VENTILATOR USING ARDUINO WITH BLOOD OXYGEN SENSOR

Ms.S.Rajalakshmi
Department of Electronics and Communication,
Sri Sairam Engineering College,
Chennai, India
rajalakshmi.ece@sairam.edu.in

S.Kavipriyabai
Department of Electronics and Communication,
Sri Sairam Engineering College,
Chennai, India
e8ec171@sairamtap.edu.in

S. Vinodhini
Department of Electronics and Communication,
Sri Sairam Engineering College,
Chennai, India
e8ec160@sairamtap.edu.in

S.Krithika
Department of Electronics and Communication,
Sri Sairam Engineering College,
Chennai, India
e8ec114@sairam.edu.in

2022 International Conference on Communication, Computing and Internet of Things (IC3IoT) | 978-1-6654-7995-0/22/$31.00 ©2022 IEEE | DOI: 10.1109/IC3IOT53935.2022.9767888

Abstract **- The human lungs use the again stress generated through the contractile motion of the diaphragm to inhale and breathe air. The ventilator uses reverse motion to inflate the lungs with pump motion. The ventilation mechanism should be able to provide 1030 breaths per minute and accommodate two sets of increments. The Ventilator ought to additionally be capable of alter the quantity of air this is driven into the lungs with every breath. Last but not least, so far it has been set to adjust the duration of the inhalation-exhalation ratio. In either case, the ventilator should be able to monitor the patient's blood oxygen levels and exhaled lung pressure while avoiding gauge / high pressure. Designed and developed using Arduino here, the ventilator meets all of these requirements, creating a reliable and affordable ventilator to help during a pandemic. Here, the ventilator bag driven by a stepper motor. Our system uses a blood oxygen sensor along with a heart rate sensor (KY039) and a temperature sensor (18B20) to monitor the patient's required vital signs and display them on a mini LCD screen. The uses of air purifier to purify the air, as normal ambient air affects the patient. Whenever a patient faces a dangerous position, a buzzer sounds to notify a nearby caretaker. The buzzer is attached to the Arduino with a relay to boom the voltage. Patient records is uploaded to the cloud through an IOT modem. The whole machine is managed with the aid of using the Arduino controller to get the preferred result.**

Keywords **– mechanical ventilator mechanism, ventilator unit, heartbeat sensor, blood oxygen sensor, temperature sensor, air purification, IOT modem.**

INTRODUCTION

In recent months, The demand for ventilators to treat COVID 19 patients has surged in recent months, and there is currently a global shortage of ventilators. The outcomes of this flaw are devastating, specially in underprivileged areas[1]. Even a well-resourced hospital has developed a protocol for two patients to share the same ventilator(figure 1).This is a questionable practise since it not only spreads the load of bacteria and viruses among patients, but it also puts patients at risk of damage. Researchers have initiated an endeavour to manufacture cost-effective open-source ventilators in an effort to combat the global shortage of ventilators. This paper is a part of that effort. The basic model of our ventilator unit is determined by Figure 1.[11].

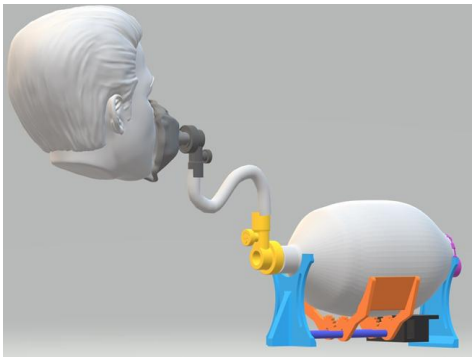

Figure 1: Basic Model

BLOCK DIAGRAM

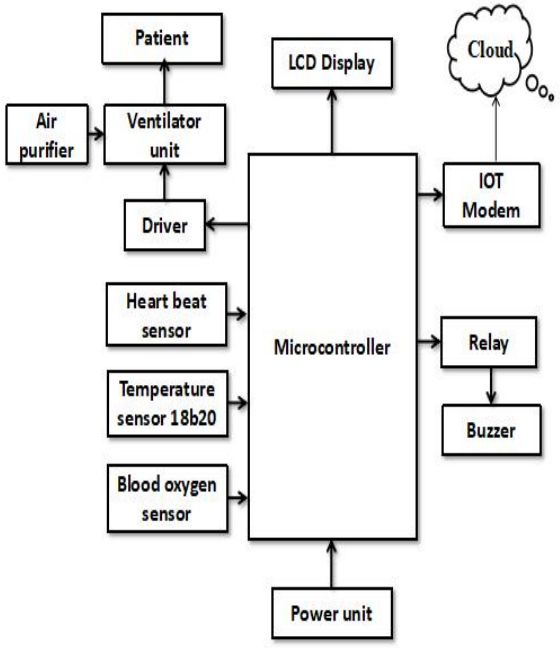

Figure 2: Block diagram

HEARTBEAT SENSOR (KY039 MODULE)

The sound of a person's heartbeat is the contraction or expansion of the valves of his or her coronary coronary heart as they move blood from one location to another. The coronary heart beat fee is the number of times the coronary heart beats per minute (BPM), and the heart beat is the pulse of the coronary heart that may be felt in any artery close to the skin.

• Manual Method: A heartbeat can be manually tested by checking one's pulses at the wrist (radial pulse) and the neck (neck pulse) (carotid pulse). The method is placing the two arms (index and middle finger) at the wrist (or neck beneath the windpipe) and counting the number of pulses for 30 seconds, then multiplying that number by two to get the heart beat rate. However, only minor tension should be applied, and arms should be moved up and down until the heart beat is felt.•

Using a sensor: Heart beat can be detected primarily based on variations in optical energy as light is dispersed or absorbed at some point in its path through the blood when the coronary coronary heart beat changes.

PRINCIPLE OF HEARTBEAT SENSOR

The heartbeat sensor (Figure 3) is entirely based on the picture phlethysmography principle. It measures the variation in blood flow through any organ of the body, which causes a variation in the mild depth through that organ (a vascular vicinity). The timing of the pulses is especially essential in programmes that monitor coronary heart pulse rate. The float of blood volume is determined by the rate of coronary heart pulses, and because light is absorbed by blood, the sign pulses are equal to the coronary heart beat pulses.

Photophlethysmography is divided into several types:

Light released from the light emitting tool is transferred through any vascular region of the frame, such as the earlobe, and acquired by way of the detector.

Reflection: The light emitted by the mild emitting device is pondered by the way the spaces are laid out. How a Heartbeat Sensor Works A small emitting diode and a detector, such as a small detecting resistor or a photodiode, make up the basic heartbeat sensor. The coronary coronary heart beat pulses cause a change in the flow of blood to bright areas of the body.

When a tissue is lit by a light source, such as light emitted by an LED, it either reflects (a finger tissue) or transmits the light (earlobe). Some of the light is absorbed via the blood, while the transmitted or contemplated light is acquired through the use of a light detector. The amount of mild absorbed in that tissue is determined by the blood volume. The detector's output is an electrical signal proportional to the rate of coronary coronary heart pulse.

This sign is actually a DC sign in terms of tissue and blood extent, with an AC component superimposed over the DC sign that is synchronised with the coronary heart beat and results from pulsatile changes in arterial blood extent. As a result, the first step is to identify that AC component, which is critical.

The output from the detector is first filtered using a 2degree HP-LP circuit, and then turned into virtual pulses using a comparator circuit or a simple ADC. The virtual pulses are sent to a microcontroller, which uses the calculation BPM (Beats per minute) to calculate the warmth beat rate. = 60*f

Where f is the heart beat frequency

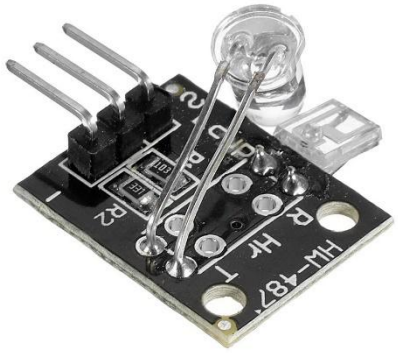

Figure 3: KY039 MODULE

Pin 1 is for delivering electricity to the LED.

Pins 2 and 3 are both grounded. The output is pin four. Pin 1 is also the permit pin, and pulling it too hard turns the LED on, causing the sensor to stop operating. It's built into a wearable tool that can be worn on the wrist, and the output may be sent wirelessly (through Bluetooth) to a laptop for processing.

Create your own Heartbeat Sensor System with this app.

A fundamental Heartbeat Sensor gadget also may be produced the utilisation of fundamental additions like a ldr, comparator IC LM358 and a Microcontroller as mentioned underneath.

As previously stated in relation to the concept of coronary coronary heart beat sensor, when the finger or earlobe tissue is lighted with a moderate supply, the moderate is communicated once it has been modulated, i.e. something is absorbed through the blood and the remainder is transmitted. The modulated moderate is received by the moderate detector in this manner.

As a mild detector, a Light Dependant Resistor (LDR) is utilised. It is based on the idea that when a resistor experiences a minor drop in voltage, its resistance changes. The resistance lessens as the mild depth increases. As a result, the voltage drop across the resistor is reduced.

In this case, a comparator is utilised to compare the LDR output voltage to the brink voltage. The threshold voltage is the voltage drop across the LDR at the same time as the mild with stable depth, from the moderate deliver, falls directly on it.

The non-inverting terminal of the comparator LM358 is connected to the LDR, while the inverting terminal is connected to the ability divider association, which is close to the edge voltage. The depth of the mild is reduced when a

human tissue is lit using the mild supply[7]. The resistance will grow when the mild depth decreases at the LDR, and as a result, the voltage drop will increase. A good judgement excessive sign is advanced on the comparator output when the voltage drops throughout the LDR or the non-inverting enter surpasses the inverting enter, and a good judgement low output is advanced when the voltage drop is smaller. As a result, the output is a series of pulses.
These pulses may be transmitted to the Microcontroller, which then processes the data to obtain the coronary heart beat rate, which is then shown on the Microcontroller's display.

TEMPERATURE SENSOR - 18B20

The DS18B20 is a type of temperature sensor (Figure 4) that provides 9 to 12 bit temperature values. These values indicate the temperature of a particular device[10].

Figure 4: Temperature sensor - DS18B20

This sensor can communicate over a single-line bus protocol that uses a data line to communicate with an internal microprocessor. Also, this sensor is powered directly from the data line, so no external power supply is required. Applications for the DS18B20 temperature sensor include industrial equipment, consumer products, heat sensitive equipment, thermostat control, and thermometers.

BLOOD OXYGEN SENSOR

A pulse oximeter (pulse oximeter-figure 5) is a non-invasive device that estimates the amount of oxygen in the blood. This is done by sending infrared rays to the capillaries of the fingers, toes, or ear lobes. Then measure the amount of light reflected from the gas[8].
. The reading indicates what percentage of the blood is saturated. This is called a pO2measurement. This check has a 2 percentage mistakes window. That is, measurements may be up to two percentage above or beneath actual blood oxygen levels. This check is much less accurate, however very smooth for docs to perform. Therefore, doctors agree with it is able to be study immediately. The oxygen saturation test is used to determine the amount of oxygen in the blood. When utilising blood gas, it is sometimes referred to as PaO2 and when using pulsed oxygen, it is referred to as O2 saturation (SpO2). These suggestions will assist you in comprehending the consequences of the findings.

Normal: In healthy lungs, normal ABG oxygen levels are 80 to 100 millimetres of mercury (mm Hg). A pulse oximeter's measurement of blood oxygen concentration (SpO2) is usually between 95 and 100 percent.

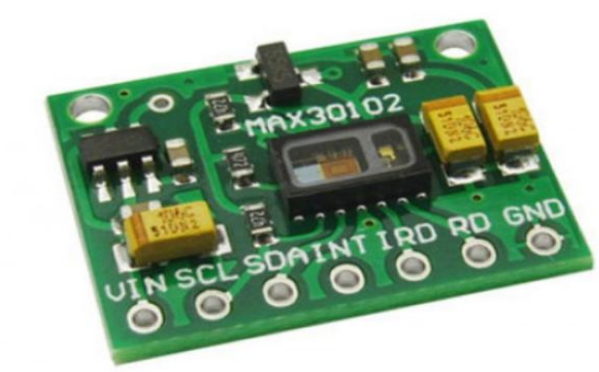

Figure 5: Blood oxygen sensor

However, those levels might not observe to COPD or different lung conditions. Your physician will inform you what's regular to your precise condition. For example, it isn't always unusual for humans with extreme COPD to keep pulse oximeter (SpO2) readings at 88-ninety two percent.
Subnormal:Hypoxemia is defined as a lack of oxygen in the blood at normal levels.
Hypoxemia is a common cause of worry. The more oxygen is depleted, the more severe the hypoxemia. This might cause headaches in the tissues and organs of the frame. PaO2 less than 80 mmHg, or pulse oximeter (SpO2) underneath 95% is typically taken into consideration low. It is critical to recognize what's regular, specifically when you have persistent lung disease.
Your physician can suggest perfect oxygen degrees[7].
Above regular: Oxygen degrees are tough to be too excessive if respiration isn't always assisted. Most often, individuals who use oxygen dietary supplements revel in excessive degrees of oxygen. These may be discovered at ABG.

BUZZER

The buzzer (figure 6) is a sounding device that might convert audio signs into sound signs. It is typically powered thru manner of way of DC voltage. It is extensively applied in alarms, computers, printers and distinctive virtual products as sound devices.

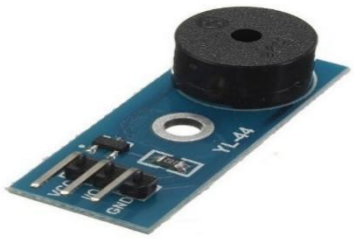

Figure 6: Buzzer

RELAY

The relay (figure 7) is an electric switch. It consists of a row of input terminals and a row of operating contact terminals for one or more control signals. A switch can have any number of contacts in multiple contact types. B. There are no contacts, NC contacts, or a combination.

The relays are used when you need to control circuits with independent low current signals, or when you need to control multiple circuits with a single signal[5].

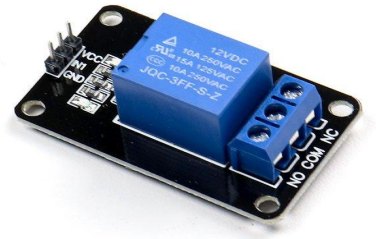

Figure 7: Relay

The relay operates on the principle of electromagnetic induction. When an electric current is passed through an electromagnet, a magnetic field is generated around the electromagnet. ... used to carry DC current through the load. In relays, the copper coil and iron core act as electromagnets.

STEPPER MOTOR

A brushless DC electric driven stepper motor (Figure 8) is a brushless DC electric powered motor that splits one revolution into numerous similar steps[6]. The function of the motor may be informed to transport and prevent at any of those steps with out a role sensor (open loop controller) for feedback, so long as the motor is torque and the velocity is adequate for the software increase.

Figure 8: Stepper Motor

The basic operating principle of a stepping motor is as follows. By energizing one or more stator phases, the current flowing through the coil creates a magnetic field that aligns the rotor with this magnetic field. By supplying different phases one after another, the rotor can be rotated by a certain amount to reach the desired end position.

IOT MODEM

The modem may be powered from a preferred 12V strength deliver or from a single-mobileular lithium-ion battery withinside the voltage variety of 4V to 14V. The board has TTL inputs / outputs (with degree shifter), UART, and USB connectors, permitting customers to connect with MCUs, PCs to switch data / ship AT instructions and replace module firmware. There is likewise an choice for the consumer to interchange among RS232 and UART (TTL) the usage of jumper settings. Modems may be without difficulty accelerated and adapted. Modem datasheets are to be had withinside the UKC app (Android and iOS). Or test the barcode in your modem to get the app. Intubation till a nation wherein it is able to run, and air flow from the nostril and mouth of the affected person and squeeze the pouch.

Figure 9: IOT modem

Using this IOT modem(Figure 9) we can directly access the internet and uploading the collected data to the cloud. Thus, the data of the patient saved for the particular day. The previous day data also been collected in the cloud using this modem.

VENTILATOR UNIT

A bag valve mask (BVM) or Ambu bag (Figure 10) is a self-inflating bag that is used to give ventilation to those who are unable to breathe normally. The BVM consists of a rebreathing valve and a face mask[2]. The opposite end of the bag is attached to an oxygen source. The mask is manually pressed against the face. Squeeze the pouch to ventilate through the patient's nose and mouth until intubation is possible. .

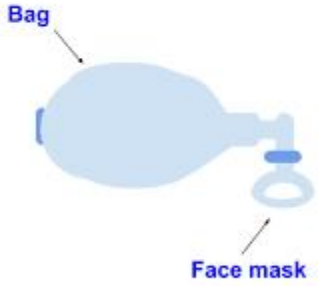

Figure 10: ventilator bag

For emergency responders, BVM ventilation is a critical ability. BVM ventilation is a technique for restoring spontaneous breathing in people who are unable to do so [9]. In most cases, the BVM is an emergency procedure performed to fill the time it takes for the intubation to complete.

Figure 11: ventilator bag model

CONCLUSION REMARKS

Since the outbreak of the -COVID19 pandemic, researchers have worked to help society deal with some of the pandemic's challenges. In a latest initiative , the writer specializes in the manufacturing of low-price open supply ventilators. The motivation comes from the worldwide scarcity of ventilators with inside the remedy of sufferers with COVID 19. Ventilators preserve significantly sick sufferers alive[5]. This paper contributes to that initiative. This paper describes the shape of a functional, low-price open supply ventilator. Our contribution to this problem is geared toward mitigating the consequences of this worldwide ventilator scarcity. This is a stunning and unlucky occasion that influences critically deprived areas. This challenge gives a numerical approach that lets in real-time tracking of a patient`s lung situation as wholesome or bad (see segment 3.2 of the context). This beneficial but easy numerical approach opens up opportunities for utility to different ventilators. In summary, this paper contributes to each theoretical and sensible aspects. The buzzer may be included into this mission the usage of both an alarm display screen or a speaker used to alert the clinician while stress reaches a positive threshold. At the equal time, the ventilator calls a few particular thresholds.

REFERENCES

[1]. Ranney,M.L; Griffeth, V; Jha, A.K. Critical Supply Shortages—The Need for Ventilators and Personal Protective Equipment during the Covid-19Pandemic.N.Engl.J.Med,2020.

[2]. Pons-Òdena, M.; Valls, A.; Grifols, J.; Farré, R.; Cambra Lasosa, F.J.; Rubin, B.K. COVID-19 and respiratory support devices. Paediatr. Respir. Rev. 2020.

[3]. Iyengar, K.; Bahl, S.; Raju, V.; Vaish, A. Challenges and solutions in meeting up the urgent requirement of ventilators for COVID-19 patients. Diabetes Metab. Syndr. Clin. Res,2020.

[4]. Ferrante, L.; Fearnside, P.M. Protect Indigenous peoples from COVID-19. Science 2020.

[5]. Taylor, L. The pandemic's new centre. New Sci. 2020, 246, 12–13.

[6]. Fitzgerald, D.A.; Maclean, J.; Rubin, B.K. COVID-19 pandemic: Impact on children, families and the future. Paediatr. Respir. Rev. 2020, 35, 1–2.

[7]. Baqui, P.; Bica, I.; Marra, V.; Ercole, A.; van der Schaar, M. Ethnic and regional variations in hospital mortality from COVID-19 in Brazil: A cross-sectional observational study. Lancet Glob. Health 2020, 8, e1018–e1026.

[8]. Levin, M.A.; Shah, A.; Shah, R.; Kane, E.; Zhou, G.; Eisenkraft, J.B.; Chen, M.D. Differential Ventilation Using Flow Control Valves as a Potential Bridge to Full Ventilatory Support during the COVID-19 Crisis: From Bench to Bedside. medRxiv J. 2020.

[9]. Chase, J.G.; Chiew, Y.S.; Lambermont, B.; Morimont, P.; Shaw, G.M.; Desaive, T. Safe doubling of ventilator capacity: A last resort proposal for last resorts. Crit. Care 2020.

[10]. Herrmann, J.; Fonseca da Cruz, A.; Hawley, M.L.; Branson, R.D.; Kaczka, D.W. Shared Ventilation in the Era of COVID-19: A Theoretical Consideration of the Dangers and Potential Solutions. Respir. Care 2020.

[11]. Low-Cost, Open-Source Mechanical Ventilator with Pulmonary Monitoring for COVID-19 Patients Leonardo Acho 1, Alessandro N. Vargas 2, and Gisela Pujol-Vázquez 1,2020