

Software Prototype Use-cases:

Scenario	Description	Tested Input	Expected Outcome
Vehicle Registration	Register a new vehicle with license plate and owner details	license_plate, vehicle_type, etc.	Returns vehicle ID and stores registration successfully
Tag Assignment	Assign RFID tag to an already registered vehicle	tag_id, vehicle_id	Tag linked to vehicle; returns confirmation
Tag Blacklisting	Add a tag to blacklist list due to fraud or loss	tag_id, reason, severity	System logs blacklisted tag and returns status
Plate Notification Check	Check if notifications are correctly logged when a valid plate is passed	Valid license_plate	Returns notification logs (non-null)
Tag Notification Check	Same as above but for RFID tags	Valid tag_id	Returns notification logs (non-null)
Security Incident Logging	Log all critical unresolved alerts into Security Incident DB	System-generated	Incident ID stored; alerts tied to unresolved notifications
Toll Deduction (Success)	Deduct toll when valid vehicle and sufficient balance exists	license_plate, plaza_id	Returns TOLL_PAID, deducts from wallet
Invalid Plaza	Handle invalid toll plaza scenario	Wrong plaza_id	Returns error: Invalid Plaza
RFID–Plate Mismatch	Simulate mismatch between registered tag and plate	Wrong license_plate with valid tag_id	Returns UNMATCHED_PLATE and logs alert
Missing Tag	Simulate entry without RFID tag	Only license_plate	Returns TAG_MISSING notification
Insufficient Funds	Simulate toll with low balance in wallet	Low balance account	Returns INSUFFICIENT_FUNDS, logs pending toll
Unregistered Vehicle (Plate Only)	Try passing a vehicle that isn't in the system	Unknown license_plate	Returns UNMATCHED_PLATE
Unknown RFID Tag	Try passing an unregistered tag	Unknown tag_id	Returns UNKNOWN_TAG
Missing License Plate for Tag	Simulate case where tag has no associated plate	Tag with missing plate	Returns LICENSE_MISSING

Table 1: Use Cases List

Use-Case –1

Vehicle Registration:

Payload Input:

Part A: Non-Registered Vehicle

```
{  
  "owner_id": "OWN032",  
  "tag_id": "TAG011",  
  "license_plate": "EU-7881-GG",  
  "vehicle_type": "Hatchback",  
  "model": "Volkswagen",  
  "color": "Green"  
}
```

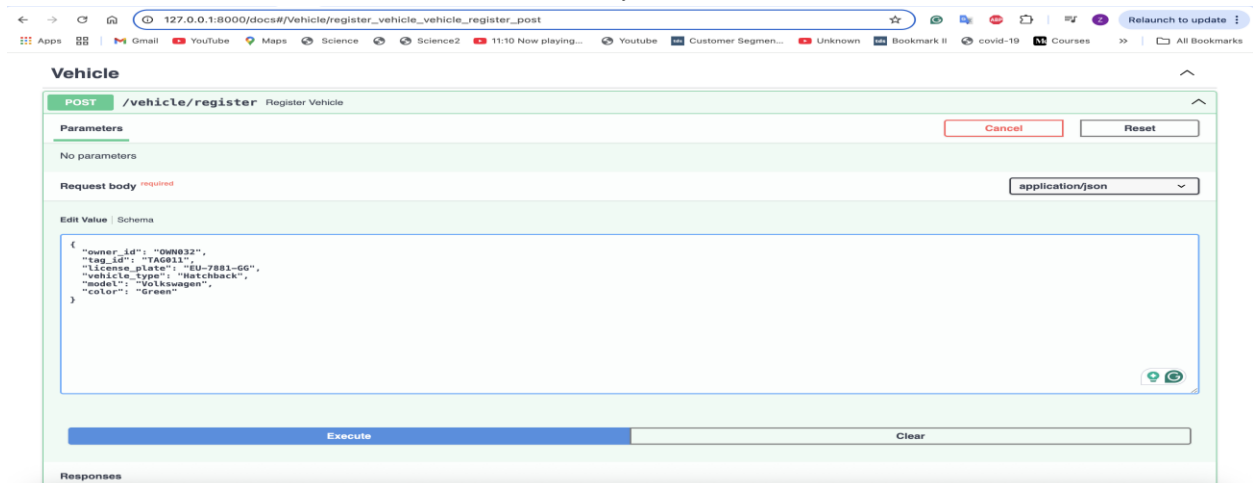


Figure 1: Payload Input for Vehicle Registration

Response

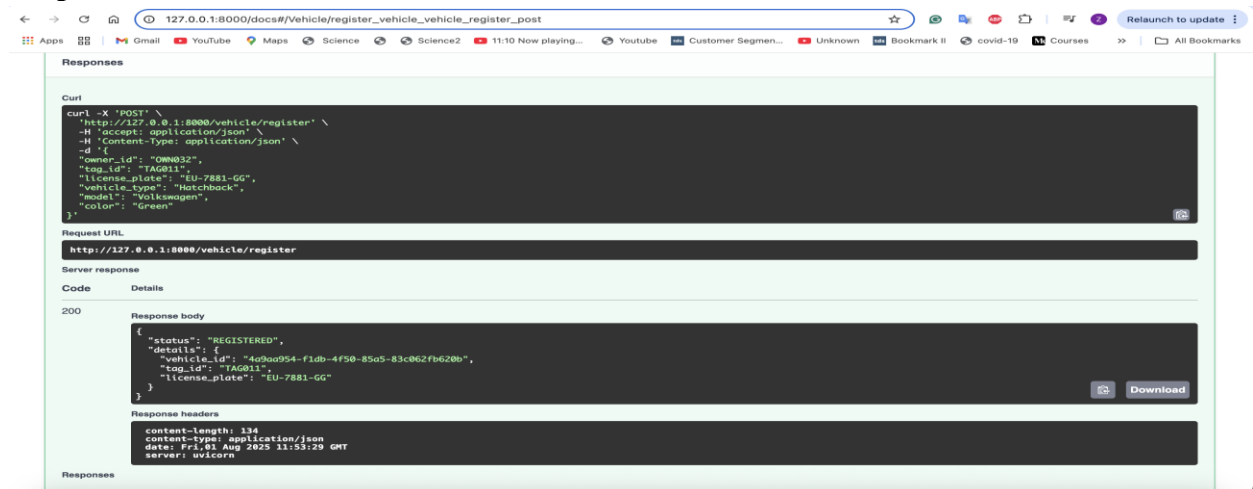


Figure 2: Response for Non-Registered Vehicle

Part-B: Registered Vehicle Tag

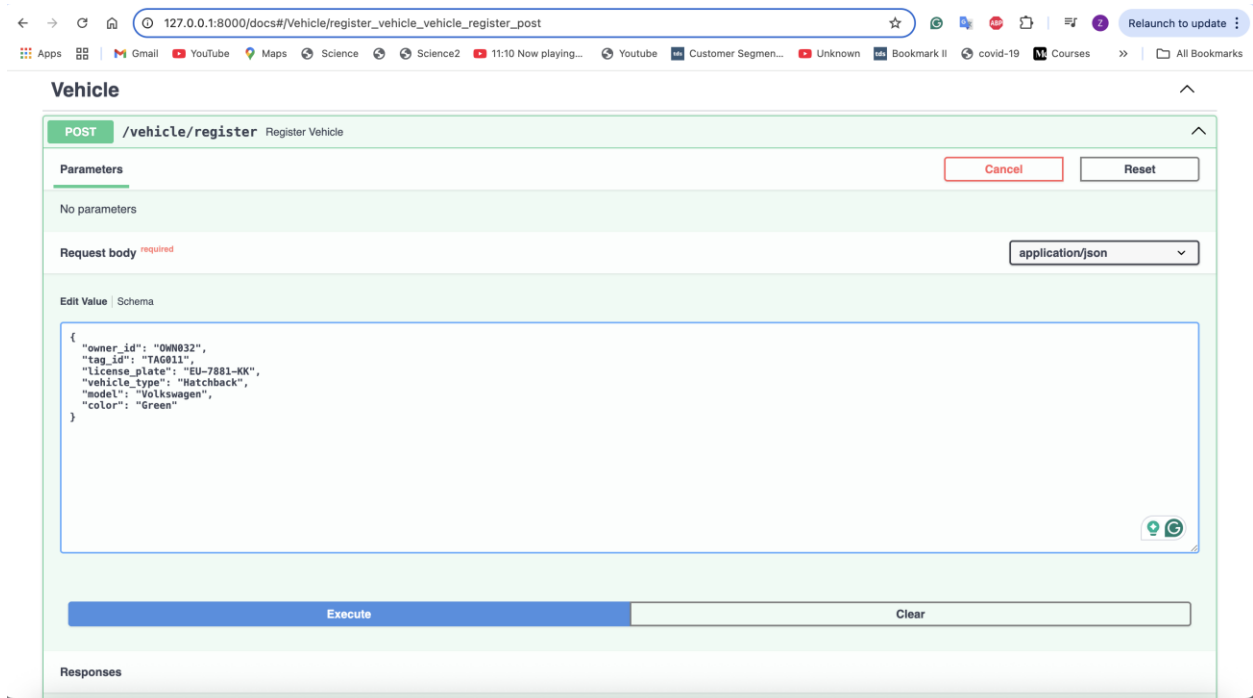


Figure 3: Passing an Existing Tag to Payload

Response:

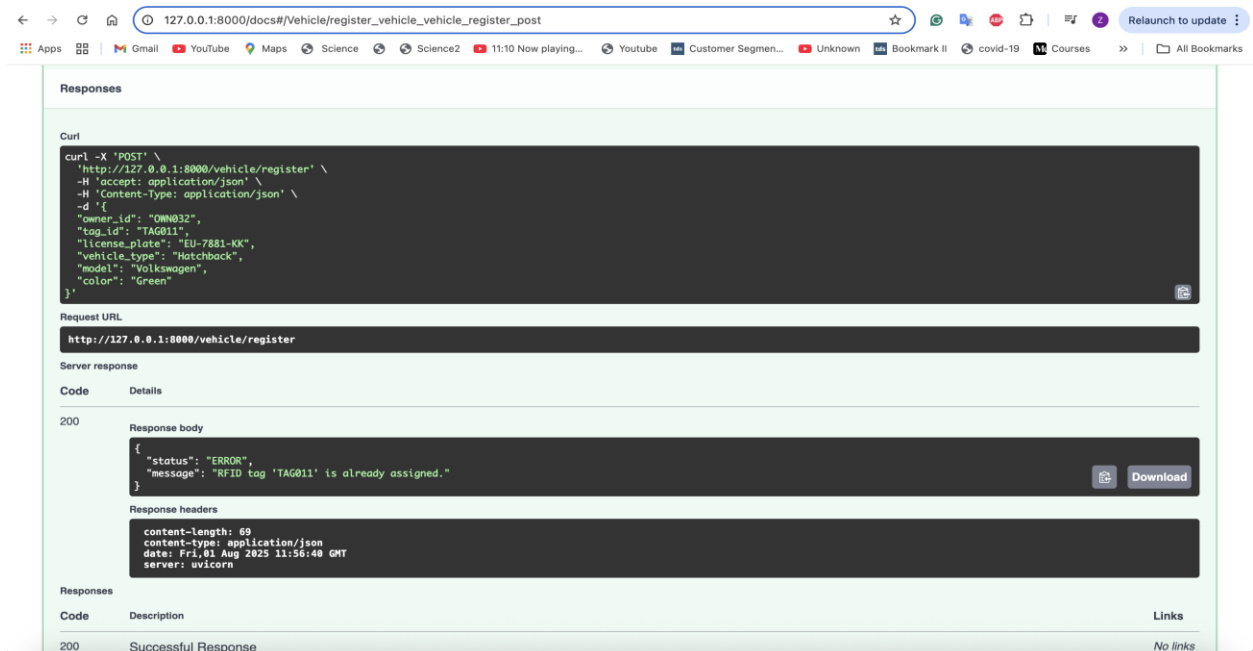


Figure 4: Response For Existing Tag

Part-C: Registered License Plate

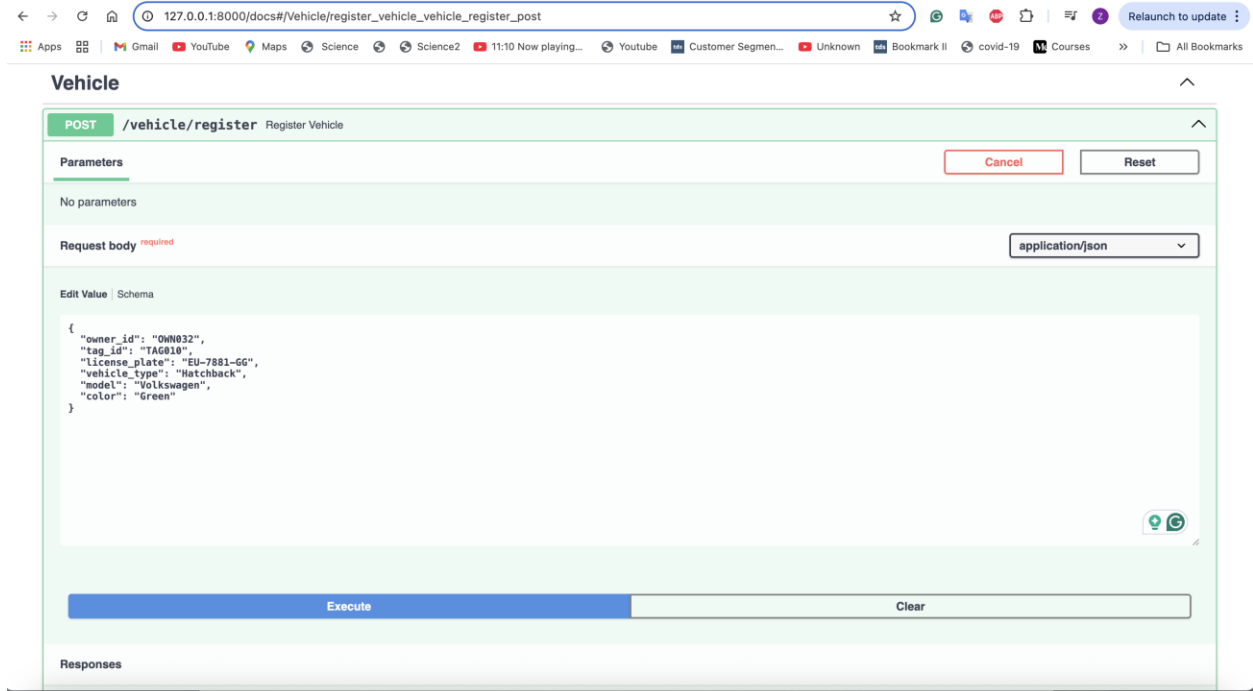


Figure 5: Existing License Plate

Response:

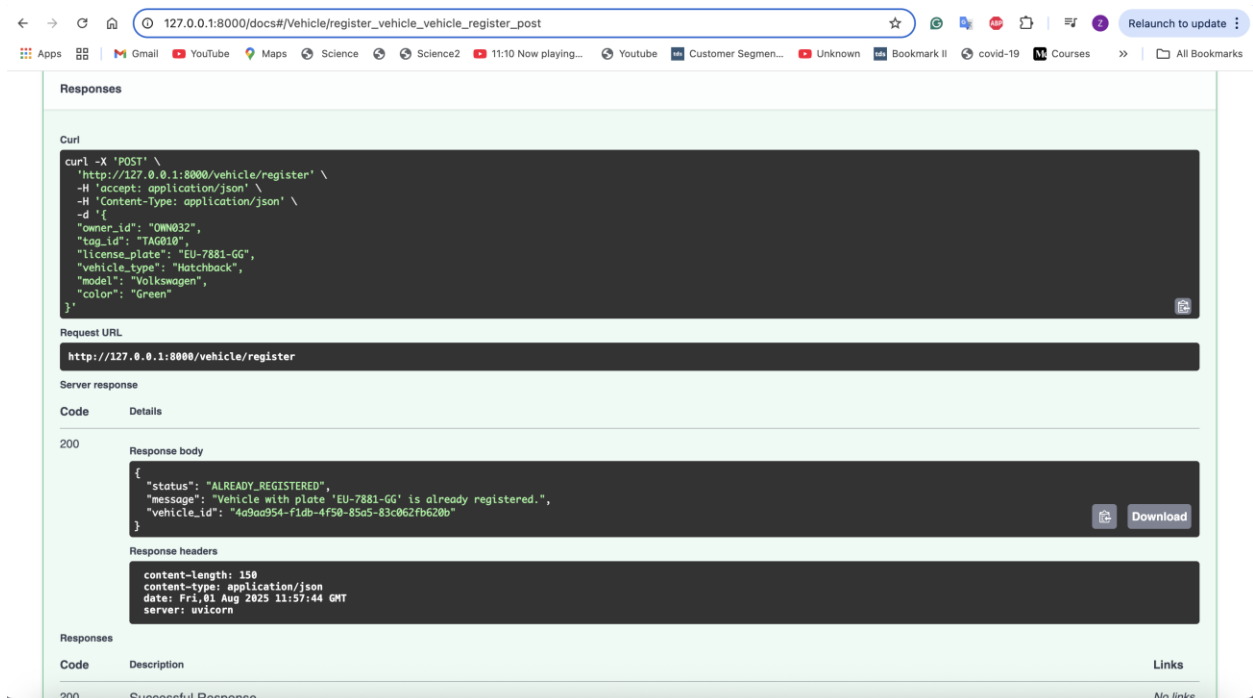


Figure 6: Response Returned for Existing License Plate

Use-Case 2: Assignment of Tag: Part A: Assigning New Tag for Registered Vehicle

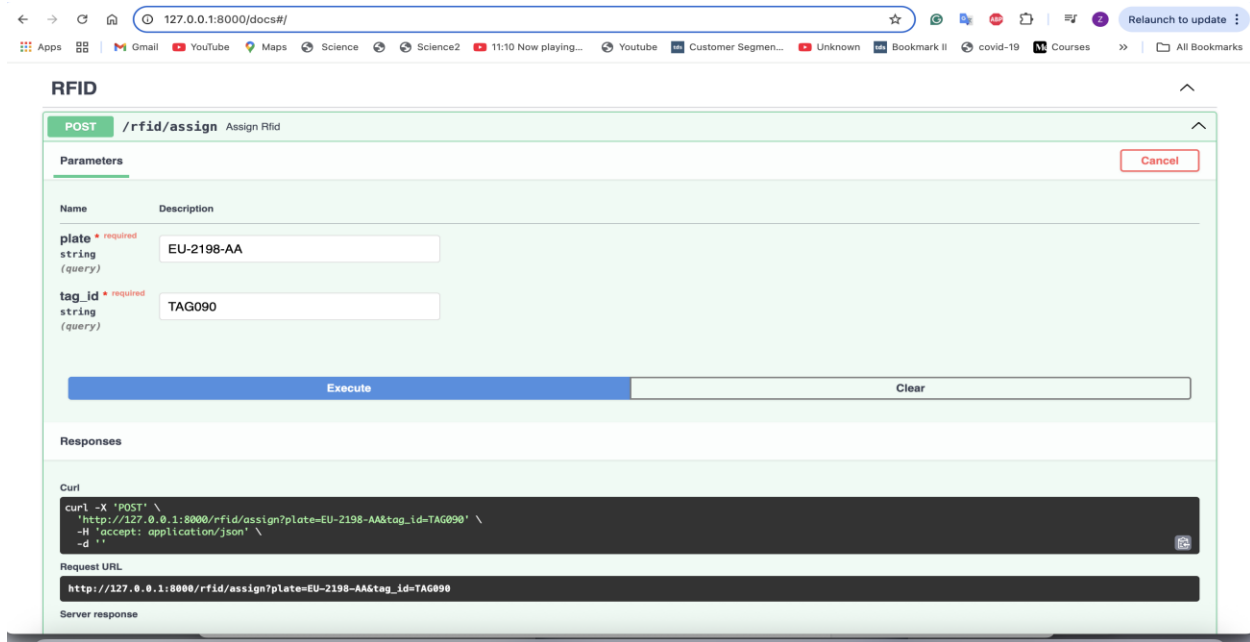


Figure 7: Tag Assignment for Licensed Vehicles Normal Condition

Response

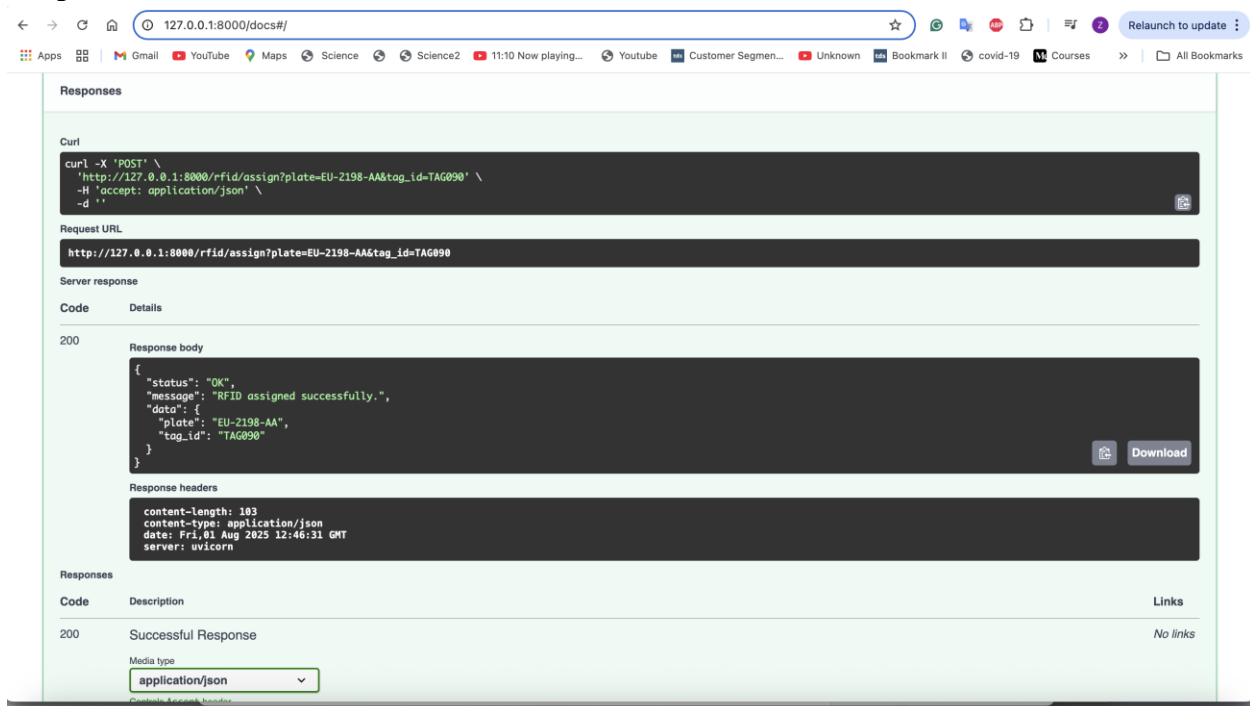


Figure 8: Response for a successful registration for Tag

Part B:

Assigning Existence Tag to Vehicle:

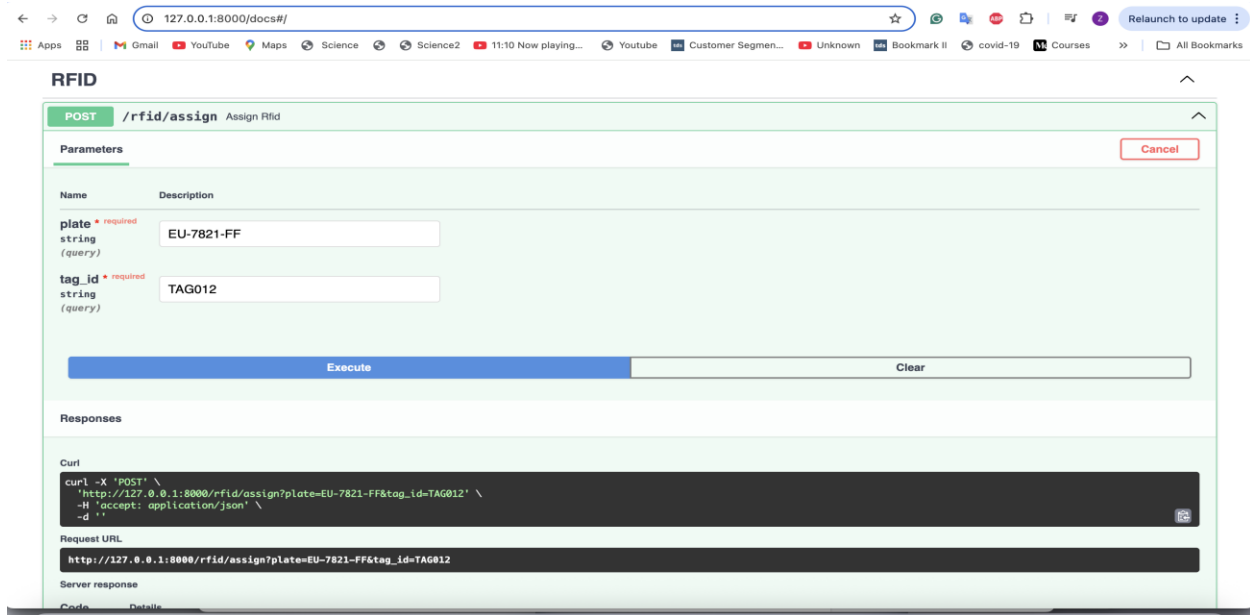


Figure 9: Assignment of Existence Tag to New Vehicle

Response:

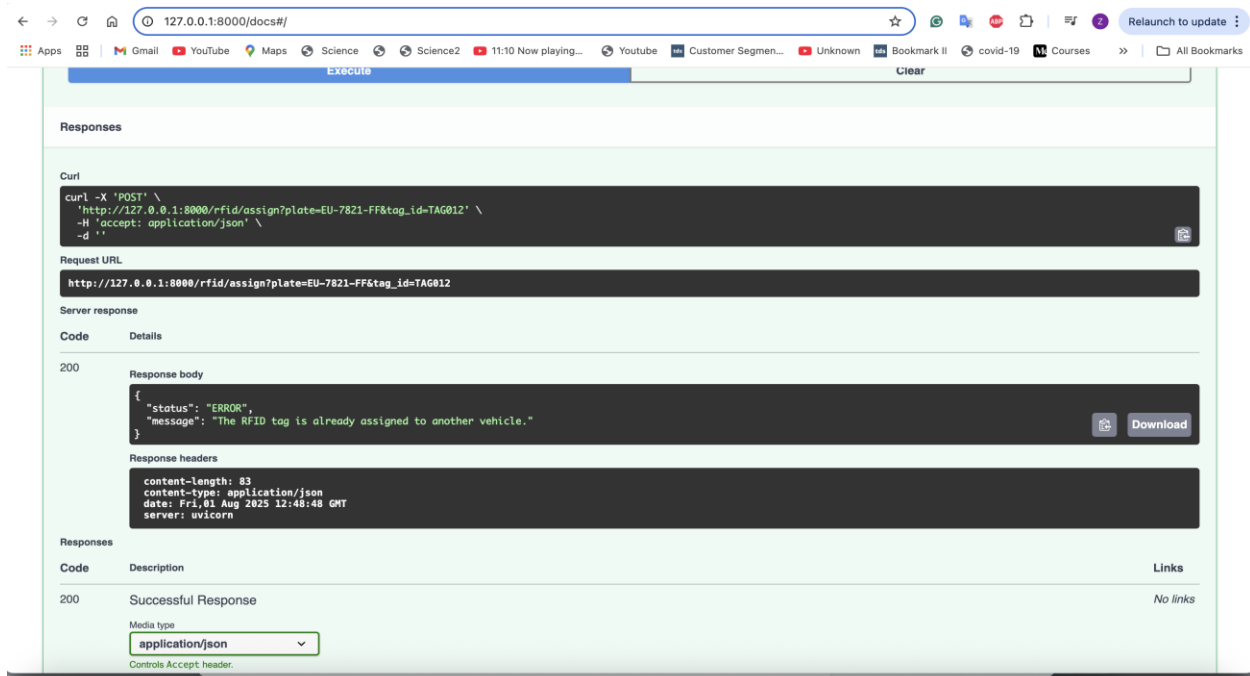


Figure 10: Response for Existing Tag

Use-Case: 3: Blacklisting RFID Tag

Part A: Normal Condition

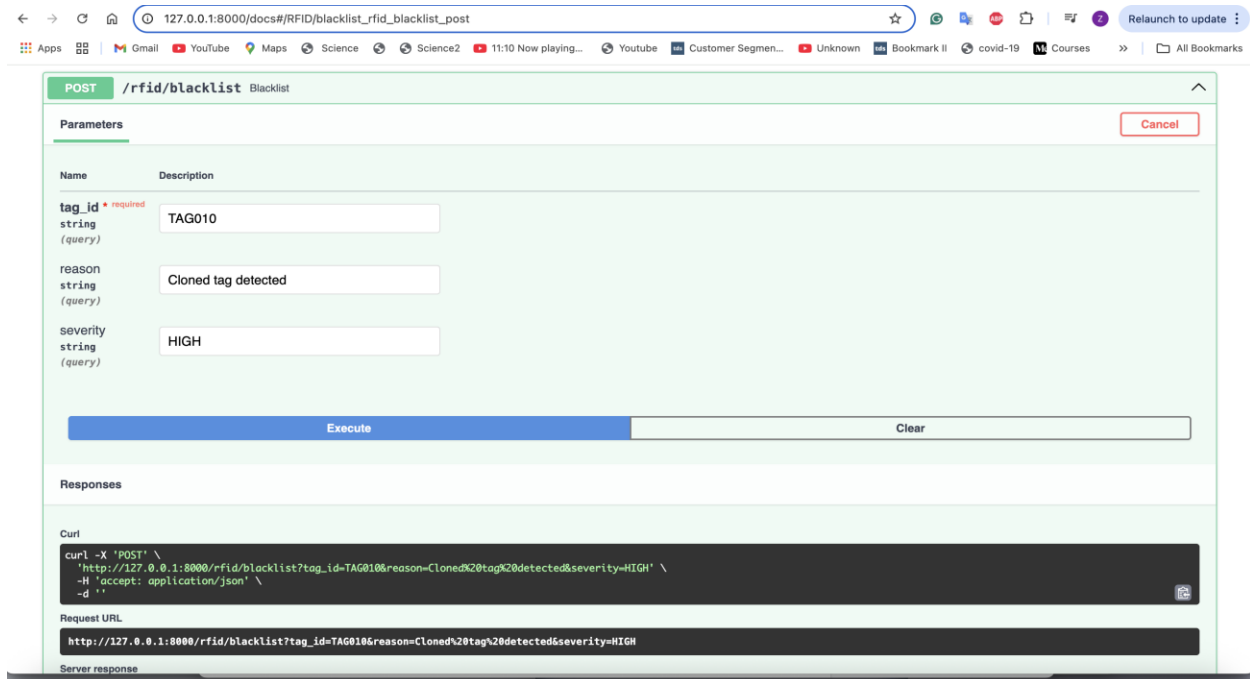


Figure 11: Blacklisting RFID Tag

Response:

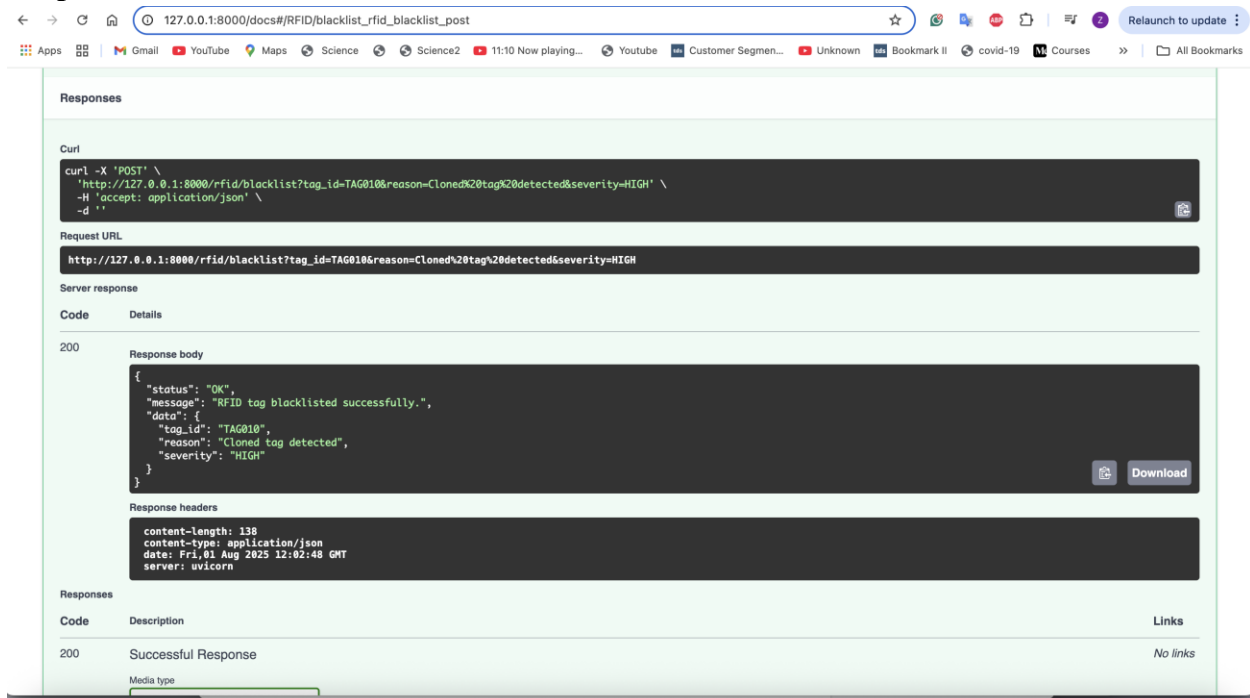


Figure 12: Response for blacklisting of Tag

Use-Case 4: Notification Checklist Part A: Only with License Plate:

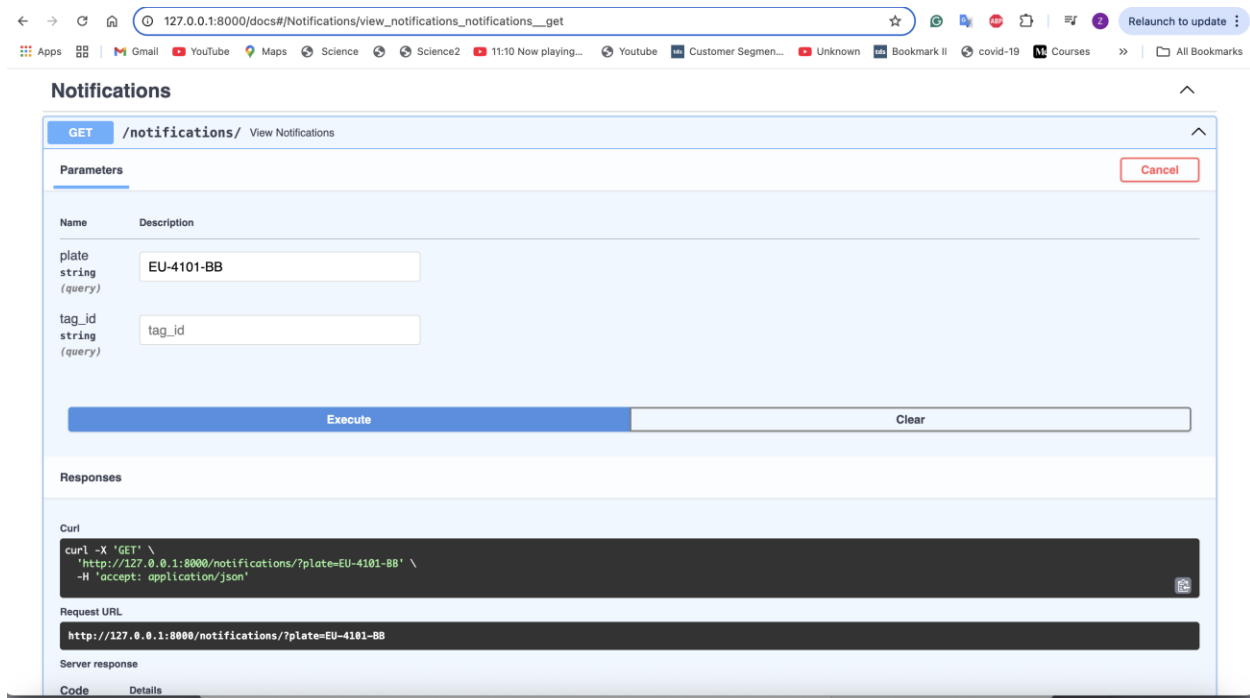


Figure 13: Checking Notifications against the License Plate

Response:

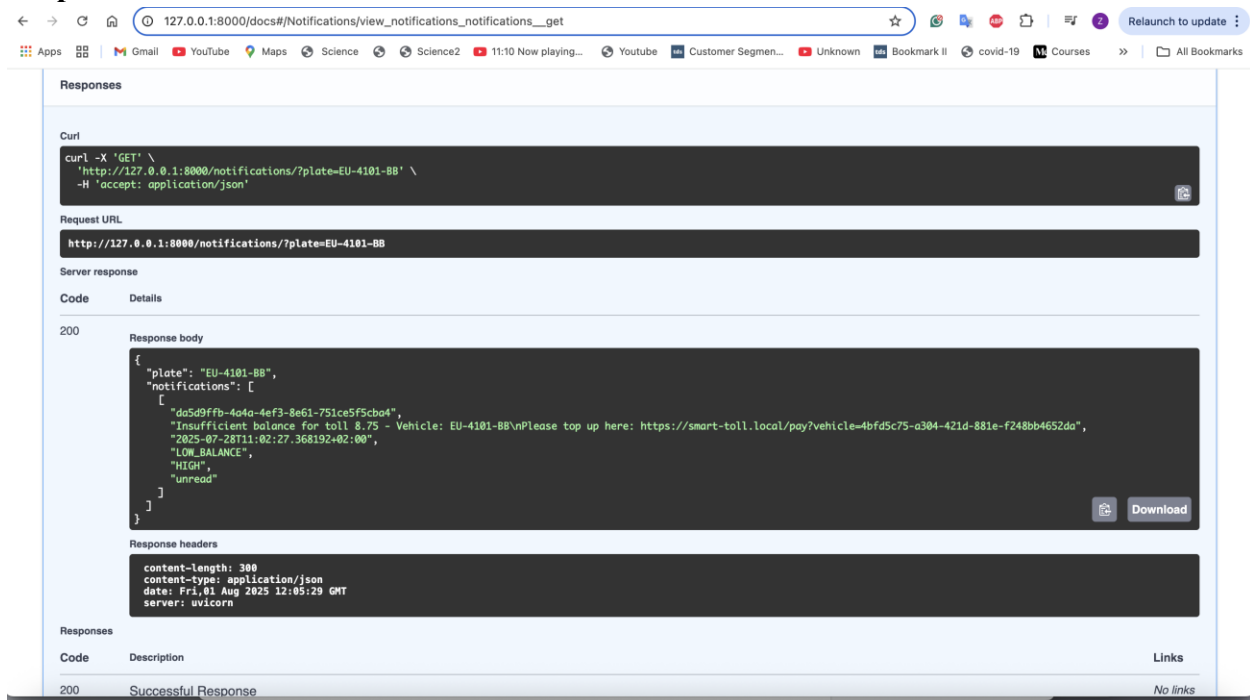


Figure 14: Response returned for notification check

Part B: With Tag only Non-Active Tag

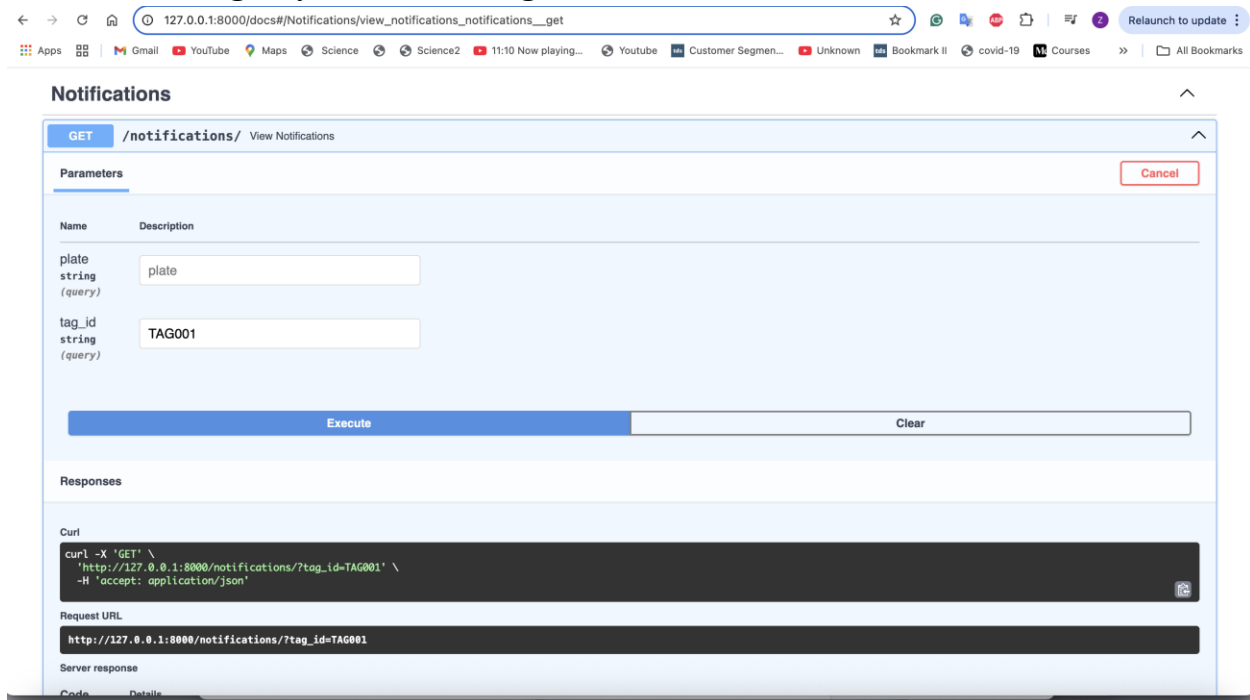


Figure 15: Notification check with Tag

Response:

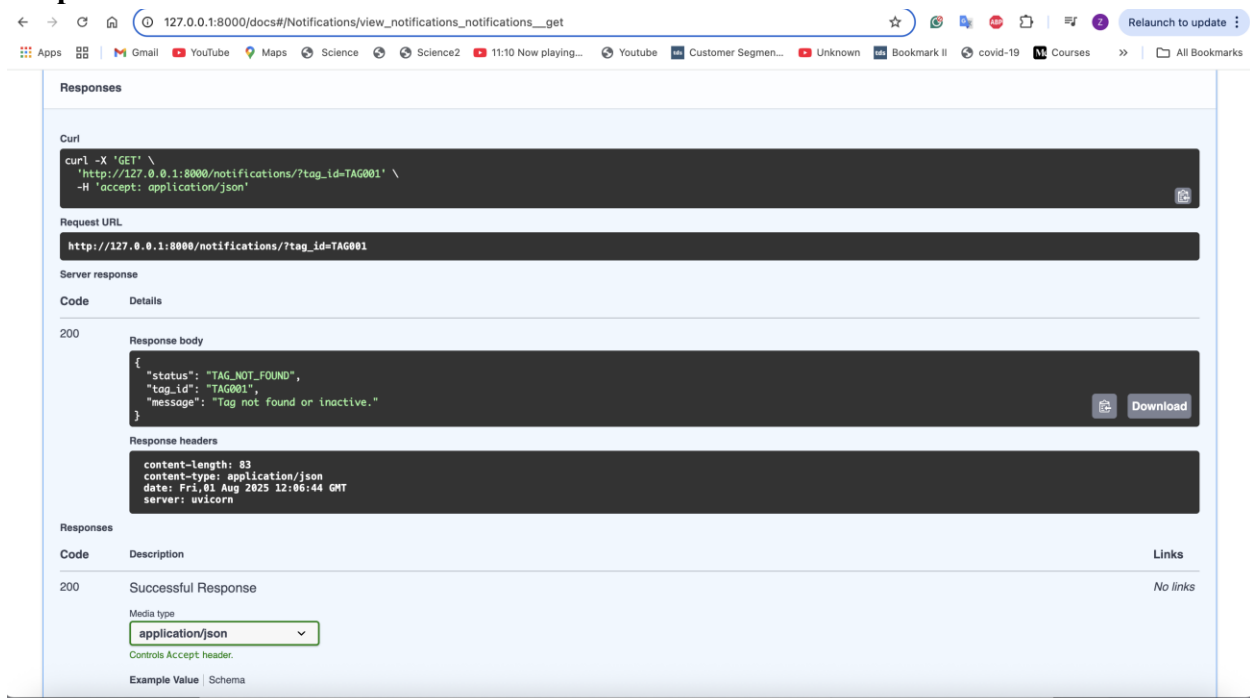


Figure 16: Response for non-registered Tag

Part C: Notifications for blacklisting Tag with Tag

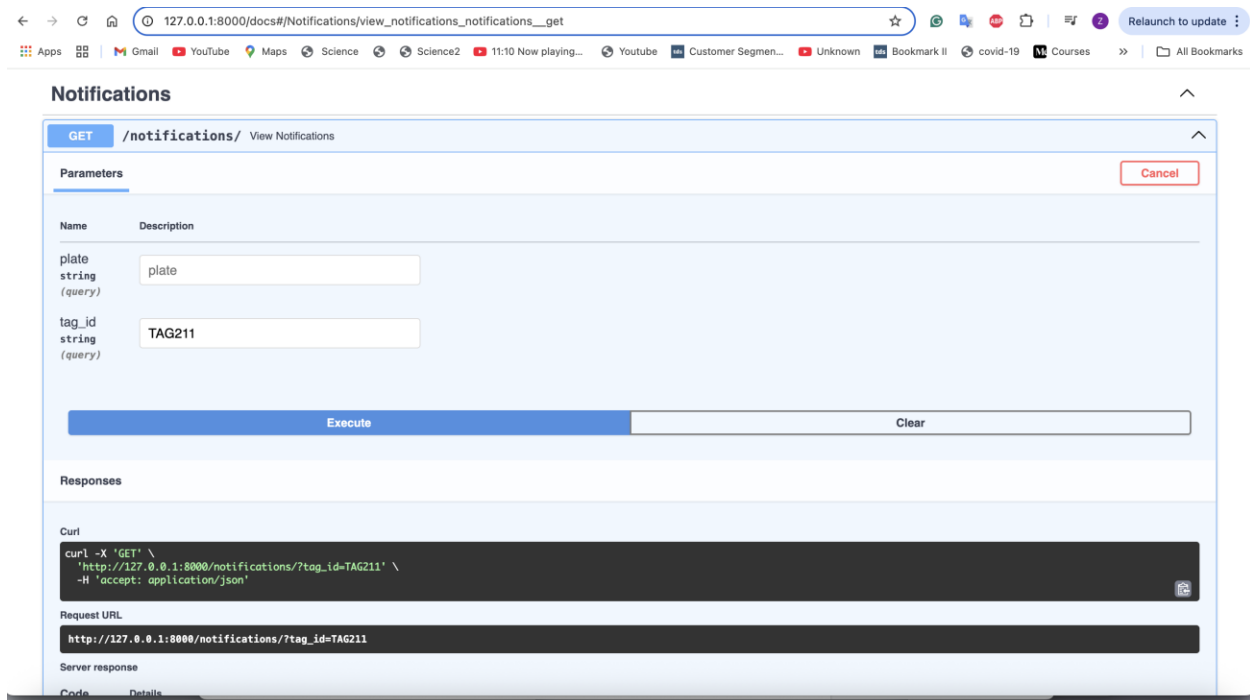


Figure 17: Blacklisted Vehicle

Response:

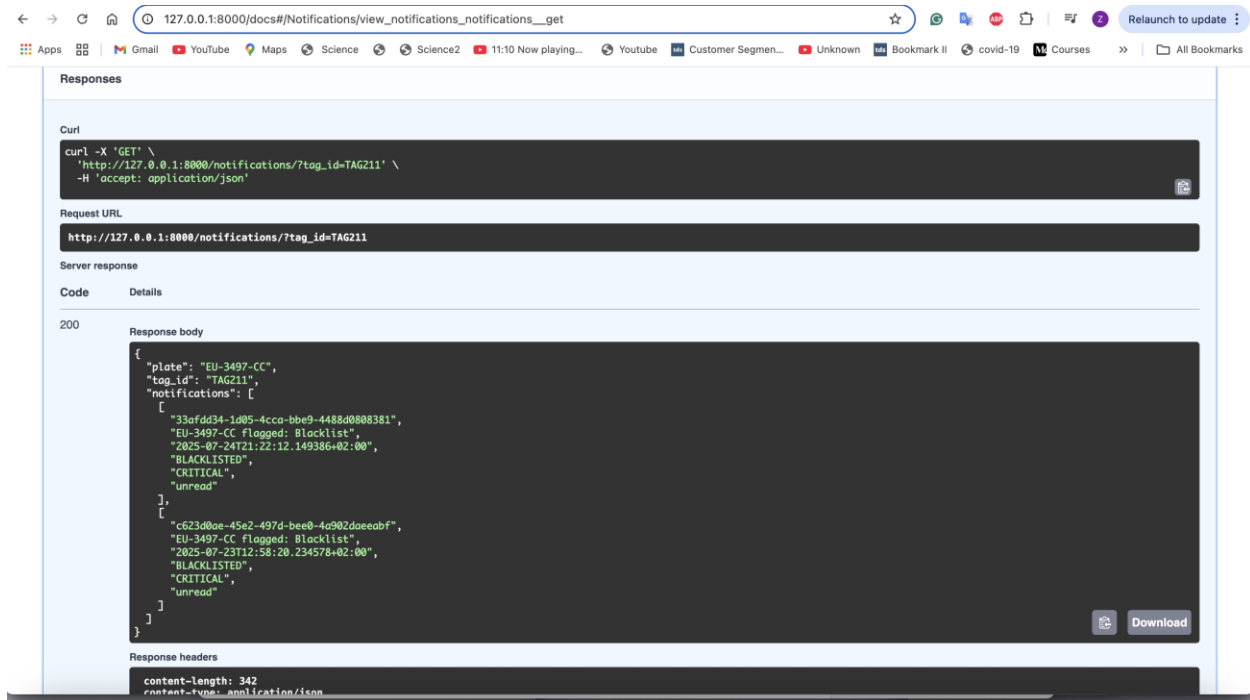


Figure 18: List of Notifications against blacklisted Tag

Part D: Low Account Balance:

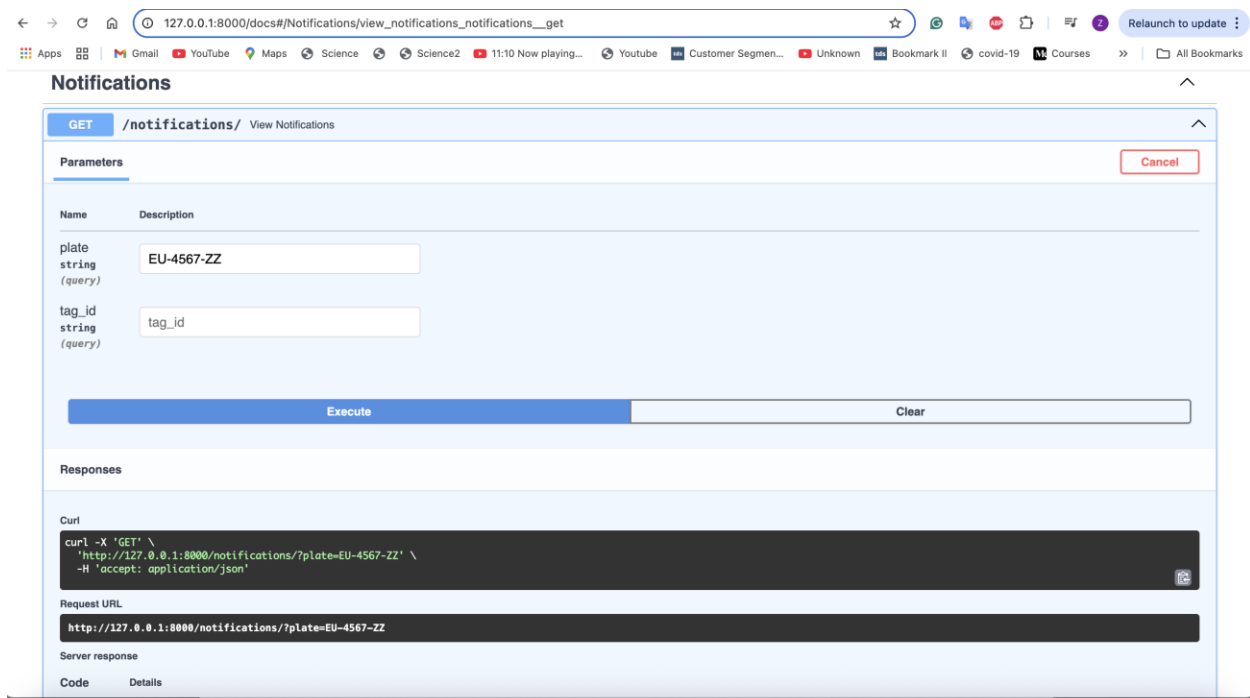


Figure 19: Notifications for Low Balance

Response: Payment Link is added to the notification

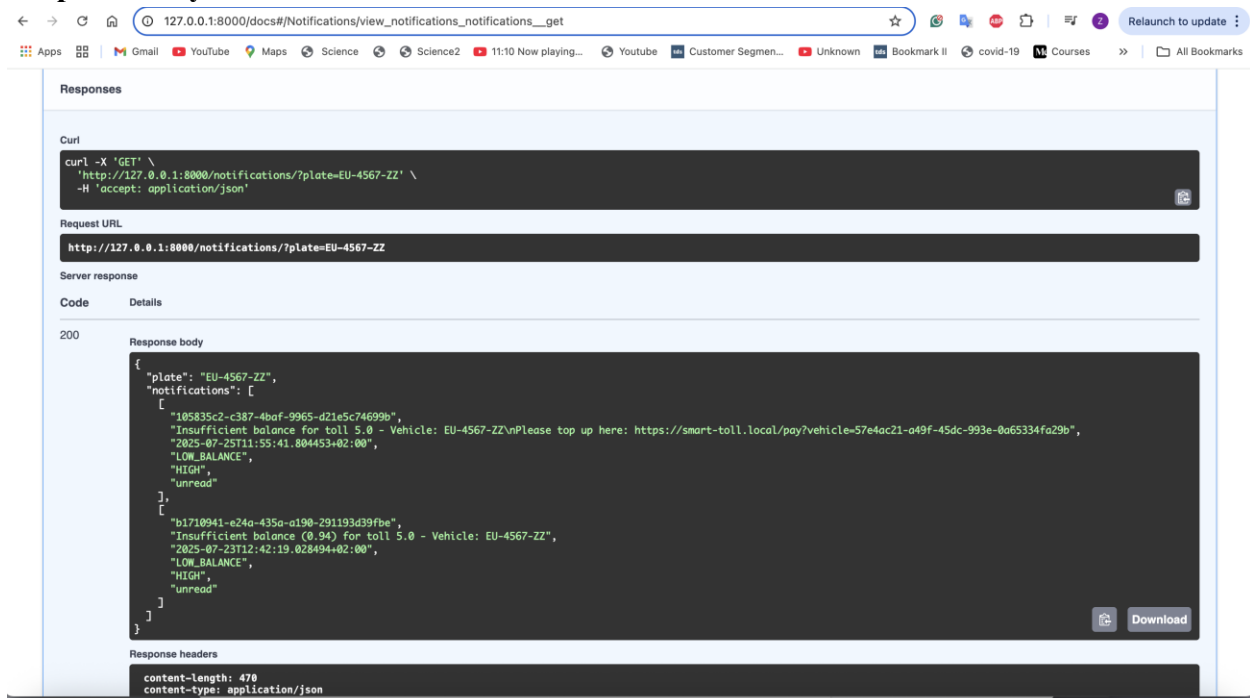


Figure 20: List of Notifications returned against low balance through vehicle (unresolved yet)
Part E: Non-Registered License Plate:

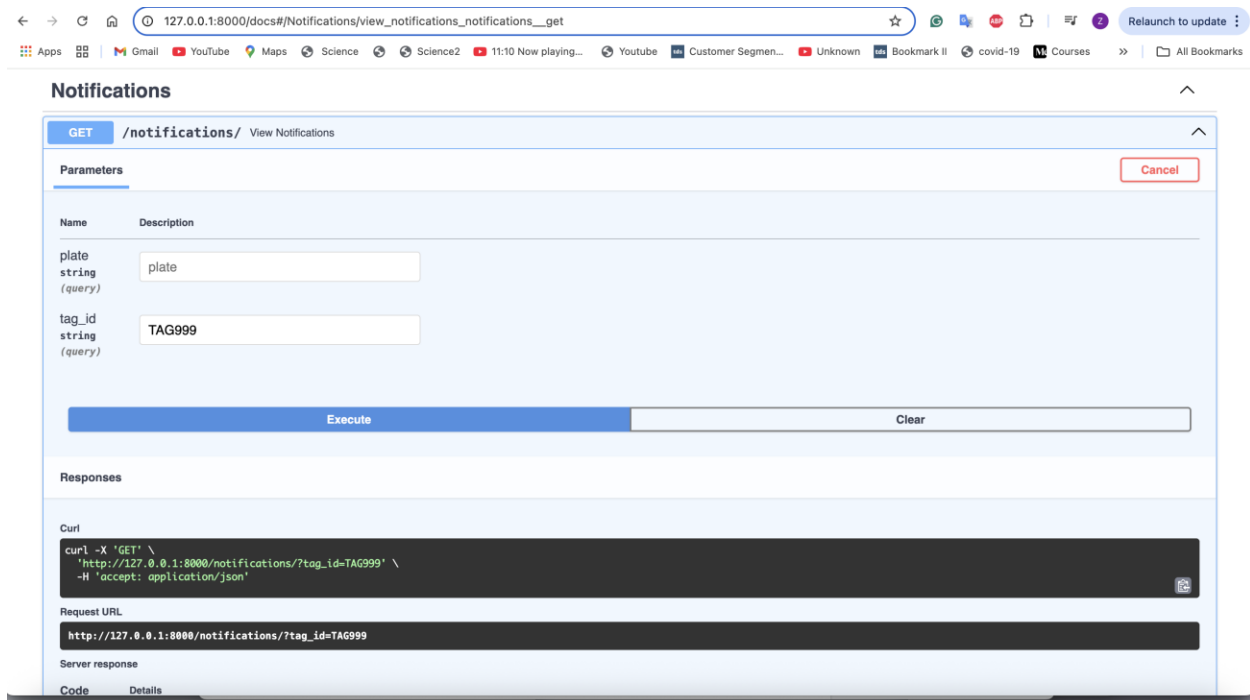


Figure 21: Non-Registered Vehicle Passed through Toll

Response:

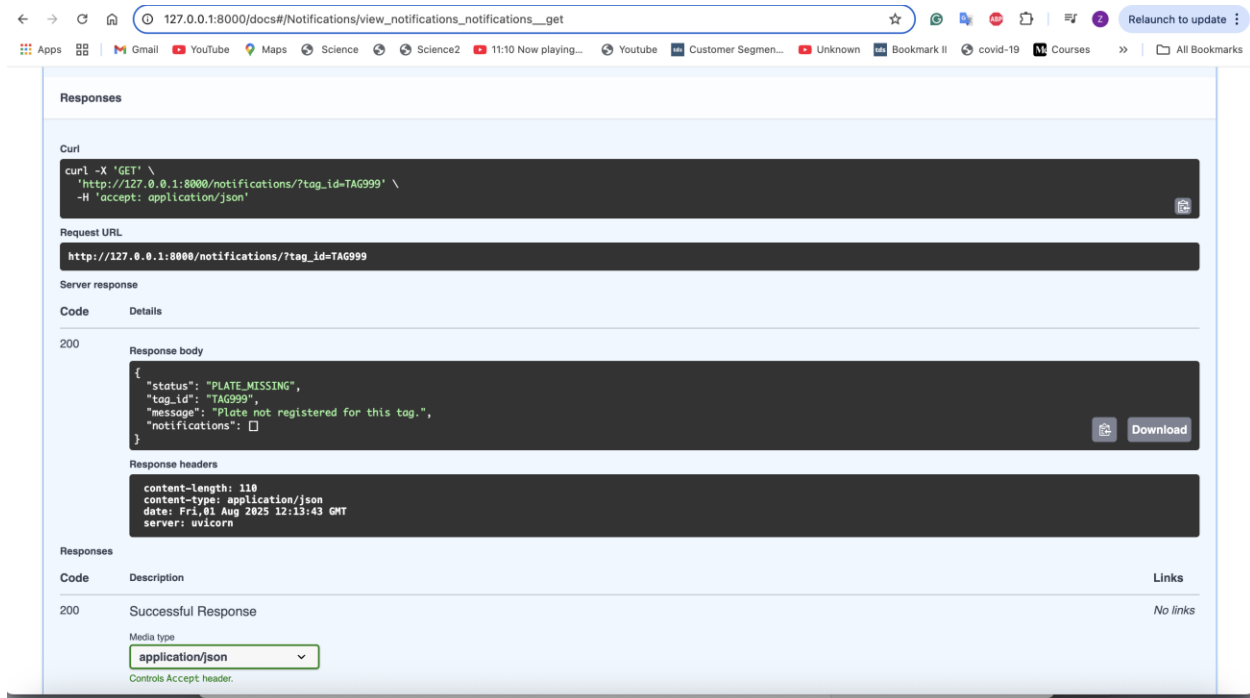


Figure 22: Notification stored for non-registered tag

Use-Case 5: Security Incidents:

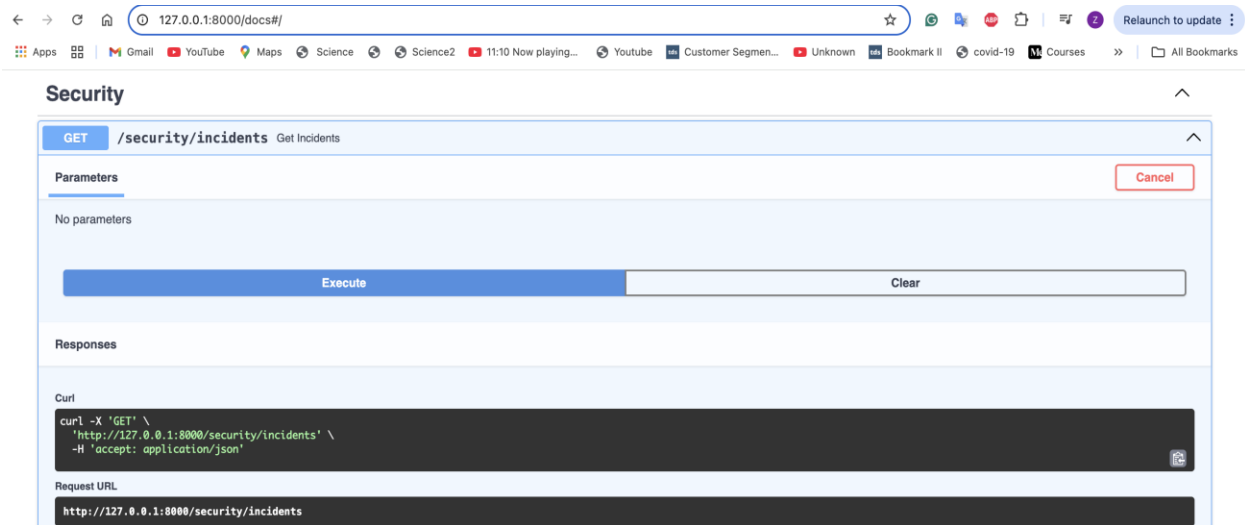


Figure 23: Security Incidents checklist (Unresolved)

Response: (Enlists All Unresolved Incidents)

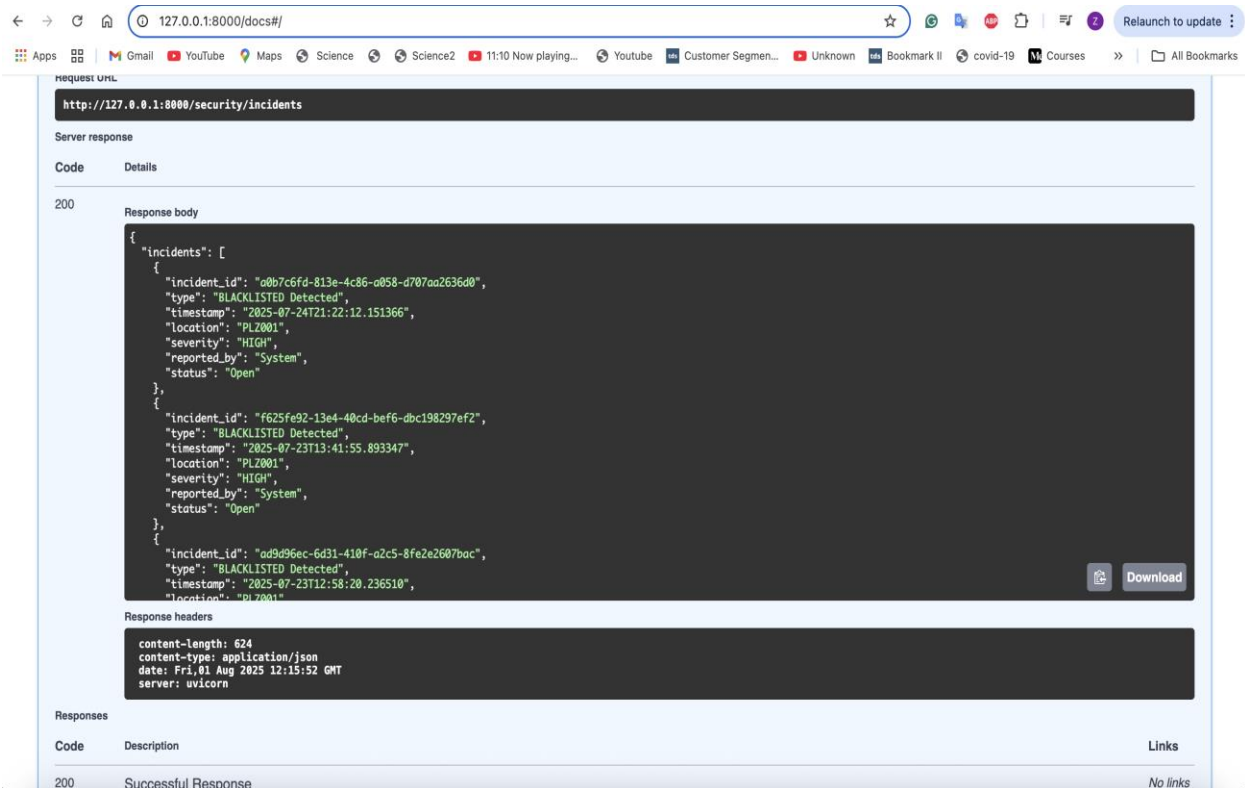


Figure 24: All Enlisted Vehicles Passed through Toll with Security Incidents

Use Case 6:

Part A: Vehicle Passing Normal Conditions

Toll

POST /toll/process Process Toll

Parameters

Name	Description
plaza_id * required string (query)	Toll plaza identifier PLZ003
license_plate string (string null) (query)	EU-2198-AA
tag_id string (string null) (query)	TAG450

Execute **Clear**

Responses

Curl

```
curl -X 'POST' \
  'http://127.0.0.1:8000/toll/process?plaza_id=PLZ003&license_plate=EU-2198-AA&tag_id=TAG450' \
  -H 'accept: application/json' \
  -d ''
```

Figure 25: Normal Vehicle Passing through Toll

Response:

Responses

Curl

```
curl -X 'POST' \
  'http://127.0.0.1:8000/toll/process?plaza_id=PLZ003&license_plate=EU-2198-AA&tag_id=TAG450' \
  -H 'accept: application/json' \
  -d ''
```

Request URL

```
http://127.0.0.1:8000/toll/process?plaza_id=PLZ003&license_plate=EU-2198-AA&tag_id=TAG450
```

Server response

Code	Details
200	<p>Response body</p> <pre>{ "status": "OK", "result": { "status": "TOLL_PAID", "amount": 6.5 } }</pre> <p>Response headers</p> <pre>content-length: 60 content-type: application/json date: Fri, 01 Aug 2025 12:35:03 GMT server: uvicorn</pre>

Responses

Code	Description	Links
200	Successful Response	No links

Media type
application/json

Controls Accept header.

Figure 26: Toll Collected for Passing Vehicle (Normal Condition)

Part B: Insufficient Balance:

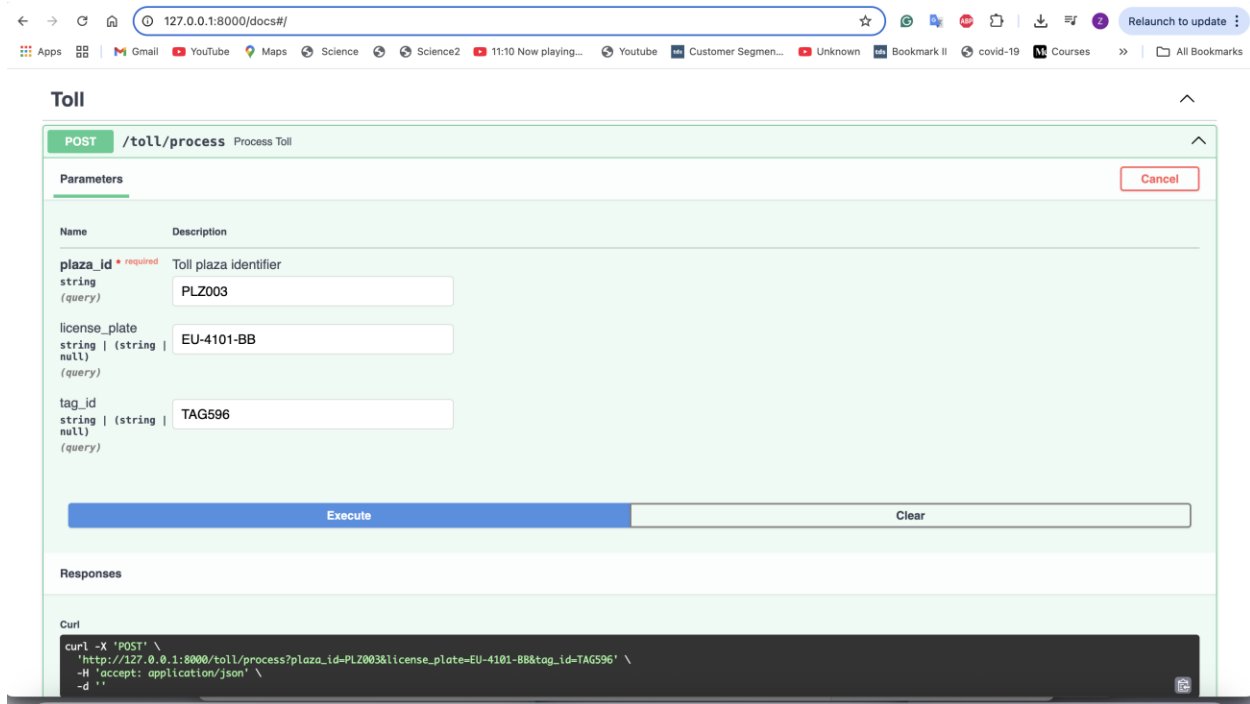


Figure 27: Vehicle Passing with insufficient account balance

Response

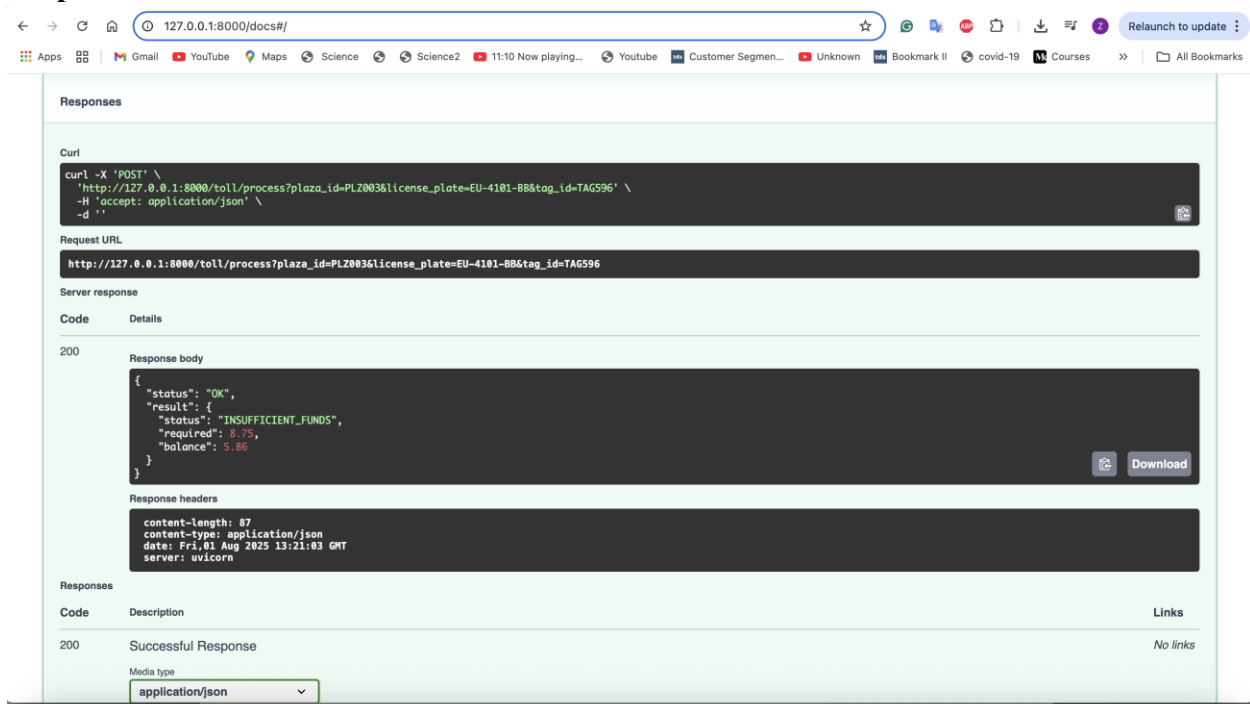


Figure 28: Response and stored notification for Insufficient balance

Part C: Tag Missing

127.0.0.1:8000/docs#/ Toll

POST /toll/process Process Toll

Parameters

Name	Description
plaza_id * required string (query)	Toll plaza identifier PLZ003
license_plate string (string null) (query)	EU-1269-BB
tag_id string (string null) (query)	tag_id

Execute Clear

Responses

Curl

```
curl -X 'POST' \
  'http://127.0.0.1:8000/toll/process?plaza_id=PLZ003&license_plate=EU-1269-BB' \
  -H 'accept: application/json' \
  -d ''
```

Figure 29: Vehicle Passed through Toll with non-registered Tag

Response:

127.0.0.1:8000/docs#/ Responses

Curl

```
curl -X 'POST' \
  'http://127.0.0.1:8000/toll/process?plaza_id=PLZ003&license_plate=EU-1269-BB' \
  -H 'accept: application/json' \
  -d ''
```

Request URL

```
http://127.0.0.1:8000/toll/process?plaza_id=PLZ003&license_plate=EU-1269-BB
```

Server response

Code	Details
200	<p>Response body</p> <pre>{ "status": "OK", "result": { "status": "TAG_MISSING" } }</pre> <p>Response headers</p> <pre>content-length: 49 content-type: application/json date: Fri, 01 Aug 2025 12:36:10 GMT server: uvicorn</pre>

Responses

Code	Description	Links
200	Successful Response	No links

Media type: application/json

Controls Accept header.

Figure 30: Response Returned along with stored notification

Part D: License Plate Missing

Toll

POST /toll/process Process Toll

Parameters

Name	Description
plaza_id * required	Toll plaza identifier
string (query)	PLZ003
license_plate	license_plate
string (string null) (query)	
tag_id	TAG999
string (string null) (query)	

Execute **Clear**

Responses

Curl

```
curl -X 'POST' \
  'http://127.0.0.1:8000/toll/process?plaza_id=PLZ003&tag_id=TAG999' \
  -H 'accept: application/json' \
  -d ''
```

Figure 31: Non-Registered/Missing Vehicle Passed through Toll

Response:

Responses

Curl

```
curl -X 'POST' \
  'http://127.0.0.1:8000/toll/process?plaza_id=PLZ003&tag_id=TAG999' \
  -H 'accept: application/json' \
  -d ''
```

Request URL

```
http://127.0.0.1:8000/toll/process?plaza_id=PLZ003&tag_id=TAG999
```

Server response

Code	Details
200	<p>Response body</p> <pre>{ "status": "OK", "result": { "status": "LICENSE_MISSING" } }</pre> <p>Response headers</p> <pre>content-length: 53 content-type: application/json date: Fri, 01 Aug 2025 12:37:53 GMT server: uvicorn</pre>

Responses

Code	Description	Links
200	Successful Response	No links

Media type: **application/json**

Controls Accept header.

Figure 32: Response for Missing License Plate

Notifications Generated While Passing Vehicles through these conditions:

245
246
247
247

```
select * from notification order by timestamp desc;
```

Data Output Messages Notifications

Showing rows: 1 to 56 Page No: 1 of 1

	notification_id [PK] uuid	message text	timestamp timestamp with time zone	type character varying	priority character	vehicle_id uuid	plaza_id character varying
1	71f2fc17-ca34-4edc-bbd5...	Insufficient balance for toll 8.75 - Vehicle: EU-4101-BB	2025-08-01 15:21:03.930425+02	LOW_BALANCE	HIGH	4bfd5c75...	PLZ003
2	62c7f8d5-828d-4e9c-aacb...	Missing license plate for tag TAG999 (Vehicle: None, white Hyundai Tucson [SUV])	2025-08-01 14:37:53.706224+02	LICENSE_MIS...	HIGH	37c2e3c5...	PLZ003
3	43a2d282-fb2f-42b3-80fa...	Missing or inactive RFID on EU-1269-BB (Vehicle: EU-1269-BB, navy Ford [SEDAN])	2025-08-01 14:36:11.484481+02	TAG_MISSING	MEDIUM	7be118dd...	PLZ003
4	8f42c90a-6701-4edc-bbd9...	Unknown vehicle EU-4454-FF	2025-07-28 12:34:31.533835+02	UNMATCHED...	HIGH	[null]	PLZ002
5	da5d9ffb-4a4a-4ef3-8e61...	Insufficient balance for toll 8.75 - Vehicle: EU-4101-BB	2025-07-28 11:02:27.368192+02	LOW_BALANCE	HIGH	4bfd5c75...	PLZ003
6	e8416b43-3ac9-4028-851...	Missing or inactive RFID on EU-5842-BB (Vehicle: EU-5842-BB, gray BMW [SUV])	2025-07-28 11:02:14.70147+02	TAG_MISSING	MEDIUM	73639e2a...	PLZ003
7	152a785a-e528-4bd3-9d7f...	Missing license plate for tag TAG999 (Vehicle: None, white Hyundai Tucson [SUV])	2025-07-25 14:55:30.110179+02	LICENSE_MIS...	HIGH	37c2e3c5...	PLZ001
8	56fb83fa-c025-4eb2-bd41...	Unknown or inactive tag TAG001	2025-07-25 14:41:24.5838+02	UNKNOWN_T...	HIGH	[null]	PLZ001
9	6e32da14-2b2d-4c93-a4f4...	Missing or inactive RFID on EU-8602-CC (Vehicle: EU-8602-CC, purple Volkswagen...)	2025-07-25 14:41:18.359337+02	TAG_MISSING	MEDIUM	5701bb85...	PLZ001

Total rows: 56 Query complete 00:00:00.061 LF Ln 251, Col 1

Figure 33: Stored Notifications for Passing Vehicles