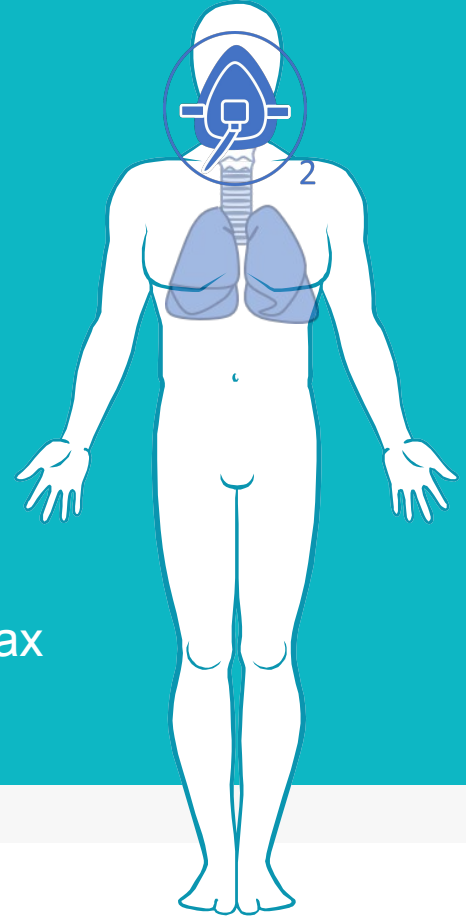


L.G.E.C: Wireless Control of an In-Home Oxygen Concentrator

Elliott Grant, Gabriel Hoppock, Lamy Jaigirdar, Carla Pax



THE DISEASE: IDIOPATHIC PULMONARY FIBROSIS (IPF)



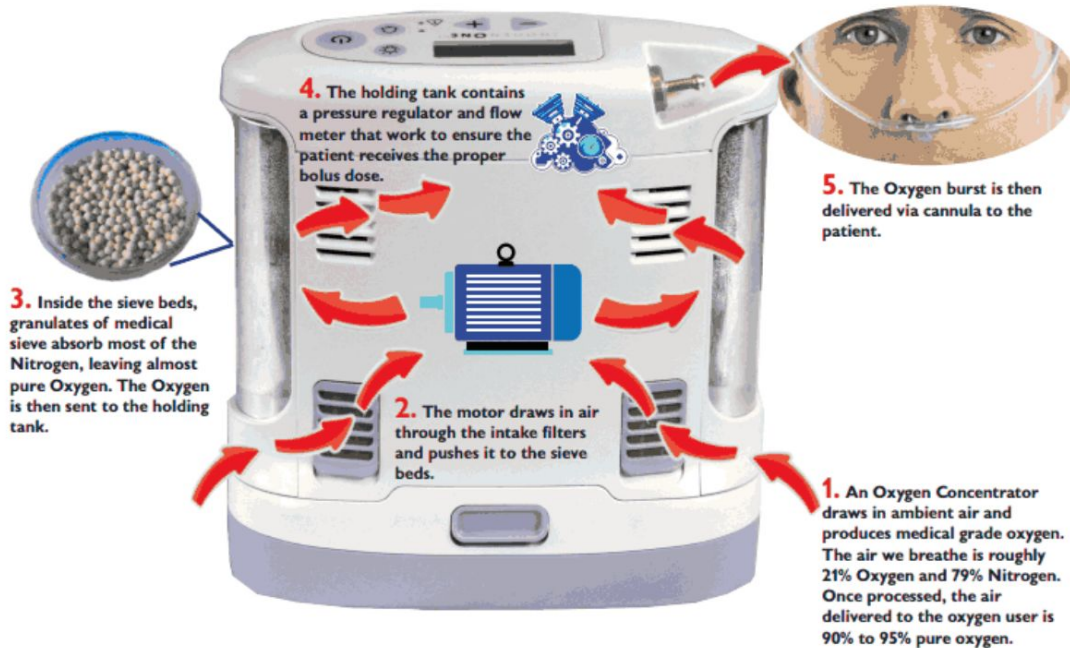
Healthy Lung



IPF Lung

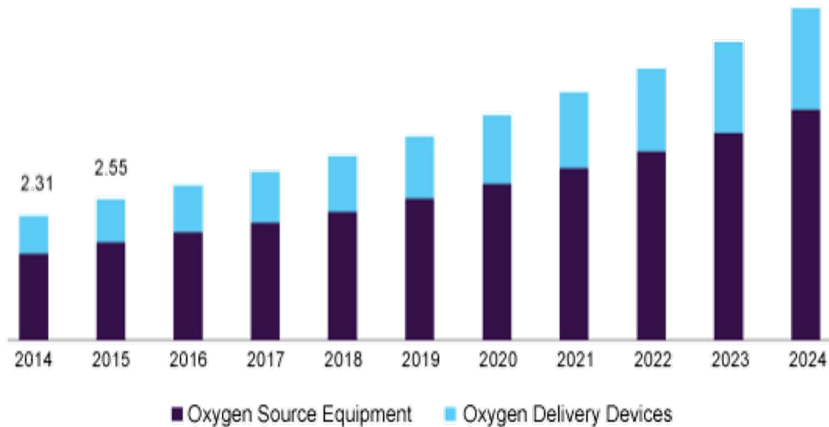
- IPF is a chronic illness
- The tissue in the lungs to thicken and scar
- The rate of oxygen transfer in the lungs is decreased
- IPF patients require Long-Term Oxygen Therapy (LTOT)

Oxygen Concentrator



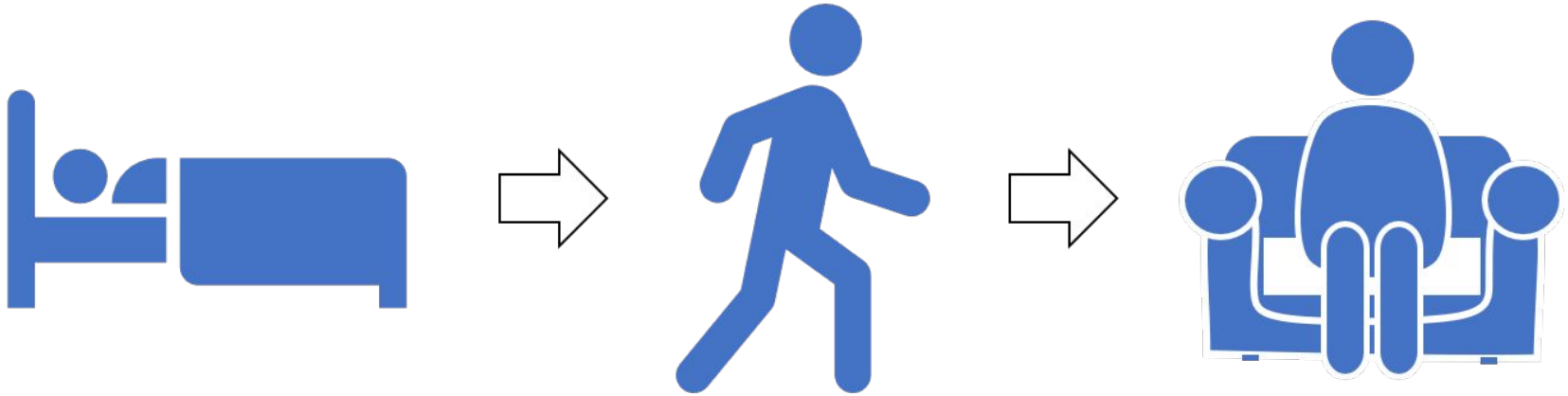
THE DISEASE: IDIOPATHIC PULMONARY FIBROSIS (IPF)

U.S. Oxygen Therapy Market Size (USD Billion)



- Initial target market: 110,000 individuals in the U.S.
- Lifespan: 3 to 5 years
- Increase in geriatric population leads to increase in IPF patients

THE PROBLEM:



Different oxygen liter flow rates are needed for each physical activity, but there is no continuous access to the oxygen concentrator to change the flow.

THE PROBLEM: Incorrect O₂ Levels have adverse side effects



- Coughing
- Fatigue
- Shortness of Breath
- Chest Pain
- Stripping of the nasal cavity
- Headaches/Disorientation
 - Myopia
- CO₂ Narcosis

IPF Patient Visit

- ▶ Lack of knowledge of IPF flow rate requirements
- ▶ Negative perception of being “Addicted to Oxygen”
- ▶ Inconsistency-Patient claims flow rate was 3 L/min when actually 2.5 L/min
- ▶ Lack of easy communication with doctors
- ▶ Never changes oxygen liter flow rate until the patient feels ill
- ▶ Physical activity is limited to sitting, eating, television, sleeping, puzzles
- ▶ Lack of easy way track and store health information
- ▶ General frustration and confusion regarding the treatment and illness

IPF Patient Visit



Date	Time	SpO ₂	Notes
Sat Sept 8 th	8:00 AM	100%	- 98
	8:15 AM	100%	- 79 after shower
	8:17 AM	100%	- 95
	9:20 AM	100%	- 70 to orchard
	9:22 AM	94/100%	
	5:30 PM	98/100%	- Resting
Sun 9 th	8:15 AM	73/100%	after shower
	8:16 AM	95/100%	
Sun 9 th	9:00	98/63	100%
	9:30	95/73	100% after folding clothes
Mon 10 th	4:30	73	100% after shower
Tue 11th	4:31	88	100%
Tue 11 th	5:30 AM	98/63	100% setting up
Tue 11 th	3:30 PM	94	100% Resting
Wed 12 th	8:00 AM	70	100% 30 min with 100%
Wed 12 th	8:01 AM	95	100%
Thu 13 th	8:30 AM	99/63	100%
Fri 14 th	9:00 AM	92/71	100%
Sat 15 th	8:45 AM	98/35	100%
Sun 16 th	9:30 AM	93/67	100%
Mon 17 th	8:40 AM	80/72	100% after shower
Mon 17 th	8:42 AM	92/70	100%
Mon 17 th	2:10 PM → 2:20 PM	70 → 97	100%
Tue 18 th	9:00 AM	82/34	100% after shower
Tue 18 th	9:01 AM	99/35	100%
Wed 19 th	9:30 AM	93/61	100%

Needs Assessment

L.G.E.C is seeking an inexpensive and novel way to

1. Wirelessly control the oxygen liter flow on the oxygen concentrator
2. Noninvasively monitor oxygen needs of IPF patients
3. Inform the specific patient on what their oxygen liter flow should be based on their oxygen requirement
4. Provide the user a way to monitor and track their oxygen liter flow

Goal:



Design And Application Requirements

Accuracy

- Based on clinical protocol
- Able to be calibrated

Safety

- Clinically tested on patients

Ease of Implementation

- Intuitive to use
- Easy to connect device and website

Device Requirements: Safety

**Will not decrease patient's
respiratory function**

**Will use a direct power
source**

**Have back-up battery capability in
case of emergencies**

**Adjust oxygen liter flow based on
patient's health condition**

Device Requirements: Cost Efficiency and Ease of Implementation

Cost Efficiency

- Should have low manufacturing costs by using inexpensive materials

Ease of Implementation

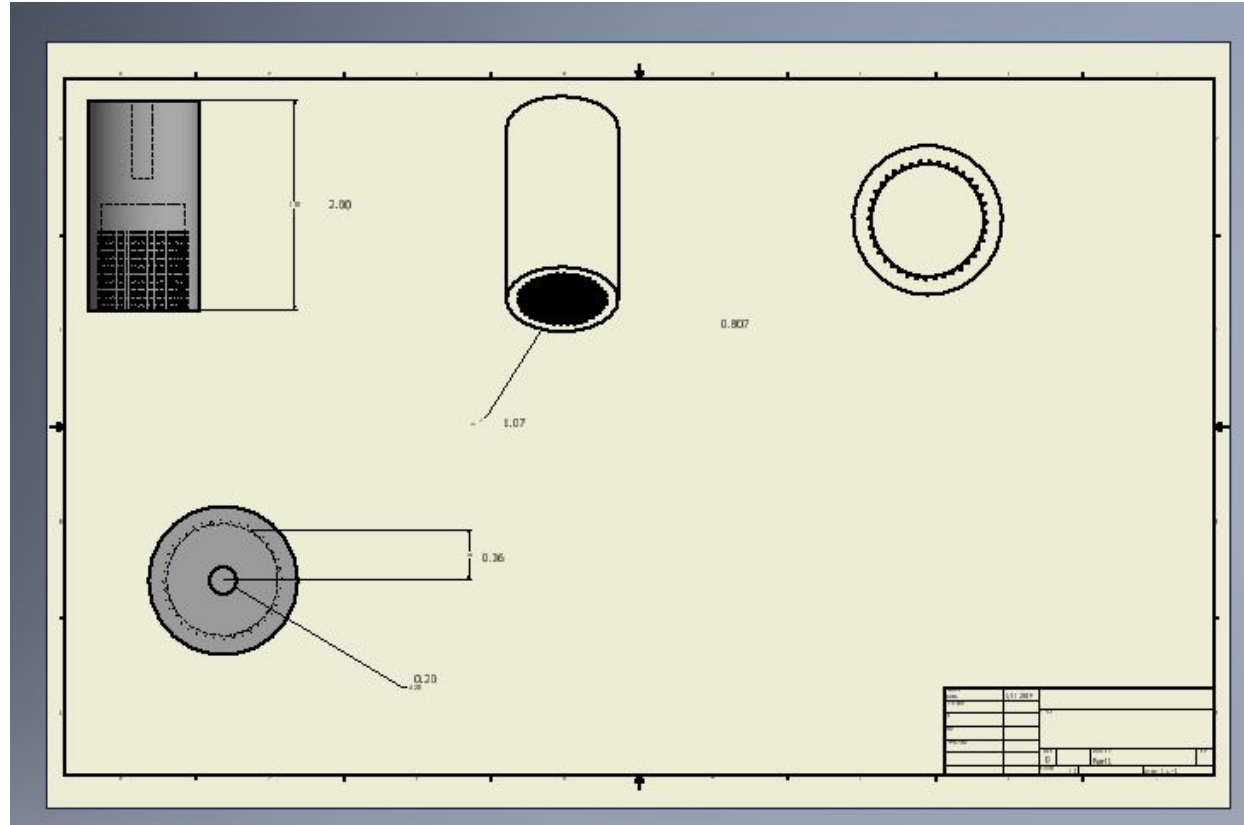
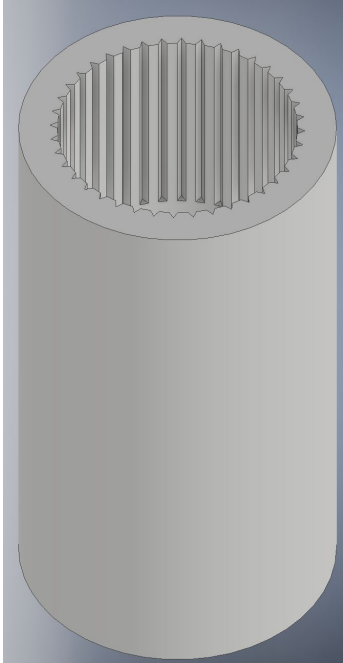
- Must be able to connect to a standard outlet
- Should be easy to install, remove, and set-up

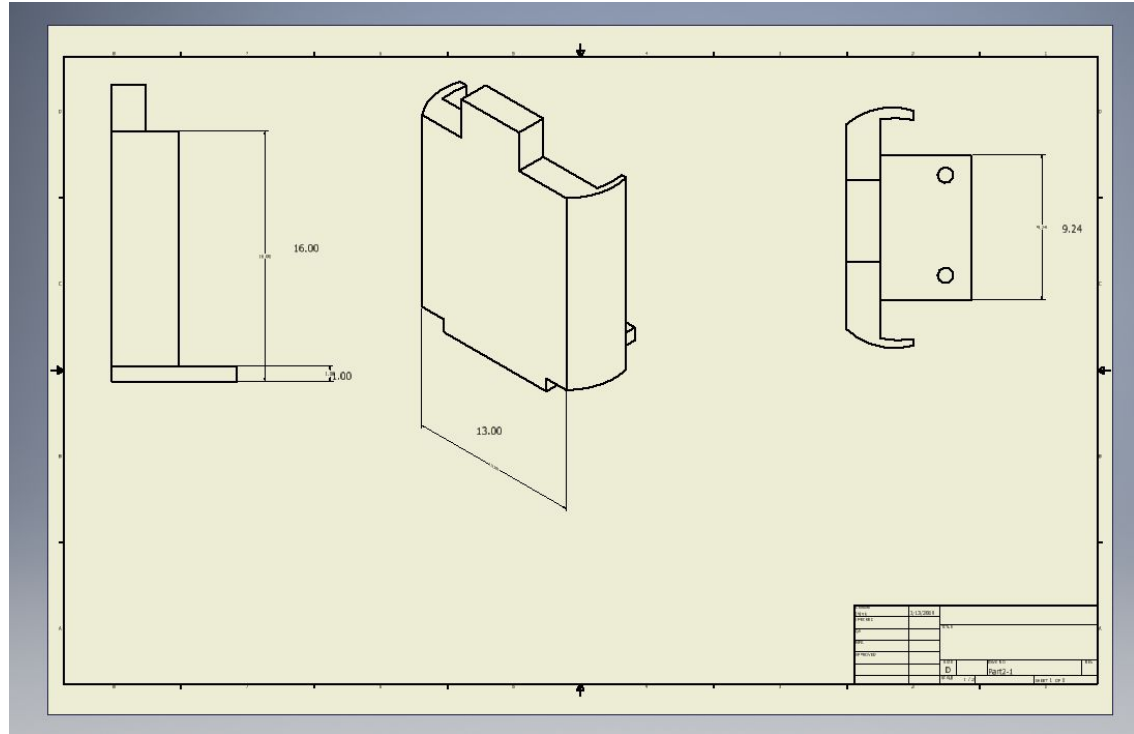
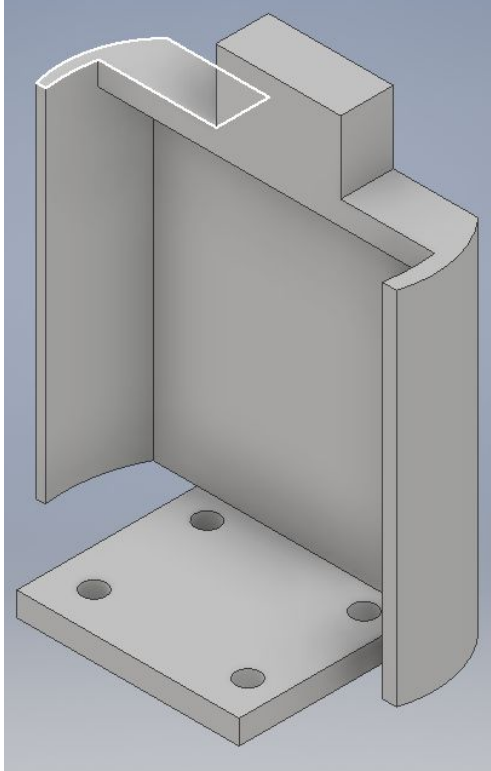
What will our device do?

- Physically change oxygen liter flow by rotating the knob
- Bluetooth enabled to wirelessly communicate with the application
- Adjustable and easily attachable

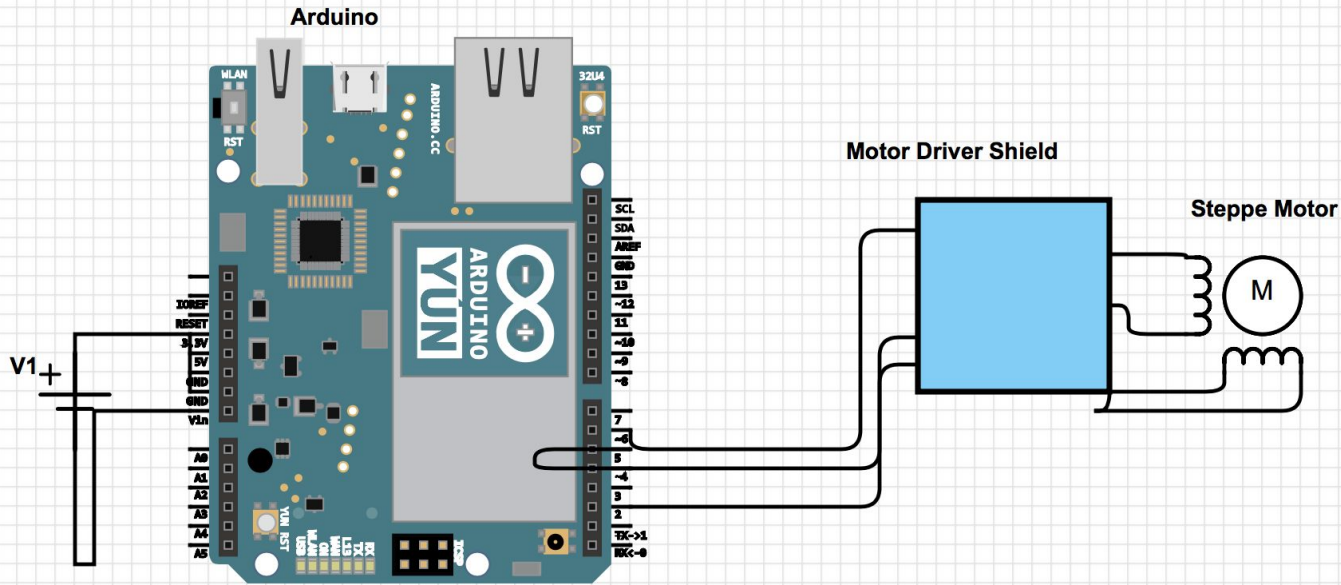


Device Design





Circuit Diagram



Application Requirements

Effective

- Explain how the application works
- Allow user to track O2 saturation and liter flow requirement

Ease of Navigation

- Adjustable font sizes
- Provide instructions on how to use application

Secure

- Collect user info into separate accounts
- Require authentication to access a user account

Ease of Implementation

- Free to download
- Compatible with all Android devices on all software versions

Front End Design

Step 1:

Option 1: Log-In

Enter: email and/or phone # and password

Option 2: Create a New Account

Enter: name, email, phone, age, birthday, gender, baseline O2 liter flow rate, password, re enter password

Step 2:

Option 1: Adjust Your Device

Option 1a: Input blood O2 saturation level

Option 2a: Manually input desired oxygen liter flow rate

Option 2: Access Your Account

Option 2a: View O2 saturation values overtime classified by activity level and O2 liter flow rate

Option 3b: Edit your account information

Option 3: Settings

Option 3a: Choose your oxygen concentrator

Option 3b: Adjust font size

Option 3c: Log out

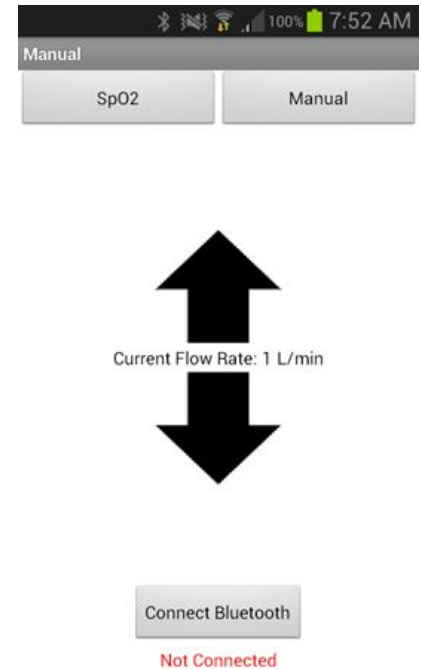
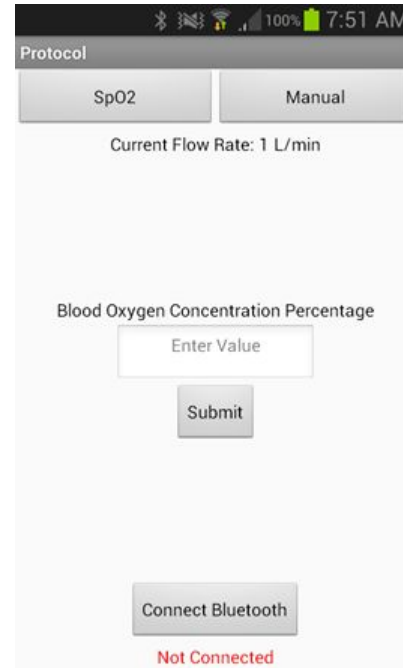
Option 4: Help

Option 4a: How to Use this Application?

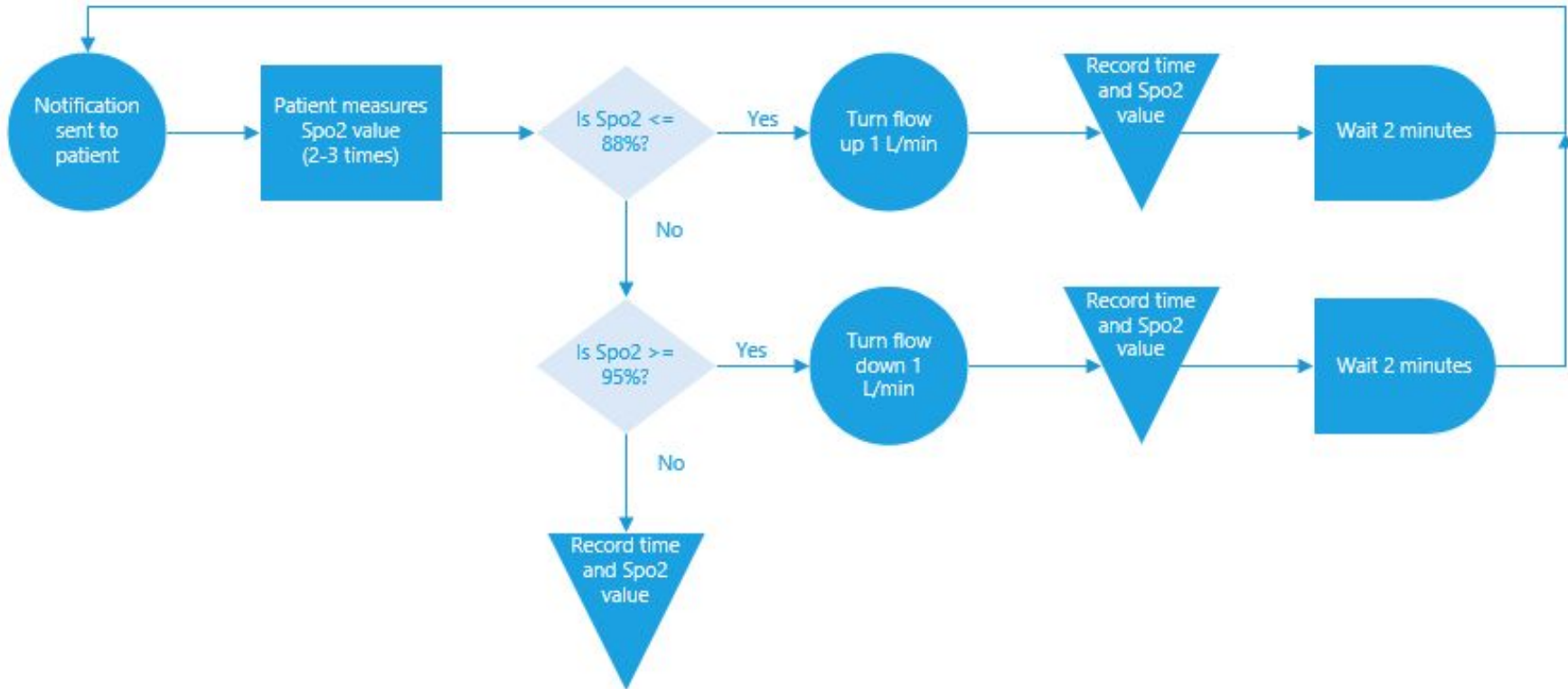
Option 4b: How this Application Works?

Front End Design

- This was created using open-source Android app code in Java powered by MIT



Protocol: How O2 Liter Flow Rate Changes with O2 Saturation Levels



Future Steps

- Add more application functionality
- Clinically test our system
- Incorporate IR technology on Android Devices
- Create customizable features
- Explore funding options

THANK YOU!

Any questions?

You can contact us at

- ▶ <https://my.vanderbilt.edu/lgecseniordesign2018/>

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