Experiment 7

Title: Interfacing ADC with UART Communication

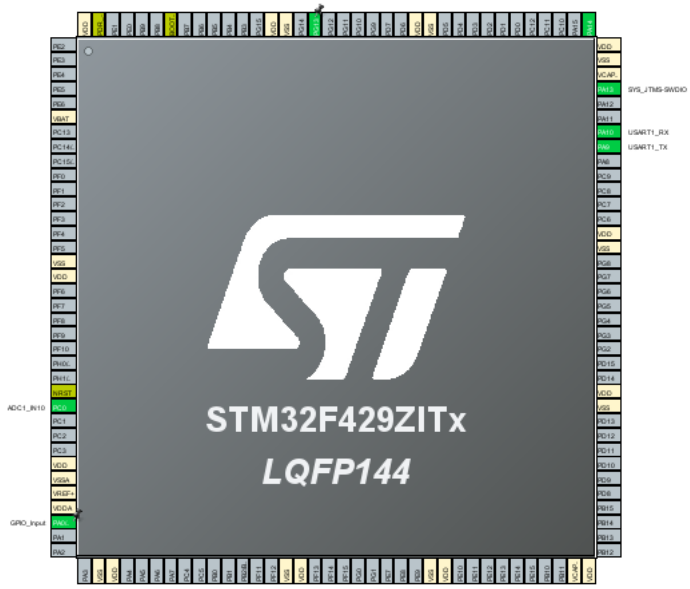
Aim: To integrate ADC with UART communication on an STM32 Microcontroller.

Tool used: Tool used in this assignment is **STM32CubeIDE.**

Procedure:

1. Create a new STM32 project with a suitable project name.
2. IOC UI will open in that configure desired pins as input/output.
3. In system core select SYS.
4. In Mode select debug as serial wire.
5. In ADC1 mode and configuration select IN10.
6. In connectivity select USART1(mode asynchronous) and in parameter settings make baud rate 9600 bits/sec.
7. Select PA0 as input(switch) and PG13 as LED.
8. Press Ctrl+S to generate the code.
9. In the main.c file add the desired code.
10. Go to Project-> Build Project
11. Connect the discovery Board and go to Run-> Run.

CubeMX Pin Diagram:



Code:

```
/* USER CODE BEGIN Header */
/**

******************************************************************************
***
  * @file           : main.c
  * @brief          : Main program body

******************************************************************************
***
  * @attention
  *
  * Copyright (c) 2023 STMicroelectronics.
  * All rights reserved.
  *
  * This software is licensed under terms that can be found in the LICENSE file
  * in the root directory of this software component.
  * If no LICENSE file comes with this software, it is provided AS-IS.
  *

******************************************************************************
***
  */
/* USER CODE END Header */
/* Includes ------------------------------------------------------------------*/
void HEX2BCDASCII(unsigned int Val,unsigned char *str)
{
	unsigned int i,BCD;
	i=0;
	BCD=Val/1000;
	str[i++]=BCD+0x30;
	BCD=(Val%1000)/100;
	str[i++]=BCD+0x30;
	BCD=((Val%1000)%100)/10;
	str[i++]=BCD+0x30;
	BCD=Val%10;
	str[i]=BCD+0x30;
}
#include "main.h"

/* Private includes ----------------------------------------------------------*/
/* USER CODE BEGIN Includes */

/* USER CODE END Includes */

/* Private typedef -----------------------------------------------------------*/
/* USER CODE BEGIN PTD */
```

```
/* USER CODE END PTD */

/* Private define ------------------------------------------------------------*/
/* USER CODE BEGIN PD */

/* USER CODE END PD */

/* Private macro -------------------------------------------------------------*/
/* USER CODE BEGIN PM */

/* USER CODE END PM */

/* Private variables ---------------------------------------------------------*/
ADC_HandleTypeDef hadc1;

UART_HandleTypeDef huart1;

/* USER CODE BEGIN PV */

/* USER CODE END PV */

/* Private function prototypes -----------------------------------------------*/
void SystemClock_Config(void);
static void MX_GPIO_Init(void);
static void MX_ADC1_Init(void);
static void MX_USART1_UART_Init(void);
/* USER CODE BEGIN PFP */

/* USER CODE END PFP */

/* Private user code ---------------------------------------------------------*/
/* USER CODE BEGIN 0 */
unsigned char MSG1[]="ADC Interfacing Sample Program \r\n";
unsigned char MSG2[]="ADC Value in Decimal:0000";
unsigned char MSG3[]="ADC input Voltage:";
unsigned char MSG4[]="V \r\n";
unsigned char MSG5[]="\r\n";
unsigned char ASCIIVAL[4];
unsigned int ADCVAL;
float ADCVTG;
unsigned char ADC_Status;

/* USER CODE END 0 */

/**
  * @brief  The application entry point.
  * @retval int
  */
int main(void)
```

```
{
 /* USER CODE BEGIN 1 */

 /* USER CODE END 1 */

 /* MCU Configuration--------------------------------------------------------*/

 /* Reset of all peripherals, Initializes the Flash interface and the Systick. */
 HAL_Init();

 /* USER CODE BEGIN Init */

 /* USER CODE END Init */

 /* Configure the system clock */
 SystemClock_Config();

 /* USER CODE BEGIN SysInit */

 /* USER CODE END SysInit */

 /* Initialize all configured peripherals */
 MX_GPIO_Init();
 MX_ADC1_Init();
 MX_USART1_UART_Init();
 /* USER CODE BEGIN 2 */
 HAL_UART_Transmit(&huart1,MSG1,sizeof(MSG1)-2,100);
 /* USER CODE END 2 */

 /* Infinite loop */
 /* USER CODE BEGIN WHILE */
 while (1)
 {
   /* USER CODE END WHILE */
  HAL_ADC_Start(&hadc1);
  ADC_Status=HAL_ADC_PollForConversion(&hadc1,10);
  if(ADC_Status==HAL_OK)
  {
        ADCVAL=HAL_ADC_GetValue(&hadc1);
        HEX2BCDASCII(ADCVAL,MSG2+21);
        HAL_UART_Transmit(&huart1,MSG2,sizeof(MSG2)-1,100);
        HAL_UART_Transmit(&huart1,MSG5,sizeof(MSG5),100);
        ADCVTG=ADCVAL*(3.3/4095);
        ADCVTG=ADCVTG*1000;
        HEX2BCDASCII(ADCVTG,ASCIIVAL);
        MSG3[18]=ASCIIVAL[0];
        MSG3[20]=ASCIIVAL[1];
        MSG3[21]=ASCIIVAL[2];
        MSG3[22]=ASCIIVAL[3];
        HAL_UART_Transmit(&huart1,MSG3,sizeof(MSG3),100);
```

```
        HAL_UART_Transmit(&huart1,MSG4,sizeof(MSG4),100);
    }
    HAL_Delay(1000);
    /* USER CODE BEGIN 3 */
  }
  /* USER CODE END 3 */
}

/**
  * @brief System Clock Configuration
  * @retval None
  */
void SystemClock_Config(void)
{
  RCC_OscInitTypeDef RCC_OscInitStruct = {0};
  RCC_ClkInitTypeDef RCC_ClkInitStruct = {0};

  /** Configure the main internal regulator output voltage
  */
  __HAL_RCC_PWR_CLK_ENABLE();

__HAL_PWR_VOLTAGESCALING_CONFIG(PWR_REGULATOR_VOLTAGE_SCALE
3);

  /** Initializes the RCC Oscillators according to the specified parameters
  * in the RCC_OscInitTypeDef structure.
  */
  RCC_OscInitStruct.OscillatorType = RCC_OSCILLATORTYPE_HSI;
  RCC_OscInitStruct.HSIState = RCC_HSI_ON;
  RCC_OscInitStruct.HSICalibrationValue = RCC_HSICALIBRATION_DEFAULT;
  RCC_OscInitStruct.PLL.PLLState = RCC_PLL_NONE;
  if (HAL_RCC_OscConfig(&RCC_OscInitStruct) != HAL_OK)
  {
    Error_Handler();
  }

  /** Initializes the CPU, AHB and APB buses clocks
  */
  RCC_ClkInitStruct.ClockType =
RCC_CLOCKTYPE_HCLK|RCC_CLOCKTYPE_SYSCLK
                              |RCC_CLOCKTYPE_PCLK1|RCC_CLOCKTYPE_PCLK2;
  RCC_ClkInitStruct.SYSCLKSource = RCC_SYSCLKSOURCE_HSI;
  RCC_ClkInitStruct.AHBCLKDivider = RCC_SYSCLK_DIV1;
  RCC_ClkInitStruct.APB1CLKDivider = RCC_HCLK_DIV1;
  RCC_ClkInitStruct.APB2CLKDivider = RCC_HCLK_DIV1;

  if (HAL_RCC_ClockConfig(&RCC_ClkInitStruct, FLASH_LATENCY_0) != HAL_OK)
  {
    Error_Handler();
  }
```

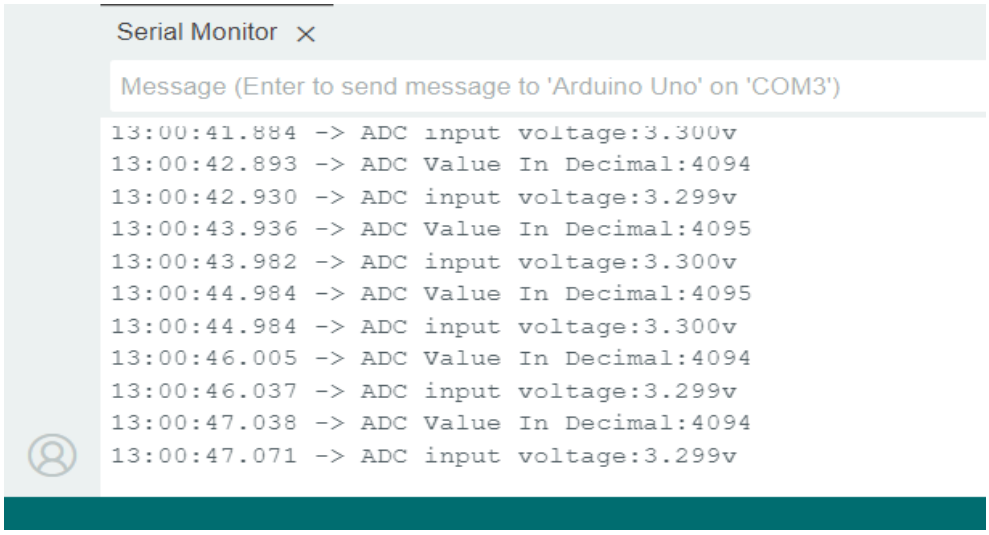
```
}

/**
  * @brief ADC1 Initialization Function
  * @param None
  * @retval None
  */
static void MX_ADC1_Init(void)
{

  /* USER CODE BEGIN ADC1_Init 0 */

  /* USER CODE END ADC1_Init 0 */

  ADC_ChannelConfTypeDef sConfig = {0};

  /* USER CODE BEGIN ADC1_Init 1 */

  /* USER CODE END ADC1_Init 1 */

  /** Configure the global features of the ADC (Clock, Resolution, Data Alignment and number of conversion)
  */
  hadc1.Instance = ADC1;
  hadc1.Init.ClockPrescaler = ADC_CLOCK_SYNC_PCLK_DIV2;
  hadc1.Init.Resolution = ADC_RESOLUTION_12B;
  hadc1.Init.ScanConvMode = DISABLE;
  hadc1.Init.ContinuousConvMode = DISABLE;
  hadc1.Init.DiscontinuousConvMode = DISABLE;
  hadc1.Init.ExternalTrigConvEdge = ADC_EXTERNALTRIGCONVEDGE_NONE;
  hadc1.Init.ExternalTrigConv = ADC_SOFTWARE_START;
  hadc1.Init.DataAlign = ADC_DATAALIGN_RIGHT;
  hadc1.Init.NbrOfConversion = 1;
  hadc1.Init.DMAContinuousRequests = DISABLE;
  hadc1.Init.EOCSelection = ADC_EOC_SINGLE_CONV;
  if (HAL_ADC_Init(&hadc1) != HAL_OK)
  {
    Error_Handler();
  }

  /** Configure for the selected ADC regular channel its corresponding rank in the sequencer and its sample time.
  */
  sConfig.Channel = ADC_CHANNEL_10;
  sConfig.Rank = 1;
  sConfig.SamplingTime = ADC_SAMPLETIME_3CYCLES;
  if (HAL_ADC_ConfigChannel(&hadc1, &sConfig) != HAL_OK)
  {
    Error_Handler();
  }
```

```
  /* USER CODE BEGIN ADC1_Init 2 */

  /* USER CODE END ADC1_Init 2 */

}

/**
  * @brief USART1 Initialization Function
  * @param None
  * @retval None
  */
static void MX_USART1_UART_Init(void)
{

  /* USER CODE BEGIN USART1_Init 0 */

  /* USER CODE END USART1_Init 0 */

  /* USER CODE BEGIN USART1_Init 1 */

  /* USER CODE END USART1_Init 1 */
  huart1.Instance = USART1;
  huart1.Init.BaudRate = 9600;
  huart1.Init.WordLength = UART_WORDLENGTH_8B;
  huart1.Init.StopBits = UART_STOPBITS_1;
  huart1.Init.Parity = UART_PARITY_NONE;
  huart1.Init.Mode = UART_MODE_TX_RX;
  huart1.Init.HwFlowCtl = UART_HWCONTROL_NONE;
  huart1.Init.OverSampling = UART_OVERSAMPLING_16;
  if (HAL_UART_Init(&huart1) != HAL_OK)
  {
    Error_Handler();
  }
  /* USER CODE BEGIN USART1_Init 2 */

  /* USER CODE END USART1_Init 2 */

}

/**
  * @brief GPIO Initialization Function
  * @param None
  * @retval None
  */
static void MX_GPIO_Init(void)
{
  GPIO_InitTypeDef GPIO_InitStruct = {0};
/* USER CODE BEGIN MX_GPIO_Init_1 */
/* USER CODE END MX_GPIO_Init_1 */
```

```
  /* GPIO Ports Clock Enable */
  __HAL_RCC_GPIOC_CLK_ENABLE();
  __HAL_RCC_GPIOA_CLK_ENABLE();
  __HAL_RCC_GPIOG_CLK_ENABLE();

  /*Configure GPIO pin Output Level */
  HAL_GPIO_WritePin(GPIOG, GPIO_PIN_13, GPIO_PIN_RESET);

  /*Configure GPIO pin : PA0 */
  GPIO_InitStruct.Pin = GPIO_PIN_0;
  GPIO_InitStruct.Mode = GPIO_MODE_INPUT;
  GPIO_InitStruct.Pull = GPIO_NOPULL;
  HAL_GPIO_Init(GPIOA, &GPIO_InitStruct);

  /*Configure GPIO pin : PG13 */
  GPIO_InitStruct.Pin = GPIO_PIN_13;
  GPIO_InitStruct.Mode = GPIO_MODE_OUTPUT_PP;
  GPIO_InitStruct.Pull = GPIO_NOPULL;
  GPIO_InitStruct.Speed = GPIO_SPEED_FREQ_LOW;
  HAL_GPIO_Init(GPIOG, &GPIO_InitStruct);

/* USER CODE BEGIN MX_GPIO_Init_2 */
/* USER CODE END MX_GPIO_Init_2 */
}

/* USER CODE BEGIN 4 */

/* USER CODE END 4 */

/**
  * @brief  This function is executed in case of error occurrence.
  * @retval None
  */
void Error_Handler(void)
{
  /* USER CODE BEGIN Error_Handler_Debug */
  /* User can add his own implementation to report the HAL error return state */
  __disable_irq();
  while (1)
  {
  }
  /* USER CODE END Error_Handler_Debug */
}

#ifdef  USE_FULL_ASSERT
/**
  * @brief  Reports the name of the source file and the source line number
  *         where the assert_param error has occurred.
  * @param  file: pointer to the source file name
  * @param  line: assert_param error line source number
```

```
  * @retval None
  */
void assert_failed(uint8_t *file, uint32_t line)
{
  /* USER CODE BEGIN 6 */
  /* User can add his own implementation to report the file name and line number,
     ex: printf("Wrong parameters value: file %s on line %d\r\n", file, line) */
  /* USER CODE END 6 */
}
#endif /* USE_FULL_ASSERT */
```

Output:



Functions used:

```
HAL_UART_Transmit (&handle_variable_name,MSG,sizeof(MSG),Timeout);
HAL_ADC_PollForConversion(&handle_variable_name,Timeout);
HAL_ADC_Start(&handle_variable_name);
HAL_ADC_GetValue(&handle_variable_name);
```

Result:

Basic STM32Cube project for interfacing ADC with UART communication was built using STM32CubeIDE.