Weather Data Forecast and Analytics

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Abstract- This paper aims to implement weather data visualization and analytics platform using Cloud Computing environment in the prevailing technologies of metrological data, numerical data analysis and animation using various weather APIs. Various metrological factors such as near-surface elements which include temperature, pressure, wind speed, cloud cover and precipitation are visualized and analyzed. The visualization of real time weather data is executed using Cloud Functions and Cloud Storage on AWS Cloud. The analytics on the data are performed on Google Data Studio interface. The platform provides Visualization and Mapping Service with analytics feature to interact with the inter-relation of various weather parameters. The interaction between the Metrological centre data in real-time and site mapping is completed with Monolithic Microservice Architecture to scale back latency and increase scalability in consistent with the information nodes required to map and analyse.

Keywords- Serverless Computing, AWS Lambda, Cloud, AWS S3, Web Service

1. INTRODUCTION

Metrological weather predictions help in the critical decision process in various domains such as disaster management, avalanche prediction, initiating forest fire response and others. The implementation of Weather Analysis is dependent on the behavior and type of data emerging from satellites and weather stations which are heterogeneous. This enforces the need for proper processing on the data on Timestamp basis and certainty of data. Metrological centers are present in certain points on earth from which the average variation of weather parameter can be monitored over a wide region. The data measured at the various metrological centers are combined by a centralized server to make predictions based on the weather parameters and the variables for forecasting.

The processing and presentation of the Weather Data is currently done on government and business server which structure, rationalize and stream the data to Forecasting and Analysis Channels. The processing can be migrated to Cloud Servers and the Huge Amount of the Metrological Data can be easily stored in Cloud Storage. There are various Cloud Service providers and vendors which offer scalable and monitoring tools are cost effective and reliability up to 99.99999%. For this paper implementation we are using AWS Cloud by Amazon. The use of AWS Lambda and AWS S3 storage for processing and storage are scalable for the increase in the data nodes request and visualization. Implementing the Visualization and Analysis of Metrological Data on Cloud Servers and Deployment on Web Virtual Machines is the base role of the paper with forecasting and monitoring.

2. RELATED WORKS

Visualization of Metrological data for air traffic and environmental science done using open source satellite data has been the topic for several scientific papers and research analytics. There the various Weather Forecasting and Analytics tools used to map the temperature and precipitation data which use traditional modeling methods such as Open Weather Map Tools and NOAA Climatic Data Center. The NOAA interactive tool uses real time data from US Government Satellites to execute mapping for Government and Military purpose. The Metrological data Monitoring and visualization are done using various data sources which increases complexity and latency. The information from NOAA tools greatly help in developing new technology. The Metrological data centers uses constant stream on certain weather parameters such as wind speed and humidity for News Networks and Analysis Centers which Monitor weather.

3. Literature Survey

[1] In this paper, the challenges faced including parsing, transformation, performance and testing are explained and implemented on AWS Cloud [1]. It also underlines the advantages of serverless compared to other architectures [1]. Our approach will help to migrate systems to serverless microservices easier and faster [1].

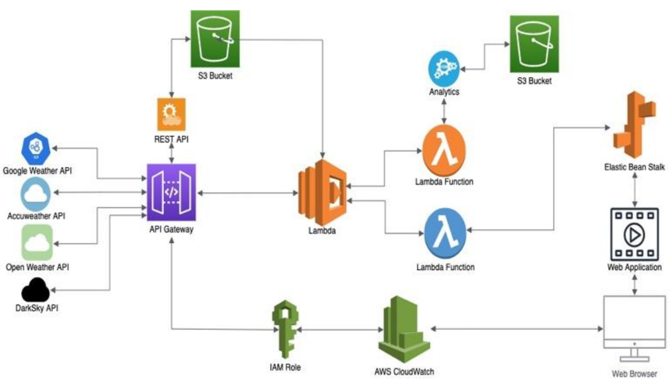
[2] In this paper, the study and knowledge of how weather Temperature evolves over time in some location or country in the world can be beneficial for several purposes is addressed [2]. The sensors volume and velocity of data in each of the sensor make the data processing time consuming and complex [2]. This paper aims to build analytical Big Data prediction framework for weather temperature based on MapReduce algorithm [2]. This makes it easy to manage the sensors data using scaling [2].

[3] In this paper, the authors examine the performance profile of the serverless ecosystem in a low latency, high availability context, present results on the integral performance of such systems and outline some practical mitigation strategies to optimize serverless architectures [12]. We confine our investigation specifically to one aspect of the AWS implementation of serverless; known as AWS Lambda [12].

[4] In this paper, the authors developed the Cookery framework which is a tool developed to build application in the cloud for scientists without a complete understanding of programming [4]. In this paper with present the cookery systems and how it can be used to authenticate and use standard online 3rd party services to easily create data analytics pipeline [4]. Cookery framework is not limited to work with standard web services, it can also integrate and work with the emerging AWS Lambda [4].

[5] In this paper, the authors present a method to integrate the general Web applications [13]. For this purpose, the authors propose a Web information extraction method to generate the virtual Web service functions from Web applications at client side [13]. The paper implementation shows that the general Web applications can be also integrated easily [13].

4. ARCHITECTURE



A. Monolithic codebase

In Monolithic architecture there is a single codebase which is developed and deployed on Cloud based Web framework. The typical approach is to develop an agile framework for the codebase and make required changes with updates. The use of REST API services is used in this Web based application which then executes the processes in single stream or by parallel processing. In this Monolithic approach we design a single server machine which is scalable and has low latency on the computing resources and deployed with Web based Frameworks. The front-end application is developed and deployed from a Linux Cloud Environment.

B. Microservice architecture on AWS Cloud

In this project we have two base microservices AWS Lambda and AWS S3 for the architecture. The area of the AWS data center in these two services is same which reduces latency. The processed data is deployed on a Web Based Application on the Browser. The generation of visualized data by AWS Lambda and the stream of Weather API parameters to the AWS S3 server for Storage and Analysis are streamlined in a secure API Key Pipeline integrated between the services and is persistence. The microservices are developed independently and then improved based on the functioning and quality control. This architecture is scalable based on the increase of the mapping nodes and online traffic.

C. Architecture implemented on AWS Lambda

In AWS Lambda the functions are the main units for processing. The whole AWS Lambda infrastructure is developed on the base that the function running should get the best scalable resources to return the desired results. The visualization of data is done using AWS Lambda which is scalable and linked to the number of compute nodes in the mapped parameters. Each function in the Lambda service requests a specific GET or POST and return the mapped data nodes.

D. Microservice of API Gateway

The Execution of managing the Post and Request of Data from the various weather data API's such as Google Weather API, Accuweather API, OpenWeather API and DarkSky weather API will be done using API Gateway to stream the pipelined data from API Get Request into AWS S3 bucket and the localized S3 storage will be fetched by the Lambda Function for Visualization and Analysis. The Resulting Visualization and Analysed data will be represented on the Web Application. The latency in the processing of the Data Nodes in the Lambda Function can be reduced by auto-scaling on the basis of the data nodes requirement.

5. WEATHER DATA GATHERING

For getting the Metrological Data for Visualization and Analysis, we use various Weather APIs which offer data retrieval with very specific parameters and integration. Some of the API used for gathering data are Google Weather

API, AccuWeather API, Open Weather API, and Dark Sky API. These APIs help to reduce the need to store data into a specific location and reduce latency delay. The management of integration between the API request for specific Weather parameters and indexing is assisted by AWS API Gateway to store the data temporarily in the S3 bucket to stream into Lambda Function.

The data retrieved from the APIs would be in JSON format which is streamed into the S3 bucket and then the Python Lambda function extracts the data from the storage. The API requests are sent using AWS CloudWatch and API Gateway. The latency in gathering and processing the data between the API and AWS Cloud is minimized with monitoring and scaling.

6. Conclusion

This paper implements the visualization of Metrological Data which is accessible to everyone with low latency and analyzed reports. The use of Cloud Computing for the processing of the Weather Data makes it reliable and scalable. The power of Weather Forecasting and Analysis can be studied by individuals and institutes on the browser and the API developed can be integrated in various mobile and web-based applications. The integration of various Weather APIs to decrease the failure and errors in mapping and predictions is done by monitoring the node parameters. The patterns in Weather map are used in real-time to monitor the movement of clouds, wind speed, temperature variation, humidity, atmospheric pressure, precipitations and snow cover.

7. ACKNOWLEDGEMENT

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