CPE403 – Advanced Embedded Systems

Design Assignment 5

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Github Repository link (root): https://github.com/AngeloNol/Design_Assignments

Youtube Playlist link (root): Assignment 5

1. Code for Tasks

```
/*********************************************************************
* INCLUDES
*/
#include <string.h>

#if (!(defined __TI_COMPILER_VERSION__) && !(defined __GNUC__))
#include <intrinsics.h>
#endif

#include <ti/sysbios/knl/Task.h>
#include <ti/sysbios/knl/Clock.h>
#include <ti/sysbios/knl/Event.h>
#include <ti/sysbios/knl/Queue.h>
#include <ti/drivers/utils/List.h>

//#include <xdc/runtime/Log.h> // Comment this in to use xdc.runtime.Log
#include <ti/common/cc26xx/uartlog/UartLog.h>  // Comment out if using xdc Log

#include <ti/display/AnsiColor.h>

#include <ti/devices/DeviceFamily.h>
#include DeviceFamily_constructPath(driverlib/sys_ctrl.h)

#include <icall.h>
#include <bcomdef.h>
/* This Header file contains all BLE API and icall structure definition */
#include <icall_ble_api.h>

/* Bluetooth Profiles */
#include <devinfoservice.h>
```

```
#include <profiles/project_zero/button_service.h>
#include <profiles/project_zero/led_service.h>
#include <profiles/project_zero/data_service.h>
#include <profiles/oad/cc26xx/oad.h>

#include "sunlightService.h"

/* Includes needed for reverting to factory and erasing external flash */
#include <ti/common/cc26xx/oad/oad_image_header.h>
#include <ti/drivers/dpl/HwiP.h>
#include <ti/drivers/NVS.h>
#include DeviceFamily_constructPath(driverlib/flash.h)

/* Application specific includes */
#include <ti_drivers_config.h>

#include <project_zero.h>
#include "ti_ble_config.h"
#include <util.h>

/*********************************************************************
* MACROS
*/

// Spin if the expression is not true
#define APP_ASSERT(expr) if(!(expr)) {project_zero_spin();}

#define UTIL_ARRTOHEX_REVERSE     1
#define UTIL_ARRTOHEX_NO_REVERSE  0

/*********************************************************************
```

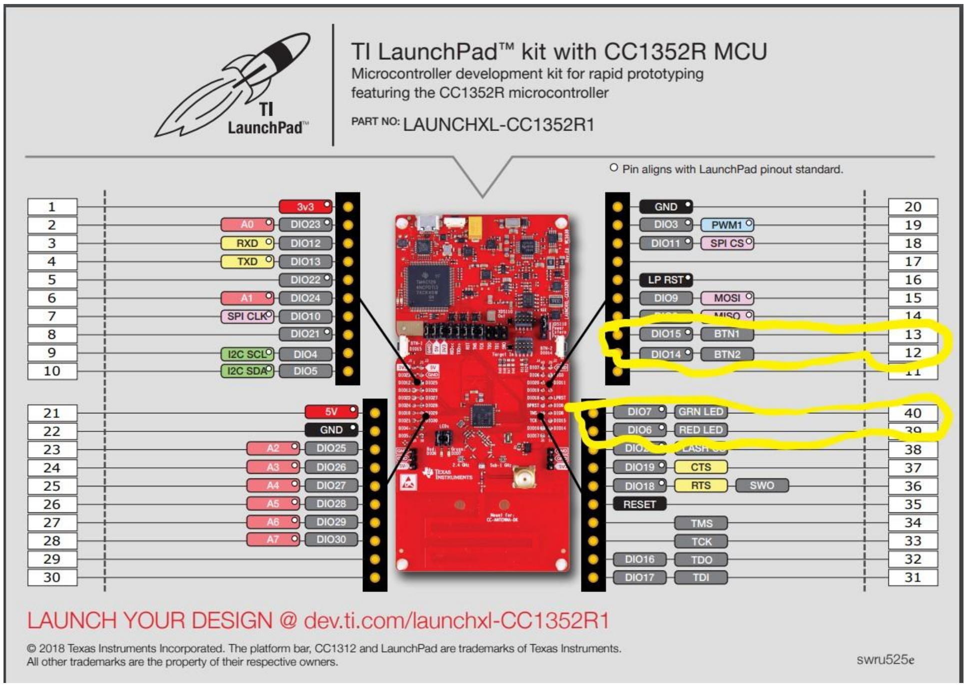
```
* CONSTANTS

*/

// Task configuration

#define PZ_TASK_PRIORITY                   1


#ifndef PZ_TASK_STACK_SIZE

#define PZ_TASK_STACK_SIZE                 2048

#endif


// Internal Events used by OAD profile

#define PZ_OAD_QUEUE_EVT                   OAD_QUEUE_EVT      // Event_Id_01

#define PZ_OAD_COMPLETE_EVT                OAD_DL_COMPLETE_EVT // Event_Id_02


// Internal Events for RTOS application

#define PZ_ICALL_EVT                       ICALL_MSG_EVENT_ID  // Event_Id_31

#define PZ_APP_MSG_EVT                     Event_Id_30


// Bitwise OR of all RTOS events to pend on

#define PZ_ALL_EVENTS                      (PZ_ICALL_EVT | \

                                 PZ_APP_MSG_EVT | \

                                 PZ_OAD_QUEUE_EVT | \

                                 PZ_OAD_COMPLETE_EVT)


// Types of messages that can be sent to the user application task from other

// tasks or interrupts. Note: Messages from BLE Stack are sent differently.

#define PZ_SERVICE_WRITE_EVT     0  /* A characteristic value has been written     */

#define PZ_SERVICE_CFG_EVT       1  /* A characteristic configuration has changed  */

#define PZ_UPDATE_CHARVAL_EVT    2  /* Request from ourselves to update a value    */

#define PZ_BUTTON_DEBOUNCED_EVT  3  /* A button has been debounced with new value  */

#define PZ_PAIRSTATE_EVT         4  /* The pairing state is updated                */

#define PZ_PASSCODE_EVT          5  /* A pass-code/PIN is requested during pairing */
```

```
#define PZ_ADV_EVT              6  /* A subscribed advertisement activity        */

#define PZ_START_ADV_EVT        7  /* Request advertisement start from task ctx   */

#define PZ_SEND_PARAM_UPD_EVT    8  /* Request parameter update req be sent       */

#define PZ_CONN_EVT             9  /* Connection Event End notice                */

#define PZ_READ_RPA_EVT        10  /* Read RPA event                             */

#define PZ_MSG_PERIODIC_TIMER   11 /* Timer has expired, set characteristic value */ //
SOLUTION


// Supervision timeout conversion rate to miliseconds

#define CONN_TIMEOUT_MS_CONVERSION           10


// Connection interval conversion rate to miliseconds

#define CONN_INTERVAL_MS_CONVERSION          1.25


// Default timeout of sunlight timer

#define DEFAULT_SUNLIGHT_TIMEOUT             5000  // SOLUTION



/*********************************************************************

* TYPEDEFS

*/

// Struct for messages sent to the application task

typedef struct

{

   uint8_t event;

   void    *pData;

} pzMsg_t;


// Struct for messages about characteristic data

typedef struct

{
  uint16_t svcUUID; // UUID of the service
  uint16_t dataLen; //
  uint8_t paramID; // Index of the characteristic
  uint8_t data[]; // Flexible array member, extended to malloc - sizeof(.)
} pzCharacteristicData_t;

// Struct for message about sending/requesting passcode from peer.
typedef struct
{
  uint16_t connHandle;
  uint8_t uiInputs;
  uint8_t uiOutputs;
  uint32_t numComparison;
} pzPasscodeReq_t;

// Struct for message about a pending parameter update request.
typedef struct
{
  uint16_t connHandle;
} pzSendParamReq_t;

// Struct for message about button state
typedef struct
{
  PIN_Id pinId;
  uint8_t state;
} pzButtonState_t;

// Container to store passcode data when passing from gapbondmgr callback
// to app event. See the pfnPairStateCB_t documentation from the gapbondmgr.h
// header file for more information on each parameter.
```

```
typedef struct
{
   uint8_t state;
   uint16_t connHandle;
   uint8_t status;
} pzPairStateData_t;

// Container to store passcode data when passing from gapbondmgr callback
// to app event. See the pfnPasscodeCB_t documentation from the gapbondmgr.h
// header file for more information on each parameter.
typedef struct
{
   uint8_t deviceAddr[B_ADDR_LEN];
   uint16_t connHandle;
   uint8_t uiInputs;
   uint8_t uiOutputs;
   uint32_t numComparison;
} pzPasscodeData_t;

// Container to store advertising event data when passing from advertising
// callback to app event. See the respective event in GapAdvScan_Event_IDs
// in gap_advertiser.h for the type that pBuf should be cast to.
typedef struct
{
   uint32_t event;
   void *pBuf;
} pzGapAdvEventData_t;

// List element for parameter update and PHY command status lists
typedef struct
{
  List_Elem elem;
  uint16_t *connHandle;
} pzConnHandleEntry_t;

// Connected device information
typedef struct
{
  uint16_t connHandle;                 // Connection Handle
  Clock_Struct* pUpdateClock;          // pointer to clock struct
  bool phyCngRq;                       // Set to true if PHY change request is in progress
  uint8_t currPhy;                     // The active PHY for a connection
  uint8_t rqPhy;                       // The requested PHY for a connection
  uint8_t phyRqFailCnt;                // PHY change request fail count
} pzConnRec_t;

// Container to store information from clock expiration using a flexible array
// since data is not always needed
typedef struct
{
 uint8_t event;
 uint8_t data[];
} pzClockEventData_t;

/********************************************************************
* GLOBAL VARIABLES
*/
// Task configuration
Task_Struct pzTask;
#if defined __TI_COMPILER_VERSION__
#pragma DATA_ALIGN(appTaskStack, 8)
#elif defined(__GNUC__) || defined(__clang__)
```

```
__attribute__ ((aligned (8)))
#else
#pragma data_alignment=8
#endif
uint8_t appTaskStack[PZ_TASK_STACK_SIZE];
```

2. Block diagram and/or Schematics showing the components, pins used, and interface.


TI LaunchPad™ kit with CC1352R MCU
Microcontroller development kit for rapid prototyping
featuring the CC1352R microcontroller
PART NO: LAUNCHXL-CC1352R1
TI
LaunchPad™
○ Pin aligns with LaunchPad pinout standard.
1 3v3
2 A0 DIO23
3 RXD DIO12
4 TXD DIO13
5 DIO22
6 A1 DIO24
7 SPI CLK DIO10
8 DIO21
9 I2C SCL DIO4
10 I2C SDA DIO5
21 5V
22 GND
23 A2 DIO25
24 A3 DIO26
25 A4 DIO27
26 A5 DIO28
27 A6 DIO29
28 A7 DIO30
29
30
GND 20
DIO3 PWM1 19
DIO11 SPI CS 18
17
LP RST 16
DIO9 MOSI 15
MISO 14
DIO15 BTN1 13
DIO14 BTN2 12
11
DIO7 GRN LED 40
DIO6 RED LED 39
38
DIO19 CTS 37
DIO18 RTS SWO 36
RESET 35
TMS 34
TCK 33
DIO16 TDO 32
DIO17 TDI 31
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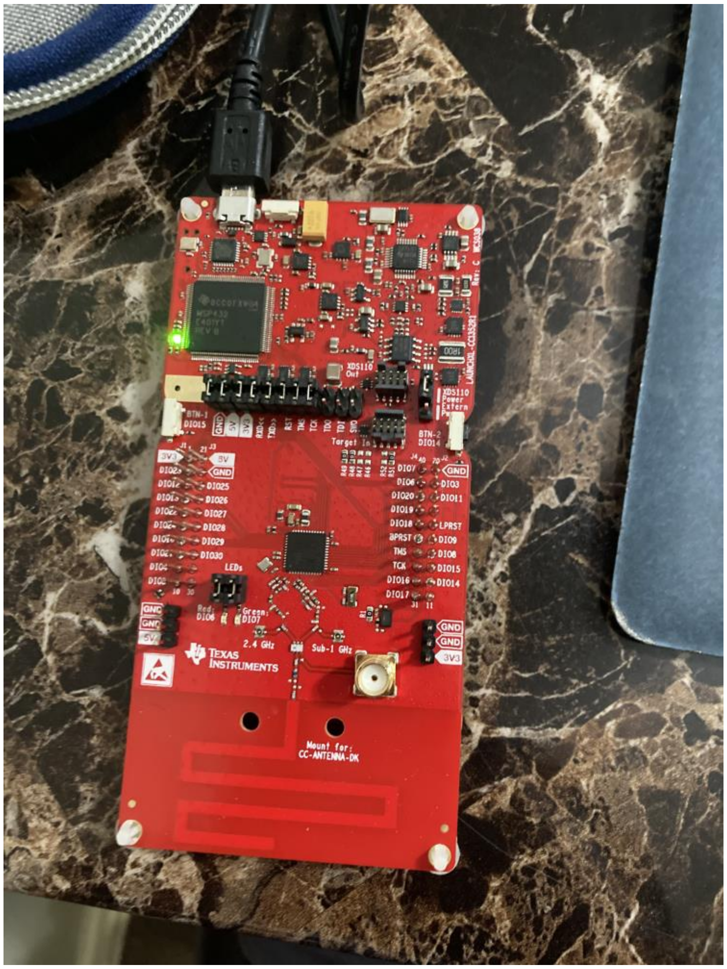
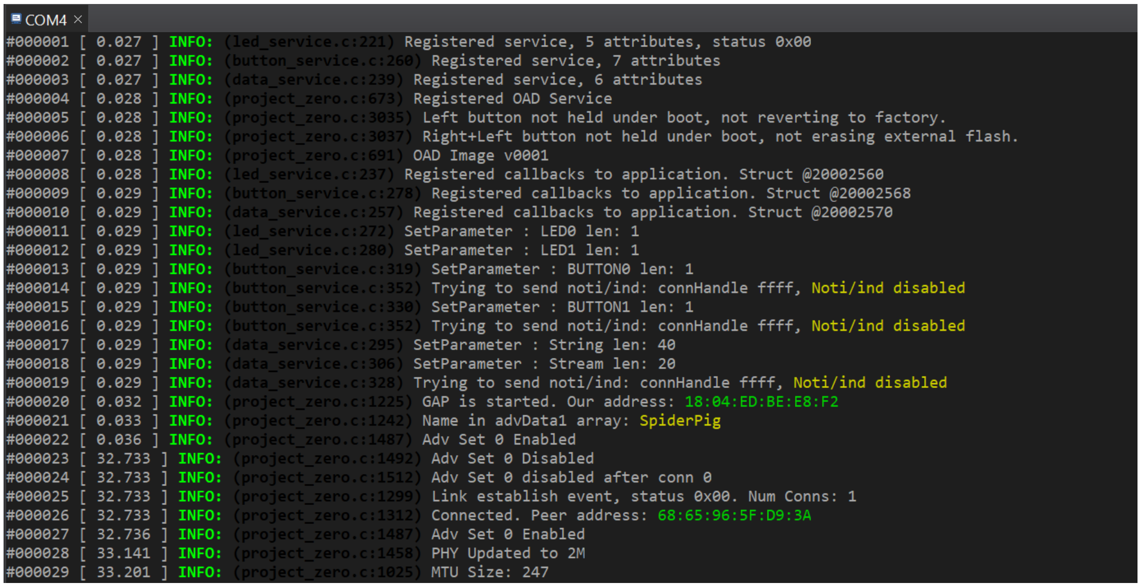
3. Screenshots of the IDE, physical setup, debugging process





```
#000001 [ 0.027 ] INFO: (led_service.c:221) Registered service, 5 attributes, status 0x00
#000002 [ 0.027 ] INFO: (button_service.c:260) Registered service, 7 attributes
#000003 [ 0.027 ] INFO: (data_service.c:239) Registered service, 6 attributes
#000004 [ 0.028 ] INFO: (project_zero.c:673) Registered OAD Service
#000005 [ 0.028 ] INFO: (project_zero.c:3035) Left button not held under boot, not reverting to factory.
#000006 [ 0.028 ] INFO: (project_zero.c:3037) Right+Left button not held under boot, not erasing external flash.
#000007 [ 0.028 ] INFO: (project_zero.c:691) OAD Image v0001
#000008 [ 0.028 ] INFO: (led_service.c:237) Registered callbacks to application. Struct @20002560
#000009 [ 0.029 ] INFO: (button_service.c:278) Registered callbacks to application. Struct @20002568
#000010 [ 0.029 ] INFO: (data_service.c:257) Registered callbacks to application. Struct @20002570
#000011 [ 0.029 ] INFO: (led_service.c:272) SetParameter : LED0 len: 1
#000012 [ 0.029 ] INFO: (led_service.c:280) SetParameter : LED1 len: 1
#000013 [ 0.029 ] INFO: (button_service.c:319) SetParameter : BUTTON0 len: 1
#000014 [ 0.029 ] INFO: (button_service.c:352) Trying to send noti/ind: connHandle ffff, Noti/ind disabled
#000015 [ 0.029 ] INFO: (button_service.c:330) SetParameter : BUTTON1 len: 1
#000016 [ 0.029 ] INFO: (button_service.c:352) Trying to send noti/ind: connHandle ffff, Noti/ind disabled
#000017 [ 0.029 ] INFO: (data_service.c:295) SetParameter : String len: 40
#000018 [ 0.029 ] INFO: (data_service.c:306) SetParameter : Stream len: 20
#000019 [ 0.029 ] INFO: (data_service.c:328) Trying to send noti/ind: connHandle ffff, Noti/ind disabled
#000020 [ 0.032 ] INFO: (project_zero.c:1225) GAP is started. Our address: 18:04:ED:BE:E8:F2
#000021 [ 0.033 ] INFO: (project_zero.c:1242) Name in advData1 array: SpiderPig
#000022 [ 0.036 ] INFO: (project_zero.c:1487) Adv Set 0 Enabled
#000023 [ 32.733 ] INFO: (project_zero.c:1492) Adv Set 0 Disabled
#000024 [ 32.733 ] INFO: (project_zero.c:1512) Adv Set 0 disabled after conn 0
#000025 [ 32.733 ] INFO: (project_zero.c:1299) Link establish event, status 0x00. Num Conns: 1
#000026 [ 32.733 ] INFO: (project_zero.c:1312) Connected. Peer address: 68:65:96:5F:D9:3A
#000027 [ 32.736 ] INFO: (project_zero.c:1487) Adv Set 0 Enabled
#000028 [ 33.141 ] INFO: (project_zero.c:1458) PHY Updated to 2M
#000029 [ 33.201 ] INFO: (project_zero.c:1025) MTU Size: 247
```

4. Declaration

I understand the Student Academic Misconduct Policy - http://studentconduct.unlv.edu/misconduct/policy.html

“This assignment submission is my own, original work”.
Angelo Nolasco