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"IOT BASED RESPIRATORY VENTILATOR FOR AMBULANCE"

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Abstract: Ventilator device are external devices that are designed to assist a patient to perform a particular task. It is to keep up or improve a breathing ability of a person if he encounters problem in his own breathing. Ventilators play a vital role in human's life. It is a piece of equipment, software program or product system that is used to increase, maintain, or improve the functional capabilities of persons with disabilities in breathing period. This paper deals with the hardware design of a lab model ventilator. A prototype model of the ventilator has been designed and tested.

Keywords: Ventilator, Respiration, Arduino, portable, flowmeter.

I. INTRODUCTION

Respiratory maladies and damage incited respiratory disappointment comprise a noteworthy general medical issue in both created and less created nations. Asthma, incessant obstructive aspiratory infection and other perpetual respiratory conditions are boundless. These conditions are exacerbated via air contamination, smoking, and consuming of biomass for fuel, which are all on the ascent in creating nations. Patients with basic lung sickness may create respiratory disappointment under an assortment of difficulties and can be bolstered mechanical ventilation. These are machines which precisely help patients move and breathe out, permitting the trading of oxygen and carbon dioxide to happen in the lungs, a procedure alluded to as fake breath.

Ventilators are one of the most important devices to keep COVID-19 patients in the most critical condition alive. As the global demand for ventilators is increasing and there is shortage of ventilators in our country as well, also managing patients during this time is a big task, so we have designed portable rechargeable battery operated Ambu bag compressing machine, which sends real time cloud messages to the doctors and other medical authorities about the patient. We have made the prototype and we are improving it's performance by adding extra new features. It can be used for emergency purposes, in hospitals, Corona virus quarantine coaches, isolation wards and rural areas as well. The shortage of ventilators can be met effectively by developing this project. This project is a low cost yet effective ventilating system for the people affected with COVID-19.

The main contribution of this project is to design low cost battery operated ventilator system which can be use in ambulance as well as in village's hospitals that can be possible to monitor the patient online.

II. LITERATURE SURVEY

- Robert L. Chatbum, Engineering Principles Applied to Mechanical Ventilation: Mechanical ventilators can be understood in terms of simple physical models that have electrical analogs. These models provide the basis for designing and classifying ventilators as well as understanding ventilator-patient interactions. The purpose of this paper is to help bridge the gap by clarifying terminology and outlining the conceptual models used to design and use mechanical ventilators

- Md. Rakibul Islam, Designing an Electro-Mechanical Ventilator Based on Double CAM Integration Mechanism. (ICASERT 2019), This paper proposes a simplified structure of microcontroller based mechanical ventilator integrated with a Bag-Valve-Musk (BVM) ventilation mechanism. Here, an Ambu bag is operated with computer-aided manufacturing (CAM) arm that is commanded via a microcontroller and manual switches by sending a control signal to the mechanical system and according to this control signal, the mechanical computer-aided manufacturing (CAM) arm simultaneously compresses and decompresses the Ambu bag.

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- S. J. Jung and W. Y. Chung studied the Flexible and scalable patient's health monitoring system in 6LoWPAN . The main advantage of this enabling factor is the combination of some technologies and communications solution. The results of Internet of Things are synergetic activities gathered in various fields of knowledge like telecommunications, informatics and electronics.

- Re za S.Dilmaghani(2016) in their study found the design of Wi-Fi sensor network that is capable of monitoring patient's chronic diseases at their home itself via a remote monitoring system. So immerging of wireless sensor technology individual test like only blood pressure, heart rate, temperature etc. can be measured but this research project enables all this parameter together to be measured under single system, and also thus all can be worn by patient and processed data send toward internet through internet of things(IOT)

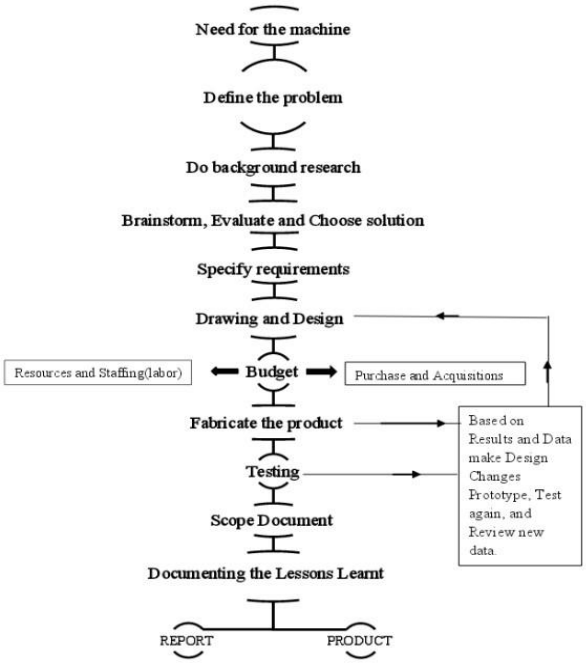
III. PROBLEM DEFINITION/VISION

On the basis of our survey it is found that there is a need of affordable Low cost ventilators in India to fight against COVID-19, also managing patients during this time challenging task. Hence, we choose our project**.**

IV. OBJECTIVES OF PROJECT

- The motivation for constructing this kind of ventilator comes from the worldwide shortage of mechanical ventilators for treating COVID-19 patients .the COVID-19 pandemic has been striking hard in some regions, especially the deprived ones. Constructing a low-cost, open-source mechanical ventilator aims to mitigate the effects of this shortage on those regions.
- According to the constitutions of World Health Organization (WHO) the highest attainable standard of health is a fundamental right for an individual. As we are truly inspired by this, we attempt to propose an innovative system that puts forward a smart patient health tracking system that uses sensors to track patient vital parameters and uses internet to update the doctors so that they can help in case of any issues at the earliest preventing death rates.
- To develop health monitoring system i.e. it measures body temperature and heart rate.
- It has a controlled breath rate of 12 RR/min and 500-600 mL tidal volume. It features assist control and provide a constant air flow to the lungs.
- Power requirement is very low and running for 3.5 hours on one battery charge at itsmost demanding setting. Battery backup also need to be checked.
- It is low cost, portable and light weight.

V. METHODOLOGY



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VI. EXISTING SYSTEM

There are several existing systems of operating an Ambu bag. Such as Ruler chain mechanism, CAM mechanism, Rack and pinion mechanism, Lead screw Mechanism. They have some advantages and disadvantages. Another existing ventilator system is integrated with the vocal alarming system to reduce noise that generates from ventilators in the hospital Ruler chain mechanism is preferred in previous for its availability and high torque gain with DC motor. When it operates, noise generates that can cause sound pollution in the care environment. Tele-controlling mechanism exists and integrated with the system. After that, another mechanism preferred called CAM mechanism eradicates the noise or additional sound. Actually, this mechanism does not generate any noise like ruler chain mechanism. Rack and Pinion mechanism makes the platform of gear for more precise controlling. Lead screw mechanism uses a threaded screw to operate a mechanical arm with a nut that compresses and relax the Ambu bag simultaneously. Authors in show the hyperbaric oxygen therapy using mechanical ventilator where the pressure is proportional to volume.

VII. PROPOSED SYSTEM

Our proposed system is based on CAM principle having some additional feature of controlling precisely with portability, battery operated, reduced size and noise removal. Several modes selected for control operation such as child mode, pediatric mode, and adult mode. These modes are selected according to the lung capacity and breath-rate of the subject as well as inspiration and expiration (I:E) ratio. All of these parameters are generally dependent on the age of the subject. The automation requires a microcontroller, some mechanical switches, and two servos. Servos are positioned face to face oppositely with the 180-degree angle. The shafts of the motor are attached with a mechanical pulley that rotates according to motor direction. A nonflexible cot wire connects one arm and one pulley and same to the second one. When the motor rotates, the torque creates tension in the cot wire through the pulley that results in pulling a mechanical arm to compress an

VIII. HARDWARE DESCRIPTION

A ventilator is a machine that relaxes for the patient or encourages patient to relax. It is likewise called a breathing machine or respirator. The ventilator is associated with a PC with handles and catches that are constrained by a respiratory specialist, medical caretaker, or specialist. It has tubes that are associated with the individual through a breathing cylinder. The breathing cylinder is put in the patient's mouth or in an opening in the neck into the windpipe (trachea). This opening is known as a tracheostomy. It makes clamours 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. The prescription may make quiet too lethargic to even think about 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. 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. 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 typ

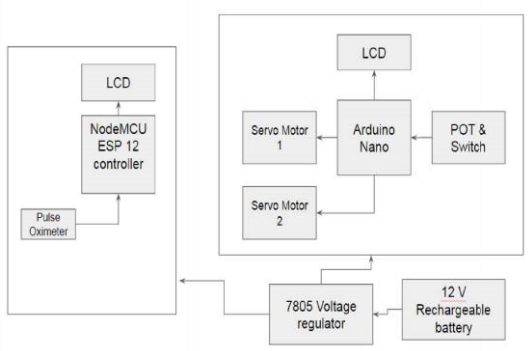

Fig.2:- Block Dig of Portable

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IX. WORKING

As shown in the above block diagram, the arrangement is divided into two parts. On the left hand side it comprises of pulse oximeter which measures the oxygen saturation level of the patients blood i.e. Proportion of oxygen carrying molecules in the blood. This is very important to monitor whenever the patient is at risk and same would be stored in the cloud server which is available live in the clients hand held device. Node MCU esp. is Wi-Fi module but it is actually microcontroller separately targeted for IOT based applications. It is program to detect the pulse rate from pulse sensor. This controller is used for communicating the results to online webpage and can also be monitor on LCD that will display the data of pulse oximeter.

On the right side of the diagram low cost ventilator arrangement which consists of Arduino uno, servo motor, potentiometer, switch, rechargeable battery, and LCD. Servo motor moves in step to give pressure to ambu bag connected with it according to the patients health. Two servo motor are used to control both sides of the servo motor for compressing the ambu bag which is controlled by Ambu bag that is programmed to communicate with them.12 V rechargeable battery us used as power supply to the ventilator. LCD will display volume & respiration per minute & this can be adjusted using potentiometer.

X. RESULT

After implementing of all setup and successful run of Arduino code operated several time to obtain result. According to our uploaded source code motor will rotate 2 sec clockwise and 3 sec anti clockwise continuously. So that, it can complete 12 Respiratory rate (RR)/min as per our calculation to provide a continuous plate pressure and air flow for the pneumonia cases of COVID-19 patient lungs

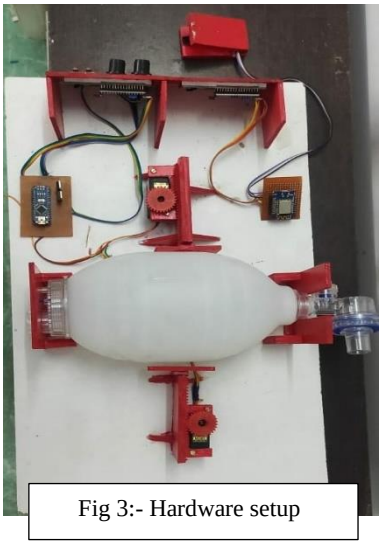

Fig 3:- Hardware setup

XI. CONCLUSION

In this paper, a prototype device to assist the patients who can partially breathe by their own is developed. This device is provided with very basic design and reliable structure that is easily acceptable by the patient. Main focus in this paper is to minimize the components and increase the efficiency of the device, so that while using this device to the patient, they should feel as comfortable as the normal ventilator. In this paper needle valve is used along with the potentiometer for replacing the flow analyzer so that the entire setup is cost effective. Arduino UNO board is used because it is easy to program. This research has led to the development of lab model ventilator.

XII. BENEFITS AND OPPORTUNITIES FOR EMERGENCY VENTILATORS

The first use of ventilators in modern medicine was reported to have been started by Bjorn Ibsen in Copenhagen in 1953, whose use of ventilation helped to save scores of lives of patients with polio, reducing mortality rate from 87% to 25%. In pre-COVID-19 days, ventilators were commonly used in patients with issues, such as chronic lung disease, severe asthma, chronic bronchitis, or pulmonary fibrosis, etc. This means that there is a long-term, growing need forl ventilation due to myriad aetiologies. This is further supported by the ageing demography—more than half of intensive care unit (ICU) patients in the United States are over the age of 65, a demographic group which is expected to grow from 46 million in 2014 to 74 million by 2030. Similar trends in Europe and Asia reflect this worldwide problem. To meet the growing demand for acute clinical care, ICUs will need to increase their capacity as well as their capabilities. Furthermore, simplified versions of ventilators may have a domiciliary role for intermittent support in chronic respiratory conditions, with the doctor's guidance via telemedicine, such as asthma or chronic degenerative/fibrosing lung

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conditions. They may be adaptable to aid delivery of inhaled medications, or to reopen blocked terminal airways. In such case, the ventilators could also be monitored remotely for oxygen concentration, frequency of use, etc. Thus, increased ventilator availability may help the clinical care of a wider variety of patients than COVID-19 cases, including patients with injury, pulmonary noncommunicable diseases, and communicable ones, such as the human immunodeficiency virus and malaria. The need for ventilatory support is of short duration in a majority of patients, for example during postsurgical recovery, infectious diseases, trauma resuscitation, and in prehospital care. In many of these settings there is a potential role for a robust, simple, ventilatory assist device, particularly to augment capacity in LMICs (low- and middle-income countries) or early phase epidemics of respiratory diseases. These devices could also have additional capacity enhancing roles, during epidemics, such as COVID-19, to release advanced ventilators from use in low-specificity indications.

Although the automated versions of manual resuscitator here cannot replace the clinical care provided by conventional ventilators, an AMBU bag as the backbone of a rapidly deployable emergency DIY ventilator has some merits, not least that most healthcare facilities have significant stock. Further, the AMBU bags have already been tested and certified for medical use, making them suitable for sterilization, while they are also compatible with a range of other equipment available in hospitals (masks, valves, intubation equipment, filters, oxygen supply). Some BVMs also come with incorporated safety features (pop-off valves, PEEP valves) thus simplifying the rest of the design. However, drawbacks exist for COVID-19.

Other barriers for ventilation in some part of world apply to both traditional mechanical ventilators and novel emergency devices, such as religious or cultural beliefs coupled with misunderstanding about treatment effectiveness. Use of any ventilator requires appropriately trained, medical or nursing staff (typically intensive care physicians, anaesthesiologists, intensive care nurses, and respiratory therapists), which are not always available. In many settings the ventilator must be synchronized with the patient's natural inhalation and exhalation efforts and be dynamically adaptable to provide the pattern of mechanical support that is optimal for the individual patient, disease, and phase of pathology. Mismatches between the patient's demand and the machine's delivery can result in (potentially fatal) iatrogenic barotrauma or cause a patient to "fight the ventilator" (e.g., if a patient naturally needs more time to exhale but the ventilator prematurely transitions to lung inflation).

XIII. REFERENCES

1. Robert L. Chatbum, Engineering Principles Applied to Mechanical Ventilation,Proceedings of the 25"' Annual International Conference of the IEEE EMBS Cancun, Mexico, September 17-2008

2. Mohiuddin Ahmad, Designing an Electro-Mechanical Ventilator Based on Double CAM Integration Mechanism,1st International Conference on Advances in Science, Engineering and Robotics Technology 2019 (ICASERT 2019)

3. SubhaHency Jose P, A Novel Methodology for the Design of a Portable Ventilator, International Journal of Innovative Technology and Exploring
Engineering (IJITEE) ISSN: 2278-3075, Volume-9 Issue-1, November 2019

4. M. Prakash, U. Gowshika, T. Ravichandran, "A Smart Device Integrated with an Android for Alerting a Person's Health Condition: Internet of Things" Indian Journal of Science and Technology, Vol 9 (6), February 2016.

5. "Healthcare Monitoring System Using Wireless Sensor Network", D. Mahesh Kumar, Department of Electronics, PSG College of Arts and Science, Coimbatore - 641 014.Volume 04, Issue 01 Pages:1497-1500 (2012), ISSN:0975-0290.

6. Fiorineschi, L.; Frillici, F.; Rotini, F. Challenging COVID-19 with Creativity: Supporting Design SpaceExploration for Emergency Ventilators. Appl. Sci. 2020, 10, 4955.

7. Ranney, M.L.; Griffeth, V.; Jha, A.K. Critical Supply Shortages—The Need for Ventilators and PersonalProtective Equipment during the Covid-19 Pandemic. N. Engl. J. Med. 2020, 382, e41.