

A Smart Ventilator System using IoT

Mr.P. Gopinathan, M.E (ECE), A.Vishwa, K.Manivel, R.Sivakasi

Assistant Professor, Department of Biomedical Engineering, Paavai College of Engineering, Namakkal,
Tamil Nadu, India

Department of Biomedical Engineering, Paavai College of Engineering, Namakkal, Tamil Nadu, India

ABSTRACT: We propose the design and development of an Internet of thing based ventilator system. The ultimate vision of IoT is to upscale communication mechanisms with a highly distributed and significantly dense heterogeneous devices network. Recently world is under stress due to the COVID-19 pandemic, which causes severe respiratory distress. Therefore, it is essential to develop low-cost and high-efficiency technologies for real-time health detection and continuous treatment system. The IoT-based ventilator is a low-cost, respiratory monitoring, and controlling system. The designed and developed ventilator delivers breaths by compressing a conventional Ambu bag with the help of a fixed arm connected to a servo motor. It eliminates the need for a human operator for the bag valve mask. Tidal volume and number of breaths per minute are set via user-friendly input modes, which help in customizing the pressure according to the real-time requirements of the patient. It has a safety mode that is when the power supply goes down; the backup battery automatically kicks in. A built-in alerts system is embedded to activate and warn the local and the remote locations about any malfunctioning for immediate attention.

KEYWORDS: Internet of Things(IoT), Health, Ventilator, Monitoring, Covid-19, Arduino UNO, SpO₂, Beats per Minute(BPM), ESP8266, Temperature, CSS, HTML, MongoDB, Express, Arduino IDE, Google Sheets

I. INTRODUCTION

There has been an exponential growth in healthcare technology in the last century. Devices like health care monitoring systems and modern ventilators are being produced. A ventilator is an electromechanical device that can be used as an alternative breathing mechanism for a patient whose lungs have lost the capacity to inhale and exhale. There are two types of such ventilators, 1. Nasal based ventilator 2. Oral based ventilator. Nasal based ventilators are used for patients having minor breathing problems. Oral based ventilators are used at times when the condition of a patient is very severe. These already available ventilators require a lot of costs, space and an expert handler. Ventilators are used only in extreme conditions. COVID-19 pandemic taught everybody that ventilators are far more important than we thought. Most of the patients who lost their lives during the pandemic were due to the unavailability of a ventilator. Along with ventilators, patient healthcare monitoring systems also played a vital role. These systems can monitor vital data such as BPM, temperature and SpO₂ levels of a patient. These can be separately used and are used in daily needs as well. In this project, we are combining these two systems but we have kept an option of using these together or separately as per need. In today's world, we need cost-friendly, portable and easy to make systems. IoT will help us to integrate these systems to a website that can be monitored by the doctors themselves and they will receive alerts if a patient's vitals fall below a certain level. With the use of IoT, the whole healthcare system based on these devices can become more efficient and reliable and fast.

II. LITERATURE SERVEY

[1] The stepper motor used in the Ambu-Bag compression mechanism is connected to the MSP430 microprocessor, which serves as the device's brain. A 15 watt solar panel is used to charge a battery that is helpful in trucking camps, military installations, and rural areas. For the purpose of connecting to the internet and receiving real-time affected person requests from the cloud, the microcontroller and the Wi-Fi module communicate verbally in serial.

[2] This work details the assessment and testing of a straightforward, inexpensive alternative ventilator that makes use of a cutting-edge pressure-sensing methodology and control algorithm. This is intended to provide lowcost, portable positive-pressure mechanical breathing while independently monitoring patient status and critical safety metrics. An anesthetic test-lung was used as a patient surrogate in the construction and evaluation of a prototype ventilator. We

looked at compliance and resistance change detection, as well as ventilation pressure waveform circuit leak detection, using a digital pressure sensor and a customizable test-lung. The prototype system demonstrated acceptable pressure waveform parameters during intermittent positive-pressure ventilation to the test lung: all simulated circuit leaks with a size of $\geq 6 \text{ mm}^2$ were detected; compliance changes were noted between $10 \text{ ml.cmH}_2\text{O}^{-1}$, $20 \text{ ml.cmH}_2\text{O}^{-1}$, and $50 \text{ ml.cmH}_2\text{O}^{-1}$; and resistance changes were noted throughout the available simulated range. These findings demonstrate that this prototype system can offer safe emergency ventilation without requiring sophisticated digital sensors or software, and that substantial cost and complexity savings are possible due to its clever construction and design.

[3] A plastic air tank, two plastic or wooden circles (movable and stationary discs), a flexible wire, two check valves, a DC motor, and a support box (guide cylinder) are the components of this idea. The higher circle's center is where the motor is fixed. When the motor is in the ON state, it rotates the top circular in a single direction. The wire bends as a result of the motor's action. The bottom circle is drawn upward as a result, pressurizing the air within the tank. As a result, the check valve directs this compressed air into pipes. This condition is associated with the inspiration stage. When the motor is turned off, it is freed. The bottom circle then descends as a result of its own weight and the wire's tension being released, returning it to its starting position. The gadget will take air from the patient's lungs since the pressure in the lungs is greater than the pressure in the air tank. As a result, the expiry phase and the OFF state coincide. Breathing is induced by the ON/OFF state cycle. Alternatively, the flexible wire's return to its starting location. The battery may be recharged by using the engine as a dynamo to produce power. As a result, the initiative would be less dependent on outside funding.

III. RELATED WORK

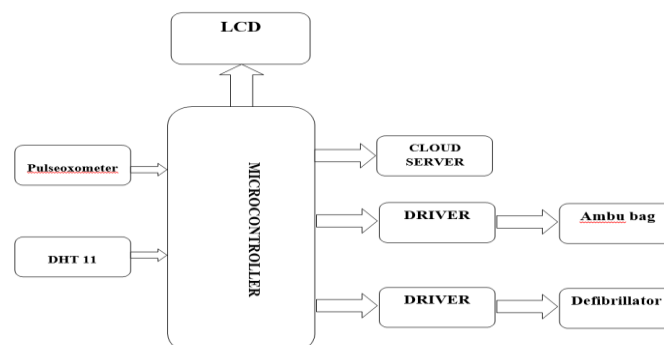
Proposed system

This project Automatic Ventilator is based on the wired technique with motion in forward, reverse direction of DC motor. From the DC Motor we press the Bag Valve Mask (BVM) and get control on it to provide the automatism to BVM. The aim is to provide ventilator in emergency pandemic situation by which we can save many lives to provide them a right time ventilator support. By digital thermometer and oxi-pulse meter we can observe on time patient heart bit and temperature record by which can provide effective treatment to patient. Idea behind 2 this work is to control the motor rotation and effective use of Bag Valve Mask (BVM) which is controlled Arduino. If pulse is down Defibrillator is automatical enabled to give electric shock in heart. This Automatic Ventilator helps patient to provide them right time ventilator support without any human. Our aim is to provide low cost ventilator by which it will be available in every hospital.

Existing system

They created a low-cost non-invasive ventilator using fast prototyping manufacturing techniques including 3D printing and product design. To ensure system dependability, This work proposes a robust control system based on supertwisting sliding modes that ensures trajectory tracking control for patients' breathing profiles. The experimental results validated the prototype design. Nonetheless, the prototype is still being evaluated and certified for medical usage. In this sense, the work The proposed prototype design is validated by experimental and simulation findings. Nonetheless, the prototype is still being evaluated and certified for medical usage.

IV. BLOCK DIAGRAM

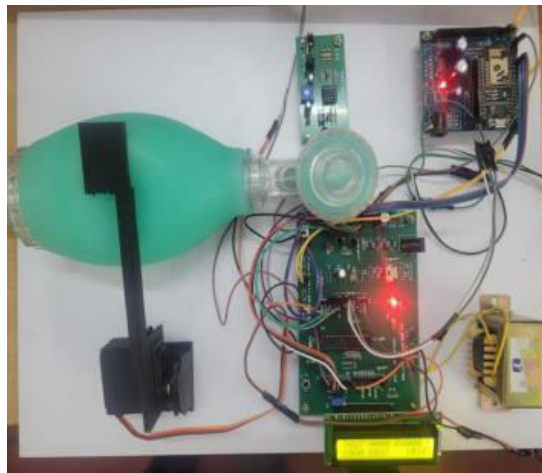


V. RESULT AND DISCUSSION

In this paper, we propose the design and development of an Internet of thing based ventilator system. The ultimate vision of IoT is to upscale communication mechanisms with a highly distributed and significantly dense heterogeneous devices network. Recently world is under stress due to the COVID-19 pandemic, which causes severe respiratory distress. Therefore, it is essential to develop low-cost and high-efficiency technologies for real-time health detection and continuous treatment system. The IoT-based ventilator is a low-cost, respiratory monitoring, and controlling system. The designed and developed ventilator delivers breaths by compressing a conventional Ambu bag with the help of a fixed arm connected to a servo motor. It eliminates the need for a human operator for the bag valve mask. Tidal volume and number of breaths per minute are set via user-friendly input modes, which help in customizing the pressure according to the real-time requirements of the patient. It has a safety mode that is when the power supply goes down; the backup battery automatically kicks in. A built-in alerts system is embedded to activate and warn the local and the remote locations about any malfunctioning for immediate attention.

VI. CONCLUSION

A smart ventilator is an advanced medical device designed to provide mechanical ventilation for patients who are unable to breathe adequately on their own. These ventilators use cutting-edge technologies such as sensors, artificial intelligence (AI), and real-time data analytics to adjust breathing parameters like pressure, volume, and oxygen levels according to the patient's condition. The integration of these technologies enhances the device's adaptability, making it suitable for both critical care and homebased settings. Smart ventilators can monitor and detect changes in a patient's respiratory status, automatically adjusting settings to improve therapeutic outcomes. They also enable remote monitoring, facilitating continuous assessment by healthcare providers and reducing human error. Additionally, these ventilators can be programmed for various types of ventilation modes to cater to specific patient needs, including those suffering from conditions such as chronic obstructive pulmonary disease (COPD), pneumonia, and acute respiratory distress syndrome (ARDS).



REFERENCES

- [1] AzanaHafizahMohd Aman, ElahehYadegaridehkordi, Zainab SenanAttarbashi, Rosilah Hassan, and Yong-Jin Park, "A Survey on Trend and Classification of Internet of Things Reviews," IEEE Access, Vol. 08, 16 June 2020.
- [2] Abdul Mohsen Al Husseini, Heon Ju Lee "Design and Prototyping of a Low-cost Portable Mechanical Ventilator" Proceedings of the 2010 Design of Medical Devices Conference DMD 2010 April 13-15, 2010, Minneapolis, MN, USA.
- [3] Valsalan P., Baomar T. A. B., and Baabood A. H. O. (2020). IoT-based health monitoring system. Journal of Critical Reviews, Vol.7, No.4, pp.739-742.
- [4] Al-Mutairi A. W. and Al-Aubidy K. M. (2020). Design and construction of a low-cost portable cardiopulmonary resuscitation and ventilator device. 17th IEEE Intr. Multi-Conf. on Systems, Signals, Devices (SSD2020), Tunisia, 20-23 July.

- [5] Ait-Khaled N, Enarson D, Bousquet J (2001) Chronic respiratory diseases in developing countries: the burden and strategies for prevention and management, *Bulletin of the World Health Organization*, 79 (10).
- [6] Chan-Yeung M, Ait-Khaled N, White N, Ip MS, Tan WC (2004) The burden and impact of COPD in Asia & Africa. *Int J Tuberc Lung Dis*.
- [7] Yin Y., Zeng Y., Chen X., and Fan Y. (2016). The internet of things in healthcare: an overview. *Journal of Industrial Information Integration*, Vol.1, March, pp.3-13.
- [8] Jusoh S. (2017). A Survey on-trend, opportunities, and challenges of mHealth apps. *International Journal of Interactive Mobile Technologies (IJIM)*. Vol. 11, No. 6, pp.73-85. <https://doi.org/10.3991/ijim.v11i6.7265>



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details