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AWS Data Visualization using DynamoDB and Lambda

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***Abstract*—AWS IoT has been one of the extremely powerful AWS service offers. AWS IoT has the ability to process more than billions and trillions of devices and messages respectively and can process and routes to endpoints (i.e. AWS DynamoDB, Aws Lambda). In this paper, we proposed a method for temperature data sensing using DHT22 sensor connected to Raspberry Pi 4B that interacts to AWS IoT which will allow us to connect to AWS DynamoDB for storing, AWS Lambda for serverless trigger in AWS services, AWS Quicksight for visualization and AWS Machine Learning for further data processing.**

Keywords—MQTT, AWS, Raspberry Pi 4 model B, DHT11, Lambda, DynamoDB

I. INTRODUCTION

Internet-of-Things (IoT) has been tremendously growing as it plays the role of connecting thing (i.e. devices such as lights, phones, cars, etc.) Recently, cloud providers such as AWS has been offering their service 'AWS IoT' platform which integrates all the necessary functions required for developing an IoT System and has the ability to process more than billions and trillions of devices and messages respectively and can process and routes to endpoints (i.e. AWS DynamoDB, Aws Lambda) provided by AWS [1]. Cloud supporting IoT has a huge impact on the performance of IoT applications when it comes to storage, computing, and cost. Many works have been performed using AWS as a cloud provider. In [2], a prototype of a pragmatic air flow control system for home automation using recently developed AWS IoT Core, efficient MQTT protocol over Websocket server and robust hardware end devices had been presented. In [3], utilized MQTT broker built using AWS to perform a smart home system for room temperature control. In [4], a home security system has been constructed using IoT and AWS Cloud Services.

II. HARDWARE DESIGN

The following are the hardware components needed for the proposed system.

A. Raspberry Pi 4 model B

Raspberry Pi 4 model B, shown in Fig. 1, is an embedded board capable for advanced machine learning application purposes. Its processor is quad-core ARM Cortex-A72 processor, Bluetooth five, two USB 2.0 ports. We can power it via a USB-C port, facultative further power to be provided to downstream peripherals, once used with associate applicable PSU [5]. Our module onboard an 8 GB RAM which is big enough to complete the process of temperature sensing and AWS connection.

Fig.1. Raspberry Pi 4 Model B

Fig. 2. DHT22 Temperature Sensor

B. DHT22 Temperature Sensor

DHT22 temperature sensor, shown in Fig. 2, is a small size, low cost and low power consumption temperature and humidity sensor. DHT22 is temperature compensated for a large range (-40 o C – 80 o C) and gives relative humidity (0-100%) which is enough to cover the small range of values for room temperatures at high accuracy (0.5 o C and 2-5%) [2].

III. SOFTWARE DESIGN

The following are the software services needed.

A. Amazon Web Services IOT (AWS IoT)

This Amazon service will serve as the interface between the Raspberry and the Cloud. AWS IoT is capable of creating a function that can trigger AWS DynamoDB.

B. AWS DynamoDB

This AWS service is a noSQL database which will store data being sent from AWS IoT.

C. AWS Lambda

AWS Lambda will allow a serverless code trigger that enables cost-friendly system for only enabling your code when needed. This service will allow DynamoDB data to be transferred to other AWS services such as S3.

Fig.3. AWS IoT JSON Output.

mac_Id	TimeStamp	Temperature Data	Humidity Data
dc:a6:32:66:2b:48	1604042900801	20.01 C	32.7 %
dc:a6:32:66:2b:48	1604043056011	20.05 C	32.0 %
dc:a6:32:66:2b:48	1604043000932	20.12 C	32.5 %

Fig. 4. AWS DynamoDB Result.

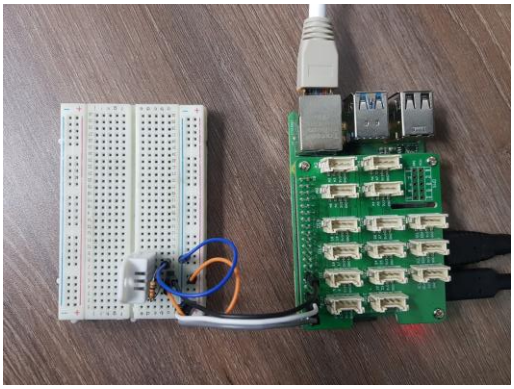

Fig.5. Hardware Implementation.

D. *AWS S3*

AWS Simple Storage Service (S3) allows files to be stored in a bucket including your code and data being sent from DynamoDB which enables you to organize project well.

E. *AWS Quicksight*

AWS Quicksight allows a visual interaction with data that is very helpful data analytics.

F. *AWS Machine Learning*

AWS Machine Learning is a cloud-based machine learning that performs data analytics and further processes in your data.

IV. Proposed Method

In this paper, we proposed a temperature data collecting system using Raspberry Pi 4 model B, DHT22 temperature sensor and AWS services. First, we developed a local-based temperature sensing system by connecting DHT22 to the GPIO pins of the raspberry pi as shown in Fig. 5. We enable IC2 and GPIO in raspberry pi for the board to detect the sensor and to enable communication for data transfer. Then, we import 'Adafruit_DHT_Python' which is a library provided by adafruit for interfacing the sensor. After a successful local implementation, MQTT protocol will be used to create and establish an interface between Raspberry board and AWS IoT. MQTT is a publish/subscribe message exchange protocol developed by IBM which is composed of MQTT broker and client. MQTT has been adopted as the message transfer binding protocol in oneM2M IoT international standards. We utilized MQTT protocol to interact Raspberry Pi board to AWS. After a successful connection, we have created a function that triggers AWS DynamoDB. This function will allow the temperature data being sent from the board to AWS IoT be permanently stored in a NoSQL database. After storing the data, we can now proceed with connecting the database through a lambda function which will enable the data to be stored in a S3 bucket so that the bucket will have to do the work of triggering AWS Quicksight for visualization and AWS Machine Learning for further data processing and analytics.

V. Recent Results

Fig. 3 shows how our implementation sends data from our Raspberry Pi to AWS IoT. We create the connection between raspberry pi and AWS IoT using the AWS python IoT SDK. This SDK allows interface between Raspberry Pi and AWS IoT. Temperature and Humidity Data was gathered from the sensor by importing the Adafruit library for DHT sensors using python programming language via pycharm IDE and was triggered using the terminal command line. Data was being sent as a JSON file. These JSON files will be transferred to a database in AWS DynamoDB using an AWS IoT rule as shown Fig. 4. The data stored can be now connected to other AWS services including Quicksight for visualization and AWS Machine Learning for further processing.

VI. Conclusion and Future Work

Our implementation shows how to connect and store data in AWS using Raspberry Pi 4B using AWS python IoT SDK and MQTT. In future works, data being stored will be utilized in other AWS services such as for machine learning and visualization.

Acknowledgment

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