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Low-Cost Ventilator with the Facility of Variable Beats per Minute and Oximeter using Arduino Based ESP32

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Abstract: *This project aims to develop a low-cost ventilator using Arduino and ESP32 platforms. The ventilator will be designed to provide basic respiratory support for patients in need, particularly in resource-constrained settings. The Arduino will be utilized for controlling the ventilator's functions, such as adjusting the breathing rate and volume, while the ESP32 will enable wireless communication for monitoring and data logging. Safety and accuracy will be paramount considerations in the design process, with adherence to medical guidelines and standards. Collaboration with healthcare professionals and engineers will ensure that the ventilator meets necessary requirements for effective and safe use. This project seeks to leverage the capabilities of Arduino and ESP32 to create an affordable solution that can potentially help address the global need for ventilators.*

Keywords: Low-cost ventilator, resource-constrained regions, variable beats per minute (BPM), oximeter, silicon ventilator bag, blood oxygen sensor

I. INTRODUCTION

Ventilators are essential medical devices that assist individuals with impaired respiratory function, offering a lifeline in critical situations. However, the high cost and limited availability of traditional ventilators have posed significant challenges, particularly in resource-constrained regions and during emergencies. To bridge this gap, our innovative low-cost ventilator provides a cost-effective yet robust solution, integrating two crucial features: variable beats per minute (BPM) and an oximeter. The variable BPM functionality allows healthcare professionals to precisely tailor the ventilator's breathing rate to each patient's unique needs. This flexibility is crucial as respiratory conditions can vary widely among individuals, and having the ability to adjust the BPM ensures optimal treatment and patient comfort. In addition to customizable BPM settings, our low-cost ventilator also incorporates an oximeter, a device used to measure the oxygen saturation levels in a patient's blood. Monitoring oxygen saturation is essential for assessing a patient's respiratory status, especially in cases where oxygen levels may fluctuate rapidly. This integrated oximeter not only enhances the device's capabilities but also eliminates the need for separate monitoring equipment, making it more cost-effective and convenient for healthcare facilities. Furthermore, our low-cost ventilator is designed with efficiency and ease of use in mind. It boasts a user-friendly interface that allows healthcare providers to set parameters quickly and accurately, ensuring that critical care is administered swiftly and effectively. In conclusion, the Low-Cost Ventilator with Variable Beats per Minute and Oximeter represents a groundbreaking advancement in medical technology. By combining affordability, adaptability, and advanced monitoring capabilities, this innovative device aims to democratize access to life-saving respiratory support worldwide. In doing so, it contributes significantly to improving healthcare outcomes, particularly in underserved communities and emergency situations, where the need for reliable and accessible medical equipment is paramount. Human lungs use the reverse pressure generated by contraction motion of the diaphragm to suck in air for breathing. A contradictory motion is used by a ventilator to inflate the lungs by pumping type motion. ventilator mechanism must be able to deliver in the range of 10 – 30 breaths per minute, with the ability to adjust rising increments in sets of 2. Along with this the ventilator must have the ability to adjust the air volume pushed into lungs in each breath. The last but now the least is the setting to adjust the time duration for inhalation to exhalation ratio. Apart from this the ventilator must be able to monitor the patients blood oxygen level

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and exhaled lung pressure to avoid over/under so that the air are get form and we took the in the air pressure simultaneously. We design and develop the ventilator using Arduino encompasses all these requirements to develop a reliable yet affordable DIY ventilator to help in times of pandemic. We here use a silicon ventilator bag coupled driven by DC motors with 2 side push mechanism to push the ventilator bag. We use toggle switch for switching and a variable pot to adjust the breath length and the BPM value for the patient. Our system makes use of blood oxygen sensor along with sensitive pressure sensor to monitor the necessary vitals of the patient and display on a mini screen. Also, an emergency buzzer alert is fitted in the system to sod an alert.

II. OBJECTIVE

- Affordability: To create a cost-effective ventilator system that is significantly more affordable than traditional ventilators, ensuring accessibility to healthcare facilities with limited financial resources Variable BPM Control develop a ventilator capable of adjusting the BPM rate to accommodate a wide range of patient needs, including pediatric and adult patients, and varying respiratory conditions. Oximeter It provide this all-possible thing.
- Oximeter Integration: Integrate an oximeter sensor into the system to continuously monitor the patient's oxygen saturation levels (SpO2), ensuring that oxygen levels remain within safe and optimal ranges. Utilize Arduino microcontroller and ISP-32 platform technology for precise control of the ventilator's functions, data processing, and communication with sensors and actuators.
- Safety and Reliability: Implement multiple safety features, alarms, and fail-safe mechanisms to ensure patient safety during ventilation, and design the system for reliable, continuous operation
- User-Friendly Interface: Create an intuitive and user-friendly interface with clear displays, controls, and alarms to facilitate easy operation by healthcare professionals with varying levels of expertise. Portability and Mobility: Design the system to be compact and portable, enabling deployment in diverse healthcare settings, including field hospitals, ambulances, and remote clinics.
- Power Management: Develop efficient power management solutions, including options for battery operation and energy-efficient modes, to ensure uninterrupted operation, even in areas with unreliable power sources. Provide real-time patient data feedback, including SpO2 levels, BPM settings, and respiratory rate, to assist healthcare providers in monitoring and adjusting treatment. Ensure compliance with relevant medical device regulatory standards, such as FDA approval (or equivalent in other regions) and adherence to ISO standards for medical devices Design the ventilator system for ease of maintenance and durability to reduce long-term operating costs and ensure longevity in demanding healthcare environments.
- Scalability: Consider scalability in the design to meet increased demand during healthcare emergencies and adapt to evolving healthcare needs. Promote an open-source development approach to encourage collaboration, innovation, and knowledge sharing within the medical and engineering communities. Develop training materials and programs to educate healthcare professionals on the proper use of the ventilator system, especially in regions with limited medical expertise. Ensure that the ventilator system can be easily deployed to healthcare facilities, including those in underserved and remote areas, to address healthcare disparities.
- Reliability and Longevity: Prioritize the reliability and longevity of the ventilator system to minimize downtime and reduce the overall cost of ownership for healthcare facilities. By achieving these objectives, the low-cost ventilator with variable BPM and oximeter integration aims to provide an accessible, reliable, and effective solution for respiratory support in healthcare, ultimately improving patient outcomes and saving live.

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III. PROPOSED METHODOLOGY

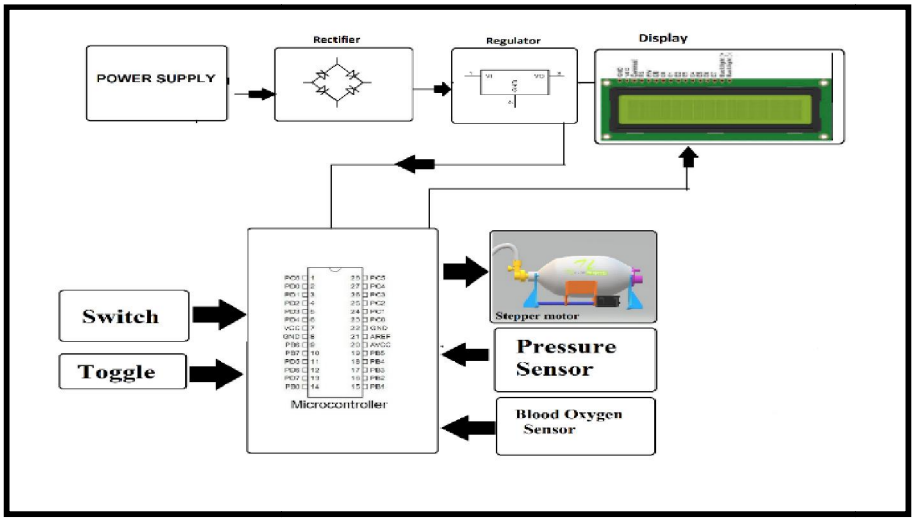

Fig. Low-cost ventilator with variable beats per minutes

The of this project is the low-cost ventilator with the facility of variable beats per minute and oximeter by using Arduino based Esp-32. The meaning of this project is nothing but the low cost means it's very inexpensive means we can by easily and ventilator means we are providing the oxygen to the patient and by using ESP-32 means we are showing bpm and oxygen level in the mobile phone. low-cost ventilator is an affordable device we can easily afford it by using the very few components for the respiratory distress people. In this project we use a very component name as the motor, motor driver, node MCU, Lcd Display, power supply, ESP-32, cloud, mobile, blink iot app and Arduino droid app for building this project. In this project first we taken the measurement of wooden sheet and we mount the pump on this sheet. And on this sheet, we mount the pump and then we mount all the component like as Jonson's motor, Oxygen mask, motor driver, electronic transducer, ESP-32, LCD Display, Heartrate sensor and also give the power supply to this whole system. When we give the power supply to this project then the pump is gone into the forward direction and comes into the backward direction when it goes into the forward direction the oxygen is get stored into the pump and then by using the pump it will reach to the patient nose in that oxygen pump there is a one sensor is present that detect if the patient having the need of oxygen, then it will give the oxygen to the patient. The Jonson's motors going into the forward direction and coming into the reverse direction all this monitoring is done by using the motor driver and in that motor driver the motor is present that motor converts the electrical energy into mechanical energy and then the Jonson's motor is get run .We place the heart rate sensor this heart rate sensor measure the both the thing like as beats per minute and oxygen level of the patient and this physical signal is get convert into the electrical and it will show on the LCD display .

This LCD Display having the 16 pins device .Then the main controller of our project is nothing but the ESP-32 in that we were stored our code and by using this component we are showing all the data in the mobile phone that's why we taken this instrument .To showing all this thing in the app first we taken the two app the Arduino droid and Blink iot. In the Arduino Droid we are compiling our code and in the aap Blink iot we are showing all the results of BPM and Oxygen level of the patient

For example, typically consists of several key components and subsystems that work together to assist with the mechanical ventilation of a patient. Here's a simplified block diagram outlining the main components and their functions. It's important to note that the specific components and their interactions can vary based on the design and complexity of the ventilator. Additionally, safety and regulatory compliance are critical when designing any medical device, including low-cost ventilators. Ventilator designs must adhere to industry standards and guidelines, and they should ideally be developed in collaboration with medical professionals and engineers who have expertise in medical device design and regulatory require. This flexibility is crucial as respiratory conditions can vary

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IV. CONCLUSION

The development of a low-cost ventilator using Arduino and ESP32 shows promise in providing basic respiratory support for patients, especially in resource-limited settings. By leveraging the capabilities of these platforms, we can create an affordable solution that addresses the global need for ventilators. It is essential to prioritize safety and accuracy in the design process, following medical guidelines and standards. Collaboration n with healthcare professionals and engineers is crucial to ensure the ventilator meets necessary requirements for effective and safe use. This project highlights the potential of DIY technologies in addressing critical healthcare challenges and underscores the importance of innovation and collaboration in creating impactful solutions.

REFERENCES

[1] This “tank ventilator” was first described by the Scottish physician John Dalziel in 1838
[2] Permanently exposed at the Museum of Life (Livet’s Museum) in Lund Photo reproduced with kind permission of Björn Jonson in 1971.
[3] the modern age of ventilators was ushered in by Sven-Gunnar Olsowho introduced the first electrically controlled ventilator (the Servo Ventilator 900).
[4] In 1864, Alfred Jones invented one of the first such body-enclosing devices. The 1955 release of Forrest Bird's "Bird Universal Medical Respirator" in the United States changed the way mechanical ventilation was performed.
[5] Famed inventor Alexander Graham Bell even took a crack at the problem of artificial respiration, developing a “vacuum jacket” with some success.
[6] In 1952, Roger Manley of the Westminster Hospital, London, developed a ventilator which was entirely gas driven, and became the] Rapidly Manufactured CPAP System (RMCPAPS) Document CPAP001-SpecificationIssued by MHRASHTRA.
[7] Europe. In 2007, Morley Safer interviewed the man who invented it—Forrest Bird. For many patients with COVID-19., a ventilator can be the difference between life and death.
[8] CBS News Aptamer inventor Alexander Graham Bell even took a crack at the problem of artificial respiration, developing a “vacuum jacket” with some success.
[9] John Emerson: He co-invented the iron lung, or "negative pressure ventilator," in the 1920s.