My partner and I used two MSP430FR6989 microcontrollers to design a diffuser pump interface and control system for an automated insulin pump diffuser system. One microcontroller runs the pump and provide status codes on command and the other sends the commands and displays the returned status. The pump system also has a small insulin reservoir that has sensors to monitor the remaining insulin dosages available. Because we don’t have access to this sensor, we assumed a starting level and kept track of the reservoir.

**Microcontroller A (pump):**

1. Receives an 8-bit code over the UART. The 8-bit code numbers are as follows:

0x01 = 1 = 40ms dose

0x02 = 2 = 80ms dose

0x03 = 3 = 120ms dose

… 4 through 122 …

0x7B = 123 = 4920ms dose

0x7C = 124 = 4960ms dose

0x7D = 125 = 5000ms dose

In addition, there is a “send status code” 0xFF = 255 = Send Status

1. On receiving a valid “run pump” code, the microcontroller sends the PWM signal required to run the pump out on P1.0 (which is connected to the pump) for the indicated length of time. That signal is 20ms period, 10% duty cycle PWM signal.
2. On receiving a valid “Send Status” code the microcontroller transmits its current status on the UART.

0x01 = Pump OFF, all normal

0x02 = Pump OFF, Less than five 5-second doses left

0x03 = Pump OFF, Less than one 5-second doses left

0x88 = Pump ON, all normal

0x89 = Pump ON, Less than five 5-second doses left

0x8A = Pump ON, Less than one 5-second doses left

1. On receiving a valid “run pump” code when there is less than one 5-second dose left the microcontroller immediately transmits an alert code via the UART. 0xFF = Alert! There may not be enough insulin for this or the next dose.
2. Allows refilling the reservoir completely (to 1 minute's supply) on button press (P1.2)
3. Safety Features:
   1. Prevents the reservoir from going negative by only pumping at most what is left in the reservoir
   2. Gives warning when supplies are accessed while critically low
   3. Active watchdog to avoid getting stuck in a loop or interrupt
   4. Button debouncing

**Microcontroller B (control and display):**

1. Responsible for transmitting the proper “dose” 8-bit codes over the UART. It currently has determined that the patient needs a 0.56 second dose (14 = 0x0E) repeating once a minute.
2. There is an emergency manual dose button that applies a 2.48 second dose every time that button 1.2 is pressed.
3. Sends a status request (0xFF) once a second. Once it receives the response it displays an appropriate message on the LCD and uses the LED to indicate various levels of alerts.
4. Safety Features:
   1. Active watchdog to avoid getting stuck in a loop or interrupt
   2. if everything is normal: Green LED
   3. if under 25 seconds, but over 5 seconds of dosage: Red LED
   4. if under 5 seconds of dosage: Blinking Red LED
   5. if there is not enough insulin left for next dosage: exclamation point on LCD
   6. the LCD displays a message showing if the pump is on or off
   7. emergency manual dose button
   8. Sends a status request (0xFF) once a second.
   9. Button debouncing