Exploring Daily Temperature and Humidity Shifts in Malate, Manila

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***Abstract*-Temperature and humidity play a crucial role in shaping daily life and influencing the local climate. This study delves into the relationship between humidity and temperature in Malate, Manila, from October 23 to 29, 2023. Through rigorous data preparation, validation, and aggregation techniques, the study reveals significant variations in daily humidity levels, ranging from 75.54% to 77.97%. Notably, October 26 stands out as a drier day, indicating the dynamic nature of humidity in the region. Additionally, temperature patterns were observed with mean afternoon temperature of 30.79°C, morning temperature of 30.76°C, and night temperature of 30.67°C. The maximum temperature reached 33.8°C, while minimum temperatures ranged from 23.6°C to 29.9°C, demonstrating daily fluctuations in temperature. These findings provide valuable insights into the complex interactions between humidity and temperature, contributing to a better understanding of daily climate patterns in Malate, Manila.**

I. Introduction

Temperature and humidity throughout the day holds importance due to its wide-ranging implications for daily life. Studying its fluctuation enhances our grasp of daily climate patterns. This study explores the relationship between humidity and temperature, two crucial environmental characteristics that impact various sectors such as meteorology, agriculture, engineering, and healthcare. Humidity, or relative humidity, measures the amount of water vapor in the air and its impact on weather patterns, crop development, and patient well-being. Temperature, on the other hand, measures the kinetic energy of molecules and controls various natural and man-made activities. Climate change has led to rising global temperatures, affecting ecosystems, sea levels, and extreme weather patterns. Precision temperature control is crucial for industry production, and monitoring body temperature is essential for diagnosing and controlling medical disorders in healthcare. Understanding the relationship between humidity and temperature is crucial for combating climate change, optimizing energy use, improving agricultural practices, and enhancing human comfort and health.

II. Theory Discussion

The employment of the DHT11 sensor for monitoring environmental conditions, specifically for gathering temperature and humidity data stands as a notable application. This incorporation highlights the essential role fulfilled by Digital Signal Processing (DSP) in the following analysis and interpretation of data generated by the sensor, guaranteeing valuable insights and actionable information. The DHT11 sensor, a fundamental element in this IoT environment, operates on analog signals reflecting variations in temperature and humidity. Grasping the inherent principles of the sensor entails delving into the relationships between these analog signals and the corresponding environmental parameters. Consultation of DHT11 datasheets or documentation becomes crucial, offering specific equations and calibration methods vital for accurate data interpretation. In the IoT context, the importance of sampling cannot be overstressed. Signal conditioning techniques come into play to refine DHT11 sensor outputs, rectifying inherent inaccuracies through calibration procedures. Equations and methods described in pertinent literature or documentation guide this process, contributing to the overall precision of sensor data. Addressing the perennial concern of noise in sensor data, DSP filters, especially low-pass filters, come into play. The application of these filters to temperature and humidity data from the DHT11 sensor heightens the reliability of the information, a crucial factor for the success of IoT applications [1].

In the arena of data transmission and compression, DSP concepts assume a central role. Protocols crafted for the efficient transmission of temperature and humidity data in IoT applications are discussed, with reference to relevant DSP literature on data compression algorithms tailored for the IoT environment. Cloud integration emerges as a pivotal component, facilitating the storage and retrieval of data in IoT systems. The utilization of DSP methodologies for the time-series analysis of temperature and humidity data is explored, with references to studies or papers highlighting effective DSP approaches within the IoT domain. Considering security considerations, a paramount aspect in the IoT landscape, DSP takes the forefront. Discussion revolves around encryption techniques and secure communication protocols, referencing pertinent literature on IoT security and DSP-based encryption methods. The incorporation of DSP theories and concepts within the IoT framework, particularly in the context of DHT11 sensor applications for temperature and humidity data, assumes a pivotal role. The application of these fundamental DSP principles ensures the accuracy, reliability, and security of sensor data, thereby ensuring the efficacy of IoT applications in environmental monitoring[2].

III. Methodology

A. Data Gathering Procedure

An internet of things (IoT) device was used in gathering data on the temperature and humidity of Malate, Manila on October 23, 2023, to October 29, 2023. By means of this method, the researchers were able to provide reliable information and data that are necessary to assess how temperature and humidity varies during day and night in Malate, Manila

B. Data Analysis

Objective: To quantitatively understand the central tendencies and variability of temperature and humidity data.

1. Data Preparation and Validation:
- Ensure data integrity by rigorously validating and cleaning the dataset, addressing missing values or outliers.
- Confirm that the dataset is organized with proper datetime, temperature, and humidity attributes.
2. Calculation of Key Statistics:
- Compute descriptive statistics, including the mean, median, mode, standard deviation, and range, for both temperature and humidity.
- These statistics provide an initial glimpse into the data's central tendencies and dispersion.
3. Aggregation of Data:
- Apply data aggregation techniques, such as resampling in Pandas, to group data into the chosen time intervals.
- Calculate summary statistics (e.g., mean temperature and humidity) within each interval to create aggregated datasets.
4. Visualization of Aggregated Data:
- Construct line charts or bar charts to visualize the aggregated data, showcasing the mean temperature and humidity across the selected time intervals.

IV. Results and Discussion

1. *What is the periodicity of the data?*

TABLE I. Periodicity of the data

Standard Deviation of Time Intervals	*906.9 seconds or 15.12 Minutes*
Standard Deviation of Time Intervals	*71.28 seconds*

A mean time interval of 906.9 seconds or 15.12 minutes indicates the average spacing between data points, and a standard deviation of 71.28 seconds reflects the degree of variability or dispersion around this average spacing.

2. *What are the central tendencies of the data according to time of day, day of week, and in general?*

TABLE II. General Central Tendencies

	Temperature (°C)	**Humidity (%)**
Mean	30.730543	76.729612
Max	33.8	84.8
Min	23.6	55.2

It can be observed that:

Mean: For Temperature, the mean is approximately 30.7305 °C, and for Humidity, it is approximately 76.7296.

Min: For Temperature, the minimum value is 23.6, and for Humidity, it is 55.2. These values represent the lowest temperature and humidity recorded.

Max: This is the maximum value in each column. For Temperature, the maximum value is 33.8, and for Humidity, it is 84.8. These values represent the highest temperature and humidity recorded in the dataset.

TABLE III. Central Tendencies by Time of Day

	Temperature (°C)			**Humidity (%)**		
Time of Day	***Mean***	***Max***	***Min***	***Mean***	***Max***	***Min***
Morning	30.761446	33.8	23.6	75.940964	84.8	55.2
Afternoon	30.795783	33.8	29.9	76.774699	84.3	67.0
Nighttime	30.679553	33.8	24.9	77.123962	84.3	57.5

Table 3 presents a comprehensive analysis of central tendencies for temperature and humidity between the mornings, afternoon, and nighttimes.This data provides valuable insights into the timely variations in local climate conditions:

1. Temperature:
   - Mean: During the afternoon the mean temperature is observed to be 30.79 °C, signifying a peak in daytime temperatures. Conversely, mornings and nighttimes have slightly lower mean temperatures, at 30.76°C and 30.67°C, respectively.

- Maximum Temperature (Max): The highest recorded temperature in all time of day at 33.8°C.
- Minimum Temperature (Min): In the morning a minimum temperature of 23.6°C, in contrast to afternoon and nighttime which record minimum temperatures of 29.9°C and 24.9°C, respectively.

2. Humidity:
   - Mean: Nighttime displays the highest average humidity level at 77.12%, followed by the afternoon and morning with mean humidities of 76.77% and 75.94%, respectively. This suggests increased moisture levels during the night.
   - Maximum Humidity (Max): The highest recorded humidity is observed during the afternoons at 84.3%, whereas the mornings and nighttime report maximum humidities of 84.8% and 84.3%, respectively.
   - Minimum Humidity (Min): the mornings have the lowest minimum humidity at 55.2%, indicating drier conditions during the early hours. nighttimes record a minimum humidity of 57.5%, while the afternoons maintain a minimum humidity of 67.0%.

TABLE IV. CENTRAL TENDENCIES BY DAY OF THE WEEK

	Temperature (°C)			**Humidity (%)**		
Day of Week	***Mean***	***Max***	***Min***	***Mean***	***Max***	***Min***
Monday	30.596154	30.9	29.8	76.947436	81.7	67.5
Tuesday	30.694792	31.3	29.8	77.970833	84.3	67.5
Wednesday	30.994737	33.8	30.2	77.789474	84.3	75.6
Thursday	30.641667	33.8	23.6	75.5375	81.7	55.2
Friday	30.792473	33.3	29.9	76.456989	84.8	67.0
Saturday	30.651042	33.8	29.9	76.417708	81.7	67.0
Sunday	30.721978	32.9	29.8	75.992308	80.9	67.0

Table 4 presents a comprehensive analysis of central tendencies for temperature and humidity across seven days of the week. This data provides valuable insights into the weekly variations in local climate conditions:

1. Temperature:
   - Mean: The mean temperature across the week ranges from 30.60°C (Monday) to 30.99°C (Wednesday), indicating slight fluctuations in average temperature.
   - Maximum Temperature (Max): The highest recorded daily maximum temperature occurs on Wednesday, reaching 33.80°C.
   - Minimum Temperature (Min): Notable temperature variation is observed on Thursday, with a minimum temperature of 23.60°C, while the other days report minimum temperatures in the range of 29.80°C to 30.20°C.
2. Humidity:
   - Mean: Humidity levels show relatively consistent weekly patterns, with mean values ranging from 75.54% (Thursday) to 77.97% (Tuesday).
   - Maximum Humidity (Max): Wednesday exhibits the highest daily maximum humidity at 84.30%, while other days report ranging from 80.90% (Sunday) to 84.80% (Friday).
   - Minimum Humidity (Min): Thursday records the lowest minimum humidity at 55.20%, suggesting dry conditions, while other days maintain minimum humidities in the range of 67.00% to 75.60%.

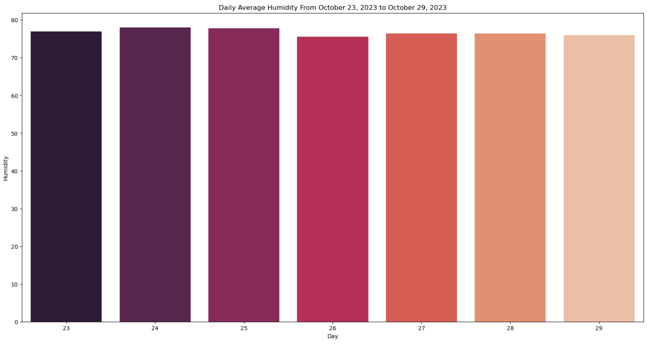

Fig. 1 Bar plot of average daily humidity

It can be observed that:

- The average daily humidity ranges from 75.537 to 77.97
- October 23, 2023: The average daily humidity on this day is approximately 76.95. This suggests that, on average, the humidity level was around 76.95% throughout the day.
- October 24, 2023: The average daily humidity on this day is approximately 77.97. This indicates that the average humidity was slightly higher compared to the previous day, at around 77.97%.
- October 25, 2023: The average daily humidity on this day is approximately 77.79. It's slightly lower than the previous day but still relatively high.
- October 26, 2023: The average daily humidity on this day is significantly lower, at approximately 75.54. This suggests that the day might have been drier or less humid compared to the previous days.
- October 27, 2023: The average daily humidity on this day is approximately 76.46, which is slightly higher than the day before but lower than the initial days.

- October 28, 2023: The average daily humidity on this day is approximately 76.42. It's similar to the humidity level on October 27, 2023.
- October 29, 2023: The average daily humidity on this day is approximately 75.99, which is similar to the humidity level on October 26, 2023.

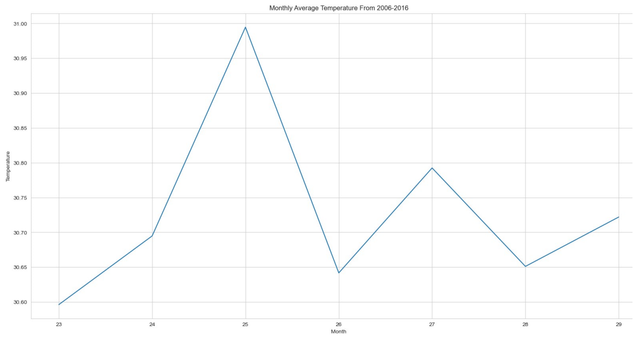

Fig. 2 Line plot of daily average temperature

Figure shows that October 25, 2023 (Wednesday) has the hottest average daily temperature while October 23, 2023 has the lowest temperature among other days.

V. Conclusion

In conclusion, the study "Exploring Daily Temperature and Humidity Shifts in Malate, Manila" provides insights into the variations in daily humidity levels during the period from October 23, 2023, to October 29, 2023. Over this seven-day period, the average daily humidity ranged from 75.54% to 77.97%. Notably, October 26, 2023, stood out with significantly lower humidity, suggesting a drier or less humid day compared to the surrounding days. These findings highlight the dynamic nature of humidity in Malate, Manila, with variations that can influence the local climate and environmental conditions. Additionally, the study reveals temperature patterns during this time frame, with mean temperatures of 30.79°C in the afternoon, 30.76°C in the morning, and 30.67°C at night. The maximum recorded temperature reached 33.8°C, while the minimum temperatures varied from 23.6°C in the morning to 29.9°C in the afternoon and 24.9°C at night, demonstrating fluctuations in daily temperature throughout the week.

References

[1] J. Botero-Valencia, L. Castano-Londono, and D. Marquez-Viloria, "Indoor temperature and relative humidity dataset of controlled and uncontrolled environments," *Data*, vol. 7, no. 6, p. 81, 2022. doi:10.3390/data7060081

[2] J. Botero-Valencia, L. Castano-Londono, and D. Marquez-Viloria, "Indoor temperature and relative humidity dataset of controlled and uncontrolled environments," *Data*, vol. 7, no. 6, p. 81, 2022. doi:10.3390/data7060081