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DESIGN AND DEVELOPMENT OF LOW-COST DATA LOGGER USING IOT FOR MULTIPLE PARAMETER

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Abstract: This research paper presents a design of a low-cost data logger system specifically developed for monitoring systems that require large-scale data storage that enables wider accessibility, versatility, and deployment in various applications. The proposed system employs an Arduino Mega 2560 board in conjunction with an ATmega2560 chip to facilitate data logging operations. DHT22 sensor is used to monitor temperature and humidity. The Arduino mega 2560 collects the raw data from a sensor then the data is transmitted by controller to a node MCU for data acquisition and subsequently stores the acquired data onto the SD card in .CSV format . The obtained results and findings are precisely compared against data collected using a calibrated thermometer and psychrometer during the rigorous testing phase. This comparative analysis is used to evaluate the accuracy and reliability of the system. The obtained results are subjected to comprehensive scrutiny to determine the system's accuracy, precision, and consistency. The accuracy obtained for temperature measurement is +/-1.25% of full scale deflection.

Keywords – DHT22 sensor, Arduino Mega 2560, Node MCU .

Index Terms - Introduction, Literature review, Methodology, Software Development, Result & Discussion.

I. INTRODUCTION

In earlier days, the methods used for data monitoring and storing was not efficient, fast, accurate and reliable. Sometimes, it was done manually by constant human observations. Data logger is an electronic device which automatically monitor and record the physical parameters over some period of time. Using an electronic data logger in various areas for monitoring parameters is much more effective, accurate and reliable. It contains a sensor to receive the information from the environment and a memory to stores it. Consequently, the information stored in data logger is moved to a server for analysis. The proposed system is developed to collect the raw data from environment using sensor. System uses 8 bit ATMega 2560 as controller, gathered data is received and convert it into .CSV format. These data is stored into SD card and simultaneously sends to Wi-Fi module. Node MCU transmits the converted data to the server.

In these system, DHT 22 sensor is used to measure the temperature and humidity. It is connected to Arduino mega 2560 board along with SD card module, Wi-Fi module, 16x2 LCD display and keypad. Arduino 2560.

converts sensor data into .CSV file & this file is stored on the SD card using the SD card module. This file is transmitted to the server using a node MCU Wi-Fi module. LCD(16x2 characters) is used to display the temperature and humidity. 16x2 LCD is used to display data and the keypad is used to provide access to the menu that contains parameter's value.

II. LITERATURE REVIEW

Mr. S. M. Gosavi, at all [1] presents idea on IoT-Based Weather Monitoring System Using Arduino UNO. This project primarily combines the two-study fields-based control systems and data collection approach, in order to establish a huge database system based on the qualities used to generate the provided data. The major items here were picked based on the sensors that are widely utilized to develop the system in order to design an effective weather monitoring project. The recommended sensors are used to monitor and collect data on temperature and humidity. Weather Monitoring presents a method for real-time weather monitoring using a mobile application Arduino UNO provides this low-cost or low-cost platform for connecting all of these electronic devices and many sorts of sensors over the internet network. The major goal of the effort is to record weather that can be readily checked remotely using an Arduino UNO and the Internet of Things. This will make it easier, more reliable, and faster for users to monitor weather and other environmental indicators.

Nuvruta Aji, at all [2] Presents utilizing an Internet of Things (IoT) system architectural concept is suggested to detect temperature and relative humidity through the use of a DHT11 temperature and humidity sensor. The sensor's ESP32 Wi-Fi microcontroller is capable of communicating with an Open Platform Communication (OPC) server through the SNMP (Simple Network Management Protocol), which is often employed to handle network devices and data transmission. In order to identify network variables, Object Identifiers (OIDs) are employed and saved in the Management Information Base (MIB). These two technologies are required by the SNMP monitoring tool. It is used for the user to keep track of the network infrastructure and execute troubleshooting operations.

Data gathered by the ESP32 Wi-Fi module is received via SNMP on the OPC server and transferred to an OPC Client and an OPC data logger. A ping channel is included in the OPC server for network latency measurement. In addition, the ESP32 microcontroller was linked through Wi-Fi to a application, allowing for real-time data presentation alongside the HMI. The suggested system architecture layout's SNMP network latency test resulted in 126.33 ms for 13 minutes with no defective data packets. According to the findings, SNMP can serve as an alternative protocol for IoT data transport, which has the potential to provide reliable and efficient data transfer for a wide range of applications.

Vivek Sehgal, at all in [3] presents Accurately capturing real-time data of operational variables is crucial in various process dynamics. In certain applications, process variables, such as temperature, pressure, flow, and level, may fluctuate over time, necessitating recording to enable control actions at specified set points. This study details the development of a portable data recorder, utilizing an 8-bit embedded controller connected to a temperature sensor through an A/D converter. The recorder is designed to track and record temperature fluctuations, which are displayed on a liquid crystal display (LCD) connected to the 8-bit integrated controller. Furthermore, the temperature data can be wirelessly transmitted to a PC or a PDA communication port using either an Infrared or Bluetooth connection.

Tarun Singh, at all in [4] Data logging has become a crucial aspect of contemporary measuring and instrumentation systems. Almost every industrial process necessitates data logging. They propose the design and development of a two-channel data logger in this work, which offers an inexpensive and practical means for keeping track of the voltage, current, power, and energy of two PV solar panels. The prototype data logger is based on the Arduino UNO and can save data to an SD card or in a smartphone. This data logger enables remote monitoring and data recording. This data logger's design is entirely based on open-source hardware and software components. The smart features of this data logger include measuring and monitoring the various parameters of two PV solar panels, as well as logging the data on suitable electronic devices.

Najawa Nazahua Mahzan, at all in [5] A universal data logger has been developed for photovoltaic (PV) monitoring systems, which is capable of storing vast amounts of data from multiple input channels in large memory storage. The system includes an Arduino Mega 2560 board, coupled with the ATmega2560 CPU, to process the incoming data. The data logger is used to monitor the electrical characteristics of a 240-W PV system, with the results sent to the input channels of the data logger. The raw data is then converted into digital input for data collection, and it is stored on an SD card. A DS1307 Real Time Clock (RTC) chip is also included in the data logger to time stamp the data on the SD card after each recording procedure. To validate the data, the observations and outcomes are compared to data obtained from a commercial Data Taker DT80 data logger throughout the testing stage. Throughout the testing process, this will be utilised to assess the reliability as well as efficiency of the given data logger. The data logger findings will be compared to the commercial data logger to confirm data correctness and reliability.

Soman Saha, at all in [6] A low-cost multi-channel (eight to twenty-two channel) data logger may be simply developed and used to transform the analog signal of physical parameters of various tests or other engineering reasons. A proper programmed code can be used to digitally read the value using a PC. Their goal was to offer a module and a software package that, when placed in a computer, allows one to remotely capture and monitor many signals of the same or different sorts consecutively at the same time. Signals from numerous sensors have been successfully conditioned. Interfacing these signals with an ADC and a computer's parallel port now fulfils the purpose of data capture. The ease of use and dependability of a PC and channel selection multiplexers contribute to the data logger's flexibility. The design and installation of such equipment costs about $30, making it quite affordable in comparison to other commercially available data loggers.

III. METHODOLOGY

The objective of this project is to log data about temperature and humidity. For this purpose, two sensors are used. A DH22 sensor module for temperature and humidity measurement is used. This sensor will provide digital outputs. These outputs are applied to the controller board (Arduino Mega) as an input. Arduino Mega board stores this incoming data in an SD card and sends it to the server. Lcd display and membrane keypad are used to give that data logger a local user interface.

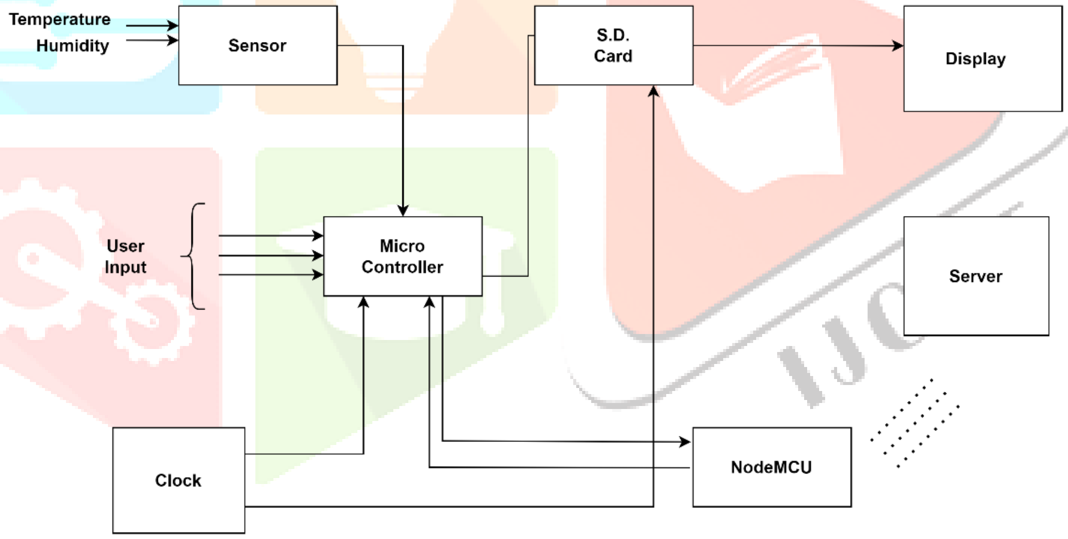


Figure 1. Block diagram for the proposed data logger.

a. DHT22 *Sensor*

It measures both temperature and humidity simultaneously. There are different sensors available to measure the temperature and humidity. The selection of the sensor is based on the following comparative points given in table no.1.

Sensor	**DHT11**	**DHT22 (AM2302)**	**LM35**	**DS18B20**	**BMP180**
Measures	Temperature and Humidity	Temperature and Humidity	Temperature	Temperature	Temperature and Pressure
Communication protocol	Serial Interface	Serial Interface	Analog	Serial Interface	I^2C
Supply Voltage	3 to 5.5V DC	3 to 6V DC	4 to 30 V DC	3 to 5.5V DC	1.8 to 3.6V
Temperature range	0 to 50ºC	-40 to 80ºC	-55 to 150ºC	-55 to 125ºC	0 to 65ºC
Accuracy	+/- 2ºC (at 0 to 50ºC)	+/- 0.5ºC (at -40 to 80ºC)	+/-0.5ºC (at 25ºC)	+/-0.5ºC (at -10 to 85ºC)	+/-0.5ºC (at 25ºC)
Humidty range	20-90%RH	0-100%RH	No	No	No

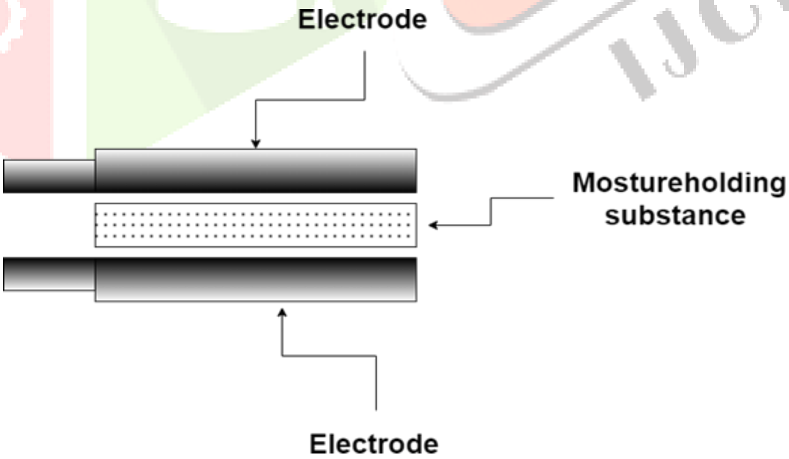
Table 1. Sensors comparison.

DHT 22 sensor is selected in the application based on following points from the comparative table no 1.

1. DH22 sensor measures both temperature and humidity in one unit.
2. Temperature and humidity measurement range is as per application.
3. Measurement accuracy is also good over the temperature measurement range
4. Resolution or sensitivity for humidity is 0.1%RH and for temperature 0.1°C.
5. It is cost-effective.

i. Humidity Sensing element

In this sensor, a moisture-holding substance is placed between two conductive plates. It works on the principle that as humidity changes, the resistance between plates changes, and this change is measured by the controller.



. Fig.2 Humidity sensor.

ii. Temperature sensing element

It works on the principle of thermistor. Its resistance is changed with respect to the temperature.

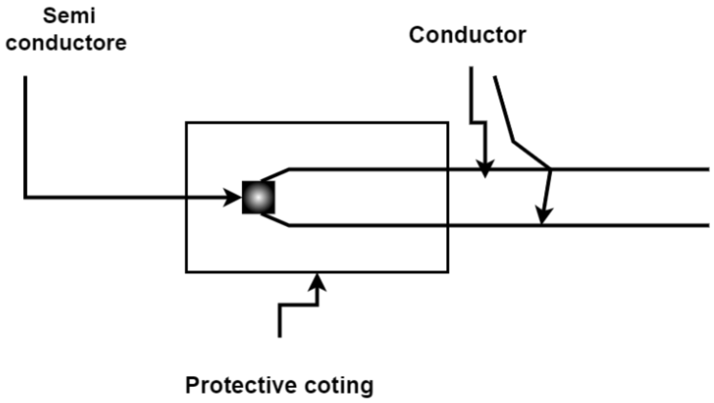


Fig. 3 Temperature sensor (Thermistor)

Interfacing of DHT22 sensor with Arduino Mega controller

The interfacing of sensor with controller is as shown in fig. no. 4

1. Signal pin is connected to D12 of Arduino and GND is connected to GND .
2. VCC is connected to 3V power supply.

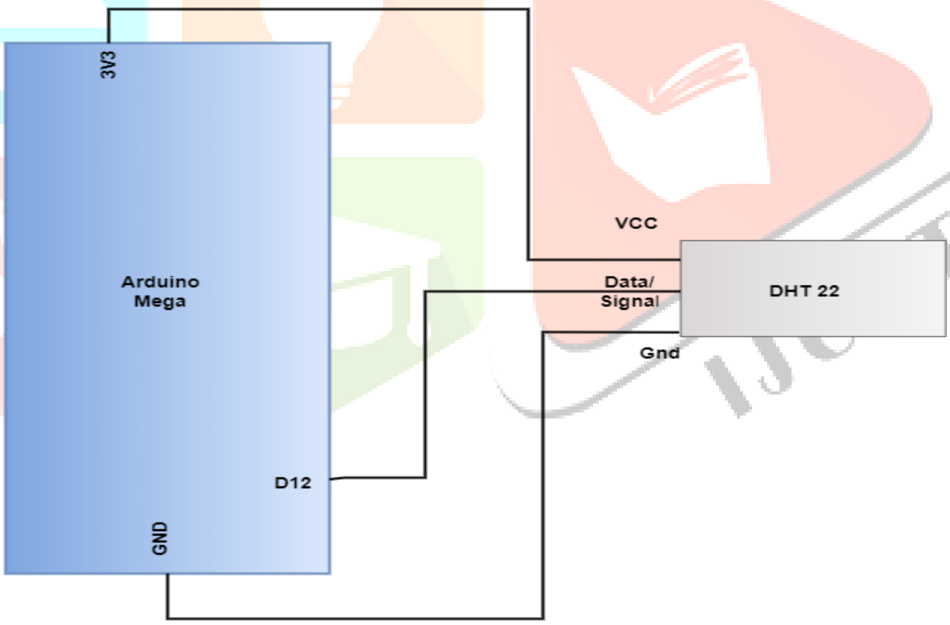


Fig. 4 Interfacing DHT22 with Arduino mega.

b. *Microcontroller*

In order to control an Arduino Mega 2560 this microcontroller board uses the 8-bit AVR RISC architecture which implements the AVR instruction set. The 16 analog inputs on the board allow to read analog signals, such as from sensors or potentiometers, and convert them to digital values that the microcontroller can process. The 4 hardware serial ports, or UARTs, allow users to communicate with other devices using serial communication protocols. The 16 MHz crystal oscillator provides the clock signal that the microcontroller uses to synchronize its operations. The 54 digital input/output pins on the board can be used for a variety of tasks, such as controlling LEDs, reading switches, or communicating with other digital devices.

c. *Node MCU*

A modest open-source IoT stage is NodeMCU. Initially, it contained equipment in light of the ESP-12 module and firmware that sudden spikes in demand for the ESP8266 Wi-Fi SoC from assuming that systems. Support for the 32-bit ESP32 MCU was subsequently added.

Interfacing of Node MCU sensor with Arduino Mega controller

Figure 5 is showing a connection between node MCU and Arduino mega.

1. TX pin of Arduino is connected to TX pin of node MCU.
2. RX pin of Arduino is connected to RX pin of node MCU.

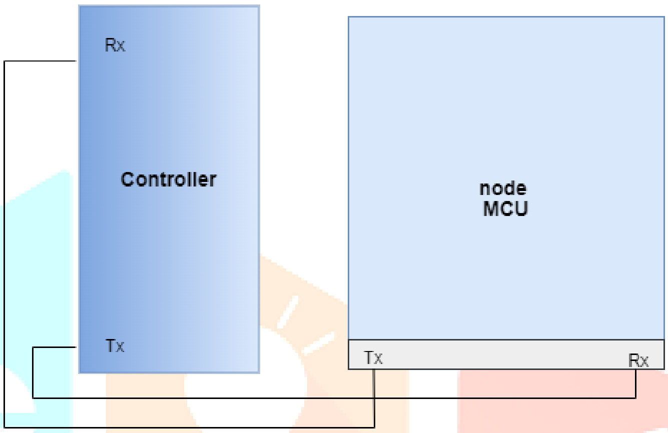


Fig. 5 Interfacing Node MCU with Arduino mega.

d. *Data storage*

A provision for transferring data to and from an ordinary system in the miniature SD Card Module. The pin out works with various microcontrollers as well as being locally viable with Arduino. You might utilize it to give your venture mass capacity and information logging. This module utilizes a 5V or 3.3V power source that is viable with the Arduino Mega and highlights an SPI interface that works with any SD card. SD Card module comprises important 2 components: a Voltage Controller Integrated Circuit and a 5V to 3.3V Level Converter Integrated Circuit. The module itself consists of 6 pins, with 2 dedicated to module control and four employed for SPI communication.

Interfacing of SD card module with Arduino Mega controller

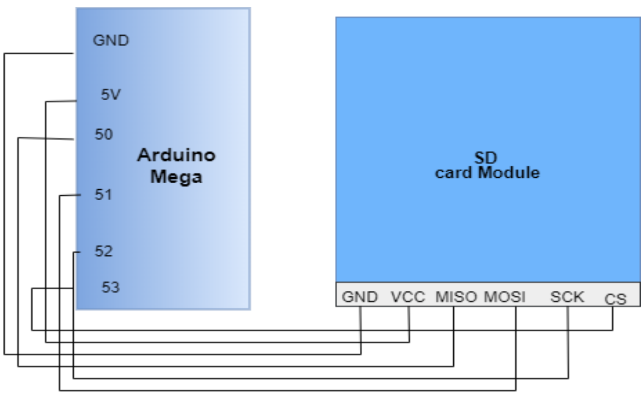


Fig. 6 SD card module with Arduino mega.

1. The 53 pin of Arduino is connected to CS (Chip Select) pin of SD Card module.
2. The 52 pin of Arduino is connected to SCK (Serial Clock) pin of SD Card module.
3. The 51 pin of Arduino is connected to MOSI (Master Out Slave In) pin of SD Card module.
4. The 50 pin of Arduino is connected to MISO (Master In Slave Out) pin of SD Card module.
5. The GND pin of Arduino is connected to GND pin of SD Card module.
6. The VCC pin of Arduino is connected to VCC pin of SD Card module.

e. *Proposed data logger*

The complete proposed schematic diagram of the data logger system is presented in Fig. 7.

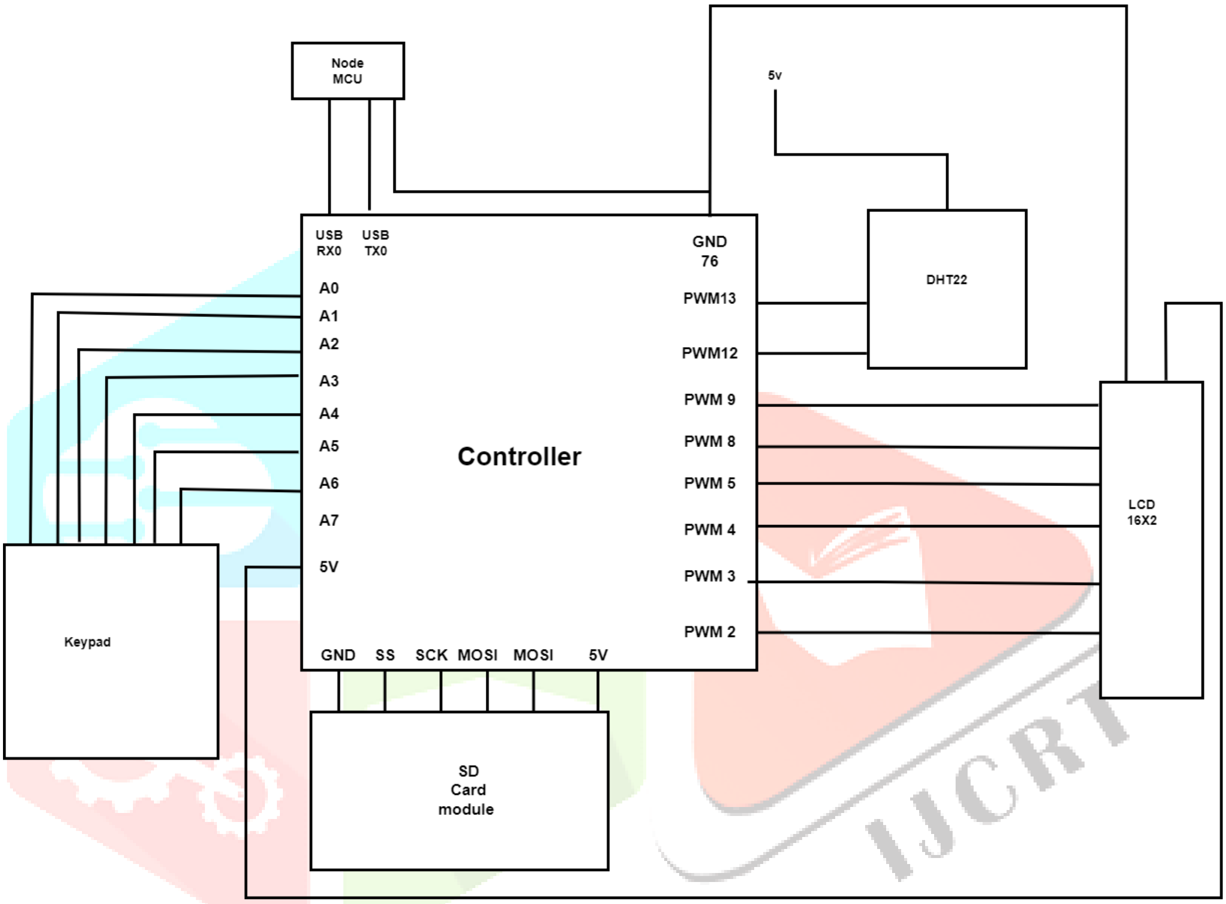


Fig. 7. Schematic diagram of proposed data-logger.

IV. SOFTWARE DEVELOPMENT

Arduino Integrated Development Environment (IDE) is chosen for constructing the codes for the proposed data logger. Below algorithm shows a brief of software procedure to be referred at before constructing code in the Arduino IDE.

Step 1. Initialize Uart

Step 2. Initialize LCD

Step 3. Initialize Keypad

Step 4. Initialize dht as input pin

Step 5. Initialize Rain sensor as input pin

Step 6. Initialize SPI

Step 7. Clear LCD

Step 8. Display the project name on LCD

Step 9. Calculate the rain sensor values

Step 10. Fetch the data of humidity and temperature

Step 11. Check the input from keypad

Step 12. If the input is 1 then display Humidity value on LCD

Step 13. If the input is 4 then display Temperature value on LCD

Step 14. If the input is 7 then display Rain gauge value on LCD

Step 15. If the input is * then display Project Name on LCD

Step 16. Send the values of the Humidity, temperature and rain to SD Card

Step 17. Send the values of the Humidity, temperature and rain to Node MCU

Step 18. Initialize the Node MCU as a client

Step 19. Connect to the Wi-Fi Network

Step 20. Connect to the server with the API key

Step 21. Receive the incoming data from the UART of Arduino

Step 22. Split the string in the values for the Humidity, Temperature & Rain

Step 23. Ping the server for the connection

Step 24. Send the data of sensors to the server

V. RESULTS

The table shows a comparison between sensor readings and calibrated thermometer readings and psychrometer readings.

Humidity in (%)	Humidity in (%) (Psychrometer)	Temperature (°C)	Temperature (Thermometer) (°C)
61.7	51	33	32
61.8	76	33.1	32.2
61.6	50.9	33.1	32.2
61.6	76	33.1	32.2
65	50.9	33.1	32.2
65.2	77	33.2	32.2
64.4	50.9	33.2	32.2
63.9	76	33.2	32.3

63.4	77	33.3	32.3
62.6	50.9	33.3	32.3
62	50.9	33.3	32.3
61.3	78	33.3	32.3
61.6	50.9	33.3	32.3
61.3	78	33.3	32.3
61.1	50.9	33.3	32.3
61.1	75	33.3	32.3
61.3	50.9	33.3	32.3
61.7	50.9	33.3	32.3
61.2	77	33.3	32.3
61	50.9	33.3	32.3
61	75	33.3	32.3

Table 2. Readings of sensors

%Accuracy for temperature = +/- 1.25%

% Accuracy for humidity = +/- 0.87%

V. CONCLUSION

In this paper, the system detects temperature & humidity in real-time. This method is very suitable for data logging in experimental and plant monitoring or at any remote location. Data logger have an % accuracy of +/- 1.25% for temperature and have +/-0.87% of accuracy in humidity.

VI. REFERENCES

[1] S.M.Gosavi , at all in [1] IoT-Based Weather Monitoring System Using Arduino UNO 2021 6th International Conference on Internet of Things: Smart Innovation and Usages (IoT-SIU). doi: 10.1109/IoT-SIU51468.2021.9479701.

[2].Nuvruta Aji , at all in [2] IoT-Based Temperature & Relative Humidity Monitoring System Using Simple Network Management Protocol 2021 International Conference on Sustainable Energy, Electronics and Computing Systems (SEEC). doi: 10.1109/SEEC51853.2021.938048.

[3].Vivek Sehgal, at all in [3] Smart Wireless Temperature Data Logger 2020 International Conference on Electronics and Sustainable Communication Systems (ICESC). doi: 10.1109/ICESC50802.2020.9307066

[4].Tarun Singh, at all in [4] Design & Development of Photovolatic Solar Pannel Data Logger. 2020 12th International Conference on Electrical and Electronics Engineering (ELECO). doi: 10.1109/ELECO50272.2020.9308910

[5].NajawaNazahuaMahzan, at all in [5] Design & Development Of An Arduino Based Data Logger For Photovoltaic Monitoring System. 2019 International Conference on Computer Engineering, Network, and Intelligent Multimedia (CENIM). doi: 10.1109/CENIM.2019.8933110

[6].Soman Saha, at all in [6] Design Of Low Cost Multi-Channel Data Logger. Journal of Physics: Conference Series, 1150(1), 012037. doi: 10.1088/1742-6596/1150/1/012037