CAPSTONE PROJECT

Microsoft Elevate

Iot Smart Home Monitoring

PRESENTED BY

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OUTLINE:

- **Problem Statement**
- **Proposed System/Solution**
- **System Development Approach** (Technology Used)
- **Algorithm & Deployment**
- **Result (Output Image)**
- **Conclusion**
- **Future Scope**
- **References**

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PROBLEM STATEMENT:

This project develops an AI-based Smart Home Monitoring System using Microsoft Azure that collects real-time sensor data from IoT devices and sends it to Azure IoT Hub. The data is processed and analyzed using Machine Learning to detect abnormal conditions such as unusual temperature or motion. The results are displayed on a live dashboard, enabling users to monitor their home environment intelligently and remotely.

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PROPOSED SOLUTION:

- **The proposed system collects real-time smart home sensor data through Azure IoT Hub, processes it using Stream Analytics, applies machine learning–based anomaly detection, deploys the model as a live service, evaluates its performance, and visualizes intelligent results on a real-time dashboard.**
- **Data Collection:**
  - **Sensors capture real-time temperature, humidity, and motion data and send it securely to Azure IoT Hub.**
  - **Each IoT device is registered and authenticated in Azure to ensure secure and reliable data transmission.**
- **Data Preprocessing:**
  - **Azure Stream Analytics cleans, filters, and routes incoming IoT data for storage and analysis.**
  - **It performs real-time transformations and aggregations before sending data to ML and dashboards.**
- **Machine Learning Algorithm:**
  - **Machine learning models analyze patterns and detect anomalies in sensor data.**
  - **Time-series and anomaly detection techniques classify events as normal or abnormal.**
- **Deployment:**
  - **The trained ML model is deployed as a live Azure endpoint for real-time prediction.**
  - **The deployed service integrates with Stream Analytics for continuous scoring of incoming data.**
- **Evaluation:**
  - **Model performance is measured using accuracy, precision, and anomaly detection rates.**
  - **Historical sensor data is used to validate predictions and reduce false alerts.**
  - Result:

SYSTEM APPROACH:

The system collects real-time sensor data from smart home devices and sends it to Azure IoT Hub for secure ingestion. Azure Stream Analytics processes the data and passes it to Machine Learning models to detect anomalies. The analyzed results and alerts are visualized on a live Power BI dashboard for intelligent home monitoring. Here's a suggested structure for this section:

- **System requirements**

1. Hardware Requirements

- Computer/Laptop (Minimum 8GB RAM recommended)
- Internet connection
- IoT sensor device (optional) or simulated device

2. Software Requirements

- Microsoft Azure Account (Free Tier)
- Azure IoT Hub
- Azure Stream Analytics
- Azure Machine Learning / Azure AI Services
- Power BI
- Python (for device simulation)
- Visual Studio Code (optional)

3. Cloud Requirements

- Azure Resource Group
- Azure Storage (Blob/SQL Database)
- Azure ML Workspace
- Stream Analytics Job

ALGORITHM & DEPLOYMENT:

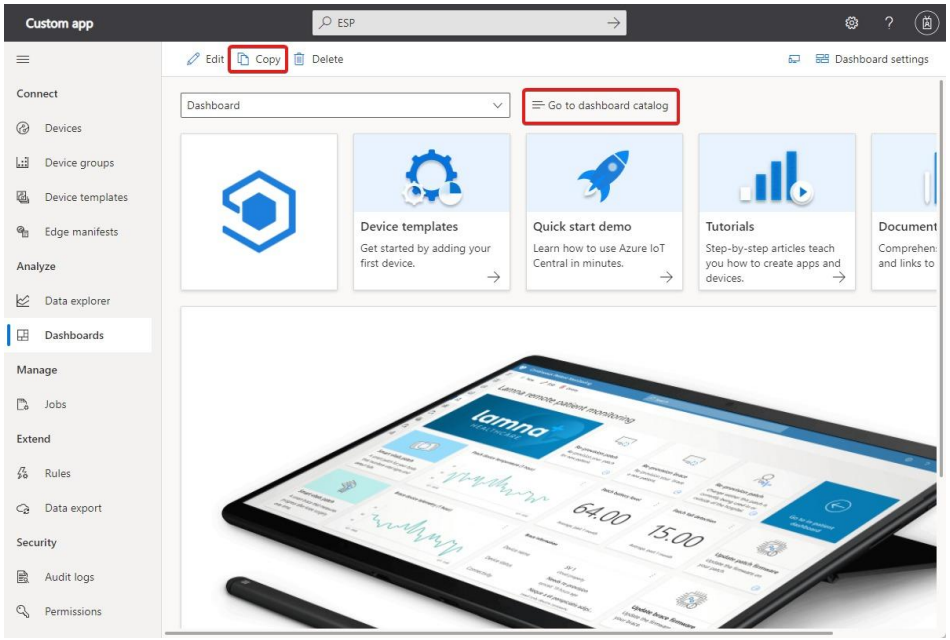
- The IoT Smart Home Monitoring System uses Artificial Intelligence and Machine Learning to analyze real-time sensor data and detect abnormal conditions in a smart home environment using Microsoft Azure.
- **Algorithm Selection:**
  - An anomaly detection algorithm such as Isolation Forest or time-series analysis is selected to identify unusual patterns in sensor data.
- **Data Input:**
  - Real-time sensor readings like temperature, humidity, and motion are used as input features for the model.
- **Training Process:**
  - The model is trained using historical smart home sensor data to learn normal behavior patterns.
- **Prediction Process:**
  - The trained model analyzes incoming live data and predicts whether the condition is normal or abnormal.

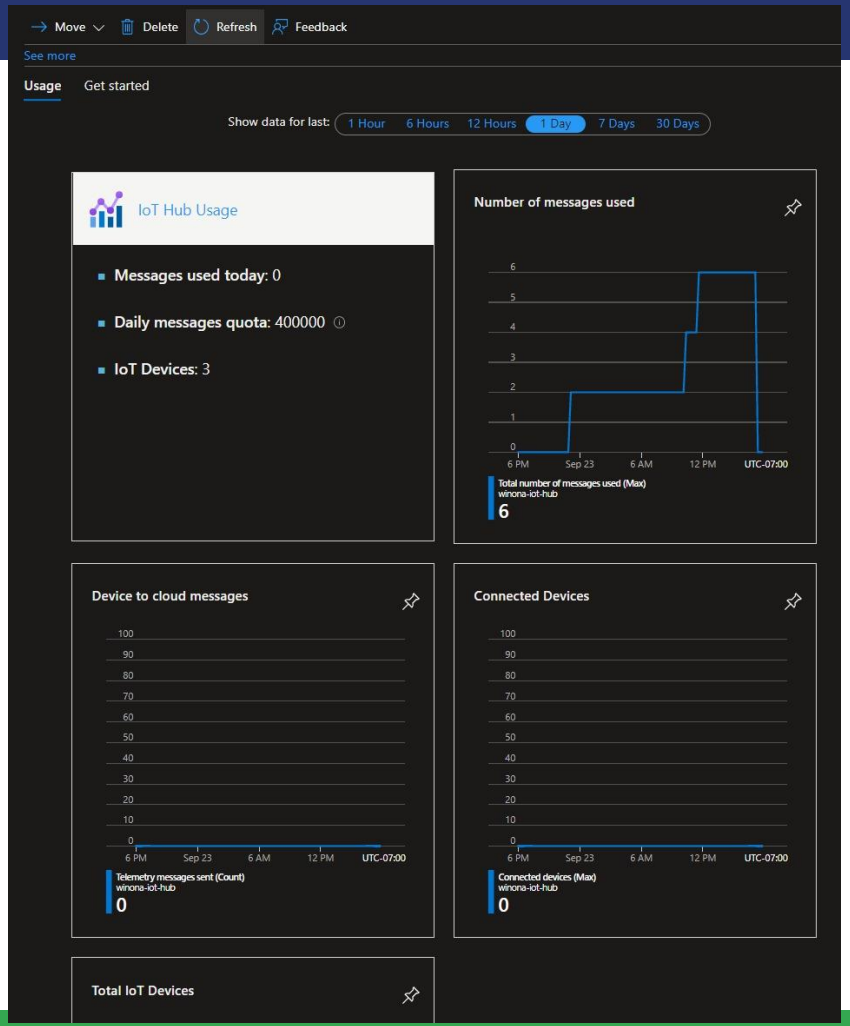
RESULT

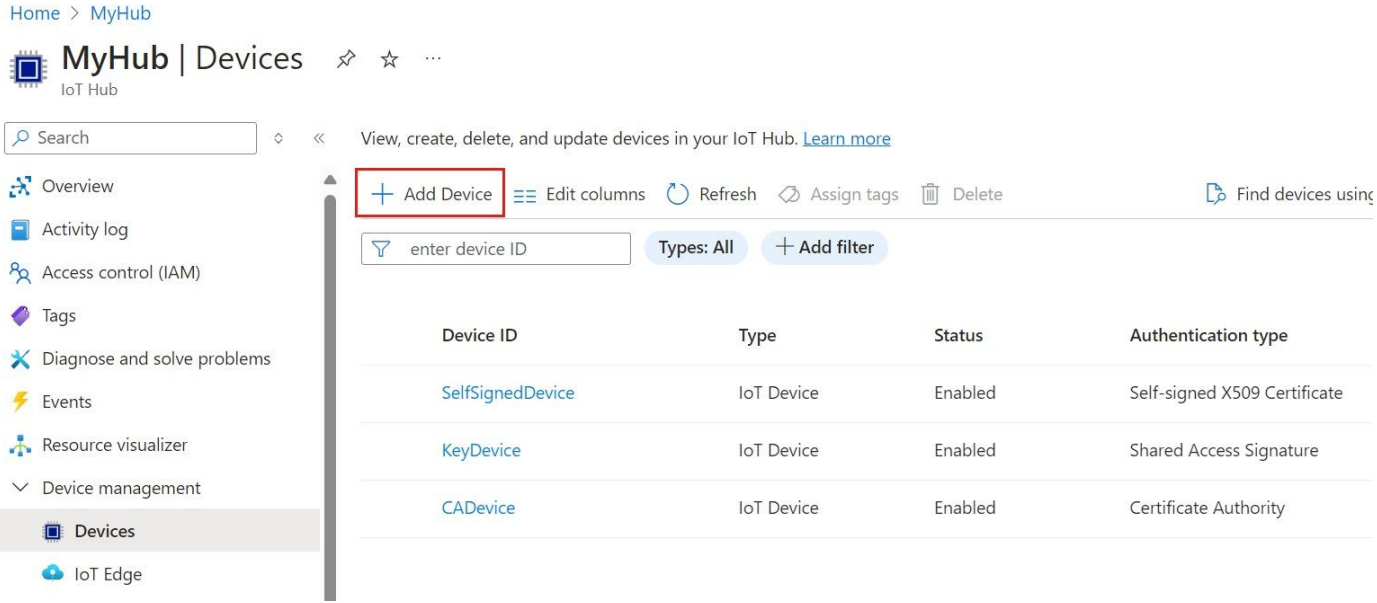
- The system successfully monitors temperature, humidity, and motion data in real time from smart home sensors.
- AI/ML models accurately detect abnormal conditions and generate instant alerts.
- A live Power BI dashboard displays sensor readings, trends, and anomaly status clearly.
- The solution improves home safety and automation through intelligent decision-making.
- The system runs efficiently on Azure Free Tier with low cost and high scalability.

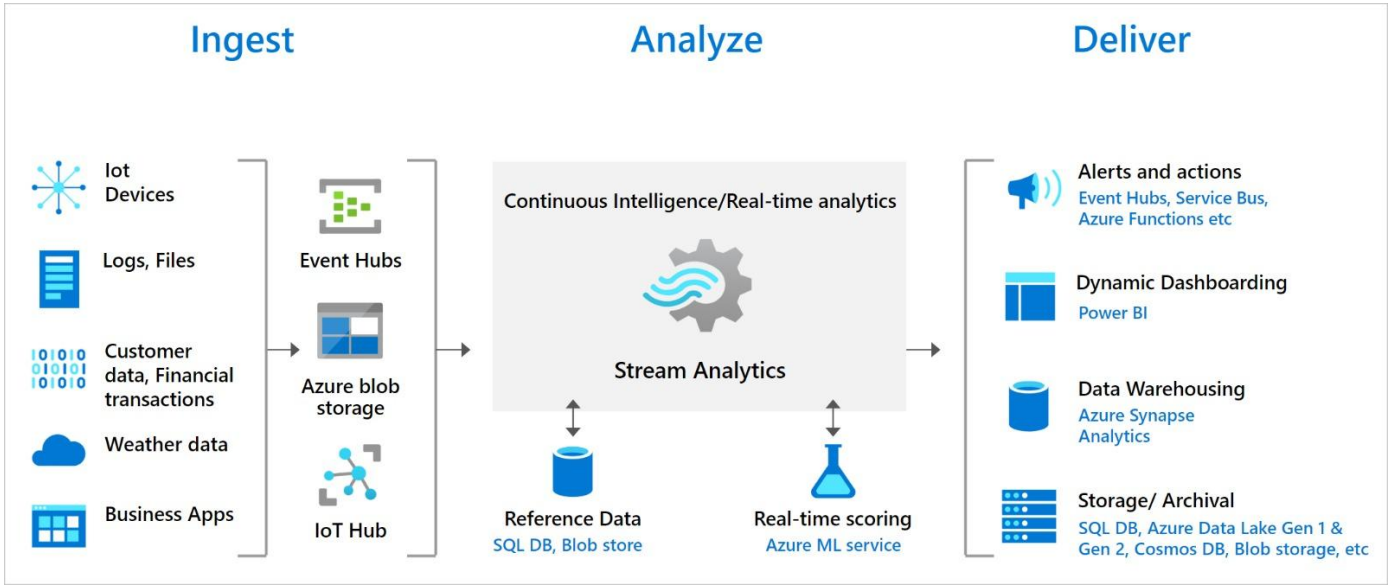
OUTPUT

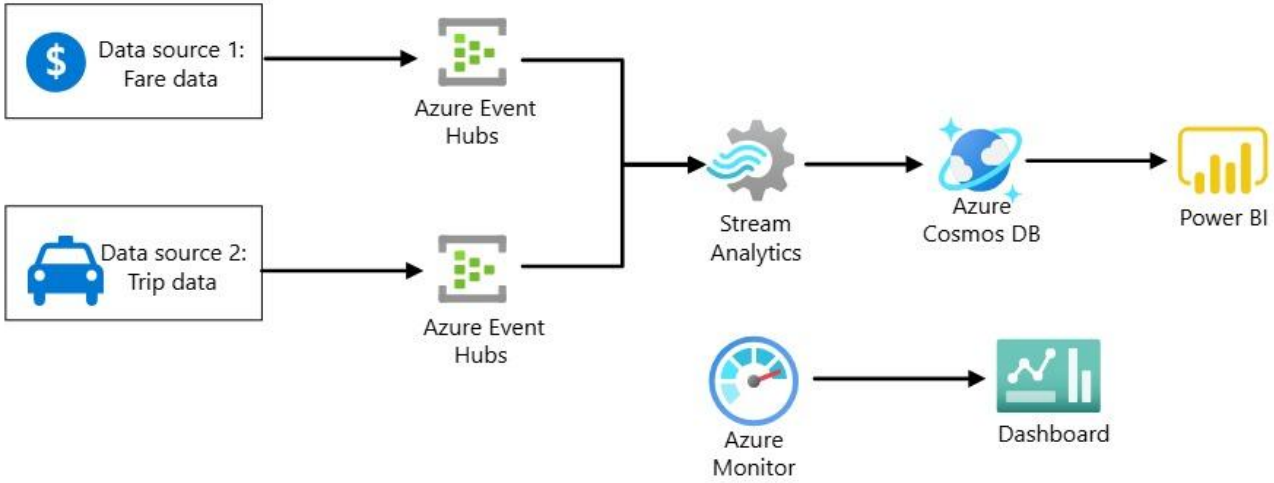
- This is an reference output images for this project.



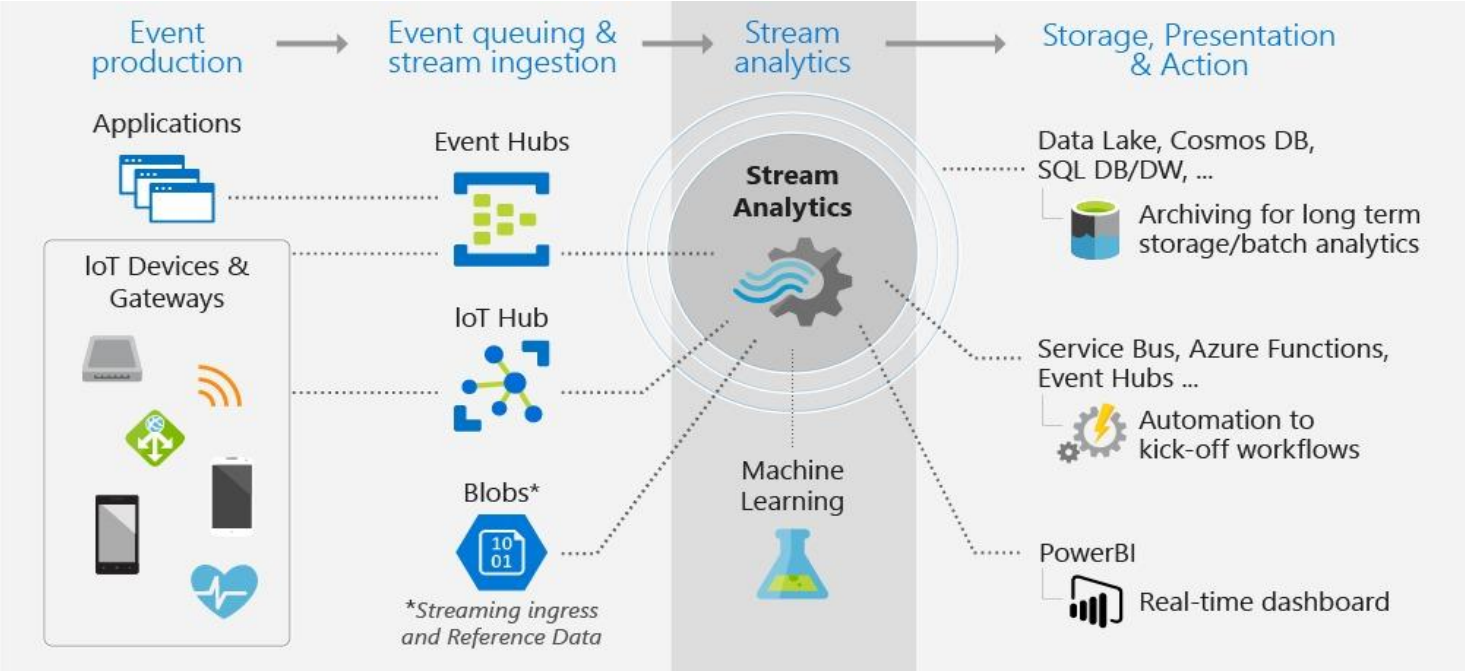

Move
Delete
Refresh
Feedback
See more
Usage
Get started
Show data for last:
1 Hour
6 Hours
12 Hours
1 Day
7 Days
30 Days
IoT Hub Usage
Messages used today: 0
Daily messages quota: 400000
IoT Devices: 3
Number of messages used
6
5
4
3
2
1
0
6 PM
Sep 23
6 AM
12 PM
UTC-07:00
Total number of messages used (Max)
winona-iot-hub
6
Device to cloud messages
100
90
80
70
60
50
40
30
20
10
0
6 PM
Sep 23
6 AM
12 PM
UTC-07:00
Telemetry messages sent (Count)
winona-iot-hub
0
Connected Devices
100
90
80
70
60
50
40
30
20
10
0
6 PM
Sep 23
6 AM
12 PM
UTC-07:00
Connected devices (Max)
winona-iot-hub
0
Total IoT Devices

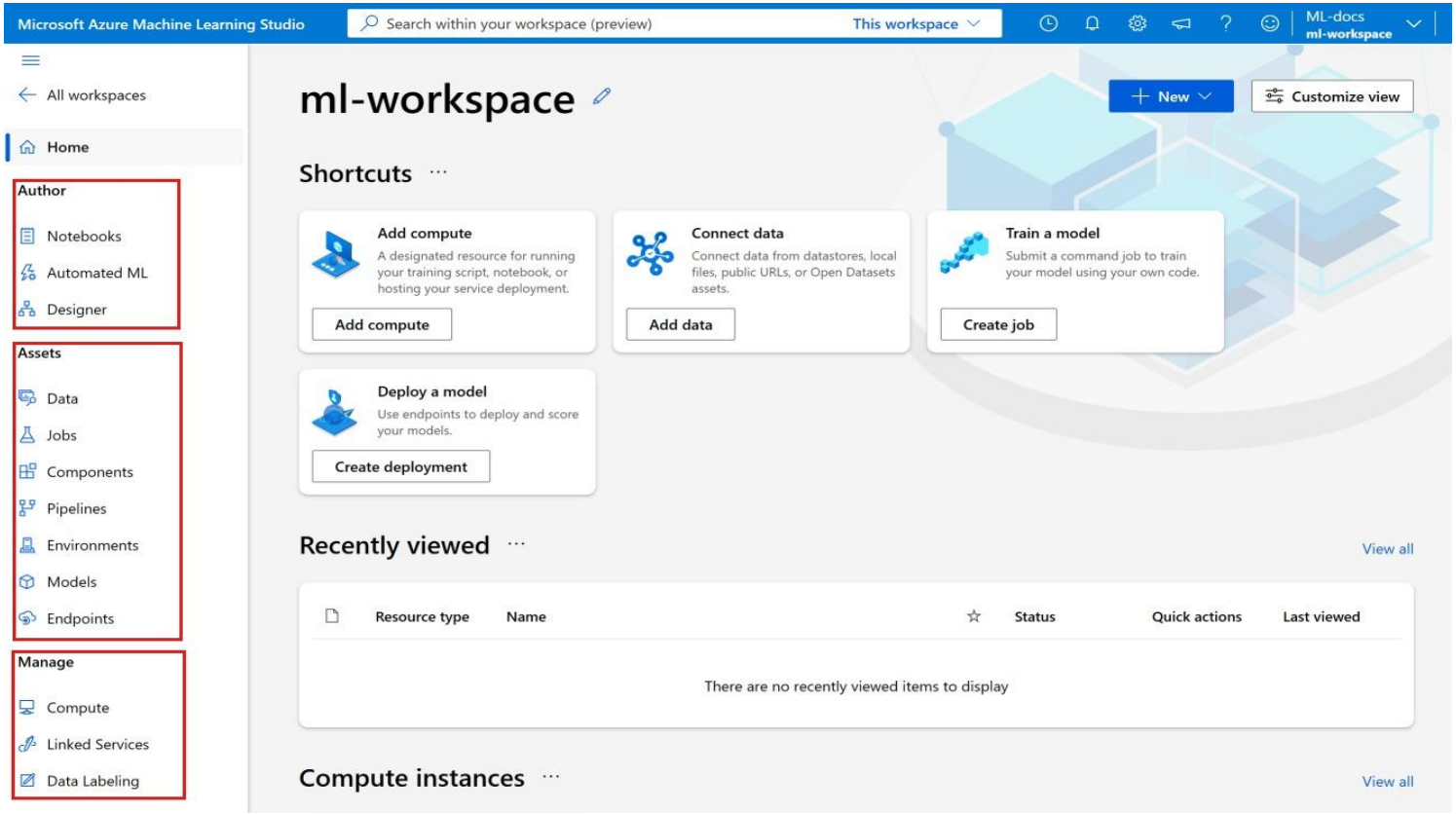

Home > MyHub
MyHub | Devices
IoT Hub
Search
View, create, delete, and update devices in your IoT Hub. Learn more
Overview
Activity log
Access control (IAM)
Tags
Diagnose and solve problems
Events
Resource visualizer
Device management
Devices
IoT Edge
Add Device
Edit columns
Refresh
Assign tags
Delete
Find devices using
enter device ID
Types: All
Add filter
Device ID
Type
Status
Authentication type
SelfSignedDevice
IoT Device
Enabled
Self-signed X509 Certificate
KeyDevice
IoT Device
Enabled
Shared Access Signature
CADevice
IoT Device
Enabled
Certificate Authority

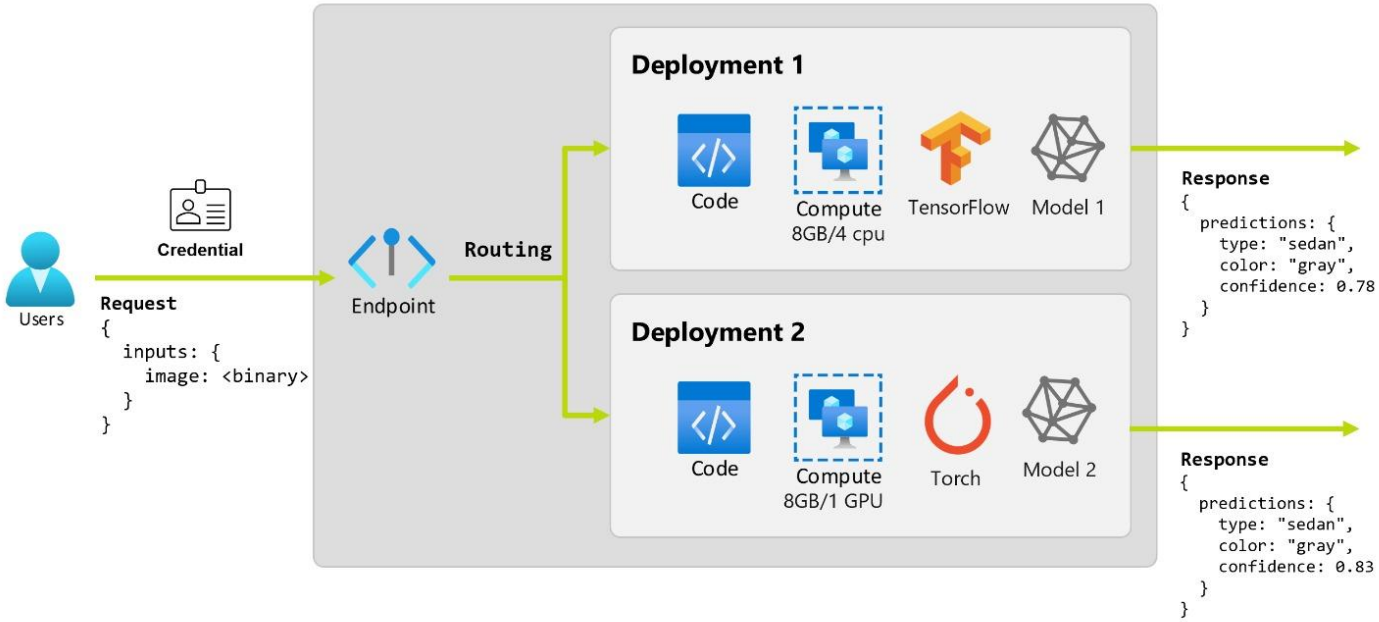

Ingest
Analyze
Deliver
Iot Devices
Logs, Files
Customer data, Financial transactions
Weather data
Business Apps
Event Hubs
Azure blob storage
IoT Hub
Continuous Intelligence/Real-time analytics
Stream Analytics
Reference Data
SQL DB, Blob store
Real-time scoring
Azure ML service
Alerts and actions
Event Hubs, Service Bus, Azure Functions etc
Dynamic Dashboarding
Power BI
Data Warehousing
Azure Synapse Analytics
Storage/ Archival
SQL DB, Azure Data Lake Gen 1 & Gen 2, Cosmos DB, Blob storage, etc

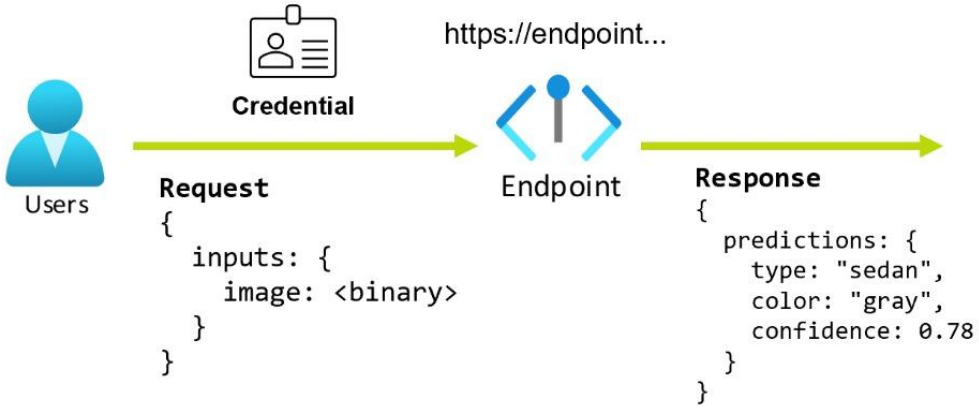


Microsoft Azure

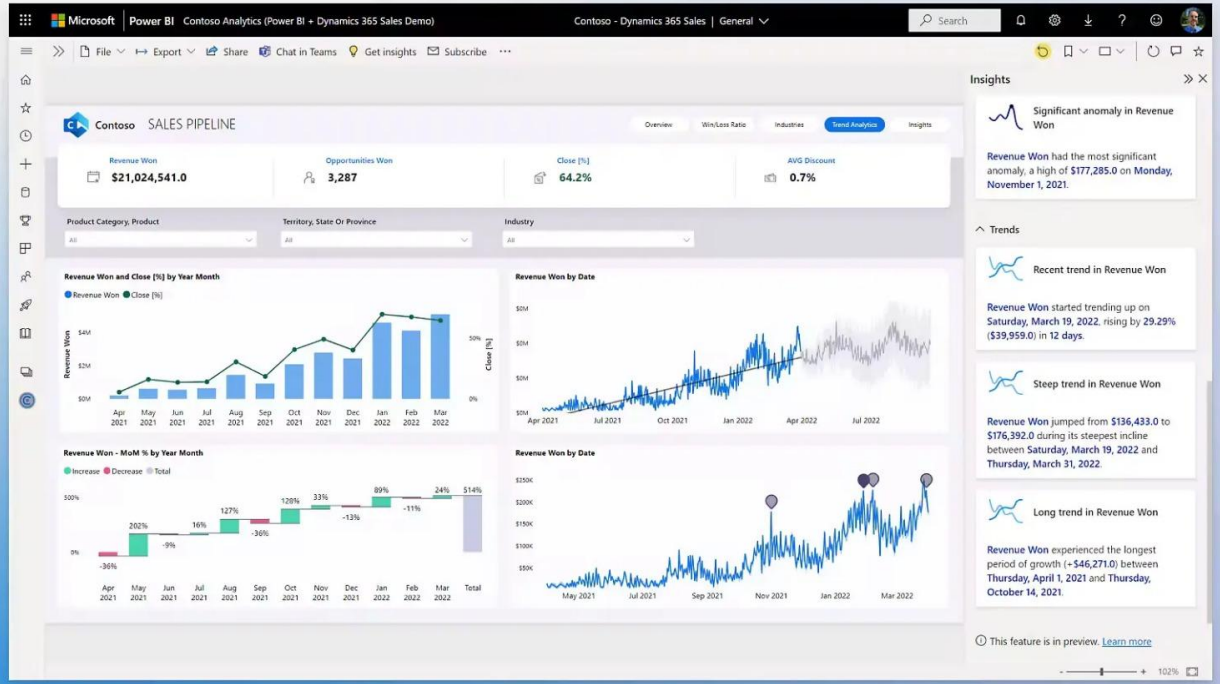

Event production
Event queuing & stream ingestion
Stream analytics
Storage, Presentation & Action
Applications
IoT Devices & Gateways
Event Hubs
IoT Hub
Blobs*
*Streaming ingress and Reference Data
Stream Analytics
Machine Learning
Data Lake, Cosmos DB, SQL DB/DW, ...
Archiving for long term storage/batch analytics
Service Bus, Azure Functions, Event Hubs ...
Automation to kick-off workflows
PowerBI
Real-time dashboard

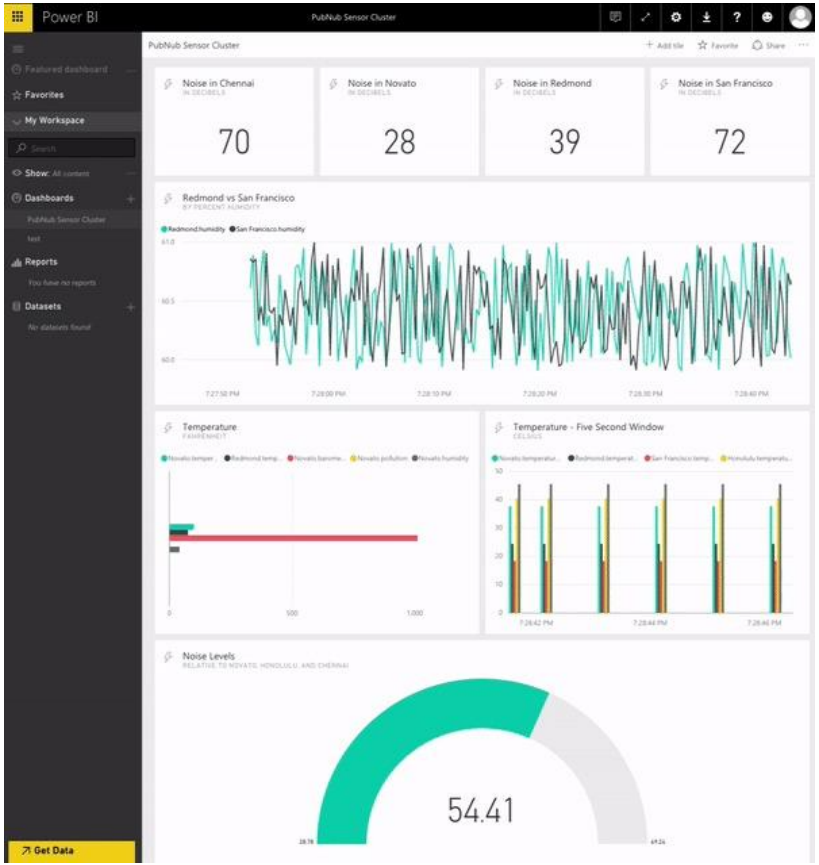

Microsoft Azure Machine Learning Studio
Search within your workspace (preview)
This workspace
ML-docs
ml-workspace
All workspaces
Home
Author
Notebooks
Automated ML
Designer
Assets
Data
Jobs
Components
Pipelines
Environments
Models
Endpoints
Manage
Compute
Linked Services
Data Labeling
ml-workspace
New
Customize view
Shortcuts
Add compute
A designated resource for running your training script, notebook, or hosting your service deployment.
Add compute
Connect data
Connect data from datastores, local files, public URLs, or Open Datasets assets.
Add data
Train a model
Submit a command job to train your model using your own code.
Create job
Deploy a model
Use endpoints to deploy and score your models.
Create deployment
Recently viewed
View all
Resource type
Name
Status
Quick actions
Last viewed
There are no recently viewed items to display
Compute instances
View all

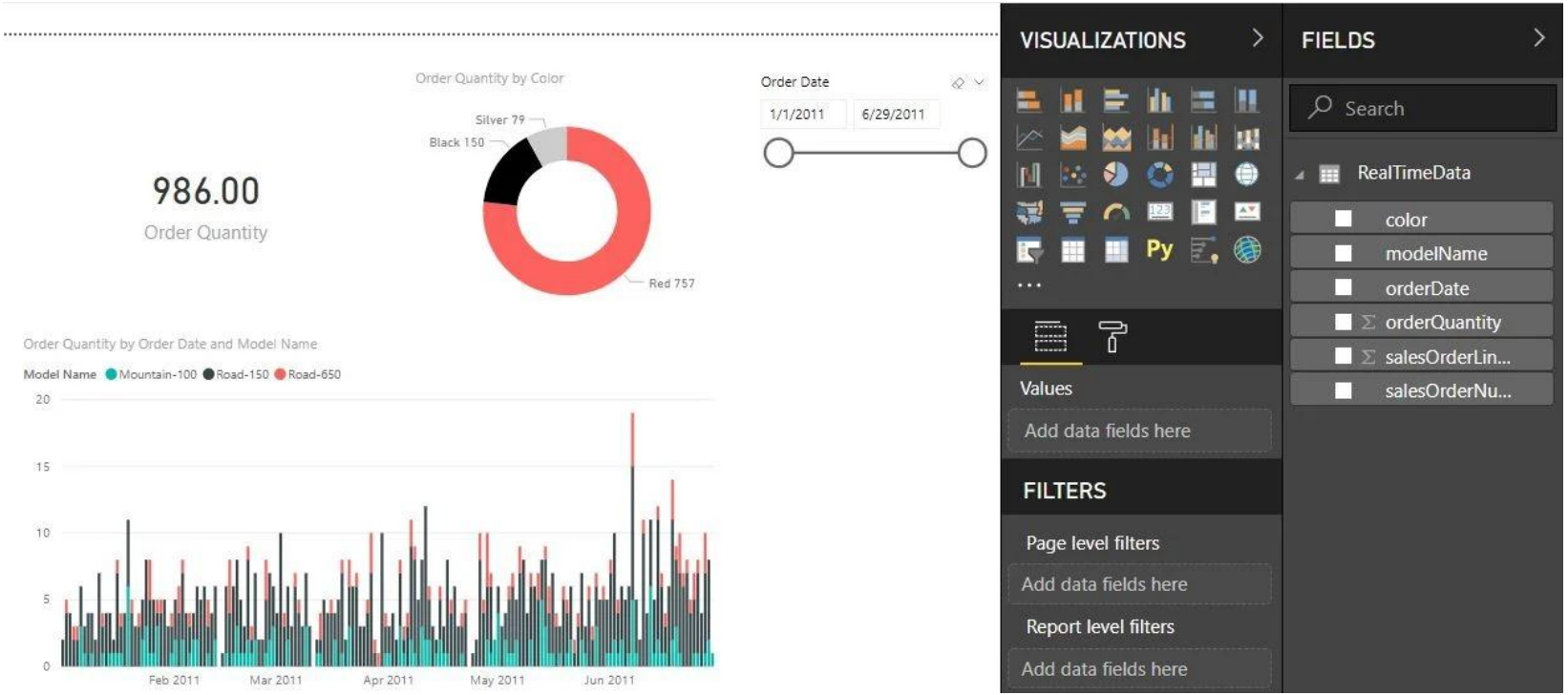

Users
Credential
Request
{
inputs: {
image: <binary>
}
}
Endpoint
Routing
Deployment 1
Code
Compute
8GB/4 cpu
TensorFlow
Model 1
Deployment 2
Code
Compute
8GB/1 GPU
Torch
Model 2
Response
{
predictions: {
type: "sedan",
color: "gray",
confidence: 0.78
}
}
Response
{
predictions: {
type: "sedan",
color: "gray",
confidence: 0.83
}
}


https://endpoint...
Credential
Users
Endpoint
Request
{
inputs: {
image: <binary>
}
}
Response
{
predictions: {
type: "sedan",
color: "gray",
confidence: 0.78
}
}

Ask a question about your data
Temp value
ROOM 1
20
humidity
47
Comparative analysis of temperature and humidity
ROOM 1
temperature
humidity
11:11:30 AM
11:11:25 AM
11:11:20 AM
11:11:15 AM
0
50
Past temperature records
ROOM 1
24
22
20
11:10:40 AM
11:10:50 AM
11:11:00 AM
11:11:10 AM
11:11:20 AM
Temperature Gauge
ROOM 1
20.00
Humidity gauge
ROOM 1
47.00
Fan on/off
ROOM 1
0


Microsoft | Power BI Contoso Analytics (Power BI + Dynamics 365 Sales Demo)
Contoso - Dynamics 365 Sales | General
Search
File Export Share Chat in Teams Get insights Subscribe
Contoso SALES PIPELINE
Overview Win/Loss Ratio Industries Trend Analysis Insights
Revenue Won
$21,024,541.0
Opportunities Won
3,287
Close [%]
64.2%
AVG Discount
0.7%
Product Category, Product
Territory, State Or Province
Industry
Revenue Won and Close [%] by Year Month
Revenue Won
Close [%]
Revenue Won by Date
Revenue Won - MoM % by Year Month
Increase Decrease Total
Revenue Won by Date
Insights
Significant anomaly in Revenue Won
Revenue Won had the most significant anomaly, a high of $177,285.0 on Monday, November 1, 2021.
Trends
Recent trend in Revenue Won
Revenue Won started trending up on Saturday, March 19, 2022, rising by 29.29% ($39,959.0) in 12 days.
Steep trend in Revenue Won
Revenue Won jumped from $136,433.0 to $176,392.0 during its steepest incline between Saturday, March 19, 2022 and Thursday, March 31, 2022.
Long trend in Revenue Won
Revenue Won experienced the longest period of growth (+$46,271.0) between Thursday, April 1, 2021 and Thursday, October 14, 2021.
This feature is in preview. Learn more
102%


Power BI
PubNub Sensor Cluster
PubNub Sensor Cluster
Featured dashboard
Favorites
My Workspace
Show: All content
Dashboards
PubNub Sensor Cluster
test
Reports
You have no reports
Datasets
No datasets found
Get Data
Noise in Chennai
IN DECIBELS
70
Noise in Novato
IN DECIBELS
28
Noise in Redmond
IN DECIBELS
39
Noise in San Francisco
IN DECIBELS
72
Redmond vs San Francisco
BY PERCENT HUMIDITY
Redmond humidity
San Francisco humidity
Temperature
FAHRENHEIT
Temperature - Five Second Window
CELSIUS
Noise Levels
54.41


Order Quantity by Color
Silver 79
Black 150
Red 757
Order Date
1/1/2011
6/29/2011
986.00
Order Quantity
Order Quantity by Order Date and Model Name
Model Name
Mountain-100
Road-150
Road-650
20
15
10
5
0
Feb 2011
Mar 2011
Apr 2011
May 2011
Jun 2011
VISUALIZATIONS
FIELDS
Search
RealTimeData
color
modelName
orderDate
orderQuantity
salesOrderLin...
salesOrderNu...
Values
Add data fields here
FILTERS
Page level filters
Add data fields here
Report level filters
Add data fields here

CONCLUSION:

- The IoT Smart Home Monitoring System successfully integrates IoT, Cloud Computing, Artificial Intelligence, and Machine Learning using Microsoft Azure to provide intelligent real-time home monitoring.
- By collecting and analyzing sensor data, the system accurately detects abnormal conditions and generates timely alerts to enhance safety and automation.
- The implementation demonstrates a scalable, secure, and cost-effective smart home solution that can be expanded for advanced monitoring and predictive analytics in real-world applications.

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FUTURE SCOPE:

- Integration of additional sensors such as gas, smoke, and energy meters for complete home automation.
- Use of advanced deep learning models for more accurate prediction and anomaly detection.
- Development of a mobile app for instant alerts and remote monitoring.
- Integration with voice assistants for hands-free control and automation.
- Implementation of edge computing for faster local decision-making.

REFERENCES:

- **Microsoft, “Azure Stream Analytics Documentation**, Microsoft Learn. [Online]. Available: https://learn.microsoft.com/azure/stream-analytics/
- **Azure IoT Hub (connect and manage IoT devices)** — Includes free tier usage: https://azure.microsoft.com/en-in/products/iot-hub/
- **Azure Stream Analytics (real-time data processing)** documentation and tutorials: https://azure.microsoft.com/en-in/services/stream-analytics/
- **Microsoft Learn (free Azure documentation & hands-on modules)** — Includes IoT, AI/ML, Power BI training: https://learn.microsoft.com/en-in/answers/questions/5595825/get-all-the-free-microsoft-azure-services
- **GitHub Link**: https://github.com/Thivya48/IOT-SMART-HOME-MONITORING

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Thank You