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Concurrent Sensors Enabled Robotic Ventilator Machine Using IoT

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Abstract
In order to breathe, human lungs use the reverse pressure created by the diaphragm's contraction motion. A ventilator uses a contrary motion to pump air into the lungs, inflating them. With the flexibility to regulate rising increments in sets of 2, a ventilator mechanism must be able to produce between 10 and 30 breaths per minute. Additionally, the ventilator must be able to modify the amount of air that is forced into the lungs with each breath. The setting to change the duration of the inhale to exhalation ratio is last but not least. In addition, to prevent over or under air, the ventilator must be able to monitor the patient's blood oxygen level and exhaled lung pressure.In addition, the ventilator needs to be able to simultaneously prevent high and low air pressure by monitoring the patient's blood oxygen level and exhaled lung pressure. The servo-driven minimised ventilator, which is designed to anticipate abnormalities in human respiration rate, automatically generates ventilation without the need for human input.
Keywords : Ventilator, Respiration rate

INTRODUCTION

All these factors are taken into account in the ventilator we design and create utilizing an Arduino to create a dependable yet economical ventilator to aid in pandemic situations.

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Here, we use a silicon ventilator bag attached to a servo motor that is powered by a side push mechanism..

Our technology uses an IoT-enabled blood oxygen sensor and a sensitive heartbeat sensor to track the patient's vital signs and display them on a webpage. The IoT application's option command can be used to set the time duration for inhalation. To obtain desired results and to help patients in COVID pandemic and other emergency scenarios, the complete system is controlled by an Arduino board..

EXISTING SYSTEM

Earlier systems usesforceful mechatronic strategy and control of a low-cost non-invasive ventilator, for which rapid prototyping manufacture strategies such as 3D printing and product design are used.

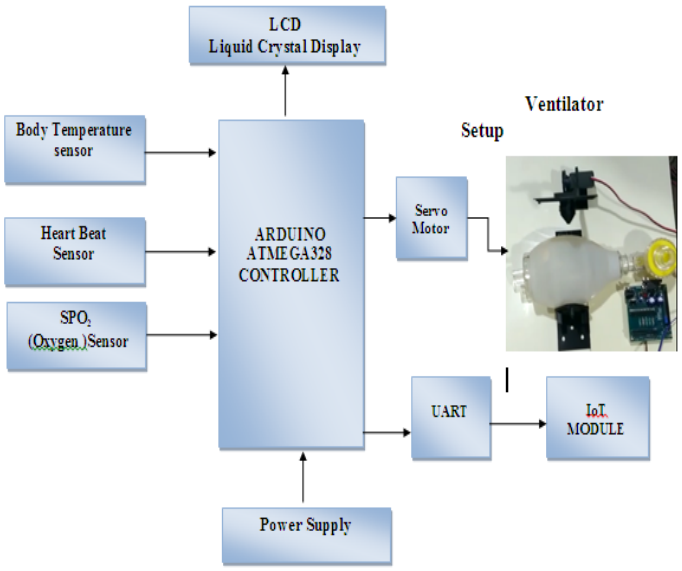
In order to guarantee the reliability of the system operation, In this existing work, a robust control scheme based on super-twisting sliding modes is proposed, which guarantees the trajectory tracking control corresponding to the breathing profiles required by the patients.

Experimental and simulation results validated the effectiveness of the prototype design. Nevertheless, the prototype is waiting to be tested and approved for use in health assistance.

In this sense,this work presents Experimental and simulation results validate the effectiveness of the proposed prototype design

Nevertheless, the prototype is waiting to be tested and approved for use in health assistance.

BLOCK DIAGRAM



PROPOSED SYSTEM

In this proposed system, we are measuring the

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multiparameter such as heart beat sensor, SPO2
sensor, body temperature sensor with Arduino
Uno board.

All the parameter data are collected and given to the ATMEGA 328 and then updated to the cloud server through IoT module. The doctor/user can monitors the health parameters.

Max30100 sensor is used to get both Heart beat and SPO2 level of the person since it works on the I2C protocol.

Temperature sensor is used to monitor the human body temperature and it is displayed in the LCD and also updated in the iot.

Comparing all these values in the Micro controller, when the SPO2 level decreases from the normal level or temperature sensor value increases to the abnormal level, then the ventilator is turned on to provide them oxygen supply.

Once our system predicts the abnormality of human respiration rate, the ventilator which is designed by servo motor produces ventilation automatically without human intervention.

COMPONENTS DESCRIPTION

POWER SUPPLY

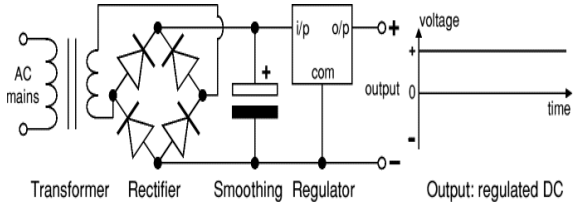
The operation of power supply circuits built using filters, rectifiers and then voltage regulators.

Starting with an AC voltage, a steady DC voltage is obtained by rectifying the AC voltage, then filtering to a DC level, and finally regulating to obtain a desired fixed DC voltage.

The regulation is usually obtained from an IC voltage regulator unit, which remain the same if the input DC voltage varies or the output load connected to DC voltage changes.

A diode rectifier that provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a DC voltage.

A regulated circuit can use this DC inputs to provide a DC voltage that not only has much less ripple voltage but also remains the same DC value even if the input DC voltage varies somewhat or the load connected to the output DC voltage changes this voltage regulation is usually obtained using one of a number of popular voltage regulation IC unit.



In this circuit 230v AC is given as input to the primary windings of the transformer, which step-down's the 230v into 12v Ac supply.

Then the 12v Ac supply is converted into the 12v dc supply using bridge rectifier.1000 uf capacitor is used to change the pulsating dc into pure dc.

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5v dc output is taken from the voltage Regulator-7805, which consists of 3 pins. First pin is given input 12v dc and centre pin given ground supply, output 5v dc is taken from the third pin.

Arduino UNO

Arduino UNO is ATmega328 based microcontroller board. Its operating voltage is 5v dc and its operating frequency is 16MHz.

It is one of the most popular prototyping boards.

The board comes with built-in Arduino boot loader.

It has 14 GPIO pins, 6 PWM pins, 6 Analog inputs and on board UART, SPI and TWI interfaces, an on-board resonator, a reset button, and holes for mounting pin headers.

While programming the board, it can be connected to the PC using USB port and the board can runs on USB power.

The Arduino UNO has 32 Kb Flash memory, 1 Kb EEPROM and 2 Kb SRAM.

The board can be connected to different Arduino Shields for connectivity with Ethernet, Bluetooth, WI-Fi, Zigbee or Cellular network and it can be connected to most of the IoT platforms.

I n our project, we use 3 types of sensor- Heartbeat, SPO2, and temperature sensor.

Arduino consists of 14 digital pins and 6 Analog pins. Since temperature sensor gives the output in analog, it is connected to the analog input of theArduinouno A0 pin.

Since MAX30100 sensor works on the I2C protocol, it is connected to the Arduino UNO through I2C protocol mode(A4 and A5 pin).

In Arduino UNO 6 digital pins(8,9,10,11,12,13) is used to connect the data pins of the LCD.

Driver Relay is used to switch the Pumps, those Two driver relays are connected to the two digital pins of Arduino (6,7).

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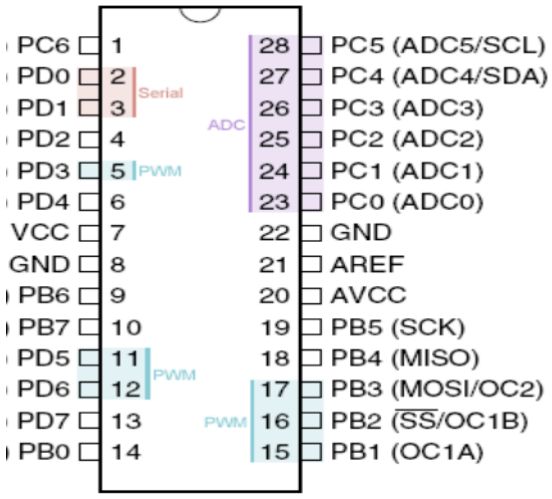


LCD display

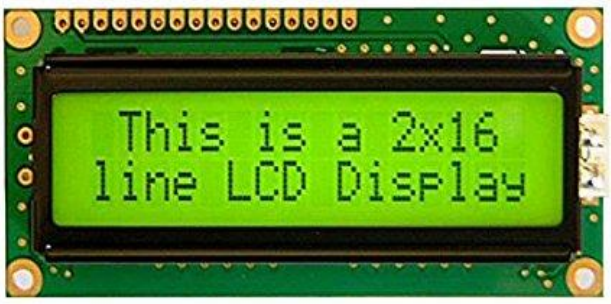
Liquid crystal displays (LCDs) are used in similar applications where LEDs are used.

LCD is used to visualize the status of our project, which is programmed to display the Temperature and MAX30100 Sensor values, so that we can easily able to visualize the health parameters.Its operating voltage is 5v dc supply.

These applications are display of numeric and alphanumeric characters in dot matrix and segmental displays.

The liquid crystal material may be one of the several components, which exhibit optical properties of a crystal though they remain in liquid form.

Liquid crystal is layered between glass sheets with transparent electrodes deposited on the inside faces.



IoT

Node MCU is an open source IoT platform.Its operating voltage is 5v dc supply. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module.

The term "Node MCU" by default refers to the firmware rather than the dev kits. The firmware uses the Lua scripting language

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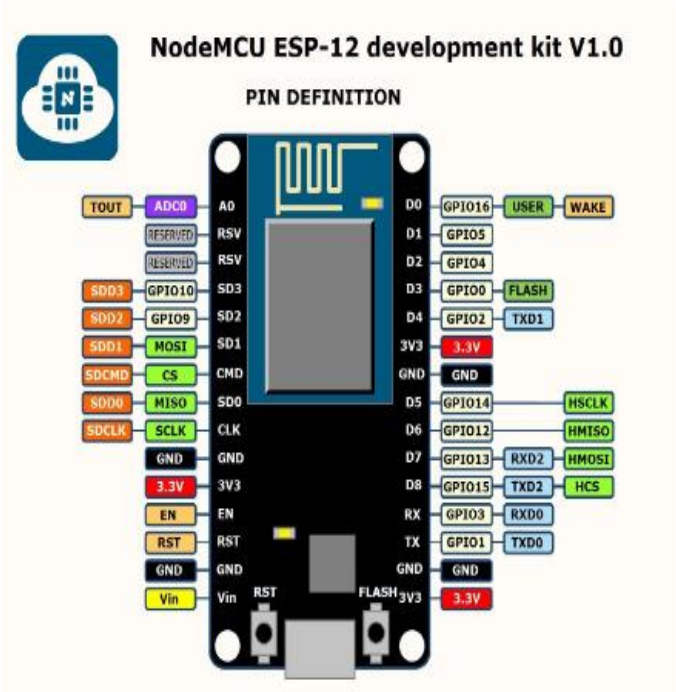
It is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266.In our Project IOT is used to monitor the Health parameters (Temperature, HB and SPO2) from far distance or from anywhere.

All the values that should be viewed by the doctors, likewise programmed for the NODE MCU which consists of inbuildwifi Shield, and transmitted to the Cayenne Server which works on the MQTT protocol.

From the Cayenne Server all the values are updated in the Mobile App/ web page of the doctors, So that they can able to monitor the Health parameters from remote place.



MQTT PROTOCOL

MQTT is a lightweight, publish-subscribe network protocol that transports messages between devices. The protocol usually runs over TCP/IP, however, any network protocol that provides ordered, lossless, bi-directional connections can support MQTT.

According to measurements in 3G networks, throughput of MQTT is 93 times faster than HTTP's. Besides, in comparison to HTTP, MQTT Protocol ensures high delivery guarantees.

HTTP is the most popular and widely used protocol. But over the last years MQTT rapidly gain tractions. Developers have to choose between them when we are talking about IoT development.

MAX30100 Pulse Oximeter

MAX30100 is an integrated pulse oximetry and
heart-rate sensor.

It’s an optical sensor that derives its readings from emitting two wavelengths of light from two LEDs – a red and an infrared one – then measuring the absorbance of pulsing blood

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through a photodetector. This particular LED color combination is optimized for reading the data through the tip of one's finger.

The signal is processed by a low-noise analog signal processing unit and communicated to the target MCU through the mikroBUS I2C interface.

When the heart pumps blood, there is an increase in oxygenated blood as a result of having more blood. As the heart relaxes, the volume of oxygenated blood also decreases. Ultimately, by knowing the time between the increase and decrease of oxygen-rich blood, the device calculates the pulse rate.

It turns out, oxygenated blood absorbs more infrared light and passes more red light while deoxygenated blood absorbs red light and passes more infrared light. This is the main function of the MAX30100: it reads the absorption levels for both light sources and stored them in a buffer that can be read via I2C.

SDA and SCL pin of MAX30100 will be connected to the A4 and A5 pin of the Arduino UNO.

Applications

- Wearable Devices
- Fitness Assistant Devices
- Medical Monitoring Devices

TEMPERATURE SENSOR

LM35 Temperature Sensor-The LM35 series are precision integrated-circuit LM35 temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.

LM35 consists of 3 pins , first pin is given 5v, third pin is given ground supply and finally output is taken from the centre pin.

The temperature is placed in surface of the Transformer poles. The temperature output is given to the RA0 pin

In our project LM35 temperature sensor is used to sense the temperature of the hospitalized persons.

The LM35 sensor thus has an advantage over linear temperature sensors calibrated in ° Kelvin.

SERVO MOTOR

A **servo motor** is a type of motor that can rotate with great precision.

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Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision.

In our project ventilator setupis coupled to servo motor When the temperature or SPO2 or heart beat exceeds the normal value then servo motor will be moved angle wise which in makes the ventilator to provide oxygen supply.

CONCLUSION

In this paper,a mixture of air and oxygenis pushed by the ventilator into the patient's lungs to get oxygen into the body. The ventilator can also hold a constant amount of low pressure, called positive end-expiratory pressure (PEEP), in order to keep the air sacs in the lung from collapsing.

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