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A Portable Iot-Based Smart Artificial Ventilator

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ABSTRACT
The current COVID-19 pandemic has produced shortages of crucial medical equipment, such as mechanical ventilators. This shortfall affects our regional medical infrastructure, causing mortality rates to rise. Due to the present coronavirus, mechanical ventilators are one of the most crucial equipment. It is difficult to reduce demand since typical mechanical ventilators are expensive, complex in design. Conversely, whereas emergency ventilators can generate shortage gaps Businesses and colleges are currently seeking for profitable ways to overcome this ventilator's flaws. This project mentions different ventilation prototypes that are low-cost, easily deployable, and light-weight. This project's design is a basic automatic manual resuscitation device used before mechanical ventilation. The system uses readily available off-the-shelf components. Non-clinicians can run the device with minimal training and no expertise. This paper intends to shed light on emergency ventilators that are low-cost and quick to deploy while meeting fundamental mechanical ventilator requirements.

Key words: IoT (Internet Of Things), Sensor, Emergency Ventilator, Low-Cost, Portable

I. INTRODUCTION

The present COVID-19 pandemic has impacted the earth greatly. The only solution is to contain the sickness. The best way to handle the sickness is to keep the PIP in quarantine and enforce the location. Remote collection, monitoring, management, and analysis of illness symptoms is only possible with IoT [1]. However, wearable technology can monitor and forecast COVID-19 using sensors like heart rate, temperature, oxygen saturation, and others. Wearable tech helps detect the newest covid-19 pandemic. Deep learning can sort sensor data. IoT and Deep Learning have revolutionised health care. These technologies have effectively addressed major medical challenges [19].

As illustrated in Fig. 1, sensors, cloud and IoT architecture offer real time applications for effective solution. COVID-19, like other viruses, travels through stages of infection, starting with asymptomatic incubation. The second stage includes high fever, cold, and cough. The third stage is when the virus is unleashed to spread, and the last step is when the infection is recovered [20]. By observing a patient and isolating him in restricted places, the virus can be contained. Thus, health indices like body temperature, SpO2 and pulse rate can help diagnose new coronavirus symptoms. According to recent research, IoT wearable sensors will reach 162 million devices by 2020-22 [18]. The Internet of Medical Things collects data from medical sensors and uses Deep Learning to analyse it to uncover serious situations. Various cloud-based architectures have greatly enhanced assistance for medical emergencies. Data from health sensors are processed using the fog and edge computing paradigms to offer location, low latency and high availability [2, 3, 4].

A. EARLY DETECTION AND REMOTE MONITORING

Wearable devices monitor potential infected people's health symptoms, detect physiological changes, and alert users of possible infection. This early detection approach helps patients self-isolate at the designated location by the authorities [5]. This can help organisations and governments prevent illness spread and development. Wearable sensors with remote patient monitoring can track the patient's location using GPS [17]. This might enable authorities confine the patient and follow their progress.

Smarthealth systems monitor physiological aspects of the body in the form of skin and motion using various devices and sensors [18]. Wearable body sensor networks are the ideal approach for remote health monitoring [6]. It uses a network of sensors to monitor a patient's health status, with a local server acting as a node to collect data and inform the physician [19]. It is used as a wearable sensor to monitor patient health in both static and dynamic modes. It is a patient monitor that uses edge, fog, and cloud level. Wearable technology can thus help monitor a COVID-19 patient [20].

B. To prevent the spread of COVID-19

Maintain a safe distance from someone who is coughing or sneezing,Wearing a mask, and staying home if we are sick. Doctors Role in COVID-19 Pandemic Their commitment to treat despite increasing personal dangers is vital for Personal Response. COVID-19 is spread through dust and fomites as well as improper contact between infector and afflicted. A major transmission engine for COVID-19 has not been observed empirically, even if such aerosol-generating techniques are carried out in medical institutions. Covid-19, or new corona virus disease, is a serious worldwide health hazard that disrupts daily life. Many countries have been plagued by a critical care crisis, despite government lockdowns and public health efforts to contain and delay the disease's spread. Outbreaks raise the need for hospital beds and medical equipment, while increasing the risk of infection among medical personnel. Future Projection is vital in reducing the burden on the healthcare system, delivering the best possible care for patients, and obtaining information on disease prognosis. Prediction models that incorporate several characteristics or attributes to predict future pandemic deaths can give needed information. Determining appropriate policies for future scenarios will be easier. This will help medical professionals deploy medical resources appropriately. Fever is one of the most critical COVID-19 symptoms, but because it is contagious, it is vital to take patients' temperatures rapidly and possibly without contact. In contrast, epidemiological and laboratory research have shown that ambient temperature can alter Coronavirus survival and transmission, making continual monitoring of both ambient and body temperature critical in the case of COVID-19. In pandemic scenarios, thermographic technologies like COVID-19 might be crucial for first temperature assessment for medical purposes, namely:

Acute human temperature screening in a public health emergency to assess the severity of fever and increased temperature in relation to probable affections. Temperature evaluation in heavy traffic places like business buildings and airports.

The added monitoring of ambient temperature can help increase the accuracy of detecting human body temperature, which is affected by humidity. Recent research has also proven the role of ambient temperature and humidity in enhanced COVID-19 transmission risk.

Advanced sensor monitoring technologies exist for both ambient humidity and human body temperature, using wireless IoT platforms or wearable sensors for automated patient temperature monitoring. Larger studies have focused on sophisticated fever monitoring and contact tracing technologies. In addition to the broad analysis of noncontact temperature measuring devices, noteworthy studies on the accuracy evaluation for infrared imaging tools under certain settings may be found in and references herein. Recent advances in the detection of aberrant breathing signals have been reported. All of the foregoing systems are expensive and can not detect environmental characteristics such as humidity, which can help trace the pandemic disease.

No integrated platform exists to date that can non-contact sense both ambient and body temperatures. A platform like this might be highly useful in both monitoring sick people's body temperatures and controlling pandemic spread, which is affected by environmental factors like temperature. This method can predict COVID-19 infection before symptoms arise if combined with body temperature monitoring. To this goal, the present work proposes an integrated hardware system with two sensor types that can independently capture ambient and body temperatures. To investigate the potential association of climate and seasonality with the spread of infection, a compact and low-cost platform solution is proposed. An infrared temperature sensor and a thermistor are used to produce a unique measurement system for temperature parameters shown on an LED panel. Studies on the impact of environmental factors on COVID-19 dissemination are ongoing, and no cohesive theory exists. Thus, using ambient humidity can assist create a more precise theory to characterise COVID-19 and separate it from past similar pandemics. The combination thermometer prototype can be used as a remote sensing device to prevent and regulate COVID-19 spread. For example, it can be put directly in a patient's room,

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allowing medical professionals to remotely manage temperature readings.

To prevent the spread of COVID-19

➢ We are using Alcohol based Hand sanitizer

➢ Maintain a safe Distance from anyone who is coughing or sneezing.

➢ Wearing Mask

➢ Staying Home if we are Feeling Unwell.

The COVID-19 pandemic catastrophe has resulted in thousands of deaths owing to lack of artificial ventilation. It proposes a robust mechatronic design and control of a low-cost non-invasive ventilator using fast prototyping manufacturing technologies like 3D printing and product design. This work proposes a robust control approach based on super-twisting sliding modes that guarantees trajectory tracking control appropriate to the patients' breathing characteristics. The proposed prototype design is validated by experimental and simulation findings. Nonetheless, the prototype is still being evaluated and certified for medical usage.

C.Related works

A few studies on wearable design and application are listed in Table 2. Wireless Body Sensor Networks (WBSN) are the ideal way to monitor covid-19 infection and limit viral spread. Each sensor is connected to an IoT cloud edge node where data is collected and analysed to determine health. It can track and monitor a COVID-19 patient in an isolated area. The IoT design framework is compared to existing technologies to assess COVID-19 smart health care systems.

Researchers have used several strategies to control different sorts of infections, such as employing health monitoring mobile applications, to control Covid-19. The system is limited but does not cover cough detection and temperature, despite the device not being worn. a PCB Board was utilised to collect multichannel amperometry data from biosensors. The electronic read-out circuit can bias the amperometry sensor. But there's no room for data analysis or storage. The work focused on locating patients without providing health information systems. Again, no hardware part application. The initiative is mainly focused on following the disease propagation pattern only through mobiles and without delivering any health data analysis. There is theoretical modelling and evaluation of disease spreading variables, but no real time application. As mentioned previously, countries have employed drones, mobile phones and thermal cameras to track infections, but solely for sport [11]. They had no physical contact, therefore it was only fleeting. Recently, a wearable IOT design framework was provided, which could serve as a strong technical foundation for the proposed system implementations.

II. EXISTING SYSTEM

They created a low-cost non-invasive ventilator using fast prototyping manufacturing techniques including 3D printing and product design. To ensure system dependability, This work proposes a robust control system based on super-twisting sliding modes that ensures trajectory tracking control for patients' breathing profiles. The experimental results validated the prototype design. Nonetheless, the prototype is still being evaluated and certified for medical usage. In this sense, the work The proposed prototype design is validated by experimental and simulation findings. Nonetheless, the prototype is still being evaluated and certified for medical usage.

III. PROPOSED SYSTEM

Using an Arduino Uno board, we can measure multiple parameters such as heart rate, SPO2, and body temperature. The IoT module updates the cloud server with the parameter data acquired by the ATMEGA 328 microcontroller. The doctor/patient can monitor health metrics. When our system predicts an irregularity in human respiratory rate, the reduced ventilator immediately produces ventilation. A low-cost non-invasive ventilator with strong mechatronic design and control using rapid prototyping technologies like IOT. Our project uses battery power for all units. The solar panel and power source attached to the battery will charge it.

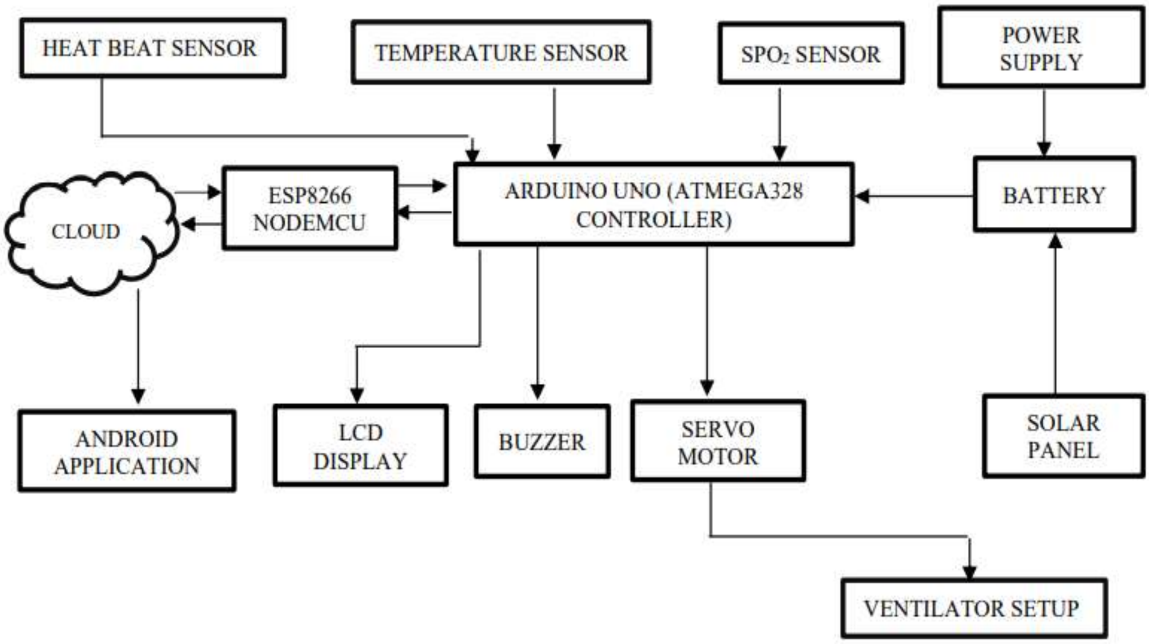

Fig. 1; General Block diagram of proposed system.

IV. CIRCUIT DIAGRAM

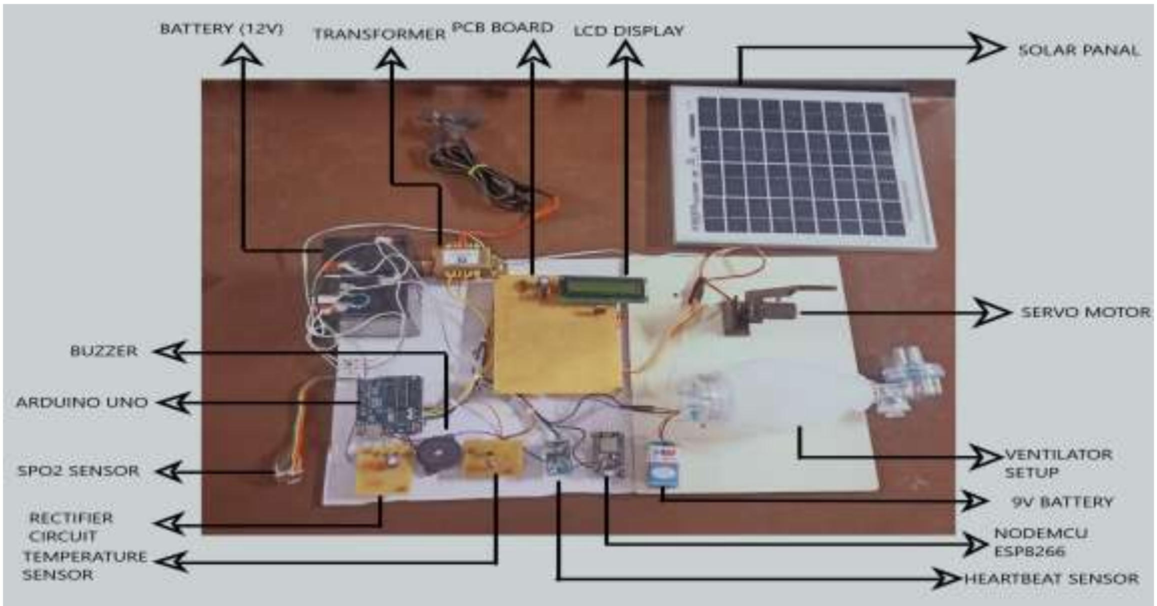

Fig.2: Hardware diagram

In this project, we will use Arduino, Servo Motor, ESP8266 Wi-Fi Module and Bag Valve Mask. The servo motor compresses the Bag Valve Mask by directly compressing the bag so that air delivery may begin.

The servo motor is an important aspect of the implementation since Arduino instructs the motor how much to rotate and in which direction to compress and expand the bag. The predetermined modes determine the compression frequency and tidal volume, allowing the user to tailor the airflow to the patient. There are three frequency options and three loudness modes. Changes can be made while fine tuning the ventilator. The modes control

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the ventilator's volume and frequency. When the modes are pressed, the servo motors' speed and volume are controlled by pre-programmed parameters. The temperature sensor DHT 11 sends data to the ESP 8266 module, which sends it to the Blynk IoT platform, which displays it on our phone. The device contains a siren that automatically sounds when the power goes off, alerting the attendant that the ventilator has ceased working and immediate attention is necessary. The device is powered by a portable battery that powers the buzzer.

A. Software Implementation

The Arduino Integrated Development Environment (IDE) is developed in C and C++ and runs on Windows, macOS, and Linux. It can write and upload programmes to Arduino compatible boards, as well as other vendor development boards using third-party cores. General Public License, version 2 is used to release the IDE source code. The Arduino IDE supports C and C++ utilising unique code structure guidelines. The Arduino IDE includes a Wiring software library with numerous typical input and output processes. To run user-written code, toolchain is used, which compiles and links two fundamental functions (start sketch and main loop) into an executable cyclic executive programme. The Arduino IDE usesavrudude to transform executable code into a hexadecimal text file that is loaded into the Arduino board's firmware. avrdude is the default uploading tool for official Arduino boards. The Arduino IDE is built on the Processing IDE, which will be replaced in version 2.0 by the Visual Studio Code-based Eclipse This IDE framework.

B. Technology Implementation

The internet of things (IoT) is a network of interconnected computers devices, mechanical and digital machinery, items, animals, and people that can exchange data without human or computer interaction. People with heart monitors, farm animals with biochip transponders, cars with sensors that notify drivers to low tyre pressure, or any other natural or man-made object having an IP address and the ability to send data across a network are all examples of things in the internet of things. Organizations across industries are increasingly using IoT to improve efficiency, better understand customers, improve decision-making, and create company value.

V. RESULTS AND DISCUSSION

The suggested system includes a web-based interface for medical authorities and an Android-based mobile app for patient family responders. Actually, both interfaces work together to collect and send health-related data. To learn more about the design architecture of an IoT-based wearable device, which is divided into three parts: The user has a wearable sensor gadget worn on any hand or ankle as a bracelet that detects physiological health problems and transmits them to the Application Peripheral Interface(API) cloud processing system. The registered user family member is responsible for receiving warnings and notifications of serious health symptoms of the patient under quarantine. For storage and retrieval, the other party is an Application Peripheral Interface (API) hosted on a web domain. In order to provide drugs and consultations, this API is controlled by medical authorities. The API interface is synced with an Android application designed to notify patients of their health issues.

A. Device testing results

The device is attached to the human body and tested in various settings, all while wearing it, measuring temperature, location, SpO2, heartbeats. In temperature situations, an external heat source was employed to test heat measurement. This is done to expose Covid-19 Patient restriction. In case of any abnormality in heart rate, temperature value, spo_2 value, the concerned sensor will sense and as result, the ventilator will turn on automatically.

B. Monitoring of person having normal signs

Sensor readings such as temperature, SpO2 and heartbeat will be uploaded to the cloud and shown in the case manager website. The device also sends periodic position data to the website, including latitude and longitude. It records and analyses cough sounds every 2 seconds and sends the count to the internet to store and process. On the map, a green icon indicates the person's name, ID, and health status (Green), and that the system has been tested at room temperature. The patient ID and device ID are assigned during the registration stage. This gives the patient's unique ID and device serial number. The longitude and latitude values are not provided until the device is assigned and starts reporting data to the website (Case manager website). The cloud-based system compares the readings and calculates the final state, which in our scenario is active safe.

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Fig. 3: SPO2 level membership function

Fig. 4: Pulse rate membership function

Fig. 5: Body temperature membership function

Fig. 6:Ventilator output

Fig. 7: Sensor Values displayed on IoT Application platform

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Fig. 8: Sensor Values Displayed on LCD

Fig. 9: sensor abnormal valve displayed on LCD

VI. CONCLUSION

The lack of mechanical ventilators has accelerated the growth in instances, and the deaths of COVID-19 victims have shocked the globe. To overcome the inadequacies in ventilators, many medical care and specialist manufacturers have prototyped Emergency ventilator. Mechanical ventilator might cause a deficit. One system, Glasvent, has been compared and reviewed here. The current situation does not allow them to match or replace existing complicated mechanical ventilators in terms of performance or stability. Emergency ventilators are low-cost, portable, and have backup battery choices. The FDA has only approved Emergency Use Authorisation (EUA) for most of the system. These prospects can thrive for idea ventilator definition methods that can be redefined by medical health experts to boost performance.

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