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# Low Cost Portable Ventilator With PressureRegulation Using Arduino

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**ABSTRACT—**The patient is suffering from an injury or illness that makes it hard to breathe. A ventilator may help to breathe during these conditions. It is useful in surgery where you are asleep,but this is usually for no more than a few hours. So simply ventilator is a machine that helps a patient to breath when they are having a surgery or cannot breath their own due to a critical illness,that is why the device is more important in hospitals .Here the patient is connected to the ventilator with a hollow tube that goes in their mouth and down into their main airway or trachea.In this paper develops a portable ventilator using AMBU (Artificial Manual Breathing Unit) Bag.The pressure and volume of air passed to the patient from the ventilator can be measured using sensors and the readings can be displayed using Android app.The count, pressure and volume of air passed to the patient from the ventilator can be measured using relevant sensors and the readings can be displayed in both LCD display and Android app.The controlling of pressure is also possible with the help of Android app.The main advantages of this ventilator is that it is less expensive, portable and also automatically works. At emergency conditions the doctor can adjust the amount of air using a control mechanism that is built in Android application .Also if the Doctor is not there a will be a notification sent to telegram of the Doctor or the hospital health assistant,and people around are alerted by the buzzer if pressure increases.

**Keywords—**AMBU Bag; Ventilator; Prototype

## I. INTRODUCTION

A biological system called the respiratory system, also known as the respiratory apparatus or ventilatory system, is made up of particular organs and structures that are utilized by both plants and animals to exchange gasses. Depending on the size of the organism, its habitat of residence, and its evolutionary background, the anatomy and physiology that cause this vary widely. The linings of the lungs internalize the respiratory surface in land animals. Millions of tiny air sacs, known as alveoli in mammals and reptiles and atria in birds, are responsible for the gas exchange that takes place in the lungs. Because of the abundant blood supply in these tiny air sacs, the air and blood are in close proximity to one another.These air sacs link with the outside world by a network of hollow tubes called airways, the greatest of which is the trachea, which divides into the two main bronchi in the center of the chest. These enter the lungs where they divide into secondary and tertiary bronchi that become increasingly more minute tubes called bronchioles.

Today, respiratory illnesses are the main causes of health issues. Chronic respiratory conditions (CRCs) affect the lungs' airways and other pulmonary structures. The most prevalent ones include pulmonary hypertension, asthma, occupational lung disorders, and chronic obstructive pulmonary disease (COPD). Air pollution, dust from the workplace, and recurrent lower respiratory infections in children are other risk factors in addition to tobacco smoke. CRDs cannot be cured, although there are numerous ways of treatment that can dilate important

airways and reduce shortness of breath can aid in symptom management and enhance the quality of life for those who have the disease. The respiratory system is also affected by the viral disease caused by the pandemic coronavirus. Dyspnea is the medical term for the coronavirus symptom of shortness of breath. Ventilator is the name of the medical device that is used to treat respiratory failures.

Ventilators are used for patients who are unable to breathe, so the term "life support" is also used. If you're unable to breathe on your own, this device will assist you. Another name for it is a "mechanical ventilator." It's also frequently referred to as a "breathing apparatus" or "respirator." When caring for someone who is ill with a contagious illness, medical professionals are required to use respirators, which are masks. A bedside device called a ventilator has tubes that attach to your airways. A ventilator mechanically assists in supplying your body with oxygen. Through a tube that enters your mouth and travels down your windpipe, air is expelled. Additionally, the ventilator might exhale for You can choose to handle it on your own.

There's a chance the breathing tube will hurt. You are unable to eat or speak while it is connected. On ventilators, some patients might not be able to eat or drink regularly. If so,you will need to receive your nutrients through an IV, which is placed into a vein with a needle. Normal breathing causes your lungs to take in the oxygen your cells require to survive and release carbon dioxide. You can programme the ventilator to breathe for you a specific number of times per minute. A doctor can also select when to activate the ventilator when you need assistance. In this instance, if you don't take a breath after a predetermined amount of time, the machine will automatically blow air into your lungs.

The patient receives air from the ventilator through a pipe that is connected either through the mouth or a hole made in the neck. A ventilator can also be used during surgery to help recovering patients breathe and to keep patients whose oxygen levels are low alive. The most potent therapeutic tools are ventilators. They can be categorized as high frequency, positive pressure, or negative pressure ventilators depending on their type of work. Due to the expensive price of this technology, hospitals only have a small supply accessible. Theailments that caused your breathing issues cannot be cured by a ventilator. It aids in your survival until your lungs can function on their own as a result of your recovery. When the medical professional deems you healthy enough, they will Trybreathing normally. Even while you can attempt to breathe on your own, the ventilator remains connected. The tubes will be taken out and the ventilator will be switched off after you start breathing normally.

## II. LITERATURE REVIEW

During the year 2020 Ryan M. Corey Evan M. Widloski, David Null, Brian Ricconi, Mark A. Johnson, Karen C. White, Jennifer R. Amos, Alexander Pagano,Michael L. Oelze, Rachel D. Switzky, Matthew B. Wheeler, Eliot B. Bethke,Clifford F. Shipley, and Andrew C. Singer are introduced Low-Complexity System and Algorithm for an Emergency Ventilator Sensor and Alarm .Numerous organizations have created affordable emergency ventilators in response to the COVID-19 pandemic's predicted lack of ventilators. These products frequently consist of pressure-cycled pneumatic ventilators, which are simple to manufacture but frequently lack the sensing or alarm capabilities present on commercial ventilators. This study describes an inexpensive, easily manufactured electronic sensor and alarm system for pressure-cycled ventilators that predicts therapeutically important metrics like pressure and breathing rate and emits an alarm when the ventilator breaks down. An electronic pressure sensor attached to the patient's airway sends a signal that is monitored by a pair of nonlinear recursive envelope trackers in a low-complexity signal processing system. The technique uses little memory and only a few calculations on each, and it was inspired by those used in hearing aids.

Abdul Mohsen Al Husseini , Heon Ju Lee , Justin Negrete , Stephen Powelson , Amelia Servi ,Alexander Slocum , Jussi Saukko in 2010; a working prototype that can be operated on a test lung has been developed. The tidal volume and breath rateof the prototype are user-configurable. In the article "Design and Prototyping of a Low Cost Portable Mechanical Ventilator," it has an assist control and an over-pressure alert. It uses very little power, lasting 3.5 hours at its most demanding setting on a single battery charge. It includes a handle and simple-to-use latches, is portable, weighs 9 lbs (4.1kg), and is 11.25 x 6.7 x 8 inches. On a computer screen, the prototype can provide settings and status. Since these ventilators frequently break down and become vulnerable over time, the manufacturer must be paid for expensive service agreements.

In the year 2018 A Portable BVM-based Emergency Mechanical Ventilator is introduced by Jozef,Michal Kelemen,Ivan Virgala,Peter Marcinko,Peter Tuleja,Marek Sukop,Erik Prada,Martin Varga,Jan Ligus,and Filip Filakovsky.The paper deals with development of an artificial lung ventilation. The purpose of the study is to demonstrate a developed bag-valve-mask ventilator that might be employed as a substitute for a mechanical ventilator in COVID-19-related life-threatening scenarios. We first go over the fundamentals of positive pressure ventilation. Then, in order for emergency mechanical ventilators to be an appropriate substitute in both homes and hospitals, we create regulations for them. The following part presents the mechanical and control design. Finally, using measured pressure in the patient's airways, we experimentally validate the ventilators that we have constructed. The data made public demonstrate the possibility for created ventilators to be deployed in real-world settings. Index Terms: pneumatic system, coronavirus, COVID-19, control system, and artificial lung ventilation.

During the year 2019 Dr. Arun Prasath D.Deeba , R.Vignesh Gandhi, R.S.Shivadarshana,Dr.G. vishnuvardhanan,N.vigneshwari are introducing Smart Ambu Bag Using Electronic devices. Accidents of many kinds occur in the world today. unable to prevent accidents. can attempt to preserve a person's life before deciding to create the ventilator that is required. Ambu bags are often utilised in the ambulance for a brief period of time. The patient will receive ample ventilation from the ambu bags. However, the patient was not receiving enough ventilation from the ambu bags for a very long period, so we made the decision to create a smart ambu bag that serves as a ventilator in the hospital. By utilizing a clever ambu bag that will give the patient enough ventilation, it will save time.

In 2020 Ryan Rhay Vicerra, Edwin Calilung, Jason Española, Elmer Dadios, Alvin Culaba, Edwin Sybingco, Argel Bandala, Alma Bella Madrazo, Laurence Gan Lim, Robert Kerwin Billones, Siegfred Lopez, Dino Dominic Ligutan, Julius Palingcod, and Carl John Patrick Castillohave effectively constructed a programmable logic controller (PLC) of industrial grade to control the mechanical ventilation of an emergency ventilator based on a bag-valve-mask. Numerous mechanisms were noticed, and the outcomes have been reported. Overall, the usage of a programmable logic controller as a component of the emergency ventilator's control system has been successfully adopted by the proponents. For the emergency biomedical equipment to potentially be commercialized in the future, the PLC, a component of industry-grade 4, is required. The advocates for the emergency ventilator with a bag valve and mask look forward to improving on adding more ventilator parameters to monitor, such as percent of oxygen (FiO2), and researching various computing approaches that can be applied through the PLC.

Edwin Calilung, Jason Española, Elmer Dadios, Alvin Culaba, Edwin Sybingco, Argel Bandala, Ryan Rhay Vicerra, Alma Bella Madrazo, Laurence Gan Lim, Robert Kerwin Billones, Siegfred Lopez, Dino Dominic Ligutan, Julius Palingcod, and Carl John Patrick Castillo in 2020; proposed creation of two main mechanical design prototypes for a BVM-based emergency ventilator. It was demonstrated that a modified Scotch yoke mechanism powered by a vehicle wiper motor may be used to create a simple, compact, and possibly inexpensive ventilator design. Controlling the speed and location of the compression pad as it compresses the BVM during each cycle was challenging due to the Scotch yoke compression mechanism. Only 2 digital proximity sensors, placed at the top and bottom of the compression stroke, servedas position feedback. The load had an impact on the motor's speed as well. These characteristics made it difficult to precisely manage the timing and rate of delivery of the necessary tidal volume of breath.

During the year 2019 Mukaram Shahid introduced a Prototyping of Artificial Respiration Machine Using AMBU Bag Compression.Ventilators are discussed here as essential medical equipment. They are mostly used to help seriously unwell patients. The AMBU (Artificial Manual Breathing Unit) bag has been used to develop a low-cost ventilator. This equipment is significantly more affordable than its competitors and is completely capable of carrying out all the duties of a typical ventilator. Additionally, it has the ability to regulate patients' BPMs (breaths per minute) to the level the doctor

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specifies. Additionally, this ventilator has the option of adjusting air delivery volume. The inspiration to expiration ratio and peep rate can both be controlled in a similar manner. As a result, it makes the ventilator practical for patients of all ages and classifications. Two modes are included with this system. The first one calls for required ventilation, while Ventilation support is a characteristic of the second. The doctor may use the ventilator's built-in trigger, which modifies the breathing pattern when it notices a change in air pressure, or he or she may specify a time period for this modification of the respiration pattern. An energy-efficient, portable, and reasonably priced ventilation system has been developed through the use of this prototype. The inexpensive price is primarily attributable to the off-the-shelf materials used in its construction and the accessibility of the sensors. In addition to all of this, the system has basic features like air volume control, BPM (breath per minute), and peep rate modification. Consequently, this device can very well be a solution to the issues facing developing nations.

A Remote Control System for Emergency Ventilators During SARS-CoV-2 was introduced in 2020 by Michael Barrow, Francesco Restuccia, Mustafa Gobulukoglu, Enrico Rossi, and Ryan Kastner from the UC San Diego Scuola Superiore Sant'Anna Pisa. Here, a global remote control system for temporary ventilators was established. It connects to various ventilators using inexpensive hardware add-on modules, and it communicates with telemedicine software by way of a three-tier control architecture. They use two example ventilator designs to show system integration in this study, andthey include a remote control option that enables caretakers to rapidly and simply monitor and manage these ventilators from a distance.

## III. METHODOLOGY

*A.* Flow chart

The obligatory control mode is automatically employed in this project.Figure depicts the breath delivery system's flow. The patient is given breath based on an equal time delay. by using the controller's internal timer. the scheduled delay based on the doctor's recommended breath rate. Due to the pressure limiting valve at the AMBU bag, the supplied breath is set at 60cmH2O (centimeter of water). This quantity was likewise discovered to be the highest breath pressure required for an older patient.The flowchart for a cheap portable ventilator is shown in the picture. The flowchart in this example has a start block that must first initialize all global variables and Communication. Global variable initialization is employed.For the initialization of communication and machine codes for the clearance of the server path. Check to see if the button is pressed.

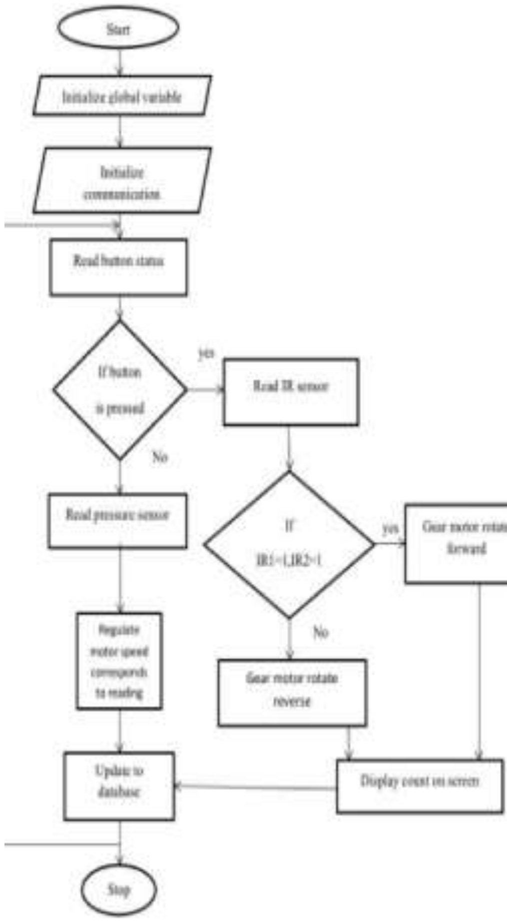


Fig 1. Flowchart

The metrics used by IR sensors. In the event that it is 1, the Gear motor turns in the opposite direction if not. They are the gear motor's outputs shown on the screen. If the no button is pressed, it changes the database and receives input is given to the path once more, and any alterations are examined; it ceases functioning after these events if the button clicked read pressure sensor with speed-controlling motor in keeping with the reading. Furthermore, this value will be kept in if a database is used, programming is stopped but a recheck is done,When the button is pushed.

*B.* Block Diagram

The schematic block diagram of the system's operation is shown in Figure. This process began with a set of coding on the microcontroller, the system's primary component.into this component, which was posted. Microcontroller output,Located in the L298 motor driver, the H-bridge was used to command an Arduino-controlled DC motor to compress and Let go of the AMBU bag.

The patient receives breaths because of this process. The air pressure sensor monitors the patient's breathing and notices any changes in respiration. checks the status of the air and oxygen filters.There are input obstructions that need to be changed. It also detects and controls the oxygen and air supplyto ventilators.

Arduino UNO occupies the center of the block diagram. The Arduino UNO includes a 28 pin ATMEGA 328 IC. Arduino begins to operate when a 5 volt power supply is connected to it for the operation.When the start button is pressed and turnedON, the device work is started by will. The AMBU bag is in its default state when the IR sensors and the dilated state will be able to detect this.The plank coupled with a 12 volt gear motor begins to revolve as Over the AMBU bag, the engine will be compressed.The air in the AMBU bag will then be delivered to the prosthetic lungs at that moment. For proper rotation, the gear motor requires 12 volts,However, the Arduino's I/O pin can only produce 5 volts. so insufficient the motor obtains the voltage supply. That'll result in the motor's correct rpm. The engine will also create a back.It causes damage to the Arduino UNO. These issues will affect a motor driver IC L293D in between an Arduino and a solution motor, too. It is possible to measure and store the pumping count in the server. The node MCU, a wifi integrated module, receives the pumping count or data first. then the data MCU was internet-transferred from the node to the server database.As a result, the data was saved in the database. Utilizing the IP In Android, the data can be displayed by IP address or server domain.Here, three LED indicators are utilized. a proper one Power LED is used to detect the power source. An LED programme is utilized as a measure of the program's effectiveness and a data LED to show whether data is effectively flowing here an alarm gadget uses a buzzer system.

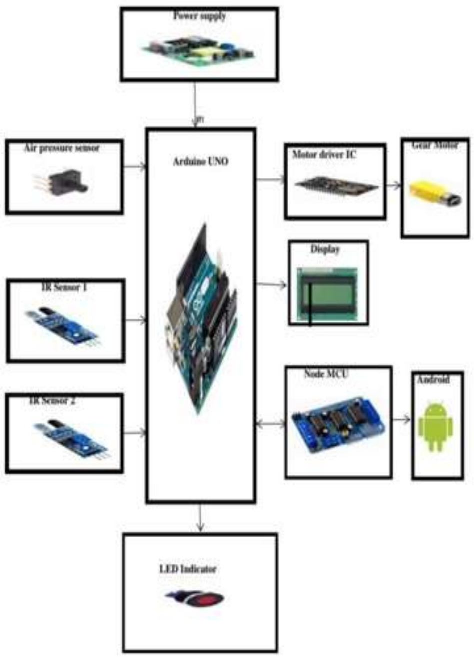


Fig 2 .Block diagramThe components are;Arduino Uno

A microcontroller board called Arduino/Genuino Uno is based on the ATmega328P (datasheet).It features 14 pins for digital input and output, 6 analogue inputs,USB connection - 16 MHz quartz crystal , a ICSP header, power jack, and reset button.It's just either use a USB cable to connect it to a computer or a power source battery or an AC-to-DC adaptor

Ambu bag

A bag valve mask, also referred to as a manual resuscitator or"self-inflating bag" or by the brand name Ambu bag. It is a portable device that is frequently used to patients who are not receiving positive pressure ventilation should get it.either breathing or not breathing enough.

Node MCU

It employs a non-module flash-based SPIFFS file system and is an open source Lua firmware for the ESP8266 WiFi SOC from Espressif. The firmware was first created as is an extension of the well-known ESP8266-based Development modules for NodeMCU

IR sensor

A sensor that measures and recognises infrared radiation in its environment is known as an infrared (IR) gadget Infrared sensors come in two varieties: active and passive. Active infrared sensors produce and pick up infrared radiation.

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Two components make up active IR sensors: a light emitting LED and a receiver.

L293D

Popular 16-Pin Motor Driver ICs include the L293D. Two DC motors can be operated simultaneously by a single L293D IC. It is quite easy to use this L293D motor driver IC. The IC utilizes the Half H-Bridge, Speed, and Direction principles Possibility of control Gear motor 3.1.6(12v, 100 rpm)

Gear Motor (12v,100 rpm)
Robotics applications use 100RPM 12V DC geared motors.It produces a powerful 27 Kg Cm of torque. The motor includes a Off-centered shaft and metal gearbox.

LCD(16×2)

Liquid crystal display is referred to as LCD. It is a specific type of electronic display module used in a wide array of devices and circuits, including mobile phones.
devices like phones, laptops, TVs, and calculators. These exhibits because multi-segment light-emitting diodes are primarily preferred and seven divisions.

Buzzer

It is a piezoelectric, electromechanical, or mechanical audio signaling device (piezo for short). Buzzers and beepers are frequently used in alarm clocks, timers, and user input confirmation, such as a mouse click or keyboard

*C.* Circuit Diagram

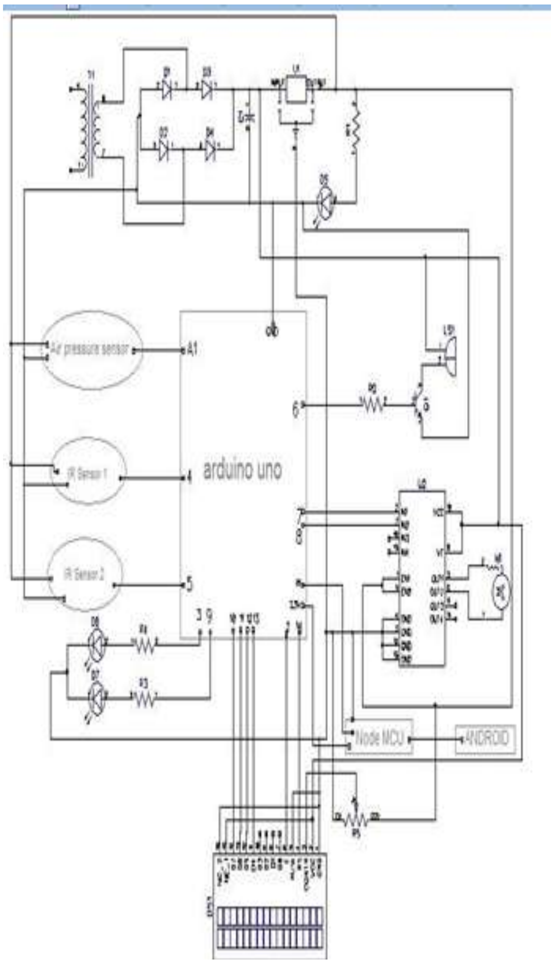


Fig 3 .Circuit Diagram

D. Ventilator Prototype

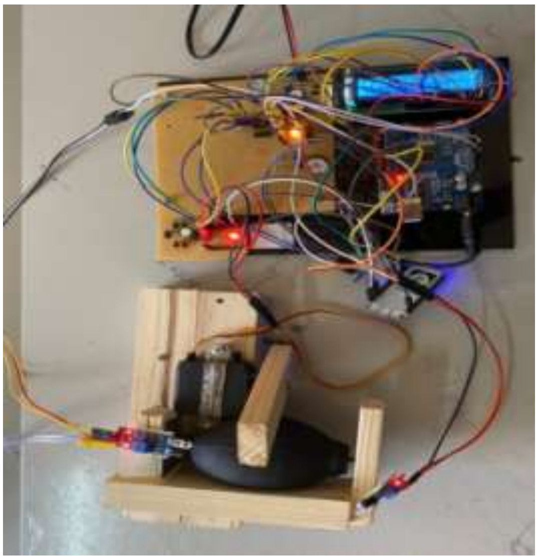

Fig 4. Ventilator prototype

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## IV. RESULT AND DISCUSSION

Successful design and development of a low-cost portable ventilator employing pressure regulation. The patient was provided information about the number, pressure, and volume of air in a particular sensors are used to record the ventilator, after which the both a 16*2 LCD panels and a database are used to store the results.Database and transmitted to an Android app for additional purposes. The physician can alter the treatment in an emergency employing a built-in regulating system, the amount of air application for Android. Additionally, a will exist if the Doctor is absent.Hospital or doctor's notification given via telegraph the bell alerts nearby individuals and the health assistant if Pressure builds.

The LCD display shows the pressure and the breath count,


Fig 5 . LCD Display

The App interface is shown below;

Fig 6. Vento App interface

The notification coming in the Telegram as follows;


Fig 7 . Telegram Notification

## V. CONCLUSION

In this work, a prototype for a transportable, inexpensive, and energy-efficient breath delivery device was created. By coupling the Arduino to this prototype, it is possible to turn on the batteries and the power supply.Inflation and deflation of the AMBU bag were detected using IR sensing technology in this investigation. Upon receiving signals, the mechanical AMBU bag's automated release mechanism would generate the air that the lung needs. This gives the prosthetic lung a steady flow of air. This task discovered that the breath had a noticeably higher consistency. supplied with a performance of 18.6 1.45 bpm and less than 10 percent difference between the two employing the developed technique like the manual way.Inflation and deflation of the AMBU bag were detected using IR sensing technology in this investigation. Upon receiving signals, the mechanical AMBU bag's automated release mechanism would generate the air that the lung needs. This gives the prosthetic lung a steady flow of air. This task discovered that the breath had a noticeably higher consistency.supplied with a performance of 18.6 1.45 bpm and less 10 percent difference between the two employing the developed technique like the manual way.

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