SMART PORTABLE BIOMECHANICAL PATIENT MONITORING VENTILATOR

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Introduction:

A ventilator is a machine that provides mechanical ventilation by moving breathable air into and out of the lungs, to deliver breaths to a patient who is physically unable to breathe or breathing insufficiently. The patient is connected to the ventilator with a hollow tube (artificial airway) that goes in their mouth and down into their main airway or trachea. They remain on the ventilator until they improve enough to breathe on their own. Almost every bed in a hospital has a manual resuscitator nearby, available in the event of a rapid response or code where healthcare workers maintain oxygenation by squeezing the bag. Automating this appears to be the simplest strategy that satisfies the need for low-cost mechanical ventilation, with the ability to be rapidly manufactured in large quantities. However, doing this safely is not trivial. For this reason, we designed Smart portable bio- mechanical patient monitoring ventilator it is a concept to realize the advancement in health monitoring system of human beings due to the COVID-19 pandemic, the medical facilities have been scares and are required to a lot of people.

Objectives:

We designed and prototyping a low-cost portable mechanical ventilator for use in mass casualty cases and resource-poor environments. There is an increasing demand for ventilators in the treatment of patients with COVID-19 and also in many different critical medical conditions. There are many open-source ventilator mechanisms because of the limited use and less availability of the same. So, our main objective of making this project is to overcome most and all the problems that occurs in all critical condition for saving lives. The Ventilator delivers breaths by comprising a conventional Bag-Valve Mask (BVM) using mechanical Actuators with the help of Servomotors using a Microcontroller with coding. The oxygen cylinders can also be used in our prototype in case of any emergency. Our project Mainly aimed to design a low cost, portable and secured ventilator. We added a fingerprint sensor which acts as a security feature to access the system. The patient monitoring system in our project includes conditional parameters, ECG, SPO2, temperature, heart beat

monitoring, humidity and room temperature and also a backup working mechanism for any failure occurrence.
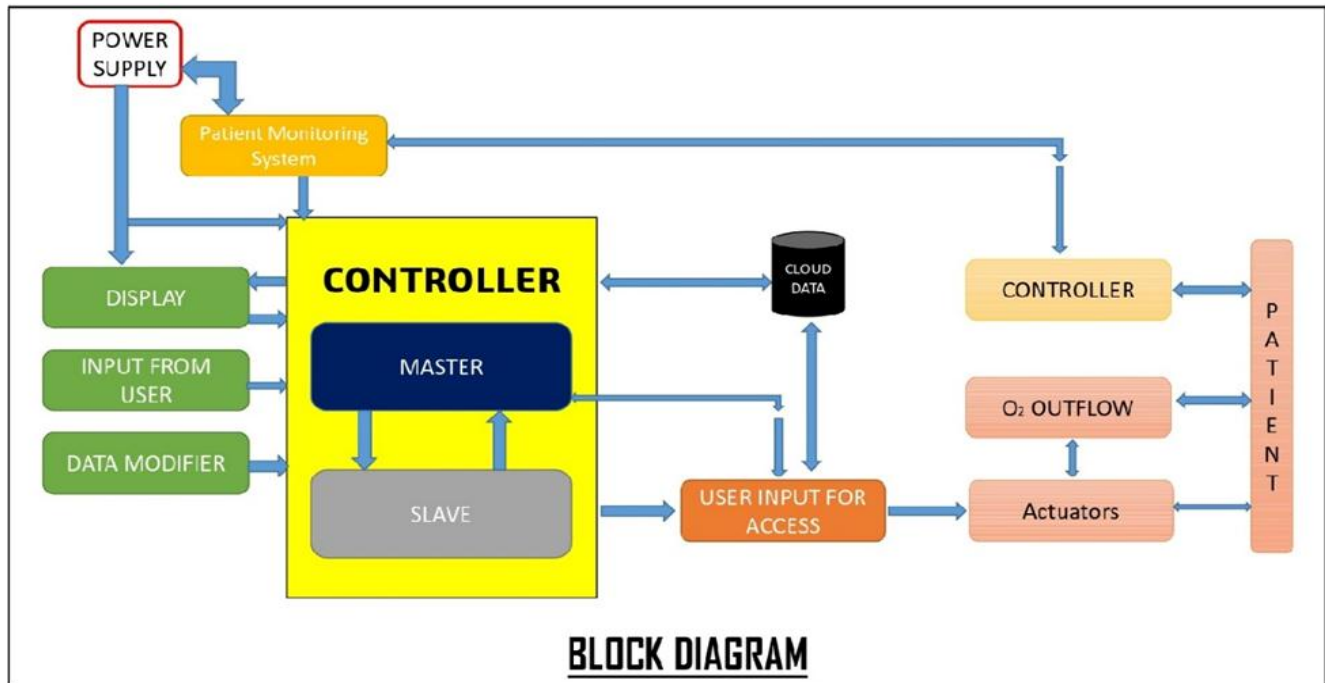
Methodology:

Figure (a) – Block Diagram

The above - shown figure represented the proposed block diagram of the project. It consists of microcontroller where we are using 2 Arduino UNO which acts as master and slave we dumped the code in both the controller in case of one gets failure other gets executed and using AMBU BAG the basic mechanism of working of ventilator start supplying the oxygen to the patient with the control of pressure,volume intake and Inhale-Exhale ratio. UV sterilization takes places during the oxygen supply. High Torque Servo motors are of 270 degrees rotation mechanical motor to press the BVM for producing the oxygen. The Main aim of the controller is to manage the toque, pressure and speed of the motor to provide a proper - parameters for pressing the BVM. The Patient Monitoring System includes Heart beat monitoring, SpO2 ,body temperature, room humidity and room temperature of the patient using wi-fi module microcontroller connected with online platform combined with the sensors to provide accurate readings to take immediate action in case of any emergency and it can be constantly monitored by doctors or family members . ECG of patient can be seen in UBI DOT platform for secured purpose and can be monitor only for doctors using patient login ID credentials. In LCD display age group, volume, pressure, BVM, I/E ratio can be seen. For security purpose we added finger print sensor(R307) for locking and unlocking of ventilator and the information is stored in google excel sheet using IFTTT. A backup power supply is made to operate the mechanism in case of any power surge to avoid the failure of the mechanism. We also added for external use Built-in Nebulizer to provide a proper nebulizer for the patients using piezo

electric material, in the container added liquid medicine that gets vaporized and it connects to inlet of BVM and also a built-in hand sanitizer so as to avail a contact disinfectant treatment. The Fabrication of our project is designed using Solid edge V19 software we use 6mm acrylic board as it is available at low cost and with better strength.
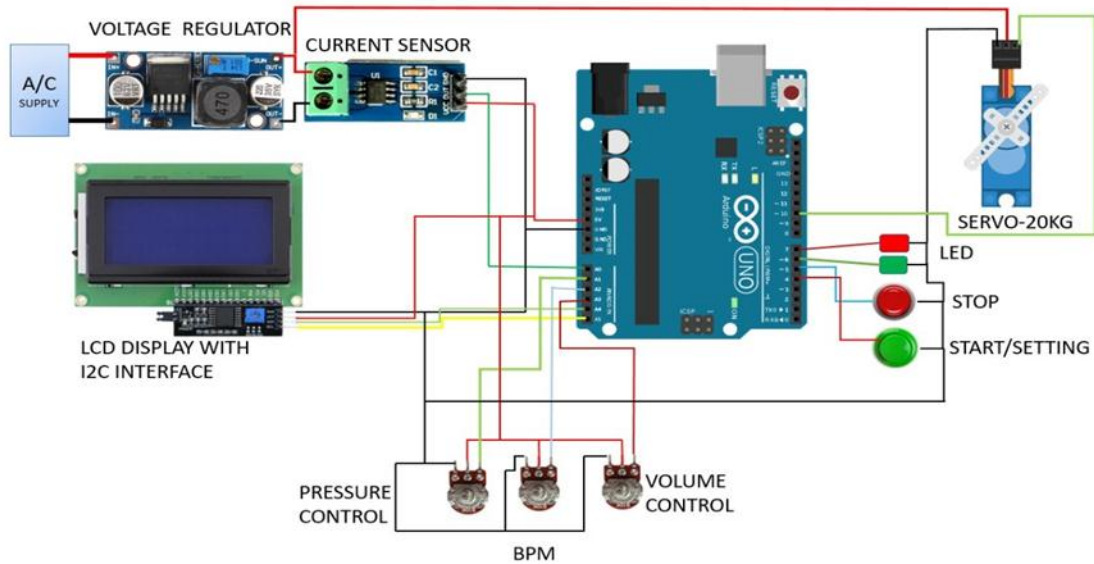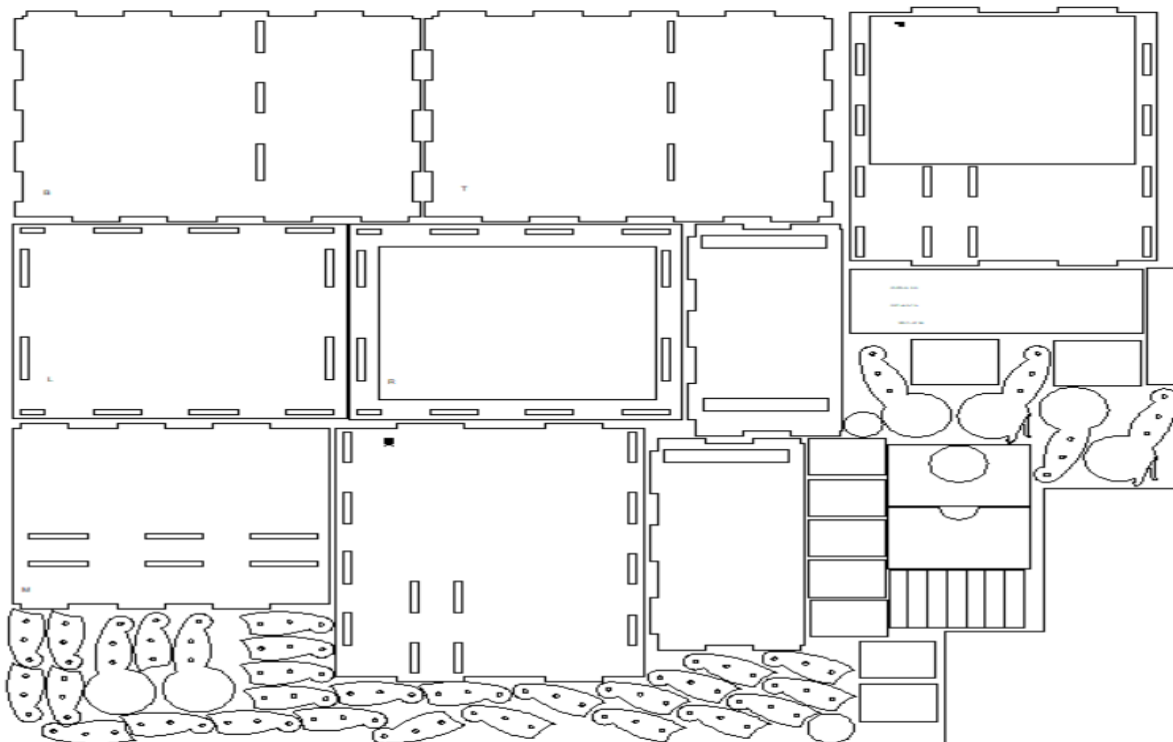

Figure (b) – Circuit Diagram
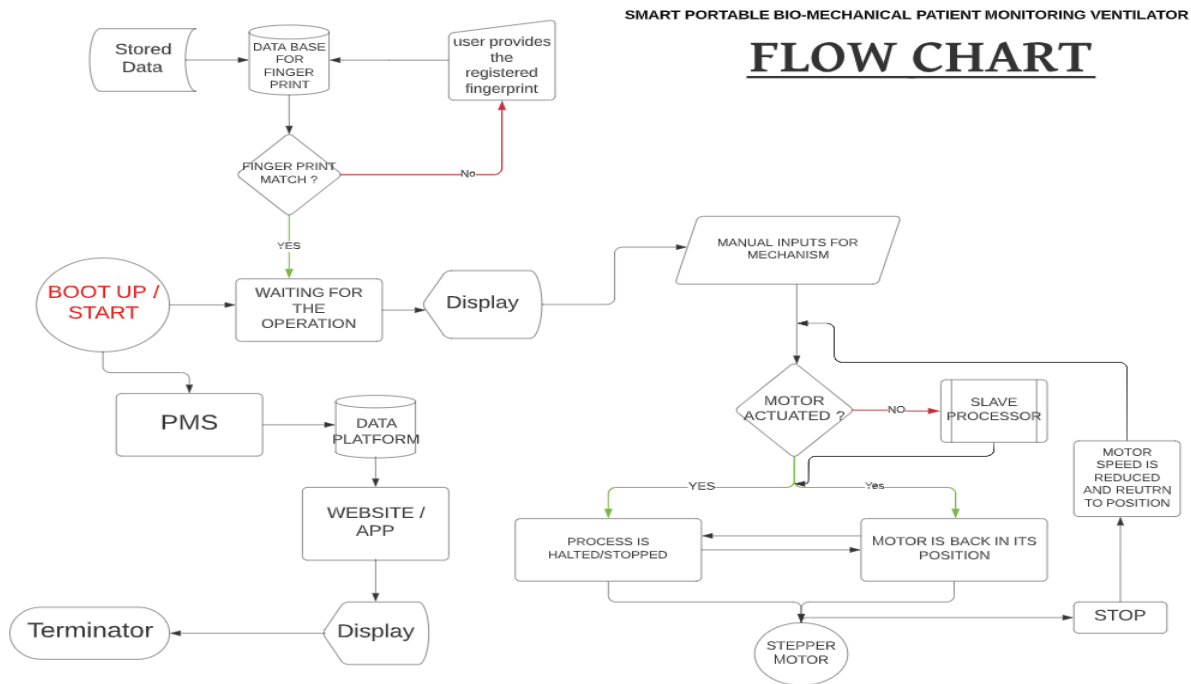

Figure (c) – Fabrication design

Figure (d) – Flow of program

Conclusion:

A working prototype of Smart portable bio-mechanical patient monitoring ventilator is designed and developed. The prototype has a user-controlled breath rate, I/E ratio and tidal volume. The Arduino along with suitable algorithm controls the motor speed and instructs the motor about the directions of rotation. It will set the proper compressions and expansions of the bag. Based on the parameter set of age the ventilator pressure and tidal volume can be determined. Patient monitoring system can be constantly monitored in web server using patient login ID which can be constantly monitor by family members & doctors , ECG of the patient can be seen in UBI DOT platform using patient ID credentials it can be seen only by doctors . Fingerprint database login and logout credentials of ventilator during operation can be stored in goggle excel sheet using IFTTT platform.

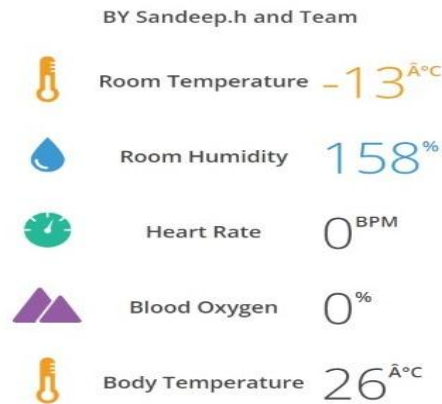Figure (e) – ECG of the patient

Figure (f) – patient monitoring system

Figure (g) – Finger print database

However, it can serve the patients well as a result of the prototype. Our Smart portable Bio-mechanical ventilator is with high effectiveness , secured , portable , light in weight, low – cost, carry like suitcase & better than other normal ventilators using Ambu Bag in terms of convenience, quiescency, better fabrication model using acrylic board with compact size and altered features when required. Our ventilator is compressed of all know-technology currently required are merged to provide data.

Scope for future work:

- Gyro sensors can be used for monitoring Coma patients.
- Gesture to speech technology for deaf people to communicate with the people for asking any help or tell their requirements can also be implemented.
- GPS system can be used to know the location if ventilators are used in ambulance.
- Wireless control of the ventilator to control the pressure, volume, Beats per minute.
- If nurse or doctor fails to lock the ventilator during operation an automatic lock settings

operation can be implemented.

- Emergency alarm can be added if ECG of the patient decreases or any failure occurs or power supply outage is down.
- We can use pressure sensors to detect some medical issues that can occur due to certain conditions.

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