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IoT-Based Temperature and Humidity Real-Time Monitoring and

Reporting System for CoVid-19 Pandemic Period

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IoT-Based Temperature and Humidity Real-Time Monitoring and

Reporting System for CoVid-19 Pandemic PerioAn IoT-based temperature and humidity real-time monitoring and reporting system can play a crucial role during the COVID-19 pandemic period, as maintaining appropriate environmental conditions can help reduce the spread of the virus

ENVIRONMENTAL MONITARING

eople are conscious about the environment they are living in. In order to help those people a smart

environment monitoring system is needed. A smart Internet of Things (IoT) based temperature and

humidity real time monitoring and reporting system is an effective system that is equipped with

temperature sensor and relative humidity sensors for taking measurement. The proposed system is an

advanced solution for monitoring and live reporting the temperature and humidity at different points in

specific locations. The real time data from thesensors are stored in cloud server and email is sent to the

predefined recipients to let them access the data remotely over internet. When the measurement of

temperature and humidity reaches over safe level then the recipients can take immediate action to alert

people to be careful about corona virus. The proposed system is designed based on Arduino UNO Board,

temperature sensor DHT11, humidity sensor, ESP8266 Wi-Fi module, IoT, DC-DC modular, and solar

panel. The main characteristics of this proposed system is low cost, low power consumption because of

self-powered device, high accuracy and user friendly. The system shows a high degree of accuracy and

reliability.

Keywords —Internet of Things, Temperature sensor DHT-11, Humidity sensor, ESP-8266 Wi-Fi

module , DC-DC Modular, Solar panel, battery 9 volt and ThingSpeak.

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I. INTRODUCTION

In COVID-19 pandemic period, environmental

concern including temperature and humidity

variations are becoming an important topic. The

random variation of temperature and humidity

caused by greenhouse effect has impact on

propagation of corona virus. These unwanted

changes are driving to develop of environment

monitoring system especially for temperature and

humidity [1]. This paper focuses an IoT based

system that effectively monitor the variation in

temperature and humidity using sensors,

microcontroller, and IoT based technologies. This

makes our system more reliable as if one of the

nodes is not working properly or been damaged

somehow than the other one will begin to function

or activate dynamically. Wireless communications

are used to collect data and to communicate

between the centralized control center and the

actuators located at different locations within a

specified area [3].In this proposed system, the data

collected from different nodes are stored in cloud

server and then sent to the recipient through email.

RESEARCH ARTICLE

OPEN

ACCESS

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The recipient can monitor the variation in

temperature and humidity both in the indoor and

outdoor environment using this proposed system.

II. RELATED WORK

A system is developed in [1] to sends measurement

data of temperature and humidity to a cloud

platform using HTTP (Hypertext Transfer

Protocol)based servicesusing energy autonomous

wireless sensors. Air quality monitoring device [2]

monitors overall toxic gases like NOx, CO2,

benzene and smoke by comprising of a NodeMCU

ESP32, a MQ-135 gas sensor and a DHT-11

temperature and humidity sensor module. Also

displays an alert message on server if the air quality

parameters exceed the standard

value.AquaponicsMonitoring and automatic

correction system set-up in a temperature controlled

greenhouse including pH level and temperature of

the recirculating water [4]. A remote monitoring

system of temperature and humidity based on

OneNet cloud service equipped with

STM32F103RCT6 of ARM CortexM3 kernel,

SIM800C communication module and GSM/GPRS

cellular communication technology having data

detection and alarming function [5]. Another

proposed system is developed to observe air

pollution information at public facilities or homes

which is capable to collect and analyze atmospheric

environment measurement results in a server

through an LTE communication network [6, 8].An

IoT-based environmental monitoring system is

developed for indoor workplaces to compare the

energy consumptions for environmental control

with the real environmental wellness [7]. Smart

environmental monitoring isto help in the

protection of environment via parameters for

monitoring such as quality of air and quality of

water [9].

III. DESIGN METHODOLOGY

The system consists of a temperature and humidity

sensor DHT11, ESP8266 WiFi module, DC-DC

Motor, Solar panel and Arduino UNO Board.

Arduino UNO is a microcontroller board based on

the ATmega328P (datasheet). It has 14 digital I/O

pins, 6 analog inputs, a 16 MHz ceramic resonator

(CSTCE16M0V53-R0), a USB connection, a power

jack, an ICSP header and a reset button. Six digital

pins can be used as PWM outputs It contains

everything needed to support the microcontroller;

simply connect it to a computer with a USB cable

or power it with an AC-to-DC adapter or battery to

get started. Fig. 1 shows the Arduino UNO Board.

Fig. 1: Arduino UNO Board

The ESP8266 is a Wi-Fi module that allows

microcontrollers access to a Wi-Fi network. This

module is a self-contained SOC (System on a Chip)

that does not necessarily need a microcontroller to

manipulate inputs and outputs. Fig. 2 shows the

ESP8266 Wi-Fi Module.

Fig. 2: ESP8266 Wi-Fi Module

The DHT-11 sensor is made of two parts, a

capacitive humidity sensor and a thermistor. It is a

device of ultra-low cost with 1 Hz sampling rate

(once every second). It provides 20-80% humidity

readings with 5% accuracy and 0-50°C temperature

readings with ±2°C accuracy.

Fig. 3 shows the DHT-11 sensor.

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Fig. 3: DHT-11

The DC-DC module is an efficient M

OSFET

tube thatmakes

efficiency up to 94 percent

(LM2577 current only 3 amp

). It is hi

frequency (400 KHZ)

that can use the small

capacity of the filter capacitor can achieve very

good effect, ripple smaller and smaller.

shows the DC-DC module.

Fig. 4: DC-DC Module

This system uses

Mini polycrystalline sol

that is shown in Fig. 5.

Fig. 5: Solar Panel

IV. SYSTEM SIMULATION

The system architecture is done in 4 stages of IoT

architecture that is a collection of numerous

elements: sensors, protocols, actuators, cloud

services, and layers.

The

architectural design of temperature and

humidity monitoring system

is shown in Fig. 6.

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OSFET

switch

efficiency up to 94 percent

). It is hi

gh switching

that can use the small

capacity of the filter capacitor can achieve very

good effect, ripple smaller and smaller.

Fig. 4

Mini polycrystalline sol

ar Panel

The system architecture is done in 4 stages of IoT

architecture that is a collection of numerous

elements: sensors, protocols, actuators, cloud

architectural design of temperature and

is shown in Fig. 6.

Fig. 6: Architectural Design of Temperature and Humidity Monitoring

System

The circuit diagram and connection status o

system is shown in Fig. 7.

(a)

(b)

Fig. 7: (a) Circuit diagram (b) Connection devices

Arduino and DHT-

11 circuit diagram with testing

result is shown in Figure 8

(a) and 8(b).

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Fig. 6: Architectural Design of Temperature and Humidity Monitoring

The circuit diagram and connection status o

f this

Fig. 7: (a) Circuit diagram (b) Connection devices

11 circuit diagram with testing

(a) and 8(b).

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Fig. 8 (a): Circuit Diagram of Arduino and DHT

Fig. 8 (b): Testing Result of Arduino and DHT

Arduino

and ESP8266 circuit diagram with testing

result is shown in Figure 9(a) and 9(b).

Fig. 9 (a): Circuit Diagram of Arduino Uno and ESP8266

Fig. 9 (b): Testing Result of Arduino UNO and ESP8266

Arduino, DHT11 and ESP8266 circuit diagram with

testing result is shown in Figure 10

(a) and 10(b).

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Fig. 8 (a): Circuit Diagram of Arduino and DHT

-11

Fig. 8 (b): Testing Result of Arduino and DHT

-11

and ESP8266 circuit diagram with testing

Fig. 9 (a): Circuit Diagram of Arduino Uno and ESP8266

Fig. 9 (b): Testing Result of Arduino UNO and ESP8266

Arduino, DHT11 and ESP8266 circuit diagram with

(a) and 10(b).

Fig. 10 (a): Circuit Diagram of Arduino Uno, DHT11 and ESP8266

Fig. 10 (b): Testing Result of ArduinoUno , DHT11 and ESP8266

V. CIRCUIT

DESIGN

AND

DEVICE

This section shows pictorial representation

circuit design and device model that are used in our

system.

The design of c

ircuit is shown in Fig.

and 11(c).

Fig. 11(a)

: Circuit Design

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Fig. 10 (a): Circuit Diagram of Arduino Uno, DHT11 and ESP8266

Fig. 10 (b): Testing Result of ArduinoUno , DHT11 and ESP8266

DEVICE

MODEL

This section shows pictorial representation

of the

circuit design and device model that are used in our

ircuit is shown in Fig.

11(a), 11(b),

: Circuit Design

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Fig. 11(b): Circuit Design

Fig. 11(c): Circuit Design

The Device Model in various positions is shown in

Fig. 12.

Fig. 12: Device Model

VI. SYSTEM FLOWCHART

The proposed system uses the first sensor on

Arduino UNO to read temperature and humidity

data for every minute and these data are stored in

the cloud server database. Air temperature and

humidity data are checked whether they exceed the

temperature limit in which a minimum temperature

is 18 °C and a maximum temperature is 30 °C or

exceed the humidity limit, that is, air humidity of at

least 65% and maximum humidity of 80%, if the

limit exceeds an email will be sent to the recipients.

The system flowchart for monitoring temperature

and humidity is illustrated in Fig. 13.

Fig. 13: System Flowchart for Temperature and Humidity Monitoring

System

VII. EXPERIMENTAL RESULTS

In this system, we use android apps named

“Thingview” which is android based wireless

communication system. The user interface of our

apps is shown in Fig. 14.

Fig. 14: The user interface of apps

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The reading

status of temperature and humidity of

both channels of our apps is shown in F

and 15(b).

Fig. 15 (a): Reading status of temperature and humidity of Channel 998897

(DIU)

Fig. 15 (b): Reading status of temperature and humidity of Channel 1006505

(Motijil)

The interface of creating channels with status is

shown in Fig. 16(a), 16(b), and 16(c).

Fig. 16 (a): Interface of creating channels

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status of temperature and humidity of

both channels of our apps is shown in F

ig. 15(a)

Fig. 15 (a): Reading status of temperature and humidity of Channel 998897

Fig. 15 (b): Reading status of temperature and humidity of Channel 1006505

The interface of creating channels with status is

Fig. 16 (a): Interface of creating channels

Fig. 16 (b): Channel Status of Channel ID

Fig. 16 (c): Channel Status of

Channel ID

Sensor value with the variation of histogram

temperature is shown in Fig. 17(a) and 17(b).

Fig. 17 (a): Sensor Valu

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Fig. 16 (b): Channel Status of Channel ID

-998897

Channel ID

-1006505

Sensor value with the variation of histogram

of

temperature is shown in Fig. 17(a) and 17(b).

Fig. 17 (a): Sensor Valu

e

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Fig. 17 (b): Histogram of variation of Temperature

IFTTT Mail Configuration

with acceptance is

shown in Fig. 18(a) and 18(b).

Fig. 18(a): IFTTT Mail Configuration

Fig. 18(b): Acceptance of Mail

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0

20

40

60

80

100

120

140

1

-

30

211

-

240

421

-

450

631

-

660

841

-

870

1051

-

1080

1261

-

1290

1471

-

1500

1681

-

1710

30 Entry AVG Value

AVG Temp

0

20

40

60

80

AVG Temp

AVG Humidity

30.78666

667

68.89068

Grand AVG

Fig. 17 (b): Histogram of variation of Temperature

with acceptance is

Fig. 18(a): IFTTT Mail Configuration

Data analysis of temperature and humidity for

certain amount of time is shown in Fig. 19(a) and

19(b).

Fig. 19 (a): Temperature and humidity AVG Value

Fig. 19 (b): Total temperature-

humidity Data Avg

Cloud platform data curve and data sheet is shown

in Fig. 20(a) and 20(b).

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0

20

40

60

80

100

120

140

160

1681

-

1710

1891

-

1920

2101

-

2130

2311

-

2340

2521

-

2550

30 Entry AVG Value

AVG Humidity

AVG Humidity

68.89068

966

Grand AVG

Data analysis of temperature and humidity for

certain amount of time is shown in Fig. 19(a) and

Fig. 19 (a): Temperature and humidity AVG Value

humidity Data Avg

Cloud platform data curve and data sheet is shown

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Fig. 20 (a): Cloud platform data curve

Fig. 20 (b): Cloud platform data sheet

VIII.

CONCLUSIONS

The proposed system in this paper

has been carried

out to monitor real-

time condition (Humidity an

Temperature) through internet. This does not

require physical presence a

nd can save

and will be a very effective

way of monitoring

environment during the COVID-

19 pandemic

situation. The system can retrieve temperature and

humidity data on the server room and the

temperature and humidity data that has been taken

can be displayed on the website in graphical form.

The advantages of this research work are that this

system can also regulate the humidity in the server

room and use one of the tools as sensors and

actuators. The system also

can send notifications

the respective stakeholders.

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has been carried

time condition (Humidity an

d

Temperature) through internet. This does not

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19 pandemic

situation. The system can retrieve temperature and

humidity data on the server room and the

temperature and humidity data that has been taken

can be displayed on the website in graphical form.

The advantages of this research work are that this

system can also regulate the humidity in the server

room and use one of the tools as sensors and

can send notifications

to

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IoT-Based Temperature and Humidity Real-Time Monitoring and

Reporting System for CoVid-19 Pandemic Period

**IoT-Based Temperature and Humidity Real-Time Monitoring and Reporting System for CoVid-19 Pandemic Period**

**Abstract:**

In COVID-19 pandemic period, corona virus propagates rapidly in cold temperature and humidity. Many people are conscious about the environment they are living in. In order to help those people a smart environment monitoring system is needed. A smart Internet of Things (IoT) based temperature and humidity real time monitoring and reporting system is an effective system that is equipped with temperature sensor and relative humidity sensors for taking measurement. The proposed system is an advanced solution for monitoring and live reporting the temperature and humidity at different points in specific locations. The real time data from thesensors are stored in cloud server and email is sent to the predefined recipients to let them access the data remotely over internet. When the measurement of temperature and humidity reaches over safe level then the recipients can take immediate action to alert people to be careful about corona virus. The proposed system is designed based on Arduino UNO Board, temperature sensor DHT11, humidity sensor, ESP8266 Wi-Fi module, IoT, DC-DC modular, and solar panel. The main characteristics of this proposed system is low cost, low power consumption because of self-powered device, high accuracy and user friendly. The system shows a high degree of accuracy and reliabilityI.

**INTRODUCTION:**

In COVID-19 pandemic period, environmental concern including temperature and humidity variations are becoming an important topic. The random variation of temperature and humidity caused by greenhouse effect has impact on propagation of corona virus. These unwanted changes are driving to develop of environment monitoring system especially for temperature and humidity [1]. This paper focuses an IoT based system that effectively monitor the variation in temperature and humidity using sensors, microcontroller, and IoT based technologies. This makes our system more reliable as if one of the nodes is not working properly or been damaged somehow than the other one will begin to function or activate dynamically. Wireless communications are used to collect data and to communicate between the centralized control center and the actuators located at different locations within a specified area [3].In this proposed system, the data collected from different nodes are stored in cloud server and then sent to the recipient through email

**DESIGN METHODOLOGY** :

The system consists of a temperature and humidity sensor DHT11, ESP8266 WiFi module, DC-DC Motor, Solar panel and Arduino UNO Board. Arduino UNO is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital I/O pins, 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. Six digital pins can be used as PWM outputs It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. Arduino UNO Board The ESP8266 is a Wi-Fi module that allows microcontrollers access to a Wi-Fi network. This module is a self-contained SOC (System on a Chip) that does not necessarily need a microcontroller to manipulate inputs and outputs. Fig. 2 shows the ESP8266 Wi-Fi Module. ESP8266 Wi-Fi Module The DHT-11 sensor is made of two parts, a capacitive humidity sensor and a thermistor. It is a device of ultra-low cost with 1 Hz sampling .It provides 20-80% humidity readings with 5% accuracy and 0-50°C temperature readings with ±2°C accuracy. Fig. 3 shows the DHT-11 sensor. International Journal of Scientific Research and Engineering Development ©IJSRED: All Rights are Reserved Fig. 3: DHT-11 The DC-DC module is an efficient MOSFET tube thatmakes efficiency up to 94 percent. It is hi frequency (400 KHZ) that can use the small capacity of the filter capacitor can achieve very good effect, ripple smaller and smaller. shows the DC-DC module.

**SYSTEM SIMULATION**

The system architecture is done in 4 stages of IoT architecture that is a collection of numerous elements: sensors, protocols, actuators, cloud services, and layers. The architectural design of temperature and humidity monitoring system. International Journal of Scientific Research and Engineering Development-– Volume X Issue X Available at www.ijsred.com ©IJSRED: All Rights are Reserved OSFET switch efficiency up to 94 percent ). It is high switching that can use the small capacity of the filter capacitor can achieve very good effect, ripple smaller and smaller. Mini polycrystalline solar Panel The system architecture is done in 4 stages of IoT architecture that is a collection of numerous elements: sensors, protocols, actuators, cloud architectural design of temperature and Architectural Design of Temperature and Humidity Monitoring System The circuit diagram and connection status o system .

**CIRCUIT DESIGN AND DEVICE**

This section shows pictorial representation circuit design and device used in our system. The design of circuit is shown in Fig. and 11(c). Fig. 11(a): Circuit Design Volume X Issue X, Year www.ijsred.com Page 1217 Fig. 10 (a): Circuit Diagram of Arduino Uno, DHT11 and ESP8266 Fig. 10 (b): Testing Result of ArduinoUno , DHT11 and ESP8266 DEVICE MODEL This section shows pictorial representation of the circuit design and device model that are used in our ircuit is shown in Fig. 11(a), 11(b), : Circuit Design International Journal of Scientific Research and Engineering Development-– Volume X Issue X, Year Available at www.ijsred.com ISSN : 2581-7175 ©IJSRED: All Rights are Reserved Page 1218 Fig. 11(b): Circuit Design Fig. 11(c): Circuit Design The Device Model in various positions is shown in Fig. 12. Fig. 12: Device Model VI.

**SYSTEM FLOWCHART**

The proposed system uses the first sensor on Arduino UNO to read temperature and humidity data for every minute and these data are stored in the cloud server database. Air temperature and humidity data are checked whether they exceed the temperature limit in which a minimum temperature is 18 °C and a maximum temperature is 30 °C or exceed the humidity limit, that is, air humidity of at least 65% and maximum humidity of 80%, if the limit exceeds an email will be sent to the recipients. The system flowchart for monitoring temperature

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**System Components:**

1. Sensors:

You would need temperature and humidity sensors to monitor environmental conditions. These sensors should be capable of real-time data collection and transmission.

2. IoT Devices:

These devices, often referred to as IoT nodes, collect data from the sensors and transmit it to a central server. These devices can be connected to Wi-Fi, cellular networks, or other communication protocols.

3. Central Server:

A cloud-based server would receive data from all the IoT devices and store it for processing and analysis. Services like AWS, Azure, or Google Cloud can be used for this purpose.

4. User Interface:

A web or mobile application can provide a user-friendly interface for users to access real-time data, receive alerts, and access historical data. This interface can also include visualization tools like charts and graphs.

**Functionality:**

1. Real-time Monitoring:

The system continuously monitors temperature and humidity levels in designated areas. If the conditions fall outside predefined thresholds, it triggers alerts.

2. Alerts and Notifications:

The system can send alerts via email, SMS, or push notifications to designated personnel when conditions breach preset limits. For example, if a room's humidity becomes too low or too high, indicating a potential problem for patients or laboratory equipment.

3. Data Storage and Analysis:

All data should be stored securely and analyzed for patterns or anomalies. This historical data can help in decision-making and compliance monitoring.

4. Reporting:

The system can generate automated reports, which could be used for compliance reports, auditing, or research purposes. These reports can be scheduled or generated on-demand.

**Benefits:**

1. Healthcare Facilities:

Hospitals and clinics can use this system to monitor environmental conditions in patient rooms, isolation units, and vaccine storage facilities to ensure optimal conditions for patient comfort and vaccine storage.

2. Laboratories:

Research labs and testing facilities can maintain ideal temperature and humidity levels for experiments, sensitive equipment, and specimen storage.

3. Public Spaces:

Airports, public transport, and public venues can monitor and report conditions to ensure the comfort and safety of passengers and attendees.

4. Compliance:

The system can help ensure compliance with regulatory requirements related to temperature and humidity in healthcare and research settings

**Challenges:**

1. Data Security:

Ensure the data collected and transmitted is secure, especially when dealing with healthcare or sensitive research data.

2. Scalability:

The system should be easily scalable to monitor multiple locations simultaneously.

3. Integration:

Ensure compatibility with existing infrastructure and devices.

4. Cost:

IoT systems can be expensive to set up and maintain.

5. Maintenance:

Regular maintenance of sensors and IoT devices is essential to ensure accurate data.

6. Regulatory Compliance:

Ensure the system complies with relevant privacy and healthcare regulations.

**CONCLUSIONS**

The proposed system in this paper has been carried out to monitor real-time condition (Humidity an Temperature) through internet. This does not require physical presence and can save and will be a very effective way of monitoring environment during the COVID-19 pandemic situation. The system can retrieve temperature and humidity data on the server room and the temperature and humidity data that has been taken can be displayed on the website in graphical form. The advantages of this research work are that this system can also regulate the humidity in the server room and use one of the tools as sensors and actuators. The system also can send notifications the respective stakeholders. International Journal of Scientific Research and Engineering Development-– Volume X Issue X Available at www.ijsred.com ©IJSRED: All Rights are Reserved has been carried time condition (Humidity and Temperature) through internet. This does not nd can save human work way of monitoring 19 pandemic situation. The system can retrieve temperature and humidity data on the server room and the temperature and humidity data that has been taken can be displayed on the website in graphical form. The advantages of this research work are that this system can also regulate the humidity in the server room and use one of the tools as sensors and can send notifications to