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SITUATION-AWARE ACCESS CONTROL FOR INTELLIGENT TRANSPORTATION SYSTEMS

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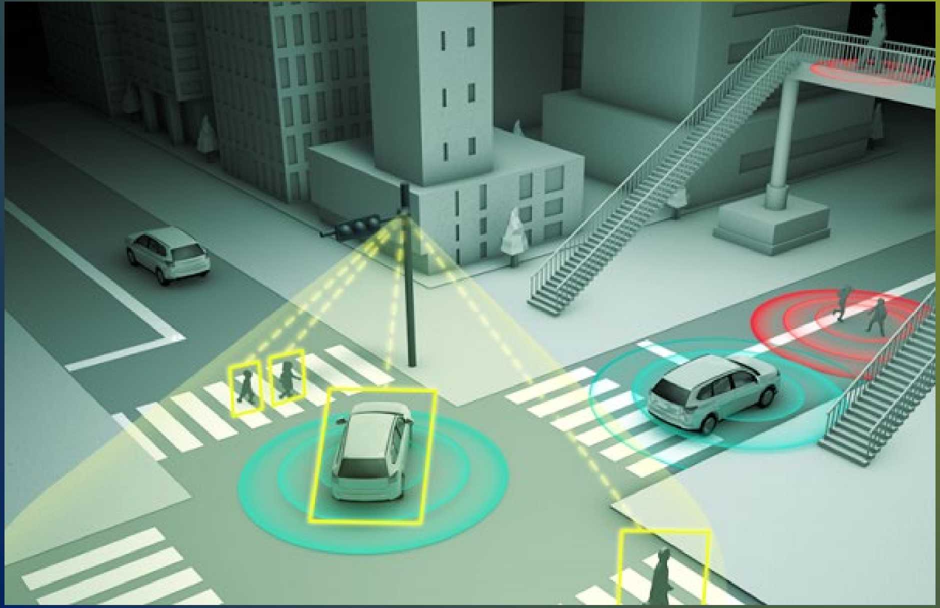
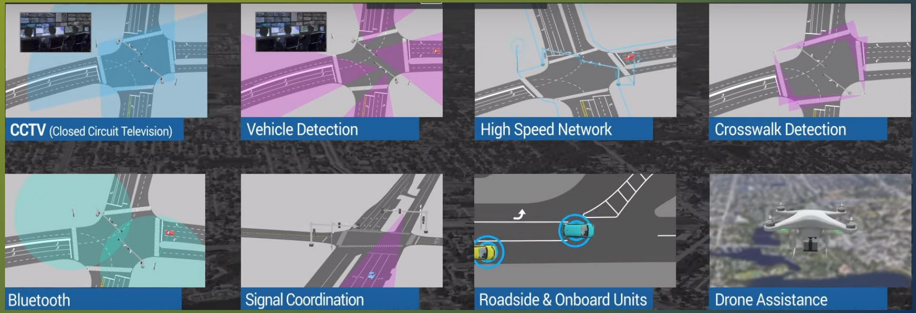
Background

- Intelligent Transportation System: ground transportation technologies





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Existing method

- The most used access control solution in ITS is role-based access control, however,
- Situation-aware access control is more appropriate for ITS because the access control decisions often depend on dynamically changing situations.
- For instance, a driver can only access availability of a parking spot when the driver's vehicle is on the associated parking lot.

Statement of the Research Problem

- To propose situation-aware access control framework for ITS
- Show that the overhead of enforcing situation-aware access control rules is acceptable.

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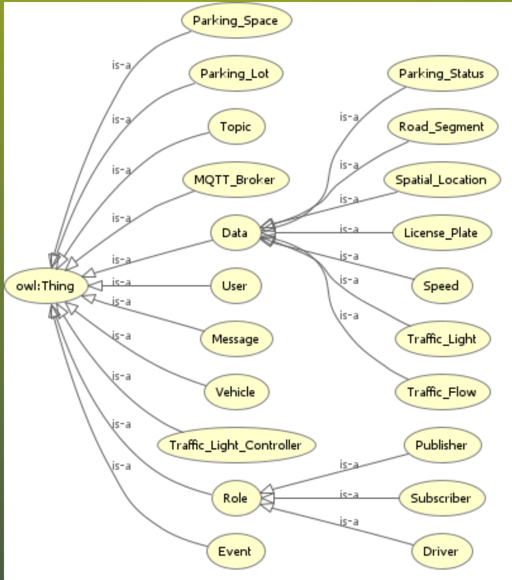
Methods/Approach

- We created an ontology for 4 ITS use cases, including major classes such as users, vehicles, infrastructure, roles, data, events, topics.
- We proposed a query rewriting method that modifies a SPARQL query over ITS data to enforce access control rules.



Methods/Approach

- We created a small TTL dataset of 157 triples then we generated more data using a python program to 1305 triples (medium dataset) and 11714 triples (large dataset).

Program to scale up data(Triples)

```
def increase_numbers_in_string(input_string):
    def increase_number(match):
        number = int(match.group(0))
        return str(number + 1)

    # Search for numbers in the input string using regular expression
    pattern = r'\d+'
    result_string = re.sub(pattern, increase_number, input_string)

    return result_string

# Test the function
test_string = "its:vehicle20  its:has  its:licence_plate20 ."
x = 0
while x < 105:
    test_string = increase_numbers_in_string(test_string)
    print(test_string)
    x+=1
```

Results/Evaluation

- **Rule 2-Smart Parking System:**

Original Query

```
Select ?status
Where {
its:parkingLot1 its:contains ?Parking_Space .
?Parking_Space its:report ?status .
}
```

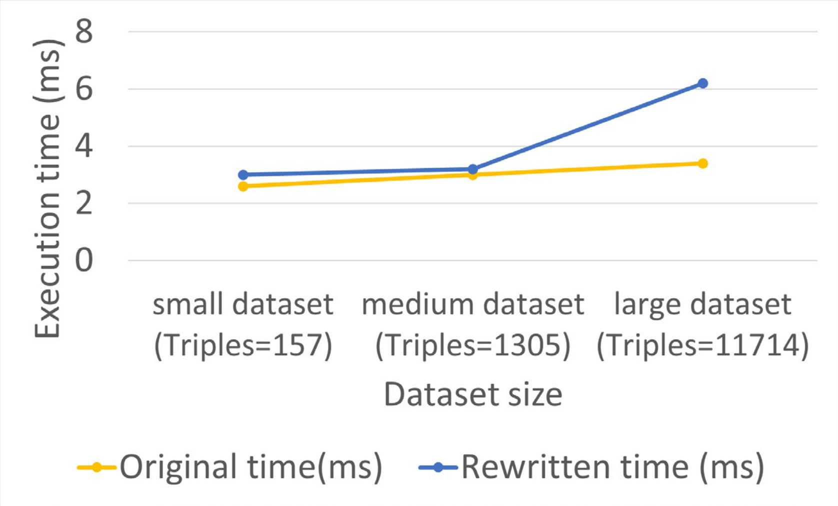
Rewritten query

```
Select ?status ?Parking_Space ?locationLot
Where {
its:user1 its:owns its:vehicle1 .
its:parkingLot1 its:contains ?Parking_Space .
?Parking_Space its:report ?status .
its:parkingLot1 its:is_at ?locationLot .
its:vehicle1 its:is_at ?locationLot .
its:user1  its:subscribes_to  its:SmartParkingTopic .
}
```

Results/Evaluation

- **Rule 2-Smart Parking System:**

SmartParkingTopic				
	Original time(ms)	Rewritten time (ms)	Original size (Triples)	Rewritten size
small dataset (Triples=157)	2.6	3	5	5
medium dataset (Triples=1305)	3	3.2	5	5
large dataset (Triples=11714)	3.4	6.2	50	50



0.35% percentage differerence

Results/Evaluation

- **Rule 4-Accident Report Event:**

Original query

```
Select ?message
where {
its:user4 its:owns ?vehicle .
?vehicle its:drives_on ?segment .
?location its:is_at ?segment .
?message its:contains ?location .
}
```

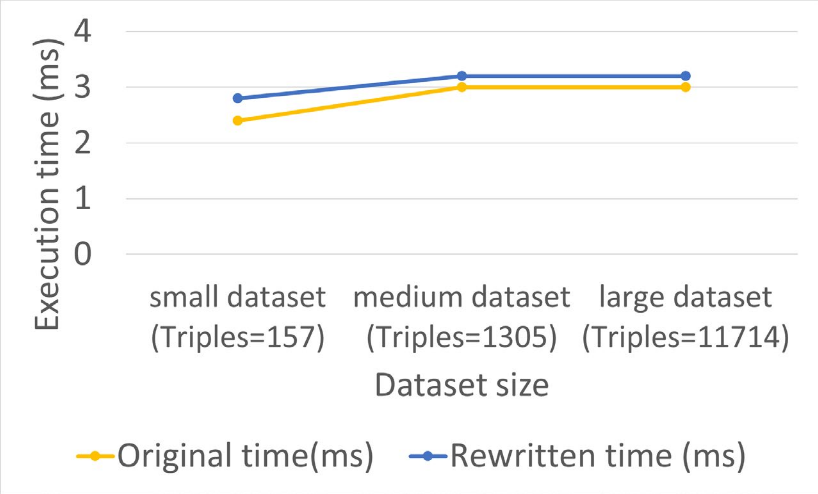
Rewritten Query

```
Select ?message ?location
where {
its:user4 its:owns ?vehicle .
?vehicle its:drives_on ?segment .
its:AccidentReport its:happens_at ?segment .
its:user4 its:subscribes_to  its:AccidentReport .
?location its:is_at ?segment .
?message its:contains ?location .
?message its:published_under its:AccidentReport .
}
```

Results/Evaluation

- **Rule 4-Accident Report Event:**

AccidentReport Event				
	Original time(ms)	Rewritten time (ms)	Original size (Triples)	Rewritten size
small dataset (Triples=157)	2.4	2.8	1	1
medium dataset (Triples=1305)	3	3.2	2	2
large dataset (Triples=11714)	3	3.2	9	9



0.1% percentage differeence

Conclusion

- The overhead of enforcing access control rules ranges from 0-0.65% over 4 test queries
- Overhead varies by queries, data sizes, result sizes.

Future Work

Use reinforcement learning to dynamically adjust access control, e.g., to block a user who keeps posting inaccurate messages.

Reference

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