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Portable Low-Cost Ventilator for Controlling Arduino Based on IoT Technique

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Abstract – *Human lungs use the reverse pressure generated by contraction motion of the diaphragm to suck in air for breathing. A contradictory motion is used by a ventilator to inflate the lungs by pumping type motion. A ventilator mechanism must be able to deliver in the range of10 – 30 breaths per minute, with the ability to adjust rising increments in sets of 2. Along with this the ventilator must have the ability to adjust the air volume pushed into lungs in each breath. Our system makes use of blood pressure sensor along with sensitive heart Beat sensor to monitor the necessary vitals of the patient and display on a webpage using IOT. When any abnormality in the HB or BP the ventilator bag automatically pumping also according the value of the Sensors the inhalation speed also varying correspondingly. The entire system is driven by arduino controller to achieve desired results and to assist patients in COVID pandemic and other emergency situations. The body temperature sensor LM35 used to sense the temperature of the patient and Pressure sensor used sense the Pressure value and Heart beat sensor to pulse of the patient. All the sensor values processed in Atmega328 arduino controller and checking for the threshold settings. If threshold exists the controller will send a signal to the servo motor in the ventilator mechanism. The NodeMCU IOT module used here to send values to cloud server for doctor checkup from remote. All the Values are displaying in LCD.*

Key Words: *Arduino, IOT, sensors, ventilator, COVID pandemic*

1. INTRODUCTION

A ventilator is a medical technology that provides mechanical ventilation by moving breathable air into and out of the lungs, to deliver breaths to a patient who is physically unable to breathe, or breathing insufficiently. Ventilators are machines that act as bellows to move air in and out of lungs. Our respiratory therapist and doctor set the ventilator to control how often it pushes air into lungs and how much air you get. You may be fitted with a mask to get air from the ventilator into lungs. Transport ventilators, also known as portable ventilators, are mechanical ventilation devices designed specifically for emergency or transport scenarios. Using arduino we can control the entire ventilator system. ventilator should have the option to screen the patient's blood oxygen level and breathed out lung strain to keep away from over/under gastension at the same time. The ventilator we here plan and foster utilizing Arduino envelops of these plan are used to required for the prerequisites to create a solid yet reasonable Low-costportable ventilator to aid seasons of pandemic and the other emergency situations. We here utilize a silicon ventilator pack coupled driven by DC engines with 2 side push system to push the ventilator sack. We utilize an electric switch for exchanging and a variable potto direct the breath length and thus the BPM an incentive for the patient. Our framework utilizes a blood oxygen sensor along with a delicate tension sensor to watch the compulsoryvitals of the patient and show them on a little screen. Likewise, a crisis ringer alert is fitted inside the framework to sound a ready when an abnormality is identified. The whole framework is driven by an Arduino regulator. A ventilator could be a machine that gives breathable air into and out of the lungs, to convey breaths to a truly incapable patient to inhale, or breathingdeficiently.

BPM (Breaths per minute): this is often the set rate for delivering breaths. Range is 10 – 30.

Inspiratory: Expiratory ratio (IE Ratio): refers to the ratio of inspiratory time: and expiratory time.

Flow rate: is that the most flow at which a set tidal volumeof breath is delivered by the ventilator.

Peep (Positive end-expiratory pressure): It's the pressure within the lungs above gas pressure that exists at the top of expiration.

SYSTEM OVERVIEW

The projected system consists of observe the breathing of the tolerant. The setup consists of a ventilator, bpm, switches, and toggles. This project was to develop a low-cost ventilator oppression one or two possible and easily obtain part in an extremely very prompt technique. The hardware strategies enclosed the developed trial of a Low cost portable ventilator.

SYSTEM DESIGN

The diagram of a ventilator using Arduino and IOT with blood oxygen sensing. It is a prototyping technology were accustomed create a medical ventilator. The unnatural physical respire element is joined to the wall oxygen source employing a flow meter as an air reservoir. It is easy to carry one place to another place. Atmega328 is a brain of system. This microcontroller connected with power supply, sensors, Stepper motor to run on the system.

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SOFTWARE APPLICATION

The ventilator running on a arduino IDE . Using the embedded C program code to executes cycle of the dextrorotary or anticlockwise rotations running.

2. LITERATURE SURVEY

The improvement of low-cost, portable ventilators. The ventilator monitoring patients pulmonary conditions. With the assistance of a pressure sensor, we will classify whether the patients are healthy or unhealthy lungs. An Arduino board collects the data from the pressure sensor and display on the LCD screen. The commands the acuter and breathing bag compress accordingly. The pressure sensor can measure differential pressure of up to 70 cm H2O. the gear was attached to the servo meter rod. The rod was made of a Plexi glass bar. The radius of this gear is 2.5cm. Aliaksei Petsiuk, Nagendra G. Tanikella, Samantha Dertinger, Adam Pringle, Shane Oberloier, Joshua M. Pearce, (Partially RepRapable automated open-source bag valve mask-based ventilator)[1]

This text shows the event of a straightforward and easy-to-build portable automated mask value bag. This handle with Arduino controller with the real-time package installed on largely repair 3d printable parameter component-based structure. For Arduino extensively grows the conceivable outcomes of the controller. A real-time software system gives fundamental capacities to software tasks, like planning, dispatching, inter-task communication, and synchronization Couchman, B. A. et al. (Nurses role in prevention and management of mechanical ventilation related complications) (2006)[2].

This text shows the paper that Anwar hussain al,(2020),proposed a method on"Role of clinical engineering To reduce patients risk f actors in life support ventilator". The patients who are unable to take breathe normally is Taken into life support ventilator, which without clinical Engineering professional (CEP) interaction , cannot be kept in safe and functional. The operational characteristics of life support ventilator used in ICU have various risk factors that as ,invasively, or non- invasively perform diagnostic and the therapeutic, corrective, or monitoring intervention of the patients. Here we have presented an approach to develop a standard of risk factor management incorporating the role of CEP to mitigate the risks in the real-time. For clinical setting and safe operation of ventilator devices ,calibration must be ensured in the standard development for proper functioning of the ventilator.

Medical aid and management of mechanically ventilated patients are challenging and requires nursing Mechanical ventilation precipitates several actual and potential complications for critically ill clients. The employment of ventilator care is effective in mechanically ventilated patients producing positive outcomes which carries with it four interventions, those are; elevation of the top of the bed, sedation vacation, peptic ulceration prophylaxis, and deep vein thrombosis prophylaxis. The medical aid practice lacks supportive significant evidence for proving one care approach is healthier than the opposite.within the care of mechanically ventilated patients, the simplest medical aid practice is that the use of the evidence- based practice in conjunction with comprehensive and systematic patients. [4]

This paper describes the look and prototyping of a low-cost portable mechanical ventilator to be used in mass casualty cases and resource-poor environments. The ventilator delivers breaths by compressing a traditional Ambu bag with a pivoting cam arm, eliminating the necessity for an individual's operator for the Ambu bag. An initial prototype is driven by an electrical motor powered by a 12 VDC battery and features an adjustable tidal volume up to a maximum of 750 ml. Tidal volume and number of breaths per minute is set as per the default conditions. Future iterations of the device will include a controllable inspiration to expiration time ratio, a pressure escape cock, an LCD screen, and an alarm to point over-pressurization of the system. Through this prototype, the strategy of automated Ambu bag compression is proven to be a viable choice to achieve low-cost, low-power portable.[5]

3. WORKING

Proposed system is a portable one. Which is helpful for transfer and carry from one place to another place. Its cost is very low compared to medical ventilator. The body temperature sensing the temperature Power supply is the consists of stepdown transformer, rectifier unit, input filter, regulator unit, output filter. The step down transformer is used to stepdown the main supply voltage from 240V AC to DC voltage. Regulator regulates the output voltage to be always constant. The sensors are temperature sensor, pressure sensor ,heart beat sensor, these are used to check and monitor the patients. Servo motor is connected to the arduino to rotate and oxygen flow to the patients. IOT module connected to the Arduino and to monitor and the control the oxygen level.

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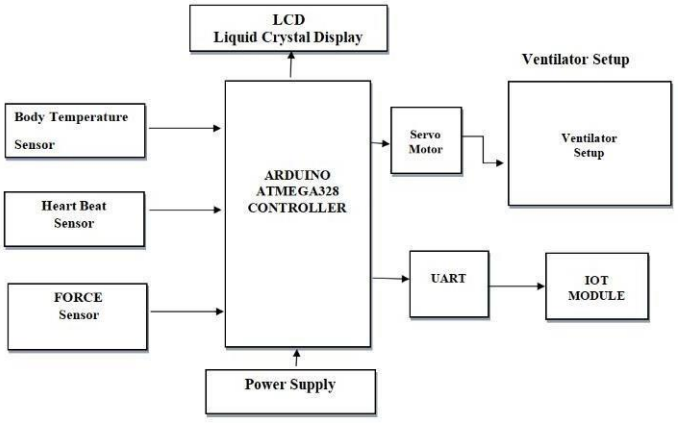
DIAGRAM:



The extension rectifier is used to change ac over completely to throbbing dc. Then, at that point, capacitors go about as channel so we use capacitor for shifting. Transformer is used to supply fixed yield voltage 5V DC. Arduino required voltage is 5V DC supply. A LCD show is utilized for show the message and it likewise required 5V DC supply. Arduino are required three essential need pr supply, reset circuit and oscillator unit. The ventilator we here plan and foster utilizing arduino envelops of those prerequisitesto create ventilator. We here utilize a silicon ventilator sackcoupled driven by DC engines with 2 side push system to push the ventilator sack. We use control for exchanging and a variable pot to control the breath length thus the BPM an incentive for the patent. Our framework utilizes blood oxygen sensor alongside delicate strain sensor to notice thepredetermined vitals of the patent and show on a small screen. Additionally a crisis ringer alert is fitted inside the framework to sound a ready when any abnormality is identified. The whole framework is driven by Arduino regulator to appreciate wanted results and to help patientsin COVID pandemic and other crisis circumstances.

STEP DOWN TRANSFORMER

The Step down Transformer is used to step down the main supply voltage from 230V AC to lower value. This 230 AC voltage cannot be used directly, thus it is stepped down. The Transformer consists of primary and secondary coils. To reduce or step down the voltage, the transformer is designed to contain less number of turns in its secondary core. The output from the secondary coil is also AC waveform. Thus the conversion from AC to DC is essential.

RECTIFIER UNIT

The Rectifier circuit is used to convert the AC voltage into its corresponding DC voltage. The most important and simple device used in Rectifier circuit is the diode. The simple function of the diode is to conduct when forward biased and not to conduct in reverse bias. Now we are using three types of rectifiers. They are

1. Half-wave rectifier
2. Full-wave rectifier
3. Bridge rectifier

INPUT FILTER

Capacitors are used as filter. The ripples from the DC voltage are removed and pure DC voltage is obtained. And also these capacitors are used to reduce the harmonics of the input voltage. The primary action performed by capacitor is charging and discharging. It charges in positive half cycle of the AC voltage and it will discharge in negative half cycle. So it allows only AC voltage and does not allow the DC voltage. This filter is fixed before the regulator. Thus the output is free from ripples.

There are two types of filters. They are

1. Low pass filter
2. High pass filter

REGULATOR UNIT

7805 Regulator

Regulator regulates the output voltage to be always constant. The output voltage is maintained irrespective of the fluctuations in the input AC voltage. As and then the AC voltage changes, the DC voltage also changes. Thus to avoid this Regulators are used. Also when the internal resistance ofthe power supply is greater than 30 ohms, the output gets affected. Thus this can be successfully reduced here. The regulators are mainly classified for low voltage and for high voltage. Further they can also be classified as:

i) Positive regulator
1---> input pin
2---> ground pin
3---> output pin
It regulates the positive voltage.

ii) Negative regulator
1---> ground pin
2---> input pin
3---> output pin
It regulates the negative voltage.

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4. HARDWARE USED

Components used are as follows:

i) Arduino Uno

The Arduino Uno **fig.4.1** is an ATmega328 grounded microcontroller. It features 14 digital I/ O legs, among which 6 can be used as PWM labors, the rest of the legs include 6 analog inputs, a 16MHZ demitasse oscillator leg, power jack point, USB connection harborage, an ISCP title leg, and a reset button. It can be powered either by with a USB string or with an AC- to- DC attachment or a battery. Though this board can accept voltages between 7 to 20 V, its operating voltage is 5V. This board can be programmed using an open-source software tool Arduino IDE.

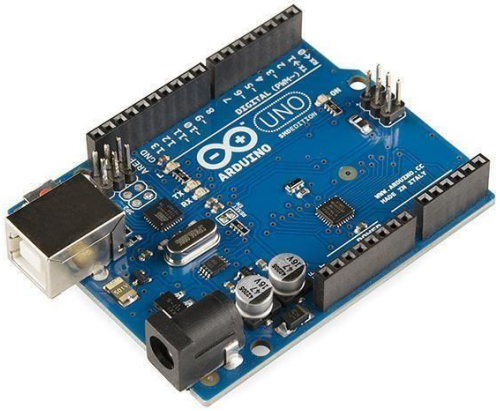

Fig.4.1 Arduino

ii) Pressure Sensor

A pressure sensor **Fig.4.2** might be a device for pressure measurement of gases or liquids. Pressure is an expression of the force necessary to prevent a fluid from expanding, and is usually stated in terms of force per unit area. A pressure sensor typically acts as a transducer; it generates a proof as a function of the pressure forced. Pressure sensors are used for control and monitor in thousands of each day of the sensor and it is used to monitor the pressure BPM of the blood pressure level in the pressor sensor. It is used to monitor the pressure inside the chamber and control the amount of pressure applied during treatment. This will typically take the form of an absolute pressure sensor capable of measuring pressure up to 100 kPa. A pressure sensor is usually acts as a transducer. It generates a signal as a function of the pressure imposed. The treatment involves using a device called a continuous positive air pressure which delivers a at a positive pressure to a mask worn over the nose and mouth of the patients. An airflow pressure sensor is used to monitor the air pressure ,detecting when the patient is breathing in and immediately turning on a fan to create positive pressure to open the airways. As the patient breaths out the fan is deactivated , allowing the ptient to exhale without forcing them to fight against the positive pressure. Pressure sensors are often classified in terms of pressure ranges they measure, temperature ranges of operation, and most extensively the kind of pressure they measure. Pressure sensors are variously named in step with their function, but the the same technology could also be used under different names.

Fig.4.2 Pressure sensor

iii) 16x4 LCD Module

LCD Module **Fig.4.3** LCD stands for liquid Display. The LCD screen is an alphanumeric display and it's various applications in several fields. This display might be a very essential module and is most normally employed in devices and circuits. A 16 x 4 LCD means it will be wont to display a maximum of 16 characters per line, and there are two such lines. Each character through this LCD is displayed in a very 5x7 pixel matrix format. The digital display is capable to display 224 various characters and symbols in two modes 4-bit and 8-bit. It consists of 16 pins. this may be operated between 4.7 V to 5.3 V.

Fig.4.3 LCD

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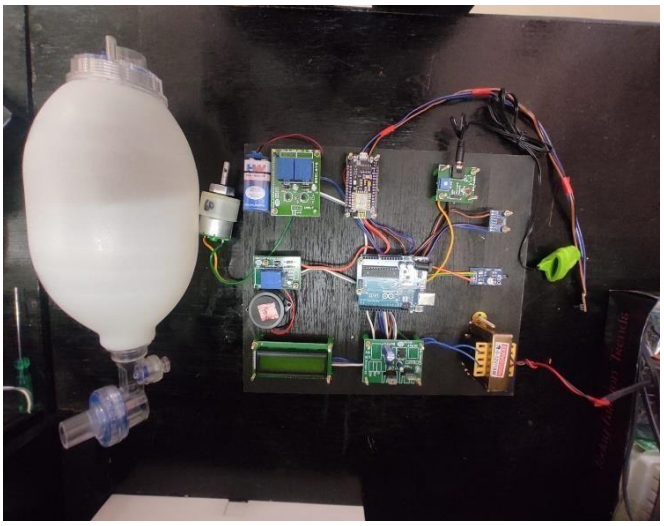
5. RESULT



Temperature	ECG (BPM)	Blood pressure	State
37	95	118/75	No oxygen Required.
37	90	120/80	No oxygen required.
38	60	95/85	Oxygen Required.
39	70	90/60	Oxygen Required.

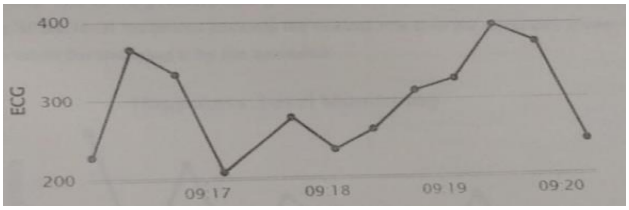


Fig.Normal ECG waveform

The project describes final results of a proposed system. The proposed system starts and battery charger level Verification done. After verification, the system proceeds to microcontroller. This ventilator will predict of an individual on the basis of his / her ECG, blood pressure, body temperature , and oxygen level of the patient. The deep learning algorithm will take parameter like ECG, oxygen level ,blood pressure, body temperature which is linked with Arduino microcontroller. This type of ventilator is a IOT based technology. In future to provide an additional feature of automatic remote or mobile phone control ventilator. It is used to control everywhere and monitor the patients in everywhere. Develop the ventilator it is more useful for patients and doctors.

6. CONCLUSION

This work proposes the design of a low-cost artificial ventilator in which mechatronic design strategies and manufacturing techniques based on rapid prototyping were implemented. To guarantee the robustness and effectiveness of the proposed design, a robust control scheme based on a sliding mode super-twisting controller is used which allows the proper trajectory tracking control and enables to follow the required respiratory profiles. experimental results validate the effectiveness of the proposed controller and mechatronic design. As future development, it is proposed to work toward the grant of the certification of this prototype in order to be used in the medical sector.

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