International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 06 | June - 2023 SJIF Rating: 8.176 ISSN: 2582-3930

ARDUINO- based OXYGEN VENTILATOR

B.Raghupathi

Assistant professor, Department of ECE

raghupathiragh4201@gmail.com

Vignana Bharathi Institute of Technology, Hyderabad, Telangana, India.

K.Poorna chander reddy
Department of ECE
poornachanderkasireddy@gmail.com

K.Anusha
Department of ECE
anushareddykoppula9@gmail.com

G.Goutham kumar
Department of ECE
gouthamkumar7667@gmail.com

K.Shanthipriya
Department of ECE
shanthikopuri119@gmail.com

ABSTRACT

The human respiratory system relies on the contraction of the diaphragm to create negative pressure, which draws air into the lungs. In contrast, a ventilator uses a pumping action to push air into the lungs. To be effective, a ventilator must be capable of delivering a high volume of breaths per minute, as well as varying the volume of air delivered with each breath. It should also be able to adjust the inhalation-exhalation ratio and monitor the patient's blood oxygen levels and lung pressure. An affordable and reliable ventilator was designed and developed using an Arduino microcontroller, featuring a stepper motor-driven bag, a blood oxygen sensor and an LCD screen to display vital signs. An air purifier was used to ensure the patient is not exposed to ambient air.

Key words: Aambu bag, Arduino uno, Pulse oximeter.

INTRODUCTION

The demand for ventilators to treat COVID-19 patients has significantly increased, resulting in a global shortage of these devices. This shortage has had devastating consequences, particularly in underprivileged areas. In response, some hospitals have resorted to sharing ventilators between two patients, which is a questionable practice that increases the risk of infection and harm to patients. To address this issue, researchers have undertaken an initiative to develop cost-effective open-source ventilators, of which this paper is a part.

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 06 | June - 2023 SJIF Rating: 8.176 ISSN: 2582-3930

Literature Survey

In recent months, The demand for ventilators to treat COVID 19 patients has surged in recent months, and there is currently a global shortage of ventilators. The outcomes of this flaw are devastating, specially in underprivileged areas. Even a well-resourced hospital has developed a protocol for two patients to share the same ventilator(figure 1).This is a questionable practise since it not only spreads the load of bacteria and viruses among patients, but it also puts patients at risk of damage. Researchers have initiated an endeavour to manufacture cost-effective open-source ventilators in an effort to combat the global shortage of ventilators. This paper is a part of that effort. The basic model of our ventilator unit is determined by Figure 1.

BLOCK DIAGRAM

Proposed method for low cost oxygen ventilator using Arduino uno and nano is shown in fig 1.The core components used in the proposed one are mainly :
Arduino uno, Arduino nano, and Pulse Oximeter.

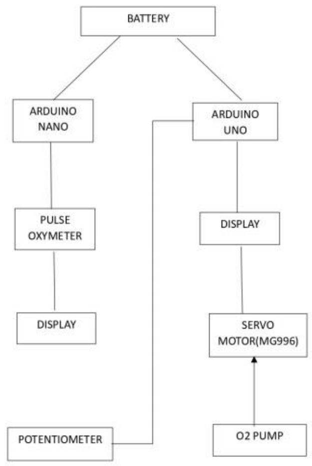

Fig.1. Block diagram of Oxygen ventilator

PRINCIPLE OF MAX30100

Fig.2 shows the MAX30100 pulse sensor uses photoplethysmography (PPG) to measure the heart rate and oxygen saturation levels in a person's blood. PPG is a non-invasive method of measuring the blood volume changes in the microvascular tissue of the skin. It works by shining a light into the skin and measuring the changes in the reflected light as blood flows through the tissue.

As the blood flows through the skin tissue, it absorbs and reflects the light in a way that varies with the pulse. During each heartbeat, the blood volume in the skin tissue increases and decreases, which causes a corresponding increase and decrease in the amount of light that is absorbed and reflected. This change in light intensity is detected by the photodetector and converted into an electrical signal, which is processed by the MAX30100 module to determine the heart rate and oxygen saturation levels.

Fig.2.Max30100 Pulse sensor

The patient's pulse rate is determined using the Max30100 Pulse sensor, which is seen in Fig2.

MG996 METAL SERVO MOTOR

Fig.3 shows MG996 is a metal-geared servo motor commonly used in robotics and other projects that require precise control of angular position or movement. It has a stall torque of up to 11 kg-cm, a speed of up to 0.17 sec/60°, and operates at a voltage range of 4.8V to 7.2V.

Metal gears: The MG996 has metal gears, which provide greater durability and resistance to wear and tear compared to plastic gears.

High torque: With a stall torque of up to 11 kg-cm, the MG996 can provide a lot of torque, making it suitable for applications that require high force, such as lifting or manipulating heavy objects.

Precise control: The MG996 servo motor is capable of precise control of angular position or movement, making it ideal for use in robotics or other projects that require accurate and repeatable positioning.

Fig.3.MG996 servo motor

PRINCIPLE OF SERVO MOTOR

The MG996 servo motor works on the principle of using an electrical signal to control the movement of the motor's output shaft. It uses a closed-loop control system, which means that it constantly compares the actual position of the output shaft with the desired position and adjusts the motor's rotation accordingly.

The MG996 servo motor has a built-in control circuit and feedback mechanism, which allows it to rotate to a precise angle based on the input signal it receives. The input signal is typically a pulse width modulation (PWM) signal generated by a microcontroller or other device. The width of the PWM signal corresponds to the desired angle of rotation, with a wider pulse resulting in a greater angle of rotation.
Overall, the principle of the MG996 servo motor is based on closed-loop control and feedback mechanism, which allows for precise and accurate control of the motor's output shaft.

AUTOMATED ARTIFICIAL MANUAL BREATHING UNITS

Automated artificial manual breathing units (AAMBU) shown in fig.4 are devices used in medical settings to provide mechanical ventilation to patients who are unable to breathe adequately on their own. They are typically used in emergency situations or in the ICU to provide temporary support for patients with respiratory distress or failure.

An AAMBU typically consists of a face mask or endotracheal tube that is connected to a bag valve mask (BVM) device. The BVM device is a handheld device that can be squeezed to force air into the patient's lungs. In an AAMBU system, the BVM is attached to a mechanical device that can automatically squeeze the bag at a set rate and volume, providing consistent and reliable ventilation to the patient.

AAMBU devices can be set to deliver different volumes and rates of ventilation, depending on the needs of the patient. They typically have alarms that can be set to alert medical staff if there are any issues with the ventilation, such as high or low pressures, or if the patient's breathing pattern changes. The use of AAMBU devices requires proper training and supervision, as they can be dangerous if not used correctly. Over-ventilation can lead to lung damage, while under-ventilation can lead to hypoxia and other complications. Additionally, the use of AAMBU devices can cause gastric insufflation, which can lead to vomiting and aspiration.

Overall, automated artificial manual breathing units can be life-saving devices when used properly in emergency and critical care settings. They allow medical staff to provide consistent and reliable ventilation to patients who are unable to breathe adequately on their own, improving their chances of survival and recovery.

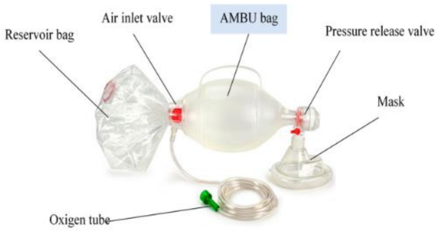

Fig.4. Aambu Bag

RESULTS

Figure 5 depicts the oxygen ventilator's final outputs, which display a patient's pulse rate along with blood oxygen levels.

Fig.5.Final Output of Oxygen Ventilator

REFERENCES:

[1]. Ranney, M. L., Griffeth, V., and Jha, A. K., Critical Supply Shortages: The Need for Ventilators and Personal Protective Equipment during the COVID-19 Pandemic, N. Engl.J. Med., 2020.

[2]. COVID-19 with respiratory support equipment, M. Pons-dena, A. Valls, J. Grifols, R. Farré, F.J. Cambra Lasosa, and B.K. Rubin, Paediatric Respiratory Review 2020

[3]. Iyengar, K., Bahl, S., Raju, and Vaish, The difficulties and solutions to supplying COVID-19 patients with ventilators in a timely manner, Diabetes Metabolic Syndrome Clinical Res, 2020.

[4]. Fearnside, P.M., and L. Ferrante, "Protect Indigenous Peoples from COVID-19." Science 2020.

[5]. The pandemic's new centre, New Science 2020, 246, 12–13 Taylor, L.

[6]. COVID-19 pandemic: Impact on Children, Families, and the Future, by D.A. Fitzgerald, J. Maclean, and B.K. Rubin, Children's Respiratory Review 2020, 35, 1-2.

[7]. Baqui, P., Bica, I., Marra, V., Ercole, A., and van der Schaar, M. Brazil's COVID-19 hospital mortality by ethnicity and region: A cross-sectional observational study, Health 2020, 8, e1018–e1026; Lancet Global

[8]. Authors include Chen, M.D., Eisenkraft, J.B., Kane, E., Zhou, G., and M.A. Levin, A., R., A., and G. Shah. During the COVID-19 Crisis, differential ventilation using flow control valves may provide a possible transitional step to full ventilatory support from bench to bedside. J. medRxiv. 2020.

[9]. Chase, J.G.; Chiew, Y.S.; Lambermont, B.; Morimont, P.; Shaw, G.M.; Desaive, T. As a final option, it is suggested that ventilator capacity be safely doubled. Critical Care 2020

[10]. Cost-Effective, Open-Source Mechanical Ventilator for COVID-19 Patients with Pulmonary Monitoring Gisela Pujol-Vazquez 1, 2020; Leonardo Acho 1, and Alessandro N. Vargas 2.

[11]. A low-oxygen consumption pneumatic ventilator for use in pandemic respiratory failure emergency construction, David Williams S. Flory, R. King, M. Thornton, and J. Dingley, DOI:10.1111/j.13652044.2009.06207.x, 2008

[12]. Textbook: "Medical Ventilator System Basics", written by Yuan Lei

[13]. In 2007, Klein KR and Nagel NE witnessed Hurricane Katrina and the airport in New Orleans' mass medical evacuation. Disaster Management Response, 2007 April-June;5(2):56-61

[14]. Development of Field Portable Ventilator Systems for Domestic and Military Emergency Medical Response, John Hopkins Applied Technology Digest, Vol. 25, No. 3, 2004 Kerechanin CW, Cytcgusm PN, Vincent JA, Smith DG, and Wenstrand DS

[15]. In 2020, Abir, M., Nelson, C., Chan, E. W., Al-Ibrahim, H., Cutter, C., Patel, K., and Bogart, A. Strategies for the critical care surge in reaction to the 2020 COVID-19 epidemic in the US RAND Corporation: Tech. Rep., Santa Monica, CA

[16]. The 2020 study was conducted by Petsiuk, Tanikella, Dertinger, Pringle, Oberloier, and Pearce. Automated open-source bag valve mask ventilator that is somewhat RepRap-able. HardwareX, e00131, page 8.

[17]. Understanding ventilator waveforms—and how to apply them in patient care, Nursing Critical Care, vol. 4, no. 1, 2009, pp. 43–55. Lian, J. X.

[18]. A New Type of Coronavirus among Individuals with Pneumonia in China, by Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al., 2019. N Engl J Med 2020;382. doi:10.1056/NEJMoa2001017.

[19]. Petras and Gelles Why COVID-19 patients require ventilators as well as how they function. United States Today, 2020 https://www.usatoday.com/in-depth/news/2020/04/10/coronavirus-ventilator-how-works-why-covid-19-patients- need/2942996001/

[20]. Ventilator Allocation during a Global Emergency in 2020: https://healthmanagement.org/c/icu/news/allocating-ventilators-in-a-pandemic

[21]. Covid-19: The 2020 Rush to Create Coronavirus Ventilation Systems, Penarredonda JL, https://www.bbc.com/future/article/20200401-covid-19-the-race-to-build-coronavirus-ventilators