IoT Based Smart ICU Ventilation System and Patient HealthMonitoring System

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Abstract

The advent of the Internet of Things (IoT) has allowed for significant advancements in the healthcare sector, especially in the monitoring of patients with respiratory disorders. This paper represents an IoT-based smart ventilation and patient health monitoring system designed to provide real-time data and improve patient's health care and full time monitoring of patient's in hospitals as well as at home. The system consists of a smart ventilation system contains various sensors to monitor vital signs and environmental factors, and a mobile application to monitor the condition of patient and activity of patient remotely. The data sensed by the sensors and then collected is transmitted to the cloud for analysis, and used to adjust the settings of ventilation system and alert the healthcare providers such as doctors and their loved ones in case of any deviations from the normal conditions in body. This system provides a extensive approach to patient healthcare and has the potential to efficiently improve outcomes for patients with respiratory conditions/disorders.

Keywords:IoT, Healthcare, Smart ventilator, Real-time data, Monitoring, sensors, remote.

Introduction

Respiratory disorders are a major cause of discouragement and mortality worldwide, with millions of people suffering from conditions such as COPD (Chronic Obstructive Pulmonary Disease), asthma, and ARDS (Acute Respiratory Distress Syndrome).

Mechanical ventilation is a life-saving mediation for patients with severe respiratory distress, but traditional ventilators don't have the capability to provide real-time data and adjust settings based on the patient's condition. With the rise of IoT, there is an opportunity to restructure the patient care by integrating smart technology into medical equipments and medical devices.

The WHO (World Health Organization) has proclaimed that healthy aging is critical for countries' economic development. The number of old and chronically ill persons living at home is steadily increasing day by day. In-home Patient health monitoring systems provide a number of advantages, including increased safety measures, enhanced quality of life, and lower hospitalization and cost on comparison. With promising technical, economic, the IoT is transforming the typical healthcare scheme into smart ventilation and monitoring. Current IoT research has opened up new opportunities in the sovereign state of medicine, with the goal of improving healthcare quality at a low cost. Many problems are faced during this process because the adoption of these new technologies by the people is tough .So, there is a lot of interest in finding efficient and reliable ways to keep track of patients and provide them proper ventilation and well-being and care for them at home with proper monitoring setup and ventilation setup and to operate all remotely with electronic devices. Constant patient health monitoring and ventilation leads to reduce hospitalizations, reduce emergency department visits, and reduce hospital expense.

In the age of ultramodern wisdom and technology, the Internet of effects (IoT) has come a popular exploration content. Remote healthcare monitoring and smart ventilation is getting popular day by day. It's marked as the most standard way of healthcare of patient.As the observation of remote cases has come more popular day by day and standard health care is demanded for healthy living, It's a veritably huge and worrying problem that how to give high- quality case care outside the sanitarium. Remote Case health monitoring system arrangement empowers observation of cases outside the conventions, hospitals and setting up a clinical terrain at home with the setup of ventilation and monitoring and with fluently operated. The core ideal of this design is to design and apply smart patient health shadowing/ monitoring and smart

ventilation system that uses detectors to track sense case health and uses Internet to inform their loved ones
in case of any issues or any diversions in case's health condition. The ideal of developing monitoring system and ventilation system is to reduce health care costs and give the medical services on time without portability issues.

Literature Survey

Internet of Things (IoT) has come a fleetly growing technology in recent times. It's defined as a network of connected bias that changes data with each other over the internet. The smart ICU ventilation system and health tracking system is one of the most promising operations of IoT, which can ameliorate the quality of life for individualities, especially those with health problems. The IoT- grounded smart ventilation and patient health monitoring system is a new approach that can contribute to health monitoring and environmental control of inner surroundings. This literature review aims to probe the current state of exploration on IoT- grounded smart ventilation and patient health monitoring systems. Health monitoring using IoT. The IoT-grounded health monitoring system is a significant operation in healthcare. Several studies have delved the development of IoT- grounded systems for remote health monitoring of cases. For illustration, the study by Kang etal.(2019) developed an IoT-grounded system to cover the health of senior people living alone. They used detectors to collect data on vital signs, similar as blood pressure, heart rate, and body temperature, and also anatomized the data to describe any abnormalities. Another study by Hong etal. (2018) proposed a wearable IoT- grounded system to cover the physical exertion and vital signs of cases with habitual obstructive pulmonary complaint (COPD). The system handed real- time monitoring of cases' health status, enabling early discovery of exacerbations and timely intervention. Smart ventilation using IoT .The IoT- grounded smart ventilation system is another promising operation of IoT in inner environmental control. Several studies have delved the development of IoT-grounded smart ventilation systems. For illustration, the study by Van den Bosscheetal. (2019) proposed an IoT- grounded smart ventilation system that uses CO2 detectors to cover inner air quality and automatically adjusts ventilation rates to maintain optimal CO2 situations. Another study by Chaturvedietal. (2020) developed an IoT- grounded smart ventilation system that uses temperature and moisture detectors to cover inner environmental conditions and adjusts ventilation rates to maintain optimal temperature and moisture situations. IoT- grounded smart ventilation and patient health monitoring system The integration of IoT- grounded smart ventilation and patient health monitoring systems is a new approach that can contribute to health monitoring and environmental control of inner surroundings. Several studies have delved the development of IoT- grounded smart ventilation and patient health monitoring systems. For illustration, the study by Wang etal.(2019) proposed an IoT- grounded smart ventilation and patient health monitoring system for sanitarium insulation apartments. The system uses CO2 and temperature detectors to cover inner air quality and adjusts ventilation rates to maintain optimal CO2 situations. It also uses wearable IoT bias to cover cases' vital signs, enabling real- time monitoring of cases' health status. IoT-grounded smart ventilation and patient health monitoring systems are promising operations of IoT in inner environmental control and healthcare. Several studies have delved the development of IoT- grounded smart ventilation and patient health monitoring systems, which can contribute to health monitoring and environmental control of inner surroundings. Farther exploration is demanded to probe the effectiveness of these systems in perfecting patient health issues and inner environmental quality.

Method Proposed

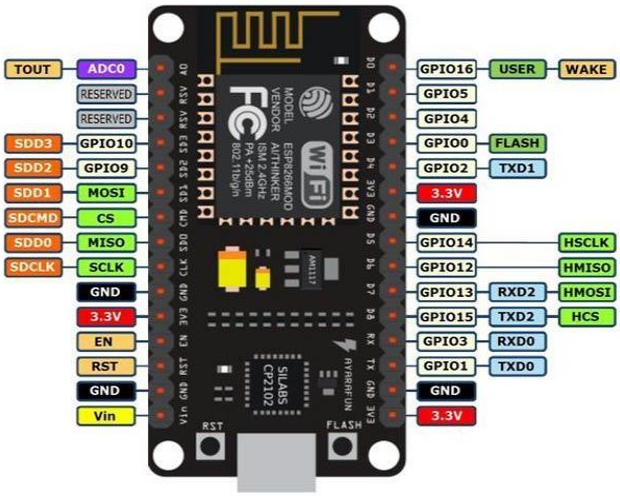
The IoT-based smart ventilator and patient health monitoring system consists of two main components: a smart ventilator for proper ventilation and a mobile application for patient health monitoring. The smart ventilator is equipped with sensors to monitor vital

signs such as oxygen level, heart rate, and respiratory rate, as well as environmental factors such as temperature and humidity in body. The data collected by the sensors is transmitted to the cloud and it is analyzed and that data is used to adjust the ventilator's settings and alert healthcare providers in case of any deviations from the normal conditions in the human body. The mobile application allows your loved ones and doctor for remote patient monitoring, giving healthcare providers/doctors access to realtime data and the ability to adjust the ventilator's settings remotely through any electronic devices.

Used Materials

HardwareNode MCU Microcontroller

Node MCU is a Microcontroller unit .It is an open-source, low cost IoT platform. It initially includes a firmware which runs on an in-built Wi-Fi module ESP8266 and hardware which was based on ESP-12 module.NodeMCU is an open-source firmware and development board specially targeted for IoT based Applications.Throughits pins we can read inputs - light on a sensor, a finger on a button, or a Twitter message -and turn them into an output - activating a motor, turning on an LED, publishing something online. It has also Wi-Fi capabilities, so we can control it wirelessly and make it work on a remote installation easily. We can tell our board what to do by sending a set of instructions to the microcontroller on the board. To do so we can use thethe Arduino Software (IDE).



Pulse Sensor

Pulse sensor basically measures the pulse rate of the patients. It works on finding the difference value of volume of blood in arteries and veins or we can say oxygenated and deoxygenated volume of blood is the pulse rate. A pulse wave is the change in the volume of a blood vessel that occurs when the heart pumps blood, and a detector that monitors this volume change is called a pulse sensor.

First, there are four main ways to measure heart rate: electrocardiogram, photoelectric pulse wave, blood pressure measurement, and phonocardiography.

Pulse sensors use the photoelectric method.

Pulse sensors using the photoelectric pulse wave method are classified into 2 types depending on the measurement method: transmission and reflection.

LM35 Temperature Sensor

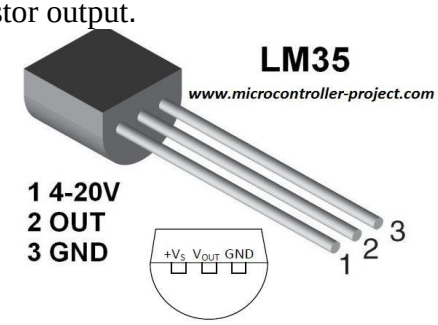
LM35 is a temperature measuring device having an analog output voltage proportional to the temperature.

It provides output voltage in Centigrade (Celsius). It does not require any external calibration circuitry.

The sensitivity of LM35 is 10 mV/degree Celsius. As temperature increases, output voltage also increases.

E.g. 250 mV means 25°C.

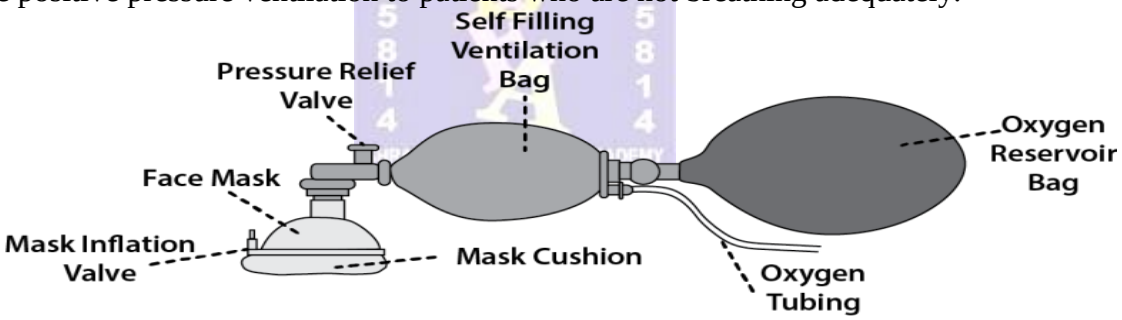
It is a 3-termi nal sensor used to measure surrounding temperature ranging from -55 °C to 150 °C. LM35 gives temperature output which is more precise than thermistor output.



Ambu Bag

The Ambu bag is used on the principle of compression of the cylinder by hands, from which air is released and sent to the human lungs, while the mask is applied to the patient's face. Because of this device, the lungs are saturated with oxygen, supports artificial human breathing. The bag is not used if the patient has a foreign body in the respiratory tract, vomiting is observed, the tongue has climbed into the larynx.

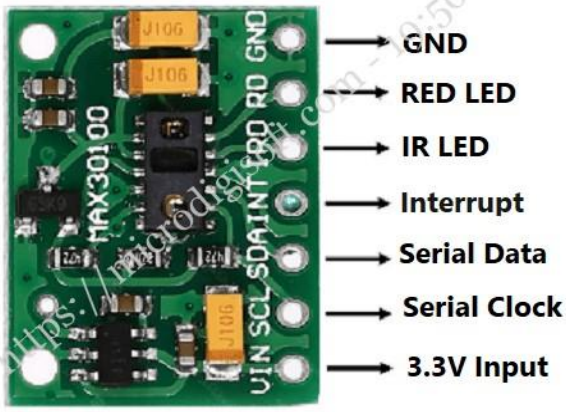
The term “Ambu Bag” comes from the acronym of “Artificial Manual Breathing Unit” and is used to refer to bag valve masks. It is a hand-held device commonly used to provide positive pressure ventilation to patients who are not breathing adequately.



MAX30100 Pulse Oximeter

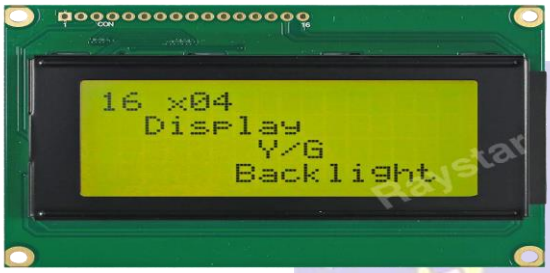
MAX30100 is an integrated pulse oximeter and heart-rate monitor sensor solution. It’s an optical sensor that derives its readings from emitting two wavelengths of light from two LEDs – a red and an infrared one – then measuring the absorbance of pulsing blood through a photo detector. This particular LED color combination is optimized for reading the data through the tip of one’s finger.

The pulse oximetry subsystem in MAX30100 consists of ambient light cancellation (ALC), 16-bit sigma delta ADC, and proprietary discrete time filter. It has an ultra-lowpower operation which makes it ideal for battery operated systems. MAX30100 operates on a supply in the range of 1.8 to 3.3V.The MAX30100 operates from 1.8V and 3.3V power supplies and can be powered down through software with negligible standby current, permitting the power supply to remain connected at all times.



LCD 16 × 4 Display

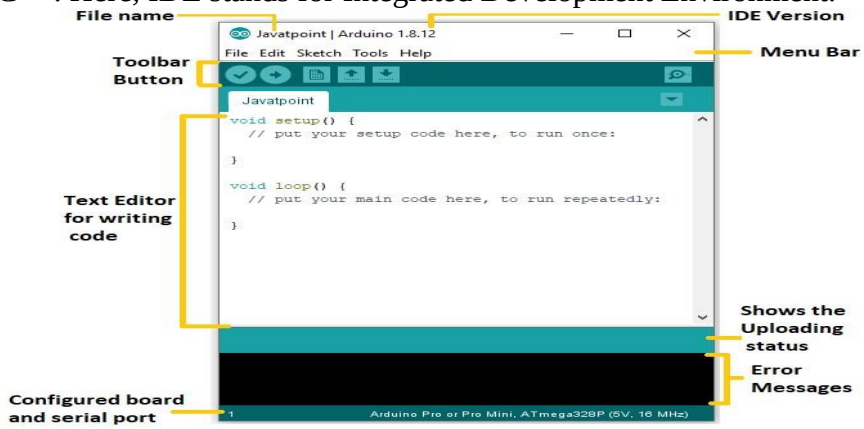
This is LCD 16×4 Parallel LCD Display that provides a simple and cost-effective solution for adding a 16×4 Black on RGB Liquid Crystal Display into your project. The display is 16 characters by 4 line display that has a very clear and high contrast black text upon a yellow background/backlight. A 16x4 LCD means it can display 16 characters per line and there are 4 such lines. This LCD has two registers, namely, Command and Data.



Software

Arduino IDE

The Arduino IDE is open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment.



Paid Cloud Service

The term "cloud services" refers to a wide range of services delivered on demand to companies and customers over the internet. These services are designed to provide easy, affordable access to applications and resources, without the need for internal infrastructure or hardware. Cloud services are fully managed bycloud computingvendors and service providers. They're made available to customers from the providers' servers, so there's no need for a company to host applications on its own on-

premises servers. If and when there's no longer a need for a particular application or platform, the business can simply cancel the subscription or shut down the service.

Result and Discussion

The IoT-based smart ventilator and patient health monitoring system has shown promising results in study of patients with respiratory conditions. The real-time data provided by the system allowed for timely mediations and adjustments to the ventilator's settings which improve the condition of patient. The ability to remotely monitor patients and adjust the ventilator's settings has also reduced the need of person to continuously monitor the patient and also reduce the cost of patient's healthcare in hospitals.

Conclusion and Future Scope

Conclusion

The IoT-based smart ventilator and patient health monitoring system represents a significant advancement in the field of respiratory care. The real-time data and remote monitoring capabilities of the system provide a comprehensive approach to patient care and have the potential to greatly improve outcomes for patients with respiratory conditions. Further studies are needed to fully assess the impact of this technology on patient outcomes, but the results thus far are promising and point towards a bright future for IoT in the healthcare sector.

Future Scope

Future scope of the Iot Based Smart Ventilation and Patient Health monitoring system is to avail the services provided in hospitals at home and also with low cost. In case of emergency proper ventilation and monitoring will be provided in any area. It is costefficient and affordable for all and it is easy to use so that everyone will be able to understand its installation and working easily. It will decrease the death rate due to unavailability of services and not getting proper requirements on time. It will be large user friendly because it has large user friendly display with real time waveform data.

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