Internet of Things based Portable Ventilator using Arduino Nano to Monitor Patient Health

Dr. S.K. Pahuja
Instrumentation and control Engineering
Dr. B.R.Ambedkar national institute of technology
Jalandhar City, Punjab, India

Vinod Kumar Singh
Instrumentation and control Engineering
Dr. B.R.Ambedkar National Institute of Technology
Jalandhar city ,Punjab, India

Abstract:- We create a low, simply built prototype for a medically portable ventilator that could be used in mass casualty and pandemic conditions without delay. It takes use of already available manual resuscitators that are easily accessible and a regulated pneumatic enclosure (AmbuBag). The AmbuBox provides equipment that is easy to tackle the issues currently present in the reduced cost ventilator designs, AmbuBox offer a wide range that is simple to set up and use while retaining a longer life span and high-precision flow control. The result was the creation of a surplus AmbuBox prototype that was authorized for use in a bench test set using a lung simulator.

This gadget will be put through clinical testing to learn more. The prototype device's capacities was defined in terms of peak flow and varied from 0.2 to 1.6 I/breath based on the overall tidal volume/min range. For ordinary respiration, the constructed device may provide a maximum flow rate within 2.02 and 32.32 l/min at an exploration of new to inspiratory of new ratio E:I = 2:1. The experimental gadget can detect around 10 and 40 breaths per minute (bpm). Patients with severe breathing issues or higher E:I ratios of 2:1 were estimated to breathe within 4.04 and 64.64 liters per minute (l/min), whereas patients with modest breathing issues or E:I ratios of 1:1 were estimated to breathe within 3.03 and 48.48 liters per minute (l/min).Lastly we measure body temp, heart rate and SPO2 level using Arduino and IOT.

Keywords:- *Ambu Bag, Servo Motor, Respiratory Rate.*

I. INTRODUCTION

The major disaster brought on by the corona virus pandemic is causing hospitals and healthcare institutions to face equipment shortages. It is our obligation as creators to remedy the scarcity by building creative, Portable Ventilator alternatives.

Basically, a ventilator is a device that provides breathable air into and out of the lungs to a patient who is physically unwilling to breathe or breathes poorly, in order to provide breaths. A Homemade ventilator may not be as effective as a ventilator of a high quality, but it can serve as an adequate substitute if it has control over the crucial elements listed below

It relates to the quantity of air that the ventilator delivers to the lungs with each breath. Breathing is done at a fixed rate, called BPM (breaths per minute).The ventilator's highest flow at which a specified peak flow breath is delivered is known as the flow rate.

Positive end exhalation pressure is the pressure in the lungs that is larger than atmospheric pressure at the ending of expiration. To maintains a constant positive pressure inside the lung in order to prevent the gas exchange components of the lung from contracting during exhale. To protect the lung, a modest quantity of PEEP is usually used.

This is due to the major lack of ventilators and a sharp increase in the Blood Oxygen & Heart Rate Monitor: Using a smartphone app, the percentage of blood oxygen levels (Sp02) and the beats per minute (BPM) are both measured.

These devices can keep patients breathing if they're unable to do so on their own and can cost per unit. Making a cheap portable ventilator might be one tool to support COVID-19-positive pneumonia patients in India. The planned inexpensive ventilator works by compressing a normal Bag Valve Mask (BVM) or Ambu bag using a pivoted motor driving mechanism without the need for a human operator. The device should, among other things, be invasive and non-invasive, handle a 500–600 mL tidal volume and a 500–600 mL tidal volume, be both invasive and non-invasive and be able to run constantly for many days. According to computations, a patient with pneumonia may obtain the right amount of tidal volume at 12 breathing rates (RR)/min. It has been determined that the automatic arm actuated BVM compression technique is a practical way of developing low-cost, low-power, and portable ventilator technology that provides important ventilator properties at a small fraction of the cost of latest versions. In the current pandemic situation of the world, mechanical ventilation, which is preferably utilized to deliver an auxiliary flow of oxygen gas through the trachea or windpipe to the respiratory challenged human individuals, is a matter of the highest necessity. This medical condition affects both industrialized and emerging nations. Numerous respiratory problems, such as chronic obstructive lung disease, asthma, and others, are lifetime. Mechanical ventilation is still a crucial component of the medical care of critically sick patients, despite changes to non-invasive respiratory support. One of the obvious reasons why there are just not enough ventilators in every hospital is that they are very expensive and cost over than 1.5 lakh rupees in India. The lower rate is the only factor in the ventilator shortfall. The only reason for the ventilator shortfall is the price increase. As a result, developing and producing mechanical and electrical components will be simple. Patients with basic lung disease who experience respiratory discomfort under various conditions may recover from mechanical ventilation. The need to ventilate a patient while traveling or relocating from one location to another gave rise to portable ventilators. The manually driven self-inflating bag assemblies are the simplest, most inexpensive, and most practical resuscitators. An emergency ventilator, also known as a disaster ventilator, is a device that is used in emergencies when there are people who have stopped breathing. A portable ventilator, also known as a transport ventilator, can provide ventilation outside of a hospital or while the patient is being transported. Whenever a hospital-grade ventilator is unavailable, an automated resuscitator, a portable ventilator, is used. It can be used in place of hand-bagging to provide oxygen to a patient who has stopped breathing. All poor function ventilators, meanwhile, are superior to a standard.

II. METHODOLOGY

Our proposed model is to design a portable ventilator device with the capacity to control growing stages in sets of two must be able to deliver around 10 and 50 breaths per minute. Furthermore, the ventilator must be able to change the volume of air that is delivered into the lungs with each breath. The setting is to change the duration of the inhale to exhale ratio is last but still not last. In moreover, the ventilator needs to be able to continuously prevent high and low air pressure by controlling the patient's c Blood oxygenation and lung pressure during exhalation. These wants might all be supplied constructing a handmade ventilator using Arduino that is durable and relatively inexpensive to aid in pandemic situations. In this case, the ventilator bag is pressed using a silicon ventilator bag coupled with servo motors and a two-side push mechanism.

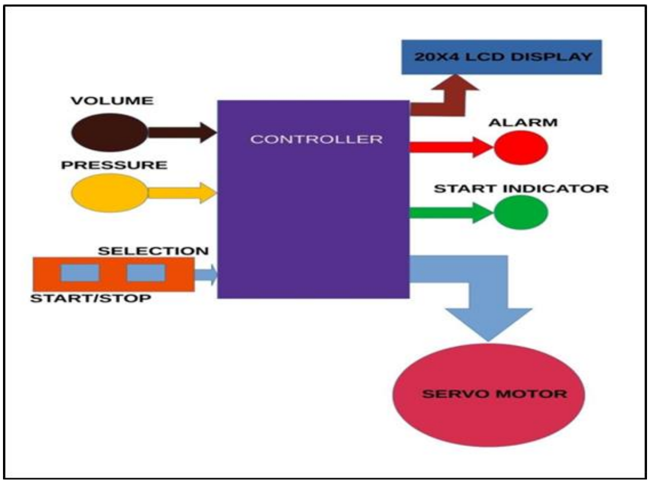

Fig.1: Block diagram

Toggle switches are used to switch between tasks, whereas pots are used to control the patient's BPM, breath volume, and breath period. Our device uses a sensitive pressure sensor and a blood oxygen sensor to record the patient's vital signs and show them on a small screen. Furthermore, the system has an emergency alert which will sound the alarm as soon as an abnormality is detected. The controller runs the entire system. To obtain the desired outcomes and to help patients in COVID pandemic and other urgent situations, the complete system is controlled by a controller.

III. RESULT

The respiratory rate for children varied by age (Breathing rate in minutes) as per international health association:

- New-born child (from Births to 1 year old): 30 to 60
- Toddler (between 1to 3 years old): 24 to 40
- Pre-schooled child (between 3 to 6 years old): 22 to 34
- School age (between 6 to 12 years old): 18 to 30
- Adult (between 12 to 18 years old): 12 to 16
- Over 18 years old: 12 to 20

For completion of objective, we called three people of different age to measure their pressure, volume and breathe rate to match within range which is specified in the range. Further we take measurement of Spo2 level, temperature, and heart rate using IOT with ESP8266 WIFI to share this parameter with mobile, laptop or any other device to doctor or physician to consult if any abnormal condition occurs. In which we are showing adult phase breathe rate, pressure and volume.

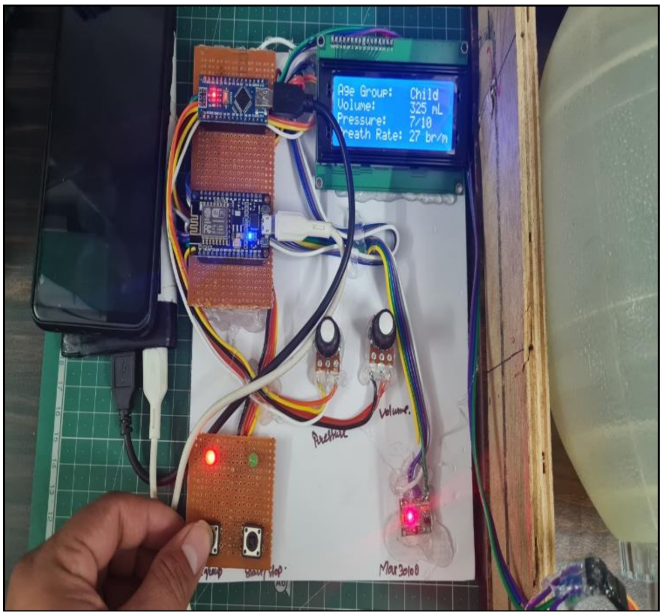

Fig 2:Preesure ,volume and breathe rate measurement for child

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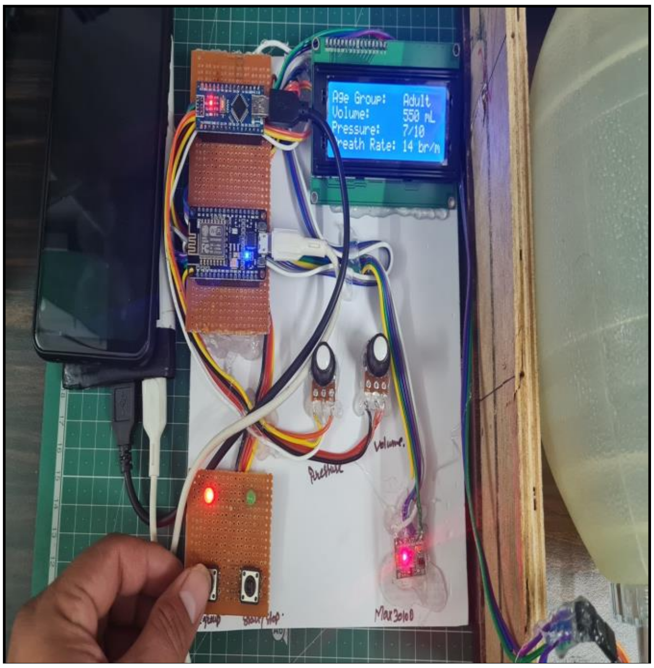

Fig3. Pressure, volume and breathe rate measurement for adult

Fig 4: Measurement of temperature, Spo2 and blood pressure

We clearly see in the result, we can measure temperature using lm35 temperature Sensor, Blood pressor using Max30100 sensor, and SPO2 level using IOT .Thus we can share this parameter to any doctor if any abnormal condition occurs like low bp or high bp, low temp or high body temp and low blood oxygen or high oxygen level.

IV. CONCLUSION

We measure breathe rate, pressure and volume in different categories to see their value to match with standard level which is given by standard health association. We also measure temperature using LM35 sensor, Spo2 level and heart beat to send the realistic data to any doctor those can monitor easily.

The possibilities of technology for lowering the portable respiratory systems, technology provides superior potential for reducing ventilator shortage during forthcoming pandemics is enormous for portable ventilator systems that can be largely produced via decentralized manufacturing. The review's outcomes demonstrates that the tested and community ventilator systems lacked proper documentation, and the portable ventilator systems which were currently observed were either in early design steps or had already undergone minimal.

Due to the substantially higher motivation provided by a continuing pandemic, it is believed that these projects will generate more interest and investment in order to substantially progress the establishment of a usable and easily implemented portable ventilator system. And raise portable ventilators to the quantity considered appropriate. And there is a large quantity of technical future effort involved to get portable ventilators up to the expectations recognized as satisfactory for scientific instruments. Medical-grade material still has to be attained through much more work.

Future work will be necessary to actually realize the potential of this strategy, including technical work as well as policy formulation, regulations amendment, and sources of funding for the testing and development of portable ventilators for the current COVID19 disease outbreak as well as for upcoming pandemics and for frequent use in minimal scenarios.

FUTURE SCOPE

Portable ventilator can be used in wide range where high costing ventilators is not available. We have seen many health problem occurs due to shortage of ventilators in India and other countries. Determining whether to release our ideas is one of the main issues for individuals who want to work on (or are already working on) the creation of portable ventilators.

It is difficult for designers not to feel responsible when people are really dying due to a scarcity of ventilators, especially if they are relatively certain that a prototype device design may perhaps stop those deaths if shared.

This type of model is cost effective and we can used in urban and rural area where we have seen lots of ventilator is not available whenever minor problem of breathe related issue happen in that scenario this will be become very helpful.

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