COVID-19

# *Jeeva-shwasam*

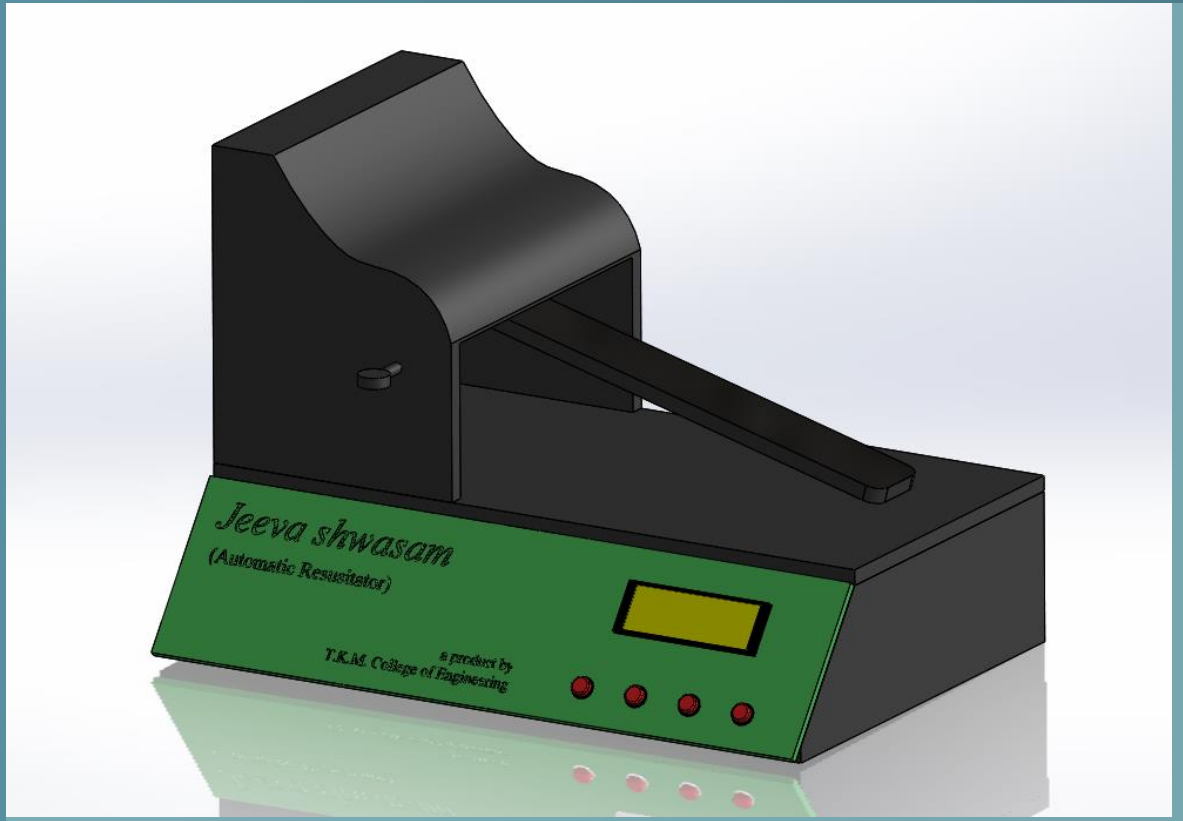
Automatic resuscitator

A product by T.K.M. College of Engineering

# Problem Statement

- In the wake of COVID-19 pandemic, there is a huge scarcity for ventilators worldwide which might shoot up still, if the situation demands.
- Even if we overcomes the shortage, Investing huge sum of money in ventilators to deal with this particular scenario is not elegant.
- World over, a number of low cost designs are currently being experimented and prototyped but on mass production availability of materials is at stake.

# Our Solution……




*Jeeva-shwasam*

An automatic resuscitator

# Features

- Highly portable
- Battery backup
- User-friendly interface
- Easy maintenance and servicing
- Smoothly available components
- Precise open loop system
- Easy access to BVM for manual take over
- Same ambu bag can be used for both adults and kids
- Control over :

  i. Flow  ii. Tidal Volume

  iii. BPM  iv. IE Ratio

  v. $FiO_2$  vi. PEEP

*All these at reasonably low price by scarifying few features* ***instead of quality***

# User Interface

- Stage 1: Initialisation
  The device choose the power supply, checks for common errors, gets ready for pumping and returns OK

- Stage 2: Input Parameter
  Asks the user for Flow rate, Tidal Volume, BPM, IE Ratio, $FiO_2$, PEEP

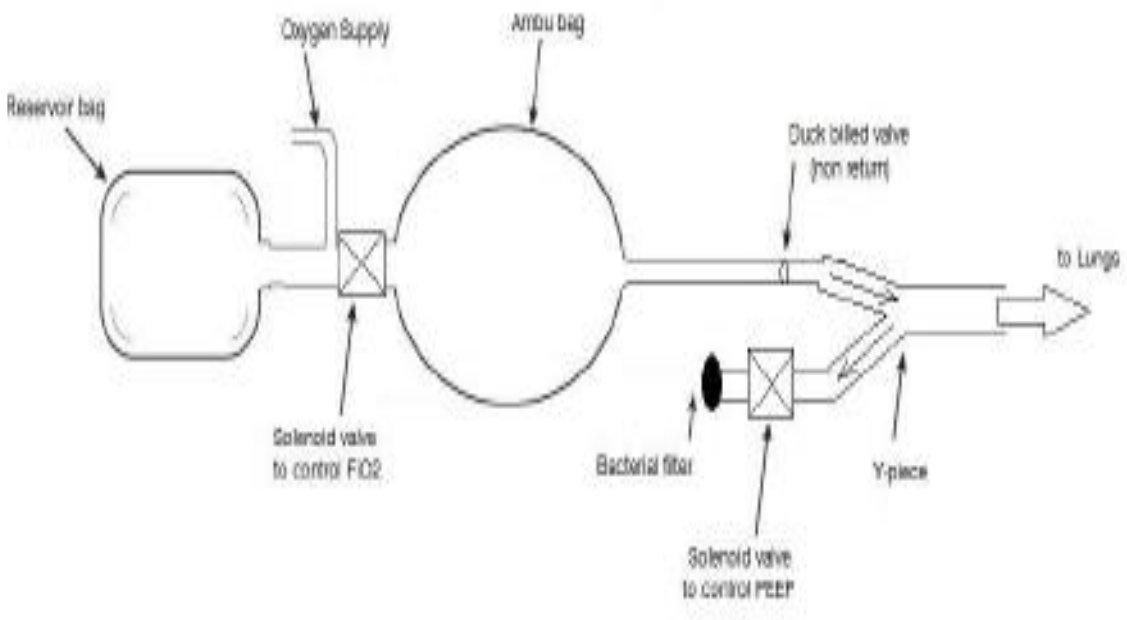
- Stage 3: Verification
  The given values will be displayed for verification throughout.

- Stage 4: Ventilation Starts
  On entering OK, the ventilation process starts as per the user defined parameters.

# Working

- The device employs a Stepper motor, pivot and lever mechanism and an Ambu Bag as the integral components
- Stepper Motor's various modes of operation enables the control of various parameters.
- Flow:- control over the flow rate is achieved by defining the delay between each step of the motor.
- Tidal Volume:- the control over tidal volume is achieved by varying the number of steps.
- IE ratio :- by the combined manipulation of delay between step and delay between every upward and downward movement of motor inhalation and exhalation time can be controlled individually


- Respiration Rate:- achieved by controlling the upward and downward movement of the lever in a minute.
- $FiO_2$ and PEEP are controlled by using position controlled solenoid valve



# Design Highlight

## UTILISED STEPPER INSTEAD OF OTHER HIGH TORQUE MOTOR

- Unlike other motors we can limit the rotation of stepper motor up to 1.8 degrees
- Reduced the need of encoders and other sensors that are hard to arrange at this scenario as 1.8 degrees step is possible
- More precise control is possible with less expense
- Makes the PCB easy to manufacture and mass produce

# Design Highlight

## EMPLOYED LEVER MECHANISM

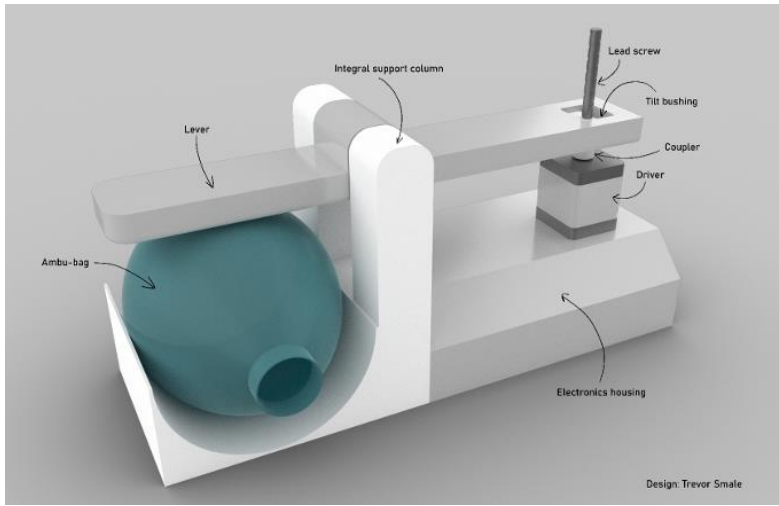
- Increased distance from the fulcrum so each rotation of motor can be amplified to greater compression of motor.

- Not expensive but effective, easy and fast manufacture possible

- Initially our design like other models used direct threaded rod mechanism. But it did not allow easy and accurate control over the parameter that we can control with our new mechanism

Initial design

Current pivot mechanism



# Design Highlight

Reliable battery backup and very high portability

- Used lead-acid battery even though it is heavy its advantage of availability weighed more
- 12V 1.3 Ah battery that gives 2 hours of battery backup
- Overall weight is 4Kg and it adds to the device portability

# Design Highlight

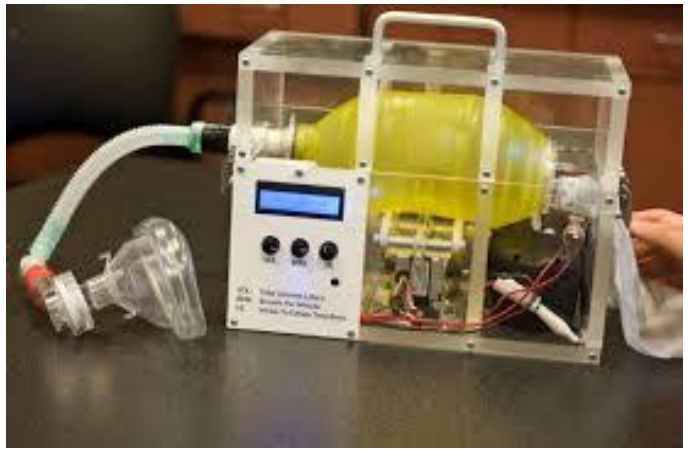
Same Ambu bag can be used for both Kids and Adults

- Ambu bag of different capacities are available for kids, adults, etc…
- Since we can control BPM and tidal volume precisely one maximum volume ambu bag can be used for the entire purpose.

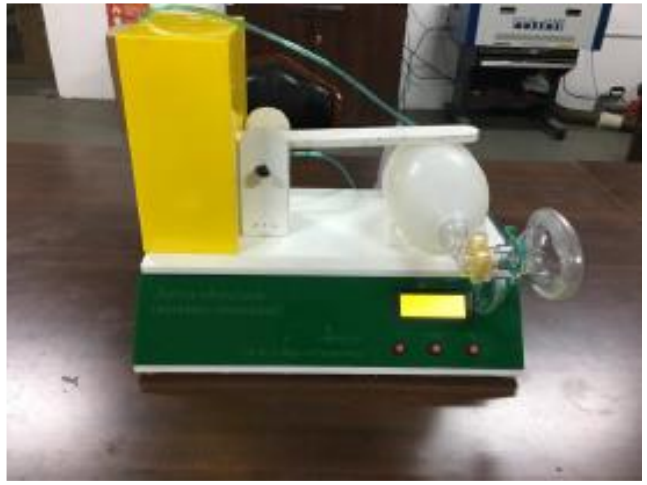
# Design Highlight

Ambu Bag can be operated manually at the worst case as it can be easily accessed unlike other designs.

- The lever of our mechanism is not directly attached to the motor so that we can bypass the device and use ambu bag manually even without taking the bag out in worst case scenarios.



Other design



Our design

Other design

| Components | Ease of Availability | Cost |
|---|---|---|
| Multi-Wood or 5mm Acrylic or any similar material | 5/5 | |
| Stepper Motor (from fab labs, common suppliers in Ernakulam, Trivandrum, etc…) | 4/5 | |
| Bag Valve Mask(hospitals, surgical shops) | 4/5 | 1800 |
| Mechanical Assembly (TKMCE) | 5/5 | |
| Power Supply (computer shops, recycling units, etc..) | 5/5 | |
| Microcontroller(IEDC TKMCE, electronic shops in Kollam, etc..) | 5/5 | |
| Stepper Driver (A4988 or DRV8825 or L293D or L298N) | 3/5 (A4988 & DRV8825)<br>5/5 (L293D & L298N) | |
| Battery 12V | 5/5 | |
| Other Electronics (Kollam or Ernakulam) | 4/5 | |
| Position Controlled Solenoid Valve (for PEEP and $FiO_2$ control) | 3/5 | |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