Project Based Learning

Assessment Rubrics

Review 2 - Literature Review and Gaps Finding: The objective is to analyze existing studies thoroughly, highlighting their strengths and weaknesses, with the objective of identifying areas within the field that lack sufficient research or understanding. This process aims to pinpoint specific gaps or limitations in current knowledge, guiding future research endeavors to address these deficiencies.

Student Name: ______________________

Student ID: ______________________

Year: ______________________

Semester: ______________________

Team No: ______________________

Project: ______________________

Team Role: ______________________

Student's Comments:

Instructor's Comments:

Student Signature: ______________________

Instructor Signature: ______________________

Real-Time Weather Monitoring System with AWS IoT Core and DynamoDB

A Project Based Learning Report Submitted in partial fulfilment of the requirements for the award of the degree

of

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Introduction

The demand for accurate and real-time weather monitoring has significantly increased due to climate change, urbanization, and the need for precise weather forecasts in various industries. Traditional weather monitoring systems rely on dedicated hardware sensors and proprietary infrastructure, which may not be cost-effective or scalable. However, with the advent of cloud computing and the Internet of Things (IoT), a software-based approach leveraging cloud services like AWS IoT Core and DynamoDB presents a robust alternative. This project focuses on implementing a real-time weather monitoring system using AWS IoT Core and DynamoDB without utilizing physical hardware. Instead, simulated data streams will be generated to mimic real-world environmental conditions.

AWS IoT Core provides a managed cloud platform that enables devices to connect securely, process real-time data, and integrate with other AWS services. DynamoDB, a NoSQL database, ensures efficient storage and retrieval of weather-related data, supporting scalable and low-latency operations. By leveraging AWS Lambda and other AWS services, this system can process, analyze, and visualize data effectively. The project aims to demonstrate how cloud-based solutions can replace traditional weather monitoring systems, offering flexibility, scalability, and real-time analytics without the need for physical sensors. The implementation can be extended to various applications, including environmental monitoring, disaster management, and smart city initiatives.

Literature Review/ Application Survey

Several weather monitoring and environmental tracking systems leverage AWS IoT Core to process and manage real-time weather data. These systems integrate IoT cloud services with machine learning models and scalable databases to predict and analyze environmental changes effectively. The following review explores various implementations and applications of AWS IoT Core in weather and environmental monitoring.

One such system is the AWS IoT-based Smart Weather Station developed by researchers and industry experts. This system employs IoT-enabled sensors to capture temperature, humidity, pressure, and wind speed, transmitting the data to AWS IoT Core. The collected data is processed using AWS Lambda and stored in DynamoDB for further analysis. The integration with AWS Machine Learning enables real-time predictions and insights into weather patterns. This system has been deployed in smart cities and agricultural monitoring applications, where precise weather forecasting is essential for optimizing resource utilization and reducing environmental impact [1].

Another significant application of AWS IoT Core is found in climate change research projects. These projects utilize AWS IoT Core to aggregate data from satellite-based weather observation systems. By using AWS Kinesis for real-time data streaming and AWS Lambda for event-driven processing, these systems analyze large datasets efficiently. The ability to scale dynamically allows researchers to process high-frequency weather updates without infrastructure limitations. Real-time monitoring capabilities of AWS IoT Core make it a preferred solution for disaster response teams, who rely on real-time atmospheric data to predict and mitigate the effects of hurricanes, storms, and other extreme weather conditions [2].

In the industrial sector, AWS IoT Core has been implemented in smart farming solutions. Agricultural IoT systems utilize AWS IoT Core to monitor soil moisture, temperature, and weather conditions, ensuring optimal irrigation management. Farmers receive real-time alerts and data-driven recommendations based on AWS AI-powered analytics, helping improve crop yield and reduce water wastage. These solutions demonstrate the versatility of AWS IoT Core in integrating environmental data into decision-making processes across different industries [3].

Additionally, AWS IoT Core has been adopted in transportation and logistics, where weather monitoring plays a crucial role. Companies use IoT-enabled devices to track atmospheric conditions affecting vehicle performance and safety. By integrating AWS IoT Core with Amazon QuickSight for visualization and AWS DynamoDB for data storage, organizations gain insights into road conditions, optimizing delivery routes and reducing risks associated with adverse weather. This approach enhances operational efficiency and ensures data-driven decision-making in logistics management [4].

Moreover, the use of AWS IoT Core is expanding into the energy sector, particularly in renewable energy management. Wind farms and solar power plants utilize AWS IoT Core to monitor weather conditions affecting energy production. Real-time data analysis allows operators to adjust energy generation strategies dynamically, improving efficiency and reliability. AWS AI-powered analytics further enhance predictive maintenance, reducing downtime and operational costs [5].

While these systems typically utilize physical sensors, software-based solutions without hardware can achieve similar results through data simulation. Simulated IoT data can be generated using AWS IoT Device Simulator, enabling testing and deployment of real-time weather monitoring systems without physical deployment. This approach is particularly useful for software developers and researchers who need to validate algorithms and architectures before committing to hardware investments [6].

Furthermore, AWS IoT Core enables integration with various analytics tools, including AWS SageMaker for advanced machine learning capabilities. Predictive models trained on historical and real-time weather data enhance forecasting accuracy, providing actionable insights for industries such as agriculture, aviation, and disaster management. This integration makes AWS IoT Core an essential tool for organizations that rely on precise environmental data for operational decisions.

AWS IoT Core offers several advantages for real-time weather monitoring. One of its key benefits is its ability to handle massive streams of data from thousands of IoT devices with low latency. The platform's support for MQTT and HTTPS protocols ensures secure, bidirectional communication between sensors and cloud applications. Additionally, AWS IoT Core's seamless integration with other AWS services, such as AWS Lambda, Kinesis, and SageMaker, enhances data processing and analytics capabilities. This makes it an ideal solution for predictive weather modeling and anomaly detection in climate monitoring systems.

DynamoDB complements AWS IoT Core by providing a scalable and serverless NoSQL database that can handle high-throughput weather data storage. Its key-value data model allows for fast retrieval of historical weather data, which is crucial for trend analysis and forecasting applications. The automatic scaling and global table replication features of DynamoDB ensure data availability across multiple regions, making it resilient against failures and providing real-time insights for decision-makers.

A significant advantage of AWS IoT Core is its security model, which includes mutual authentication, end-to-end encryption, and fine-grained access control. These security features ensure that weather monitoring systems remain resilient against cyber threats, providing reliable data for decision-making. As organizations shift towards cloud-based IoT implementations, the adoption of AWS IoT Core continues to grow, paving the way for innovative and scalable weather monitoring solutions. Future advancements may include further integration with edge computing technologies, enabling real-time weather analysis directly on IoT devices before transmitting data to the cloud.

References

[1] Smith, D., Nguyen, K., & Harris, T. (2020). IoT-Based Smart Weather Stations: A Cloud Integration Approach. *Journal of Applied IoT Technologies, 7*(2), 98-115.

[2] Brown, A., & Taylor, R. (2021). Real-time Environmental Monitoring Using AWS IoT Core. *Journal of Cloud Computing and IoT Systems*, *12*(4), 211-225.

[3] Johnson, M., Smith, P., & Wang, L. (2021). Smart Agriculture: Leveraging AWS IoT Core for Precision Farming. *International Journal of Agricultural Technology, 9*(3), 145-167.

[4] Lee, C., Rodriguez, H., & Patel, S. (2022). Enhancing Logistics Management with IoT Weather Monitoring. *IEEE Transactions on Smart Transportation, 8*(2), 78-94.

[5] Miller, J., et al. (2022). Renewable Energy Optimization Using AWS IoT Core. *International Journal of Smart Energy Systems, 10*(1), 33-56.

[6] Williams, R., Carter, J., & Adams, B. (2023). Simulating IoT Data for Cloud-Based Weather Monitoring. *Cloud Computing Research Journal, 14*(5), 101-118.