

SliceKit GPIO Example Applications

REV A

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Table of Contents

1 Overview	3
2 Evaluation Platforms	4
2.1 Recommended Hardware	4
2.2 Example Applications	4
2.2.1 app_slicekit_simple_demo	4
2.2.2 app_slicekit_com_demo	4
3 Programming Guide	6
3.1 Simple Demo	6
3.1.1 Structure	6
3.1.2 API	6
3.1.3 Usage and Implementation	7
3.2 COM Port Demo	9
3.2.1 Structure	9
3.2.2 API	9
3.2.3 Usage and Implementation	10

1 Overview

This document covers two example applications that demonstrate various features of the XA-SK-GPIO Slice Card including the ADC, LEDs, UART connector and buttons, the I2C master xSOFTip component, as well as various basic features of the xCORE processor.

Low level details of how the application is implemented are covered here, with information about how to modify and experiment with them.

For getting started instructions for both applications, please refer to their respective Quick Start guides.

2 Evaluation Platforms

IN THIS CHAPTER

- ▶ Recommended Hardware
 - ▶ Example Applications
-

2.1 Recommended Hardware

This application may be evaluated using the SliceKit Modular Development Platform, available from digikey. Required board SKUs are:

- ▶ XP-SKC-L2 (SliceKit L2 Core Board) plus XA-SK-GPIO plus XA-SK-XTAG2 (SliceKit XTAG adaptor) plus XTAG2 (debug adaptor),

2.2 Example Applications

2.2.1 app_sliceKit_simple_demo

This application has the following features:

- ▶ module_i2c_master from the xSOFT ip library is used to access the external ADC, which is equipped with an external linearised thermistor circuit for temperature sensing.
- ▶ simple code to print the recorded temperature to the XDE debug console on the press of one of the Slice Card buttons
- ▶ simple code to cycle through the 4 LEDs each time the other button is pressed.
- ▶ demonstrates use of XC select statements for handling multiple concurrent inputs
- ▶ demonstrates basic usage of XCore ports

2.2.2 app_sliceKit_com_demo

This application extends the simple demo to provides the following functionality (all options are dynamically reconfigurable via the APIs for app_sliceKit_com_demo application):

- ▶
 - ▶ Baud Rate: 150 to 115200 bps
 - ▶ Parity: None, Mark, Space, Odd, Even
 - ▶ Stop Bits: 1,2
 - ▶ Data Length: 1 to 30 bits (Max 30 bits assumes 1 stop bit and no parity)

- ▶ Cycles Through LEDs on button Press
- ▶ Displays temperature value and button press events on the terminal console of a host PC via the UART

3 Programming Guide

IN THIS CHAPTER

- ▶ Simple Demo
 - ▶ COM Port Demo
-

3.1 Simple Demo

3.1.1 Structure

All of the files required for operation are located in the `app_sk_gpio_simple_demo/src` directory. The files that are need to be included for use of this component in an application are:

File	Description
<code>common.h</code>	Header file for API interfaces and Look up tables for thermistor.
<code>main.xc</code>	Main file which implements the demo functionality

3.1.2 API

```
void app_manager(chanend c_uartTX,  
                chanend c_chanRX,  
                chanend c_process,  
                chanend c_end)
```

Polling uart RX and push button switches and send received commands to `process_data` thread.

This function has the following parameters:

<code>c_uartTX</code>	Channel to Uart TX Thread
<code>c_chanRX</code>	Channel to Uart RX Thread
<code>c_process</code>	Channel to process data Thread
<code>c_end</code>	Channel to read data from process thread

```
int linear_interpolation(int adc_value)
```

Calculates temperatue based on linear interpolation.

This function has the following parameters:

<code>adc_value</code>	int value read from ADC
------------------------	-------------------------

This function returns:

Returns linear interpolated Temperature value

```
int read_adc_value()
```

Read ADC value using I2C.

This function returns:

Returns ADC value

3.1.3 Usage and Implementation

The port declaration for the LEDs, Buttons and I2C are declared as below. LEDs and Buttons use 4 bit ports and I2C uses 1 bit port for SCL(I2c Clock) and SDA (I2C data).

```
on stdcore[CORE_NUM]: out port p_led=XS1_PORT_4A;
on stdcore[CORE_NUM]: port p_PORT_BUT_1=XS1_PORT_4C;
on stdcore[CORE_NUM]: struct r_i2c i2cOne = {
    XS1_PORT_1F,
    XS1_PORT_1B,
    1000
};
```

The app_manager API writes the configuration settings information to the ADC as shows below.

```
i2c_master_write_reg(0x28, 0x00, data, 1, i2cOne); //Write configuration information to
↳ ADC
```

The select statement in the app_manager API selects one of the two cases in it, checks if there is IO event or timer event. This statement monitors both the events and executes which ever event is occurred first. The select statement in the application is listed below. The statement checks if there is button press or not. If there is button press then it looks if the button state is same even after 200msec. If the buton state is same then it recognises as an valid push.

```
select
{
    case button => p_PORT_BUT_1 when pinsneq(button_press_1):> button_press_1: //
↳ checks if any button is pressed
        button=0;
        t:>time;
        break;

    case !button => t when timerafter(time+debounce_time):>void: //waits for 20ms and
↳ checks if the same button is pressed or not
        p_PORT_BUT_1:> button_press_2;
        if(button_press_1==button_press_2)
            if(button_press_1 == BUTTON_PRESS_VALUE) //Button 1 is pressed
            {
                printstrln("Button 1 Pressed");
                p_led<:(led_value);
                led_value=led_value<<1;
                led_value|=0x01;
```

```

        led_value=led_value & 0x0F;
        if(led_value == 15)
        {
            led_value=0x0E;
        }
    }
    if(button_press_1 == BUTTON_PRESS_VALUE-1) //Button 2 is pressed
    {
        data1[0]=0;data1[1]=0;
        i2c_master_rx(0x28, data1, 2, i2cOne); //Read ADC value using I2C
        ↪ read
        printf("Reading Temperature value...\n");
        data1[0]=data1[0]&0x0F;
        adc_value=(data1[0]<<6)|(data1[1]>>2);
        printf("Temperature is :");
        printf("%d",linear_interpolation(adc_value));
    }

    button=1;
    break;
}

```

After recognising the valid push then it checks if Button 1 is pressed or Button 2 is pressed. If Button 1 is pressed then, the application reads the status of LEDs and shift the position of the LEDs to left by 1. If Button 2 is pressed, then the application reads the contents of ADC register using I2C read instruction and input the ADC value to linear interpolation function as shown below.

```

int linear_interpolation(int adc_value)
{
    int i=0,x1,y1,x2,y2,temper;
    while(adc_value<TEMPERATURE_LUT[i][1])
    {
        i++;
    }
    //::Formula start
    //Calculating Linear interpolation using the formula  $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$ 
    //::Formula
    x1=TEMPERATURE_LUT[i-1][1];
    y1=TEMPERATURE_LUT[i-1][0];
    x2=TEMPERATURE_LUT[i][1];
    y2=TEMPERATURE_LUT[i][0];
    temper=y1+(((adc_value-x1)*(y2-y1))/(x2-x1));
    return temper;//Return Temperature value
}

```

The linear interpolation function calculates the linear interpolation value using the following formula and returns the temperature value from temperature look up table.

```
//Calculating Linear interpolation using the formula  $y=y_1+(x-x_1)*(y_2-y_1)/(x_2-x_1)$ 
```

```

int TEMPERATURE_LUT[][2]= //Temperature Look up table
{
    {-10,845},{-5,808},{0,765},{5,718},{10,668},{15,614},{20,559},{25,504},{30,450},{35,395},
    ↪
    {40,352},{45,308},{50,269},{55,233},{60,202}
}

```



```
};
```

3.2 COM Port Demo

3.2.1 Structure

All of the files required for operation are located in the `app_sliceKIT_simple_demo/src` directory. The files that are need to be included for use of this component in an application are:

File	Description
<code>common.h</code>	Header file for API interfaces and Look up tables for thermistor. FIXME - what about the uart
<code>main.xc</code>	Main file which implements the demo functionality

3.2.2 API

```
void app_manager(chanend c_uartTX,
                 chanend c_chanRX,
                 chanend c_process,
                 chanend c_end)
```

Polling uart RX and push button switches and send received commands to `process_data` thread.

This function has the following parameters:

`c_uartTX` Channel to Uart TX Thread
`c_chanRX` Channel to Uart RX Thread
`c_process` Channel to process data Thread
`c_end` Channel to read data from process thread

```
void process_data(chanend c_process, chanend c_end)
```

process received data to see if received data is valid command or not Polling switches to see for button press

This function has the following parameters:

`c_process` Channel to receive data from app manager Thread
`c_end` Channel to communicate to app manager thread

```
void uart_tx_string(chanend c_uartTX, unsigned char message[100])
```

Transmits byte by byte to the UART TX thread for an input string.

This function has the following parameters:

`c_uartTX` Channel to receive data from app Uart TX Thread

`message` Buffer to store array of characters

`int linear_interpolation(int adc_value)`

Calculates temperatue based on linear interpolation.

This function has the following parameters:

`adc_value` int value read from ADC

This function returns:

Returns linear interpolated Temperature value

`int read_adc_value()`

Read ADC value using I2C.

This function returns:

Returns ADC value

3.2.3 Usage and Implementation

The port declaration for the LEDs, Buttons, I2C and UART are declared as below. LEDs and Buttons uses 4 bit ports, UART uses 1 bit ports both for Transmit and Receive and I2C uses 1 bit port for SCL(I2c Clock) and SDA (I2C data).

```
#define CORE_NUM 1
#define BUTTON_PRESS_VALUE 2
on stdcore[CORE_NUM] : buffered in port:1 p_rx = XS1_PORT_1G;
on stdcore[CORE_NUM] : out port p_tx = XS1_PORT_1C;
on stdcore[CORE_NUM]: port p_led=XS1_PORT_4A;
on stdcore[CORE_NUM]: port p_button1=XS1_PORT_4C;
on stdcore[CORE_NUM]: struct r_i2c i2c0ne = {
    XS1_PORT_1F,
    XS1_PORT_1B,
    1000
};
```

The `app_manager` API writes the configuration settings information to the ADC as shows below.

```
i2c_master_write_reg(0x28, 0x00, i2c_register, 1, i2c0ne); //Configure ADC by writing the
↳ settings to register
```

The `select` statement in the `app_manager` API selects one of the three cases in it, checks if there is IO event or timer event or any event on the Uart Receive pin. This statement monitors all the events and executes which ever event is occurred first. The `select` statement in the applcation is listed below. The statement checks if there is button press or availability of data on the Uart Receive pin. If there is button press then it looks if the button state is same as even after 200msec. If the buton state is same then it recognises as a valid push. If there is data on the Uart Receive

pin the it echoes the data back to the uart Transmit pin until > character is received in the input data.

```

select
{
    case c_end:>data:
        c_end:>data;
        if(data == BUTTON_1) //Cycle LEDs on button 1 press
        {
            printstrln("Button 1 Pressed");
            p_led<:(led_value);
            led_value=led_value<<1;
            if(led_value == 16) //If LED value is 16 then
                ↳ assigns LED value to 1 which cycles LEDs by
                ↳ button press
            {
                led_value=0x01;
            }
        }
        if(data == BUTTON_2) //Displays Temperature on console if
            ↳ Button 2 is pressed
        {
            adc_value=read_adc_value();
            data_arr[0]=(linear_interpolation(adc_value));
            printstr("Temperature is :");
            printint(linear_interpolation(adc_value));
            printstrln(" C");
        }
        break;
    case uart_rx_get_byte_byref(c_uartRX, rxState, buffer):
        //:::Command start
        if(buffer == '>') //IUF received data is '>' character
            ↳ then expects cmd to endter into command mode
        {
            j=0;
            uart_rx_get_byte_byref(c_uartRX, rxState, buffer)
                ↳ ;
            cmd_rcvbuffer[j]=buffer;
            if((cmd_rcvbuffer[j] == 'C' )|| (cmd_rcvbuffer[j]
                ↳ =='c')) //Checks if received data is 'C' or
                ↳ 'c'
            {
                j++;
                uart_rx_get_byte_byref(c_uartRX, rxState,
                    ↳ buffer);
                cmd_rcvbuffer[j]=buffer;

                if((cmd_rcvbuffer[j] == 'm' )|| (
                    ↳ cmd_rcvbuffer[j] =='M')) //Checks if
                    ↳ received data is 'M' or 'm'
                {
                    j++;
                    uart_rx_get_byte_byref(c_uartRX,
                        ↳ rxState, buffer);
                    cmd_rcvbuffer[j]=buffer;
                    if((cmd_rcvbuffer[j] == 'D' )|| (
                        ↳ cmd_rcvbuffer[j] =='d'))//
                        ↳ Checks if received data is '
                        ↳ D' or 'd'
                    {

```

```
        uart_tx_send_byte(  
            ↪ c_uartTX, '\r');  
        uart_tx_send_byte(  
            ↪ c_uartTX, '\n');  
        uart_tx_string(c_uartTX,  
            ↪ CONSOLE_MESSAGES[0])  
            ↪ ;  
        COMMAND_MODE=1; //  
            ↪ activates command  
            ↪ mode as received  
            ↪ data is '>cmd'  
        uart_tx_send_byte(  
            ↪ c_uartTX, '\r');  
        uart_tx_send_byte(  
            ↪ c_uartTX, '\n');  
        uart_tx_send_byte(  
            ↪ c_uartTX, '>'); //  
            ↪ displays '>' if  
            ↪ command mode is  
            ↪ activated  
    }  
    else  
    {  
        uart_tx_send_byte(  
            ↪ c_uartTX, '>');  
        for(int i=0;i<3;i++)  
            uart_tx_send_byte  
                ↪ (c_uartTX,  
                ↪ cmd_rcvbuffer  
                ↪ [i]); // if  
                ↪ received dta  
                ↪ is not 'c'  
                ↪ displays  
                ↪ back the  
                ↪ received  
                ↪ data  
    }  
} else  
{  
    uart_tx_send_byte(c_uartTX, '>');  
    ↪ //if received data is not '  
    ↪ m' displays the received  
    ↪ data  
    for(int i=0;i<2;i++)  
        uart_tx_send_byte(  
            ↪ c_uartTX,  
            ↪ cmd_rcvbuffer[i]);  
}  
}  
else  
{  
    uart_tx_send_byte(c_uartTX, '>');  
    uart_tx_send_byte(c_uartTX, cmd_rcvbuffer  
        ↪ [j]);  
    j=0;  
}  
}  
else  
{
```



```

                                                                    for(int inc=0;inc
                                                                    ↳ <20;inc++)
                                                                    ↳ //Clears the
                                                                    ↳ command
                                                                    ↳ buffer
                                                                    cmd_rcvbuffer
                                                                    ↳ [inc
                                                                    ↳ ]='0';
                                                                    ↳
                                                                    j=0;
                                                                    }
                                                                    break;
//::Send
                                                                    case c_end:>data:
                                                                    if(data!=EXIT && data!=
                                                                    ↳ INVALID )
                                                                    {
                                                                    uart_tx_string(
                                                                    ↳ c_uartTX,
                                                                    ↳ CONSOLE_MESSAGES
                                                                    ↳ [3]); //
                                                                    ↳ Displays
                                                                    ↳ Command
                                                                    ↳ Executed
                                                                    ↳ Message on
                                                                    ↳ Uart
                                                                    }
                                                                    switch(data)
                                                                    {
                                                                    case EXIT: //Exit
                                                                    ↳ from
                                                                    ↳ command mode
                                                                    COMMAND_MODE
                                                                    ↳ =0;
                                                                    skip=0;
                                                                    uart_tx_string
                                                                    ↳ (
                                                                    ↳ c_uartTX
                                                                    ↳ ,
                                                                    ↳ CONSOLE_MESSAGES
                                                                    ↳ [1]
                                                                    ↳ ;
                                                                    uart_tx_string
                                                                    ↳ (
                                                                    ↳ c_uartTX
                                                                    ↳ ,
                                                                    ↳ CONSOLE_MESSAGES
                                                                    ↳ [13]
                                                                    ↳ ;
                                                                    break;
                                                                    case SET_LED_1:
                                                                    ↳ //Read port
                                                                    ↳ Value and
                                                                    ↳ Set LED 1 ON
                                                                    p_led:>
                                                                    ↳ data
                                                                    ↳ ;

```

```
        data=data
        ↳ | 0
        ↳ xE;
    p_led<:
        ↳ data
        ↳ ;
        break;

case CLEAR_LED_1
↳ //Read port
↳ Value and
↳ Set LED 1
↳ OFF
    p_led:>
        ↳ data
        ↳ ;
    p_led<:
        ↳ data
        ↳ &0x1
        ↳ ;
        break;

case SET_LED_2:
↳ //Read port
↳ Value and
↳ Set LED 2 ON
    p_led:>
        ↳ data
        ↳ ;
    p_led<:
        ↳ data
        ↳ | 0
        ↳ xD;
        break;

case CLEAR_LED_2:
↳ //Read port
↳ Value and
↳ Set LED 2
↳ OFF
    p_led:>
        ↳ data
        ↳ ;
    p_led<:
        ↳ data
        ↳ &0x2
        ↳ ;
        break;

case SET_LED_3:
↳ //Read port
↳ Value and
↳ Set LED 3 ON
    p_led:>
        ↳ data
        ↳ ;
    p_led<:
        ↳ data
        ↳ | 0
        ↳ xB;
```

```
        break;

    case CLEAR_LED_3:
        ↪ //Read port
        ↪ Value and
        ↪ Set LED 3
        ↪ OFF
        p_led:>
            ↪ data
            ↪ ;
        p_led<:
            ↪ data
            ↪ &0x4
            ↪ ;
        break;

    case SET_LED_4:
        ↪ //Read port
        ↪ Value and
        ↪ Set LED 4 ON
        p_led:>
            ↪ data
            ↪ ;
        p_led<:
            ↪ data
            ↪ | 0
            ↪ x7;
        break;

    case CLEAR_LED_4:
        ↪ //Read port
        ↪ Value and
        ↪ Set LED 4
        ↪ OFF
        p_led:>
            ↪ data
            ↪ ;
        p_led<:
            ↪ data
            ↪ &0x8
            ↪ ;

        break;

    case CLEAR_ALL:
        ↪ //sets all
        ↪ four LEDs
        ↪ OFF
        p_led<:0
            ↪ xF;
        break;

    case SET_ALL: //
        ↪ sets all
        ↪ four LEDs ON
        p_led<:0
            ↪ x0;
        break;

    case
        ↪ BUTTON_PRESSED
```



```
↳ : //Checks
↳ if button is
↳   pressed
↳     c_end:>
↳       ↳ button
↳       ↳ ;
↳     if(button
↳       ↳ ==
↳       ↳ BUTTON_1
↳     ) //
↳     Prints
↳     ↳ Button
↳     ↳ 1
↳     ↳ is
↳     ↳ pressed
↳     ↳ on
↳     ↳ the
↳     ↳ Uart
↳     {
↳       ↳ console_message
↳       ↳ [4][9]='1'
↳       ↳ ;
↳     }
↳     uart_tx_string
↳     ↳ (
↳     ↳ c_uartTX
↳     ↳ ,
↳     ↳ console_message
↳     ↳ [4])
↳     ↳ ;
↳     button1_pressed
↳     ↳ =1;
↳     ↳ ;
↳   }
↳   if(button
↳     ↳ ==
↳     ↳ BUTTON_2
↳   ) //
↳   Prints
↳   ↳ Button
↳   ↳ 2
↳   ↳ is
↳   ↳ pressed
↳   ↳ on
↳   ↳ Uart
↳   {
↳     ↳ console_message
↳     ↳ [4][9]='2'
↳     ↳ ;
↳   }
↳   uart_tx_string
↳   ↳ (
↳   ↳ c_uartTX
↳   ↳ ,
↳   ↳ console_message
↳   ↳ [4])
↳   ↳ ;
↳   ↳ ;
```

```
        button2_press
            ↳ =1;
            ↳
        }
        break;
case HELP: //
    ↳ Displays
    ↳ help
    ↳ messages on
    ↳ Uart
        uart_tx_string
            ↳ (
            ↳ c_uartTX
            ↳ ,
            ↳ CONSOLE_MESSAGES
            ↳ [14])
            ↳ ;
        uart_tx_string
            ↳ (
            ↳ c_uartTX
            ↳ ,
            ↳ CONSOLE_MESSAGES
            ↳ [7])
            ↳ ;
        uart_tx_string
            ↳ (
            ↳ c_uartTX
            ↳ ,
            ↳ CONSOLE_MESSAGES
            ↳ [8])
            ↳ ;
        uart_tx_string
            ↳ (
            ↳ c_uartTX
            ↳ ,
            ↳ CONSOLE_MESSAGES
            ↳ [9])
            ↳ ;
        uart_tx_string
            ↳ (
            ↳ c_uartTX
            ↳ ,
            ↳ CONSOLE_MESSAGES
            ↳ [10])
            ↳ ;
        uart_tx_string
            ↳ (
            ↳ c_uartTX
            ↳ ,
            ↳ CONSOLE_MESSAGES
            ↳ [15])
            ↳ ;
        uart_tx_string
            ↳ (
            ↳ c_uartTX
            ↳ ,
            ↳ CONSOLE_MESSAGES
            ↳ [11])
            ↳ ;
        uart_tx_send_byte
            ↳ (
```

```
        ↪ c_uartTX
        ↪ , '\
        ↪ r');
    uart_tx_send_byte
    ↪ (
    ↪ c_uartTX
    ↪ , '\
    ↪ n');
    break;
case READ_ADC: //
    ↪ Displays
    ↪ temperature
    ↪ value on the
    ↪ Uart
    adc_value
    ↪ =
    ↪ read_adc_value
    ↪ ();
    data_arr
    ↪ [0]=(
    ↪ linear_interpolat
    ↪ (
    ↪ adc_value
    ↪ ));
    uart_tx_string
    ↪ (
    ↪ c_uartTX
    ↪ ,
    ↪ CONSOLE_MESSAGES
    ↪ [12])
    ↪ ;
    uart_tx_send_byte
    ↪ (
    ↪ c_uartTX
    ↪ , (
    ↪ data_arr
    ↪ [0]/10)
    ↪ +'0')
    ↪ ;
    uart_tx_send_byte
    ↪ (
    ↪ c_uartTX
    ↪ , (
    ↪ data_arr
    ↪ [0]%10)
    ↪ +'0')
    ↪ ;
    uart_tx_send_byte
    ↪ (
    ↪ c_uartTX
    ↪ ,
    ↪ 32);
    uart_tx_send_byte
    ↪ (
    ↪ c_uartTX
    ↪ , 'C
    ↪ ');
    break;
case INVALID: //
    ↪ Displays
    ↪ command
```

```
↳ input is
↳ invalid
↳ command on
↳ the Uart
    uart_tx_string
    ↳ (
    ↳ c_uartTX
    ↳ ,
    ↳ CONSOLE_MESSAGES
    ↳ [2])
    ↳ ;
    break;
case CHK_BUTTONS:
↳ //Checks if
↳ button are
↳ pressed and
↳ displays on
↳ the Uart
    if(
↳ button1_press
↳ )
    {
        CONSOLE_MESSAGES
↳ [4][9]='1'
↳
        uart_tx_string
↳ (
↳ c_uartTX
↳ ,
↳ CONSOLE_M
↳ [4])
↳ ;
↳
↳ //
↳ Displays
↳ Button
↳ 1
↳ is
↳ pressed
    }
    if(
↳ button2_press
↳ )
    {
        CONSOLE_MESSAGES
↳ [4][9]='2'
↳
        uart_tx_string
↳ (
↳ c_uartTX
↳ ,
↳ CONSOLE_M
↳ [4])
↳ ;
↳
↳ //
```

```
↪ Displays
↪ Button
↪ 2
↪ is
↪ pressed
↪
}
↪ if( !
↪   ↪ button1_press
↪   ↪ &&
↪   ↪ !
↪   ↪ button2_press
↪   ↪ )
↪ {
↪     ↪ uart_tx_string
↪     ↪ (
↪     ↪ c_uartTX
↪     ↪ ,
↪     ↪ CONSOLE_M
↪     ↪ [5])
↪     ↪ ;
↪     ↪ //
↪     ↪ Displays
↪     ↪ No
↪     ↪ Buttons
↪     ↪ are
↪     ↪ pressed
↪     ↪
↪     ↪ button1_press
↪     ↪   ↪ =0;
↪     ↪ button2_press
↪     ↪   ↪ =0;
↪     ↪ break;
↪ }
↪ if(data != EXIT) //Exits
↪   ↪ from command mode
↪   ↪ {
↪     ↪ uart_tx_send_byte
↪     ↪   ↪ (c_uartTX,
↪     ↪     ↪ '\r');
↪     ↪ uart_tx_send_byte
↪     ↪   ↪ (c_uartTX,
↪     ↪     ↪ '\n');
↪     ↪ uart_tx_send_byte
↪     ↪   ↪ (c_uartTX,
↪     ↪     ↪ '>');
↪   ↪ }
↪   ↪ break;
↪ }
↪ //select
↪ //skip
↪ //::State
```

```

                j=0;
            } //command mode
            break;
        } //main select

```

If the received data is > character the it waits to see if the next received successive bytes are c, m and d. If the successive received data is >cmd then the application activates command mode otherwise the data is echoed back to the Uart Transmit pin. The part of code which explains about the command mode is as blow.

```

if(buffer == '>') //IUF received data is '>' character then expects cmd to endter into
↳ command mode
{
    j=0;
    uart_rx_get_byte_byref(c_uartRX, rxState, buffer);
    cmd_rcvbuffer[j]=buffer;
    if((cmd_rcvbuffer[j] == 'C') || (cmd_rcvbuffer[j] == 'c')) //Checks if received
↳ data is 'C' or 'c'
    {
        j++;
        uart_rx_get_byte_byref(c_uartRX, rxState, buffer);
        cmd_rcvbuffer[j]=buffer;

        if((cmd_rcvbuffer[j] == 'm') || (cmd_rcvbuffer[j] == 'M')) //Checks if
↳ received data is 'M' or 'm'
        {
            j++;
            uart_rx_get_byte_byref(c_uartRX, rxState, buffer);
            cmd_rcvbuffer[j]=buffer;
            if((cmd_rcvbuffer[j] == 'D') || (cmd_rcvbuffer[j] == 'd')) //Checks
↳ if received data is 'D' or 'd'
            {
                uart_tx_send_byte(c_uartTX, '\r');
                uart_tx_send_byte(c_uartTX, '\n');
                uart_tx_string(c_uartTX, CONSOLE_MESSAGES[0]);
                COMMAND_MODE=1; //activates command mode as received data
↳ is '>cmd'
                uart_tx_send_byte(c_uartTX, '\r');
                uart_tx_send_byte(c_uartTX, '\n');
                uart_tx_send_byte(c_uartTX, '>'); //displays '>' if
↳ command mode is activated
            }
            else
            {
                uart_tx_send_byte(c_uartTX, '>');
                for(int i=0; i<3; i++)
                    uart_tx_send_byte(c_uartTX, cmd_rcvbuffer[i]); //
↳ if received dta is not 'c' displays back
↳ the received data
            }
        }
        else
        {
            uart_tx_send_byte(c_uartTX, '>'); //if received data is not 'm'
↳ displays the received data
            for(int i=0; i<2; i++)
                uart_tx_send_byte(c_uartTX, cmd_rcvbuffer[i]);
        }
    }
}

```

```

else
{
    uart_tx_send_byte(c_uartTX, '>');
    uart_tx_send_byte(c_uartTX, cmd_rcvbuffer[j]);
    j=0;
}
}
else
{
    uart_tx_send_byte(c_uartTX,buffer); //Echoes back the input characters if not in
    ↪ command mode
}

```

After the command mode is active the application receives all the input commands and send to the process_data API using a channel. The part of the code is shown below.

```

select
{
    case uart_rx_get_byte_byref(c_uartRX, rxState, buffer):
        cmd_rcvbuffer[j]=buffer;
        if(cmd_rcvbuffer[j++] == '\r')
        {
            skip=0;
            j=0;
            while(cmd_rcvbuffer[j] != '\r')
            {
                c_process<:cmd_rcvbuffer[j]; //received valid command and
                ↪ send the command to the process_data thread
                uart_tx_send_byte(c_uartTX, cmd_rcvbuffer[j]);
                j++;
            }
            cmd_rcvbuffer[j]='\0';
            c_process<:cmd_rcvbuffer[j];
            for(int inc=0;inc<20;inc++) //Clears the command buffer
                cmd_rcvbuffer[inc]='0';
            j=0;
        }
        break;
}

```

The process_data thread checks if any button is pressed or checks if there is any command from app_manager thread. If there is button press then the thread sends instructions to the app_manager thread about the button or if command is received, then it send instructions about the command received. The details in the process_data thread is as shown below.

Process_data thread send instructions to the app_manager thread about the command received. The app_manager thread then implementys the state machine according to the instructions received from the process_data thread. The state machine of app_manager thread is as below.



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