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FABRICATION OF MECHANICAL VENTILATOR WITH MEDICAL PARAMETERS

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Abstract: The ventilators used in the hospitals are specified only for breathing purposes and are also costly. even the multi-specialty hospitals cannot buy them in bulk, due to which our country has faced difficulty in shortage of ventilators during the outrage growth of a covid virus. During the lockdown period, due to less pollution, the oxygen levels increased in nature but, the fate was we were not able to supply that for those who are in extreme need of it and many deaths and pains occurred during this period. The large availability of these ventilators could have saved many lives. In concern with this and to eradicate this situation in the future, with the help of trending technology Internet of things, we have developed a low-cost mechanical ventilator with medical parameters added to it so it can be used in finding other health-related issues. The main concern here is to get in ease the essentials of our project to those who are in need and at a low cost. The operation of this model is controlled with the help of an Arduino UNO microcontroller and the switching operation of the model is controlled by the mobile app. The actual mechanical work is performed by the dc motor. The model consists of several sensors which are used to collect the level of oxygen in the blood, pulse rate, and the temperature of the body. When these values are below normal then the patient's condition is not good and indicates us to switch on the ventilator.

Index Terms **- Ventilator, Health, Mobile app, Low-Cost.**

I. INTRODUCTION

A mechanical ventilator is a machine or device used for mechanical ventilation, which is beneficial to ventilate patients who are physically unable to breathe. This machine works on an IoT [Internet of Things] concept. In the covid situation, we have been an enormous number of demands for ventilators in the treatment of covid-19 patients. The outcome of this shortage is terrible, especially in underprivileged areas. Even well-resourced hospitals have a protocol of sharing the same ventilator between two patients due to this the virus spreads to other patients also due to scarcity of ventilators. To avoid this problem, we can produce an affordable, open-source mechanical ventilator.

During the pandemic time loss of life dramatically increased where the number of patients in need of hospital care. a lot of cases come across respiratory distress this condition can be treated using a mechanical ventilator. It is an alternative to a hospital ventilator which is a simple, cost-effective, and lower capability for controlling air flow during ventilation. the Mechanical ventilator can harm the lungs, the most repeated types of damage are volutrauma and atelectrauma.

Volutrauma creates an inflammatory reaction, that leads to the rupture of the alveolar walls. Atelectrauma can be caused by inadequate ventilation. Physicians suggest doing mechanical ventilation with positive end-expiratory pressure (PEEP) to avoid atelectrauma. PEEP is a pressure applied by the ventilator at the end of each breath to make sure that the alveoli are not so prone to collapse.

It also contains a patient monitoring system, which is used to monitor the patients' vital functions, which monitors oxygen level, temperature, and pulse here IoT technology provides convenient features for remote control. The IoT network can be controlled using Bluetooth, wi-fi, or the internet. It is likely to implement a monitoring and control system.

The main aim of this paper is to design a cost-effective, simple, open-source mechanical ventilator for patients with covid-19. An electronic machine that has been generally used in this affordable inventiveness is the ESP microcontroller. ESP microcontroller is a cost-effective wi-fi microchip, which consists of built-in TCP/IP networking software and microcontroller capability. In summary, the prototype was designed for all cases of patients with breathing problems, mainly for patients with covid-19.

2. Existing method

The existing ventilator is the one that is used in the hospital, these ventilators are high cost to purchase for their purpose. Hospitals provide them with daily rental basics which is also high. These ventilators can only be affordable by hospitals and some

people, sometimes even hospitals cannot buy them in bulk when needed immediately during the covid times' many breaths were stopped due to the shortage of these ventilators.

The external gas cylinder must be required for the supply of oxygen to the patient which the ventilator is a waste and there is a worldwide shortage in the production of oxygen. These ventilators don't have many specifications and these are particularly built for only breathing purposes. These ventilators work only with the help of a continuous power supply and the construction and maintenance are more complex. The installation also requires more skills. The monitoring and operations of these ventilators require more skills that cannot be handled by common people

3. Proposed System

This paper proposes a model where the sensors are just placed on the outer surface of the patient's body which detects the oxygen level, temperature, and pulse rate of the body and these data is been sent to the microcontroller and it displays the data is been though the mobile blynk application the controller who is controlling the mechanical ventilator will decide whether to turn mechanical ventilator or off depending on the values of the sensors.

The mechanical ventilator will be connected to the microcontroller and it consists of a fiber packet that compresses and rare fraction so that the air is pushed through the pipe. The recorded results have to be manually entered to the GUI form which is converted to python and run in Jupiter notebook so it advises that das to be followed by the patients do e by using machine learning

4. Implementation

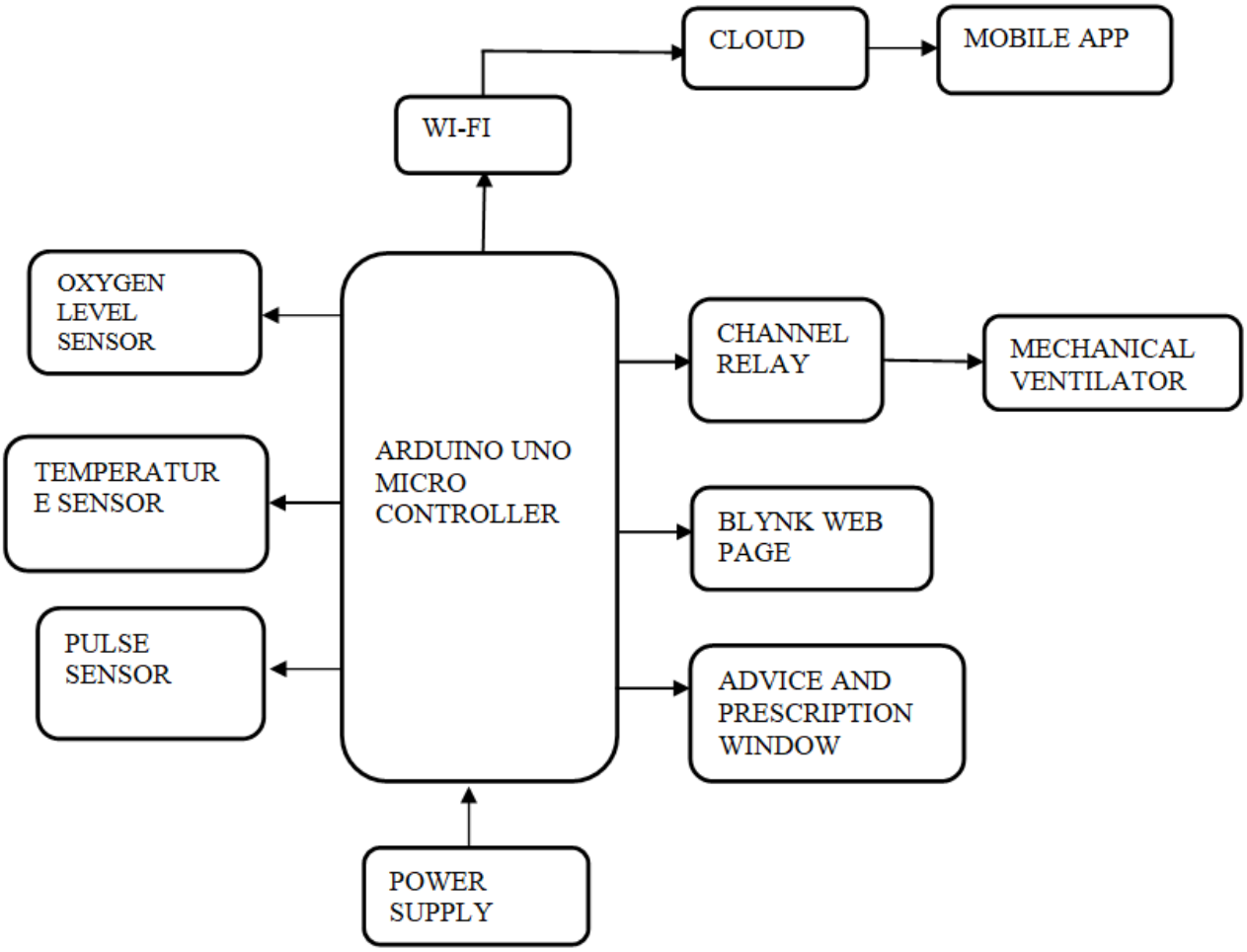

Fig 1: Block diagram

The proposed paper consists of L shaped rigid surface, on which the fiber packet is placed. The other empty side of the packet is covered by placing a movable thin wooden sheet. This wooden sheet is given the support for mobility by the DC motor whose needle part is intern connected to an oval shape metal ring. Whenever the dc motor rotates if a region with an intern pushes air through the pipe and when the region with the lowest diameter of ring presses the wooden surface it completely relaxes the fiber packet. This function of the mechanical ventilator will be controlled by the wireless mobile application. These control and operation are all done through an Arduino microcontroller as the mechanical ventilator will be connected to Arduino through the channel relay. The pulse sensor, blood-oxygen sensor, and temperature sensor are the non-invasive sensor placed on the patient's body. The readings of these sensors are collected and displayed on the mobile application. Based on the results the switching on and off of the ventilator is decided. Once the patient returns to the normal conditions, it can be turned off the prescription window, which gives the advice and prescription whenever the sensor values are entered into it manually is built by software tool using python libraries and machine learning algorithms. The GUI form is created through the designer.exe tool and is then converted to python programming. The convert python file is the backend program. By adding functions that perform the necessary action, the output is made to display on the window

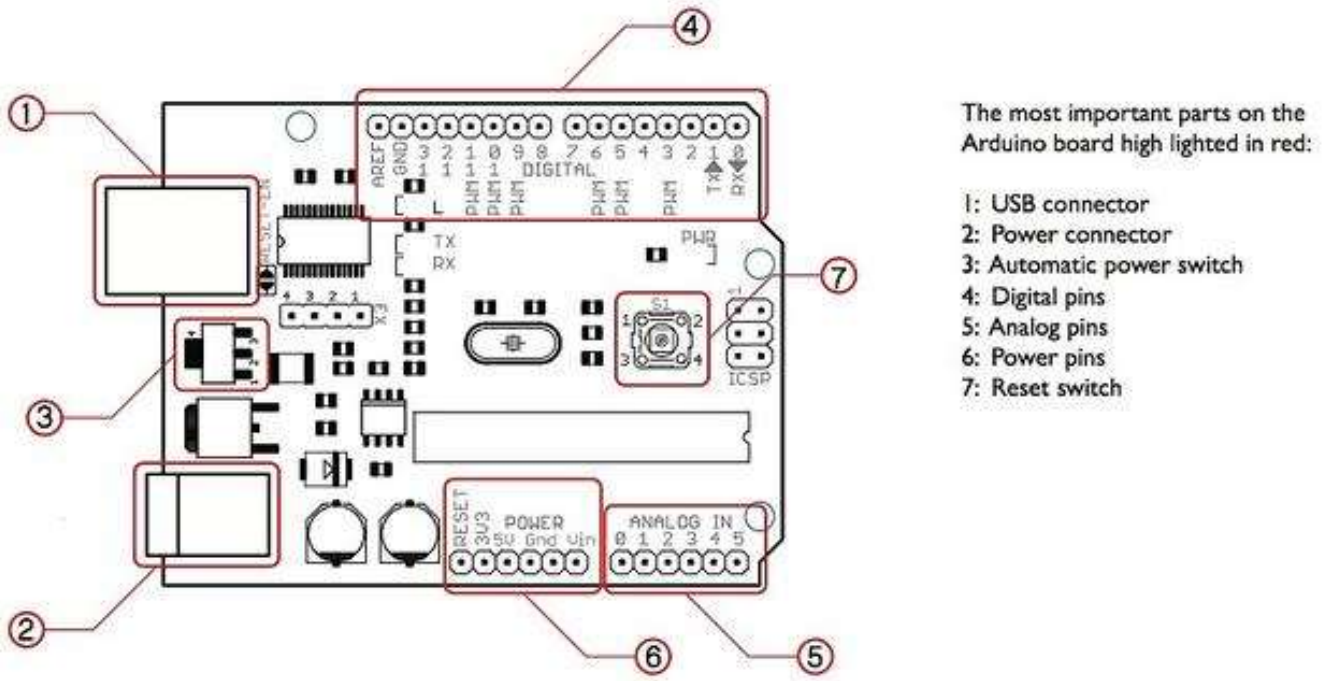

Fig 2: Arduino connections

5. Hardware parts

- Arduino Uno
- Pulse sensor
- Blood oxygen sensor
- Temperature sensor
- DC Motor
- Channel relay
- Wooden sheets

6. Software parts

- Arduino ide
- Jupyter notebook
- Blynk app

7. Design Methodology

The figure 3 shows the flow of the process of the model. The sensors sense different values like pulse rate, blood oxygen level, and the temperature of the patient's body. The readings are displayed on the blynk application. There are two ways to know whether ventilation is required or not, one is just by handling the values and turning them on and the second method is for those who don't know how to analyze the sensor reading, just by feeding the readings into output window, the windows advise the controller whether to switch on or off the ventilator. once the patient is recovered to the normal state, then the ventilator can be turned off, otherwise, it can be continued to run.

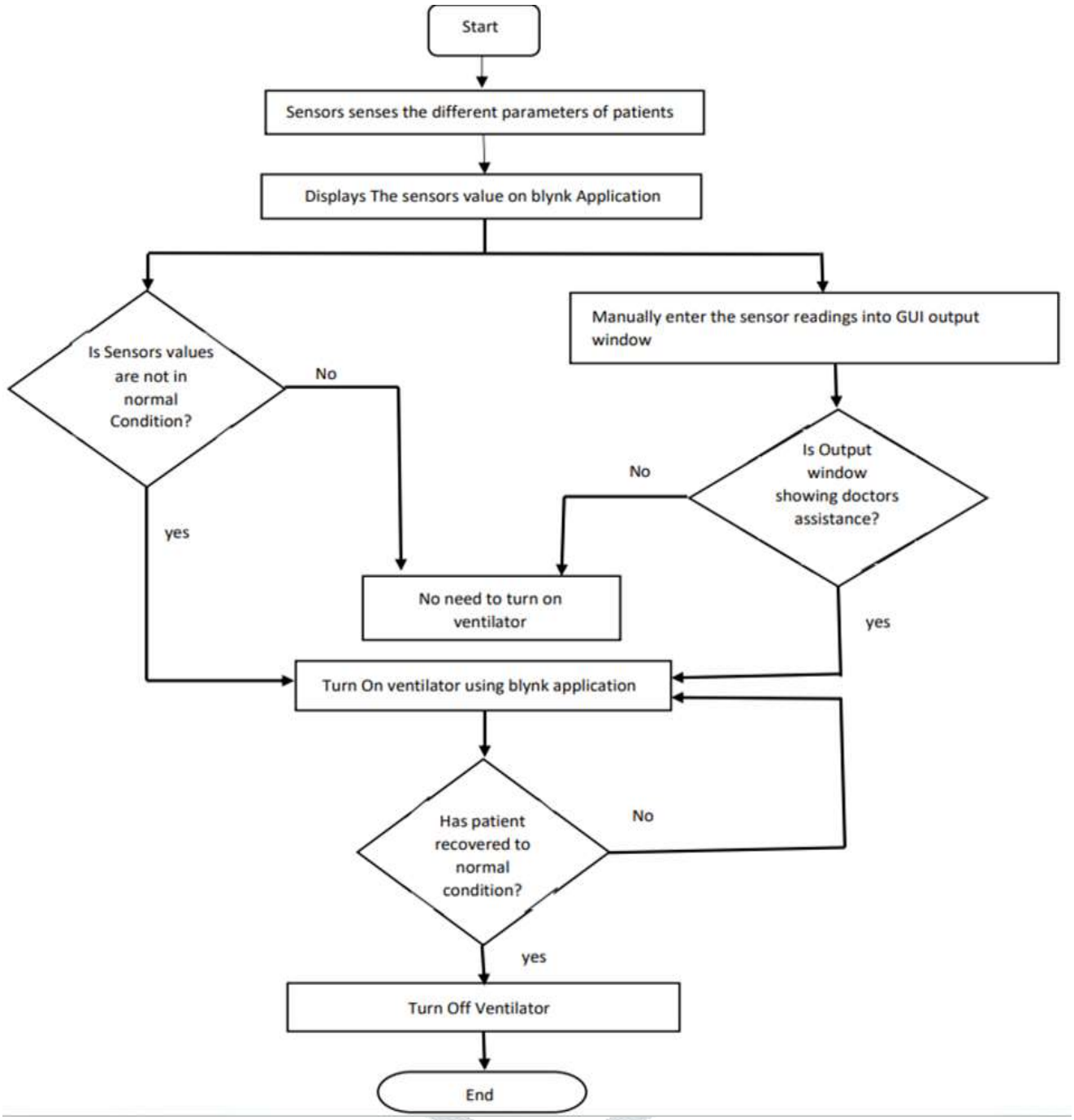

Fig 3: Flow chart of Working

8. Advantages

- The main advantage is that it is of low cost.
- This mechanical ventilator is multifunctional as it has sensor technologies in addition to ventilation properties.
- It is easily portable so that one can use it anywhere and whenever needed.
- The installation and monitoring require less skill, which makes this model user-friendly and easy to access.
- The maintenance cost is also much lesser than the existing ventilator.
- The device is also displayed in the output window, so even if one doesn't know how to analyze and monitor the ventilator will be assisted.
- Contactless treatment to the patient can be achieved which reduces the spread the contagious diseases.

9. Results

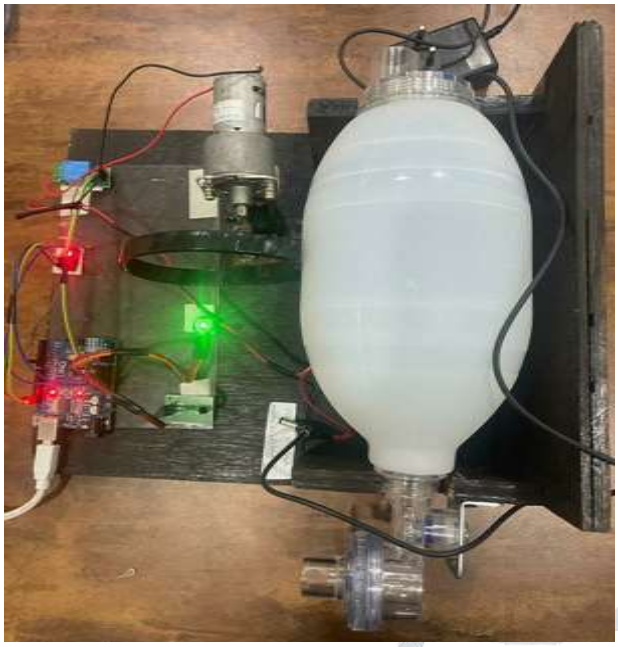

Fig 4: Final model of ventilator

Fig 5: Readings in blynk app

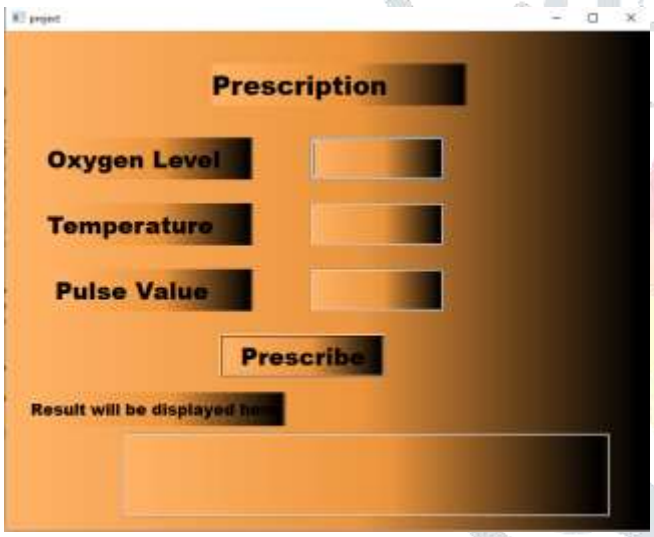

Fig 6: Output window before entering readings

Fig 7: Output window after entering readings

10. Future scope

- The ventilator that is mentioned in the paper can only be used when it is only during the initial stages of breathing problems, so it can be enhanced such that it can be checked even in extreme conditions by using high-quality motors and with a greater power supply.
- Only 3 non-invasive sensors are used, in addition to these extra sensors like blood pressure sensors and other sensors can be used so that the health condition can be monitored more specifically.
- The readings of sensors are made to be displayed on the blynk application and it can be further developed that the readings can be sent as a message to the person who is taking care of the patient.
- This can be used as the emergency kit in every public place like railway stations, buses, malls, and schools everywhere as we use the first aid kit, which helps in saving many lives.

11. Conclusion

We all know that India is a populated country. in the future, the population further increases. At that time, if a contagious disease like covid strikes again, it would be very difficult to handle the situation as the world already suffered a lot due to a shortage of resources. These situations can be overcome by the pre-planned arrangement of equipment that helps in saving the victim from diseases. This paper shows one such technology that helps in saving a victim who is suffering from a breathing problem. This type of model is very much useful even when the pandemic is not there as the existing ventilators are highly expensive, so in concern with providing ventilation to each and every one who needs it but cannot afford the cost, this can be provided as it is of low cost. These things are used in emergency cases, not at an extreme level where a little amount of extra time can save a life. These kinds of technologies are the most required things in the future.

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