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Health Monitoring System with Ventilator Using Arduino

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ABSTRACT

This paper refers to the problems faced of shortage of ventilators and comes with a reliable and homemade ventilator which is easy to use. During the pandemic year's like covid 2019 diseases arrived and during this we were out of oxygen ventilators and we lost many lives. To overcome this situation, we built homemade electronic machine using Arduino which works like oxygen ventilator. The ventilator develop here is somehow similar to the ventilator used today at various hospital's ICU, but comes with low cost and are made for only emergency purposes. But several features will clearly separate them from the current generation of ventilators as things changes with time. There will be integration with other bedside technology and developed according to new era. After some decades, all ICUs will have electronic charting may be integrated with several sensors and can be monitored or controlled with several types of microprocessors, where data from all sensors will be transmitted to electronic documentation systems or may use cloud computing sort technologies for further references. As a result, we developed ventilators that are able to be integrated electronically with mechanical actuation. And to avoid overall problems faced by users or patients.

Keywords : Automatic Ventilator, Pulse sensor, Respiration.

I. INTRODUCTION

A ventilator is a machine or a sort of mechatronic device here that provides mechanical ventilation by moving breathable air into and out of the lungs, to deliver breaths in form of air to a patient who is physically unable to breathe, or breathing inefficiently [1]. From last few years there was a tremendous shortage of oxygen ventilators and also of oxygen. The countries like Africa suffered a lot due to lack of ventilators and even some developed hospitals have developed protocols to use same oxygen ventilators for 2 or more patients [2]. Ventilators are computerized microprocessor-controlled machines using proper methods, but patients can also be ventilated with a simple, hand- operated bag valve mask and it is often called as ambu bag in medical terms. Ventilators are chiefly used in intensive-care medicine, home care, and emergency medicine (as standalone units) and in anesthesiology (as a component of an anesthesia machine) [3]. Ventilators have also been used on some patients diagnosed with

COVID-19 during the 2020 pandemic. This is only for the most severe cases. The majority of people diagnosed with COVID-19 will experience mild symptoms. A ventilator can save your life. However, like other treatments, it can sometimes cause side effects. This is more common if you use a ventilator for a long time.

II. METHODS AND MATERIAL

The ventilator here designed is in the sense that it can be operated in only emergency purposes and if needed for longer duration then it must be used under doctor's prescription and guidelines [4].Ventilator mainly works on the conditions as described: Respiratory frequency of patient, that can be obtained by Max30102 sensor which provide BPM and Spo2 level. Ratio of inspiration and expiration, that can be controlled by compression and expansion of ambu bag. Air volume being supplied to patient, it can be controlled through the valves of oxygen cylinders. To keep it simple and easy to use we designed the mechanism in such a way that everyone can monitored and control it with some knowledge only. It consists of only 1 knob that controls the mechanism of ambu bag's compression and expansion.

Ventilators and are computerized microprocessor-controlled machines, but patients can also be ventilated with a simple, hand- operated bag valve mask here we use ambu bag as a reference and a mask which is wearable by the patient. Ventilators are used mainly in intensive-care medicine/hospitals, home care, and emergency medicine as standalone units and may also play vital role in anesthesiology as a component of an anesthesia device.

A ventilator is an electromechanical or a mechatronics branch related device in made using expert engineering (or, possibly, completely mechanical) device designed to provide all or part of the effort and comfort to patient who is unable to do proper natural respiration process in which patient required to move gas into and out of a person's lungs [1].

The exchange in the lungs occurs only in the smallest airways and the alveoli, tiny gas-exchange sacs and oxygen as a main reference that is provided using an oxygen cylinder [3].To build homemade ventilator as per our requirements we have designed a microcontroller-based system (Arduino) and many other small electronics devices as they play a vital role in medical issues. Introduction to Arduino: Arduino is an open-source physical computing microcontroller platform based on simple input/output board and an integrated development environment that implements the Processing language.

Arduino can be used to develop codes that can be assemble various sort of unique features in many sectors interactive objects or can be connected to software on your computer. It can be used for number of applications in electronics and other sectors as required. The boards can be assembled by hand or purchased preassembled if needed; the open-source IDE (Integrated Development Environment) can be downloaded for free. Arduino is an architecture that combines Atmel microcontroller family with all essential pins and plugs with supply and a USB type A connector to upload various types of codes to perform numerous of application. It is low power microcontroller that uses 12V DC power supply or can simply be powered using a USB type A directly to PC or a laptop.

Further all coding is done using cable and you may monitor all charts and details along with all your laptop so you may observe and controls the local controls using the knobs, which will make your task easier.

III. FLOWCHART

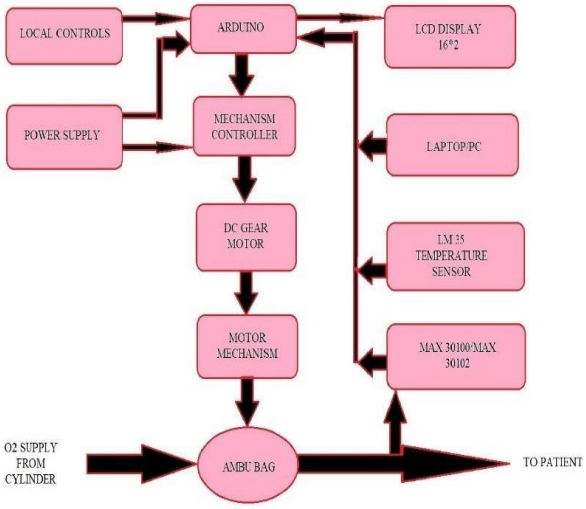

Fig.1. Flowchart

Arduino is the basic building block of ventilator. All others devices are based on it like all sensors and mechanism works on it as per requirement. Local controls consist of all knobs and controls of the ventilator through which we can set the ventilator to acquire the desired output. All the components are powered with a 12V 2A power supply to work efficiently.

All the compression and expansion of the ambu bag are done with the help of dc gear motor and the motor is controlled over knobs with all the parameters specified. We can also use servo motor for the working of the mechanism but instead servo the dc motors performs well as they are able to carry the load of the mechanism. Dc gear motor bears and tolerated more load in comparison with normal servo motor.

The mechanism is made in such a way that the flow of the can be made easily and is in controllable manner. The ambu bag plays vital role in overall all the mechanism as it has all the oxygen and outlet which are supposed to provide proper intake to the patient. Max 30100/30102 provides the oxygen and BPM readings of the patient which can be monitored by the user and adjust all the knobs according to it. We can monitor all the readings using the 16*2 LCD display. The readings on the LCD are the gives the user a basic idea that the patient is suffering with. Further we added temperature sensor which too can be monitored using a laptop and lcd display through which the user gets confirm idea about the situation of the patient suffering with.

I.HARDWARE DESCRIPTION

A. MAX 30100/30102

Fig.2. Max 30100/30102

MAX30100 is a multipurpose sensor used for multiple applications. Here we used it for ventilator for measuring blood pressure and SP02 level in patients' body. It is a heart rate monitoring sensor along with a pulse oximeter. The sensor comprises two Light Emitting Diodes, a photodetector, and a series of low noise signal processing devices to detect heart rate and to perform pulse oximetry.

Features of MAX03100:

Here are some of the features and specifications of the MAX03100 Heart Rate Oxygen pulse sensor.

1. Operating Voltage - 1.8V to 3.3V
2. 2. Input Current - 20mA
3. Integrated Ambient Light Cancellation
4. High Sample Rate Capability
5. Fast Data Output Capability

B. Temperature Sensor Lm35

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external

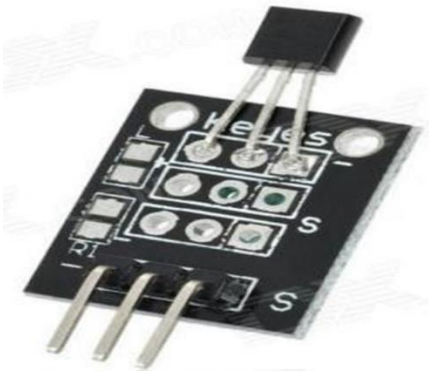

Fig.3. LM35 Sensor

calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°Cover a full –55°C to 150°C temperature range. Lower cost is assured by trimming and calibration at the wafer level.

The low-output impedance, linear output, and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy.

C. Ambu Bag

Fig.5. Ambu Bag

A bag valve mask (BVM), sometimes referred to as an Ambu bag, is a handheld tool that is used to deliver positive pressure ventilation to any subject with insufficient or ineffective breaths used for ventilators. It consists of a self-inflating bag, one-way valve, mask, and an oxygen reservoir.

D. Arduino

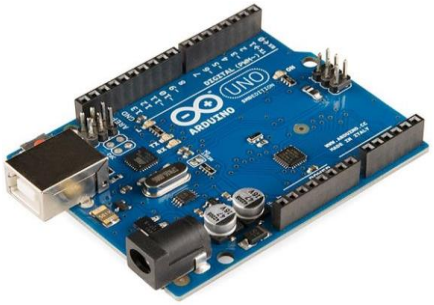

Fig.6.ArduiO

Arduino is a prototype platform (open-source) where it can be accessible by any user and free to use. It is easy-to-use hardware and software thorough which user can interface details so it gets easier to find faults and analyze the circuits. It consists of a microcontroller, which can be programed and a ready-made software called Arduino IDE (Integrated Development Environment) which is easily available over internet, it can used to write and upload the computer code to the physical board and make physical connections.

Arduino provides a standard form factor that breaks the functions of the micro-controller into a more accessible package and it all works on the HIGH and LOW sort of instructions.

Features of the Arduino UNO family:
Microcontroller used: ATmega328. Operating Voltage: 5V to 12V.
Input Voltage (recommended): 7-12V and can also work on 5V if needed for low powered devices.
Input Voltage (limits): 6-20V.
Digital I/O Pins: 14 pins are available (of which 6 provide PWM output)
Analog Input Pins: 6 pins.
DC Current per I/O Pin: 40 mA. DC Current for 3.3V Pin: 50 mA

II. ALGORITHM

Steps to follow:

1. Start.
2. Initialization.
3. Measure the temperature of body.
4. Monitored LCD display.
5. Measure the oxygen of body and monitored the display.
6. According to oxygen level of body set the BPM of ventilator using knobs.
7. When oxygen level is less then pressing the ambu bag speedily.
8. When knob is set then motor is ON and compression and expansion process of ambu bag will start.
9. Again, monitored the LCD display.
10. Repeat from step 3.
11. End.

In step 1 start the power supply and wait for the Arduino and initialization of the machine to start. First measure the temperature of the patient to get some basic idea who is not feeling well. Monitored over its LCD then measure BPM and SPO2 level of the patient in found improper, connect the one end of the ambu bag to the oxygen cylinder and wear the mask to the patients face proper. According to the readings obtained adjust all the knobs and adjust the oxygen level and air intake make the patient comfortable with proper oxygen level. Repeat the following procedures continuously after sometimes and modify the knobs as per requirement.

III. RESULTS AND DISCUSSION

The medical caretaker, or specialist handles those controls. It has tubes that are associated with the individual through a breathing cylinder O2(oxygen) it is in the stored form in the cylinder or we often called it as liquid oxygen. The breathing cylinder is put in the patient's mouth or in an opening in the neck into the windpipe (trachea) through which it gets easier for the patient to get oxygen directly to organs. This opening is known as a tracheostomy.

It makes clamors and has cautions that alarm the social insurance group when something should be fixed or changed. An individual gets the medication to stay agreeable when associated with the ventilator, particularly when they have a breathing cylinder in their mouth.

Opening their eyes or remain conscious for in excess of a couple of minutes. Patient can't talk on account of the breathing cylinder.

At the point when patient is alert enough to open their eyes and move, they can impart recorded as a hard copy. Quiet on ventilators have numerous wires and cylinders on them there may be sensors and other devices that are put on the patient's body like here oximeter to measure BPM (blood pressure). We use max 30100 sensor to monitor the blood pressure and SP02 level in patients' blood and body. That may look unnerving; however, these wires and cylinders help the specialists to painstakingly screen them. Some patients may have limitations on them. These are utilized to keep them from pulling off any significant cylinders and wires. Patients are put on ventilators when they can't inhale alone and require the external device for proper and easier breathing. This might be for any of the accompanying reasons: To ensure that the patient is getting enough oxygen and is disposing of carbon dioxide.

After medical procedure, the patient may require a ventilator to inhale since they may have been given a few meds that reason them lethargic and their breathing has not come back to typical or as natural.

A patient has a sickness or damage and can't inhale ordinarily. More often than not, a ventilator is required distinctly for a brief span like hours, days, or weeks. Be that as it may, at times, the ventilator is utilized for a considerable length of time, or now and

then years. In the emergency clinic, an individual on a ventilator is observed intermittently by medicinal services suppliers including specialists, attendants, and respiratory advisors. Patients who need ventilators for extensive stretches may remain in long haul care offices. A few patients with tracheostomy might almost certainly be at home if duration of ventilator is required for long duration [5]. Tolerant on a ventilator are watched cautiously for lung diseases. At the point when associated with a ventilator, a patient gets an opportunity of hacking out bodily fluid. In the event that bodily fluid gathers, the lungs can't get enough oxygen. The bodily fluid can likewise prompt pneumonia in patient. To dispose of bodily fluid, The method called suctioning is required. This is finished by bringing a little slender cylinder into the patient's mouth or neck opening to vacuum out the bodily fluid.

Fig.7. Output displayed on LCD screen.

Those are the measurements that are obtained while performing the operation of the mechanism. The normal BPM is considered to be in between 60 to 100 for teens and 80 to 120 for adults. These measurements are taken from pulse sensor and are displayed on this LCD screen. The role of LM35 was used to measure the patient's body temperature, and was monitored using the same LCD screen, as shown in Fig.7.

At normal condition it indicates the normal room temperature but while testing it on human body it indicates the temperature of human body, this makes user to verify the symptoms the patient is going through. Those were the basic measurements and the ventilator handled according to them.

For further monitoring the details obtained from the max 30102 sensor the Arduino is connected to laptop and the by using the serial plotter and serial monitor we can check the readings and their instruction sets that are not displayed and monitored on the LCD screen. So further detailing can be obtained from the laptop and data can be used for further procedure, as shown in Fig.8. To read the data from max 30102 the Arduino plotter and monitor should be first set to BOTH NL and CR and appropriate baud rate should be selected.

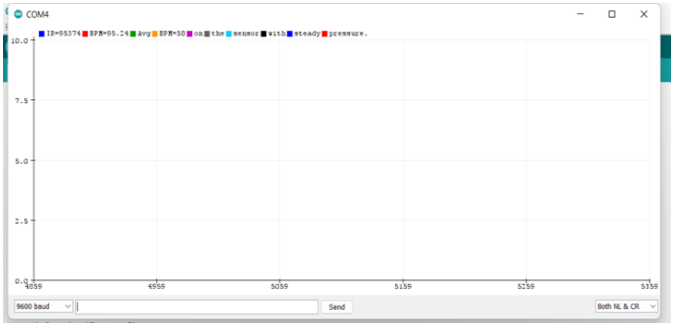

Fig.8. Data from Serial Plotter.

Data from serial plotter indicating the IR statements along with BPM and average BPM. It also shows the details if the sensor fails and the instruction are displayed so it gets easier for fault detection and troubleshooting the sensor. After performing all operations of the sensors and equipment's the ventilator is ready to assembled.

Fig.9. Final Model of Ventilator.

After assembling each component and equipment the final model of ventilator is made as shown in Fig.9. It was further made in such a manner that it can be made rigid so it can be made portable and taking into consideration about emergency situation it was made tough, as shown in Fig.9.

IV. CONCLUSION

A ventilator has been designed, fabricated and tested. It has a structured like box, it is used in medical fields for patients who are unable to breath naturally. These are used where respiration process is in critical condition and where the patient is unable to take oxygen directly as in normal condition. The ambu bag and oxygen cylinder helps the patients to inhale the oxygen directly to lungs rather than taking oxygen and carbon dioxide along with other ingredients of air. It makes patient to relax and feel better and can be recovered through various problems and disease and ultimately it only requires electricity to work and also don't have severe drawbacks. So, these systems can work efficiently as per required and is much reliable. This system is designed for emergency purposes and since it is low powered device so it is portable. Further it can be advanced including sensors but for the aim as ventilator it works efficiently.

IV. REFERENCES

[1]. Gattinoni, L.; Quintel, M.; Marini, J.J. Volutrauma and atelectrauma: Which is worse? Crit. Care 2018, 22,13.

[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]. R. Robert, P. Micheau, O. Avoine, B. Beaudry, A. Beaulieu and H. Walti, "A Regulator for Pressure-Controlled Total-Liquid Ventilation," in IEEE Transactions on Biomedical Engineering, vol. 57, no. 9, pp. 2267-2276, Sept. 2010.

[4]. Kerechanin CW, Cytcgusm PN, Vincent JA, Smith DG, Wenstrand DS (2004) Development of Field Portable Ventilator Systems for Domestic and Military Emergency Medical Response, John Hopkins Apl. Tech. Digest Vol 25, Number 3

[5]. M.Borrello,"Modelingandcontrolofsystemsforcriticalcareventila tion," Proceedings of the 2005, American Control Conference, 2005., Portland, OR, US.

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