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FABRICATION OF LOW-COST AUTOMATIC WITH KEEP TRACK OF PATIENT

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***Abstract*— A ventilator is a machine that assists you in taking breaths if you are unable to do so on your own. Your doctor may refer to it as a "mechanical ventilator." It is also known as a "breathing machine" or "respirator." A respirator is a mask that medical personnel wear when caring for someone who has a contagious illness. A ventilator is a bedside machine that connects to your airways via tubes. When you normally inhale and exhale air, your lungs take in oxygen for your cells and expel carbon dioxide. COVID-19 can cause airway inflammation and effectively drown your lungs in fluids. A ventilator mechanically aids in the delivery of oxygen to your body. Air enters your mouth and travels down your windpipe via a tube. The ventilator may also breathe for you, or you may do it on your own. The ventilator can be programmed to take a certain number of breaths for you per minute. Your doctor may also decide to programme the ventilator to activate only when you require assistance. In this case, if you haven't taken a breath in a certain amount of time, the machine will automatically blow air into your lungs. The breathing tube may be uncomfortable. You cannot eat or speak while it is connected. Some people on ventilators may be unable to eat or drink normally. If this is the case, you'll need to get your nutrients from somewhere else. If that's the case, you'll need to get your nutrients through an IV, which is a needle inserted into one of your veins.**

***Keywords—Ventilator, patient, oxygen, doctor, temperature sensor, mobile app, oxygen sensor*.**

I. INTRODUCTION

Adults and children have normal oxygen saturation (spo2) levels ranging from 95% to 100%. Oxygen concentrations between 91% and 95% may indicate a medical problem. People in this situation should contact their healthcare provider. When your oxygen saturation falls to between 80% and 85%, your brain may be affected by the lack of oxygen. You might also notice changes in your vision. People over the age of 70 may have an oxygen level closer to 95%, which is considered normal for their age group. Hypoxia is defined as a low level of oxygen in the body. The consequences of this scarcity are disastrous, particularly in impoverished areas. Even well-equipped hospitals have developed protocols for sharing the same ventilator between two patients, which is a dubious practice because it opens the door to not only sharing bacterial and viral load among patients, but also causing unintended harm. To address the global problem of ventilator scarcity, researchers have launched an initiative to develop low-cost, open-source ventilators.

This paper helps with this initiative. Electrum, on the other hand, appears to be caused by inadequate ventilation; inadequate ventilation allows alveolar units to collapse and reopen in a repetitive, sequential movement, which may also cause injury. Most researchers advise clinicians to use mechanical ventilation with positive end-expiratory pressure to avoid electrum (PEEP). PEEP has become a common tool for preventing electrum, as evidenced by the seminal results. However, using PEEP to reduce lung injury is debatable because recent research indicates that PEEP causes other problems such as lung inflammation and formation.

II. OBJECTIVE

Authors have launched an initiative to produce low-cost, open-source ventilators with patient monitoring in order to address the global problem of ventilator shortage. This paper contributes to the success of this initiative. A mechanical ventilator forces air into the patient's lungs to assist them in breathing when it is difficult or impossible for them to do so on their own. Mechanical ventilation improves lung function until it is no longer necessary. Relieving respiratory discomfort decreasing the work of breathing, improving gas exchange (oxygen/carbon dioxide), healing the lung, reversing respiratory muscle fatigue, and allowing the patient to rest and recover. To keep track of the patient's vital signs, such as temperature and pulse rate.

III. RESEARCH OBJECTIVES

- One option for identifying patients faster while minimizing the gap between the patient and a hospital is to use sensors that can be worn on the body
- Doctor with timely insights into various health parameters.
- A health monitoring system is an important step in determining whether or not a visit to a specialist is necessary for his or her symptoms.

IV. PROPOSED SYTEM

We have a Health Monitoring System and a Mechanical Ventilator in this proposed model. The health monitoring system consists of a few wireless sensors such as a temperature sensor, which is used to measure the body temperature, and a blood oxygen level sensor, which is a noninvasive device that estimates the amount of oxygen in your blood. It accomplishes this by directing infrared light into the capillaries of your finger, toe, or earlobe. And a pulse sensor is used to measure the heart rate. All of this sensor data represents the patient's health condition and is stored in a server so that anyone can access it. If there is a problem with the heart rate and blood oxygen level, we can activate the mechanical ventilator using the Blink Mobile application.

V. METHODOLOGY AND DESIGN

To identify patients faster while minimizing the distance between the patient and the hospital, sensors that can be worn on the body could monitor the person's health status and provide the user, just like the doctor, with timely insights into various health parameters. Each patient is unique, so utilizing the patients' anamnesis in addition to the measurements provided by this Health monitoring system is a necessary step in determining whether or not a visit to the specialist is required for his or her symptoms. Virus symptoms include fever, exhaustion, shortness of breath, and so on. In this section, we will discuss the covid19 patient's health monitoring system.

A. Block Daigram

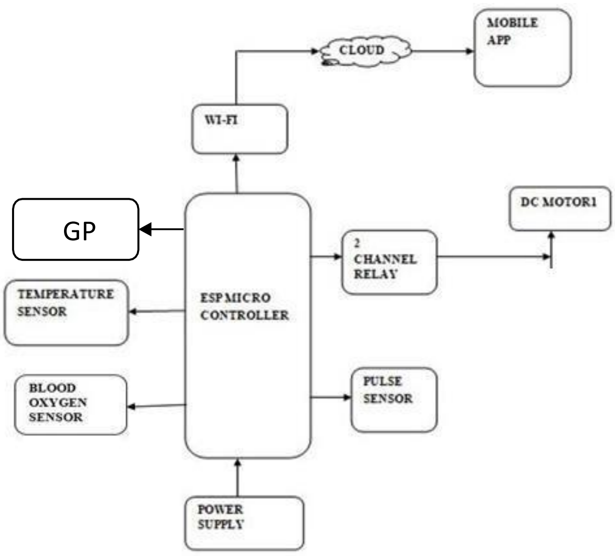

Figure 1: Block Diagram

A. ESP32 Microcontroller: The ESP32 is a low-cost, low-power Microcontroller with Wi-Fi and Bluetooth built in. It is the successor to the ESP8266, another low-cost Wi-Fi microchip with severely limited functionality. It includes an integrated antenna, as well as a power amplifier, low-noise amplifiers, filters, and a power management module. The entire solution occupies the smallest amount of printed circuit board space. This board is used with 2.4 GHz dual-mode Wi-Fi and Bluetooth chips from TSMC 40nm low power technology, which has the best power and RF properties and is safe, reliable, and scalable to a wide range of applications.

B. Channel Relay Module: Relays are electronic and electromechanical switches that are used to close and open circuits. It regulates the opening and closing of an electronic circuit's circuit contacts. When the relay contact is open (NO), the relay is not energized. However, if it is closed (NC), the relay does not have any energy. Given the closed contact, 1ize. When energy (electricity or charge) is supplied, however, the states are prone to change. The relays have two primary functions: high voltage application and low voltage application.

C. LM35 Temperature Sensor: Temperature sensors that are directly connected to microprocessor input can communicate with microprocessors in a direct and reliable manner. The sensor unit can effectively communicate with low-cost processors without the use of A/D converters. The LM35 is an example of a temperature sensor. The LM35 series are precision integrated-circuit temperature sensors with output voltages that are linearly proportional to the temperature in Celsius. The LM35 operates between -55 and +120 degrees Celsius.

D. Pulse Sensor: An alternate name of this sensor is heartbeat sensor or heart rate sensor. The working of this sensor can be done by connecting it from the fingertip or human ear to Arduino board. So that heart rate can be easily calculated.

E. Blood Oxygen Sensor: A pulse oximeter (also known as a pulse ox) is a noninvasive device that measures the amount of oxygen in your blood. It accomplishes this by directing infrared light into the capillaries of your finger, toe, or earlobe. The amount of light reflected off the gases is then measured. A reading, known as the SpO2 level, indicates what percentage of your blood is saturated. The error window for this test is 2%. That means the reading could be up to 2% higher or lower than your actual blood oxygen level.

F. GPS: The number of satellites in the constellation is represented by the space segment. It consists of 29 satellites that circle the earth every 12 hours at an altitude of 12,000 miles. The space segment's function is to route/navigate signals as well as to store and retransmit the route/navigation message sent by the control segment. The satellites' highly stable atomic clocks control these transmissions.

VI. IMPLEMENTATION

Blynk was created with the Internet of Things in mind. It can control hardware remotely, display sensor data, store data, visualize it, and do a variety of other cool things.

The platform is made up of three major components: Blynk App enables you to create amazing interfaces for your projects by utilizing the various widgets we provide. Blynk Server is in charge of all communications between the Smartphone and the hardware. You can use our Blynk Cloud or set up your own private Blynk server. Its open source, can handle thousands of devices, and can even run on a Raspberry Pi. Blynk Libraries enable communication with the server and process all incoming and outgoing commands for all popular hardware platforms.

The breathing circuit includes a 0.5-PSI (35 cm H2O) pressure relief valve to limit airway pressures above 35 cm H2O, as well as a negative pressure relief valve to allow for spontaneous room air inspiration at any point during the respiratory cycle, preventing negative pressure injury (if the assist-control [AC] portion fails). A pressure transducer continuously measures airway pressure and displays a green light emitting diode (LED) for pressures between 0 and 20 cm H2O, an amber LED for pressures between 20 and 30 cm H2O, and a red LED for pressure.

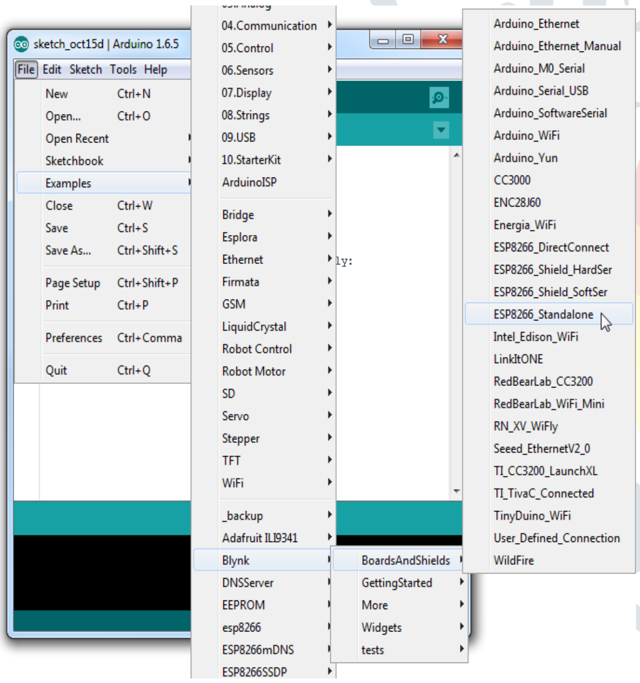

Figure 2: Arduino Setup

The inspiratory valve is closed after inspiration, and the expiratory valve is opened. The expiratory valve opens via a positive end-expiratory pressure (PEEP) valve, allowing the patient to receive PEEP (0-20 cm H2O). This device's tidal volume is adjusted by adding or removing expansion chambers. Each chamber adds approximately 45 mL of tidal volume (Table 1). The attached controls are used to set the respiratory rate and inspiratory time. Furthermore, if the patient is breathing spontaneously, the ventilator can detect a respiratory effort by measuring decreased airway pressure and augment by delivering a breath. Controls attached to the microcontroller are used to adjust sensitivity to the patient's inspiratory effort.

TABLE 1. - Ranges of Values for Performance of the Ventilator

Parameter	Range
Respiratory rate	4–30 RPM
Inspiratory time	0.5–7.5 s
Positive end-expiratory pressure	0–20 cm H_2O
Max plateau pressure	35 cm H_2O
Tidal volume	350–800 mL
Fio_2	21–100%

Table 1: Ranges of values for Performance of the ventilator

VII. MEASUREMENTS AND RESULTS

The ALS 5000 was used to simulate human lung function (IngMar Medical, Pittsburg, PA). Compliance and resistance testing were carried out in a similar manner to that described by Cristiano et al (11). The Portsmouth Ventilator with pressure and volume control was compared to a commercially available ventilator (Dräger Apollo, Dräger, Lubeck, Germany). Three preliminary trials with the following lung parameters were completed:

- The resistance is 20 cm H2O/L/s and the compliance is 60 mL/cm H2O.
- The resistance is 12 cm H2O/L/s, and the compliance is 50 mL/cm H2O.
- The resistance is 10 cm H2O/L/s, and the compliance is 40 mL/cm H2O.

Time (min)	Respiratory Rate (Beats/min)	Tidal Volume (mL)	Number of Expansions	Positive End-Expiratory Pressure (cm H_2O)	pH
Spontaneous ventilation					
0	20	600	–	0	7.51
Conventional ventilator					
15	12	500	–	0	7.49
30	18	500	–	0	7.51
45	18	500	–	0	7.52
60	18	500	–	0	7.5

Table 2: Measures of ventilation during testing

Based on existing literature for lung respiratory parameters, we further tested the device with varying degrees of airway resistance and lung compliance to simulate severe ARDS and chronic obstructive pulmonary disease (12–15).

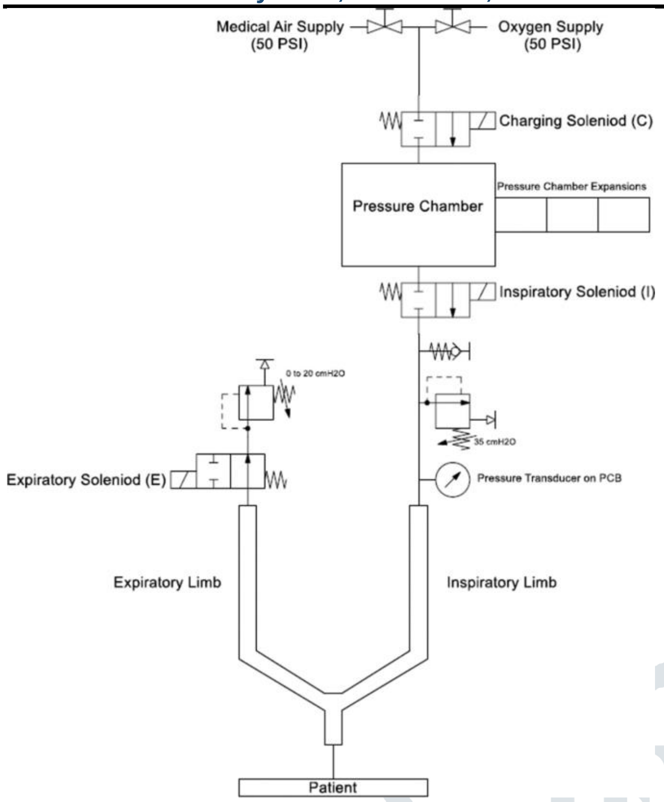

Figure 3: Mechanical Ventilator System Diagram

We tested compliance and resistance extremes to further validate the range of path physiologic states that the ventilator can safely operate in. This included extremely low compliance with high resistance, extremely high compliance with low resistance, and a variety of high/low compliance and resistance combinations.

Other examples of ventilator testing were included based on these(Table 2), we performed testing at resistances of 5 cm H2O/L/s and compliance of 100 mL/cm H2O, resistances of 20 cm H2O/L/s and compliance of 30 mL/cm H2O (ARDS), and resistances of 50 cm H2O/L/s and compliance of 100 mL/cm H2O (obstruction) (16). We used an extra protocol to compare resistances of 5, 10, and 20 cm H2O with compliances of 30, 70, and 120 mL/cm H2O. (17). Overall, the ventilator performed similarly to existing ventilators across a wide range of pulmonary mechanics. PEEP and tidal volume changes had no effect on predicted tidal volume delivery. Despite changes in airway resistance and compliance, the ventilator maintained adequate tidal volume breaths.

CONCLUSION

Resources for healthcare may be scarce as a result of the present international COVID-19 outbreak. The possibility of having insufficient ventilators is among those that cause the most worry. In the event of a spike in demand, a dependable ventilator manufactured from readily available components may be easy to construct and run. Similar to how it could possibly offer a ventilator solution in other resource-constrained contexts, it is quite inexpensive (around $250). Although the Portsmouth Ventilator has several drawbacks when compared to contemporary ventilators, we think it offers a secure, efficient, and quickly scalable alternative ventilation solution.

FUTURE ENHANCEMENT

Because the majority of recently mass-produced ventilators are regarded as emergency ventilators, Global Data is optimistic about the market for ventilators in the future. These less complex ventilators are unable to produce the precise air delivery needed for ARDS patients or offer the decision-making tools necessary for lung-protective ventilation. Advanced ICU ventilators that are made for invasive ventilation of seriously ill patients during their stay in the ICU are still in demand in some areas. The pandemic also has a favourable effect on the market for general respiratory care infrastructure. In the upcoming years, nations will continue to accumulate stocks of ICU ventilators and related capital equipment, such as humidifiers, oxygen delivery systems, and disposables.

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