Modular Real-Time Spectroscopy Instrument

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Introduction

Whether researching new antibiotics, cancer treatments, or biofilm inhibitors, spectroscopy affords unique insight into nanoscale biochemical processes. Spectroscopy allows both the quantification and characterization of proteins, enzymes, DNA, and bacteria. Existing lab devices contain advanced optical systems which support selection of wavelengths. However, shortcomings of present equipment include high cost, the assumption of an on-site operator at each measurement interval, and limited sensitivity under particular circumstances. Furthermore, existing optical systems are incompatible with hybrid experimental arrangements such as automated fluid exchange or sample exposure to electromagnetic fields. We present an in-process update on the development of a modular spectroscopy instrument centered around the Raspberry Pi (RasPi) single board computer (Figure 1).

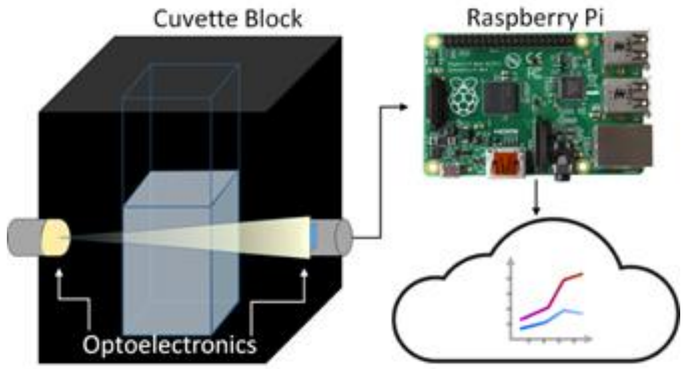
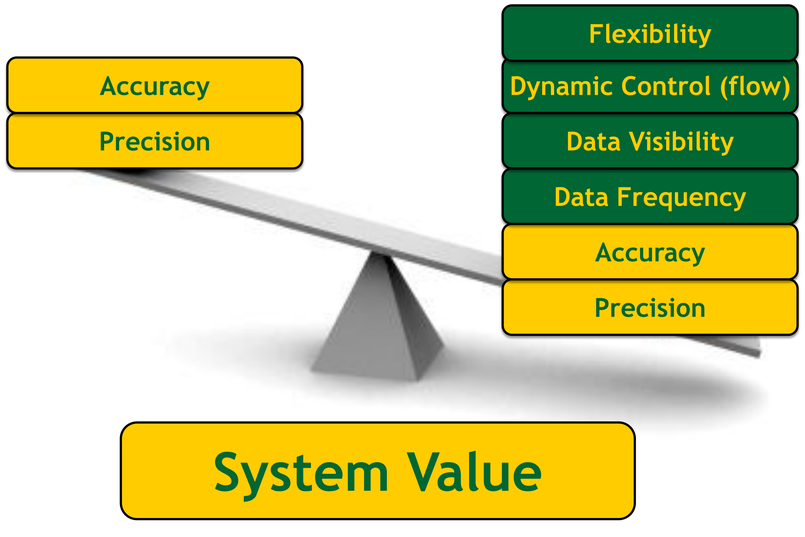


Figure 1: The principle elements of the RTSpec system are a cuvette block, input/output (I/O) optoelectronics, and a Raspberry Pi computer. Measured data is pushed to a publicly accessible web server for remote viewing and plotting.

Hypothesis



Results

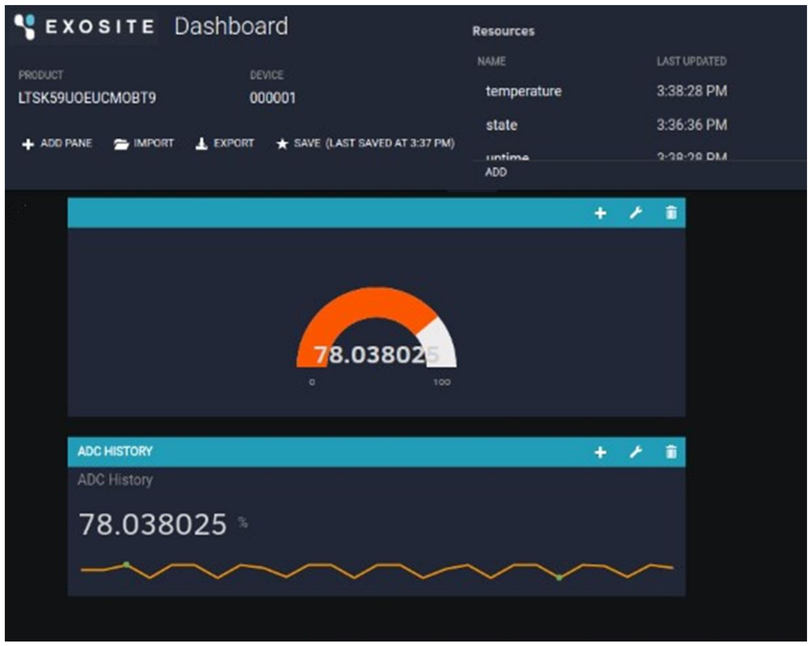


Figure 2: Measurements are published in real-time to a public web server. Researchers may now monitor experimental progress at any time via a smartphone or computer.

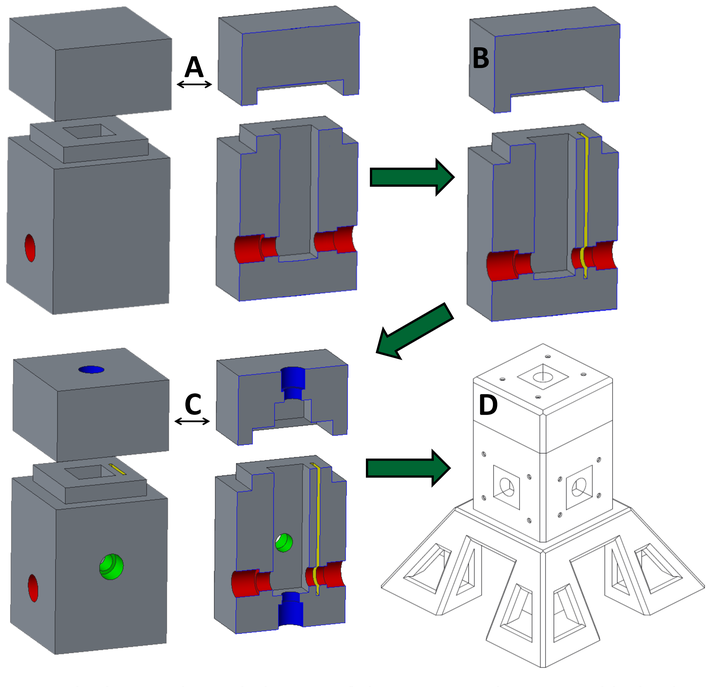


Figure 3: The key mechanical element of the system is the cuvette block. The original block (A) was revised to accommodate an optical filter (B) and multi-axis measurement (C). The block was further revised (D) for enhanced stability and to add mounting holes for I/O electronics.

Results

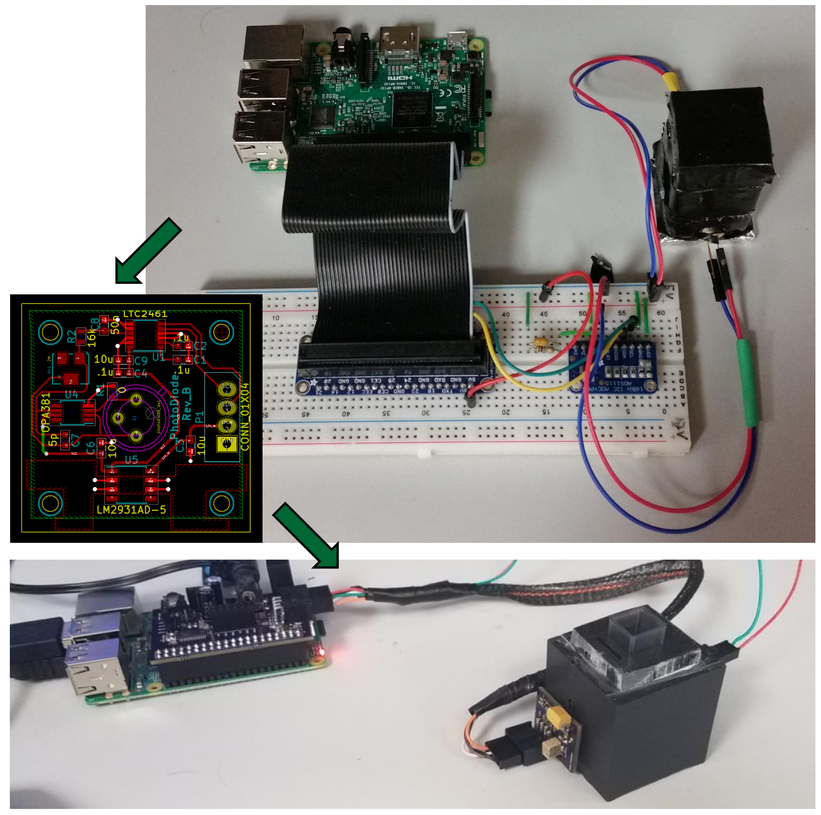


Figure 4: Electronics were revised to increase reliability and signal integrity. Breadboard circuits were converted to custom PCB's with keyed and locking interconnects.

Future Work

- Download data sets from website
- Add controlled fluid exchange
  - Prevent drug saturation
  - Deliver nutrient-rich media
- Add magnetic coil for nanoparticle + DNA dehybridizing experiments

References

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