LOW COST VENTILATOR-Breathing made easy

[1] Prof. Naveen Kumar H, [2]Ms. MD Fatima Zohara, [3]Ms. Thaisin Banu
[4]Ms. Lubna V, [5]Ms. Kanis Fathima K
Proudhadevaraya Institute Of Technology, Karnataka 583201

ABSTRACT

This project aims to design and test a low-cost, easy to build and non-invasive mechanical ventilator to reduce the shortage of ventilators during the COVID 19 pandemic. It utilizes a single arm rod mechanism to compress a bag-valve mask, eliminating the need for a human operator. It also includes a sensor and alarm system to monitor the pressure rate and sound an alert in case of malfunctions.

INTRODUCTION

Respiratory diseases and injury-induced respiratory failure are a major public health problem in both developed and less developed countries. A low-cost ventilator has been prototyped using the AMBU (Artificial Manual Breathing Unit) bag compression which has the potential to be a solution for this problem. It comes with the option of adjusting BPM (Breaths per Minute) of patients, inspiration to expiration ratio, and peep rate The prototyping price is lesser than its contemporaries, making it a product which has the potential to greatly reduce the pressure on the healthcare systems all over the world The last few years have seen exponential growth in wireless communication technologies which have an enormous impact on the medical and health care industries Modern ventilators are expensive and have a high maintenance cost making them more of a death sentence than a lifesaver. Ventilators are used in intensive care medicine home care, emergency medicine, and anaesthesiology They are used to pump up air for ease in breathing if breathing is difficult due to infection The COVID-19 pandemic has cast a spotlight on ventilators, but they are in acute shortage due to the cost. A simple and inexpensive alternative is needed to handle a respiratory emergency.

LITERATURE SURVEY

1) Calculating AMBU Bag Dimensions for Use in Portable Ventilators

This paper proposes the AMBU bag, to determine the feasibility of creating a portable electrical AMBU bag ventilator. The project calculates the minimum volume required for an AMBU bag to provide sufficient oxygen for average total lung capacity and uses the Disk Method formula to reverse-engineer the shape of an AMBU bag based on predetermined volume and desired dimensions By developing a motorized, portable AMBU bag ventilator, the project aims to address the need for more ventilators during the COVID-19.

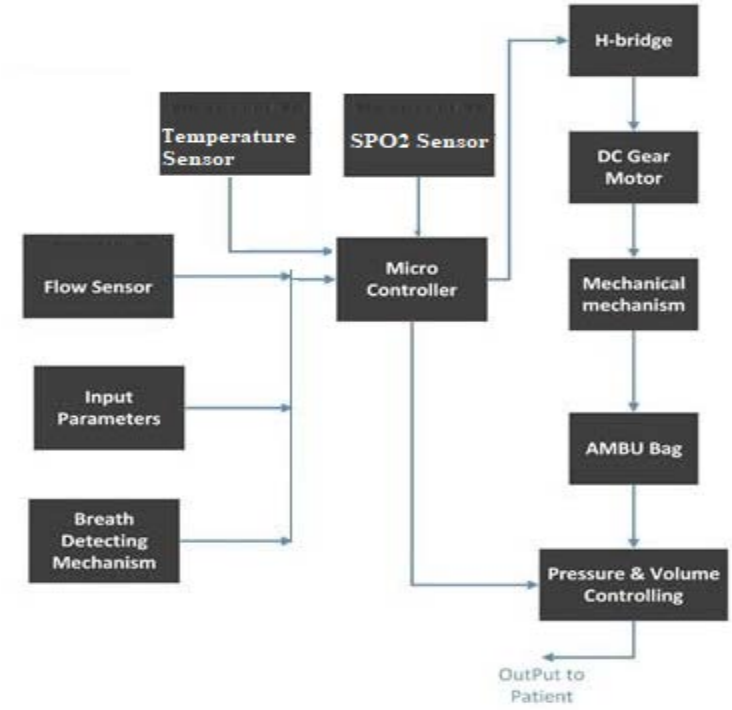
2) Mathematical Modelling of an Automatic Bag Mask Valve Emergency Ventilator

This paper investigates different approaches to capture lung mechanics using electro-mechanical models to augment the design process of ABVMs and enhance the understanding of the patient-ventilator system. The first section of the paper analyses the required ventilator power, compliance, and restrictive losses through a thermodynamic analysis of a mechanical model for respiration. The second section develops an equivalent electric circuit for the human respiratory system in conjunction with an ABVM ventilator, and the response for different modes of ventilation was analysed and found to be satisfactory This research can help in selecting ventilator components and improving ABVM ventilator design for both pandemic and non-pandemic scenarios.

METHODOLOGY

The DC motor is connected to a belt and the arm moves in a pumping mechanism, controlled by a PEEP valve. The pressure sensor senses the pressure and gives data to the Arduino, which compares it to the optimum pressure. The

temperature sensor and spo2 sensor are used to check the condition of the patient. The Ambu-Bag compressing mechanism is operated with a stepper motor connected to an ATMEGA microcontroller. The microcontroller is in serial communication with the Wi-Fi module to access real-time patient requests from the cloud. The degree of compression and output air pressure can be controlled by adjusting potentiometer knobs, and a button with extendable wire is provided for patients to call the doctor. Cloud messages are sent if the doctor is unable to hear the sound.



BLOCK DIAGRAM

RESULTS

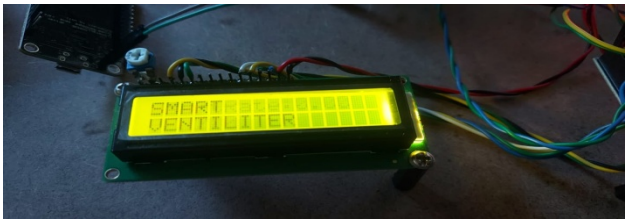


Fig 1: Displaying as a Smart Ventilator

Fig 2: Displaying heartrate and spo2 values

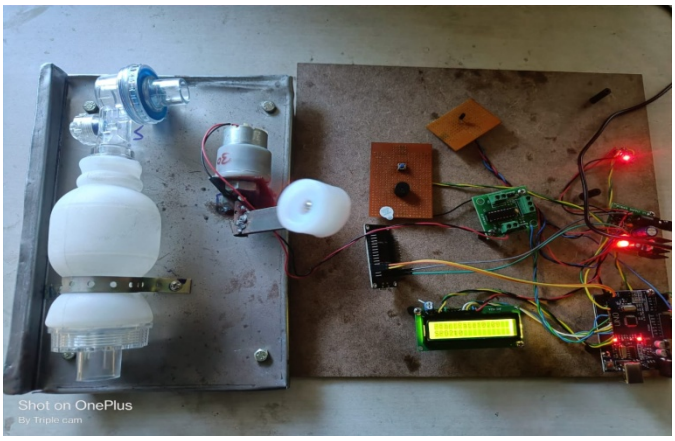


Fig 3: DC motor starts based on the spo2 level

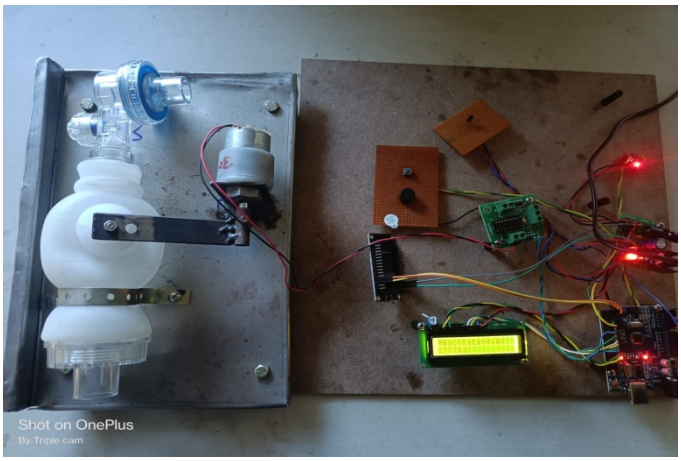


Fig 4: Pumping the oxygen

Fig 5: Doctor getting an emergency message

CONCLUSION

The project involves designing and developing a working prototype of an IoT-based ventilator that can be controlled by the user to adjust breath rate and tidal volume An Arduino and algorithm control the motor speed and direction to ensure proper compressions and expansions of the bag. The system aims to improve the quality of life by saving time money and resources through increased efficiency affordability and reduced mean time between failure The feedback system can be modified to handle active cases in real-time.

REFERENCES

[1] AnnaGlazova, Zafar Yuldashev, Anna Bashkova, “A Method and Algorithm for Remote Monitoring of Patients in Asthma” ,2018 Ural Symposium on Biomedical Engineering, Radioelectronics and Information Technology (USBEREIT)

[2] Vitacca M, Montini A, Comini L. How will telemedicine change clinical practice in chronic obstructive pulmonary disease? Therapeutic Advances in Respiratory Disease, 2018, 12, 1-19.
DOI: 10.1177/1753465818754778

[3] SE-J. Maalouf, A.Aoun,N. Marina, “Asthma Irritant Monitoring” ,2018 30th International Conference on Microelectronics (ICM)