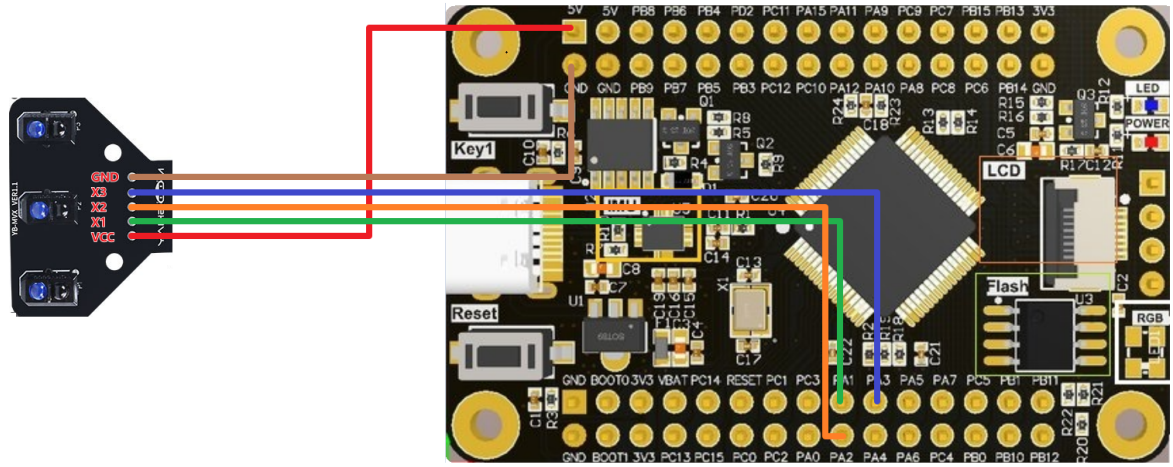
3-channel tracking module: ADC multichannel conversion

Hardware wiring



Three-way line patrol module	STM32F103RCT6
VCC	5V/3.3V
X1	PA1
X2	PA2
X3	PA3
GND	GND

Brief principle

The three-way line patrol module can output the analog values of X1, X2, and X3.

The analog value data of the three-way line patrol module X1, X2 and X3 is obtained through ADC conversion, and the data range is 0-4095, which can be seen in the code for details.

Main code

main.c

```
#include "stm32f10x.h"
#include "SysTick.h"
#include "UART.h"
#include "ADC.h"

int main(void)
{
    SysTick_Init();//滴答定时器初始化
    UART1_Init();//UART1初始化
```

```
    ADC1_Init();//ADC1初始化

    printf("Trail module!\n");//打印Trail module!

    while(1)
    {
        Trail_X_Y_Z_Data();//获取JoyStick X Y轴数据 并打印相关信息到串口
    }
}
```

SysTick.c

```
#include "SysTick.h"

unsigned int Delay_Num;

void SysTick_Init(void)//滴答定时器初始化
{
    while(SysTick_Config(72));//设置重装载值 72 对应延时函数为微秒级
    //若将重装载值设置为72000 对应延时函数为毫秒级
    SysTick->CTRL &= ~(1 << 0);//定时器初始化后关闭，使用再开启
}

void Delay_us(unsigned int NCount)//微秒级延时函数
{
    Delay_Num = NCount;
    SysTick->CTRL |= (1 << 0);//开启定时器
    while(Delay_Num);
    SysTick->CTRL &= ~(1 << 0);//定时器初始化后关闭，使用再开启
}

void SysTick_Handler(void)
{
    if(Delay_Num != 0)
    {
        Delay_Num--;
    }
}
```

SysTick.h

```
#ifndef __SYSTICK_H__
#define __SYSTICK_H__

#include "stm32f10x.h"

void SysTick_Init(void);//滴答定时器初始化
void Delay_us(unsigned int NCount);//微秒级延时函数

#endif
```

UART.c

```
#include "UART.h"

void UART1_Init(void)//UART1初始化
{
    USART_InitTypeDef USART_InitStructure;
    GPIO_InitTypeDef GPIO_InitStructure;

    /* Enable GPIO clock */
    /* 使能GPIOA AFIO时钟 TXD(PA9) RXD(PA10) */
    RCC_APB2PeriphClockCmd(RCC_APB2Periph_GPIOA | RCC_APB2Periph_AFIO, ENABLE);

    /* Enable USART1 Clock */
    /* 使能串口1 */
    RCC_APB2PeriphClockCmd(RCC_APB2Periph_USART1 , ENABLE);

    /* Configure USART1 Rx as input floating */
    /* 配置RXD引脚 PA10 浮空输入模式 */
    GPIO_InitStructure.GPIO_Pin = GPIO_Pin_10;
    GPIO_InitStructure.GPIO_Mode = GPIO_Mode_IN_FLOATING;
    GPIO_Init(GPIOA, &GPIO_InitStructure);

    /* Configure USART1 Tx as alternate function push-pull */
    /* 配置TXD引脚 PA9 复用推挽输出模式 */
    GPIO_InitStructure.GPIO_Pin = GPIO_Pin_9;
    GPIO_InitStructure.GPIO_Speed = GPIO_Speed_50MHz;
    GPIO_InitStructure.GPIO_Mode = GPIO_Mode_AF_PP;
    GPIO_Init(GPIOA, &GPIO_InitStructure);

    /* USART1 configured as follow:
    - BaudRate = 115200 baud
    - Word Length = 8 Bits
    - One Stop Bit
    - No parity
    - Hardware flow control disabled (RTS and CTS signals)
    - Receive and transmit enabled
    */
    USART_InitStructure.USART_BaudRate = 115200;//波特率设置
    USART_InitStructure.USART_WordLength = USART_WordLength_8b;//8位数据位
    USART_InitStructure.USART_StopBits = USART_StopBits_1;//1位停止位
    USART_InitStructure.USART_Parity = USART_Parity_No;//无奇偶校验位
    USART_InitStructure.USART_HardwareFlowControl =
USART_HardwareFlowControl_None;//无需硬件流控
    USART_InitStructure.USART_Mode = USART_Mode_Rx | USART_Mode_Tx;//全双工 即发送
也接受
    USART_Init(USART1, &USART_InitStructure);

    /* Enable USART1 Receive and Transmit interrupts */
    USART_ITConfig(USART1, USART_IT_RXNE, ENABLE);
    USART_ITConfig(USART1, USART_IT_TXE, ENABLE);

    /* Enable the USART1 */
    /* 使能USART1 */
    USART_Cmd(USART1, ENABLE);
```

```
}

void NVIC_UART1_Init(void)//UART1 NVIC配置
{
    NVIC_InitTypeDef NVIC_InitStructure;

    /* Configure the NVIC Preemption Priority Bits */
    NVIC_PriorityGroupConfig(NVIC_PriorityGroup_0);

    /* Enable the USART1 Interrupt */
    NVIC_InitStructure.NVIC_IRQChannel = USART1_IRQn;
    NVIC_InitStructure.NVIC_IRQChannelSubPriority = 0;
    NVIC_InitStructure.NVIC_IRQChannelCmd = ENABLE;
    NVIC_Init(&NVIC_InitStructure);
}


void USART_SendString(USART_TypeDef* USARTx, char *pt)//给指定串口发送字符串
{
    while(*pt)
    {
        while(USART_GetFlagStatus(USARTx, USART_FLAG_TXE) == RESET);
        USART_SendData(USARTx,*pt);
        while(USART_GetFlagStatus(USARTx, USART_FLAG_TC) == RESET);
        pt++;
    }
}

int fputc(int c, FILE *pt)//printf重定向
{
    USART_TypeDef* USARTx = USART1;
    while(USART_GetFlagStatus(USARTx, USART_FLAG_TXE) == RESET);
    USART_SendData(USARTx, c);
    while(USART_GetFlagStatus(USARTx, USART_FLAG_TC) == RESET);
    return 0;
}

void USART1_IRQHandler(void)
{
    unsigned char ch;
    while(USART_GetFlagStatus(USART1, USART_FLAG_RXNE) == SET)//接收到数据
    {
        ch = USART_ReceiveData(USART1);
        printf("%c\n",ch);
    }
}
```

UART.h

```
#ifndef __UART_H__
#define __UART_H__

#include "stm32f10x.h"
#include "stdio.h"

void UART1_Init(void);//UART1初始化
void USART_SendString(USART_TypeDef* USARTx, char *pt);//给指定串口发送字符串
int fputc(int c, FILE *pt);//printf重定向
void NVIC_UART1_Init(void);//UART1 NVIC配置

#endif
```

ADC.c

```
#include "ADC.h"

void ADC1_Init(void)//ADC1初始化
{
    GPIO_InitTypeDef GPIO_InitStructure;
    ADC_InitTypeDef ADC_InitStructure;

    /* ADCCLK = PCLK2/6 */
    RCC_ADCCLKConfig(RCC_PCLK2_Div6);

    /* Enable ADC1, and GPIOA clocks */
    /* 使能ADC1 GPIOA时钟 */
    RCC_APB2PeriphClockCmd(RCC_APB2Periph_ADC1| RCC_APB2Periph_GPIOA, ENABLE);

    /* Configure PA1 (ADC Channel) as analog inputs */
    /* 配置ADC 通道1 通道2 PA1 PA2 PA3模拟输入引脚 */
    GPIO_InitStructure.GPIO_Pin = GPIO_Pin_1 | GPIO_Pin_2 | GPIO_Pin_3;
    GPIO_InitStructure.GPIO_Mode = GPIO_Mode_AIN;
    GPIO_Init(GPIOA, &GPIO_InitStructure);

    /* ADC1 configuration */
    /* ADC1 配置 */
    ADC_InitStructure.ADC_Mode = ADC_Mode_Independent;//独立模式
    ADC_InitStructure.ADC_ScanConvMode = DISABLE;//扫描模式
    ADC_InitStructure.ADC_ContinuousConvMode = DISABLE;//单次转换
    ADC_InitStructure.ADC_ExternalTrigConv = ADC_ExternalTrigConv_None;//软件触发
    ADC_InitStructure.ADC_DataAlign = ADC_DataAlign_Right;//数据右对齐
    ADC_InitStructure.ADC_NbrOfChannel = 3;//双通道
    ADC_Init(ADC1, &ADC_InitStructure);

    /* Enable ADC1 */
    /* 使能 ADC1 */
    ADC_Cmd(ADC1, ENABLE);

    /* Enable ADC1 reset calibration register */
    /* 使能ADC1复位校准寄存器 */
    ADC_ResetCalibration(ADC1);
    /* Check the end of ADC1 reset calibration register */
    /* 检查ADC1复位校准寄存器的末端 */
```

```
    while(ADC_GetResetCalibrationStatus(ADC1));

    /* Start ADC1 calibration */
    /* 启动 ADC1 校准 */
    ADC_StartCalibration(ADC1);
    /* Check the end of ADC1 calibration */
    /* 检查ADC1校准结束 */
    while(ADC_GetCalibrationStatus(ADC1));
}

uint16_t ADC1_Result(unsigned int Channel)//获取ADC通道转换数据
{
    /* ADC1 regular channels configuration */
    /* ADC1 规则通道配置 */
    ADC_RegularChannelConfig(ADC1, Channel, 1, ADC_SampleTime_55Cycles5);
    /* Start ADC1 Software Conversion */
    /* 启动 ADC1 软件转换 */
    ADC_SoftwareStartConvCmd(ADC1, ENABLE);

    while(ADC_GetFlagStatus(ADC1, ADC_FLAG_EOC) == RESET);
    return (ADC_GetConversionValue(ADC1));
}

uint16_t ADC1_Result_Average(unsigned int Channel, unsigned int Times)//获取ADC通
道数据平均值
{
    int i;
    uint16_t Total = 0;

    for(i = 0; i < Times; i++)
    {
        Total += ADC1_Result(Channel);
                Delay_us(5000);
    }
     return (Total / Times);
}

void Trail_X_Y_Z_Data(void)//获取循迹模块X1 X2 X3输出数据 并打印相关信息到串口
{
    uint16_t ADC1_X, ADC1_Y, ADC1_Z;

    ADC1_X = ADC1_Result_Average(ADC_Channel_1, 10);//获取ADC1 通道1 的10次数据平均
值
    ADC1_Y = ADC1_Result_Average(ADC_Channel_2, 10);//获取ADC1 通道2 的10次数据平均
值
    ADC1_Z = ADC1_Result_Average(ADC_Channel_3, 10);//获取ADC1 通道2 的10次数据平均
值

        printf("%d\n",ADC1_X);
        printf("%d\n",ADC1_Y);
        printf("%d\n",ADC1_Z);
}
```

ADC.h

```
#ifndef __ADC_H__
#define __ADC_H__

#include "stm32f10x.h"
#include "UART.h"
#include "SysTick.h"

void ADC1_Init(void);//ADC1初始化
uint16_t ADC1_Result(unsigned int Channel);//获取ADC 通道转换数据
uint16_t ADC1_Result_Average(unsigned int Channel, unsigned int Times);//获取ADC通道数据平均值
void Trail_X_Y_Z_Data(void);//获取三路巡线模块X1 X2 X3输出数据 并打印相关信息到串口

#endif
```

Phenomenon

After downloading the program, press the Reset key once, and the downloaded program will run.

When you place the three-way line patrol module in different environments or backgrounds, the serial port will output the current corresponding analog value.

Note: The three-way line patrol module X1, X2, and X3 correspond to X, Y, and Z in the code, respectively.

```
[2023-05-31 18:56:54.997]# RECV ASCII>
Trail module!

[2023-05-31 18:56:55.508]# RECV ASCII>
Trail module!

[2023-05-31 18:56:55.661]# RECV ASCII>
4095
4095
4095

[2023-05-31 18:56:55.818]# RECV ASCII>
245
268
3215

[2023-05-31 18:56:55.958]# RECV ASCII>
239
284
358

[2023-05-31 18:56:56.111]# RECV ASCII>
293
2091
706

[2023-05-31 18:56:56.268]# RECV ASCII>
309
1017
668

[2023-05-31 18:56:56.421]# RECV ASCII>
1956
608
288

[2023-05-31 18:56:56.576]# RECV ASCII>
1539
1309
270

[2023-05-31 18:56:56.716]# RECV ASCII>
1050
252
278

[2023-05-31 18:56:56.870]# RECV ASCII>
296
463
4095

[2023-05-31 18:56:57.025]# RECV ASCII>
323
```