

Auto Adjustable Flow Regulator

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Members:

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Introduction:

The project goal is to create an updated automatic oxygen flow regulator for low-flow nasal cannula devices. The main stakeholder is Dr. John M. Gormley, who is a physical rehabilitation physician. Previous work on the project has been done by Alexander Tkatchouk, Harshesh Panchal, Stephen Hubbs, and Yasmina Yerima. Individuals with obstructive breathing disorders need supplemental oxygen titration to overcome their lowered tidal volume. Current treatment requires a medical professional to set a fixed flow rate by adjusting a manual valve based on the patient's blood oxygen readings. The patient or healthcare provider will then manually regulate the flow to match their own needs. This results in inaccurate oxygen titration for most patients and can lead to carbon dioxide retention due to a lowered breathing rate. Most current solutions use manual valves, and the few automatic designs on the market are expensive, not portable, and only intended for clinical use. The design goal of this project is to update the current prototyped device to be portable and reliable (functioning consistently), with a user-friendly interface and optimized calibration. These updates should improve the existing device which measures blood oxygen content using photoplethysmography and continuously alters the oxygen flow rate to match immediate demand.

Device Description and Indications for Use:

The Auto-Adjustable Oxygen Flowmeter device is to be used in conjunction with an oxygen source or reservoir, as well as a low-flow nasal cannula apparatus. The device is applicable for patients requiring an oxygen flow rate of 0-6 L/min. Further, the device works to maintain a healthy blood-oxygen concentration of 90-94% for typical patients, as well as an 88-92% range for COPD patients who are chronic CO₂ retainers. A reflective pulse oximeter will record the SpO₂ concentration of the patient. The outputted SpO₂ concentration will be transmitted to an internal processing PCB from which it will interact with the oxygen valve, causing it to contract or expand based on the patient's need or surplus of oxygen. The patient's target SpO₂ range will be inputted using a screen interface. This screen interface will also output the patient's SpO₂ value, current oxygen flow rate through the system, and plethysmography graph. If the device loses power, the flow will be redirected through a manual valve that can be hand-adjusted by the patient or care team on site.

Discussion:

Development of this prototype is set to be continued by another senior project group in the Spring of 2024. This group will be implementing a custom PCB to replace the Arduino and many of the relevant electrical components. As a result of this, we will not be publishing

our entire final report, only the abbreviated introduction and device description depicted above. All relevant material will be released to Digital Commons once the project has been completed in June 2024.