MocRate: A Portable Pulse Oximeter

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Abstract

Detecting a patient's heart rate and oxygen is a very common practice in the medical world. Due to this, a solution for a portable and user friendly monitor for efficient use is crucial. In this project, we have designed and deployed a battery-powered and portable sensor that can quickly get an individuals heart rate by them simply placing their finger into a clip that measure their heart rate and oxygen levels and provide them that information quickly and clearly.

Components

- **SparkFun Pulse Oximeter and Heart Rate Sensor -MAX30101 & MAX32664 (~42.50 USD)**
  - An small and easy to use sensor for measurement.
- **Arduino Uno Rev3 (~25.29 USD)**
  - A popular and beginner-friendly micro-controller board.
- **AA Batteries (~3.00 USD)**
  - An easy to purchase and install power source.
- **AA Battery Holder (~6.48 USD for 6)**
  - To hold the batteries.
- **Waveshare 4.2inch E-Ink Display (~34.99 USD)**
  - To provide a minimalist showing of the patient/user's status.
- **Power Button (~2.00 USD)**
  - To allow the user to easily turn the monitor on and off.
- **3D Printed Chassis (Price Varies)**
  - Custom built to easily fit the interior components. Figures containing the final design are attached in the **Models** section.

Methods and Overview

Creating the contraption was fairly straightforward, especially with the choice of parts. Using the Arduino UNO and its companion application, Arduino IDE, we were able to program the calculation of the sensor efficiently. The SparkFun Sensor family has pre-built libraries that translate the pulse oximeter's signals to readable numbers. In addition to this, the libraries allowed us to print whether or not the user is correctly using the tool. Whilst the patient is interacting with the machine, the following statuses may be displayed:

- **NO OBJ** - The tool does not detect anything.
- **OBJ DETECTED** - The sensor detects the touch of an object.
- **NOT FINGER** - The object detected is not a human finger.
- **MEASURING** - The finger is successfully detected and is being measured.
- **UNKNOWN** - Internal error, should almost never occur.

Models

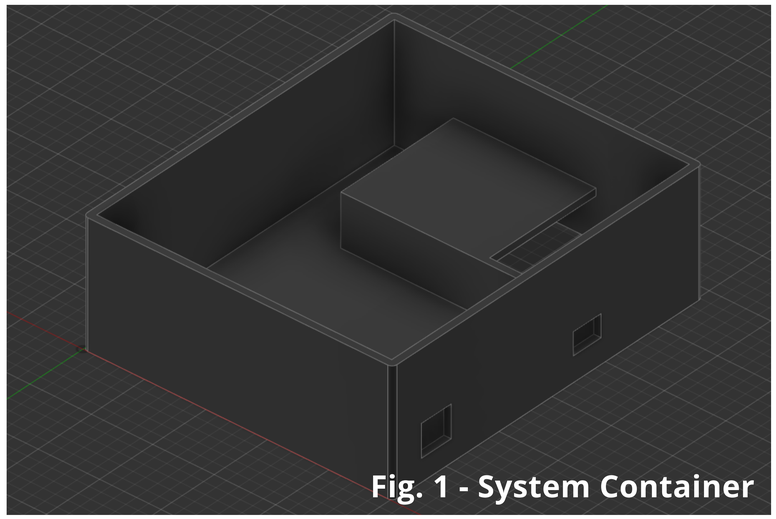


Fig. 1 - System Container

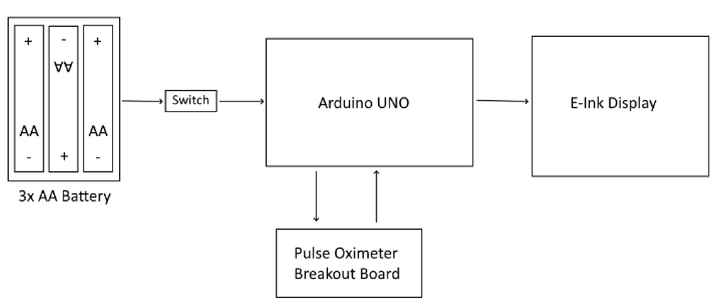


Fig. 2 - Block Diagram

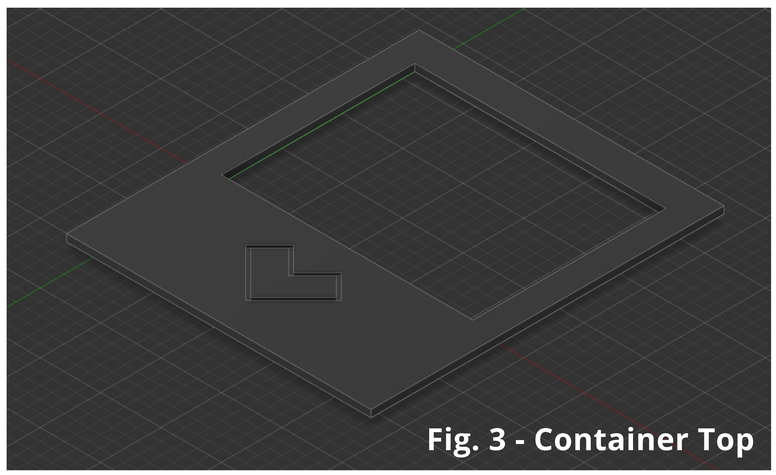
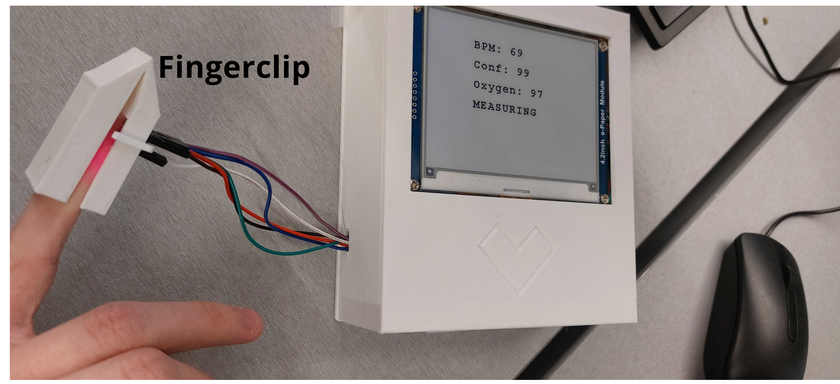


Fig. 3 - Container Top

Final Product



Shown above is an example of the device in action. The subject places their index finger within the clip and subject's readings are displayed on the screen of the device.

Tested on one subject with 5 trials, the readings are nearly as accurate as the common pulse oximeter found in commericial and professional markets. The margins of error are presented below.

Results and Conclusion

After thorough testing, we can comfortably say that the final product is sufficiently accurate and suitable for commercial and personal use. In comparison to our reference device, the margin of error for heart rate and blood oxygen was only **±1 BPM** and **±1%**, respectively.

Additionally, we noticed that in order for the patient to successfully get their results, they need to place the bottom of their fingers flat on the sensor; the fingertip does not suffice.

With this, we consider our final project a success in not only its use case, but as an application of the Arduino systems family. Although it is typically seen as a hobbyist tool, we have proven with this project that it can be just as beneficial in the professional world; all while learning important programming and circuitry skills.

Acknowledgements

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