Internet of things based Cloud Data Logging System using Thingspeak

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Abstract
The Internet of Things (IoT) comprises a network of intelligent objects that integrates sensors with networking technology, cloud computing, and various data concepts[2]. Currently, the IoT is utilized across various domains, with health monitoring systems being one of the most crucial areas of focus. This is due to statistical analyses indicating that a human life is lost every minute worldwide[2]. The ThingSpeak API is an open-source interface that receives incoming data, timestamps it, and presents it for both human users (via visual graphs) and machines (through easily parseable code)[6].

Keywords:
Internet of Things, network, cloud computing, monitoring systems, ThingSpeak

1. Introduction

The Internet of Things (IoT) connects the digital and physical realms through advanced, always-available communication techniques. The modern internet's heightened demand for services has made efficient data collection and exchange necessary. By utilizing electronic sensors and the internet to link physical equipment and vehicles, the internet of things (IoT) has promised to facilitate efficient data storage and interchange[5]. There is no single definition of the Internet of Things (IoT); various foundations and parties use different definitions. In 2012, the International Telecommunication Union (ITU) released an overview of the IoT, defining it as a global information infrastructure that allows interconnected objects to communicate with one another and access advanced services based on current and developing interoperable information and

communication technologies. The Internet of Things (IoT) uses contemporary, pervasive communication techniques to bring the digital world into the real world[3]. The focus of the Internet of Things is on configuring, controlling, and networking "Internet of Devices" or "Things," such as thermostats, electronic devices, home appliances, utility meters, medical

devices, cameras, and various sensors that were not previously connected to the Internet[3]. This is true

even though many common devices, like networked computers or mobile phones, have unique identities and are connected to the Internet. There is no agreed-upon definition of the Internet of Things (IoT); instead, several foundations and parties utilize different definitions. In their 2012 overview, the International Telecommunication Union (ITU) defined the Internet of Things (IoT) as a global information infrastructure society that allows interconnected objects to communicate with one another and provide sophisticated services based on current and developing interoperable informationand communication technologies[4]. The current research encompasses creating remote real-time monitoring systems for sensor equipment, backed by web-based data collection to enable user access to data and analysis using different machine learning algorithms.

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2. The Dht11, Temperature and Humidity Sensor

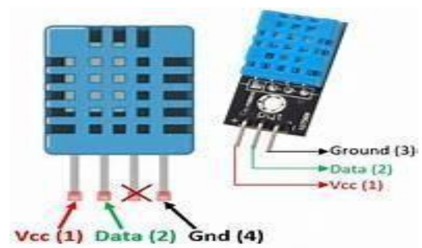
The DHT11 is a simple, very inexpensive digital sensor for temperature and humidity. It employs a capacitive humidity measuring element (measuring range: 20%–80%; precision: ±5%) calibrated with an NTC thermistor (measuring range: 0°C–50°C; precision: ±0.2°C) to assess the surrounding air, providing a calibrated digital signal output of temperature and relative humidity (no analogue input pins required). The only genuine drawback of this sensor is that new data can be obtained from it only every two seconds. One sensor, the DHT11, has the ability to simultaneously measure temperature and humidity (humidity). A thermistor of the NTC type is present in this sensor[10]. The DHT11 sensor module is a dual-purpose device that detects humidity and temperature, providing a calibrated digital output signal. With a DHT11, we obtain highly accurate temperature and humidity readings. It guarantees a system with long-term stability and great reliability. internet to increase the monitoring's range. The ESP8266 module integrates the Thingspeak application with the Internet of Things (IoT) to provide an LM35 temperature sensor that serves as a temperature detector, a DHT11 sensor that detects humidity, and a MQ-135 sensor that detects air quality[10]. The DHT11 sensor features a resistive humidity measurement component and an NTC temperature measurement component, along with an integrated 8-bit microcontroller that offers a rapid response and is economical. It is available in either a 4-pin or a 3-pin single-row package.

2.1 Temperature Detector

A temperature is an impartial way to compare how hot or cold something is. It is measured in either 0 c or 0. Thermometers are sensors used to measure temperature. In many different applications, from scientific research to industrial processes, temperature detectors are essential. Temperature is one of the most often measured physical quantities. Creating a legible signal from an object's or environment's temperature is the main purpose of a temperature detector.

They could be contact or non-contact sensors. The sensor ought to possess the following attributes:

- Range: the range of values that a sensor performs well at both the maximum and minimum.
- Accuracy: the sensor's ability to measure the environment precisely.
- Resolution: the sensor's capacity to detect minute variations in readings.
- Repeatability: The capacity of a sensor to repeat a measurement in the same setting.



Humidity sensor, with a stream of 1 and 0 as its output. The power source for the DHT11 is 3-5.5V DC. To get out of the unstable state, don't provide the sensor any instructions for a second after power is applied. To filter power, a 100nF capacitor can be placed between VDD and GND. The data single-bus free status is at a high voltage level. MCU's program will set the data single-bus voltage level from high to low when communication with DHT11 starts. This procedure must take at least 18 ms to guarantee that DHT detects the MCU's signal. After that, MCU will draw up the voltage and wait 20–40 us for DHT's response.

3. Geometric Mean Optimizer (Gmo)

One optimization technique that takes advantage of some relationships' multiplicative character is the Geometric Mean Optimizer (GMO). It works especially well when the task is optimizing products of variables or when a multiplicativity rather than an additive representation is more appropriate for the relationship between a system's characteristics. The method mimics the mathematical geometric

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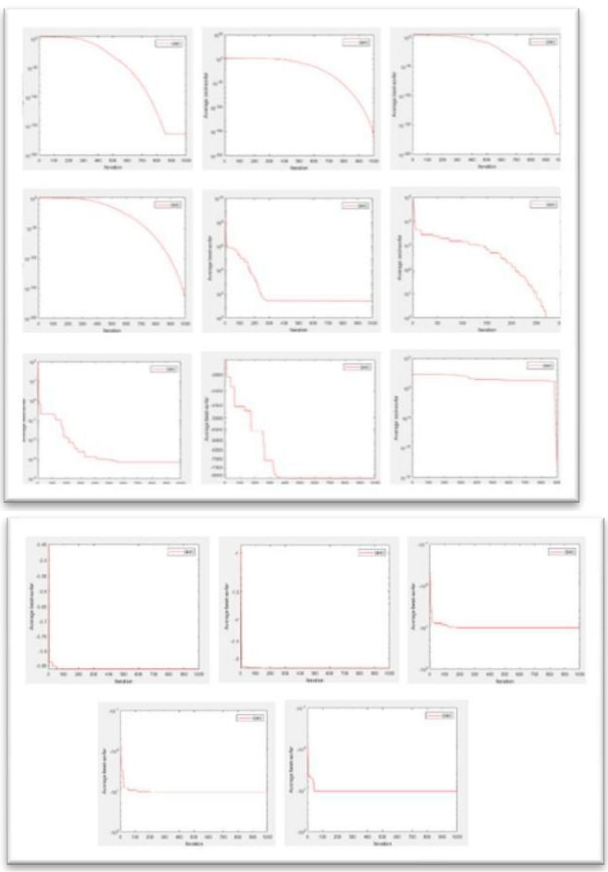
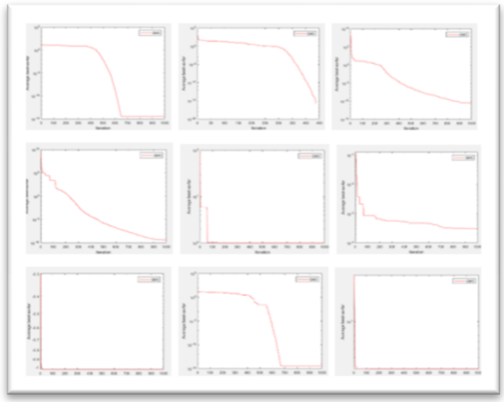
mean operator. The Dual-Fitness Index (DFI), a novel index that assesses search agents' variety and fitness, is presented. This makes it easier to choose qualified advisers without having to be aware of the optimization procedure stage. It resolves the issue of distinguishing between phases of exploration and exploitation, which differs depending on the topic. Other benefits include adopting Gaussian mutation, employing distinct search agent guides, and avoiding the need for parameter modification to achieve dependable outcomes. A system that measures the temperature of an object or environment is called a temperature detector. When talking about a temperature detector in a research article, one would go over its types, applications, and possible uses in technological or scientific studies.

A) Conversion Curve



B) Pseudo-Code



The provided pseudo code is intended for an Internet of Things (IoT) system that gathers sensor data, feeds the data to the ThingSpeak cloud platform, and uses a Geometric Mean Optimizer (GMO) to optimize the data collection process. The ultimate objective is to log and analyze sensor data effectively while minimizing needless transfers and maximizing system performance.

1. **Define problem settings**:
   - Set dimension (D) of the problem (e.g., 10).
   - Set the lower and upper bounds of the search space (e.g., -5.12 and 5.12).
   - Set the population size (e.g., 50).
   - Set the maximum number of iterations (e.g., 100).

2. **Define the objective function:**
   - Objective function: f(x) = sum(x^2 - 10 * cos(2 * pi * x) + 10) for the Rastrigin function.

3. **SetDifferentialEvolution(DE) Parameters:**
   - Set mutation factor F (e.g., 0.8).
   - Set crossover probability CR (e.g., 0.9).

4. **Initialize population:**
   - Randomly initialize a population of size `population_size` with values between ` `lower_bound` and `upper_bound` for each individual in D-dimensional space.

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5. Initialize best solution:

- Set `best_sol` to NaN.
- Set `best_obj` to infinity to store the best objective value.
-

6. For each iteration from 1 to `max_iter`

7. For each individual in the population:

- Randomly select three individuals from the population.
- Assign them to vectors a, b, and c.

8. PerformDifferentialEvolution (DE) mutation:

- Generate a mutant vector: `mutant = a + F * (b - c)`.
- Apply boundary constraints to the mutant vector, ensuring its values are between lower_bound` and `upper_bound`.

9. Perform crossover to generate a trial vector:

- For each dimension in the individual, with probability CR, replace the value of the trial vector with the corresponding value from the mutant vector.

10. Evaluate the objective function of the trial vector.

11. Evaluatetheobjective function of the current individual.

12. If the trial vector has a better objective value (lower value), replace the individual with the trial vector.

13. After evaluating the entire population, find the best solution by comparing all individuals' objective values:

- If an individual has a lower objective value than the current `best_obj`, update `best_sol` and `best_obj`.

14. Display the current iteration number and the best objective value found so far.

15. After all iterations, display the final best solution and its objective value:

- Output the best solution and the corresponding best objective value.

4. Results & Discussions

These are the outcomes of the Geometric mean optimizer from F1 to F23 showing different conversion curve.

Function	Original Value	Hybrid Value
Function 1	4.3643e-164	6.9163e-164
Function 2	1.1424e-161	1.6729e-162
Function 3	6.1073e-165	1.3412e-164
Function 4	4.7447e-164	2.346e-163
Function 5	26.1177	25.71
Function 6	0	0
Function 7	0.00069108	0. 0014298
Function 8	-8224.9569	-5245.487
Function 9	0	0
Function 10	3.9968e-15	3.9968e-15
Function 11	0	0
Function 12	3.1694e-11	8.7082e-11
Function 13	4.3442e-10	2.8507e-10
Function 14	0.998	1.992
Function 15	0.00030849	0.00031049
Function 16	-1.0295	-1.0316
Function 17	-1.178	0
Function 18	3	3
Function 19	-3.8628	-3.8628
Function 20	-3. 322	-3.322
Function 21	-10.1532	-10.1532
Function 22	-10. 4029	-10.4029
[illegible]	[illegible]	[illegible]

5. Conclusion

This study has proposed and implemented a Cloud Data Logging System based on the Internet of Things (IoT) using ThingSpeak, demonstrating a real-world application of IoT technology integrated with cloud computing for real-time data collection, analysis, and monitoring.
The integration of ThingSpeak with MATLAB enables sophisticated data analysis, which enhances the system's decision-making and trend-predicting capabilities. To sum up, the IoT-based cloud data logging system utilizing ThingSpeak shows a practical, efficient, and scalable solution for real-time data acquisition, storage, and analysisA decent mix of digital and analog sensors are used by the system in both wired and wireless modes of operation. Consequently, a proof of concept for an Internet of Things gadget for a

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weather monitoring system in real time has been created. Future efforts might aim at improving the security of the system, adding more advanced data processing algorithms, and broadening the system's ability to manage larger and more varied data sets.

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