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Low Cost Open Source Ventilator to Fight against Covid - 19 and Any Other Future Pandemics

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ABSTRACT:COVID 19, caused by the novel corona virus (SARS_CO_V_2), daily challenges ourmedical infrastructure as we haven't sufficient arrangement of our essential medical equipment likeventilator. In the event of Covid 19 FDA approved ventilators are designed to convert a lower costcontinuous positive airway pressure (CPAP) blower into rudimentary non-invasive pressure supportventilator and it helps breathing problem during respiratory distress. A large amount of hard workis needed to move open source ventilator up to this label. The work will achieve after regular updateand secure of the mechanism of the system by potentially. The low cost open source ventilator alsocan be used in any other respiratory problems.

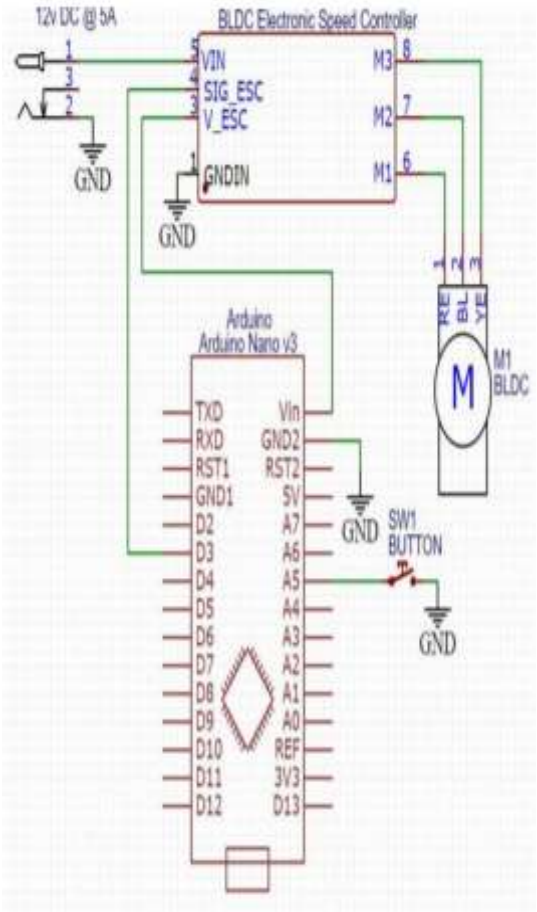
KEYWORDS:ventilator, pandemic, open source, medical hardware, continuous positive airway pump(CPAP), 12v inflator pump, Arduino compatible nano/clone

I. INTRODUCTION

Ventilators are essential medical equipment for treating people against influenza as well lyingfor it. In that event the idea of low cost open source ventilator comes. The project can also use to create areasonable low-cost powered air purifying respiratory (paper) with filter adapted and mask. It is effectivepiece for the PPE kit for doctors and nurses. Using non-invasive interfaces like mask and mouth pieces cancreate aerolite virus and affect may people in clean environment. So the uses should be restricted amongthe areas.

The rudimentary design can have a programmable breathing rate like 10_15/min. it can have programmedpositive End-Expiratory pressure (PEEP). The blower is physically able to hit a peak airway pressure up to45cmh2o but if it goes above 20cmh2o it can be dangerous. The level of accuracy should be 100ml. it doesnot regulate fractional oxygen (FiO2). But a downstream connection to an o2 is possible to boost o2concentration with manual flow adjustment. Critical features can also be added whenever needed. The blower component should be under $20. Arduino nano /clone is used to control the motor speed and thebreathing cycle. Brushless DC motor is capable of at least 10A. The breathing cycle can create voltagedrops which will reset the Arduino if the supply is not strong enough.

II. SCHEMATIC DESIGN



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The schematic that is able to sense blower current . cost-performance shown by the ventilator is given below:

VORTRAN Automatic Resuscitator (VAR™), a single patient, disposable resuscitator, and the reusable Lifesaving Systems Inc.'s Oxylator, Two CAREvent® Handheld Resuscitators and Ambu Matic. However, these systems cost an order of magnitude more than our target price and depend on external pressurized air, a resource to which our target market may not have access.

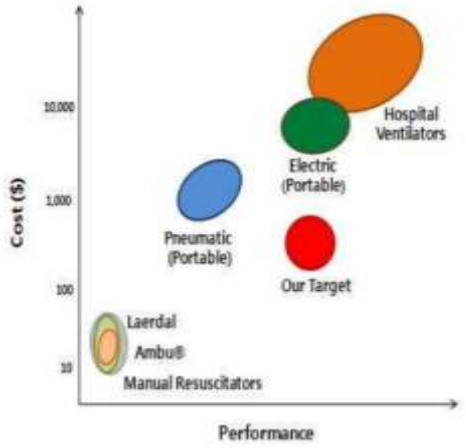

Figure 1: Cost-performance distribution of ventilators

MEDICAL DEVICE REQUIREMENTS:

Medical	User-specified breath/min insp./exp ratio, tidal volume - Assist control - Positive end-expiratory pressure (PEEP) - Maximum pressure limiting - Humidity exchange - Infection control - Limited dead-space
Mechanical	-Portable -Standalone operation -Robustmechanical, electrical and software systems - Readily sourced and repairable parts - Minimal power requirement - Battery-powered
	- Indicators within 10% of correct reading
Repeatability	- Breath frequency accurate to one breath per minute
Economic	- Low-cost (<$500)

III. COMPONENTS

The picture is with the full system of mask, tubing, pump, 12v battery and switch for input. The system canrun with a DC power supply since thebattery will only let about 3-4 hours. It can act as an inline batterybackup to wallpower and at the same time it can be charged and supplied.

The code then changed to an Arduino nano. It has a 3d printed tapered hose adapter on itti fit in the hose.The microcontroller software can be programmed with the Arduino IDE. The software goes through a shortinitialization sequence to configure the ESC, it then starts at the lowest CPAP setting. It can be used toswitch to cycle through pressure levels and double click to cycle through operation modes.

This is a face mask or tube adapter. In order to get a good air seal to get enough positive pressure. a little bit of leakage is actually desirable to allow co2 to escape near the mouth and nose to flush out the air overtime ; this prevents co2 from being stuck in the tube.

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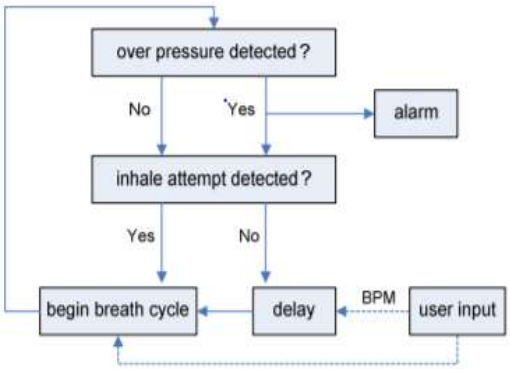
This is the picture to measure the output pressure. This is a U-shaped tube with an attached measuring tapeto check the displacement of water. The actual liquid displacement is 2x of the measures line since liquidis being pushed downwards an equal amount of other side of the U.

IV. CONTROL IMPLEMENTATION

-control design: this ventilator provides assured tidal volumes using an assist-control (AC) mode.
-controller: there are many controller but anoff-the-shelf Arduino Duemilanove microcontroller board is used to control our ventilator.
A simple word diagram that shows how the controller working



V. ANALYSING AND TESTING

First of all battery life should be tested while running the ventilator until the battery voltage dropped to level that is sufficient for the operation

VI. FUTURE WORK

it is clearly shown that there is more work to do. They are the early stages designs. Alot of work and many more research is needed to make significant progress of the open source ventilator asit is the essential equipment to fight against the life taken diseases.

There is another challenge that FFF-based 3-D printing parts as they become sterile at time of the print soif they not kept in a sterile environment then it can be biological contaminated. Washing or chemical bathcan be the solution of this.

As many open source equipment like syringe pumps are available in the medical ground then also when theventilators will available and can be useable after they manufactured properly, it must be convinced that itwill not harm the doctors as well as the patients.

VII. CONCLUSION

it is clear that low cost open source ventilators are the best weapon to fight against COVID 19and anyof it her future pandemics usingdistributed manufacturing. As a result we can say that the opensource system lacked complete and the ventilator system is the early stage of design or it has gone throughrudimentary system. It can be assumed that this project will earn everyone's attention .there is a largeamount of mechanical and technical hard work needed to reach the functional and easily replicated opensource ventilator system. The future work is needed to move the open source ventilator asper the desiredscientific level. The work should not only based to the technical ground but also updating regulations, eachand every policies for the development and testing the open source ventilator for any pandemics .

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