"OPEN SOURCE VENTILATION USING IOT"

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ABSTRACT

Corona virus Disease 2019 (COVID-19) threatens to overwhelm our medical infrastructure at the regional level causing spikes in mortality rates because of shortages of critical equipment, like ventilators. Fortunately, with the recent development and widespread deployment of small-scale manufacturing technologies like Rap-class 3-D printers and open source microcontrollers, mass distributed manufacturing of ventilators has the potential to overcome medical supply shortages. In this study, after providing a background on ventilators, the academic literature is reviewed to find the existing and already openly-published, vetted designs for ventilators systems. These articles are analyzed to determine if the designs are open source both in spirit (license) as well as practical details (e.g. possessing accessible design source files, bill of materials, assembly instructions, wiring diagrams, firmware and software as well as operation and calibration instructions). Next, the existing Internet and gray literature are reviewed for open source ventilator projects and designs. The results of this review found that the tested and peer-reviewed systems lacked complete documentation and the open systems that were documented were either at the very early stages of design (sometimes without even a prototype) and were essentially only basically tested (if at all).

Keyword: *IOT(Internet of things),AMBU BAG, Application Patience Hospitalization Condition checking.*

INTRODUCTION

An open-source ventilator is a disaster-situation ventilator made using a freely licensed (open-source) design, and ideally, freely available components and parts (open-source hardware). Designs, components, and parts may be anywhere from completely reverse-engineered or completely new creations, components may be adaptations of various inexpensive existing products, and special hard-to-find and/or expensive parts may be 3D-printed instead of purchased. The first mechanical ventilators date back to more than 150 years ago. In the time since, they have undergone considerable design modifications; including, crucially, the transition from pure mechanical devices to the modern electronic machines in use today. Despite their commercial availability, very few platforms have been made open and fully transparent. Such a platform will enable the production of high-quality devices in virtually any laboratory, will further efforts in teaching and research/development, and may serve as development platform for a future medical tool. In response to these challenges, we present an open-source, rapid-deploy ventilator design with minimal reliance on specialized medical devices and manufacturing equipment. The People's Ventilator Project (PVP1) is a pressure-controlled and fully automatic mechanical ventilator that can be built for $1,700 by a single person in few days. As a point of reference, the lower-end average market values of open ventilators such as the freely-released Puritan Bennett 560 or the Mechanical Ventilator Milano cost approximately $10,000. PVP1's parts were selected for widespread availability, and its modular software was designed to support component substitutions and extensions to new ventilation modes. Further, we have included comparisons here to commercial, pediatric-grade ventilators to emphasize the versatility of PVP1 and the goal of increasing global access to critical-care ventilation technology and making such technology available for teaching and research.

PROBLEM STATEMENT

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.

While the ventilators utilized in current emergency clinics are exceptionally practically and innovatively complex, their obtaining expenses are correspondingly high.

OBJECTVES

The clinical objectives of mechanical ventilation can be highly diverse: To maintain gas exchange, to reduce or substitute respiratory effort, to diminish the consumption of systemic and/or myocardiac O2, to obtain lung expansion, to allow sedation, anesthesia and muscle relaxation, and to stabilize the thoracic wall.

1. To save time 1and money

2. To make easy to use ventilator

3. To Reduces unwanted cost of technical manpower

4. To display the heart rate and spo2 of patient so that nurse or doctor can change ventilator configurations

5. Build a continuous positive airway pressure device.

6. Helps you breathe when you're sick, injured, or sedated for an operation.

7. It pumps oxygen-rich air into your lungs.

8. It also helps you breathe out carbon dioxide, a harmful waste gas your body needs to get rid of.

HARDWARE COMPONENT

1. ARDUINO UNO

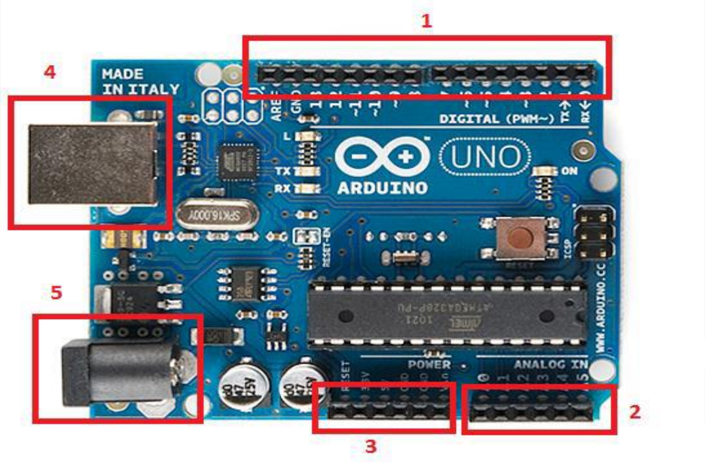


Fig1.1Arduino Uno

The Arduino Uno development board is based on the Atmel ATmega328, an 8-bit, 16 MHz microcontroller with 14 digital input/output (I/O) pins, 6 of which are capable of pulse-width modulation (PWM), as well as a 6-channel, 10-bit analog-to-digital converter. Digital communication capabilities include UART TTL serial, SPI serial, and two-wire interface serial (I2C). The Arduino development platform features a cross-platform, Java-based IDE as well as a C/C++ library which offers high-level access to hardware functions. LCD has 2 Power Sources.

2. Wi-Fi Module

Fig1.2 ESP 01 Wi-Fi Module

The ESP8266 ESP-01 is a Wi-Fi module that allows microcontroller access to a Wi-Fi network. This module is a self-contained SOC (System On a Chip) that doesn't necessarily need a microcontroller to manipulate inputs and outputs as you would normally do with an Arduino, for example, because the ESP-01 acts as a small computer.

3.LCD

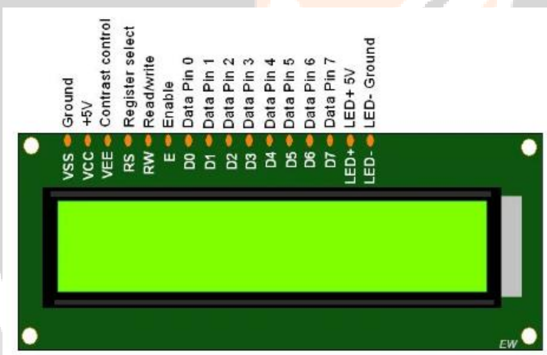


Fig1.3 LCD

A 16x2 LCD (Liquid Crystal Display) Module is a common type of character display used in various electronic projects. Here are the specification typically associated with a standard 16x2 LCD module: when using a16x2 LCD module, you typically control it by sending commands and data through a microcontroller such as an Arduino or raspberry Pi, allowing you to display information like sensor redaing, messages, or menu options.

4.ServoMotor

Fig1.4 LCD

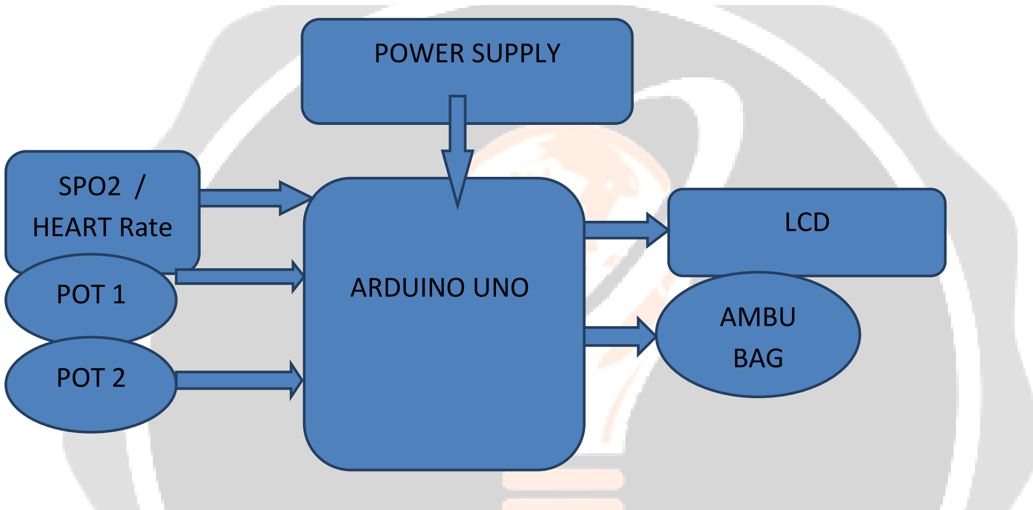
A servo motor is defined as an electric motor that provides precise control of angular or linear position, speed, and torque using a feedback loop system

MEHODOLOGY

1.Amid the global crisis caused by the corona virus pandemic, hospitals and healthcare facilities are reporting shortages of vital equipments.

2.As makers it's our responsibility to combat the shortage by constructing makeshift-open-source substitute devices. Our country might be in a lock down but our ingenuity

BLOCK DIAGRAM



3.One important device for which demand has ramped up is ventilators for patients who need assistance with their breathing due to the respiratory effects of COVID-19.

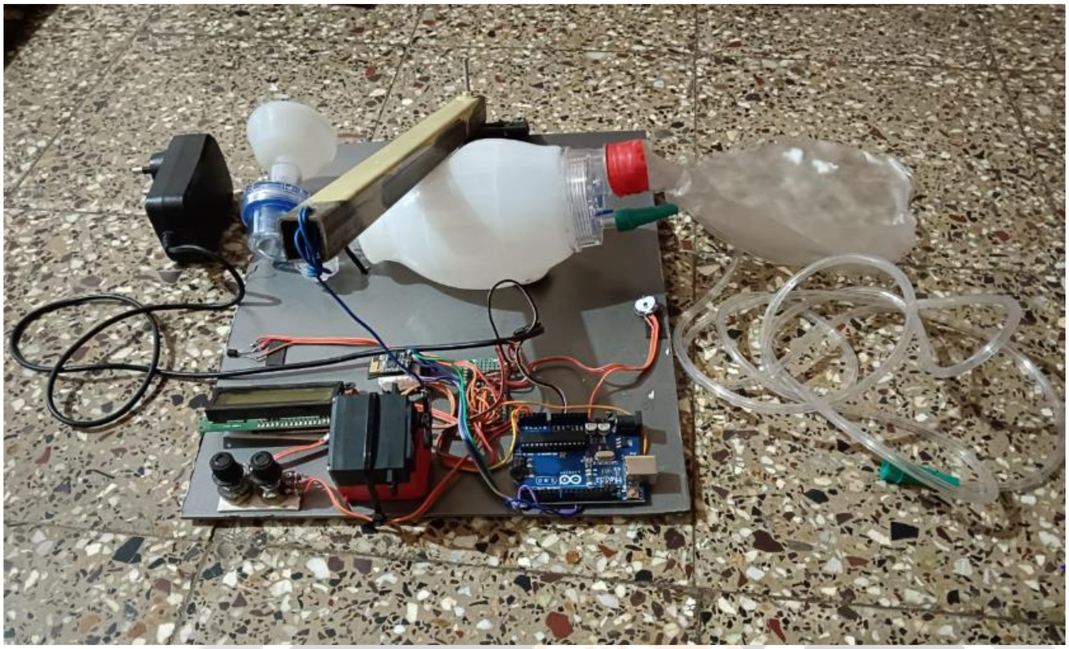
4.Basically a ventilator is a machine that provides breathable air into and out of the lungs, to deliver breaths to a patient who is physically unable to breathe, or breathing insufficiently.

5.A DIY ventilator may not be efficient as that of a medical grade ventilator but it can act as a good substitute if it has control over the following key parameters Tidal volume: It's the volume of air delivered to the lungs with each breath by the

- ventilator - typically 500ml at rest.
- BPM (Breaths per minute): This is the set rate for delivering breaths.
- Inspiratory: Expiratory ratio (IE Ratio): refers to the ratio of inspiratory
- time: expiratory time.
- Flow rate: is the maximum flow at which a set tidal volume breath is delivered by
- the ventilator
- Peep (Positive end expiratory pressure): It is the pressure in the lungs above atmospheric pressure that exists at the end of expiration.

My design is based on the automation of the manual BVM (Ambu-bag),which you can find in any medical supply store. It is a hand-held device commonly used to provide positive pressure ventilation.

HARDWARE SYSTEM DESIGN



SOFTWARE SYSTEM DESIGN

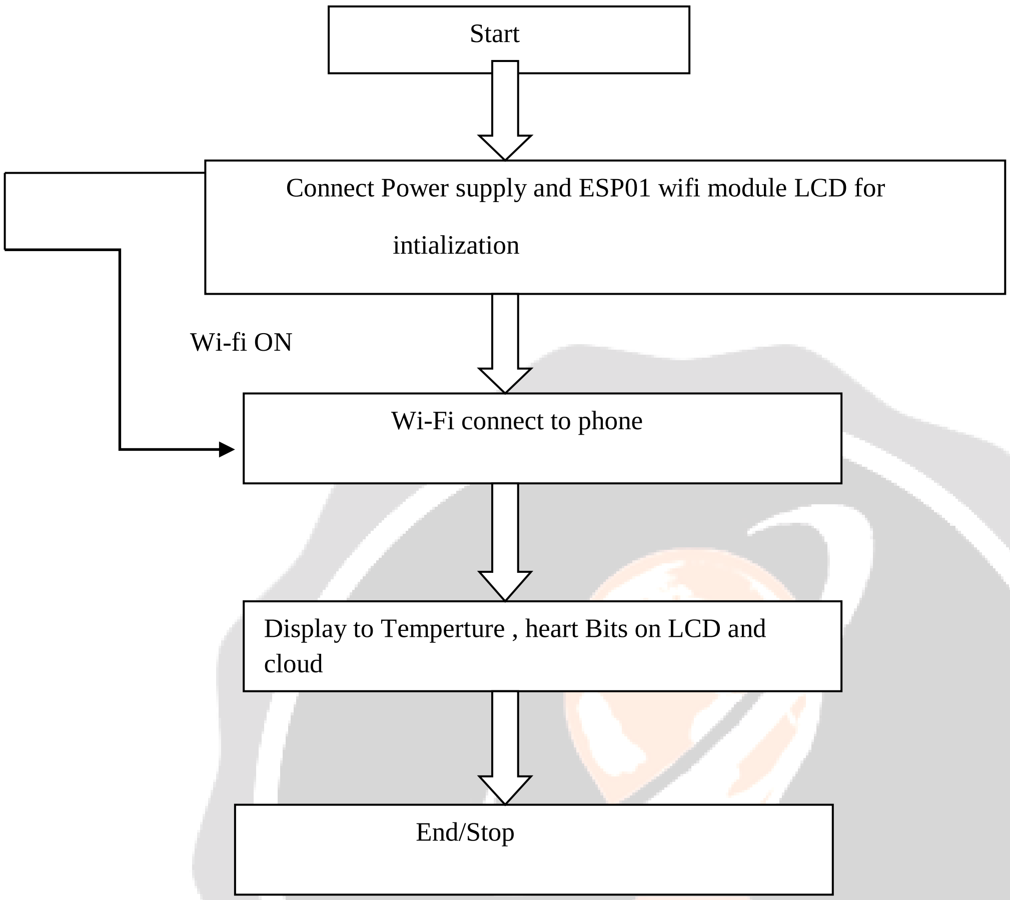
1.ARDUINO IDE (Programming)

The Arduino Integrated Development Environment (IDE) is an open-source software tool used for programming Arduino Boards.It provides a user-friendly interface and a set of libraries that make it easy to write,compile and upload code to Arduino microcontroller
Code Editor: The main code, also known as a sketch, created on the IDE platform will ultimately generate aHex File which is then transferred and uploaded in the controller on the board.

2.THING SPEAK

- Things Speak is a versatile IOT platform that is widely used for implemenating open source ventaliation with advanced features like real time monitoring ,data analytics ,and control capabilities.
- When integrated with IOT – enabled Ventalition , Things Speak allows for seamless communication Temperature sensor, Heart Bit senser, Heart rate sensor.
- One of the day advantages of using Thigs Speak app conjuncation with IOT – based Open source ventalition its ability to collect and analyze large volumes of data generated by the open source ventalition.
- To show graph Things Speak app easy to analyzing data of Temperature sensor, Heart bit sensor, Heart rate Sensor

Flow chart



ADVANTAGE AND LIMITATION

1.1 ADVANTAGE

1.It’s more comfortable than a breathing tube that goes down your throat.

2.It doesn’t require sedation.

3.It allows you to talk, swallow, and cough.

4.It may lower the risk of side effects and complications, such as infection and pneumonia, which are more common with breathing tube ventilation

1.2 LIMITATION

This low-cost, open-source mechanical ventilator has never been used in animals. For this reason, the results presented in this paper preclude their interpretation for in vivo lungs. Anatomy and physiology of the lungs cannot be oversimplified by an Ambu bag. For this reason, it is difficult to predict whether our algorithm will work in experiments involving in vivo lungs. In summary, the experimental data presented here were taken in a laboratory environment that considered electronic and mechanical parts only. Understanding the potential and consequences of using this low-cost mechanical ventilator in the lungs requires more research. Attempts to use it in lungs should be made with care

RESULT

1. Data Saving: The system allows for the storage and saving of monitored data, temperature readings.
2. .Graphical Representation: The system provides graphical representation of the monitored data, allowing for easy visualization and analysis of battery performance temperature variations
3. In summary, the expected results include enhanced temperature regulation, stability and reliability of the Heart rate sensor monitoring, , graphical representation for easy visualization and analysis, data analytics capabilities to identify usage patterns, detect anomalies, and provide performance trends considering temperature variations, such as low

CONCLUSION

There is clear technical potential for alleviating ventilator shortages during this and future pandemics using open sourceventilator designs that can be rapidly fabricated using distributed manufacturing. The results of this review, however, found thatthe tested and peer-reviewed ventilator systems lacked complete documentation and that the current open systems that were documented were either at the very early stages of design or had undergone only early and rudimentary testing. With the considerably larger motivation of an ongoing pandemic, it is assumed these projects will garner greater attention and resources to make significant progress to reach a functional and easily replicated open source ventilator system. There is a large amount of technical future work needed to move open source ventilators up to the level considered adequate for scientific-grade equipment and further work still to reach medical-grade. Future work is needed to achieve the potential of this approach not only on the technical side, but lso by developing policies, 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.

The designing and development of Power Supply for Ventilator is done through UPS system. The designing of various components is done according to the Texas Instruments Standards and the obtained values are verified by simulating the circuit in the MATLAB Software. In the proposed system, the DC power supply of 48V is designed for the Mechanical Ventilator by implementing Forward converter along with Boost PFC converter Circuit. Both the converters are closed-loop controlled in order to get the required constant output voltage. The filtering is done using low pass filter for filtering the dc input fluctuations. Feedback is taken from the converter output and fed to the PID controller and PID Controller is used for controlling output voltage using proportional, Integral and derivative

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