Development of an IoT Based Real Time Embedded System for Monitoring Temperature and Humidity by using ESP WROOM 32 MCU

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Abstract: **This paper introduces a temperature and humidity monitoring system, which is based on digital and cloud technology, using the low-cost digital temperature and humidity sensor DHT22 and ESP WROOM 32 Microcontroller. This research involves an affordable and high-performance intelligent system to measure the physical parameters humidity and temperature and then store the data to the Google Sheets. This data can be easily accessed through the internet.**

Keywords: **ESP WROOM 32; DHT22; Cloud Technology; Google Sheets; Internet of Things (IoT).**

1. INTRODUCTION

Nowadays, devices can range from small ordinary household cooking appliances to sophisticated industrial tools that are IoT-enabled. To control, store and retrieve their data over the internet, we must use an IoT cloud service[1]. There are plenty of different IoT cloud services and protocols available [2] but these services are limited in one way or another. Some are free, while others are paid. The free services will have a limit on how much data you can collect at a time or how many devices you can attach at a time while with the paid services, you have to pay a large sum depending on your data cluster. This will not only be a huge financial burden but if you develop a product that depends on a particular third-party service, that will be a huge risk.

That's where the Google Sheets come to play as these are free, familiar, and most importantly reliable. It has a lot of functionalities and built-in integration with many other Google services and APIs.

Based on the above-mentioned discussions, we have designed and implemented a temperature and humidity system that allows the user to log the details humidity and temperature to Google Sheets at regular time intervals as set by the user.

2. BLOCK DIAGRAM AND WORKING

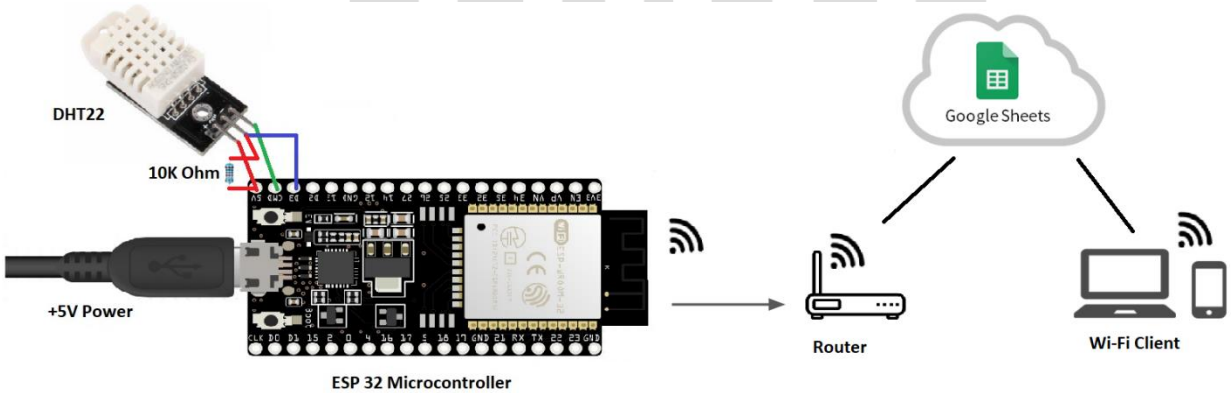

Fig:1

Block Diagram of the system

Fig:1 Demonstrates the block diagram of the affordable and high-performance intelligent system for measuring humidity and temperature [3]. It consists of ESP32 Node MCU [4] as Transmitter, web server Google Sheets and web client. This research discusses the implementation of the project from three perspectives: Hardware, Software, and connectivity.

2.1 Hardware Implementation

The hardware components considered in this work are ESP WROOM 32 MCU, DHT22.

2.1.1 ESP WROOM 32 MCU

ESP32 is a series of low-cost, low-power system on a chip microcontrollers with integrated Wi-Fi 802.11b/g/n and dual-mode Bluetooth. ESP-Wroom-32 contains a low-power Tensilica Xtensa® Dual-Core 32-bit LX6 microprocessor with clock frequency up to 240 MHz, 448 KB of ROM for booting and core functions, 520 KB of on-chip SRAM for data and instructions, and 4MB of Flash Memory. ESP32 is capable of functioning reliably in industrial environments, with an operating temperature ranging from –40°C to +125°C. ESP32 is highly integrated with built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power management modules. Engineered for mobile devices, wearable electronics, and IoT applications. Fig:2 demonstrates the ESP WROOM 32 Microcontroller [5].

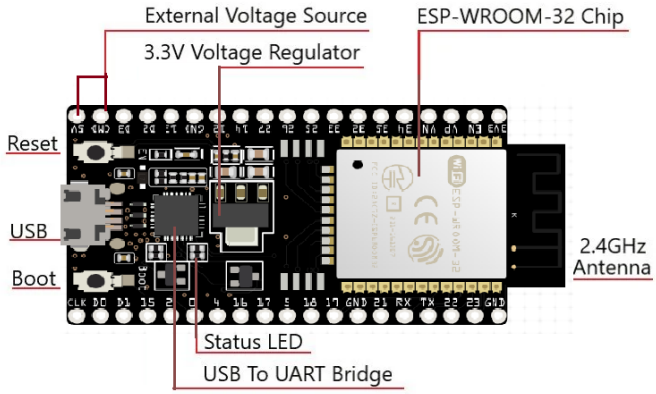

Fig:2 ESP WROOM 32 Board Highlights

2.1.2 DHT22 (Temperature and Humidity Sensor)

DHT22 output calibrated digital signal utilizes exclusive digital signal collecting technique and humidity sensing technology, assuring its reliability and stability. Its sensing elements are connected with an 8-bit single-chip computer. Every sensor of this model is temperature compensated and calibrated in an accurate calibration chamber and the calibration-coefficient is saved in type of program in OTP memory, when the sensor is detecting, it will cite the coefficient from memory. Small size & low consumption & long transmission distance (20m) enables DHT22 to be suited in all kinds of harsh application occasions. Single-row packaged with three pins as shown in Fig:3, making the connection very convenient.

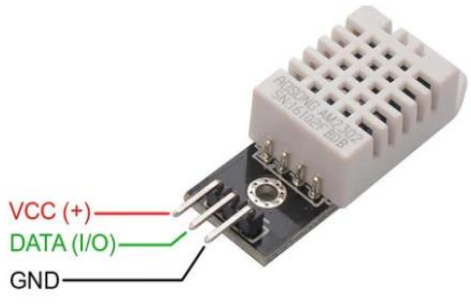

Fig:3 DHT22 Sensor

DHT22 is specified with the following operating voltage: 3.5V to 5.5V, operating current: [0.3MA (measuring), 60uA (stand by)], output serial data, temperature range from -40 degree Celsius to 80 degree Celsius, humidity ranges from 0% to 100% RH, resolution of temperature and humidity are both 16-bit, and the accuracy are +/- 0.5 degree Celsius and +/- 2RH% [6].

2.2 Software Implementation

The Opensource Arduino Integrated Development Environment (IDE) used for developing the data logger software. Arduino IDE contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the ESP32 (Node32) hardware to upload programs and communicate with them. Fig:4 demonstrates the Arduino IDE [7].

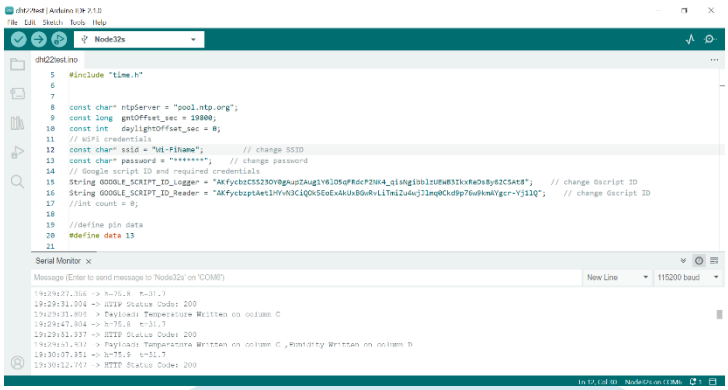

Fig:4 Arduino IDE

2.3 Connectivity Implementation

The transmitter part consists of ESP32 MCU connected with DHT22 sensor, and resistor 10K for reducing the voltage difference and protecting the sensor from the high current [6] as shown in fig:1. The collected data is processed via an ESP32 MCU and sent to the gateway server. Google Sheet is used for the web user interface, graphical interpretation and display of collected results. The HTTP [8] protocol provides easy connectivity between ESP32 MCU and the Google Sheet. The Google Script user interface updates Humidity and Temperature Parameters every 20 sec. The data are easily accessed through any network supported devices.

Fig:5 demonstrates the flowchart for ESP WROMM32 Microcontroller (Web Client) Side Software and Fig:6 demonstrates the flowchart for google sheet Scripting software (Web Server) .

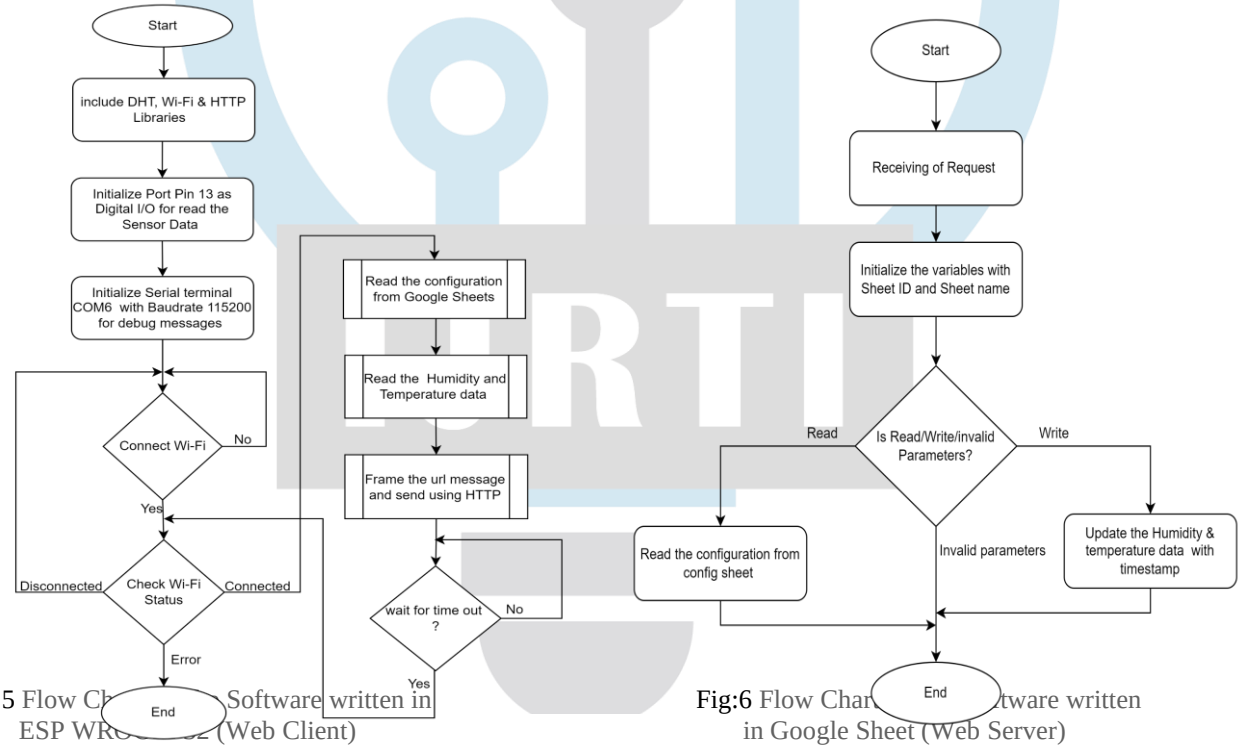

Fig:5 Flow Ch[illegible] Software written in ESP WR[illegible] (Web Client)

Fig:6 Flow Char[illegible]tware written in Google Sheet (Web Server)

3. RESULTS

Affordable and high-performance intelligent system to measure the physical parameters humidity and temperature as shown in Fig:7. This system measures and updates the Temperature and humidity data in Google Sheets [9]. This data can be easily accessed through the internet.

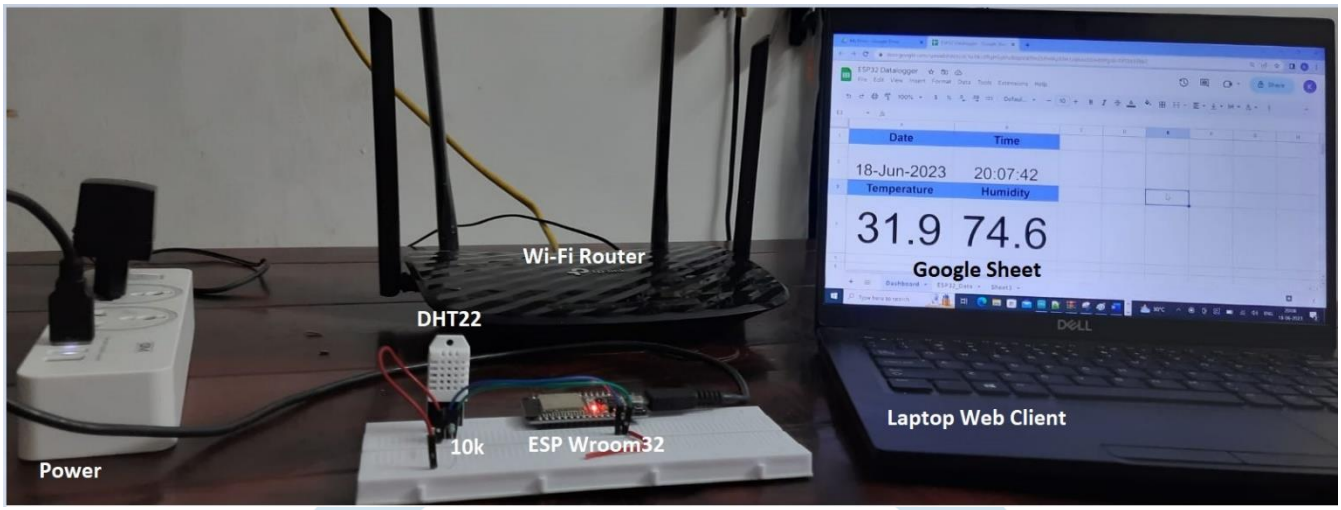

Fig:7 The System Assembly DHT22 Sensor and ESP WROOM32 MCU

The Standalone System ran for 24 Hours and samples were taken every 20 sec. Plotted the graph with respect to Time and Temperature as shown in Fig:8, Plotted the graph between with respect Time and Humidity as shown in Fig:9.

Fig:10 demonstrates the real time datalogging and Fig:11 demonstrates the Snapshot of Current Temperature and Humidity with timestamp.

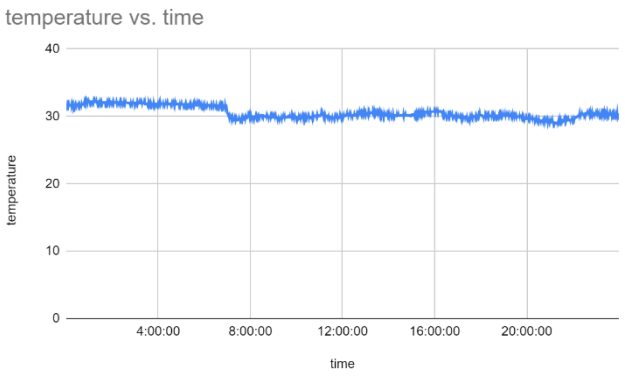

Fig:8 Temperature vs Time

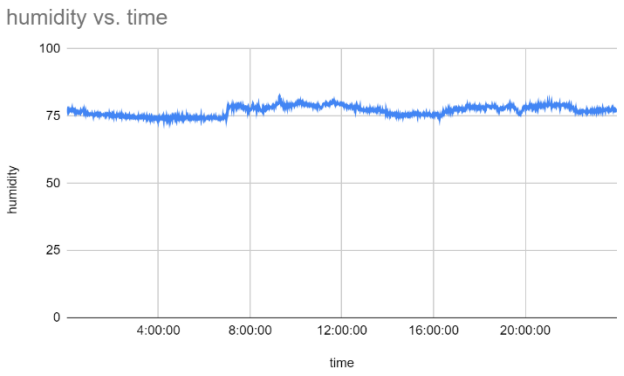

Fig:9 Humidity vs Time

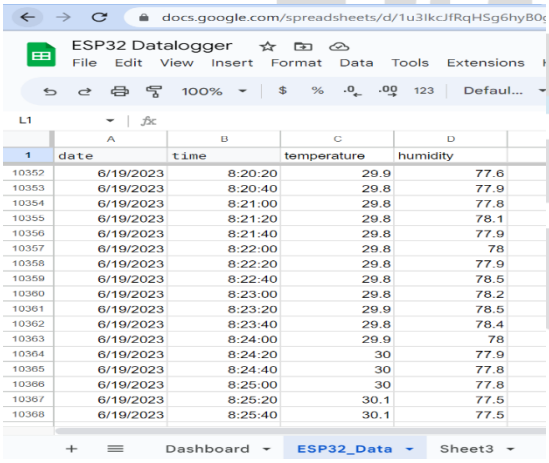

Fig:10 Google Sheet datalogger

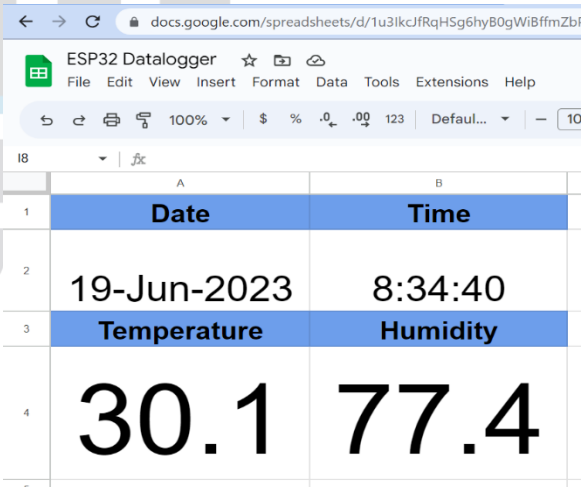

Fig:11 Google Sheet Snapshot

4. CONCLUSION

Monitoring and displaying weather conditions Temperature & humidity around the world is made possible by the Proposed Internet of Things (IoT) advanced system. The Internet of Things (IoT) is the technology is an advanced and efficient method for connecting things to the internet and connecting the entire world of things on a network. The System records the data every 20 sec and uploads it on Google Sheets, which will then display the data in the form of graphs. The updated data can be accessed from anywhere in the world through the internet. This describes physical parameters Humidity & Temperature data logging system is affordable and simple to use. This System is scalable and flexible to extent other sensors.

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