

**OXYGEN ENRICHED AIR SUPPLY DEVICE  
FOR COVID - 19 CONVALESCING PATIENTS**

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By Ram Ganesh and Team

Ramganeshlankada@gmail.com

The Oxygen enriched air supply device gets simply break down to the following systems on which we've worked to deliver the required constraints.

1. PLANT SELECTION
  - a. Plant should possess maximum oxygen generation ability.
  - b. Should do maximum possible photosynthesis
  - c. Ability to provide oxygen 24/7 continuously to the patient
  - d. It should be an indoor or semi-indoor plant.
2. PLANT GROWTH SYSTEM
  - a. The system on which the plant grows should be clean and sterile
  - b. The plant growth system should be easy to be maintained by the user
  - c. The growth system should provide maximum possible strength to the plant for better growth and photosynthesis.
3. PHOTOSYNTHESIS OPTIMIZATION SYSTEM
  - a. To optimize the photosynthesis process in plants to produce maximum possible oxygen.
  - b. To enrich the air with oxygen to get a fraction of inspired oxygen (FiO<sub>2</sub>) of 40% - 50% .
4. OXYGEN COLLECTION AND FLOW SYSTEM
  - a. To collect the oxygen enriched air.
  - b. To deliver it at a constant flow of 4 – 5 liters per minute.
5. OXYGEN AND CARBON DIOXIDE CYCLE
  - a. To supply the oxygen enriched air to the patient using a SIMPLE FACE MASK
  - b. To deliver the patient exhaled air to the device.

## **PLANT SELECTION**

The plant that we've selected is SNAKE PLANT.

### **WHY SNAKE PLANT ?**

Snake plant is a household plant which perfectly suits device environment.

It holds a unique property that it continuously absorbs carbon dioxide from the air and also removes formaldehyde to create a healthy environment even during the night.

It is easy to grow low maintenance plant that does not need water regularly.

It is said to produce more oxygen than all the other plants in this pool of plant species

It also removes air pollutants which will be an added advantage when kept in a plant chamber

It absorbs carbon dioxide even at night which means that it also does the photosynthesis process even at night and the reason behind this is CRASSULACEAN ACID METABOLISM in snake plant.

It tolerates low light, snake plant grows fastest in bright conditions.

## **PLANT GROWTH SYSTEM**

To meet the constraints we have selected the HYDROPONICS plant growth system , following are the reasons why we've selected the HYDROPONICS system over the soil growth system.

### **GROWTH IN SOIL SYSTEM**

**Difficult to grow plants in this system in home.**

**Slow Growth of plants.**

**Possible growth of weeds**

**Spraying of pesticides is required**

**Requires watering everyday. High water consumption.**

**Very difficult to grow from seeds.**

**Plants fail / wilt soon due to lack of root aeration.**

**Needs materials like compost to enhance the growth which are – smelly, made from waste, attract flies & bugs.**

**Requires high maintainance.**

**Overall, high cost and low benefit.**

**Use various fertilizers –different fertilizers for different soils – don't know what to use.**

**Requires guidance from local gardeners – not reliable.**

### **WHY HYDROPONICS?**

**Fast growth of plants – ensures more oxygen generation.**

**Lush green & healthy plants.**

**No pesticides usage.**

**Requires watering just once in 2-3 days. Water consumption very low by comparison.**

**Very easy to grow from seeds.**

**Excellent aeration of roots, so plants do not fail / wilt.**

**Extremely hygienic. No waste. No smell. No bugs or insects.**

**No need of high maintainence**

**Overall, lower cost and high benefit.**

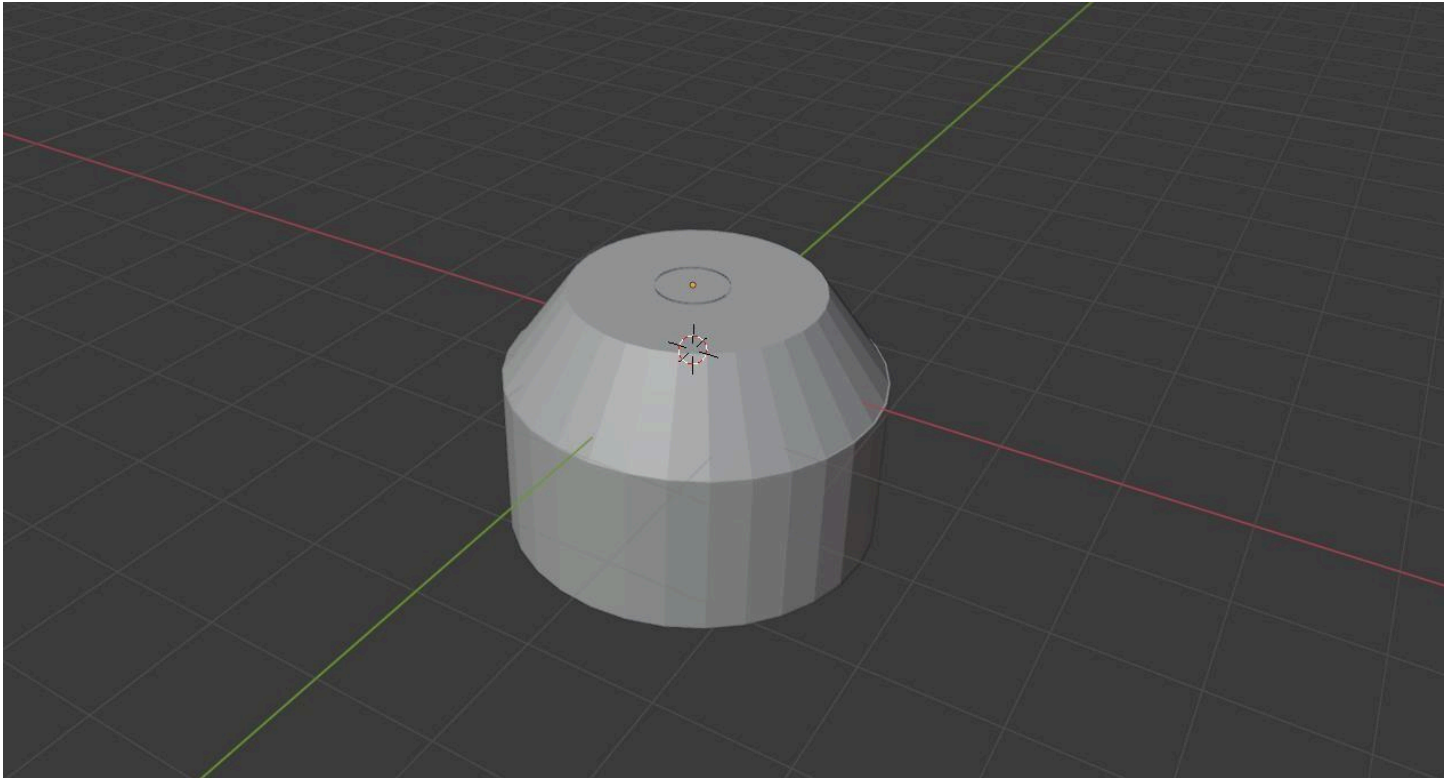
**We should just add the nutrient rich liquid for the required growth of the plants**

**Can make the nutrient rich hydroponic solution at home or purchase the nutrient rich solution**

**makers at affordable prices on internet.**

We can use a product called green loop leafy – 200 to make up the nutrient rich hydroponic solution for a faster growth of plants.

## DESIGN OF THE PLANT GROWTH MODULE



The total growth module of the plant consists of a CYLINDRICAL GLASS CHAMBER and a designed CYLINDRICAL MODULE ( PLASTIC ).

Both the things used in the Growth module are threaded so that they can be air locked with each other by fitting them together just like a bottle cap and the bottle.

A designed cylindrical module is used to store the Hydroponic solution in it.

A inverse L structured pipe is at the middle of the cylinder trunk which is adjustable to act as both inlet and outlet pipe.

The cylindrical module consists of a small circular hole at the middle of top surface to make the plant we use to fit in to.

And it is provided with a small system at the circular hole to hold the trunk of the plant ( just above it's roots ) tightly , and provides an airlock between the glass chamber and the solution in the cylindrical module at the same time.

NOTE: Other specifications of the glass chamber will be discussed later in the PHOTOSYNTHESIS OPTIMIZATION SYSTEM section.

# PHOTOSYNTHESIS OPTIMIZATION SYSTEM

The factors which affects the rate of photosynthesis are

Internal factors of plant like chlorophyll , leaf anatomy , hormones , enzyme activity etc.

Nutrition through water

Light – Intensity and wavelength of light

Concentration of carbon dioxide

Humidity in the air

Temperature

The rate of photosynthesis can be increased at constant rate

by experimentation on increasing the factors like nutrition through water , Intensity of Light and concentration of carbon dioxide.

By improving the quality or quantity of input of Limiting factor which can be determined by knowing the saturation point of a factor.

Saturation point of a affecting factor can be known by plotting the graph of rate of photosynthesis with factor affecting the photosynthesis.

## TOOLS AND PARAMETERS REQUIRED TO OPTIMISE PHOTOSYNTHESIS

Arduino uno module

Modified Electrochromatic glass – to wind it around the glass chamber.

LED Light of 27,000 lumens or 500 PPF with a power rating of 300 Watts and with a light wavelength of ( 400 – 425 ) nanometers or ( 600 – 700 ) nanometers.

Oxygen sensor OOM202.

Temperature and humidity controller ( stc – 3028 ) – to maintain temperature and humidity in the chamber

Temperature : daytime = 25 degrees Celsius and night time = 20 degrees Celsius

Humidity : 60 %

NOTE: All the parameters that are required to optimize the rate of photosynthesis i.e rate of oxygen generation are taken from the good pool of Research papers.

## INFORMATION ABOUT THE TOOLS USED

### 1. ELETROCHROMATIC GLASS

Electrochromatic glass also called as smart glass is made up of polymer plastic. The speciality of this glass is , it becomes transparent upon the passage little current to it and becomes completely opaque when the current is not passed to it.

### 2. Oxygen sensor OOM202

It measures the percentage of oxygen in air present in the enclosed chamber.

## PRINCIPLE AND PROCESS USED IN PHOTOSYNTHESIS OPTIMIZATION

1. The principle used here is subjecting the plant to continuous light and dark cycles , where the light used is an artificial light and the process is proven to accelerate the photosynthesis , which accelerates the production of oxygen.
2. The plant is subjected to a light duration of 1/100,000th of a second followed by a dark period of 1/100th of a second duration.
3. The subjected light has a light intensity of 500 ppfd or 27000 lumens with a power rating of 300 watts operating at wavelength of either ( 400 – 425 ) nanometers or ( 600 – 700 ) nanometers.
4. According to a research based on “Influence of light intensity and the leaf movement on photosynthesis” in China it was concluded that the use of above parameters rather than any other random parameters shown a drastic growth in soybean plants which indicates elevated amount of glucose and oxygen generation in plants.
5. The electrochromatic glass is connected to Arduino uno module containing a program of light duration and dark duration parameters in it.
6. Temperature and the humidity will be maintained as per the above mentioned parameters with the above mentioned device.
7. Oxygen sensor is used to measure the rate of photosynthesis and use it to plot the graphs ( using the data values provided by the sensor ) with other factors affecting the rate of photosynthesis that is concentration of carbon dioxide and other internal factors , practically on experimental values.
8. Plotting the graphs with other factors helps us to determine the limiting factor.
9. Improving the quality / quantity ( as per required ) of the limiting factor enables us to improve the oxygen generation which in turn increases the fraction of inspired oxygen (  $FiO_2$  ).
10. Improving the limiting factors are done until the required constraint of  $FiO_2$  is achieved.

## OXYGEN COLLECTION SYSTEM

### DUAL AIR FLOW SYSTEM

#### TOOLS USED :

1. A circuit of two cylinders parallel to each other having their vertical inputs and outputs both connected to a common pipe vertically.

This system of dual air flow system is used :

1. To prevent the continuous flow of air which could deliver the air which is not completely enriched with oxygen.
2. To make the air stay constant for a while with the plant chamber, which allows the air to get enriched with oxygen.

#### FUNCTION OF THE CYLINDER CIRCUIT:

1. The circuit is connected to the glass tube coming out of the plant chamber letting the air to pass into the circuit.
2. This air passed into the cylinder circuit will not be flowed continuously.
3. The outlets of each individual cylinder gets opened and closed one after other , getting the air to get delivered to the next section.
4. Simply the cylinder 1 lets the air flow from it when the outlet of cylinder 2 is closed and the process occurs vice – versa continuously .

## **OXYGEN AIR FLOW SYSTEM**

### **TOOLS USED:**

1. A plastic cylinder.
2. A vacuum fan of radius slightly less than that of glass cylinder.
3. Electronic regulator to regulate the fan speed.
4. Oxygen Flowmeter – it helps us to modulate the flow rate of oxygen in liters per minute.

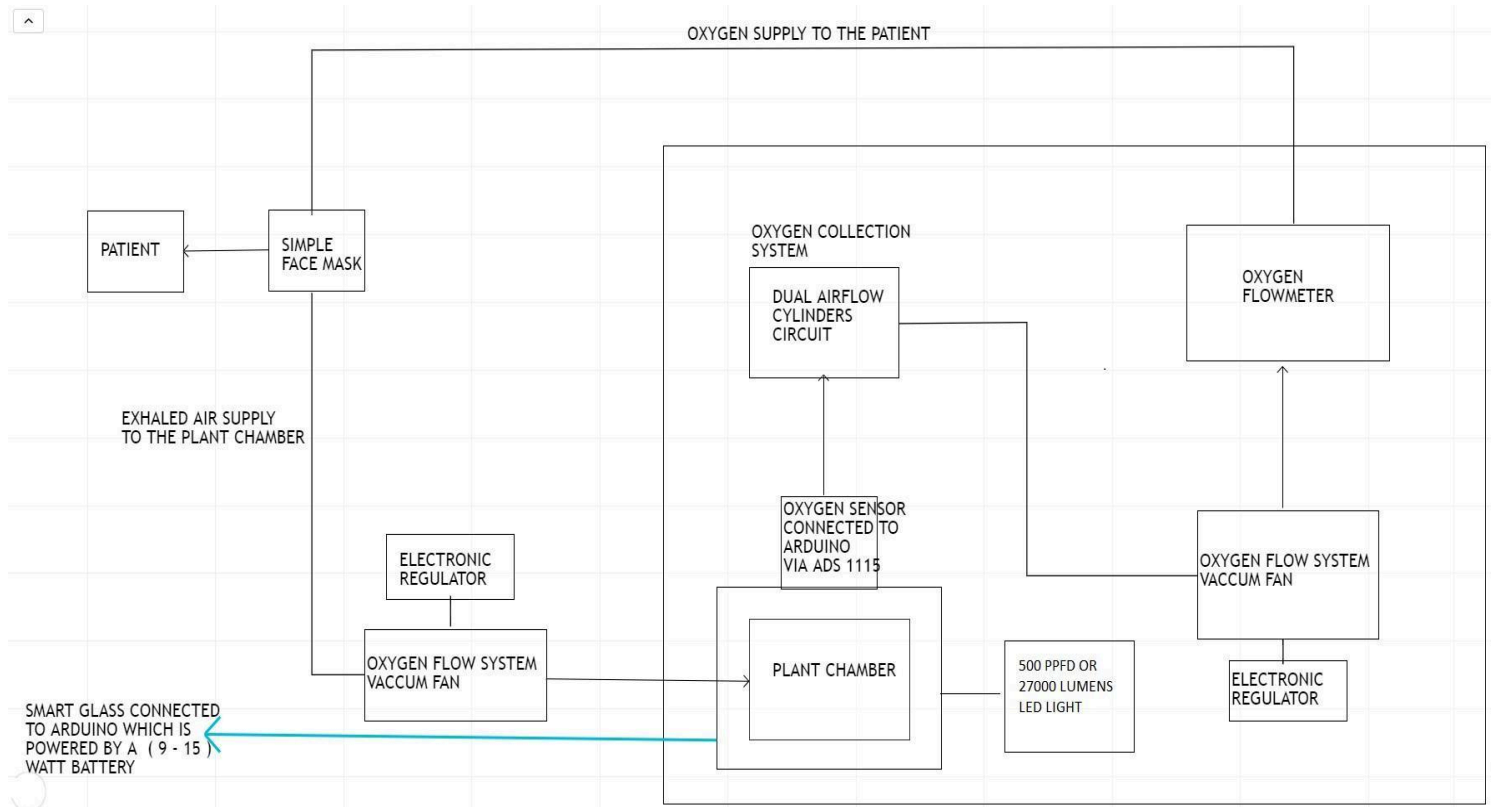
### **MAKING THE AIR FLOW SYSTEM**

1. The plastic cylinder will be cut open and the vacuum fan connected to a regulator will be fitted inside the cylinder exactly at the center such that the fan is perpendicular to the inlets and outlets and electronic regulator is outside of the cylinder.
2. The vacuum fan is used to deliver the oxygen enriched air to the oxygen flowmeter at a constant rate.+++
3. The cylinder will be completely sealed using the some sealing procedures after the installation of motor in it.
4. The electronic regulator which is outside of the cylinder will be used to maintain the speed of the rotations of motor per minute.
5. The voltage supply to the electronic regulator and the motor will be given as per the motor selected.
6. This system will be connected to the oxygen collection system.
7. The outlet from this air flow system will be now connected to the OXYGEN FLOW METER.

## **OXYGEN AND CARBON DIOXIDE CYCLE**

1. A plastic air tube will be connected to the outlet of oxygen flowmeter and it is made connected to the simple face mask which will be made fit to the patient's head.
2. The mask used here will also have the air tubes which will be used to take away the exhaled air from the patient.
3. These tubes will be connected to the another cylindrical chamber which will be connected to the plant chamber.
4. The cylindrical chamber contains the motor whose speed can be controlled using an electronic regulator , same as the equipment used in the air flow system.
5. This cylindrical chamber is used to draw the exhaled air in a periodic manner. That is the motor fan will be in ON position on when the patient is exhaling.
6. This tubes will deliver the exhaled air which is carbon dioxide enriched air to the plant chamber which will be used for the photosynthesis process.
7. This cycle of supply of oxygen and carbon dioxide cycle runs continuously.

# DEVICE FLOWCHART



ROUGH SKETCH OF THE DEVICE

