Developing an edge computing platform for real-time descriptive analytics

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People in Motion

Outline

- Introduction
- Related work
- Edge analytics platform
- Results and Discussion
- Conclusion and Future research

Introduction

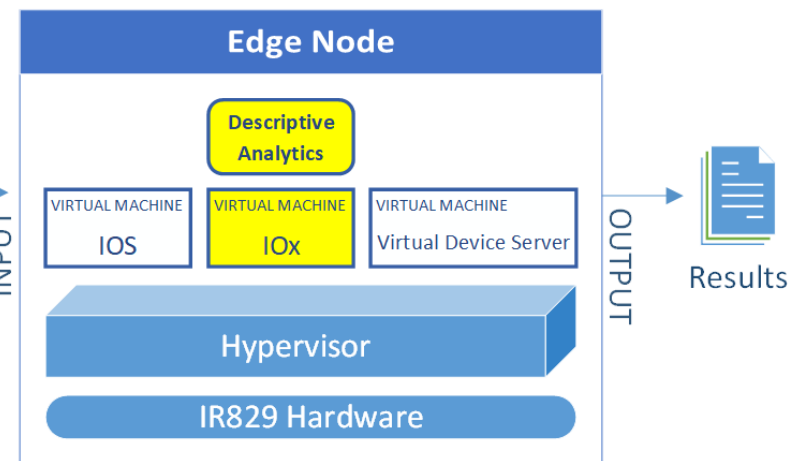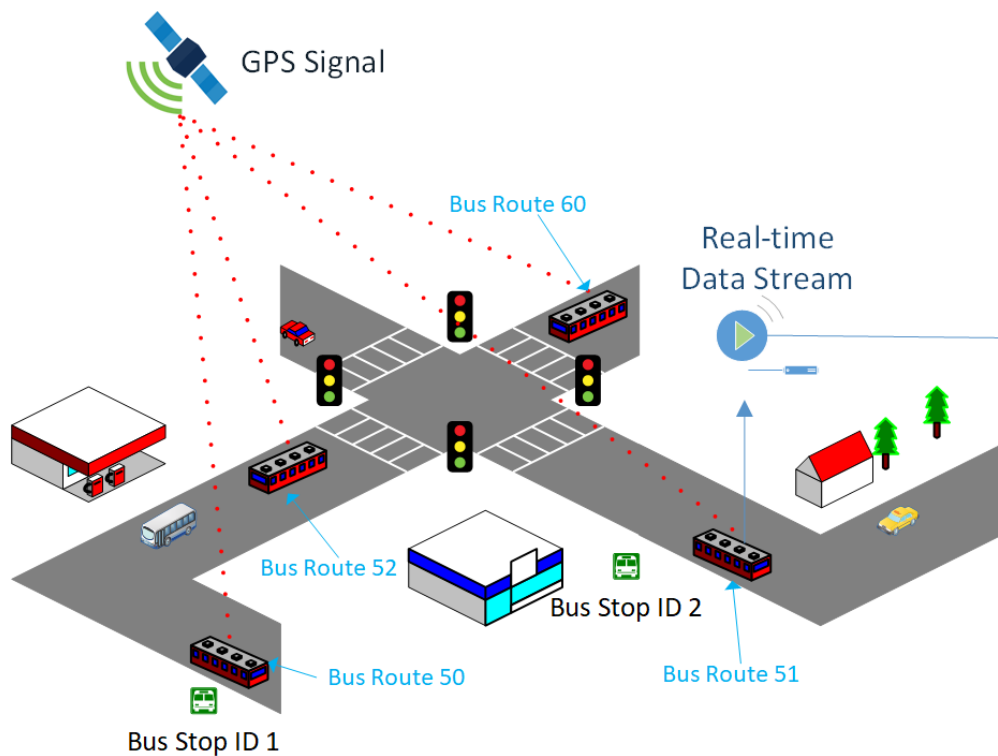Data streams generated by the Internet of Mobile Things (IoMT) poses several challenges

1 The harsh **communication** environment inside and/or outside a moving vehicle.

2 V2V, V2X connectivity are stringently dependent on **latency** and **reliability** for controlling and monitoring purposes.

3 Mobility applications require **seamlessly computation**, **storage**, and **connection** services over a **vast geographical area.**

4 Data streams might be **unbounded**, **noisy**, and **incomplete.**

Related work

	Fog computing	Mobile Edge Computing	Mobile Cloud Computing
Owned & Managed by	Any (Mobile Network Provider, Cloud Service Provider, Organizations, Individuals)	Mobile Network Provider	Private Organization, Individuals
Target Users	Any user	Available to mobile users	Specific users
Network Access	Any short and long range networks	Mobile networks	Any short range networks
Geo-distribution	Any location	Co-located with base station	Static location (data center, cloudlet)
Computing Environment	Indoor / Outdoor	Indoor / Outdoor	Indoor
Computing and Storage Capability	Yes	Yes	Yes
Latency (Delay)	Low latency	Low latency	Ranges from low latency to high latency
Edge Analytics	Not deployed yet	Not deployed yet	Edge Analytics [21]

Edge Analytics Platform

GPS Signal

Bus Route 60

Real-time
Data Stream

Bus Route 52

Bus Stop ID 2

Bus Route 50

Bus Route 51

Bus Stop ID 1

Edge Node

Descriptive Analytics

INPUT

VIRTUAL MACHINE
IOS

VIRTUAL MACHINE
IOx

VIRTUAL MACHINE
Virtual Device Server

OUTPUT

Hypervisor

IR829 Hardware

Results

Edge Analytics Platform (Cont)

A. Real-time Data Streaming

This transit data streams consist of a sequence T_1, ..., T_n of tuples containing attributes in the format:

$$T_i = (S_i, x_i, y_i, t_i)$$

where

S_i: is a set of attributes containing telemetry data;

x_i, y_i, t_i: are the geographical coordinates x_i, y_i of the device at the sampling time t_i.

Edge Analytics Platform (Cont)

B. Mobile Edge Node

Cisco IR829 Industrial Integrated Services Router:

Edge Analytics Platform (Cont)

C. Data Pre-Processing at the Mobile Edge Node

(1)missing tuples

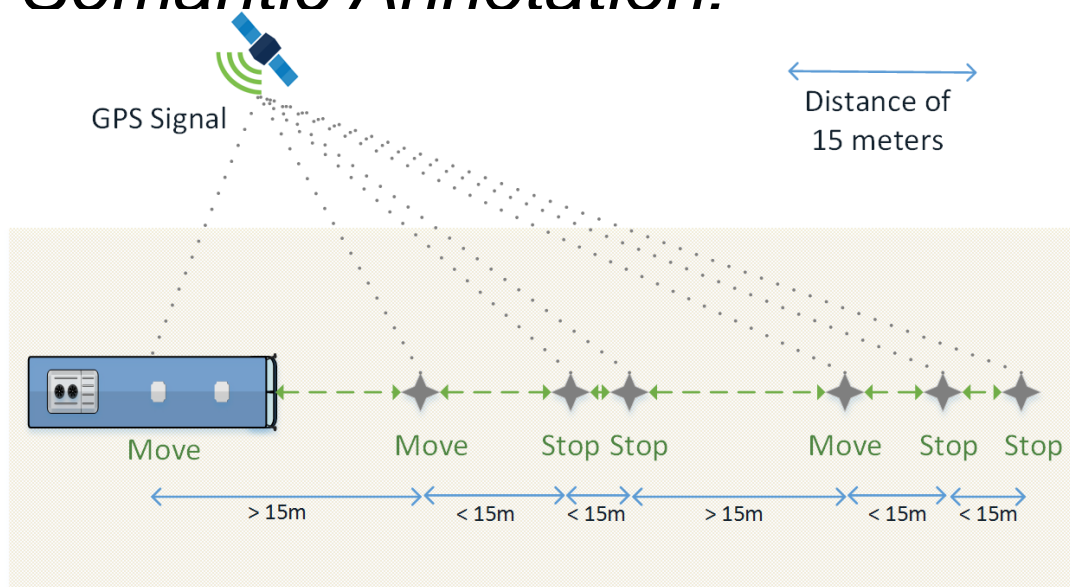*(2)duplicated tuples*

(3)missing attribute values

(4)redundant attributes

(5)wrong attribute values

Edge Analytics Platform (Cont)

D. Descriptive Analytics at the Mobile Edge Node

Task 1 - Semantic Annotation:

Edge Analytics Platform (Cont)

D. Descriptive Analytics at the Mobile Edge Node

Task 2 - Temporal Aggregation: At the end of each trip, this task computes

- the actual duration and length of the trip
- the total number of stops
- the total number of moves

Task 3 – Summary Function: It is used to compute the average trip time in the morning (5h-12h), afternoon (13h-18h), and evening (19h-24h).
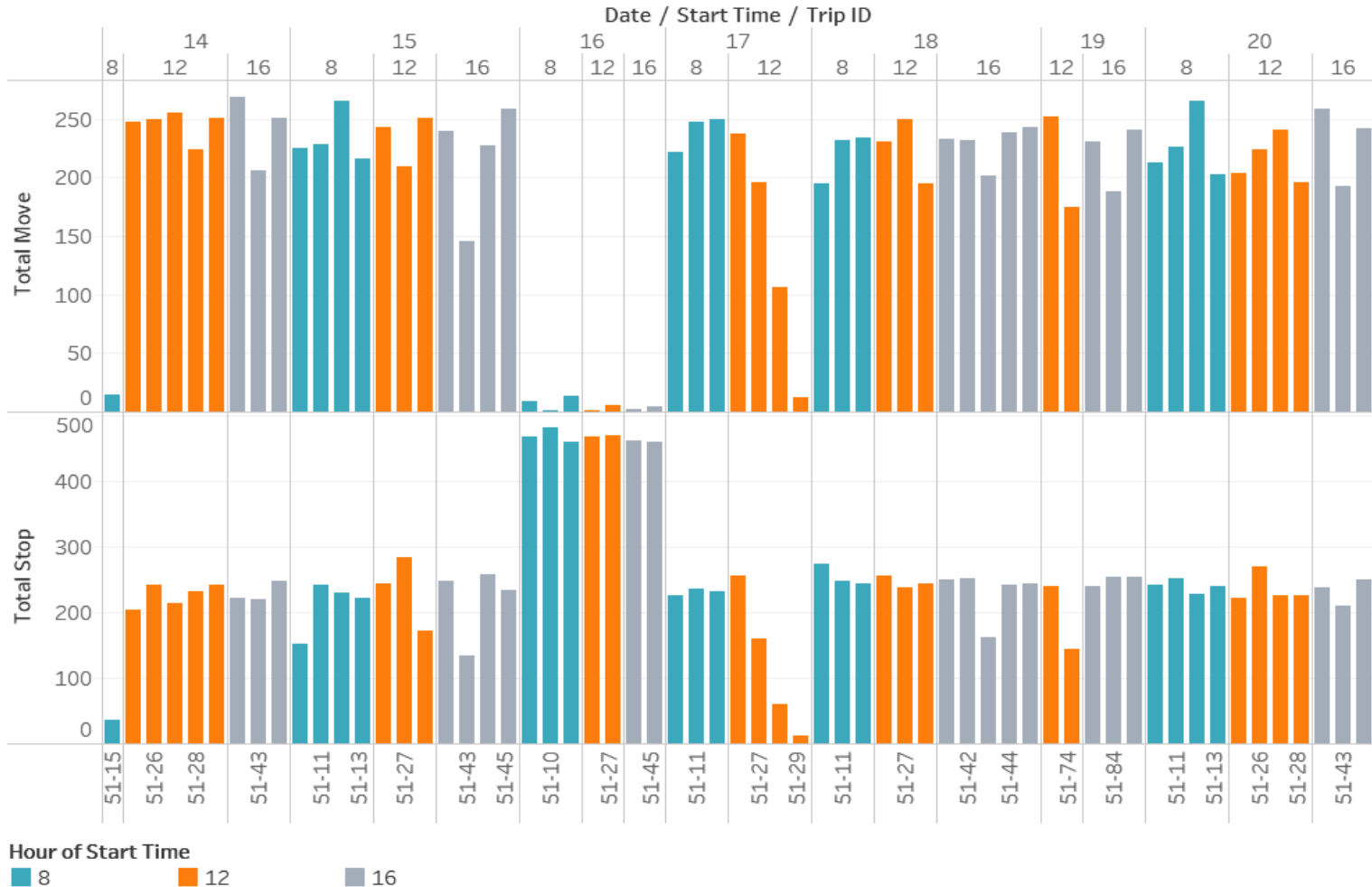
Results and Discussion

Results for Task 2 – Temporal Aggregation

Results and Discussion

Results for Task 2 – Moves/Stops Aggregation

Results and Discussion

OVERVIEW OF DESCRIPTIVE STATISTICS FOR TASK 3 – SUMMARY FUNCTION

		Date						
	Period	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Average Trip Time (Seconds)	Morning	3,056	2,559	2,563	2,562	2,561	2,400	2,551
	Evening	2,393	2,390	2,691		2,443		2,395
	Afternoon	2,693	2,693	2,691		2,693	2,532	2,692
Average Number of Moves	Morning	70	218	10	216	214	191	215
	Evening	224	208	7		224		203
	Afternoon	234	211	2		227	214	218
Average Number of Stops	Morning	288	225	440	221	234	214	231
	Evening	210	222	473		204		221
	Afternoon	229	233	460		230	218	238

Conclusions

- Our experiment has demonstrated the potential of applying edge descriptive analytics for monitoring one bus route.

- However, the proposed edge computing platform supports the scalability to an entire transit system.

- It also paves the way to developing new analytical services at the edge network in the near future in order to solve the challenge of fast-growing data produced by the edge devices and sensors.

- Potential of applying our edge analytical platform in other applications such as autonomous vehicles, smart intersections, and smart traffic light systems

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