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Design And Development of Auto Oxygen Concentrator with Sos Alert for Hiking Peoples



Abstract: - One has to begin somewhere and thus 'The journey of a thousand miles begins with a single step'. Remember there are very many people who actually have a passion for trekking and things related to it. Walking is a shorter way and comparatively less strenuous than hiking which is generally done on a looped line, to-and fro routes or destination routes. Trekking always has an objective which is a particular place. Trekking involves a track that moves from one stage to another, through different grounds that can be rugged and hence, one has to carry many things and is more prepared than the one doing hiking. Trekking is acceptance among the people as one of the most preferred hobbies. Because of high altitude of a mountain the oxygen level reduces. Early method does not have the means of automatic supply of oxygen, thus if the person chokes with the health issue he/she is unable to supply oxygen on his/her own. This work has a system to automatically provide oxygen to the hiking people at the correct time dependent on the health condition of the hiker. Oxygen, on the other hand is mainly delivered by the oxygen concentrator.

Keywords: GPIO, ADC, DAC, SPI, UART, Oxygen, Concentrator, SOS, Hiking

I. INTRODUCTION

LTOT and new methods of establishing treatment outcomes in COPD have improved the disease quality and reduced the costs of the treatment. Since a pulmonary blood gas test can be availed in a total of \$300 while oxygen therapy costs 48 hours of \$100 and a hospital stay that equals one month of oxygen therapy worth \$1200, long-term oxygen therapy (LTOT) is cost-effective in managing this disease. Clinical studies concerning LTOT are scarce but a few of them report that LTOT enhances the quality of life of COPD patients by minimizing the deterioration of respiratory function. The analysis of the treated Danish 8487 patients demonstrated that if LTOT was used for 1,524 hours per day, the life expectancy would be prolonged. 07 to 40 years. Oxygen-enriched streams generated from air are applied in most fields ranging from classical chemical

Engineering, biological, and medical fields. One of the popular oxygen therapies requires the patient to have a built-in oxygen tank for personal use. Clinical research in humans including Chronic Obstructive Pulmonary Disease or COPD it reduces the volume and elasticity of the lung thus prevents it from oxygenating the blood in the same way that it oxygenates the external atmospheric air. Another requisite is a reliable source of pure oxygen or oxygen rich air to enable the patients to breathe easily. Oxygen concentrators as per the records of LTOT are a good idea.

In the case of Turkey, the first application of the 1, 8 LTOT was in 1986. France uses oxygen concentrators at 90/10 while United States uses is at 80/20 According to 10 Karat et al. 6, 39% of people had LTOT issues. Malfunctioning equipment, not having patient details, working abnormal shifts, low oxygen concentrations, infractions in electrical supply, and high electrical consumption were some of the issues. Nevertheless, 16% of it was renewed each year while 45% of the equipment was ineffective. An oxygen concentrator has to be fixed by a professional technician. It is recommended to carry out the analysis of the oxygen quality and the discharge rate every month. Turkey et al. 2 established inadequate technical assistance, misuse of almost all the devices by patients, annual repair age of a limited number of devices, and occasional or non-existent trips of some devices. Based on the results of the research, some oxygen concentrators cannot manage hypoxemia due to the provision of inadequate amounts of pure oxygen. Every single proof points to problems with the design of oxygen concentrators and that businesses don't properly service their assets. They added that wireless communication has developed from a technology applicable in one sector to a technology that has influenced many different fields, including biology.

It enables the creation of inexpensive wearable health monitoring gadgets that can also track the patient and gadget data in real-time. Presently the market has been flooded with miniature wireless health monitors and the total number is eleven. This group comprises ECGs, pulse ox meters, sphygmomanometers and any other related

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devices. About the same occasion, the great majority of these gadgets incorporate Bluetooth, IEEE 802. 11. 19 to use in conveying wireless medical information.

Other developments are multimedia tele monitoring network for health care,²¹ wireless (GPRS based) mobile real-time patient monitoring,²² a wireless PDA based physiological monitoring system for patient transport,²³ and wireless stand-alone portable patient monitoring and log all of which are based on this topic. The major issues associated with oxygen concentrators include high temperature, low pressure, excessive pressure, and low oxygen purity; most of these issues can be wirelessly transferred to a technical support or, device monitoring center. If this technology is included in the oxygen generator, maintenance and repairs may be done more quickly hence minimizing on treatment hitches attributed to the previously highlighted factors.

OXYGEN CONCENTRATOR

What Is An Oxygen Concentrator?

An oxygen concentrator is a device used to give additional or extra oxygen to the person having trouble in breathing. The device used in such treatment includes a compressor, sieve bed filter, Oxygen tank, pressure valve and nasal canola (oxygen mask). Similar to an oxygen cylinder/tank, a concentrator delivers oxygen to a patient through a mask or nasal prongs. Yet, it is different from the oxygen cylinders as concentrator does not needs refilling and it provides oxygen continuously throughout the day. A common type of oxygen concentrator can deliver between 5 to up to 10 liters in a minute of oxygen.

How Does An Oxygen Concentrator Work?

An oxygen concentrator operates with the principle of filtering and enriching oxygen molecules in the surrounding air thereby catering to the 90% to 95% oxygen needs of the patients. This oxygen concentrators compressor draws in normal air and alters the extent of pressure to which the air is supplied. The nitrogen is separated from the air in a sieve bed reminiscing of a crystalline structure known as Zeolite. A concentrator always has two sieve beds that perform a dual function of this it releases oxygen into a cylinder besides discharging the separated nitrogen back into the air.

Who Should Use an Oxygen Concentrator And When?

Pulmonologists grouped it to be effective for mild to moderately ill patients with oxygen saturation of 90 % to 94% and administered under medical prescription. These can be used for patients with oxygen saturation even as low as fifty percent and five percent respectively, in emergent cases or wait for a hospital bed to be available. Nevertheless, it is advised that such patients exchange the cylinder for one with a higher flow rate and head for the nearest hospital. It should also be noted that side from hemorrhaging with a high risk to the patient's life, the device is not advisable for patients from ICU wards.

II. EXISTING SOLUTION

Compared to the traditional method, pressure swing adsorption (PSA) oxygen concentrators are used extensively in healthcare operations for oxygen delivery where liquid or pressurized oxygen is likely to be hazardous or impractical, such as in homes or portable clinics. For other purposes, there are also concentrators on the basis of nitrogen separation membrane technique.

They take air from the surrounding environment and then filter it to separate nitrogen from oxygen and produce an oxygen rich gas to be used by persons with low oxygen demands in their bodies through medical points. Oxygen concentrators can be defined as an economical means of producing oxygen in industrial applications, which are also called oxygen gas producers or oxygen production plants. These particular oxygen concentrators employ a molecular sieve to selectively adsorb the gases and function on the basis of the technique of high pressure, intermediate pressure, and low pressure, rapid pressure swing adsorption of nitrogen from the air onto zeolite minerals. This type of adsorption system can, therefore, be summarized as being functionally a nitrogen scrubber while allowing the other atmospheric gases to pass through; resulting in oxygen as the dominant gas. PSA technology as a technique of oxygen generation is efficient and cost-effective for small to medium volume oxygen requirement. Cryogenic separation is appropriate in large volume while the external delivery is appropriate in small volume.

At high pressure, large amount of nitrogen is adsorbed by the porous zeolite due to the large surface area of the material and its chemical properties. The oxygen concentrator then makes the air pressurized and then passes the same through a bed or Zeolite which results in the Nitrogen to get trapped by the material called Zeolite. It then

gathers the remaining gas, that is, principally oxygen, whereas the nitrogen is desorbed from the zeolite as a result of the reduced pressure and is just released. At the same time, pressure increases in the first cylinder from atmospheric pressure to about 2. Five times normal atmospheric pressure, which may be 20 psi (gage), or 138 kPa(g), or 2.36 ATA, and the zeolite is fully nitrogen-saturated. As the first cylinder is approaching particularly close to pure oxygen (it contains minute amounts of argon, carbon dioxide, water vapor, radon, and other components of the Earth's atmosphere in the first half-cycle, the valve opens, and an oxygen-rich gas mixes with the pressure equalizing reservoir connected to the patient's oxygen hose. At the beginning of the second half of the cycle there is then another change in the position of the valve so that it directs air from the compressor to the second cylinder. A pressure is released in the first cylinder and the oxygen enriched passes to the reservoir to let the nitrogen to be desorbed again to its gaseous state. Midway through the second half of the cycle, there is another valve position change to release the gas in the first cylinder back into the ambient atmosphere to their maintain the concentration of oxygen in the pressure equalising reservoir above about 90%. The pressure inside the hose which delivers oxygen from the equalizing reservoir is maintained due to a pressure reducing valve.

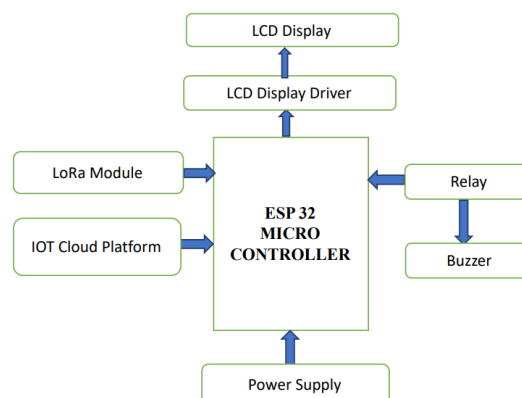
For a period of approximately 20 seconds, older units cycled and delivered up to 5 liters per minute of oxygen of 90+%. Since about 1999, units of capacities up to 10 L/min are available in the market.

There are two types of oxygen concentrators: those with two-bed molecular sieves and the new concentrators which employ the multi-bed molecular sieves. The main winning point about the multi-bed technology is that the 10 L/min molecular sieves are shifted and duplicated in one or several frameworks. That is why over 960 L/min can be produced with this. The response time- the time taken until a multi-bed concentrator starts generating oxygen at a concentration higher than 90% - is often less than 2 minutes which is shorter than the time taken for 2 bed concentrators. This is a big advantage in mobile emergencies because the patient does not require stabilizing, enabling the doctor to attend to the actual disease, ailment or condition. Regarding this, the option to fill standard oxygen cylinders (e. g. 50 L at 200 bar = 10,000 L each) with high-pressure boosters, to feature previously filled reserve oxygen cylinders for automatic failover and to secure the oxygen supply chain e. g. in case of power failure is provided with those systems. At the present moment there is no executed technology that can help to deliver the oxygen supply to the people who are on trucking independently. If they need oxygen, then they can themselves handling the oxygen tubings. The type of exposed population's health condition and the data about the place they are located are not available in the traditional approach. Other than that there is no GPRS system in early method, which creates the correct location of the hiking people and which can also create the location of the wandering people for rescuing them and they can also immediately take them to the nearest hospital for the treatment.

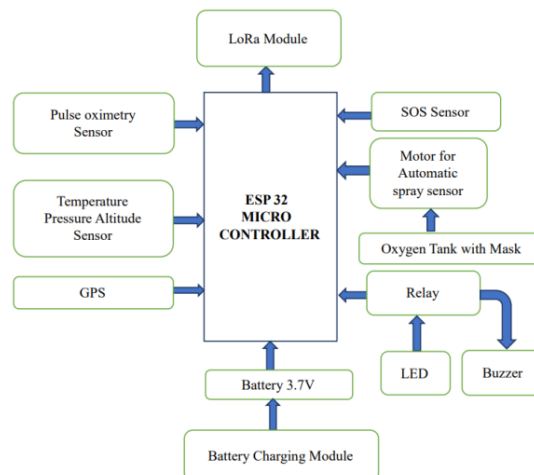
III. PROPOSED SOLUTION.

BLOCK DIAGRAM

3.1.2 RECEIVER



3.1.1 TRANSMITTER



The people's health condition on trucking can be observed and pass the data through LORA, Oxygen, pulse, temperature and pressure are measurable by Pulse Oximetry Sensor and Temperature Pressure Altitude Sensor. Location data about where the people are located is also monitored and GPS transmits the data. If the Oxygen level is checked below the set limit, the oxygen can be given to the people that are suffering from health issues and are out of breathe.

Connecting transmitter ESP32 MCU with sensors. H1: Atmospheric pressure – to which extent s it effective; Altitude; Body temperature; Pulse rate; Blood oxygen level. The parameter corresponding to the health condition and the state of the atmosphere are determined. The installed self regulated oxygen cylinder which is connected to the servo power operated switch box.

Alarm system, which consist of the GPS for collecting the location data. SOS Button for give the alert signal to the receiver side. Relay is employed to switch the led lights and buzzer in the project. The data is then sent wireless to the ground station by the help of LoRa Module.

Receiver LoRa to receive the signals from the hiking people, illuminate the data log and retailer the data log at the IoT server. In transmitter side and if the SOS button is pressed an emergency buzzer in the receiver side will buzz.

IV. HARDWARE DESCRIPTION

HARDWARE REQUIREMENTS

- Stepper Motor and Driver
- GPS Module
- Temperature, Pressure, Altitude sensor
- Lo Ra Module
- ESP 32
- Pulse Oxi-metry Sensor
- Relay Module
- LCD 12C Base
- Buck Converter
- Oxygen Concentrator

V. WORKING

Relays are nothing but the electro mechanical device that can be used as a switch. The circuit and the operation of the relay is explained below.

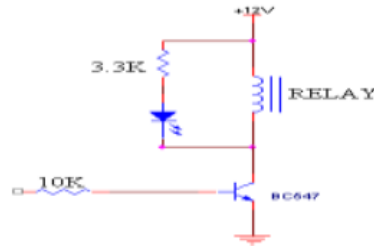


Fig 4.1 Relay Circuit

A relay is a switch operated by an electromagnet. It is useful when we have, as received, a small current in one circuit and a large current in another circuit containing i. e. a lamp or electric motor which requires lots of current or when one wants several different switch contacts to be in one position simultaneously. When the controlling current flows through the coil, soft iron core gets energized and attracts the L shaped soft iron armature. This rocks on its pivot and opens, closes or changes over, the electrical contacts in the circuit being controlled: it closes the contact the current needed to operate a relay is called the pull-in current and the dropout current its coil when the relay just stops working.

Pin Configuration and Functions



Fig4.27.Pin Configuration

LM2596 series of regulators are monolithic integrated circuits that has included all the active functions for a step-down switching regulator, the circuit is capable of driving a 3A load having excellent line and load regulation. These devices only come in fixed output voltages of 3 against a guaranteed input voltage of 5 volts. To be precise, there are three models namely 3V, 5V, 12V and one with an adjustable voltage.

These are easy to use regulators with least external components having internal frequency compensation and a fixed frequency oscillator. The LM2596 series has a switching frequency of one hundred and fifty KiloHertz therefore the filter components are smaller as compared to a low switching frequency of the switching regulators. They are available in a standard 7-pin TO-220 through-hole package with several leads options such as straight leads, Laird's BS107-7-SIP bent leads, or SIP-107 recommended assembled bend and a 7-pin surface mount TO-263 package.

REED SWITCHES

Relays are comparatively slow while for the switching of signal circuit used in telephone exchange and similar applications reed switches are employed. The reeds are slender bars of soft magnetic and soft diamagnetic materials. They are housed in a glass tube with the aid of an inert gas like nitrogen so as to minimize the rate of corrosion of the contacts.

It can be operated by either presenting it with a magnet or by passing a current through a coil around it. In both cases the reeds get magnetized, they attract one another and on contact an electrical circuit is made on the connected terminals. It differs when the magnet is pulled out or the flow of current in the coil is ceased.

During the operation of the changeover reed switch the reed is pulled from the non-magnetic contact to the magnetic contact.

Protection of transistor-controlled relays and reed switches

In reed switch whenever the current through the coil gets to zero, a large voltage gets developed in the coil as a result of inductance. This voltage could destroy any transistor that was used in the control of the current that circulates in the coil. But if a diode is connected with its reverse bias connection to the supply voltage it provides an easy path to the induced voltage and it does not allow its build up to a very high value.

Relay content

- The relay is based on the contact points' junction. The relay contact points may be flat, spherical, pointed and combination of these. Some of the contact types are as indicated in the figure above.
- Flat contacts need more pressure on the pill to ensure that they close to the perfection of the circuit. Half round (spherical) contacts are better because there will be certainly minimum surface contamination.
- But it has one drawback and that is due to fault current this type of contacts can be either closed or opened irrespective of supply is available or not.

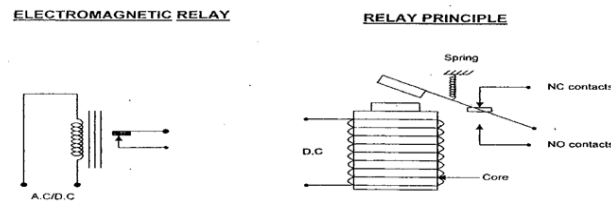


Fig 5.1 Relay working

VI. RESULT AND DISCUSSIONS

The life-threatening analysis of the auto oxygen concentrator with SOS alert system for hiking people has been demonstrated through the following experimental studies; Innovation of a transmitting gadget and another receiving gadget for those who are often on a truck for long. The transmitting device is applied to the body surface to be able to monitor and relay data on the health status of the concerned body. The mentioned receiving device is placed in the monitoring station which is near the living area so that the health state of the people can be checked repeatedly.

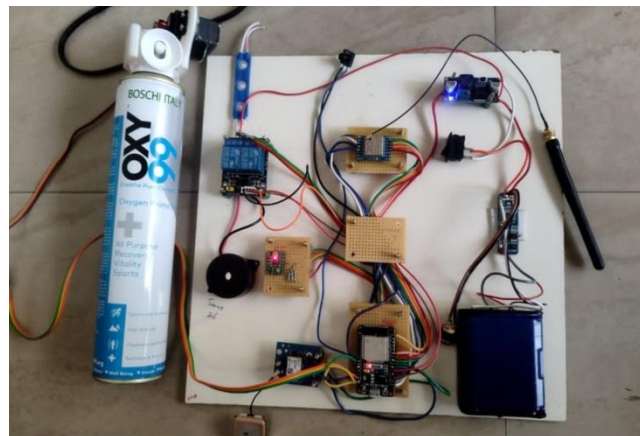


Fig 6.1 Transmitter (Experimental setup)

In other words, if there are afflictions to the health status of the people, the rescue team will be assisting the afflicted. Some examples of the parameters include human pulse, temperature, altitude of the mountain, level of oxygen, the GPS position. If the people on trucking choke due to any health issues, then they can press the button present on the said kit. Such that the SOS alert message will be passed to the local monitor station. If at any point the oxygen level is reduced according to the set parameter the oxygen will be delivered.

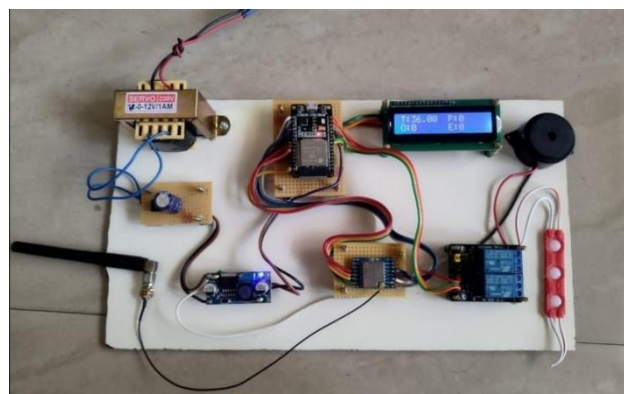


Fig 6.2 Receiver (Experimental setup)

External health condition specialists for people on trekking can be tracked and the data sent using LORA while Oxygen level, Pulse, temperature, pressure can be measures using Pulse Oximetry Sensor, Temperature Pressure Altitude Sensor. The status information of such a position where people are present is observed, and the data transmitted by GPS. If Oxygen level is less than specific standard limit, oxygen can themselves be provided to the suffocating people who are suffering from some diseases. Lo-Ra to receive the signals from the hiking people, and to show and store the data log on IoT server. If in the transmitter side there is an emergent buzzer which is use as SOS.

Oxygen Concentrator: A respiratory equipment which selectively, directly and independently draws the required quantity of oxygen from the surrounding air for use by the patient/ user.

SOS Alert System: An emergency alerting mechanism that would allow the device to send an emergency alert, SOS signals along with location details to the emergency services or contacts of the owner's choice.

Automatic Oxygen Detection: The device will have sensors to keep track of the hiker's peripheral oxygen saturation or SpO2 as well as the concentration of oxygen around the hiker. Once again depending on the SpO2 level when they drop below a certain level, the concentrator is initiated.

Portability: The oxygen concentrator will be portable in the sence of being light weight thus easily carried during hiking activities.

Battery Life: Extending battery life is essential and provision of rechargeable batteries and solar charging are some of the features to consider.

SOS Alert System: Incorporation of GPS and communication modules to enable the hiker send alerts together with his or her location. This system will be activated either by the user through manually or if advised by the critical conditions.

User Interface: Non-Complex Design with icons that depict battery status, oxygen levels and SOS state.

Prototyping: Constructing the primary functioning models of the oxygen concentrator and evaluating how long they would hold up before they started failing, how comfortable they were to use, etc.

Field Testing: Carrying out tests putting the device under actual hiking circumstances to be given to test the performance reliability and effectiveness of the device.

User Feedback: Including inputs from hikers regarding the design as well as making changes to make it even more useful to the users.

Improved Safety: Thus, through offering adequate supplementary oxygen using the auto oxygen concentrator, altitude sickness and other related ailments will not occur.

Enhanced Emergency Response: This specific use of SOS alert system will help to minimize the cycle time in emergencies, therefore reducing fatalities.

User Satisfaction: Hikers' reception of the device, its ergonomics, and functionality

CONCLUSION

Thus, in this study, we have considered that the oxygen supply is relevant for hiking people in hill areas. Thus, replenishing the oxygen component at the right time is the most critical factor of all. Thus in this project there is an automatic supply of oxygen for the hiking people at a time when the oxygen level comes down the said threshold value. The health condition of the people on trucking can be monitored and the data can be sent through LORA and the Oxygen level, pulse, temperature, Pressure can be obtained by the use of Pulse Oximetry Sensor, Temperature Pressure Altitude Sensor. Thus, the health condition of the hiking people will be monitored by the nearby receiving station. Want to join a fun, affordable and healthy activity and become one of the many hikers that The Appalachian Trail rewards with the joy of discovering their bodies' capabilities? This assists the rescue team in determining the overall health status of the people and take them to the hospital when due.

About the area where the people are situated monitoring information is given and through GPS data is transmits. Thus the nearby receiving station can be informed of the exact location of the people by calculating the distances. The receiving station is often founded in down of the hills or some distance far away from the hiking mountain. They supervises the health state of each people. If the people choke with any health condition, the monitoring station may know the exact position of people with the help of GPS and rescue them.

This idea may also be used during the COVID-19 which supplies the oxygen to the patient as long as the patient's oxygen level is below the threshold. Most patients with COVID-19 have hypoxia, meaning that they have low oxygen saturation in their blood even when they have no symptoms. Sometimes, the first sign that a person

requires medical help is that the level of oxygen in the blood has fallen. In COVID situation one should not even talk to the affected person, so this automatic supply of oxygen can be useful to enhance the oxygen level of the patient. However, aiming for 92-96% seem reasonable because research data, albeit indirect, from patients with any conditions other than COVID-19 indicate that enticing SpO₂ below 92% or above 96% may be detrimental. Given the decrease of the safety level in the described position the automatic supply of the oxygen to the patient is introduced in this work.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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