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Smart Portable Ventilator Using Arduino withPulse, Oxygen Sensing

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ABSTRACT: The COVID-19 pandemic has placed vast strain on global healthcare due to the immediate and intemperate caseload burdens, compounded by insufficient access to the requisite supplies and equipment necessary to treat patients. This paper shows the evolution of a low-cost, open- source mechanical ventilator. Establish low-cost, open- source mechanical ventilator aims to reduce the result of this scarcity on those regions.

I. INTRODUCTION

Ventilator or mechanical ventilator is a piece of hardware that help the human who is going through an issue breathing without anyone else/herself, by recreating the activity of relaxing. The breathing activity in people is finished by the descending development of the stomach, this descending development makes the pessimistic tension due consequence of which the climatic air is sucked into the lungs. This activity is fiercely called negative tension ventilation. During past times to help the human to inhale a framework was made which comprised of a crate and a strong siphon. The container used to cover the entire of human body omitting the head and was vacuum pressed. A siphon was joined to make a vacuum at first and afterward on to make negative tension and because of this negative strain, any man/lady utilizing that framework had the option to inhale somewhat better. This method of ventilation is only bad tension ventilation. Positive tension ventilation is totally the opposite of negative strain ventilation. In certain tension ventilation the cycle permits the patients to acquire breaths and to lessen crafted by taking in a fundamentally sick patient. The compressed air or the are conveyed to the patients through the endotracheal tube or a tracheostomy tube. Positive strain ventilation has two similarities, one is painless positive tension ventilation (NIPPV) conveyed through a veil which is water/air proof inside covering from nose to jaw of the patient and the other is meddling positive strain ventilation (IPPV) which is pretty much stay away from the nose and mouth.

In this pandemic circumstance, because of the great transferable of the Coronavirus there was an abrupt flood in the quantity of patients getting contaminated each day then again, this infection didn't have a lot of fleetingness rate as in excess of 90% individuals were recuperating from it rather than enduring life misfortune. As the Corona infection helps into a human body through nose or through mouth, right off the bat it imitates itself, then, at that point, it assaults the lungs. Answering to such a deadly assault the resistant framework attempts to battle the infection yet thus makes harm the alveoli of the lungs which causes ARDS (Acute respiratory pain disorder). To fix the ARDS of the patients they need appropriate drug yet alongside it they likewise need help with breathing and for that reason the mechanical ventilators are utilized. Mechanical ventilation machines are widely used to help the patient help with relaxing. The significant disadvantage these machines face is its powerful instrument and an extremely significant expense. A circumstance where there is a need of more than huge number of mechanical ventilation machines it is undeniably challenging to assemble and create these machines under the given time. Regardless of whether we dismiss the reality of its intense component, we can't ignore that it requires an exceptionally more subsidizing as a normal ventilation machine costs around INR 500 thousand to INR 2 million. To address such an issue, it was important to foster versatile as well as minimal expense ventilation component.

II. LITERATURE SURVEY

Balamurugan C.R. et al. [1] made a ventilator with a push instrument in every breath. This ventilator is exceptionally modest and reasonable. An engine system is utilized to push the airbag. Whenever oxygen level count is low, this instrument is performed. A little screen is utilized to show the oxygen level continuously. The whole framework is controlled with Arduino. On the off chance that the oxygen level is low, the signal rings. Flip is exchanging and variable pot to check patients' breath length and BPM level.

Leonardo Acho et al. [2] shows the development of a minimal expense, open-source mechanical ventilator. This article additionally shows a mathematical technique for checking patient's aspiratory condition. With the assistance of a tension sensor, we can characterize the patients are sound or undesirable lungs. An Arduino board gathers the data from

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the strain sensor and sends them to the raspberry pi. The raspberry pi orders the actuator, and the breathing sack packs as needs be. As per the assembling, the tension sensor can quantify differential strain of up to 70 cm H2O. the stuff was associated with the servo meter bar. The bar was made by plexiglass bar. The sweep of this stuff is 2.5cm.

AliakseiPetsiuk et al. [3] shows the advancement of a basic and simple to construct compact computerized veil esteem pack. This handle with Arduino regulator with the ongoing working framework introduced on generally RepRap 3d printable boundary part-based structure. For Arduino significantly develops the possible results of the regulator.

B. A. et al. [4] In their article named, Nursing care of the precisely ventilated patient: What does the proof say? Summed up as nursing care and the executives of precisely ventilated patients is testing and requires nursing ability to know the mechanical issues undying the patient-focused approach. Mechanical ventilation accelerates a few genuine and possible inconveniences for fundamentally sick clients. Ventilator care is compelling in precisely ventilated patients delivering positive results, comprising of four intercessions: rise of top of the bed, sedation get-away, peptic ulcer counteraction, and profound vein apoplexy prophylaxis. The nursing care practice needs huge supporting proof for demonstrating one consideration approach is better compared to the next. Being taken care of by precisely ventilated patients, the best nursing practice is proof based practice related to the complete and efficient patient.

Abdul Mohsen Al Husseini et al. [5] Designed and made a minimal expense compact mechanical ventilator model in mass regular cases and asset unfortunate conditions. The ventilator packs Bag Valve Mask (BVM) with a cam arm to convey breaths. This framework wipes out human administrators for compacting BVM. They fostered a functioning model with the assistance of control and overpressure caution. The framework needs low power prerequisites and runs for 3.5 hours on a solitary battery charge.

Subha Hence Jose P et al. [6] Developed a model of the gadget to help patients who can to some degree inhale autonomously. They made it by utilizing a base number of parts. They utilized a needle valve with a potentiometer to reestablish the stream analyzer and make it financially savvy.

Carrie S. Sona et al. [7] Determined the impacts of a straightforward, minimal expense oral consideration convention on ventilator-related pneumonia rates in a careful emergency unit. Carrying out a basic, minimal expense oral consideration convention in careful ICU prompted an essentially diminished hazard of procuring ventilator-related pneumonia.

III. PROPOSED SYSTEM

The Ambu-Bag compressing mechanism is operated with a DC motor connected to the NodeMCU microcontroller, which acts as the system's brain. The microcontroller is in serial communication with the Wi-Fi module to connect with the Internet and access real-time patient data from the cloud. We have developed a user-friendly android application with which the doctors and other authorities can easily monitor the patient data. The Ambu bag of the system is pushed automatically using a DC motor controlled through the L298N H bridge motor driver. The blood oxygen is measured using oxygen sensor Max30102, and pressure is measured using MPS20N0040D. The oximeter and pressure meter data is uploaded to the Blynk cloud, which is shown on the web and mobile App.

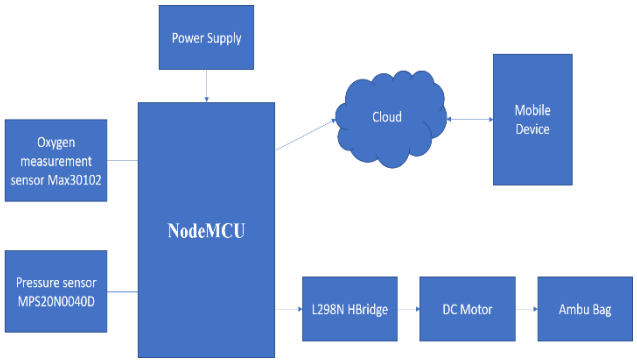

Fig 1. Layout diagram Block diagram of the portable ventilator

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IV. HARDWARE SPECIFICATION

Clinical ventilators are very complex systems with many sophisticated ventilation modes and closed-loop control abilities, much more than we sought to replicate in the VOV, and we consciously made the decision to emphasize a minimum viable ventilator with the necessary functionality to meet the immediate emergent potential needs during the pandemic. Through many conversations between clinicians and engineers, we arrived at the following understanding of what it is required to ventilate COVID-19 patients. Dynamics of Mechanical Ventilation Clinical mechanical ventilators operate by the principle of intermittent positive pressure ventilation (IPPV), wherein the patient's lungs are inflated by applying positive pressure to the airways. There are two primarymodes of IPPV: Volume Controlled Ventilation (VCV) and Pressure-Controlled Ventilation (PCV). As the names imply, VCV operates by modulating the volume of air forwarded tothe lungs, whereas PCV modulates the airway pressure. The VOV described in this article provides ventilation by compressing an Ambu bag by a programmable amount, implementingthe VCV paradigm. Challenges of pulmonic Health observance the most objective of a pulmonic health observance system is tosee whether or not the processed knowledge comes from healthy or unhealthy lungs. Faults of any type within the equipment's operation ought to even be classified as injurious condition. Classifying whether or not the information comes from a healthy or unhealthy condition is significant for the patient's safety. Hardware Contain Servo Motor, One Ambulatory Bag Arduino Microcontroller, Power Supply and LCD Display.

IV.I. NODE MCU

The NodeMCU ESP8266 advancement board accompanies the ESP-12E module containing the ESP8266 chip having Ten silica Xtensa 32-digit LX106 RISC microchip. This chip upholds RTOS and works at 80MHz to 160 MHz flexible clock recurrence. NodeMCU has 128 KB RAM and 4MB of Flash memory to store information and projects. Its high handling power with in-constructed Wi-Fi/Bluetooth and Deep Sleep Operating highlights make it ideal for IoT projects. NodeMCU can be controlled utilizing a Micro USB jack and VIN pin (External Supply Pin). It upholds UART, SPI, and I2C interfaces.

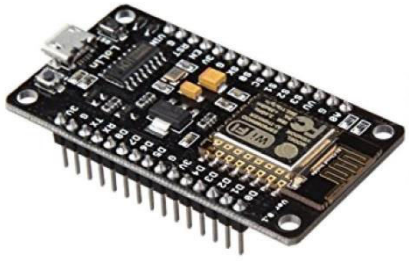

Fig 2. NodeMCU IOT Chip

IV.II. MAX30102 SENSOR

The MAX30102 is incorporated heartbeat oximetry and a pulse screen module. It incorporates interior LEDs, photodetectors, optical components, and low-commotion hardware with encompassing light dismissal [2]. The MAX30102 gives a total framework answer for facilitate the plan in process for portable and wearable gadgets.

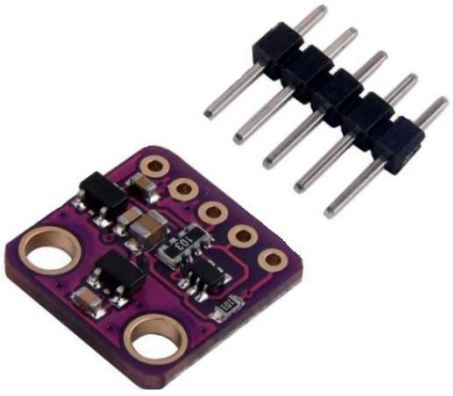

Fig 3. .MAX30102 Sensor

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IV.III. MPS20N0040D SENSOR

MPS20N0040D Atmospheric Pressure Sensor Module. This barometric tension sensor is enhanced for altimeters and variometers with a height goal of 10 cm. The sensor module incorporates a high linearity pressure sensor and a super low power; 24-bit ADC with interior production line adjusted coefficients. It gives an exact digital 24 Bit tension and temperature esteem and different activity modes that permit the client to enhance for change speed and current utilization. This HX710B pneumatic force sensor module utilizes a high-accuracy AD inspecting chip, embraces a 0-40KPa gaseous tension sensor, interfaces a 2.5mm hose, and identifies water level and other pneumatic force.

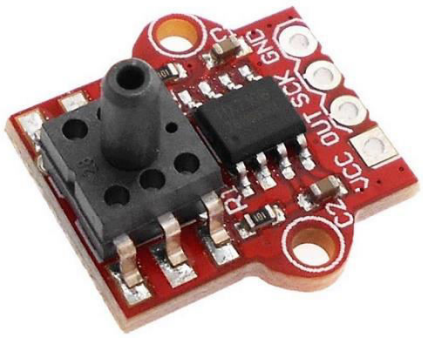

Fig 4.MPS20N0040D Sensor

IV.IV. L298N H BRIDGE

This engine driver for DC Motors and Stepper Motor is broadly well known on the grounds that it utilizes the popular L298N Dual H Bridge Driver Chip. This engine driver is advanced for greatest execution at an expense everybody can manage.

The L298N Dual H Bridge DC/Stepper Motor Driver Controller Module drives two robot engines. It utilizes the well-known L298N Dual H-Bridge Motor Driver chip and is sufficiently strong to drive engines from 5-35 Volts at up to 2 Amps for every channel. The adaptable computerized input controls permit each engine to be completely free with unlimited authority over speed heading and slowing down activity.

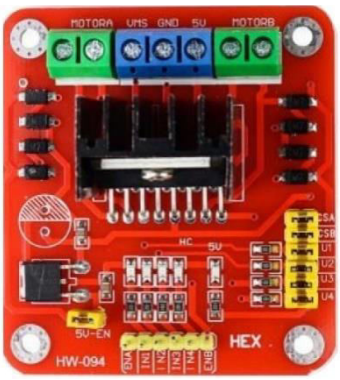

Fig 5. MPS20N0040D Sensor

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V. RESULTS

The results of the proposed system is explained in this section.

V.I. CASE 1

Whenever a finger is put on an oximeter sensor, it will show an individual's HR and SpO2 levels on LCD.

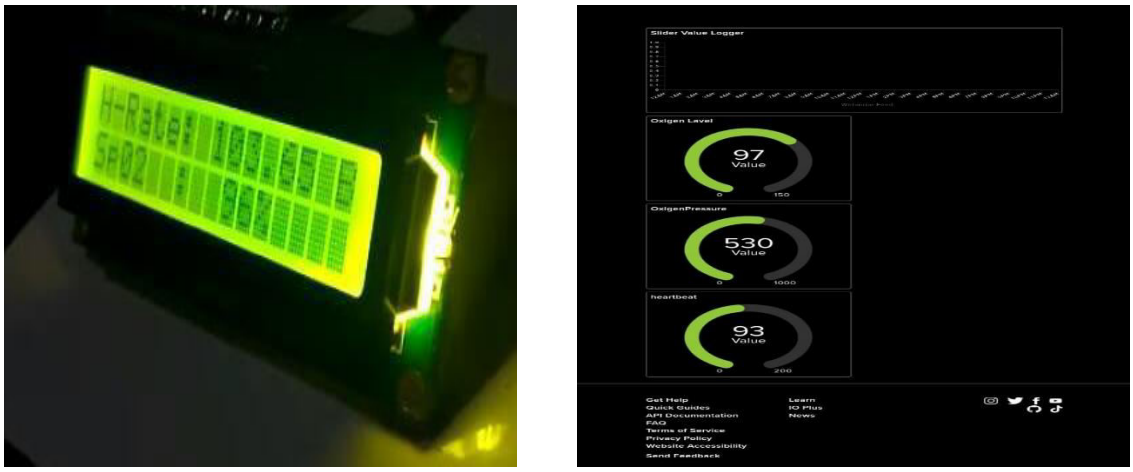

Fig 6. oximeter sensor result

V.II. CASE 2

Assume SpO2 readings on LCD is more huge than 90% and less than or satisfactory to 95%. all things considered, it produces buzz feels like a caution at the patient and sends the wellbeing status as a crisis, type of ventilator as understanding required 5-liter oxygen concentrator, and tests as CRP test.

V.III CASE 3

Likewise, If SpO2 readings on LCD are more prominent than 85% and less than or able 90%, it creates a humming sound as a caution at the patient. It sends the wellbeing status as Critical, and kind of ventilator as quiet required 15-liter oxygen concentrator.

VI. CONCLUSION

This approach proposes a cheap heartbeat screen upheld an Arduino stage synchronized with Android. It can screen SpO2 and important bodily function upheld the deliberate qualities. It can dissect the patient's wellbeing status. The outcomes are shipped off the gatekeeper or specialist through an android application. By following these expectations and ideas, we can save individuals' lives.

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