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Automated Ventilator with Heartrate and SpO2 Monitoring

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Abstract: ***As we all witnessed COVID-19 pandemic all over the world the*** **virus that causes COVID-19, gets in the human body, it comes into contact with the mucous membranes that line our nose, mouth, and eyes, and infects the upper or lower part of respiratory tract. As a result, the respiratory tract and lungs swells, become irritated and inflamed. For those who develop trouble breathing, medical care outside of the home is needed. The seriously ill patients suffering from COVID-19 need respiratory support, as their lungs get damaged by the coronavirus leading to breathing difficulties. Ventilators are needed in such cases for supplying adequate oxygen into their lungs and also removing the carbon dioxide, as a lifesaving supportive measure. The ventilators are one of the most vital medical devices needed to keep these critically ill COVID-19 patients alive. The ventilator we design and develop using Arduino encompasses all these requirements to develop a reliable yet affordable ventilator to help in times of pandemic. Also, it monitors the body temperature. We use toggle switch for switching and a variable pot to adjust the breath length and the BPM value for the patient. Our system makes use of blood oxygen sensor to monitor the necessary vitals of the patient and display on a mini screen.**

Keywords: COVID-19 pandemic, trouble breathing, ventilator, Arduino, body temperature, breath length, BPM value.

I. INTRODUCTION

There is an increase in air pollution which resulting in various respiratory diseases. Some of the respiratory diseases patients require the instant support of ventilator and also there has been a drastic increase in the number of patients struck by COVID-19 pandemic in the hospitals and ICUs worldwide. However, sufficient ventilators are not available in the hospitals at present. An influential report from Imperial College London estimates that 30% of patients admitted in hospitals due to COVID-19 are expected to need the mechanical ventilation. According to the WHO, one in six COVID-19 patients has significant difficulty in breathing and may require ventilator support. However, the patients who require ventilator support have low survival rates of 20% because many of these infected patients (40%) develop acute respiratory distress syndrome (ARDS), which has a high mortality[1].

II. OBJECTIVE

The main objective of our paper is to make an low cost ventilator with heart rate, SPO2 levels and temperature monitoring. It can be useful for the patients, who are suffering with breathing problems and it can be helpful in emergency situations. The patients can check their temperature, heart rate and SpO2 levels without consulting any doctor.

III. LITERATURE SURVEY

Rouf-ul-Aalam, Afshan Amin Khan, Dr Liyaqat Nazir proposed a design of a ventilator which can be easily manufactured and integrated into the hospital environment to support COVID-19 patients. The proposed ventilator essentially uses electronically controlled mechanical ventilation that is achieved by precise calculated periodic compression and expansion of a readily available ambulatory bag [1].

Muhammad Jawad Ghafoor, Mustafa Naseem designing the robustness and functionalities of ventilator which is not only easily transferable as well as it is very low cost and economics friendly. It is designed under the basic idea of being incorporated in huge human catastrophes in poorly resources enriched environments. Ventilator under the proposed design was being developed with wooden pieces with a weight of 6 kg and has a volume of 14 × 7 × 9 inches. It functions without human operator as it delivers breaths through the compression of an orthodox bag valve mask [2].

Ryan M. Corey, Member IEEE; Evan M. Widloski, Student Member IEEE proposed sensor and alarm system can improve the functionality of pressure-cycled emergency ventilators. While it is not as robust as a full-featured commercial ventilator system, it provides critical monitoring features that are not available on purely mechanical ventilators. The recursive envelope-tracking algorithm allows the system to track breathing, estimate metrics and detect malfunctions with only a few calculations per sample and a tiny memory footprint. Therefore, the system can be built quickly using nearly any low-cost microcontroller and a few other electronic components [3].

IV. IMPLEMENTATION

The ventilator can be implemented by using Arduino and Node MCU. The Arduino uno is an open-source microcontroller board. The board is equipped with sets of digital and Analog input/output pins that may be interfaced to various expansion boards and other circuit, and is programmable with the Arduino IDE (Integrated Development Environment). Node MCU is an open-source firmware for which open source prototyping board designs are available. The name "Node MCU is a combination of “Node” and “MCU” (microcontroller unit). Both the firmware and prototyping board designs are open source. The firmware uses the Lua scripting language. The firmware is based on the Lua project, and built on the Espressif Non-

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OS SDK for ESP8266. It uses many open-source projects, such as lua-cjson and SPIFFS. The Max30100 sensor is used to measure the heart rate and SpO2 levels. The DHT11 sensor is used to measure the temperature, and the both the sensors are connected to Node MCU. The potentiometer (pot), servo motor is connected to Arduino board with Node MCU board.

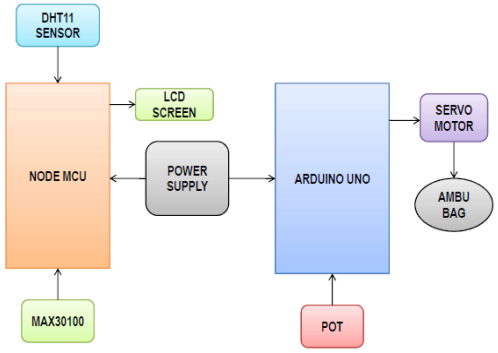

Fig 1: Block Diagram

V. RESULT

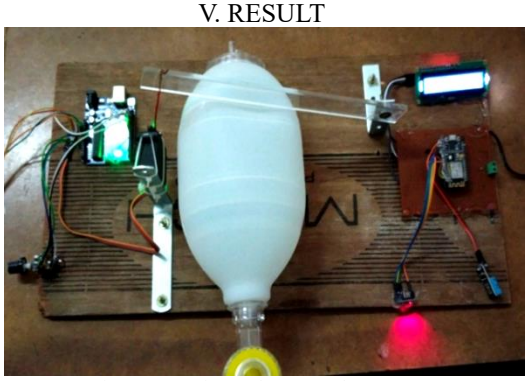

Fig 2 : Top View Of Proposed Prototype

Our proposed system is user friendly and plays an important role in emergency situations where there is an at most need of ventilators. This system is portable and can be easily handled and operated by each and every one including old aged people. The proposed system is efficient and useful to monitor the necessary vitals of the patient and display them on the screen.

CONCLUSION

The Automated ventilator with heart rate and SpO2 monitoring system can be very useful for every patient, who are been suffering with COVID-19, respiratory diseases. This system is available in low cost. We can operate this system in a easy way. It will monitor our heart rate, blood pressure, temperature levels. Anyone can operate it as no need to study or training of ventilation rules like ICU ventilator. As the reliability of the sensors are very less the estimation of oxygen requirement is not so accurate, but this project is very much needed and useful in the present pandemic. This study explains how to make open source mechanical ventilators for patients at a reasonable cost.

FUTURE SCOPE

By using this project we can establish different modules to the AUTOMATED VENTILATOR WITH HEART RATE AND SpO2 MONITORING USING ARDUINO, it can be very helpful in every health emergency situations. It will be useful for senior citizens, children, who are suffering with different lung infections, breathing problems, etc. to interface Bluetooth module we can connect device directly to mobile phones. By interfacing temperature sensor we can measure the temperature of the patient. May be in future we can add different modules to perform various operations at low cost. This equipment will be available for every person in future. Updating regulations and securing funding mechanisms for the development and testing of open source ventilators for both the current COVID19 pandemic, as well as for future pandemics and for everyday use in low-resource settings.

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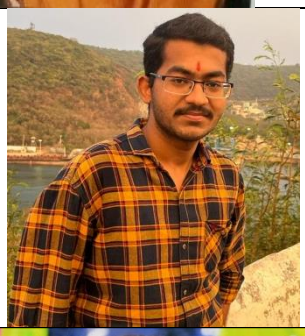	J. Vishal, Studying B. Tech in Electronics and Communication Engineering at N S Raju Institute of Technology, Visakhapatnam.
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