Smartphone Image Processing for the Internet of Dumb Things

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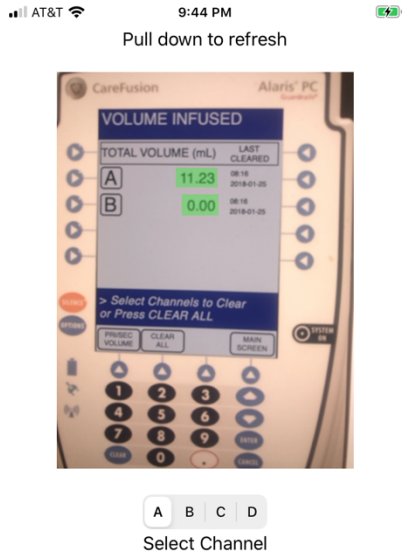
There is considerable enthusiasm for an integrated clinical environment comprised of devices that communicate with a central messaging broker – the Internet of Things. Despite this, there are many “dumb things” in the anesthesia environment that force the clinician to manually enter data into clinical information systems. We might wish that the forced air warming system could report its state wirelessly, but we won’t buy a new one whose only new feature is Bluetooth connectivity. Our infusion pumps might support the ability to report infusion rates to Epic, but the implementation is slated for 2022. A simple approach employing a smartphone and openly available software libraries is described to address this problem.
In the depicted example, we want to read two numbers on the screen of an Alaris Medley pump, which the app has done. It must solve several problems:



1) The image needs to be registered, as the picture was taken off-axis and tilted
2) The areas of interest need to be identified, as shown in green
3) The characters in green need to be recognized
4) The phone must transmit the data to the broker labelled with the correct pump

To perform these tasks, we employ a number of open source libraries:
1) OpenCV
2) Google Firebase/MLVisionTextModel
3) Paho MQTTClient/Websocket
4) QRCodeReaderViewController

In this example, we already know the propofol with concentration 10 mg/ml has been mounted on Channel A in OR 2 by scanning a QR code; what we need transcribed is the volume (11.23 ml). The phone app needs to understand the geometry of the image to find the characters to recognize, but does not need to know the details of the consumer of the data, as this can be done on the MQTT server using technologies such as Spark to emit HL7 FHIR. This permits the phone app to be completely generic. The utility of such a system in rapidly adding data sources to an integrated clinical environment will require clinical validation.