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DIY COVID PANDEMIC RESPIRATOR WITH AN ARDUINO AND BLOOD OXYGEN SENSOR

Agamanti Saikiran
(PG student), Global Institute of Engineering And Technology, Moinabad, Telangana, India.

Dr. G. Ahmed Zeeshan
(Professor and Head Department of ECE), Global Institute of Engineering And Technology, Moinabad, Telangana, India.

Mr. Md Altaf ur Rahman
(Assistant Professor Department of ECE), Global Institute of Engineering And Technology, Moinabad, Telangana, India.

Abstract – This essay presents the findings of various studies that were conducted. Humans take air using their lungs. Every time they motivate themselves to breathe out or inhale, they use a thrust method. To aid people during the Covid epidemic, we have configured a DIY ventilator. It is incredibly sensible and humble. This can be applied to a patient's fundamental state at the moment when patients suffer the negative impacts of lung or breathing problems. The ambu bag is propelled by a dc motor component. This component can be carried out while breathing and pulse levels are minimal. The amounts of breathing and pulse are displayed on the LED panel. Additionally, a ringer is installed in the system to sound a ready whenever any anomalies are discovered in a patient with a fundamental condition or respiratory problem. In addition, the respirator should be able to check the patient's blood oxygen level and lung exertion as they breathe out to prevent over or under air pressure at the same time. The ventilator we here design and promote using Arduino incorporates a substantial number of requirements to produce a reliable yet affordable DIY ventilator to assist during a pandemic.
Key Words: Arduino, ventilator, bag valve mask, pneumatic, COVID-19

1. INTRODUCTION

The opposite pressure created by the stomach's compression action is used by human lungs to draw oxygen in for relaxation. A ventilator uses an unnatural action, akin to siphoning, to enlarge the airways. A respirator component should be able to deliver between 10 and 30 breaths per minute with the flexibility to handle increasing augmentations in groups of two. In addition, the ventilator should be able to control the amount of oxygen that is pumped into the lungs with each inhalation. The option that regulates the ratio of the duration of the inhalation to the exhalation is last but not least for now. In addition, the respirator should have the capability of monitoring the patient's blood oxygen level and lung strain as they are exhaled in order to prevent over/under gas stress at the same time. The ventilator we here develop using Arduino encloses these requirements to produce a reliable yet affordable DIY ventilator to assist epidemic seasons. Here, we press the ventilator sack using a silicon ventilator pack combined with DC engines and a two-side push system. We use an electronic switch for switching and a changeable pot to control the breath duration and, as a result, the patient's BPM. Our system uses a blood oxygen gauge and a sensitive stress sensor to monitor the patient's essential vitals and display them on a small screen. Additionally, a crisis ringer warning is built into the structure to sound a notification when an anomaly is discovered. The entire system is controlled by an Arduino regulator to recognise desired outcomes and assist patients during the COVID epidemic and other emergency situations. The Covid pandemic has caused a global catastrophe, and medical clinics and medical service agencies are pointing out major equipment flaws. It is our responsibility as producers to address the shortage by developing creative open-source replacement tools. Our country might be on absolute isolation, but not our ingenuity! Ventilators for people who require assistance with breathing are one major device whose demand has increased as a result of COVID19's respiratory effects. In its most basic form, a ventilator could be a device that delivers breathable air into and out of the lungs in order to provide respiration to a patient who is genuinely unable to breathe on their own or who is not inhaling enough. Even though a DIY ventilator is unlikely to be as effective as a commercially available one, it can serve as a reasonable replacement if it can control the following crucial parameters.

Tidal volume is the amount of air that the respirator delivers to the lungs with each inhalation; at rest, this amount is usually 500ml.

Breaths per minute (BPM): This is frequently the fixed pace for breathing. between 10 and 30. The amount of inspiratory to expiratory duration is known as the inspiratory to expiratory ratio (IE amount). What is the ventilator's maximum flow at which it can give a predetermined tidal amount of breath?

Positive end-expiratory pressure, or peep, is the pressure inside the lungs that is higher than the gas pressure at the peak of exhalation.

2. LITERATURE SURVEY

This article shows the creation of open source, low cost automated ventilators. Additionally, this piece illustrates the numerical method for keeping track of patients' pulmonary condition. Using a pressure sensor, we can ascertain whether the patients' airways are sound or not. An Arduino device collects data from the pressure gauge, which is then sent to a raspberry pi for additional processing. The raspberry pi transmits the necessary commands to the acuter and respiratory sack compress. The pressure gauge can measure differential pressures of up to 70 centimetres of water, according to the manufacturer's specs. The shaft that was attached to the servo metre had the gear affixed to it. The shaft was made from a Plexiglass bar. The radius of this gear is 2.5 cm.

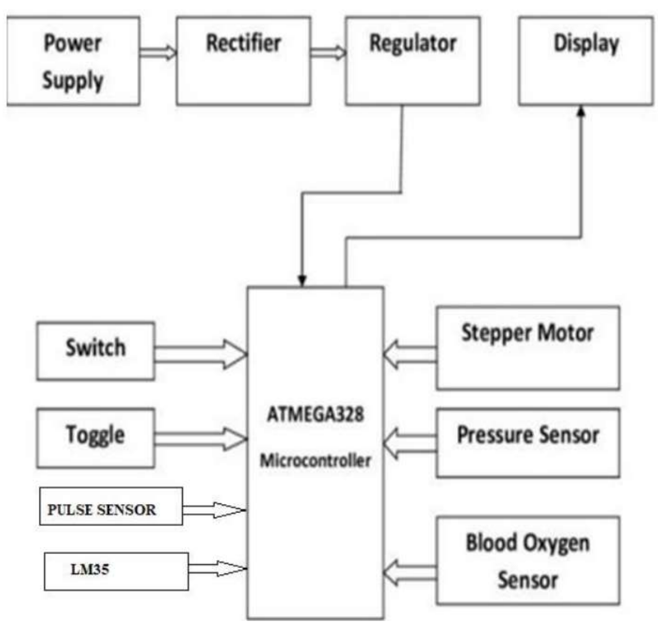
This paper by Aliaksei Petsiuk, Nagendra G. Tanikella, Samantha Dertinger, Adam Pringle, Shane Oberloier, and Joshua M. Pearce [1] demonstrates the development of a portable automated mask value bag that is quick and easy to construct. This handle is operated by an Arduino driver, and it is built primarily from RepRap 3D printed parameter components with the real-time software installed. Thanks to Arduino, the controller's range of potential outcomes may considerably increase. Software tasks like planning and scheduling, as well as inter-task contact and synchronization, are made possible by real-time software systems. Couchman, B.

A. "Nurse involvement in the prevention and treatment of problems related to mechanical ventilation." et al (2006)

[2] What does the data indicate about the medical care given to a patient who is being mechanically ventilated? is the name of the essay that was written by them. In conclusion, handling patients who are manually ventilated and giving medical care to them requires the expertise of nurses who are acquainted with the technological challenges that emerge within a patient-centered strategy. A number of problems related to artificial respiration are more likely to occur and worsen in patients who are already very ill. In manually ventilated patients, the use of ventilator treatment is effective and leads to positive results. This approach includes four interventions: raising the top of the bed, taking sedation intervals, avoiding deep venous thrombosis and peptic ulceration, and reducing the risk of peptic ulceration. There isn't enough solid proof to prove that one therapy approach is better than another in the practise of medical aid. The most basic rule for treating patients who are manually ventilated is to give them meticulous, thorough treatment while using techniques that are supported by the best available scientific data.

[3] The goal of this research is to outline the development of a low-cost, transportable mechanical ventilator for use in crisis zones and other areas with a high death toll but few medical institutions. The ventilator uses a revolving cam arm to squeeze the bag and provide respiration, doing away with the need for a human user required for a typical Ambu bag. An early variant has a 12 V DC electronic motor that is driven by a battery and has a tidal capacity that varies from 0 to 750 mL. Additionally, the tidal volume can be changed up to a limit of 750 cc. Both the tidal amount and the breathing rate have upper bounds under normal conditions. Future iterations of the gadget are expected to include extra features like a configurable inspiration-to-expiration time ratio, pressure release valve, LCD screen, and an indicator that warns the user when there is too much pressure in the system. This sample demonstrated that an automated Ambu bag compression technique can be used to produce medical apparatus that is portable, affordable, and highly effective.

3. BLOCK DIAGRAM



3.1 SYSTEM OVERVIEW

The proposed method comprises of monitoring the patient's breathing. Switches, toggles, a ventilator, and pulse make up the wedding setting. The goal of this endeavour was to create a low-cost ventilator that could be readily obtained and be used in one or two incredibly quick techniques. The created ventilator model ventilator experiment was included in the hardware methods.

3.2 SYSTEM DESIGN

The rapid prototyping technologies used to build a medical ventilator are shown with a schematic of a ventilator that uses an Arduino with blood oxygen sensing. By using a flow metre as an air tank, the artificial physical respire component is connected to the wall oxygen supply.

3.3 SOFTWARE APPLICATION

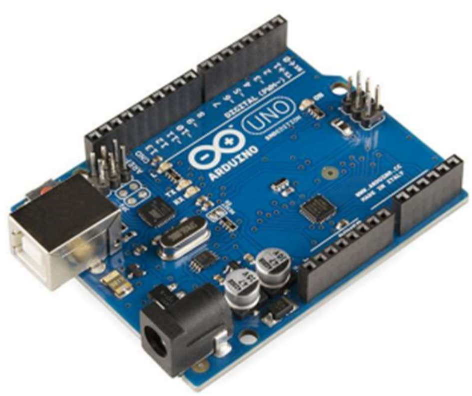
The motor rotates clockwise or anticlockwise in stages when the Arduino is operating, allowing you to check that everything is working as it should.

4. HARDWARE USED

Components used are as follows:

4.1 Arduino Uno

An ATmega328 grounded microprocessor is used in the Arduino Uno. It has 14 digital I/O legs, six of which can be used as PWM labours. The remaining legs include six analogue inputs, a leg for a 16 MHZ demitasse oscillator, a point for a power jack, a port for a USB link, an ISCP title leg, and a restart button. It is capable of being fueled by a battery, an AC-to-DC adapter, or a USB cable. Despite the fact that this chip can handle voltages of up to 20 V, its working voltage is only 5 V. An opensource software application called Arduino IDE can be used to configure this board.

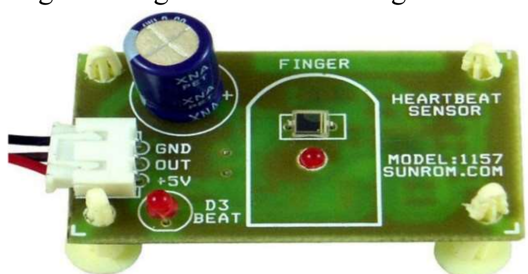


4.2 Pressure Sensor

A instrument for measuring the pressure of gases or liquids could be a pressure gauge. The force required to stop a fluid from growing is expressed as pressure, which is typically expressed in units of force per unit area. Typically, a pressure gauge functions as a transducer, producing an evidence in response to applied pressure. Numerous apps use pressure sensors for monitoring and management on a daily basis. Pressure gauges are frequently categorised according to the pressure ranges, operating temperatures, and most significantly, the type of pressure they detect. Although pressure sensors have varying names depending on what they do, the same technology can also go by several distinct identities.

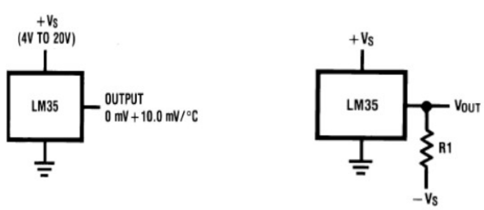
4.3 Heart Beat Sensor

The gadget can display the user's heart rate digitally when their finger is placed on the heart rate monitor. The beat LED will flash in rhythm with each pulse when the heartbeat monitor is working correctly. This digital output can be immediately connected to the microcontroller to enable precise determination of the user's heart rate in beats per minute. (BPM). With each beat, blood movement through the finger modulates the light.



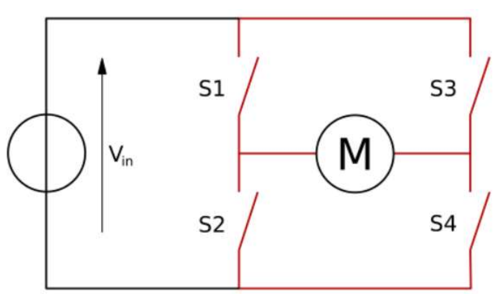
4.3 Temperature Sensor (Lm35)

In order to compare the temperature to the intended temperature that has been written into the device, the temperature must first be read and entered into the microcontroller. This makes it possible to keep an eye on the weather in real time. To use the given value, you must obtain a temperature measurement. As a result, a sensor is needed; for this specific purpose, the LM35 sensor has been chosen. By turning temperatures into electrical impulses, it achieves this.



4.4. H-BRIDGE

Electric DC motors can be controlled in either the forward or backward motion using an H-bridge electrical circuit. In automation, these circuits are utilised quite frequently. The H-bridge can be purchased already put together as an integrated circuit or built from scratch using separate parts.



5. MODEL WORKING

The entire system is switched from alternating current (ac) to direct current using an extended converter. (dc). At that moment, since capacitors act as conduits, we use them for shifting. To provide a constant 5V DC output power, transformers are used. A minimum of 5V DC must be supplied to an Arduino. A liquid crystal monitor (LCD) is used to showcase the message, necessitating a 5V DC power source. In order to operate, Arduino needs a power source, restart circuit, and oscillator device. All of these requirements are satisfied by the Arduino-based DIY ventilator we've been working on, which enables us to lend a helping hand during the epidemic without going over budget. Here, two side push systems and a silicon ventilator bag with DC motors are utilised for horizontal movement. We employ an exchange control and a changeable pot to manage the breath duration and, consequently, the BPM, the driving force behind the innovation. Our gadget monitors the preset vitals of the patent by coupling a blood oxygen sensor with a delicate strain sensor. On a screen, tiny versions of the tracking statistics are displayed. The structure also has a crisis ringer alert that can go off if an anomaly is found. The entire design is controlled by an Arduino regulator in order to get the outcomes we need and save people during COVID pandemics and other critical situations. We can evaluate the patient's health by keeping an eye on vital indicators like temperature and heart rate thanks to the placement of temperature and pulse sensors.

6. EXPERIMENT RESULTS

7. CONCLUSIONS

This essay offers a feasible strategy for dealing with emergencies and pandemics brought on by Covid. This ventilator system, which was created using dispersed manufacturing, is freely downloadable. This study's goal is to give a detailed justification for providing patients with open source motorised ventilators at low expense. This is when the concept was still in its early phases and required more turns. This collection of work will undoubtedly receive more important attention. There will be a considerable amount of additional effort necessary to bring the system up to the degree of complexity needed for therapeutic use. It is a major hotspot for frequent use in poor asset situations as well as for causes related to the ongoing pandemic condition and crises. It also serves as a frequent problem hotspot. In the essay "Ventilator Utilizing Arduino for Covid19," it is suggested that the previously manual operation of the ambu bag be mechanised. Technology has advanced significantly as a result of its beneficial traits, which include low cost and customer ease. Additionally, this strategy may result in less personnel being needed in clinics. By employing this technique, medical workers like nurses and doctors may be able to reduce the number of mistakes they make when performing physical tasks. A menu can be changed at any time to represent the variety of foods that are presently on hand in the kitchen. Using this extremely effective method could greatly increase the effectiveness of the medical system. By addressing all of the issues that are currently faced by both individuals and medical workers, we can conclude that this system will operate correctly and effectively. This article's goal is to give a thorough explanation of how to make patient ventilators that are open source and inexpensive. The planning process is still in its very early stages, so more work needs to be done. This collection of work will undoubtedly continue to gain respect. In the near future, there will be a substantial quantity of additional work required to bring the technology up to medical standards. It is a crucial resource for the current epidemic situation as well as for emergency requirements, and it is also helpful for routine use when there are few resources available.

8. FUTURE SCOPE

The design and construction of an automatic respirator prototype was done for COVID-19 patients with pneumonia. Its tidal capacity fluctuates between 500 and 600 milliliters, and its respiration rate is controlled at 12 per minute. It maintains a constant oxygen supply to the lungs and has an assist setting. Even in its most demanding setting, the device can run for 3.5 hours on a single charge thanks to its very low power usage. An additional element that needs to be investigated is the battery reserve. It is inexpensive, lightweight, movable, and has the capacity to simultaneously charge two DC motors. The product will be made more user-friendly in the following step of production by adding an overpressure warning, an air flow meter, and a pressure sensor. This business has the ability to act as a first assistance system in an emergency. Consider the case of an individual who has a lung condition. While he is being transferred in the emergency vehicle or while he is at the scene of the accident, he really wants to be taken to the clinic as soon as possible. He also needs a ventilator to breathe, so when this happens, our effort is minimal, useful, and likely to succeed in saving a daily life. Our project's cost is reasonable, so selling to affluent people is an easy process for a group of people who are monetarily challenged. We will be able to progress the project in the future by adding a GSM module that will let us communicate with medical personnel even though we are going in an emergency car. We will also be able to include a camera so that we can stay in direct contact with medical professionals so that we can deliver better first aid care while we are traveling, as well as a blood pressure sensor instead of a pressure sensor to achieve greater precision.

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