PSoC 4 BLE – HRM Data Collector

Objective

This example demonstrates a simple Heart Rate Collector, which receives the Heart Rate information from a Heart Rate Sensor.

Overview

This example project demonstrates the BLE Heart Rate Collector. The project receives Heart Rate data from any BLE enabled Heart Rate Sensor and indicates that data on any terminal software via UART.

Requirements

Design Tool: PSoC Creator 3.1 SP2, CySmart 1.0

Programming Language: C (GCC 4.8.4 – included with PSoC Creator)

Associated Devices: All PSoC 4 BLE devices

Required Hardware: CY8CKIT-042-BLE Bluetooth® Low Energy (BLE) Pioneer Kit

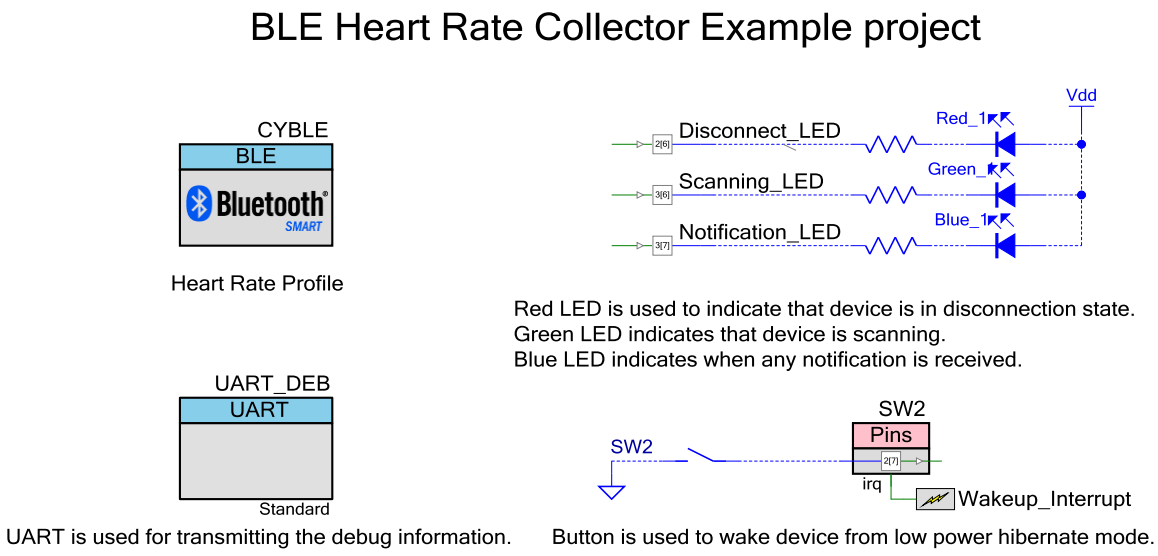
Hardware Setup

The BLE Pioneer Kit has all of the necessary hardware required for this lab. In this setup, following connections are done in the BLE Pioneer Kit.

- The UART RX pin is connected to port 1 pin 4.
- The UART TX pin is connected to port 1 pin 5.
- The red LED (port 2 pin 6) is used to indicate the BLE disconnection state.
- The green LED (port 3 pin 6) is used to indicate the advertising state.
- A mechanical button (port 2 pin 7) is used to wake up the device and start re-scanning.
- The blue LED (port 3 pin 7) is used to indicate the battery discharge (low power).

PSoC Creator Schematic

Figure 1. PSoC Creator Schematic



Project Description

The project demonstrates the BLE workflow procedures like scanning, discovering, connecting, writing/reading characteristics/descriptors, receiving notifications etc. It is designed to work in pair with the BLE Heart Rate Sensor Example Project.

The project is designed so there is no need to initiate any of mentioned actions manually – it automatically starts the BLE stack, then when stack is on (STACK_ON event is received) the scanning GAP procedure is initiated, then it receives and parses advertisement data. The green LED is blinking while the device is scanning. Once it finds out that there is Heart Rate Service UUID in the advertisement packet then it immediately connects to that device and starts to discover all primary services which are supported (configured in the GATT tab): in our case they are: Generic Access (GAP) and Attribute (GATT) services, then Heart Rate (HRS), Battery (BAS) and Device Information Service (DIS). Then the project discovers included services (which may be secondary) and characteristics of each mentioned above primary services. Then it discovers descriptors of each service characteristic which can have descriptors.

After the discovery process (when the DISCOVERY_COMPLETE event is received) project sends a request to read the Body Sensor Location characteristic and waits for HRSC_BSL_READ_RESPONSE event in the heart rate profile's callback (HeartRateCallBack()). In this event project indicates received Body Sensor Location value and enables the Heart Rate Measurement Notification. The notifications come approximately once a second. The project also enables the Battery Level notification, which comes immediately after enabling and then when battery level changes.

The red LED is turned on after disconnection to indicate that no Server is connected to the device. On disconnection event the device immediately starts to scan peripherals. When the Central device connects successfully, both red and green LEDs are turned off.

Expected Results

The project is intended to work in pair with the BLE Heart Rate Sensor Project. However, it can work with any other BLE heart rate sensor (e.g. HRM-10 chest belt) which exposes Heart Rate and Battery Services. When in connection with any Heart

Rate sensor device, the project indicates the received heart rate notifications through UART. Also the LEDs are blinking as described in Project Description section.

The example log is shown below:

```
BLE Heart Rate Collector Example Project
Stack Version: 1.0.0.169
EVT_STACK_ON
Start Scan
EVT_GAPC_SCAN_START_STOP, state: 3
SCAN_PROGRESS_RESULT: peerAddrType - 0, peerBdAddr - 0: 00a050000006, rssi - -67 dBm, data - 02 01 06 12 09 48 65 61 72 74 20 52 61 74 65 20 53 65 6e 73 6f 72 05 02 0d 18 0a 18        This device contains Heart Rate Service
Stop Scanning, waiting for Scanning event
SCAN_PROGRESS_RESULT: peerAddrType - 0, peerBdAddr - 0: 00a050000006, rssi - -68 dBm, data - 12 09 48 65 61 72 74 20 52 61 74 65 20 53 65 6e 73 6f 72 03 02 0d 18        This device contains Heart Rate Service
Stop Scanning, waiting for Scanning event
EVT_GAPC_SCAN_START_STOP, state: 5
Connect to the Device: 0
EVT_HCI_STATUS 12
EVT_GATT_CONNECT_IND: attId 0, bdHandle 3
EVT_GAP_DEVICE_CONNECTED: 3
Authentification request is sent
EVT_GAP_AUTH_COMPLETE: security:1, bonding:1, ekeySize:10, authErr 0
Start Discovery
EVT_GAP_ENCRYPT_CHANGE: 1
EVT_GATTC_DISCOVERY_COMPLETE
Body Sensor Location Read Request is sent
Body Sensor Location: WRIST (2)
HRM CCCD Write Request is sent
Heart Rate Measurement Notification is Enabled
Heart Rate Notification: Heart Rate: 72   EnergyExpended: 0   RR-Interval 0: 833
HRM CCCD Read Request is sent
HRM CCCD Read Response: 0001
Heart Rate Notification: Heart Rate: 84   EnergyExpended: 0   RR-Interval 0: 714
Battery Level CCCD Write Request is sent
BAS event: 11f, Battery Level Notification is Enabled
Heart Rate Notification: Heart Rate: 96   EnergyExpended: 0   RR-Interval 0: 625
Heart Rate Notification: Heart Rate: 108   EnergyExpended: 0   RR-Interval 0: 555
Heart Rate Notification: Heart Rate: 120   EnergyExpended: 0   RR-Interval 0: 500   RR-Interval 1: 501
BAS event: 11c, Battery Level Notification: 100
BL CCCD Read Request is sent
BAS event: 11e, BAS descriptor read rsp: 0001
Heart Rate Notification: Sensor Contact is supported but not detected
Heart Rate Notification: Sensor Contact is supported but not detected
Heart Rate Notification: Sensor Contact is supported but not detected
BAS event: 11c, Battery Level Notification: 100
Heart Rate Notification: Heart Rate: 168   EnergyExpended: 0   RR-Interval 0: 357   RR-Interval 1: 358
Heart Rate Notification: Heart Rate: 180   EnergyExpended: 0   RR-Interval 0: 333   RR-Interval 1: 334   RR-Interval 2: 335
Heart Rate Notification: Heart Rate: 192   EnergyExpended: 0   RR-Interval 0: 312   RR-Interval 1: 313   RR-Interval 2: 314
BAS event: 11c, Battery Level Notification: 100
Heart Rate Notification: Sensor Contact is supported but not detected
Heart Rate Notification: Sensor Contact is supported but not detected
```

Related Documents

Table 1 lists all relevant application notes, code examples, knowledge base articles, device datasheets, and Component / user module datasheets.

Table 1. Related Documents

Document	Title	Comment
AN91267	Getting Started with PSoC 4 BLE	Provides an introduction to PSoC 4 BLE device that integrates a Bluetooth Low Energy radio system along with programmable analog and digital resources.
AN91445	Antenna Design Guide	Provides guidelines on how to design an antenna for BLE applications.