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Smart Ventilator Using Arduino with Blood Oxygen Sensing

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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 Along with this the ventilator must have the ability to adjust the air volume pushed into lungs in each breath. The last but not 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 with design and develop using Arduino encompasses all these requirements to develop a reliable yet affordable ventilator to help in times of pandemic.

Keywords: contradictory motion, diaphragm, exhalation, inhalation, ventilator,

I. INTRODUCTION

The main role of Engineers is to find a complete and compact solution to the problem experienced by people of all categories. The category may contain criteria of various types. But a problem statement once identified can be solved efficiently only by the solution formula identified by quality engineers who can locate the area where the solution has to be created and may be applied to eliminate the problems faced. In this project, the same type of is followed to eliminate the problems identified by people of vast diversity with a common action and with diversified variety of problems which utmost lead to a common point. In this project, we as a team of emerging engineers have identified a basic problem statement which is faced by most of the people who live in and around urban areas and the solution identified is proved to be a great ideology to overcome the problem identified by most of the people and the ideology proposed also has a vast future expansion scope of improvement. Current Global Technology plays an important role in the field of medical. Automation is the technology with which the procedure of process executed without human assistance.

II. OVERVIEW

The ventilator works on the combination of a microcontroller based working environment. The

microcontroller has the capability to send and receive data from various inputs and output devices and process the received data and send it as a complete output in the form of digital signal. In this project module, the microcontroller receives the data over pressure sensor and oxygen sensor. The microcontroller calculates the both sensors value and according to the conditions it gives signal to servo motor. Servo motor handles the silicon bag to send the oxygen.

III. EXISTING SYSTEM

The size of the project is big, cannot be used for transportation purposes. Sensors used in this project are highly sensitive and it will damage easily. It is not an automatic; it requires some Man power to access the project. Due to highly sensitive sensors and other components the value of the project is high.

IV. PROPOSED SYSTEM

The size of the project is small and compact easily used for transportation purposes. Sensors used in our project are simple and cost efficient. It is an automatic pumping, so there is no necessary requirement for any Man power to access the project. Though, it is a prototype the value of the project is low.

4.1. BLOCK DIAGRAM

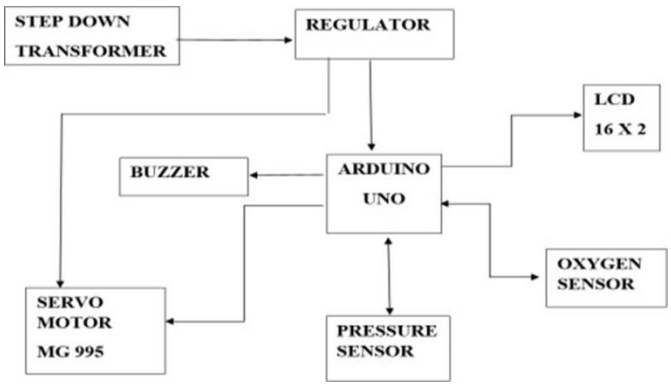


Fig.4.1 SYSTEM BLOCK DIAGRAM

4.2. ARDUINO UNO:

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available.

The word "uno" means "one" in Italian and was chosen to mark the initial release of Arduino Software. The Uno board is the first in a series of USB-based Arduino boards; it and version 1.0 of the Arduino IDE were the reference versions of Arduino, which have now evolved to newer releases. The ATmega328 on the board comes preprogramed with a boot loader that allows uploading new code to it without the use of an external hardware programmer.

While the Uno communicates using the original STK500 protocol, it differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it uses the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial

4.3. SERVOMOTOR

MG995 is a servo motor providing precise rotation over 180º range its applications are many and in them a few are stated below. The servo is suited for

designing robotic arm in which wear and tear of motor is high. Being metal geared, the servo has long life and can be installed on system like robotic arm were motor work is huge. The servo is also suited to be used in drones and toy planes. Having a satisfying torque which is enough to overcome air resistance and control wings of plane, the servo is preferred in toy planes and drones which need precision control no matter the condition.

MMG995 FEATURES AND ELECTRICAL CHARACTERSTICS:

- Metal geared servo for more life
- Stable and shock proof double ball bearing design
- High speed rotation for quick response
- Fast control response
- Constant torque throughout the servo travel range
- Excellent holding power
- Weight: 55 g
- Dimension: 40.7×19.7×42.9mm
- Operating voltage range: 4.8 V to 7.2 V
- Stall torque: 9.4kg/cm (4.8v); 11kg/cm (6v)
- Operating speed: 0.2 s/60º (4.8 V), 0.16
- s/60º (6 V)
- Rotational degree: 180º
- Dead band width: 5 µs
- Operating temperature range: 0ºC to
- +55ºC
- Current draw at idle: 10mA
- No load operating current draw: 170mA
- Current at maximum load: 1200mA

4.4. HEART BEAT SENSOR:

Heartbeat Monitor/ Digital Pulse Meter is the economically priced instrument with latest technology. Using an advanced micro controller-based circuit & probe design it provides an easy way to measure and monitor heartbeat rate. The instrument uses Infrared sensors, which can easily be clipped to finger ends to detect the heartbeat by finger plythysmography technology. A bar graph is provided to adjust the position of sensors at the best signal location. The unit is lightweight, easy to handle, extremely durable.

The detachable Infrared probe is designed to get the best results in all type of pulse rate measurement applications.
The pulse is also shown by LED indication.

4.5. PRESSURE SENSOR:

This is a pressure sensitive resistor with a round, 0.5" diameter, sensing area. This FSR will vary its resistance depending on how much pressure is being applied to the sensing area. The harder the force, the lower the resistance. When no pressure is being applied to the FSR its resistance will be larger than 1MΩ. This FSR can sense applied force anywhere in the range of 100g-10kg.
Interlink Electronics FSRTM 400 series is part of the single zone Force Sensing Resistor family. Force Sensing Resistors, or FSRs, are robust polymer thick film (PTF) devices that exhibit a decrease in resistance with increase in force applied to the surface of the sensor.

4.6. STEPDOWN TRANSFORMER:

The Step-down Transformer is used to step down the main supply voltage from 230V AC to lower value. This 230 AC voltage cannot be used directly, thus it is stepped down. The Transformer consists of primary and secondary coils. To reduce or step down the voltage, the transformer is designed to contain less number of turns in its secondary core. The output from the secondary coil is also AC waveform. Thus the conversion from AC to DC is essential. This conversion is achieved by using the Rectifier Circuit/Unit.
Step down transformers can step down incoming voltage, which enables you to have the correct

voltage input for your electrical needs. For example, if our equipment has been specified for input voltage of 12 volts, and the main power supply is 230 volts, we will need a step down transformer, which decreases the incoming electrical voltage to be compatible with your 12 volt equipment.

4.7. 7805 VOLTAGE REGULATOR:

Regulator regulates the output voltage to be always constant. The output voltage is maintained irrespective of the fluctuations in the input AC voltage. As and then the AC voltage changes, the DC voltage also changes. Thus to avoid this Regulators are used. Also when the internal resistance of the power supply is greater than 30 ohms, the output gets affected. Thus this can be successfully reduced here. The regulators are mainly classified for low voltage and for high voltage. Further they can also be classified as:

i) Positive regulator

1. ---> input pin
2. ---> ground pin
3. ---> output pin

It regulates the positive voltage.

ii) Negative regulator

1. ---> ground pin
2. ---> input pin
3. ---> output pin

It regulates the negative voltage.

The 7805 provides circuit designers with an easy way to regulate DC voltages to 5v. Encapsulated in a single chip/package (IC), the 7805 is a positive voltage DC regulator that has only 3 terminals. They are: Input voltage, Ground, Output Voltage.

INPUT VOLTAGE	230V
OUTPUT VOLTAGE	12V
OUTPUT CURRENT	1A

4.8. BUZZER:

- A buzzer is an electrical device that makes a buzzing noise and is used for signaling.
- A buzzer has a piezo dis cand an oscillator inside. When the buzzer is powered, the oscillator generates a frequency around 2-4 kHz.
- The piezo element vibrates accordingly to produce the sound. As soon as the gas leak is detected, the buzzer automatically rings to alert the users about the gas leak.

4.9. LCD DISPLAY:

- A liquid-crystal display is a flat-panel display used to present textual information to the user.The type of LCD used in this system is 16X2 LCD display. The use of LCD is to display the concentration levels of gases in the air and also to display a warning message on the display to alert the user around about the gas leak

V. WORKING

The input for the kit is 230V, 50Hz Ac Supply. It is given to the step-down transformer which provides the output of 12V AC. It is then transferred to the bridge rectifier which converts AC to DC and provides 12V DC which is unfiltered. It is then filtered to have Pure DC of 12V using capacitor. The rectified output is regulated using 5V regulator which is provided as input to the Arduino board. The sensors are connected to the analog pins and inbuilt A/D converter will provide the sensor values in decimal format. The output pin of HB sensor is connected to the A0 pin of the arduino. The HB sensor is provided with 5V DC supply and Ground pin. The output pin of the Pulse sensor is connected to the A1 pin of the

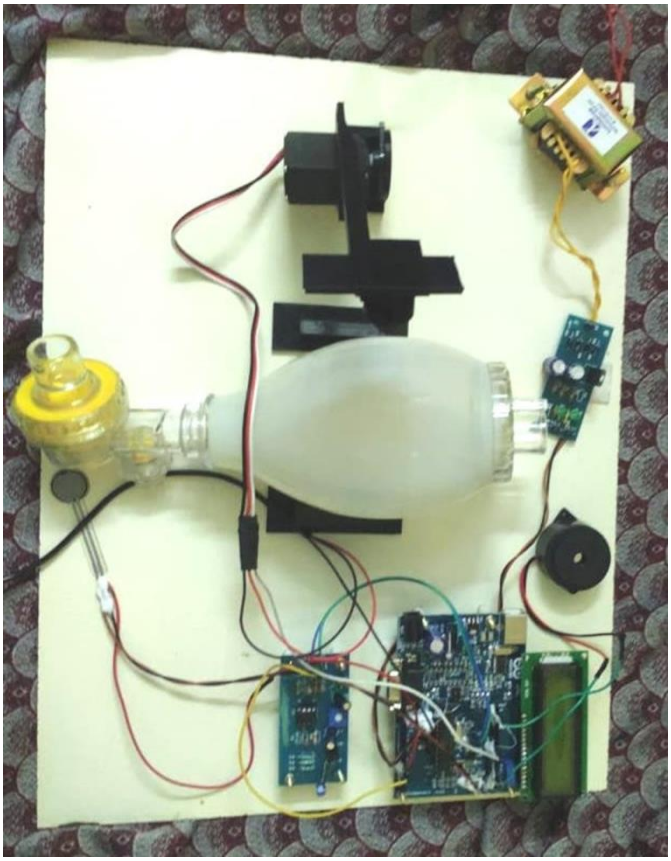
arduino. The PX sensor is also connected with 5V and Ground Pin. The 16x2 (16 columns and 2 rows) LCD is connected to the arduino. The LCD is given 5V supply and Ground pin. The LCD is connected to 13, 12, 11,10,9 and 8 pins of arduino. In the 6pins, 4 pins are data lines for sending data and the remaining two lines are read and write pins. Servo motor is connected to the 7th pin of arduino. The Pulse is send to the servo motor for the ventilator operation. The pins are defined as input and the output in the void setup function. The sensor values are read in the main loop continuously and it is displayed in the LCD. When the PX value reduces below 90, the ventilator operation will start operating using servo motor. Once the kit is ON, the main loop will work continuously. Here we have added two condition. Condition-1 if the oxygen level is from 80-90 means then the servomotor beats faster in the oxygen bag. Condition-2 if the oxygen level is from 90-100 which is normal level but some patients feel difficult to breath so we have added this condition, at that time the servomotor beats normally so patients feels like self-breathing.

VI. FUTURE SCOPE OF PROJECT

We can use this project in time of emergency as a first aid tool. For example: If a person gets a respiratory problem. He/She needs to taken to hospital immediately while travelling in ambulance or in the accident location he/she needed of ventilator to breath so at that time our project is small , handy and to operate which can save a life. Since the price of our project is affordable it is easy buy by a poor people to rich people. In future we can develop the project by adding GSM module to stay connected with doctors during travelling in ambulance, we can add BP sensor instead of pressure sensor for more accuracy, we can add camera to live communication with doctors for better fid aid treatment while travelling.

VII. RESULT

We hereby propose a design model as Smart Ventilator Using Arduino with Blood Oxygen Sensing which is able to rescue a patient who need emergency ventilator. It can measure oxygen level as well as the pressure. The proposed model design is supposed to look like the following:



VIII. CONCLUSION

- A working prototype that can be operated on a test lung has been developed.
- The prototype has user-controlled breath rate and tidal volume.
- It features assist control and an over-pressure alarm.
- Further development of this proof-of-concept is planned.
- Future iterations will incorporate changes prompted by the results of our prototype testing.

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