IoT BASED SMART VENTILATOR

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Keywords:

Internet of Things (IoT), Ventilator, SPO_2, CAM (Computer Aided Manufacturing), Ambu

Introduction:

Positive pressure ventilation has been an important components of respiratory disease management for the last 50 years. External instruments called ventilators are intended to provide artificial breath to a patient. In view of the covid 19 pandemic and its cause of respiratory distress. Low cost, portable, fast reproducible and accurate ventilators are the need of hour. The ventilator serves to exhale gas (oxygen) into the patient's lungs and helps strengthen the work of the respiratory muscles. The IoT based smart ventilator uses computer aided manufacturing (CAM) principle embedded with IoT. One of the fastest growing internet of thing application is in medicine called the medical IoT. The functions and benefits of internet networks such as sharing data, remote control and soon can connect objects in the real world, so that objects in real world can communicate with each other. Through IoT results such as temperature. Pulse rate, heartbeat, SPO_2 can be communicated or monitored an LCD rate, heartbeat, SPO2 can be communicated or monitored on LCD will display the data of sensors.

Objectives:

1. The motivation for constructing this kind of ventilator comes from the worldwide shortage of mechanical ventilator for treating covid 19 patients.
2. Devising a mechanical ventilator that should allow users to set:
    a. The ratio of Inspiration to each Expiratory cycle (I: E)
    b. Air volume supplied to the cycle.
3. Devising a mechanical ventilator that has features like Portability, Simplicity, Fast reproducibility, Proximity, Robustness.
4. To develop a health monitoring system i.e., it measures body temperature and heart rate.
5. Power requirement is very low and running for 3.5 hours on one battery charge at its most demanding setting. Battery backup also need to be checked.
6. Devising a mechanical ventilator that have controlled respiratory rate and tidal volume.

Methodology:

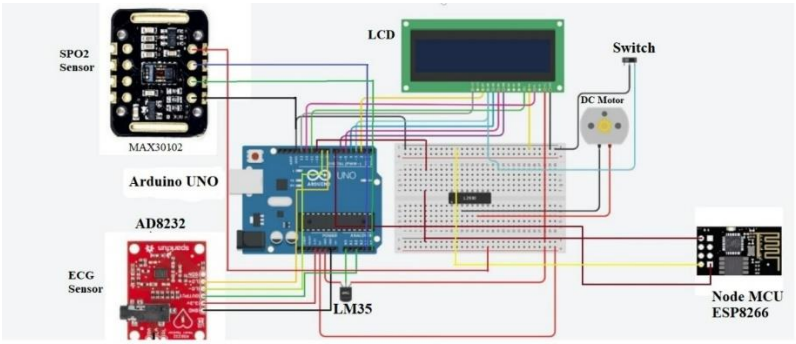
Components Required: ESP8266 Wi-Fi module, Arduino UNO, 16*2 LCD Display, I2C Module, AD8232 ECG Sensor, MAX30102 SPO_2 Sensor, LM35 Temperature Sensor, DC Motor, L293D Motor Drive IC

Working Principle:

The Proposed system is based on CAM (Computer Aided Manufacturing) principle and it has some features of controlling precisely with portability, battery operated, reduced size and noise removal. The arrangement is divided into two parts. One part consists of SPO2 Sensor, ECG Sensor which measures the oxygen saturation level, Heart Rate of the patient's blood. This is very important to monitor whenever the patient is at risk and same would be stored in the cloud server. Along with this temperature sensor is used to measure the body temperature of the patient. Node MCU ESP8266 is a Wi-Fi module, is used for communicating the results to online webpage and can also be monitored on LCD that will display the data.

Another part is a low-cost ventilator arrangement which consists of Arduino UNO, DC motor, switch, rechargeable 12V battery, and LCD. DC motor give pressure to Ambu bag connected with it. DC motor is used for compressing the Ambu bag which is controlled by Arduino Uno. 12 V rechargeable battery is used as power supply to the ventilator.

Circuit Diagram:



Results:

• The proposed project will minimise the components. Anticipation of a good comfort and most likely reliable, it can be used in emergency.

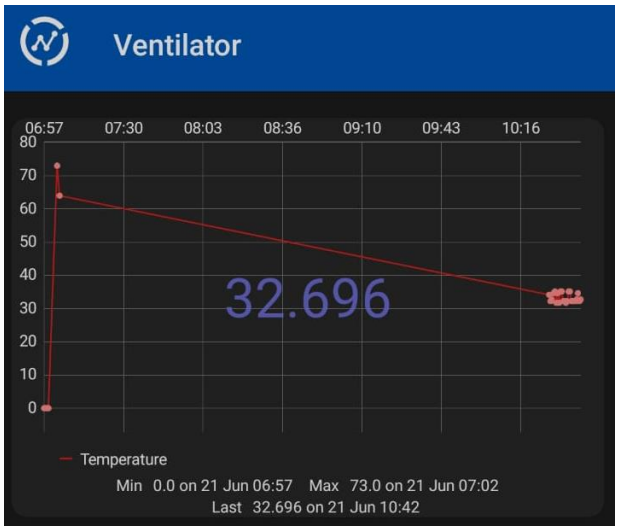
• Mechanical ventilator is not only simple and portable but also fast reproduceable and cost effective.

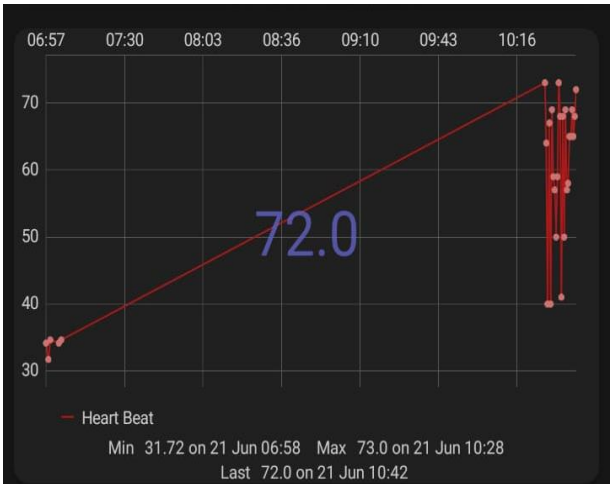
• The proposed system will able to measure Heart Rate, Body temperature, Pulse rate and SPO2 of a patient in real time.

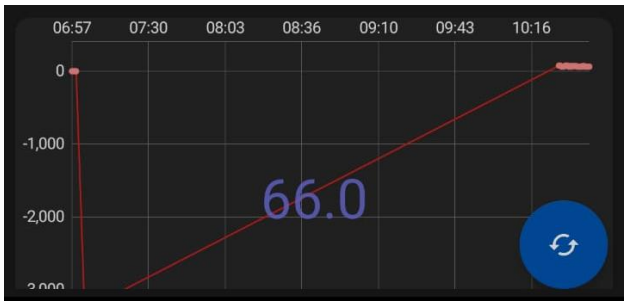
Results with reference to our work are shown below.

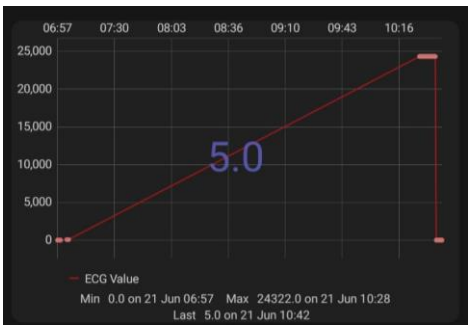
1) LCD Display

2)









Conclusion:

In this proposed project, a prototype device to assist the patients who can partially breathe by their own is developed. The motivation come from world-wide shortage of mechanical ventilators in the treatment of covid-19 patients. This device is provided with very basic design and reliable structure that is easily acceptable by the patient. Main focus

in this model is to minimize the components and increase its efficiency, so that while using this device to the patient, they should feel as comfortable as the normal ventilator. The biggest advantage of our system is that it includes health monitoring system where it measures body temperature, heart rate, oxygen level in blood. Through IoT it ensures the patient is under control and adequate action can be taken. Thus during pandemics doctors can monitor patient via online in real time.

Scope For Future Work

- Alert system:

Any low level of oxygen can be detected using a Buzzer. A built-in alert system can be embedded to active and warn the local and remote locations about any malfunctioning for immediate attention.

- IoT based ventilator:

The last few years have seen exponentially growth in wireless communication technologies with the emergency of 5G, artificial intelligence, robotic, cloud computing wireless sensor network. A ventilator can be monitor remotely by a mobile application using advance technology and IoT devices. And IoT based ventilator can be design to display output and parameters in applications using graph widgets which provide low latency, enhanced and fast service, location awareness notification services etc

- An alternator ventilator controlling system

The IoT based ventilator can be embedded with PMW controlling system with the main control chip using ESP32. The use of ESP32 chip aims to control IoT based ventilator with Bluetooth communication so that distance can be maintained. In addition to the IoT based monitoring and controlling functions. The ventilator can also be adjusted with several control buttons provided near the system.

- Safety mode:

An alternator power source can be embedded so that when power goes down the back up battery automatically kicks in.