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"IOT BASED HEALTH MONITORING & VENTILATOR SYSTEM USING RASPBERRY PI"

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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 of 10 – 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. The last but now the least is the setting to adjust the time duration for inhalation to exhalation ratio. Apart from this the ventilator must be able to monitor the patient's blood oxygen level and exhaled lung pressure to avoid over/under air pressure simultaneously. The ventilator we here designing and developing using raspberry pi encompasses all these requirements to develop a reliable yet affordable ventilator to help in times of pandemic. We here use a silicon ventilator bag coupled driven by servo motor with one side push mechanism to push the ventilator bag. Our system makes use of blood oxygen sensor along with sensitive heart Beat sensor to monitor the necessary vitals of the patient and display on a webpage using IoT. To adjust the time duration for inhalation the option command given in the IoT application to set. The entire system is driven by raspberry pi controller to achieve desired results and to assist patients in COVID pandemic and other emergency situations.

INTRODUCTION

The coronavirus pandemic is a major health emergency, as of 15 July, the World Health Organization (WHO) has reported over 1.3 Million of confirmed coronavirus cases all over the world. According to data provided by WHO, 80% of confirmed coronavirus cases will be able to recover without the need for hospitalization. However, 1 in 6 patients could have significant aggravated symptoms, causing damage to the lungs and therefore decreasing the levels of oxygen in the body. In this sense for patients with severe effects of the infection, an artificial ventilator may offer the best chance of survival [1]. Since 1990, the interest in providing positive pressure ventilation (PPV) through a mask rather than through an endotracheal tube has increased. This method has been called non-invasive ventilation NIV [2], since the patient is not intubated, NIV has certain potential advantages compared with invasive ventilation methods. NIV is relatively easy to apply and can be used for short intervals because it can be started and stopped very easily and the major advantage of avoiding the complications associated with intubation and they are usually more comfortable for the patients reducing the need for anaesthesia required for intubation [3]. In recent works it is possible to find developments of artificial ventilators as full-professional devices [4]–[6], nonetheless, different efforts have been done in order to develop low-cost artificial ventilators as seen in [7], [8], and due to the COVID-19 pandemic, the efforts for developing a low-cost ventilator have increased significantly because of the lack of this devices within the public health institutions. One of the possible solutions for the development of an artificial ventilator is the conditioning of existing technology, such as the case of airway mask units (AMBU) [9], which are devices for manual artificial ventilation, that can be automated by using adequate mechanisms and control systems. In this sense, this paper leads to the mechatronic design and robust control of a low-cost artificial ventilator, in response to the COVID-19 pandemic.

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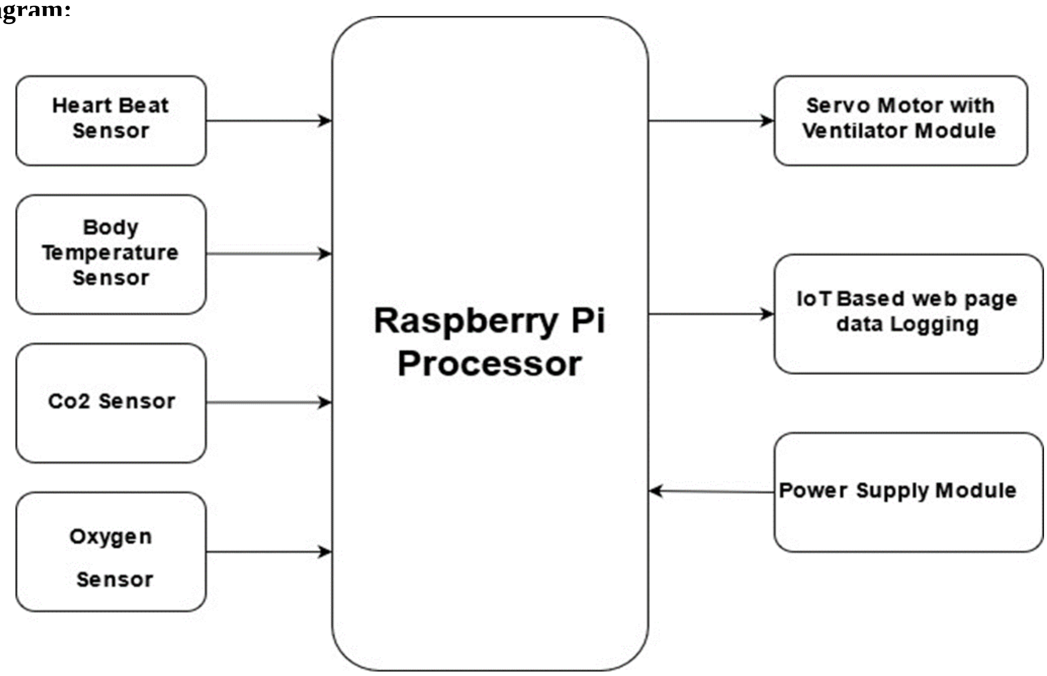
Block Diagram:



EXPERIMENTAL WORK FLOW

The artificial ventilation process consists of a periodical behaviour of filling and evacuating the lungs, this process is carried out by the proper control of an artificial ventilator by following the ventilation cycle as seen in Fig. 1. The respiratory cycle consists of an expiration phase, an inspiration phase, and a pause phase. During the resting phase, the expiratory muscles are at rest, the diaphragm does not contract, air does not enter or exit, and the three chest diameters are anatomically positioned. In the anatomical position, the pressure inside the lungs is going to be equal to the atmospheric pressure. The inspiration phase begins with a contraction of the diaphragm and all the inspiratory muscles and an increase in the three chest diameters occurs in such a way that inside the lungs, the intrapulmonary volume increases.

HARDWARE

Power Supply:

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of rical loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely toothers.

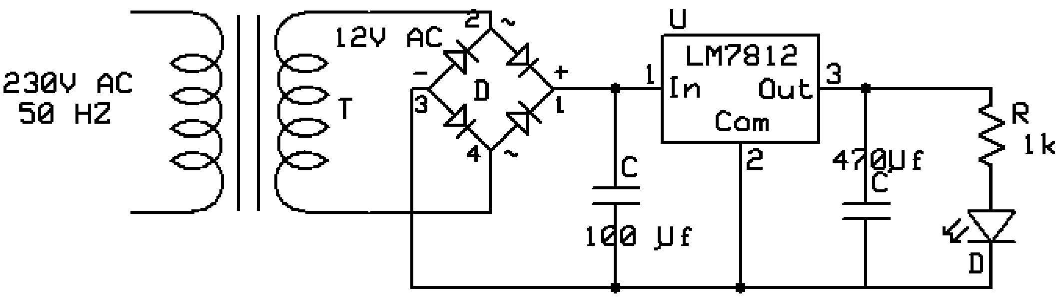


Fig.Circuit Diagram of Power Supply

Transformer:

A transformer is a static device that transfers electrical energy from one circuit to another through inductively coupled conductors—the transformer's coils. A varying current in the first or primary winding creates a varying magnetic flux in the transformer's core and thus a varying magnetic field through the secondary winding. This varying magnetic field

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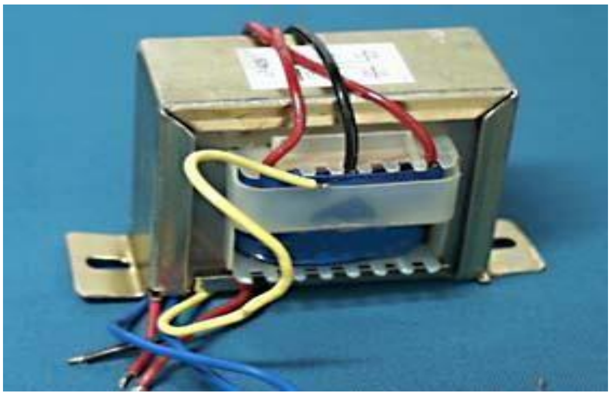
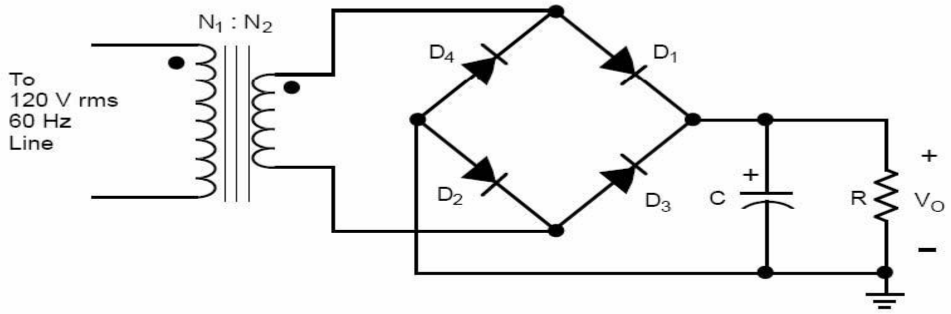
induces a varying electromotive force (EMF) or "voltage" in the secondary winding. This effect is called mutual induction.

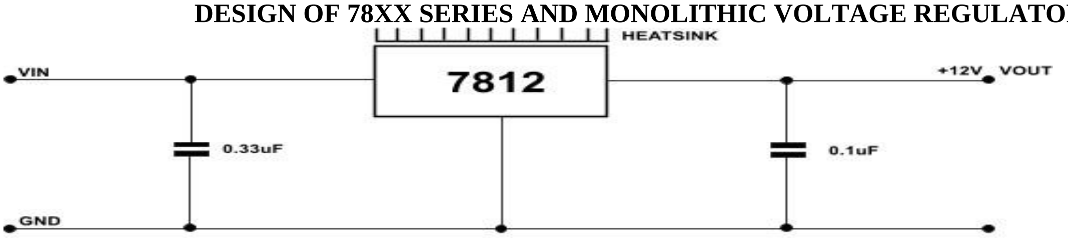


Bridge Rectifier:



A Rectifier is a device which converts A.C. voltage to pulsating D.C. voltage using one or more P-N junction diodes. The P-N junction conducts only in one direction. It conducts when forward biased while practically it does not conduct when reverse biased. Thus, if an alternating voltage is applied across P-N junction diode, during positive half cycle the diode will be forward biased and will conduct successfully.

DESIGN OF 78XX SERIES AND MONOLITHIC VOLTAGE REGULATOR



Features of voltage regulator:

- Output current up to1A
- Output voltages of 5,6,8,9,10,12,15,18,24v
- Thermal overload protection
- Short circuit protection

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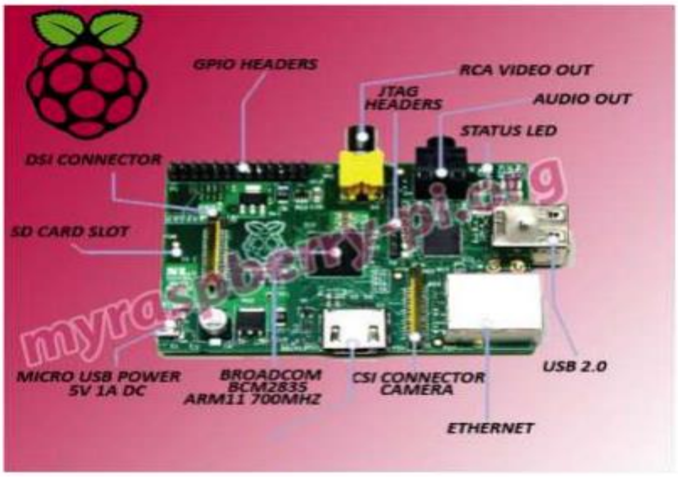
Raspberry Pi:

✓ Raspberry Pi being very cost effective can be deployed in large numbers in underdeveloped and developing countries like Africa, India, China, Brazil etc. to schools and colleges and to everyone who is interested in computers and electronics. It can be used in robotics for controlling motors, sensors, etc.

✓ It can be used as a downloading machine replacing desktop computers. It consumes very low power and also can be accessed remotely.

✓ It can be used as a media centre at home. Any television can be converted to a smart TV with internet capabilities with the Pi

✓ Can be used in creating and handling small servers can be used for making digital photo frames, tablets etc



HEART BEAT PCB TYPE:

Heart beat sensor works on a very basic principle of optoelectronics. All it takes to measure you heart rate is a pair of LEDs and LDR and a microcontroller. IR led emits infrared radiation and surface reflects the infrared light.

LM35 DEVICE:

LM35 is a precision IC temperature sensor with its output proportional to the temperature (in ºC). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With LM35, temperature can be measured more accurately than with a thermistor. It also possesses low self-heating and does not cause more than 0.1 ºC temperature rise in still air.

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ADVANTAGES

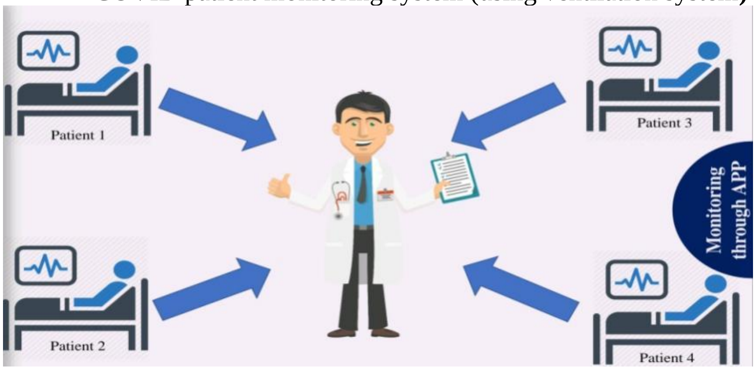
- Reduction of healthcare cost
- Provide real time feedback
- Improved treatment management
- Medical data accessibility
- Critical cases monitor

DISADVANTAGES

- Cost
- Risk of failure
- Security and privacy

APPLICATIONS

- In patient monitoring system
- COVID patient monitoring system (using ventilation system)



RESULT & CALCULATION

In this section, the simulation results obtained from the mechanical modelling of the system are presented as well as the experimental results for the artificial ventilator prototype are presented. Both simulation and experimental results were carried out by using VB Frame work.3D printing, it is important to mention that the proposed design is based on a design for manufacture and assembly (DFMA), which means the design for ease of manufacture of the ventilator. The lengths of the links of the slider-crank mechanism as well as the dimensions of the proposed design are shown in Table I. Fig.

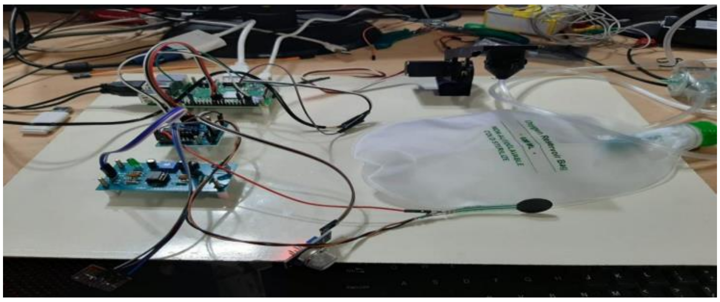


Fig: Hardware Picture of Project

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The main advantage of this type of configuration is that makes this proposal capable of following different breathing cycles in a robust and constant way depicts the trajectory tracking control for the crank, by means of the sliding modes controller (8), with the parameters $\lambda 1 = 100$, $\lambda 2 = 0.1$ and $\lambda 3 = 3$ and the proposed sliding surface (9). The tracking profile consists of a trajectory of 0° to 180° degrees, corresponding to half a revolution of the crank, which produces a compression cycle of the AMBU.

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. Simulation and 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.

LITERATURE SURVEY

In this paper, we present the patient emulator (PE), a novel system that can be used as a platform for in-silico testing of mechanical ventilation therapies. In response to anticipated shortages of ventilators caused by the COVID-19 pandemic, many organizations have designed low-cost emergency ventilators. Many of these devices are pressure-cycled pneumatic ventilators, which are easy to produce but often do not include the sensing or alarm features found on commercial ventilators. Artificial ventilation by using an automatic ventilator is a standard treatment for a patient who has an abnormality in his respiratory system or his own spontaneous breathing is not enough to maintain an oxygenation in a safety level. We also intend to focus on lung compliance and an airway resistance setting in our test lung module in order to test and verify the performance of our ventilator model in case of patient pathology change to better or worse (0.5C, 2R) which commonly found in ICU patient.

FUTURE SCOPE

According to the availability of sensor or development in biomedical trend more parameter can be sensed and monitored which will drastically improve the efficiency of the wireless monitoring system in biomedical field. A graphically LCD can be used to display a graph of rate of change of health parameter over time. The whole health monitoring system which we have framed can be integrated into a small compact units as small as a cell phone.

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