Recruitment development project

Goal

The programming example of this recruitment development project gives FBI Medizintechnik GmbH a better understanding of the programming capabilities of the candidate. It is not important which programming language or IDE is used. The project shall rather reveal the structured working method of the job applicant and also the approach to solve complex problems.

Technical background

The recruitment development project uses recorded data from an OEM III Pulse Oximetry Module from Nonin to measure functional oxygen saturation of arterial hemoglobin (%SpO2) and the pulse rate for adult, pediatric, and neonatal patients.

Pulse oximeters measure functional oxygen saturation using two components – the oximeter and the sensor – which are validated and calibrated as a system. Pulse oximeter sensors pass red and infrared light through perfused tissue and detect the fluctuating signals caused by arterial blood pressure pulses. Well-oxygenated blood is bright red, while poorly oxygenated blood is darker in color. The pulse oximeter determines functional oxygen saturation of arterial hemoglobin from this color difference by calculating the ratio of absorbed red and infrared light as the blood volume at the sensor site fluctuates with each heart beat. Since steady conditions (steady venous blood flow, skin thickness, bone, fingernails, etc.) are not pulsatile, they do not affect the saturation reading.

The OEM III features three selectable data format options. Data format #1 is ideal for real time monitoring or data logging and applications where only SpO2, pulse rate, and signal quality are needed. Data format #2 includes the same parameters as data format #1, six different averaging options for the SpO2 value, 4 different averaging options for the HR value, plus the pulse waveform using 8 bit compression. Data format #7 is based on data format #2, except it provides a full 16 bit uncompressed resolution for greater pulse waveform analysis.

More details can be found in the accompanying documents:

- OEM III Specifications 4518-001 Rev 12.pdf
- OEM III Integration Guide 4785-000-05.pdf

Task

The task of the candidate is to develop a simple desktop application which

- reads the pleth signal from the recorded data file, which contains Nonin sensor data using the data format #7 and
- displays the pleth curve on the screen in a simple line chart.
- If there is time the SpO2 and HR values (4-beat average values in standard mode) can also be displayed as single values on the screen.

There are two sensor data files provided. One is a binary file (file extension *.dat), which contains the real Nonin sensor data without modifications or interpretations. Using this file is similar to reading directly from the sensor. The second file is a simple CSV file (file extension *.csv) and contains the preprocessed data from the binary file for easy use. Both files can be used. The binary file is more challenging and requires the synchronization of the start byte of each Nonin data package (see documentation above for further details).

The programming language and the IDE can be selected freely. The source code and comments and maybe some simple documentation (mainly project setup and compile instructions) should be returned before the deadline. Questions can also be asked per e-mail, but the response time may be a day or two.

Hints

- The Nonin integration guide describes the correct interpretation of the binary stream (either from a real sensor or from the binary file). The handling of data format #7 is mentioned on page 6.
- The Nonin specification guide describes the basic connection settings used for the recording (page 3). It also contains the description of the data format #7 on page 6 (including the notes on page 7).
- The binary file was recorded using a Nonin sensor with data format #7 and the connection settings mentioned in the Nonin specification guide.
- The CSV file contains the same data as the binary file, but was already preprocessed (recognize the first byte of each frame via checksum and also recognize the first frame of a package).
- A possible start could be, to read the data from the CSV file and show the pleth values as line chart on the screen. Then move the data source from the CSV file to the binary file (including the interpretation of the byte stream). This can easily be tested because the CSV file contains the same content (excluding the first bytes until a whole data package is found).

The following screenshot shows a sample pleth curve, collected with the Nonin evaluation program.