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LOW COST, NON- INVASIVE AUTOMATIC VENTILATOR SYSTEM FOR UNDER RESOURCED REGION

Priscilla Vilma Manorathi

S Melaka Devi. B.E ,

R Pandimeena B.E *,

T Ranjitha B.E

A Sarumathi B.E

Electronics and communication Engineering –
Indra Ganesan College Of Engineering

mekaladevi0606@gmail.com
pandimeena1305.r@gmail.com
ranjithavamani611@gmail.com
charuaathi1805@gmailcom

Abstract— Breathing is the sign of life, the human body is fueled by a proper combination of food and oxygen. The accurate amount of oxygen is a vital factor for health and even survival of life in some cases. Mechanical ventilators are the machines which are commonly used in hospitals, Intensive Care Unit (ICU) and prolonged treatment centres for assistive or complete breathing. Automated Oxygen Delivery Device is closed-loop system designed by to automatically adjust oxygen flow according to the patients oxygenation. The operation of the oxygen delivery system depends on a microcontroller, an electromagnet valve and a pulse oximeter. In any hospitals or ambulances or even at some healthcare centres, the oxygen supply and pulse oximetry system is working independently in fact both has a relativity.Also the oxygen valve adjustment and pressure settings are in manual control which won't be consistent every time. For any patient, the level of oxygen in their body will vary at any time and maximum during night time. It will be a difficult task to monitor the patient all time. The proposed system is to build a system which will sense the oxygen level in human body and once it decreases to certain level, then automatically solenoid valve will be turned on and oxygen will be supplied to the patient through oxygen mask. Till that, minimum oxygen flow will be given to the patient and also oximeter will also be connected with them. There is evidence that, for people who are hypoxemic, supplemental oxygen improves quality of life, exercise tolerance and even survival. Supplemental oxygen can also help relieve the symptoms. The patients feels relief from shortness of breath, fatigue, dizziness and depression. This device not only helps the patients, it can also used in daily to enhance the oxygen human body.

***Keywords*—Arduino mega, MAX 30100 sensor, LCD 16x2 display screen, Pneumatic solenoidal valve, 5V relay module, Arduino software, Embedded c program.**

Introduction

A ventilator is a machine that provides mechanical ventilation by moving breathable air into and out of the lungs to deliver breaths to a patient who is physically unable to breathe or

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Breathing insufficiently.

Ventilators are computerized microprocessor-controlled machines, but patients can also be ventilated with a simple, hand-operated bag valve mask. Ventilators are chiefly used in intensive-care medicine, home care and emergency medicine (as standalone units) and in anesthesiology (as a component of an anesthesia machine). Ventilators are sometimes called "respirators", a term commonly used for them in the 1950s (particularly the "Bird respirator"). However, contemporary hospital and medical terminology uses the word "respirator" to refer to a protective face-mask. A standard setup for a ventilator in a hospital room. The ventilator pushes warm, moist air (or air with increased oxygen) to the patient. Exhaled air flows away from the patient.in its simplest form, a modern positive pressure ventilator consists of a compressible air reservoir or turbine, air and oxygen supplies, a set of valves and tubes, and a disposable or reusable "patient circuit". The air reservoir is pneumatically compressed several times a minute to deliver room-air, or in most cases, an air/oxygen mixture to the patient. If a turbine is used, the turbine pushes air through the ventilator, with a flow valve adjusting pressure to meet patient-specific parameters. When over pressure is released, the patient will exhale passively due to the lung's elasticity, the exhaled air being released usually through a one-way valve within the patient circuit called the patient manifold. Ventilators may also be equipped with monitoring and alarm systems for patient-related parameters (e.g., pressure, volume and flow) and ventilator function (e.g., air leakage, power failure, and mechanical failure), backup batteries, oxygen tanks and remote control. The pneumatic system is now a days often replaced by a computer-controlled turbo pump.

II. Related Works

AUTOMATED OXYGEN SUPPLY

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It will be a difficult task to monitor the patient all time. So the proposed system is to build a system which will sense the oxygen level in human body and once it decreases to certain level then automatically solenoid valve will be turned on and oxygen will be supplied to the patient through oxygen mask. Till that, minimum oxygen flow will be given to the patient and also oximeter will also be connected with them. There is evidence that for people who are hypoxemic supplemental oxygen improves quality of life, exercise tolerance and even survival.

Supplemental oxygen can also help relieve your symptoms. The patient's feels relief from shortness of breath, fatigue, dizziness and depression. This device not only helps the patient's it can also used in daily to enhance the oxygen supply in human body.

SENSING INPUTS IN HUMAN BODY

Pulse oximetry is a non-invasive method for monitoring a person's oxygen saturation. Peripheral oxygen saturation (SpO_2) readings are typically within 2% accuracy (within 4% accuracy in the worst 5% of cases) of the more desirable (and invasive) reading of arterial oxygen saturation (SaO_2) from arterial blood gas analysis. But the two are correlated well enough that the safe, convenient, noninvasive, inexpensive pulse oximetry method is valuable for measuring oxygen saturat in clinical use.In its most common (transmissive) application mode, a sensor device is placed on a thin part of the patient's body, usually a fingertip or earlobe or in the case of an infant, across a foot. Fingertips and earlobes have higher blood flow rates than other tissues which facilitates heat transfer.

The device passes two wavelengths of light through the body part to a photodetector. It measures the changing absorbance at each of the wavelengths, allowing it to determine the absorbances due to the pulsing arterial blood alone, excluding venous blood, skin, bone, muscle, fat and (in most cases) nail polish.

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Reflectance pulse oximetry is a less common alternative to transmissive pulse oximetry. This method does not require a thin section of the person's body and is therefore well suited to a universal application such as the feet, forehead and chest but it also has some limitations. Vasodilation and pooling of venous blood in the head due to compromised venous return to the heart can cause a combination of arterial and venous pulsations in the forehead region and lead to spurious SpO_2 results. Such conditions occur while undergoing anesthesia with endotracheal intubation and mechanical ventilation or in patient's in the Trendelenburg position.

A pulse oximeter is a medical device that indirectly monitors the oxygen saturation of a patient's blood (as opposed to measuring oxygen saturation directly through a blood sample) and changes in blood volume in the skin, producing a photo plethysmogram that may be further processed into other measurements. The pulse oximeter may be incorporated into a multiparameter patient monitor. Most monitors also display the pulse rate. Portable, battery-operated pulse oximeters are also available for transport or home blood-oxygen monitoring.

USES OF OXYGEN VENTILATORS

Pulse oximetry is particularly convenient for non-invasive continuous measurement of blood oxygen saturation. In contrast, blood gas levels must otherwise be determined in a laboratory on a drawn blood sample. Pulse oximetry is useful in any setting where a patients oxygenation is unstable, including intensive care, operating, recovery, emergency and hospital ward settings, pilots in unpressurized aircraft for assessment of any patients oxygenation and determining the effectiveness of or need for supplemental oxygen.

Although a pulse oximeter is used to monitor oxygenation, it cannot determine the metabolism of oxygen or the amount of oxygen being used by a patient.

For this purpose, it is necessary to also measure carbon dioxide (CO_2) levels. It is possible that it can also be used to detect abnormalities in ventilation. However, the use of a pulse oximeter to detect hypoventilation is impaired with the use of supplemental oxygen, as it is only when patients breathe room air that abnormalities in respiratory function can be detected reliably with its use. Therefore, the routine administration of supplemental oxygen may be unwarranted if the patient is able to maintain adequate oxygenation in room air, since it can result in hypoventilation going undetected.

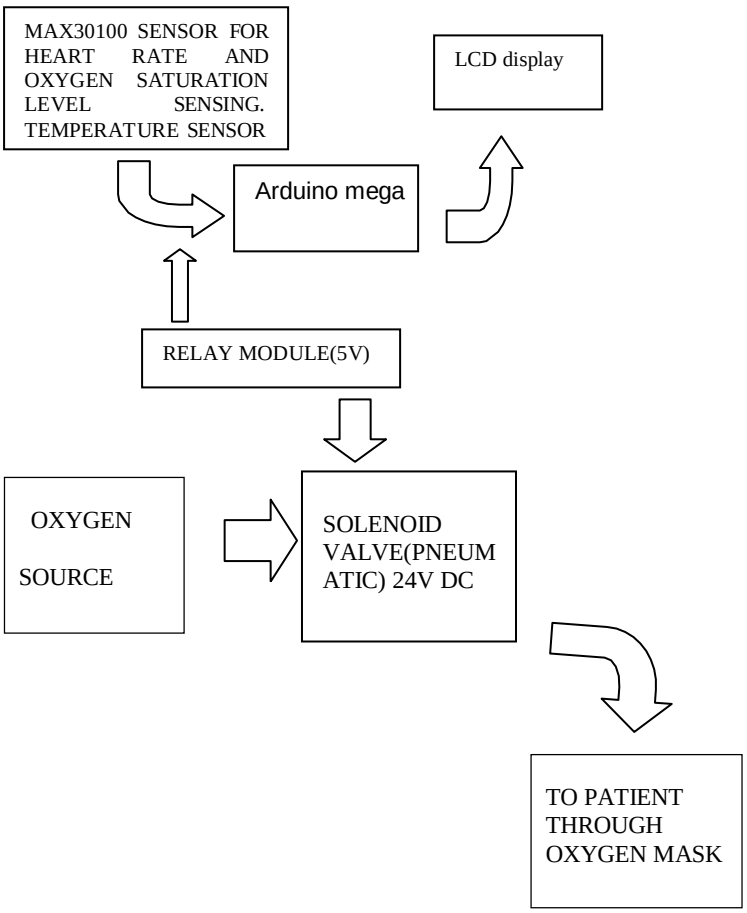
Because of their simplicity of use and the ability to provide continuous and immediate oxygen saturation values, pulse oximeters are of critical importance in emergency medicine and are also very useful for patients with respiratory or cardiac problems especially COPD or for diagnosis of some sleep disorders such as apnea and hypopnea. For patients with obstructive sleep apnea, pulse oximetry readings will be in the 70%-90% range for much of the time spent attempting to sleep.

Portable battery-operated pulse oximeters are useful for pilots operating in non-pressurized aircraft above 10,000 feet (3,000 m) or 12,500 feet (3,800 m) in the U.S. where supplemental oxygen is required.

Portable pulse oximeters are also useful for mountain climbers and athletes whose oxygen levels may decrease at high altitudes or with exercise. Some portable pulse oximeters employ software that charts a patient's blood oxygen and pulse, serving as a reminder to check blood oxygen levels.

Connectivity advancements have made it possible for patient's to have their blood oxygen saturation continuously monitored without a cabled connection to a hospital monitor without sacrificing the flow of patient data back to bedside monitors and centralized patient surveillance system.

ARCHITECTURE OF THE SYSTEM



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Testing:

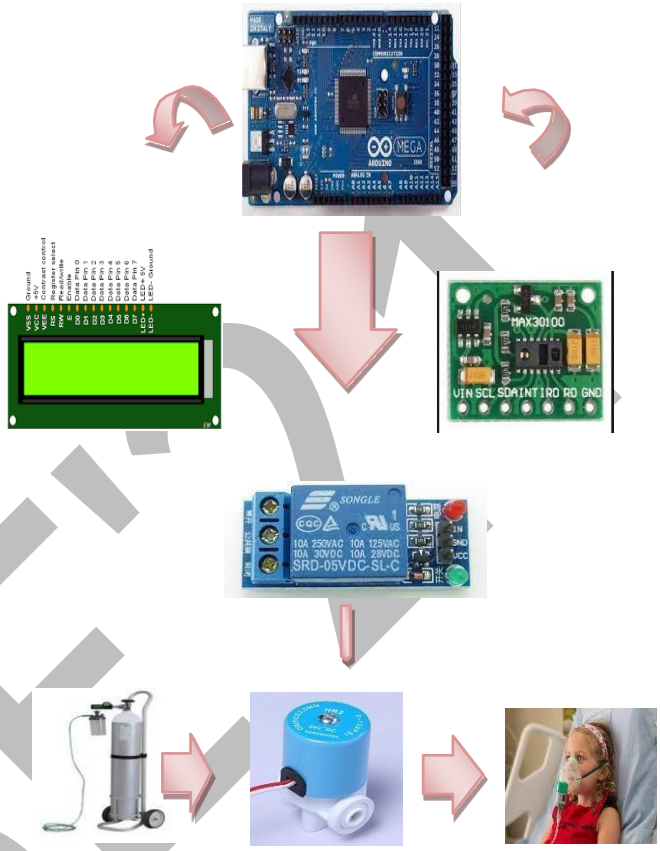
Testing is the process of evaluating the correctness, the quality and the completeness of the system developed. The system was tested across a variety of applicants. The patients should get oxygen flow directly , if the oxygen level decreases to 94% and below. The finger should be placed on the sensor. OLED display displays the heart rate and oxygen level and temperature successfully. If oxygen level decreases to 94% and less, the solenoid volve must actuate for oxygen supply to patients. If temperature goes 98% and above an indication is shown in display. If heart rate rises up to 120+ per minutes, indication is shown in the display. The oxygen level is deceased the ventilator is ON automatically.

Table 1

Blood Flow Measurement Ranges:

Function	Normal	High	Low
Pulse Rate (HR)	60-100 beats per minute	130-150 beats per minute	Below 60
Oxygen Rate (SpO2)	95-100 percent	100 above	Below 90 percent

Schematic Design of the System



Schematic design of the system

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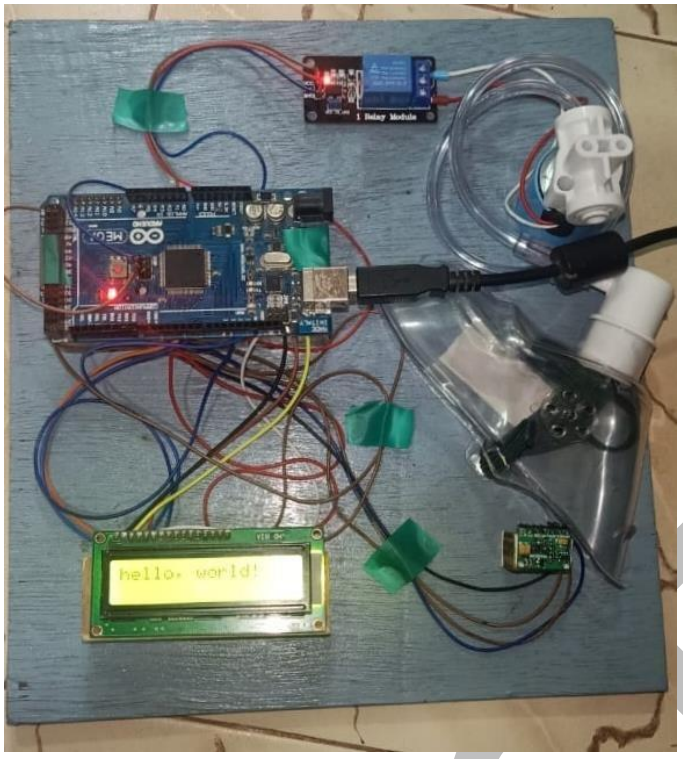

Fig : Arduino mega, MAX 30100 sensor, LCD 16x2 display screen , 5V relay module, pneumatic solenoidal valve, Oxygen mask.

APPLICATIONS AND FUTURE ENHANCEMENT

Aeromedical

The hypobaric (75–85 kPa) environment of the aircraft cabin, pressurized to resemble altitudes between 1500 and 2500 m, has implications for both patient and equipment. Patients with respiratory failure present particular challenges. Maintaining constant alveolar oxygen tension at reduced barometric pressure requires increased inspired oxygen concentration or may necessitate the use of PEEP. If lung function is marginal, positive pressure ventilation may be necessary at cabin pressure in patients requiring only facemask oxygen at sea level Gas within the cuff of tracheal tubes expands and may compromise tracheal mucosal perfusion at cabin pressure. Gas can be partially removed during ascent and replaced during descent or substituted for saline. Ventilation can also be compromised by gaseous expansion within pneumothoraxes, intestines or the abdominal cavity.

Pediatrics

Pediatric patients require ventilators capable of consistently delivering low tidal volumes at increased ventilatory frequencies. The susceptibility of infants to barotrauma and the use of uncuffed tracheal tubes favour pressure-controlled ventilation. The pneumatic characteristics of the Venturi in the VentiPAC cause it to act as a pressure-generator at flow rates, 0.25 litres with the 'air mix' setting. The VentiPAC, LTV-1000 and Oxylog 3000 can all ventilate infants as small as 5 kg but specialized pediatric ventilators are required beyond this.

Domiciliary ventilation

Domiciliary ventilation is associated with survival benefits in patients with neuromuscular disease and has also been used when chest wall and lung diseases result in respiratory insufficiency.10 Patients may receive support nocturnally or continuously, provided invasively by tracheostomy or non-invasively by facemask. The LTV series of ventilators was originally developed for domiciliary ventilation. Supplemental oxygen is usually not required in patients with neuromuscular disease and the ability of these ventilators to operate on battery without compressed gas supply maximizes portability, enabling them to be mounted on electrical wheelchairs.

Non-invasive ventilation

The emergence of non-invasive ventilation without tracheal intubation has inevitably resulted in the requirement to transfer patients undergoing this therapy. Gas leakage from around the mask is often a problem within the critical care environment and slight dislodgement during transport may increase leak and significantly reduce effectiveness. The combination of sophisticated sensors and basal gas flows within the patient circuit allows microprocessor controlled ventilators to compensate for circuit leaks. There is increasing experience in the use of these ventilators for noninvasive ventilation during the transfer of acutely unwell patients and domiciliary ventilation in chronic disease. Expiration still occurs through the patient circuit exhalation valve so a non-vented mask is required.

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Conclusion

The objective of this project is to provide an automated system which will support the patients and humans at the critical conditions and at the extreme situations where there is scarcity of oxygen in the human body. The low level of oxygen may cause the humans to faint or some breathing troubles may occur. So portable and non-invasive automated ventilators are the only solution for such conditions.

Various portable ventilators are available, driven by demands for equipment suitable for different clinical situations and environments. Their design reflects availability of gas and electrical supplies and the modes of ventilatory support required by the patient population. When transporting critical care patient's provision for estimated gas and electrical requirements should be made. A ventilatory mode suited to the patient's clinical condition should be selected and trialed before departure. An appreciation of how different portable ventilators function, preferably supported by comparative data, can help when an organization purchases such equipment. Understanding the strengths and weaknesses of a specific ventilator and breathing circuit may help anticipate and prevent complications during transfer

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