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Low Cost Ventilator Using Arduino with Blood Oxygen Sensing for Covid Pandemic

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ABSTRACT: The ventilator we here design and develop using arduino encompasses all these requirements to develop a reliable yet affordable DIY ventilator to help in times of pandemic. We here use a silicon ventilator bag coupled driven by DC motors with 1 side push mechanism to push the ventilator bag. 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 along with sensitive pressure sensor to monitor the necessary vitals of the patient and display on a mini screen. Also an emergency buzzer alert is fitted in the system to sound an alert as soon as any anomaly is detected. The entire system is driven by arduino controller to achieve desired results and to assist patients in COVID pandemic and other emergency situations.

KEYWORDS: Arduino Uno , Heartbeat Pulse Sensor,Ambu Bag.

I.INTRODUCTION

Respiratory diseases and injury-induced respiratory failure constitute a major public health problem in both developed and less developed countries. Asthma, chronic obstructive pulmonary disease and other chronic respiratory conditions are widespread. These conditions are exacerbated by air pollution,smoking, and burning of biomass for fuel, all of which are on the rise in developing countries1,2Patients with underlying lung disease may develop respiratory failure under a variety of challenges and can be supported mechanical ventilation. These are machines which mechanically assist patients inspire and exhale,allowing the exchange of oxygen and carbon dioxide to occur in the lungs, a process referred to as artificial respiration3. While the ventilators used in modern hospitals in the United States are highly functionally and technologically sophisticated, their acquisition costs are correspondingly high (as much as $30,000).High costs render such technologically sophisticated mechanical prohibitively expensive for use in resource-poor countries.Additionally, these ventilators are often fragile and vulnerable during continued use, requiring costly service contracts from the manufacturer. In developing countries, this has led to practices such as sharing of ventilators among hospitals and purchasing of less reliable refurbished units. Since medical resources in these countries are concentrated in major urban centers, in some cases rural and outlying areas have no access at all to mechanical ventilators.The need for an inexpensive transport ventilator is therefore paramount

In the developed world, where well-stocked medical centers are widely available, the problem is of a different nature. While there are enough ventilators for regular use, there is a lack of preparedness for cases of mass casualty such as influenza pandemics, natural disasters and massive toxic chemical releases. The costs of stockpiling and deployment of state-of-the-art mechanical ventilators for mass casualty settings in developed countries are prohibitive.

According to the national preparedness plan issued by President Bush in November 2005, the United States would need as many as 742,500 ventilators in a worst-case pandemic. When compared to the 100,000 presently in use, it is clear that the system is lacking4. One example of this shortage occurred during Hurricane Katrina, when there were insufficient numbers of ventilators 5 , and personnel were forced to resort to manual BVM ventilation6. Measures to improve preparedness have since been enacted;most notably the Center for Disease Control and Prevention (CDC) recently purchased 4,500 portable emergency ventilators for the strategic national stockpile 7 .

II.LITERATURE SURVEY RELATED TO SENSORLESS BLDC MOTOR

- The design and prototyping of a low-cost portable mechanical ventilator for use in mass casualty cases and resource-poor environments.The ventilator delivers breaths by compressing a conventional bag-valve mask (BVM) with a pivoting cam arm, eliminating the need for a human operator for the BVM. It is driven by an electric motor powered by

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a 14.8 VDC battery and features an adjustable tidal volume up to a maximum of 750 ml. Tidal volume and number of breaths per minute are set via user-friendly input knobs.The prototype also features an assist-control mode and an alarm to indicate overpressurization of the system.Future iterations of the device will include a controllable inspiration to expiration time ratio, a pressure relief valve, PEEP capabilities and an LCD screen.With a prototyping cost of only $420, the bulk-manufacturing price for the ventilator is estimated to be less than $200. Through this prototype, the strategy of cam-actuated BVM compression is proven to be a viable option to achieve low-cost, low-power portable ventilator technology that provides essential ventilator features at a fraction of the cost of existing technology.

- This paper unfolds the design of a low cost portable IoT controlled electro-mechanical ventilator. The specialty of this system is we can provide artificial respiration for single or dual ways to the patients at a time through this single system.The designed system consist of a microprocessor which is the main part of our system, OLED screen, battery pack for power back up, pressure controller, I-E controller(Inspiration and expiration controller),alarm, stepper motor, motor driver, dual and single selection mode feature selection through mode selection mechanism.
- Multi operational mechanical machine this work was mainly carried for manufacturing and fabrication industries.The machine which is used to produce the product with high accuracy and quality and produce the goods in an economical way.It makes the inventory cost less.The multipurpose machine has performed different operations simultaneously with high possibility.The scotch yoke mechanism which is attached with the main drive shaft directly attached then it is used for different operation.Number of operations has been performed by a single drive system. The main focus of the work is to reduce power usage and increase the productivity reduced floor space.Portability is an important quality in any machine in today's world; every field of science and engineering has got portability as one of its most important advancements.Therefore, the machine we have designed satisfies this principle with respect to the manufacturing industry.
- The manuscript describes the design and efficacy of a low-cost automated Artificial Manual Breathing Unit (AMBU) bag ventilation device for use in developing countries, where economic constraints do not allow expenditures on high-end conventional ventilators. This device makes use of a Bag-Valve Mask (BVM) or AMBU bag, which is automatically pressed from two sides by a linear actuator to deliver the desired tidal volume at the set respiration parameters. It is expected that the cost of manufacturing at scale shall be 1/100th when compared with conventional hospital high-end ventilators and hence will prove to be a boon for the health care industry in particular for developing nations.

III. PROPOSED SENSORLESS BLDC MOTOR DRIVE

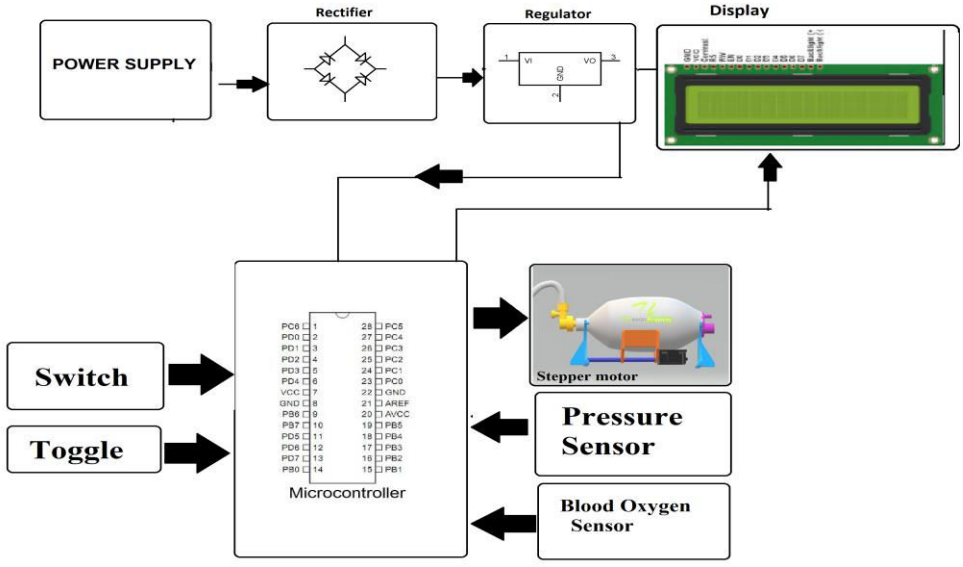

Fig. 1 Block diagram of the proposed system

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Fig.1 shows the ventilator we here design and develop using arduino encompasses all these requirements to develop a reliable yet affordable DIY ventilator to help in times of pandemic.We here use a silicon ventilator bag coupled driven by DC motors with 2 side push mechanism to push the ventilator bag. 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 along with sensitive pressure sensor to monitor the necessary vitals of the patient and display on a mini screen. Also an emergency sms alert is fitted in the system to iot an alert as soon as any anomaly is detected.

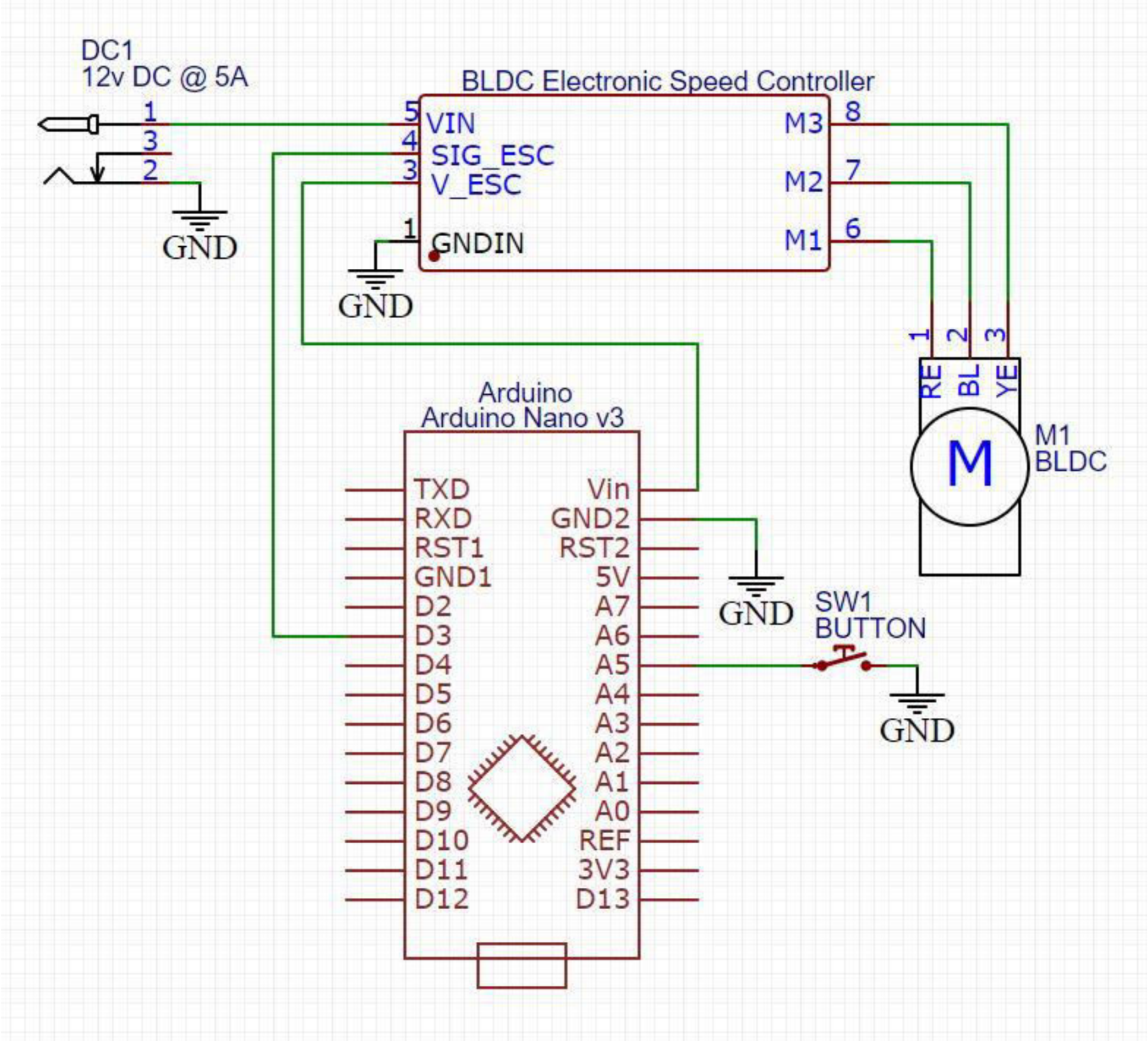

Fig.2 Equivalent circuit of Sensorless BLDC Motor Drive

Fig.2 shows the ventilator we here design and develop using arduino encompasses all these requirements to develop a reliable yet affordable DIY ventilator to help in times of pandemic.We here use a silicon ventilator bag coupled driven by DC motors with 2 side push mechanism to push the ventilator bag. 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 along with sensitive pressure sensor to monitor the necessary vitals of the patient and display on a mini screen. Also an emergency sms alert is fitted in the system to iot an alert as soon as any anomaly is detected. The ventilator we

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IV. WORKING PRINCIPLE OF PROPOSED SYSTEM

The ventilator we here design and develop using arduino encompasses all these requirements to develop a reliable yet affordable DIY ventilator to help in times of pandemic.We here use a silicon ventilator bag coupled driven by DC motors with 2 side push mechanism to push the ventilator bag. 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 along with sensitive pressure sensor to monitor the necessary vitals of the patient and display on a mini screen. Also an emergency sms alert is fitted in the system to iot an alert as soon as any anomaly is detected. The ventilator we here design and develop using arduino encompasses all these requirements to develop a reliable yet affordable DIY ventilator to help in times of pandemic.We here use a silicon ventilator bag coupled driven by DC motors with 2 side push mechanism to push the ventilator bag. 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 along with sensitive pressure sensor to monitor the necessary vitals of the patient and display on a mini screen. Also an emergency sms alert is fitted in the system to iot an alert as soon as any anomaly is detected.

V. CONCLUSION & FUTURE ENHANCEMENTS

This resulted in an open-source design that is set apart from other solutions by its manufacturing simplicity and reliance on components that are either readily available locally or ubiquitous enough that they could be sourced quickly even in the face of pandemic-induced shortages and Scotch Yoke Mechanism and microcontroller. Mechanical ventilation is an essential component in the delivery of modern critical care, peri-operative practice and transfer medicine .

Dual Ventilator Using Scotch Yoke Mechanism. Surely, this system makes a good challenge in the medical system. The current ventilation system is expensive, and this problem is overcome by using an “Iot Controlled Portable Ventilator With Dual Operation Mechanism”. The speciality of this system is less cost, dual mechanism so that we can provide air to two patients at a time. It is an IoT controlled device so that if the technician is cannot reach the patient pass, but he can control and monitor the device if any failure in the device operation with help internet connected devices like computer, mobile, tab etc.

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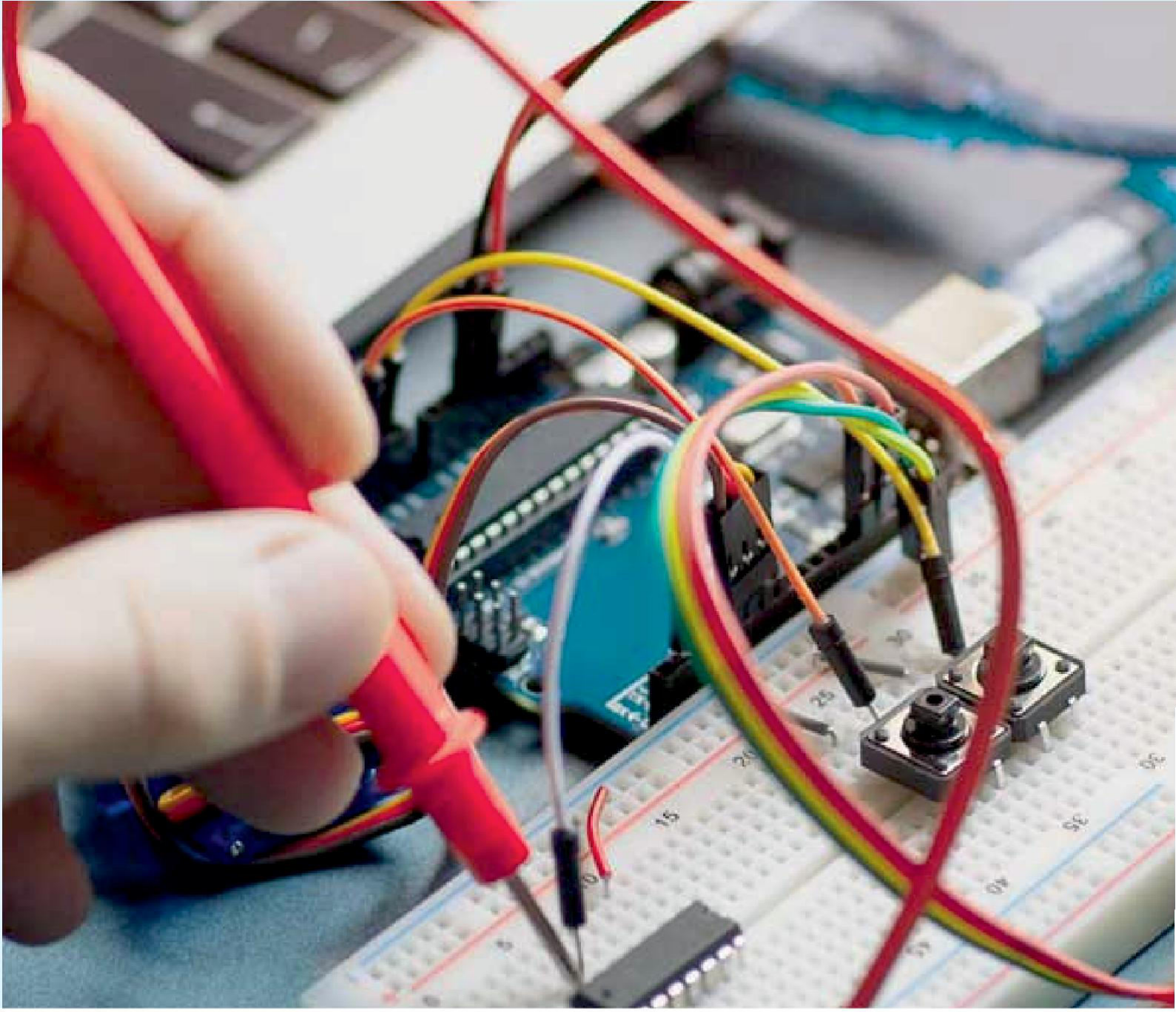

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