



Milestone 2

Real-Time Processing

Milestone 2: Real-Time Processing

Objective

Implement real-time analysis of traffic data to detect speed violations, congestion, and possible accidents using Azure Stream Analytics (ASA).

Tasks

1. Azure Stream Analytics Setup

- Created a Stream Analytics Job named projectasa.
- Input: trafficeventsinput (data from Python simulator through Event Hub).
- Outputs:
 - overspeedoutput
 - underspeedoutput
 - congestionoutput
 - accidentoutputAll stored in Azure SQL Database.

2. Real-Time Queries

- Overspeed Detection:
Detects vehicles moving >15% above the speed limit.
- Underspeed Detection:
Detects vehicles moving <80% of the speed limit (excluding intersections).
- Congestion Detection:
Flags locations where ≥ 3 vehicles in the same minute have average speed <60% of the limit.
- Accident Risk Detection:
Detects potential accident zones when vehicles move extremely fast (>140%) or very slow (<10 km/h) on highways or main roads.

3. Database

Processed data from ASA is stored in Azure SQL Database in four tables:

- `dbo.OverspeedOutput`
- `dbo.UnderSpeedOutput`
- `dbo.CongestionOutput`
- `dbo.AccidentOutput`

Each table contains insights like timestamp, location, vehicle count, average speed, etc.

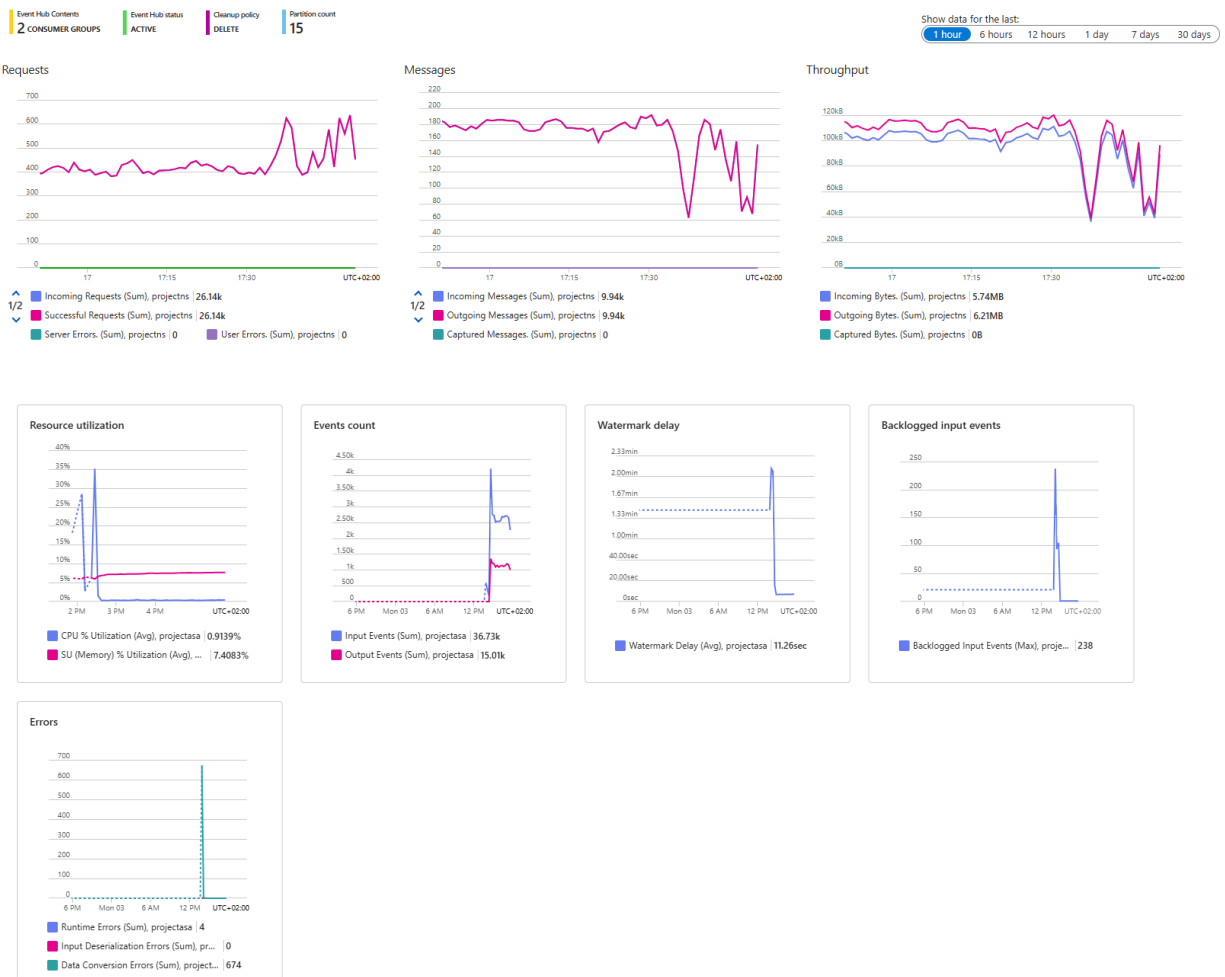
Results

- Streamed data successfully from Python simulator → Event Hub → ASA → SQL.
- Overspeed and underspeed detections appeared frequently.
- Congestion and accident detections appeared less often due to strict conditions and simulator randomness.
- Job runs without errors after fixing data type casting issues.

Deliverables

- Real-time ASA query configuration.
- Azure SQL database with processed insights.
- Working data simulator (Python).

View from Event hub and Stream analytics job



Data generation and results from the analysis



Query 1 × Query 2 × Query 3 × Query 4 × Query 5 ×

Run Cancel query Save query Export data as Show only Editor

1 SELECT TOP (1000) FROM [dbo].[AccidentOutput]

Results Messages

Search to filter items...

WindowEnd	location_id	location_name	risky_vehicle_count	avg_speed	speed_limit_in_area
2025-11-03T12:31:00.0000000-00:00	179	El Thawra	2	115	80
2025-11-03T12:36:00.0000000-00:00	650	Al Amriya Road	2	146.5	100
2025-11-03T12:39:00.0000000-00:00	960	Ramess	2	116	80
2025-11-03T12:43:00.0000000-00:00	790	El Nozha	2	58.5	40
2025-11-03T12:43:00.0000000-00:00	435	Gamaat El Dowal	2	116.5	80
2025-11-03T12:44:00.0000000-00:00	349	Al Rehab Road	2	58	40
2025-11-03T12:55:00.0000000-00:00	430	Giza Corniche (segment 430)	2	117.5	80
2025-11-03T12:54:00.0000000-00:00	435	Gamaat El Dowal	2	116	80
2025-11-03T12:52:00.0000000-00:00	164	El Nozha	2	58.5	40
2025-11-03T13:08:00.0000000-00:00	561	Nasr City	2	73.5	50
2025-11-03T13:13:00.0000000-00:00	480	El Sakakini (segment 480)	2	115.5	80

Query 1 × Query 2 × Query 3 × Query 4 × Query 5 ×

Run Cancel query Save query Export data as Show only Editor

1 SELECT TOP (1000) FROM [dbo].[CongestionOutput]

Results Messages

Search to filter items...

WindowEnd	location_id	location_name	road_type	vehicle_count	avg_speed	speed_limit_in_area
2025-11-03T12:36:00.0000000-00:00	520	Ramess	Bridge	3	27.666666666666668	50
2025-11-03T13:08:30.0000000-00:00	578	Heliopolis Avenue (segment 578)	Highway	3	31	60
2025-11-03T13:54:30.0000000-00:00	944	El Marg (segment 944)	Bridge	3	23.333333333333332	40
2025-11-03T13:55:00.0000000-00:00	944	El Marg (segment 944)	Bridge	4	23.5	40
2025-11-03T15:01:30.0000000-00:00	336	El Teseen (segment 336)	Highway	3	23.666666666666668	40
2025-11-03T15:01:30.0000000-00:00	607	6th October Bridge	Intersection	3	30.333333333333332	60
2025-11-03T15:05:00.0000000-00:00	899	Ring Road (segment 899)	Main Road	3	34	60
2025-11-03T15:21:00.0000000-00:00	497	Dokki (segment 497)	Intersection	3	23.666666666666668	40

Query 1Query 2Query 3Query 4Query 5

Run

Cancel query

Save query

Export data as

Show only Editor

1

SELECT TOP (1000) * FROM [dbo].[OverspeedOutput]

ResultsMessages

Search to filter items...

WindowEnd	event_id	plate_number	location_id	location_name	road_type	speed	speed_limit	kmh_over	sensor_id	severity
2025-11-03T12:30:48.8273200...	7428	3XJ 995	623	El Teseen	Highway	73	50	23	MultiSensor_El_Teseen_0160	High
2025-11-03T12:26:44.9291290...	6724	0X BY7FVP	354	El Haar Road	Urban Road	107	80	27	TrafficCounter_El_Haar_Road_0...	Medium
2025-11-03T12:26:46.5338750...	6729	JZ 4352	66	Salah Salem	Urban Road	79	60	19	TrafficCounter_Salah_Salem_0048	Medium
2025-11-03T12:26:46.6445960...	6730	9M 3K91CF	954	El Orouba	Intersection	118	80	38	CCTV_El_Orouba_0625	High
2025-11-03T12:26:47.4639670...	6732	R 585784	804	El Tayaran	Urban Road	118	100	18	TrafficCounter_El_Tayaran_0375	Medium
2025-11-03T12:26:47.7727580...	6733	1B7 R10	600	Wahat Road	Intersection	84	60	24	TrafficCounter_Wahat_Road_00...	High
2025-11-03T12:26:48.0634210...	6734	4LB9715	148	El Gesh	Urban Road	122	100	22	TrafficCounter_El_Gesh_0433	Medium
2025-11-03T12:26:48.7021350...	6736	M57-HUD	252	El Omranjya	Intersection	131	100	31	TrafficCounter_El_Omranjya_0341	Medium
2025-11-03T12:26:49.3313530...	6738	356-VHRD	904	El Haar Road	Intersection	71	60	11	CCTV_El_Haar_Road_0039	Medium
2025-11-03T12:26:51.5290200...	6745	753 YZF	821	El Shorouk Road (segment 821)	Main Road	48	40	8	CCTV_El_Shorouk_Road_segme...	Medium
2025-11-03T12:26:51.8385200...	6746	KDN 802	375	El Nozha	Intersection	148	100	48	CCTV_El_Nozha_0343	High
2025-11-03T12:26:52.1475450...	6747	1B 05220	339	El Mokattam (segment 339)	Highway	74	50	24	Radar_El_Mokattam_segment_3...	High
2025-11-03T12:26:53.4420860...	6751	MY1 B71	387	El Shorouk Road	Main Road	65	50	15	TrafficCounter_El_Shorouk_Roa...	Medium

Query 1Query 2Query 3Query 4Query 5

Run

Cancel query

Save query

Export data as

Show only Editor

1

SELECT TOP (1000) * FROM [dbo].[UnderSpeedOutput]

ResultsMessages

Search to filter items...

WindowEnd	event_id	plate_number	location_id	location_name	road_type	speed	speed_limit
2025-11-03T12:26:43.0198020...	6718	QVN 674	232	Heliopolis Avenue (segment 232)	Urban Road	52	80
2025-11-03T12:26:49.0211670...	6737	37Q Q70	486	Abbass Al Akkad (segment 486)	Main Road	24	40
2025-11-03T12:26:50.5766900...	6742	87-F452	471	Tahrir	Main Road	58	100
2025-11-03T12:26:53.1328010...	6750	WZ5 ETH	930	Abdel Aziz Fahmy (segment 930)	Bridge	59	80
2025-11-03T12:26:58.1355370...	6766	OZO 490	983	El Qahera Street	Main Road	20	40
2025-11-03T12:27:04.2266450...	6785	004-RWK	257	El Mokattam	Main Road	21	40
2025-11-03T12:27:05.3675110...	6788	APA9810	507	Heliopolis Avenue	Main Road	60	100
2025-11-03T12:27:06.9438550...	6793	ZV 28053	951	El Sakkakini (segment 951)	Highway	30	40
2025-11-03T12:27:11.4179300...	6807	754 RGA	543	Salah Salem	Main Road	68	100