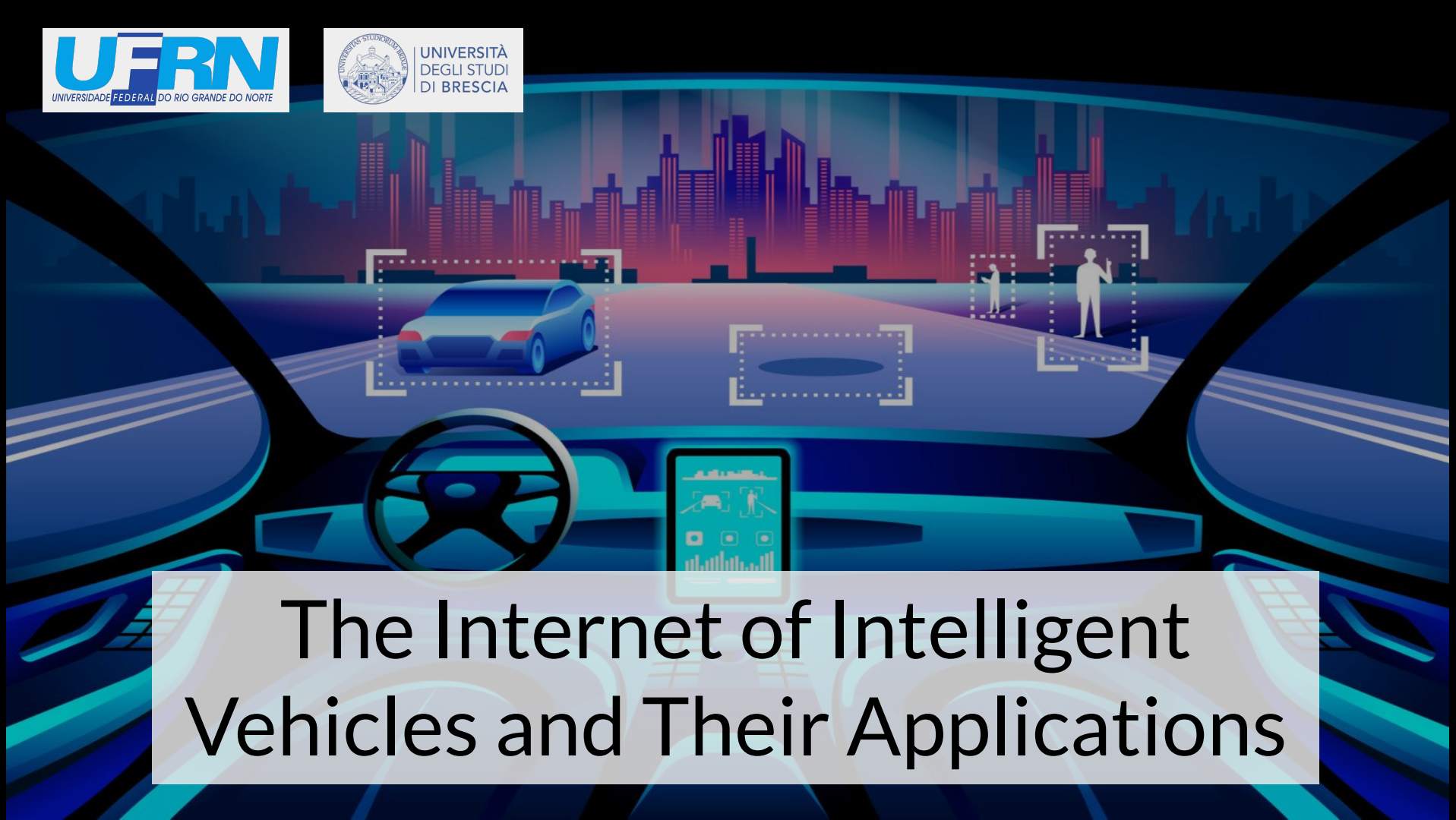


The Internet of Intelligent Vehicles and Their Applications

Natal-RN:

"The City of Sun"


Baffin Bay
Barents Sea
Greenland
Iceland
Sweden
Hudson Bay
United Kingdom
Poland
Ukraine
Kazakhstan
France
University of Brescia
United States
Spain
Greece
Turkey
Portugal
North Atlantic Ocean
Tunisia
Iraq
Iran
Morocco
Algeria
Libya
Egypt
Saudi Arabia
Mexico
Western Sahara
Cuba
Puerto Rico
Guatemala
7,260 km
+-14h
Mauritania
Mali
Niger
Chad
Sudan
Yemen
Gulf of Aden
Nicaragua
Burkina Faso
Ethiopia
Venezuela
Guinea
Nigeria
Guyana
Colombia
Ghana
Somalia
Suriname
Gulf of Guinea
Kenya
Ecuador
Gabon
DRC
Tanzania
Peru
Brazil
Natal
Angola
Zambia
Bolivia
Zimbabwe
Namibia
Chile
South Atlantic Ocean
South Africa
Argentina
Google

LABORATÓRIO DE INFORMÁTICA INDUSTRIAL

ivanovitch.silva@ufrn.br @ivanovitchm

UFRN
UNIVERSIDADE FEDERAL DO RIO GRANDE DO NORTE

ABOUT US

The group has expertise in software development for Industrial Automation, Internet of Things and Data-Driven solutions

The group has developed several systems in a long path which more than ten years of partnership with Petrobras

BR-AlarmExpert
Gerenciamento de alarmes

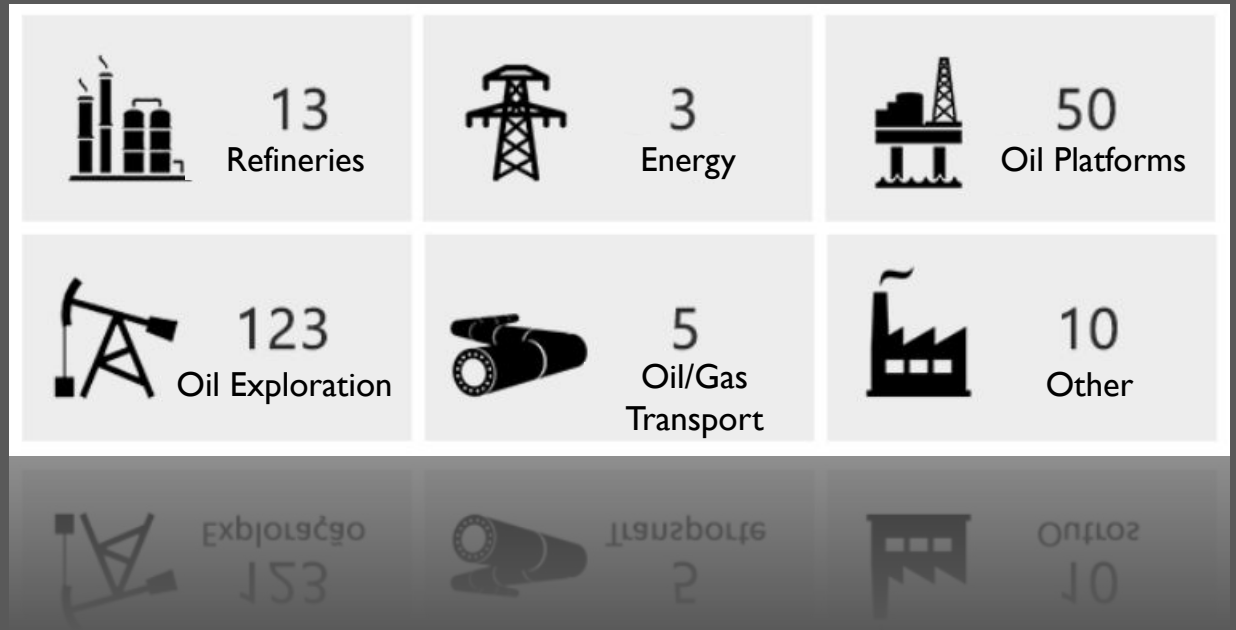
BR-PlantViewer

BR-PlantHistorian

BR-PlantExpert®

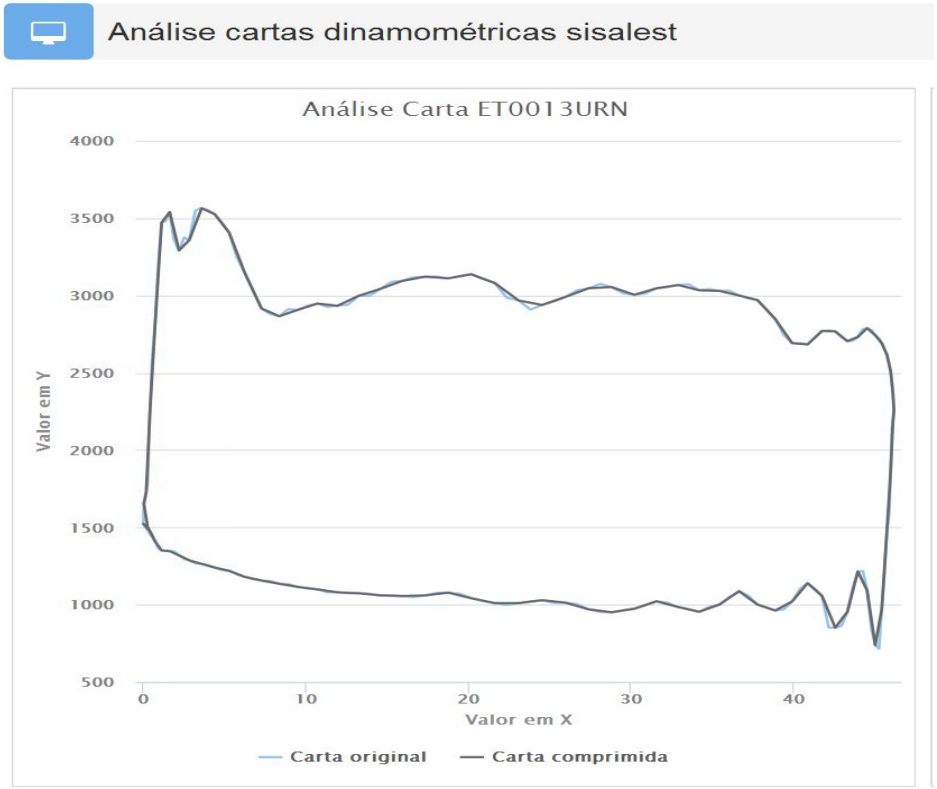
BR-AlarmExpert
Gerenciamento de alarmes

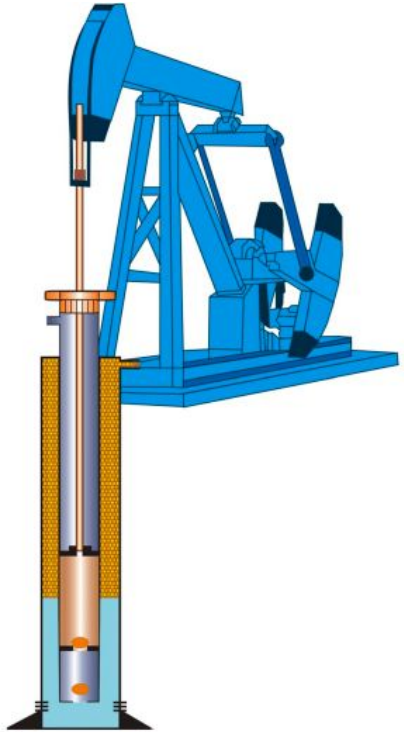
Product widely adopted by Petrobras



BR-PlantHistorian

Distributed data historian





Responsible for storing mechanical pump data from Petrobras.

Numbers

Monitors approximately 1.4 million tags corresponding to over 10 billion stored records

Inicio
Analisar Tags
Tela
Componente
Usuário
Gerenciar Grupos

Tela 2

Tela 4

Grafico Faixas
Grafico Faixas

Período 1M Todos

Componente Label 4
Program
CDM158

Componente Label 3
24.448,495 m
tag_test236

Grafico Multiplos Eixos
Grafico Multiplos Eixos

Período 1M Todos

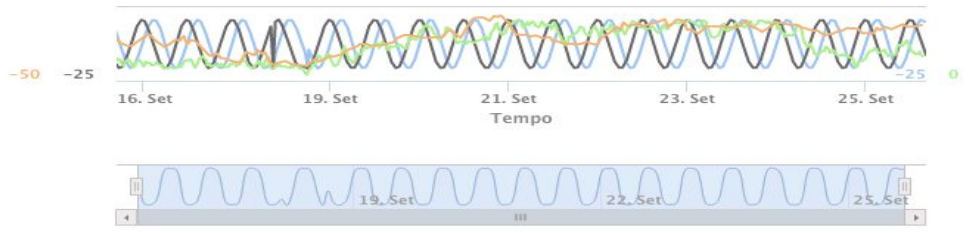
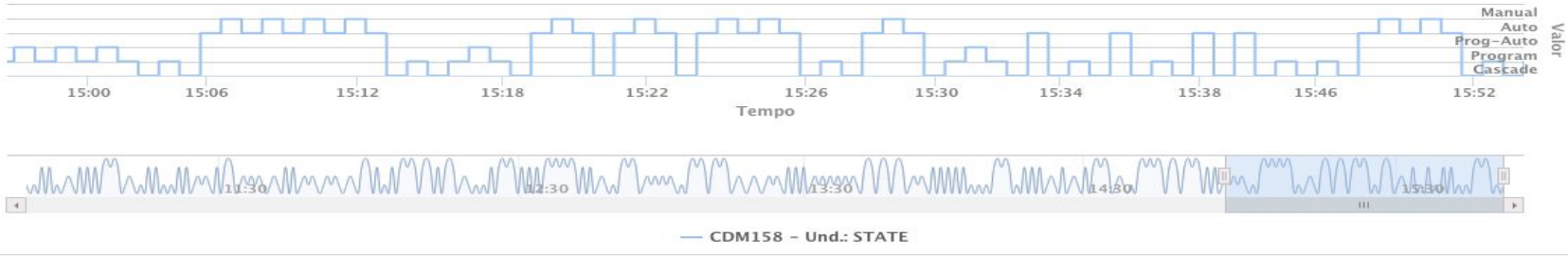


Gráfico Digital 2
Gráfico Digital 2

Período 1M Todos



BR-PlantExpert®

Automation Asset Management System

What is?

Performs asset monitoring for performance analysis.

Assets are monitored from two perspectives:

Process Safety

Losses

Monitored Assets

On-off valve

Control valve

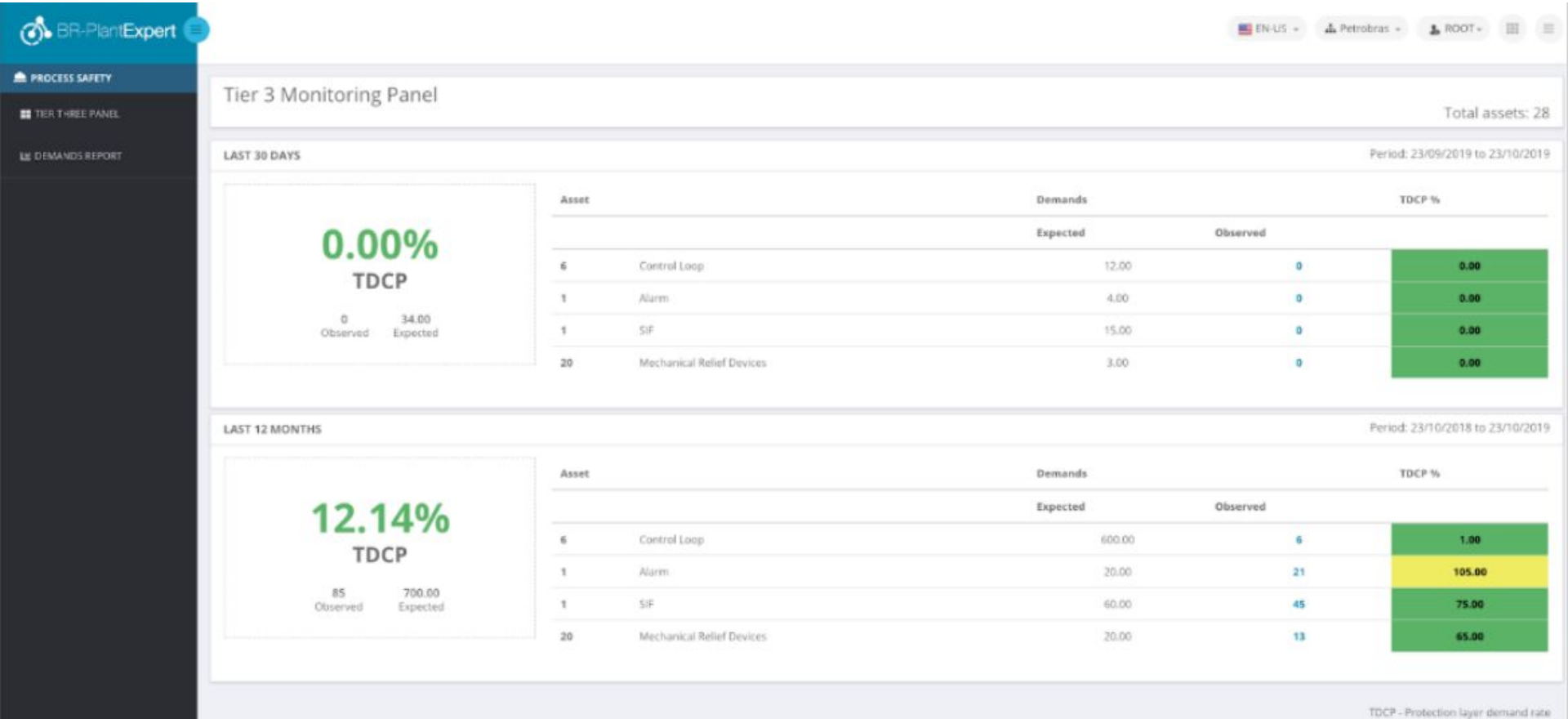
PSV

Control loop

Safety Instrumented System

Automation system

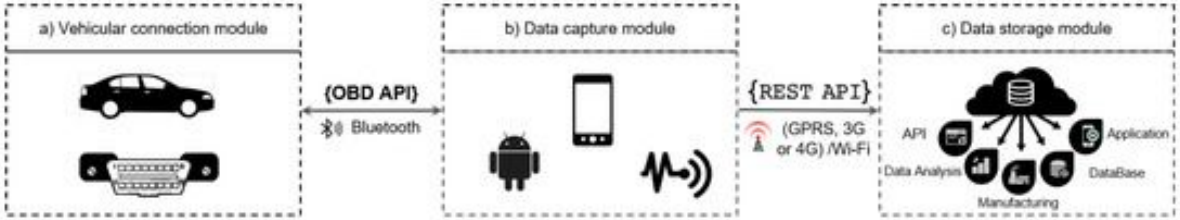
Proactive monitoring of process security layers



Losses

Performs loss inference through mathematical models.


IoT



Fleet monitoring

OBD-II raw data logging

High speed accelerometer logging

Driver Behavior

Soft Sensor

Tiny Machine Learning

Vehicle Data Analytics

#04
Elements to consider/reflect

#hardware

2010

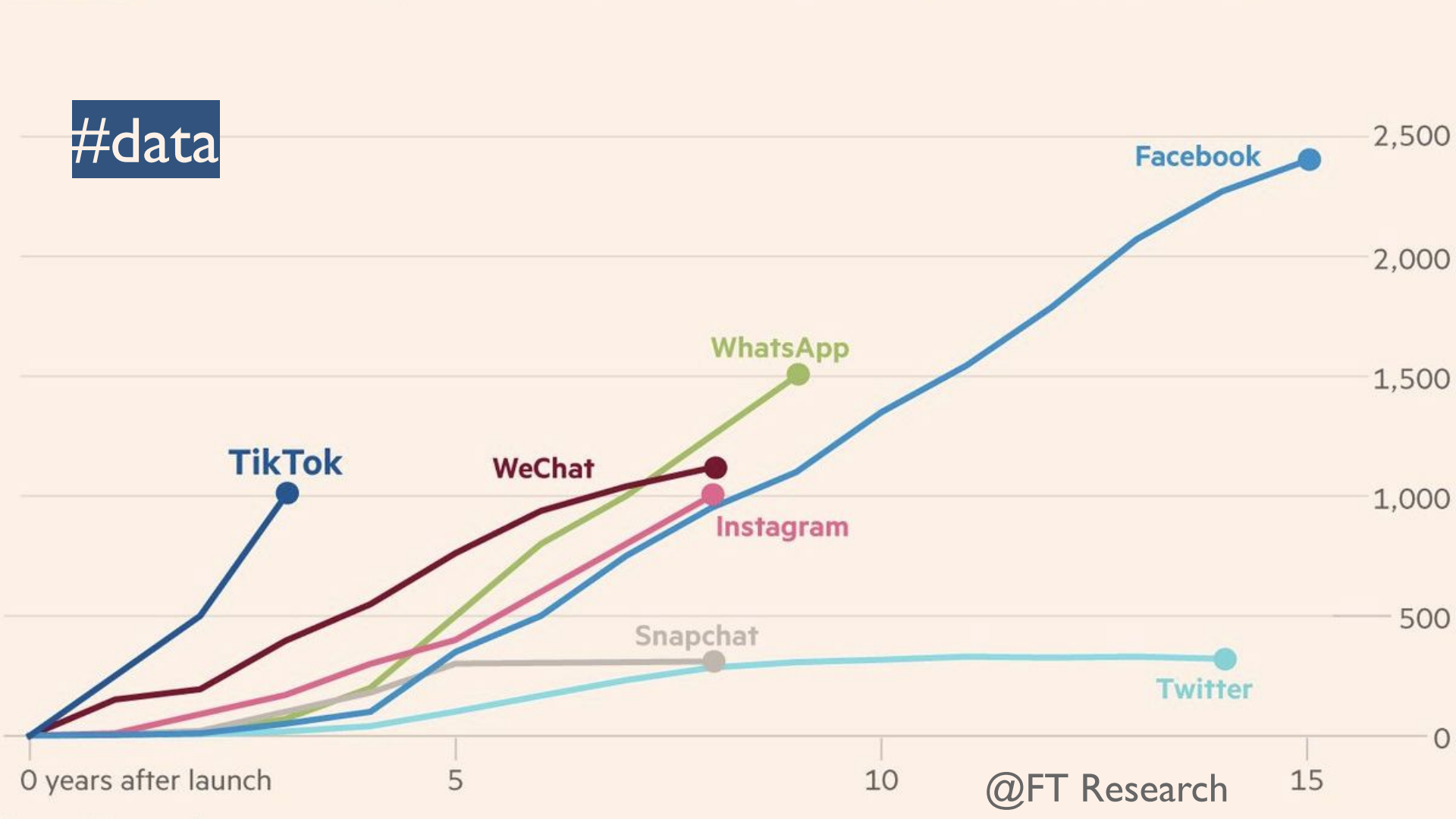
2020

#internet

1Mbps
€ 48,00
2010

100Mbps
€ 16.00
2021

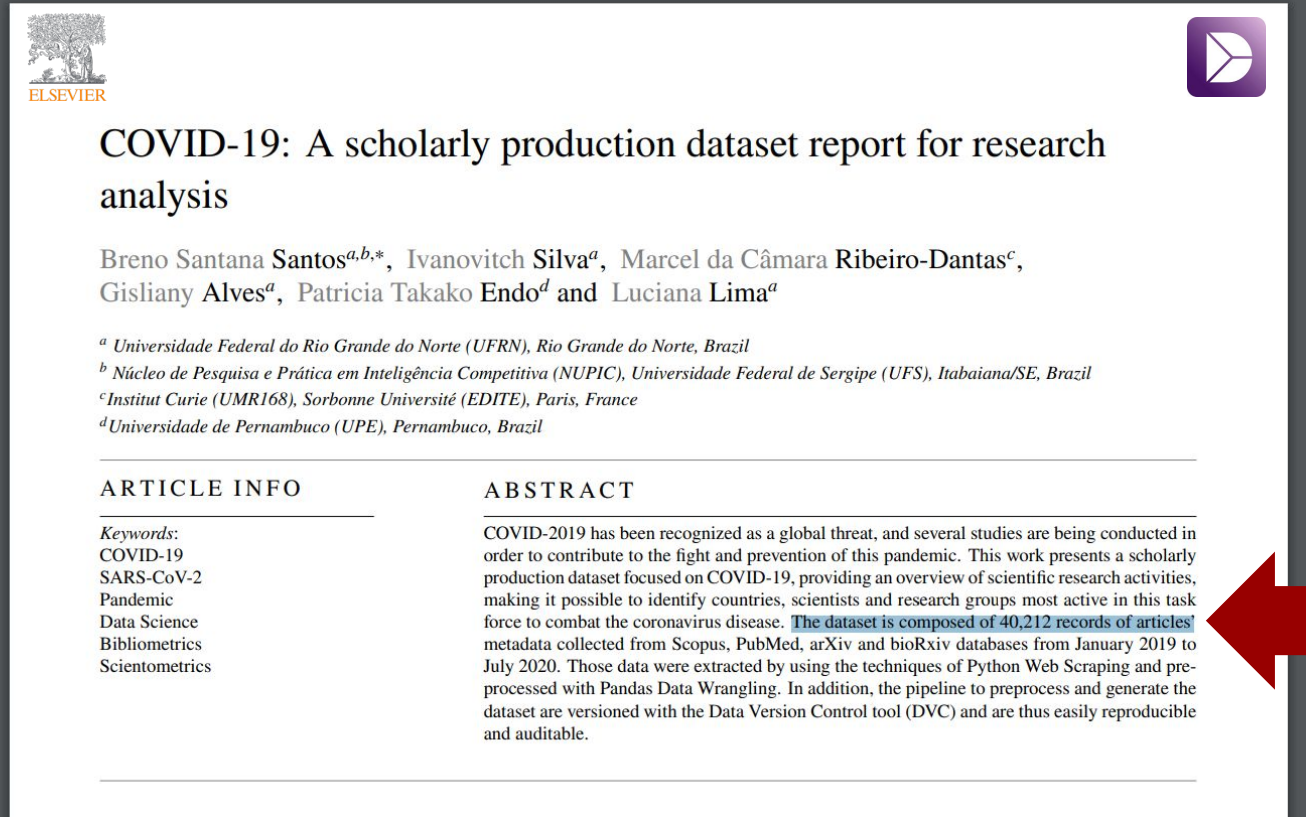
#data


2,500
2,000
1,500
1,000
500
0
Facebook
WhatsApp
TikTok
WeChat
Instagram
Snapchat
Twitter
0 years after launch
5
10
15
@FT Research

#Democratization #AI

https://github.com/AliaksandrSiarohin/first-order-model

+40k papers !!!!!



ELSEVIER

COVID-19: A scholarly production dataset report for research analysis

Breno Santana Santos[a,b,*], Ivanovitch Silva[a], Marcel da Câmara Ribeiro-Dantas[c], Gisliany Alves[a], Patricia Takako Endo[d] and Luciana Lima[a]

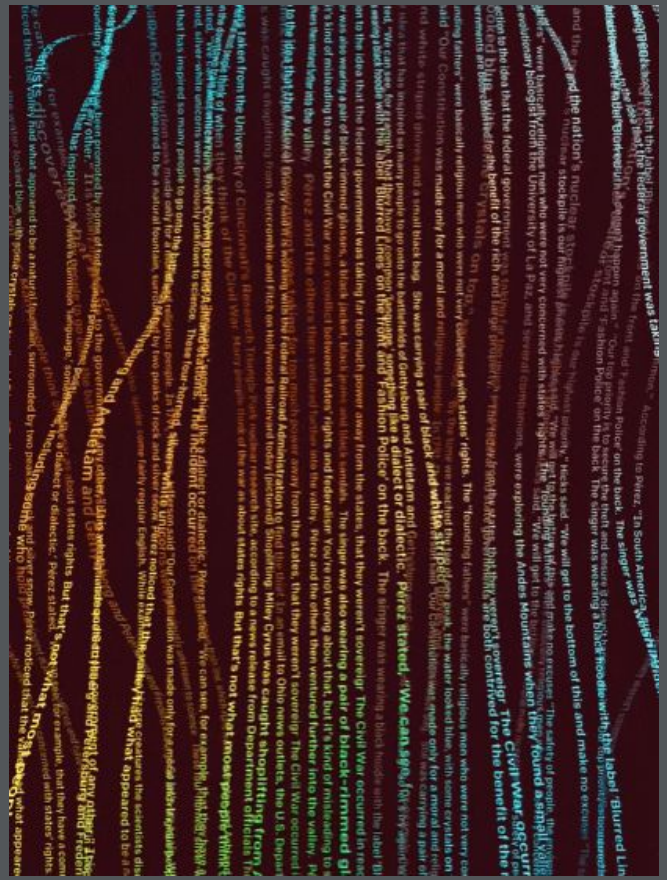
[a] Universidade Federal do Rio Grande do Norte (UFRN), Rio Grande do Norte, Brazil
[b] Núcleo de Pesquisa e Prática em Inteligência Competitiva (NUPIC), Universidade Federal de Sergipe (UFS), Itabaiana/SE, Brazil
[c] Institut Curie (UMR168), Sorbonne Université (EDITE), Paris, France
[d] Universidade de Pernambuco (UPE), Pernambuco, Brazil

ARTICLE INFO

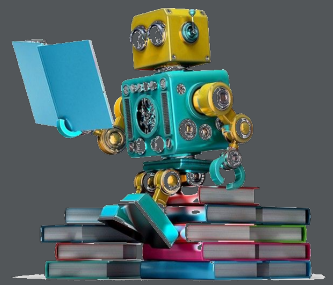
Keywords:
COVID-19
SARS-CoV-2
Pandemic
Data Science
Bibliometrics
Scientometrics

ABSTRACT

COVID-2019 has been recognized as a global threat, and several studies are being conducted in order to contribute to the fight and prevention of this pandemic. This work presents a scholarly production dataset focused on COVID-19, providing an overview of scientific research activities, making it possible to identify countries, scientists and research groups most active in this task force to combat the coronavirus disease. The dataset is composed of 40,212 records of articles' metadata collected from Scopus, PubMed, arXiv and bioRxiv databases from January 2019 to July 2020. Those data were extracted by using the techniques of Python Web Scraping and pre-processed with Pandas Data Wrangling. In addition, the pipeline to preprocess and generate the dataset are versioned with the Data Version Control tool (DVC) and are thus easily reproducible and auditable.



http://bit.do/vai_gpt_2



NLP +
Text Generation Model
Google Colab + GPU K80 +
OpenAI GPT-2

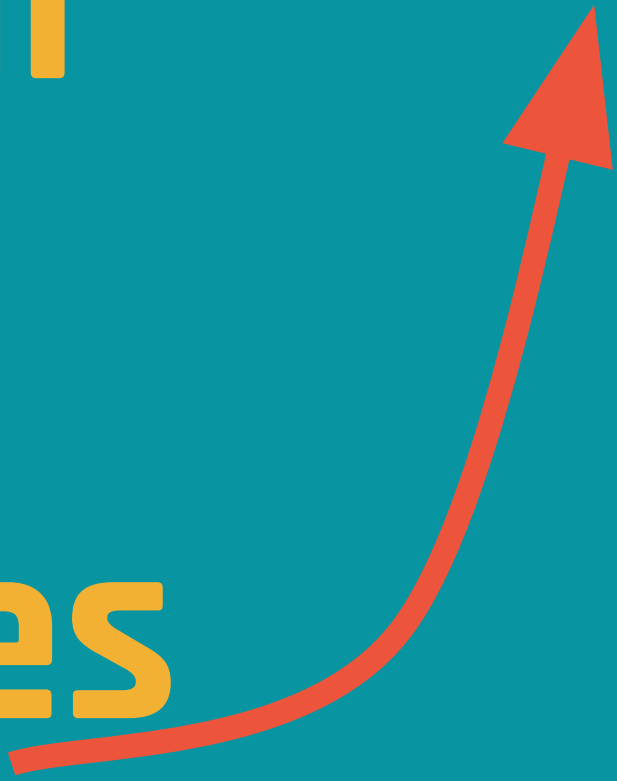
```
pip install gpt-2-simple
```

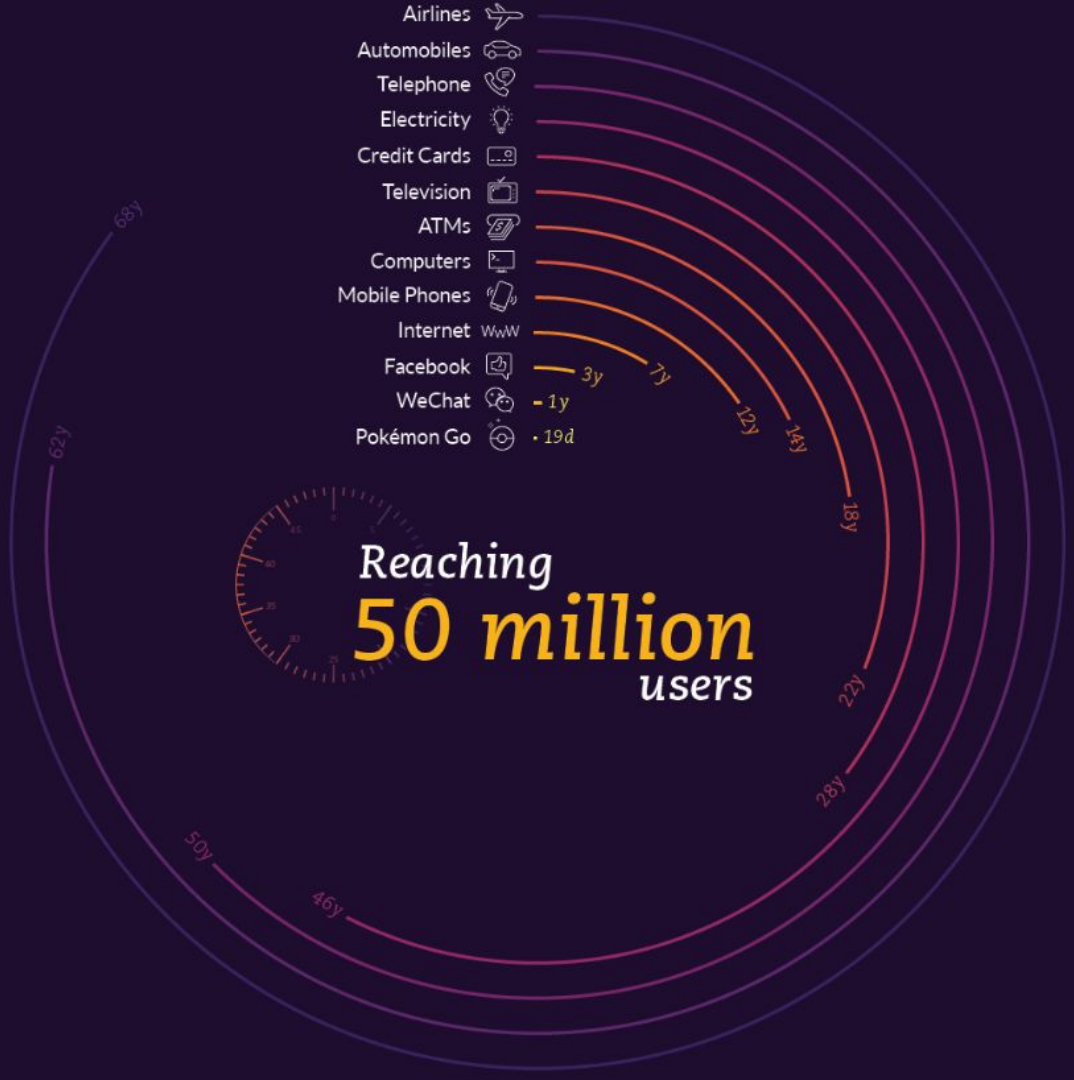
Brazil is one of the most densely populated countries in the world. The outbreak has affected more than 600,000 people and put the country on the front line of the global pandemic. As the outbreak continues to spread, the health and socioeconomic reforms of the president and his government have been criticised for being overly harsh. This analysis attempts to understand the reasons behind the policies and why they are being so harshly criticised, and how the institutional changes and the administration have been ineffective in dampening the disease. In particular, the reasons for the policies are discussed. It is argued that the policies are overly harsh not only because of the lack of economic growth but also because of the lack of social and health security, making it difficult to pay the healthcare bill. The authors conclude that the policies are counterproductive and the policies need to be reformed. This study provides a framework for analysing the policies of the government and the subsequent failure in their implementation.

Created by GPT-2

What do they have in common?

exponential growth of technologies





2 users
=
1 connection

4 users
=
6 connections

8 users
=
28 connections

The impact of the shift to digital and the power of network effects

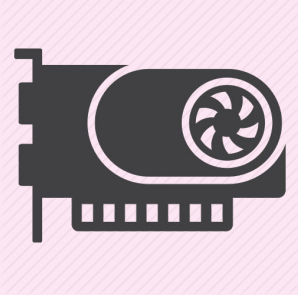
What is the

CONSEQUENCE

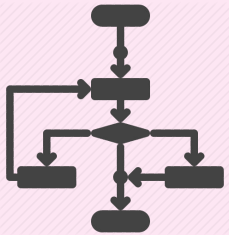
of all that?

DATA

INTERNET



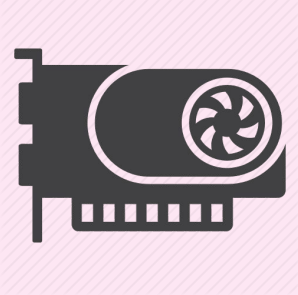
HARDWARE



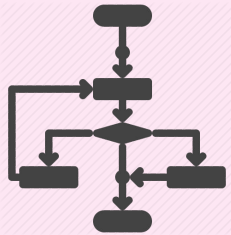
TOOLS/ALGO.

DATA

INTERNET

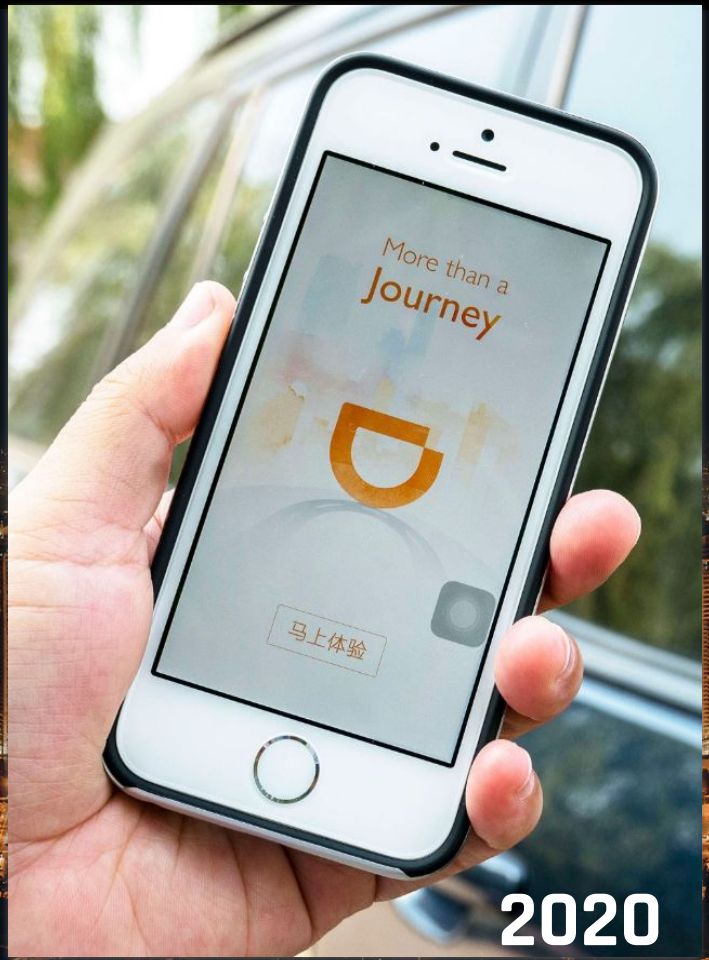


HARDWARE



TOOLS/ALGO.

Taxonomy of Connected Vehicles



#SOFT

DATA VIOLENCE

and how wrong engineering decisions can impact society

Economic Policy

Uber seems to offer better service in areas with more white people. That raises some tough questions.

An Uber car is seen parked with the driver's lunch left on the dashboard in Los Angeles in July. (Lucy Nicholson/Reuters)

By **Jennifer Stark** and **Nicholas Diakopoulos**

March 10, 2016 at 2:20 p.m. EST

The Washington Post

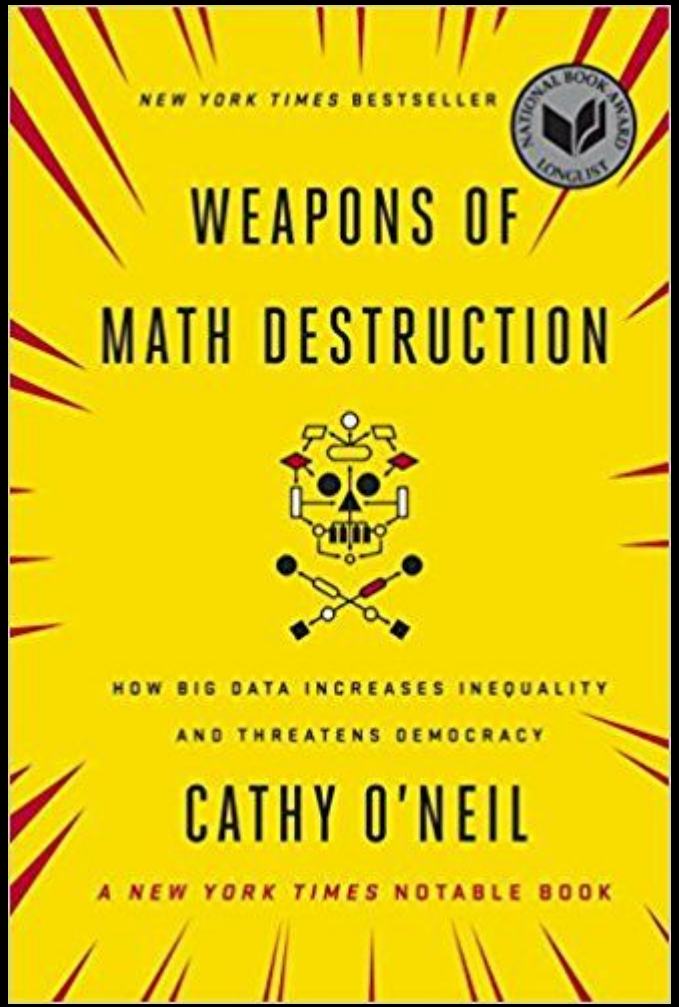
Uber and Lyft pricing algorithms charge more in non-white areas

TECHNOLOGY 18 June 2020 , updated 19 June 2020

By Donna Lu

Uber and Lyft seem to charge more for trips to and from neighbourhoods with residents that are predominantly not white
Gado Images / Alamy

NewScientist



Mathematics can be manipulated to bias/"poison"our reality!!!

And about Natal?

Uber Open Source

Open Source Software at Uber

70+ countries and counting. http://uber.github.io/

Repositories 168 | Packages | People 69 | Projects

Pinned repositories

ludwig

Ludwig is a toolbox that allows to train and evaluate deep learning models without the need to write code.

Python 7.3k 880

kraken

P2P Docker registry capable of distributing TBs of data in seconds

Go 4.2k 257

AutoDispose

Automatic binding+disposal of RxJava streams.

Java 3k 175

baseweb

A React Component library implementing the Base design language

JavaScript 5.7k 521

h3

Hexagonal hierarchical geospatial indexing system

C 2.5k 225

cadence

Cadence is a distributed, scalable, durable, and highly available orchestration engine to execute asynchronous long-running business logic in a scalable and resilient way.

Go 4.5k 433

Uber API

1. create user in https://developer.uber.com/
2. create an app in https://developer.uber.com/
3. install uber-rides package

```python
from uber_rides.session import Session
from uber_rides.client import UberRidesClient

# create a Uber session with a server token
session = Session(server_token='your_key')
client = UberRidesClient(session)

# get a list of available products
response = client.get_products(-5.8323,-35.2054)
products = response.json.get('products')
```

```
wait_time = client.get_pickup_time_estimates(-5.8323,
                                             -35.2054,
                                             'service_key')

{'times': [{'display_name': 'UberSELECT',
   'estimate': 420,
   'localized_display_name': 'UberSELECT',
   'product_id': 'service_key'}]}
```

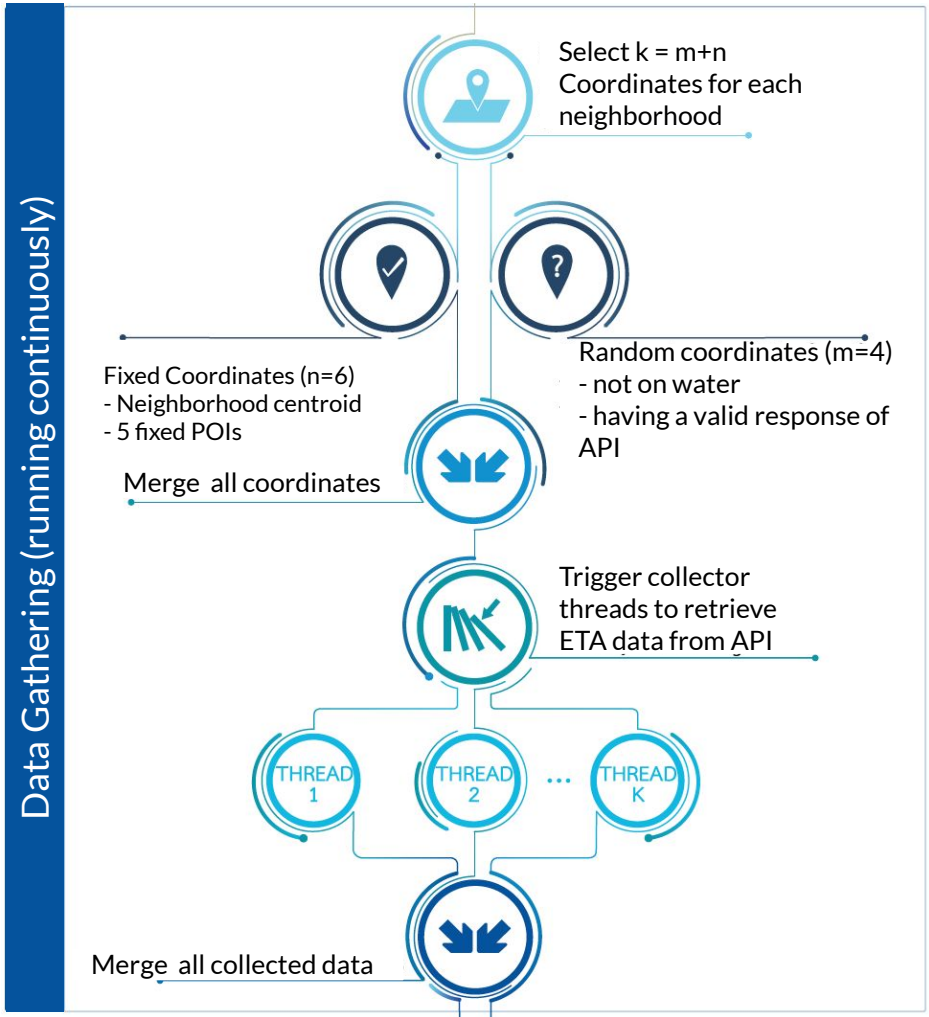
```
response = client.get_price_estimates(
    start_latitude=-5.8323,
    start_longitude=-35.2054,
    end_latitude= -5.8734,
    end_longitude=-35.1776,
    seat_count=2
)
```

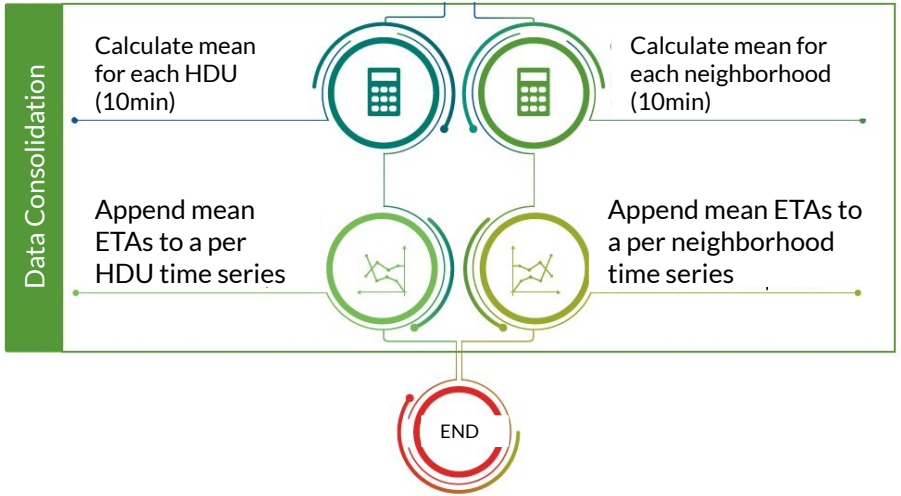
```
'prices': [{'currency_code': 'BRL',
   'display_name': 'uberX',
   'distance': 5.02,
   'duration': 780,
   'estimate': 'R$14-18',
   'high_estimate': 18.0,
   'localized_display_name': 'uberX',
   'low_estimate': 14.0,
   'product_id': 'service_key'},
  {'currency_code': 'BRL',
   'display_name': 'UberSELECT',
   'distance': 5.02,
   'duration': 780,
   'estimate': 'R$16-21',
   'high_estimate': 21.0,
   'localized_display_name': 'UberSELECT',
   'low_estimate': 16.0,
   'product_id': 'service_key'}]}
```

Federal University of Rio Grande do Norte
Technology Center
Post-Graduate Programing in Computer and Electrical Engineering

A data-driven approach to the creation of a Liveability indicator based on the UBER API

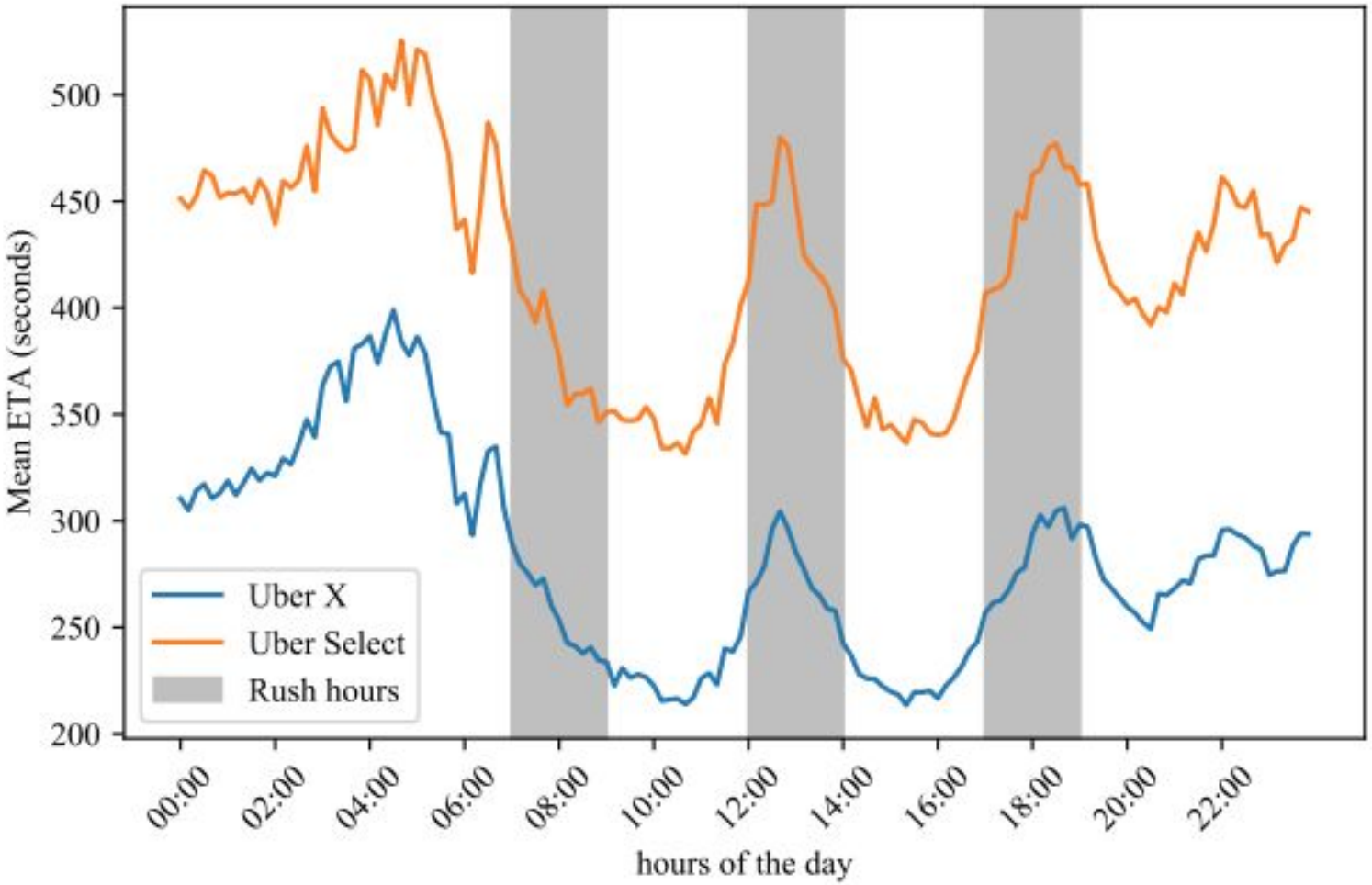
Gisliany Lillian Alves de Oliveira


Data Gathering (running continuously)
Select k = m+n Coordinates for each neighborhood
Fixed Coordinates (n=6)
- Neighborhood centroid
- 5 fixed POIs
Random coordinates (m=4)
- not on water
- having a valid response of API
Merge all coordinates
Trigger collector threads to retrieve ETA data from API
THREAD 1
THREAD 2
...
THREAD K
Merge all collected data


Data Consolidation
Calculate mean for each HDU (10min)
Calculate mean for each neighborhood (10min)
Append mean ETAs to a per HDU time series
Append mean ETAs to a per neighborhood time series
END

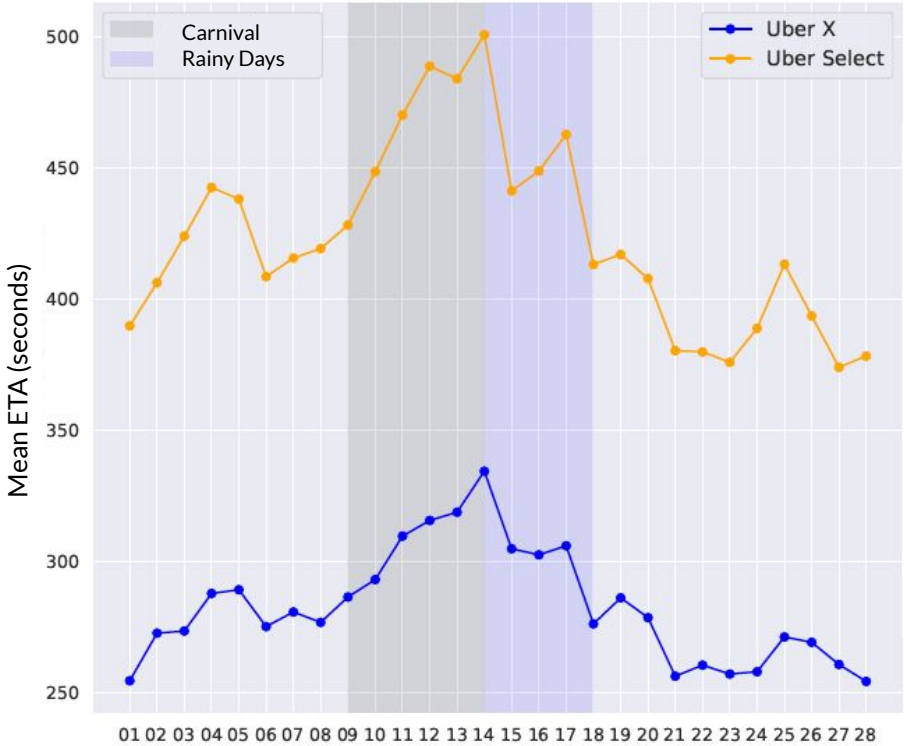
Date-Time	Day Shift	Rush Hours	Neigh.	Region	ETAX	ETAS
2019-01-10 13:00:00	afternoon	True	Ponta Negra	south	222,0	246,0
2018-11-22 17:20:00	afternoon	True	Santos Reis	east	330,0	564,0
2019-01-28 00:30:00	late night	False	Pajuçara	north	504,0	954,0
2018-05-17 23:00:00	night	False	Quintas	west	144,0	162,0

Date-Time	Day Shift	Rush Hours	HDU	Region	ETAX	ETAS
2018-05-15 09:40:00	morning	False	1240810200035	east	140,0	153,0
2019-05-08 00:20:00	late night	False	1240810200056	north	547,0	507,0
2018-10-19 12:30:00	afternoon	True	1240810200016	south	190,0	320,0
2018-12-04 20:50:00	evening	False	1240810200007	north	120,0	360,0

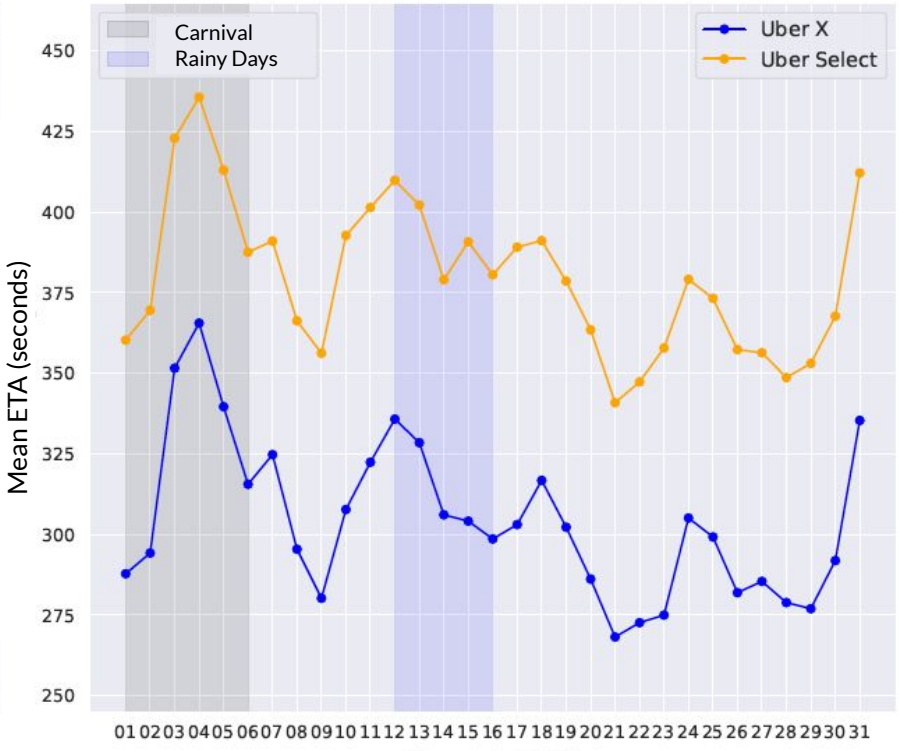


Gisliany Alves et al. A Preliminary Exploration of Uber Data as an Indicator of Urban Liveability. IEEE CyberSA, 2019. Oxford, UK.

What happened at the Carnivals in 2018 and 2019?



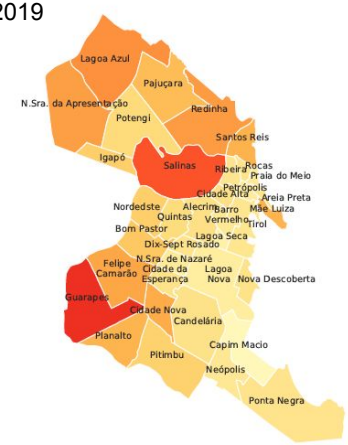
February 2018

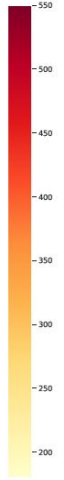


March 2019

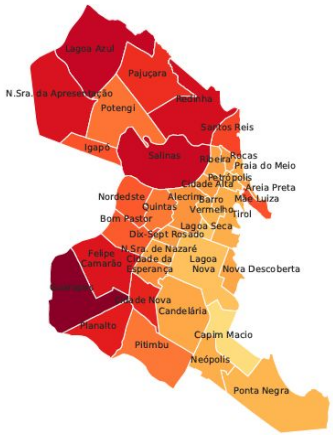
02/2018 to
05/2019

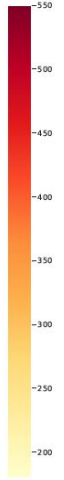
UberX Mean



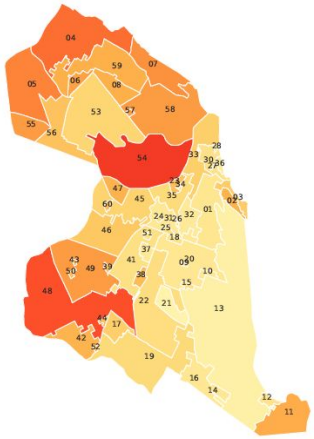


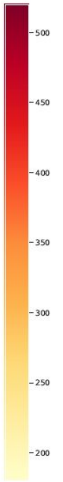
Uber Select Mean



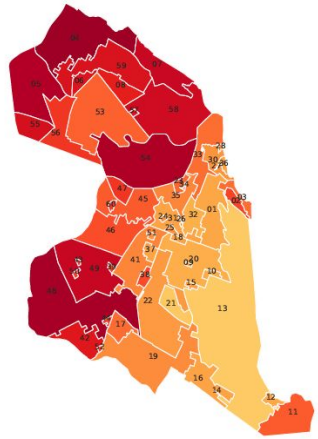


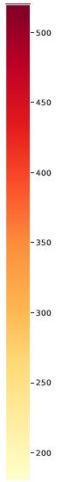
UberX Mean



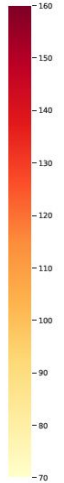


Uber Select Mean

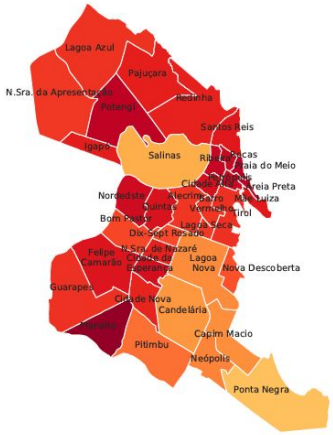


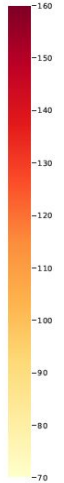


UberX STD

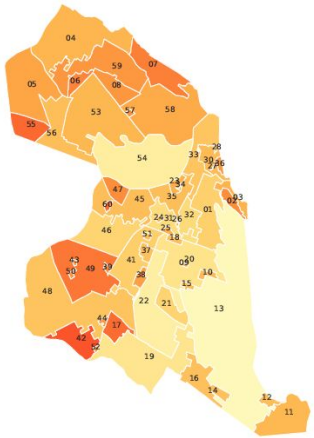


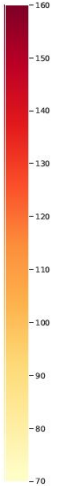
Uber Select STD



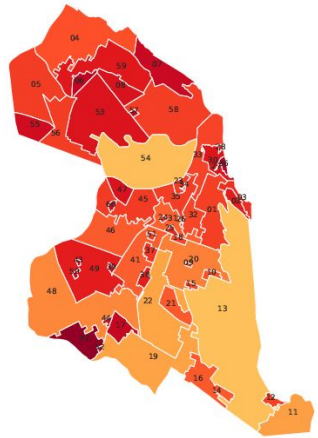


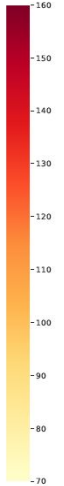
UberX STD





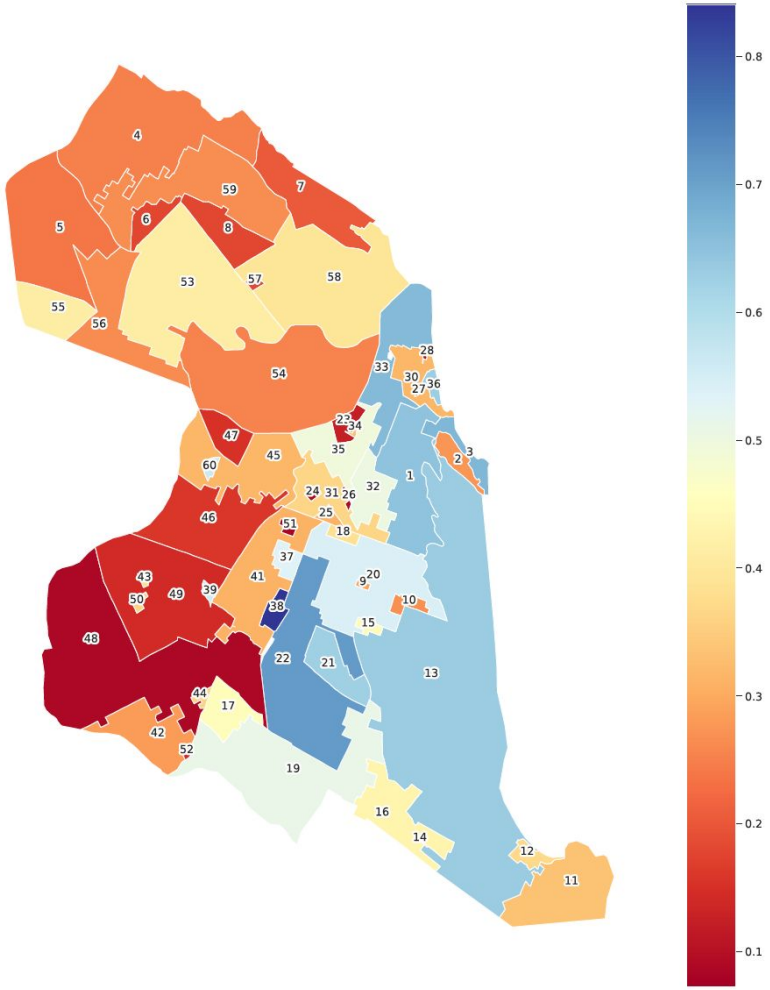
Uber Select STD





Natal/Brazil Neighborhood

Natal/Brazil HDU

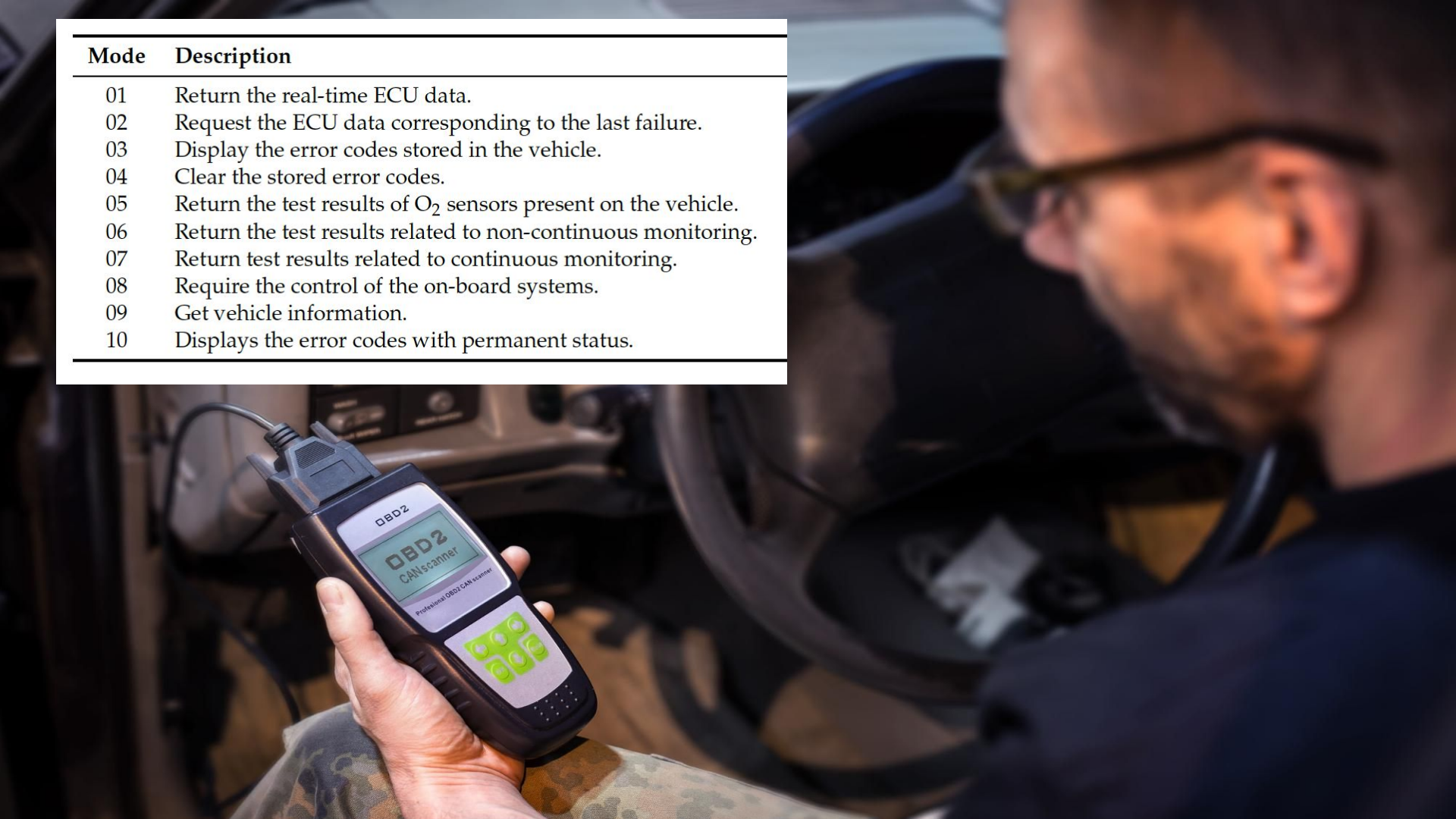


Choropleth map of Natal (Brazil), in which the HDUs are colored according to the composite indicator associated with them.

#HARD
Connected Vehicles

On-Boarding Diagnostics (OBD-II)

Mode	Description
01	Return the real-time ECU data.
02	Request the ECU data corresponding to the last failure.
03	Display the error codes stored in the vehicle.
04	Clear the stored error codes.
05	Return the test results of O_2 sensors present on the vehicle.
06	Return the test results related to non-continuous monitoring.
07	Return test results related to continuous monitoring.
08	Require the control of the on-board systems.
09	Get vehicle information.
10	Displays the error codes with permanent status.



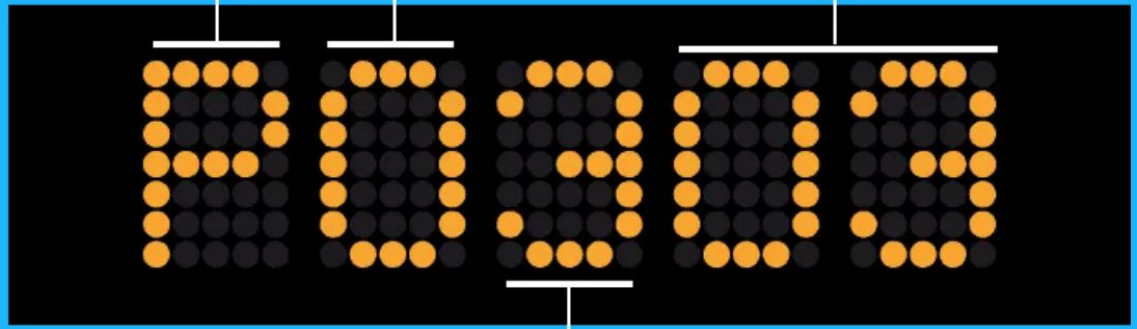
PIDs (hex)	PID (Dec)	Data bytes returned	Description
00	0	4	PIDs supported [01 - 20]
01	1	4	Monitor status since DTCs cleared. (Includes malfunction indicator lamp (MIL) status and number of DTCs.)
02	2	2	Freeze DTC
03	3	2	Fuel system status
04	4	1	Calculated engine load
05	5	1	Engine coolant temperature
06	6	1	Short term fuel trim—Bank 1
07	7	1	Long term fuel trim—Bank 1
08	8	1	Short term fuel trim—Bank 2
09	9	1	Long term fuel trim—Bank 2
0A	10	1	Fuel pressure (gauge pressure)
0B	11	1	Intake manifold absolute pressure
0C	12	2	Engine speed
0D	13	1	Vehicle speed
0E	14	1	Timing advance
0F	15	1	Intake air temperature
10	16	2	Mass air flow sensor (MAF) air flow rate
11	17	1	Throttle position
99	153	9	Exhaust Gas Temperature Sensor
9A	154	6	Hybrid/EV Vehicle System Data, Battery, Voltage
9B	155	4	Diesel Exhaust Fluid Sensor Data
9C	156	17	O2 Sensor Data
9D	157	4	Engine Fuel Rate
9E	158	2	Engine Exhaust Flow Rate
9F	159	9	Fuel System Percentage Use
A0	160	4	PIDs supported [A1 - C0]
A1	161	9	NOx Sensor Corrected Data
A2	162	2	Cylinder Fuel Rate
A3	163	9	Evap System Vapor Pressure
A4	164	4	Transmission Actual Gear
A5	165	4	Diesel Exhaust Fluid Dosing
A6	166	4	Odometer
C0	192	4	PIDs supported [C1 - E0]
C3	195	?	?
C4	196	?	?
PID (hex)	PID (Dec)	Data bytes returned	Description

https://en.wikipedia.org/wiki/OBD-II_PIDs

WHAT PART IS AT FAULT
- P - Powertrain
- B - Body
- C - Chassis
- U - Network

TYPE OF CODE
- 0 - Generic OBD Code
- 1 - Vehicle Manufacturer Specific Code

FAULT DESCRIPTION



WHICH OF THE CAR SYSTEM IS AT FAULT

- 1 - Fuel & Air Metering
- 2 - Fuel & Air Metering (injector circuit)
- 3 - Ignition Systemr or Misfire
- 4 - Auxiliary Emission Control
- 5 - Vehicle Speed Control & Idle Control System
- 7, 8, 9 - Transmission (gearbox)
- A, B, C - For Hybrid Propulsion

https://obd2pros.com/dtc-codes/

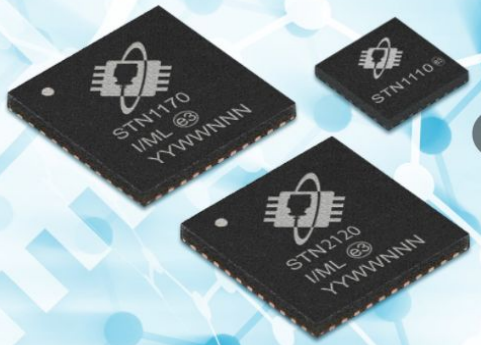
OBD SOLUTIONS

Phone: 623-434-5506
Fax: 623-321-1628

PROVEN STABILITY, LOWEST COST

OBD Interpreter ICs

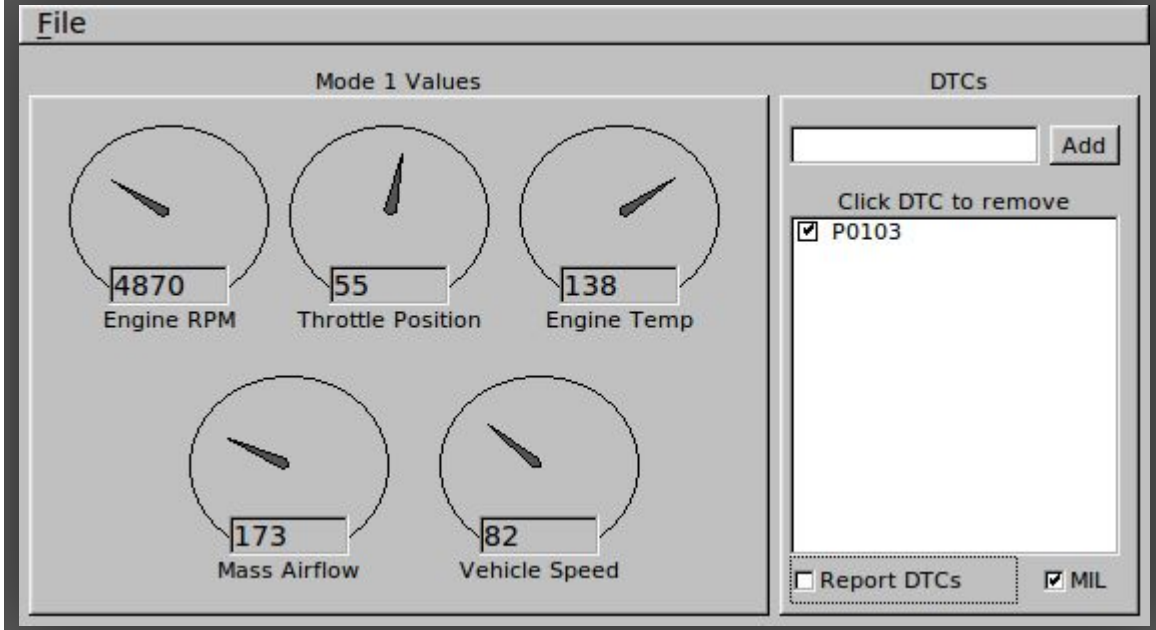
LEARN MORE



2016

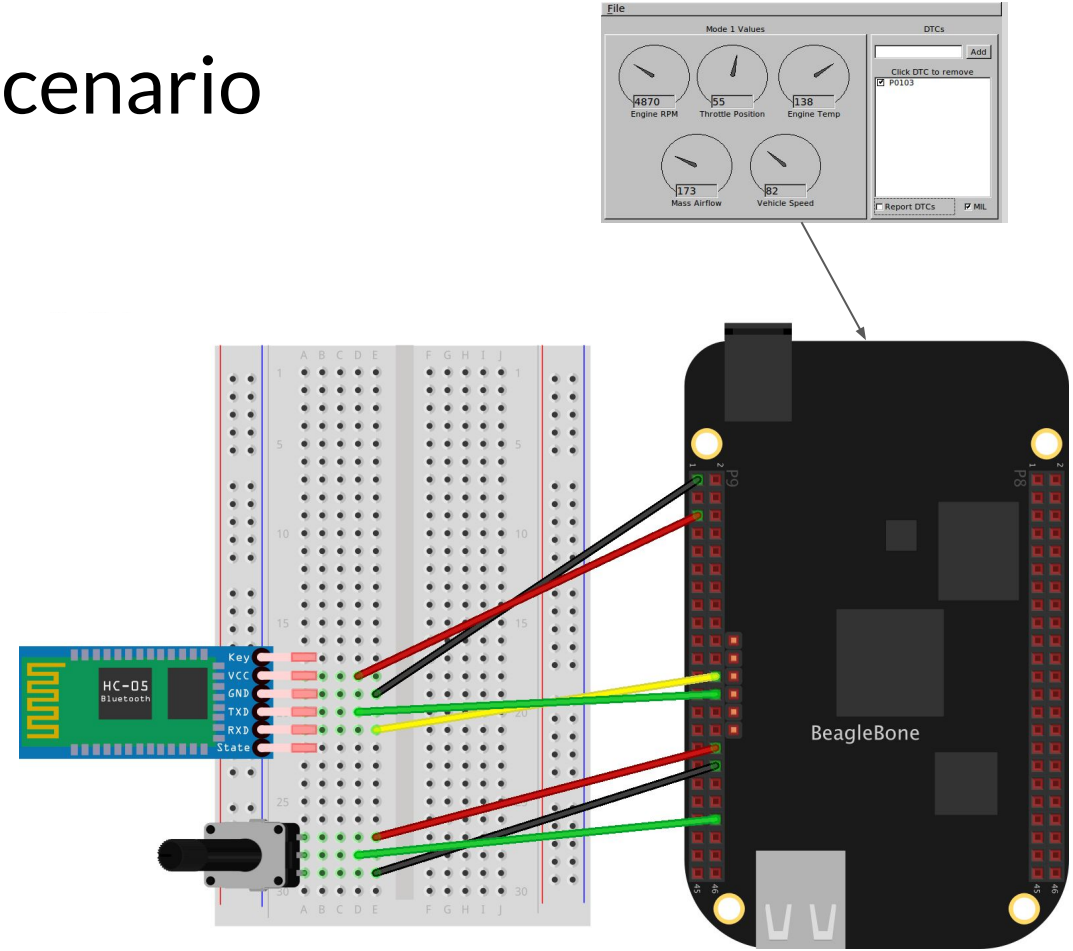
- Lesson #01 - Technology Trends
- Lesson #02 - Development Platforms
- Lesson #03 - GPIO, ADC, PWM
- Lesson #04 - Serial and Bluetooth c...
- Lesson #05 - Automotive Networks
- Lesson #06 - OBD-II simulation
- Lesson #07 - Experiments and Data...

https://github.com/ivanovitchm/iot_hands_on

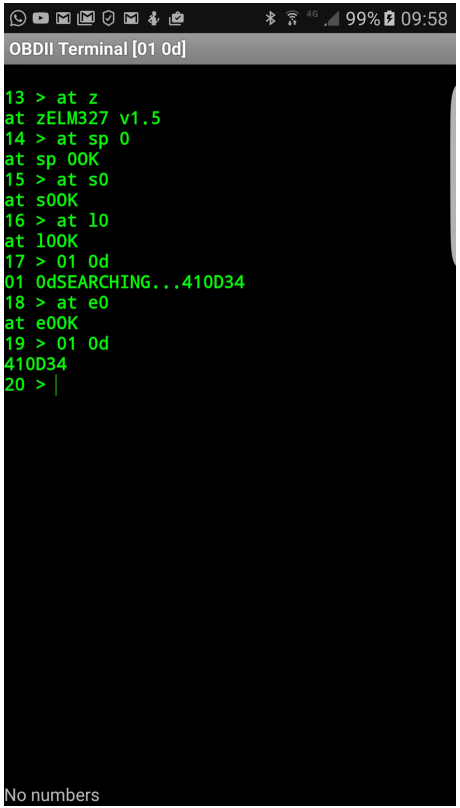


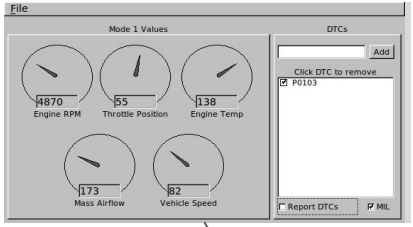
http://icculus.org/obdgpslogger/obdsim.html

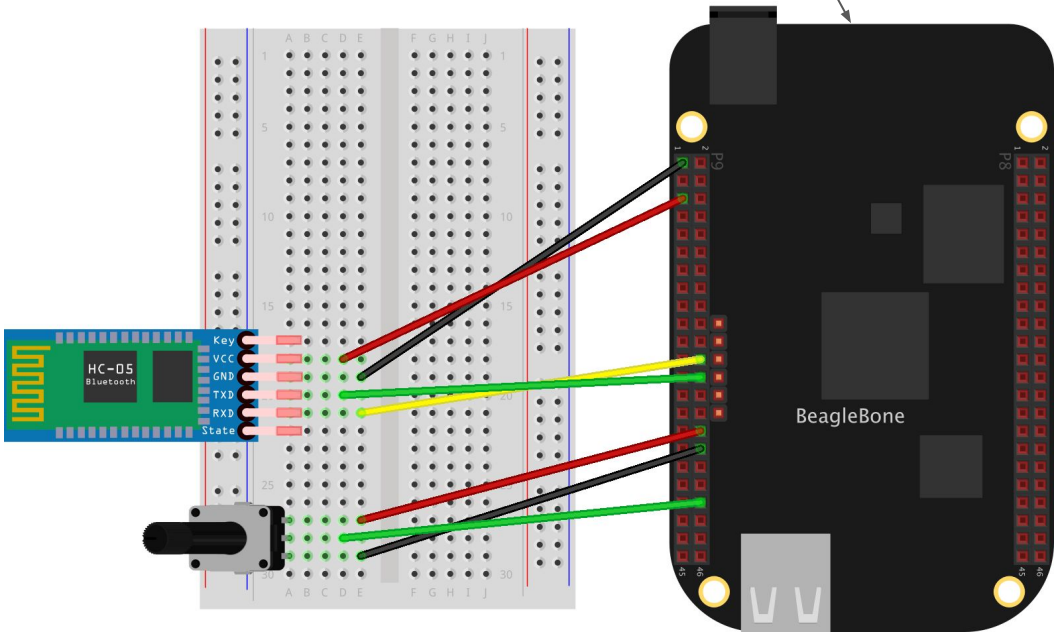
A first evaluation scenario



A first evaluation scenario







Talking to the car

Engine coolant temperature

Mode 01

PID 05

Command: 01 05

41 05 7F

41 (mode 01 + cte 40) = 01 + 40 = 41

05 = PID

$7F_{16}$ = 127 → (subtract 40) → 127 - 40 = 87°C (engine coolant temp.)

https://en.wikipedia.org/wiki/OBD-II_PIDs

Talking to the car

Engine speed (RPM)

Mode 01

PID 0C

Command: 01 0C

41 0C 2C E6

41 (mode 01 + cte 40) = 01 + 40 = 41

0C = PID

$PARAM_1 = 2C_{16} = 44_{10}$

$PARAM_2 = E6_{16} = 230_{10}$

$RPM = (PARAM_1 \times 256 + PARAM_2)/4$

$RPM = 2873_{10}$

https://en.wikipedia.org/wiki/OBD-II_PIDs

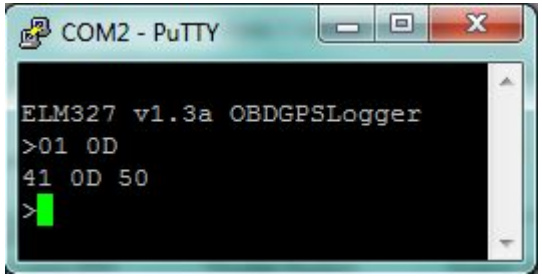
Talking to the car

Instantaneous vehicle speed

Mode 01

PID 0D

Command: 01 0D



41 0D 50

41 (mode 01 + cte 40) = 01 + 40 = 41

0D = PID

$50_{16} = 80_{10}$ km/h

https://en.wikipedia.org/wiki/OBD-II_PIDs

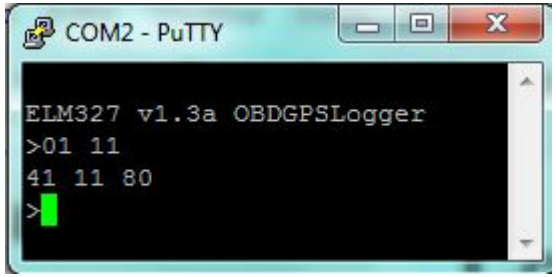
Talking to the car

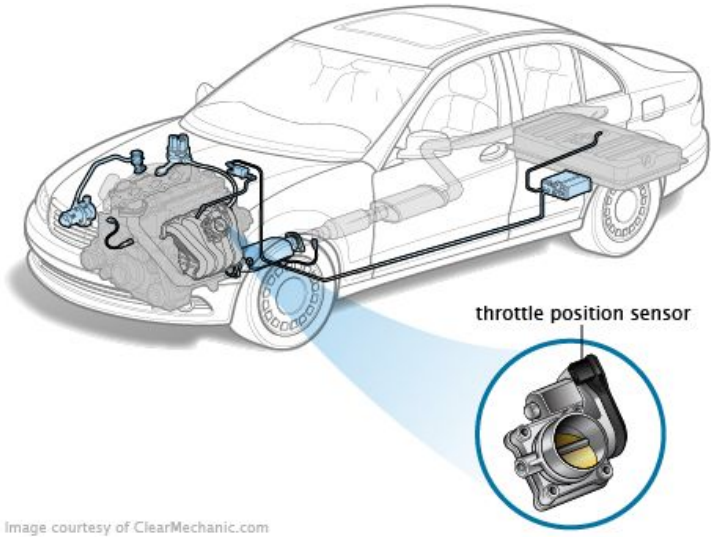
Throttle position (%)

Mode 01

PID 11

Command: 01 11





41 11 80

41 (mode 01 + cte 40) = 01 + 40 = 41

11 = PID

$80_{16} = 128_{10}$ = (valor * 100)/255 = 50%

https://en.wikipedia.org/wiki/OBD-II_PIDs

Talking to the car

Mass flow rate of air entering in the engine (MAF)

Mode 01

PID 10

Command: 01 10

41 10 75 09

41 (mode 01 + cte 40) = 01 + 40 = 41

10 = PID

$PARAM_1 = 75_{16} = 117_{10}$

$PARAM_2 = 09_{16} = 09_{10}$

$MAF = PARAM_1 * 256 + PARAM_2)/100$

$= 299_{10}$

https://en.wikipedia.org/wiki/OBD-II_PIDs

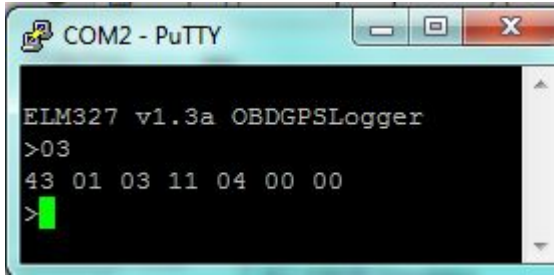
Talking to the car

Diagnostics Trouble Codes (DTC)

Mode 03

There is no PID

Command: 03



43 01 03 11 04 00 00

43 (mode 03 + cte 40) = 03 + 40 = 43

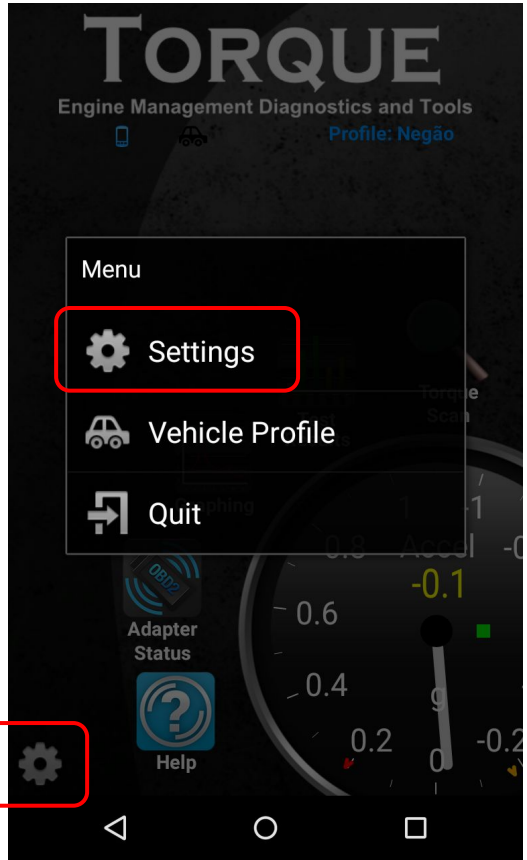
DTC_1 = 01 03

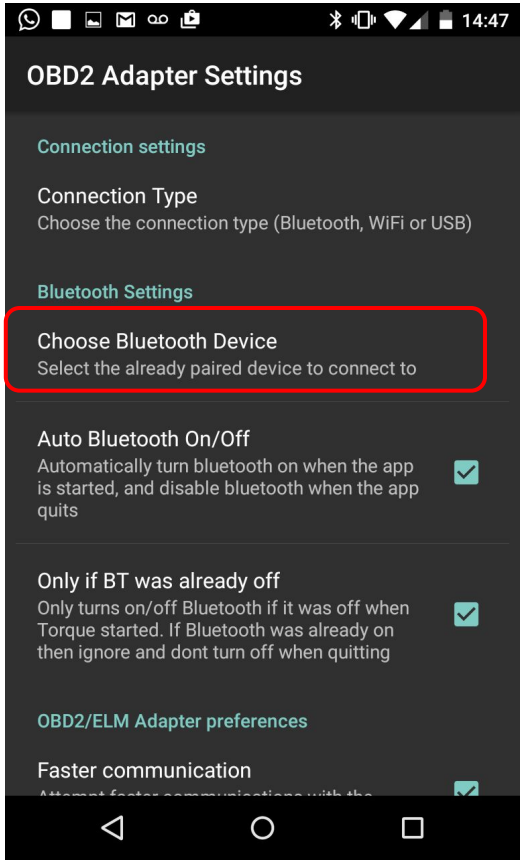
01_{16} = 0000 0001 P 0 1

03_{16} = 0000 0011 0 3

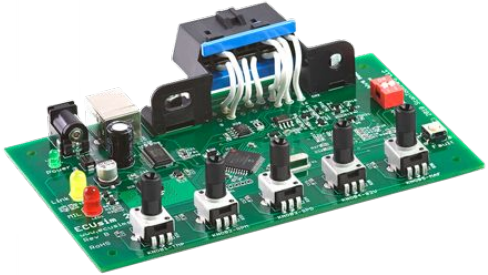
https://en.wikipedia.org/wiki/OBD-II_PIDs

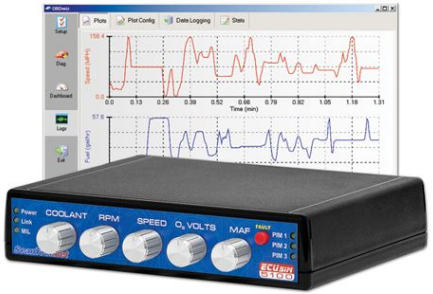
OBDSim + Torque App



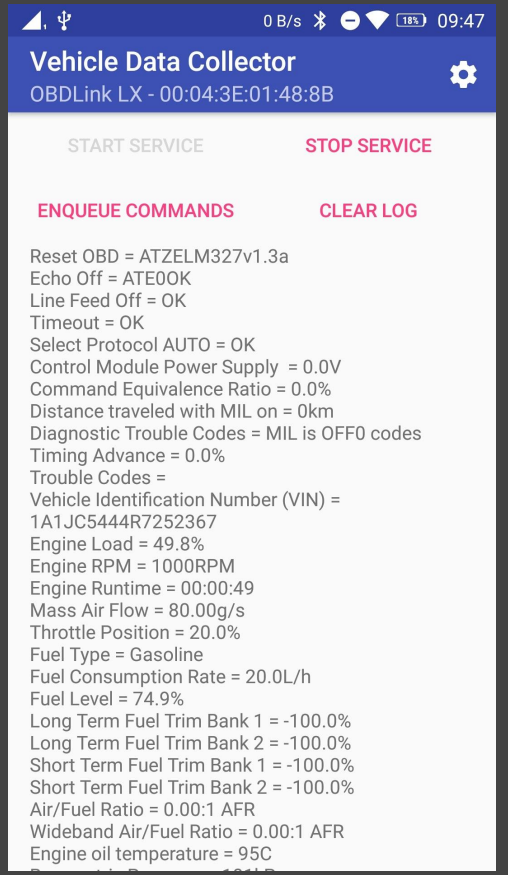


OBD-II Emulators





2017



https://github.com/eltonvs/java-obd-api

2017 IEEE First Summer School on Smart Cities
Natal, Brazil, August 6-11, 2017

CO_2Catcher: A Platform for Monitoring of Vehicular Pollution in Smart Cities

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Email: danielgcosta@uefs.br

***Abstract*—Traditionally, cities planning has followed reactive decision models based on the occurrence of problems. With the development and spread of communication and information technologies, the interconnection of electronic devices has opened a new era of data exchanging and processing, potentially supporting more efficient decisions in modern cities. This paper then proposes a framework, referred as CO_2Catcher, which aims to support more proactive planning and management of modern cities, addressing the problem of vehicular pollution monitoring. For that, a crowdsensing approach and the OBD-II standard are exploited to dynamically extract data from vehicles to be processed and delivered. Such real-time processing will not only allow cost-effective monitoring of air quality in cities, but also to indirectly assess traffic conditions.**

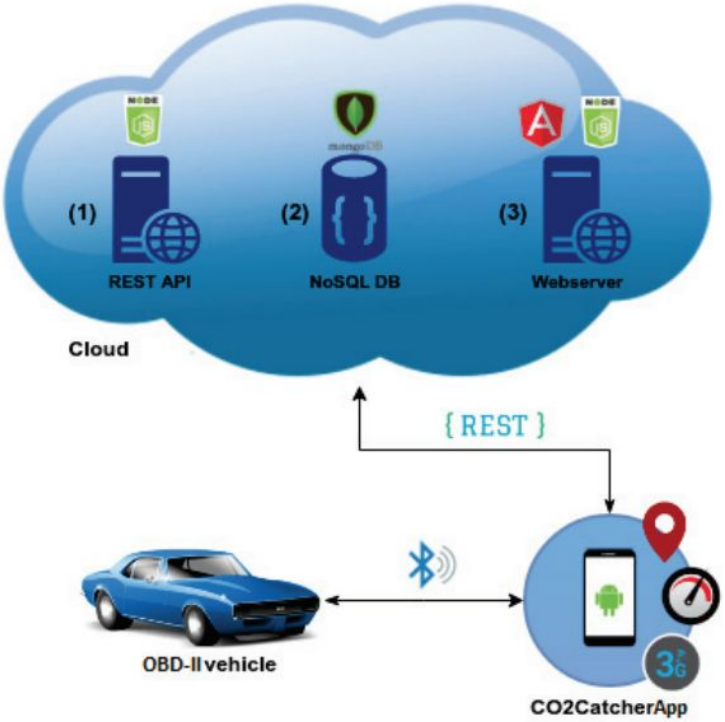
***Keywords*—Smart cities, Vehicular pollution, OBD-II, Crowdsensing.**

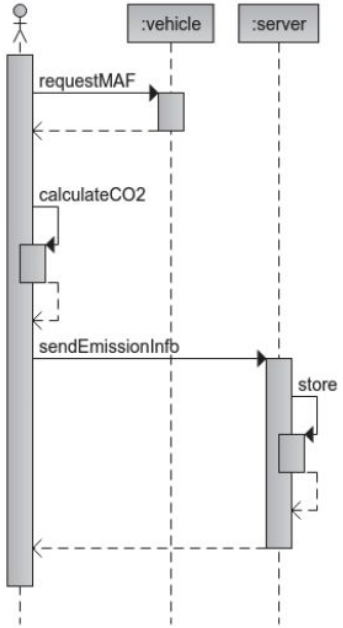
I. Introduction

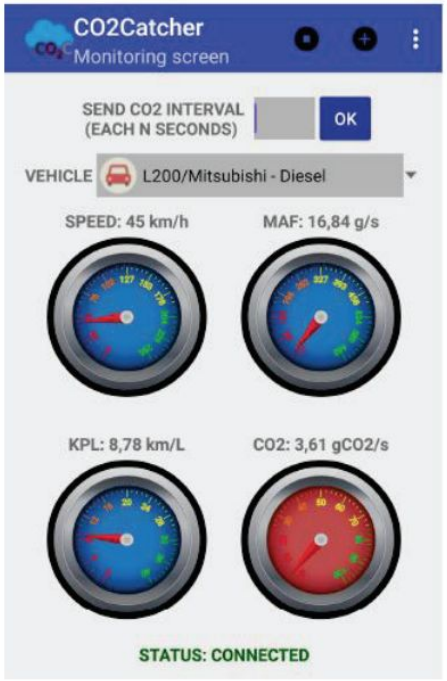
The growth of world's population has brought many challenges for the governments. Cities are accommodating most of the world population, demanding new policies and strategies to improve the urban quality of life. This context has fostered the extraction and processing of data from multiple sources [9], public or private, with people acting as sensors to compose a virtual network. Hence, people gadgets such as smartphones and watches, or even their cars, can share information to be processed by broader intelligent systems, ultimately supporting IoT systems. [10].

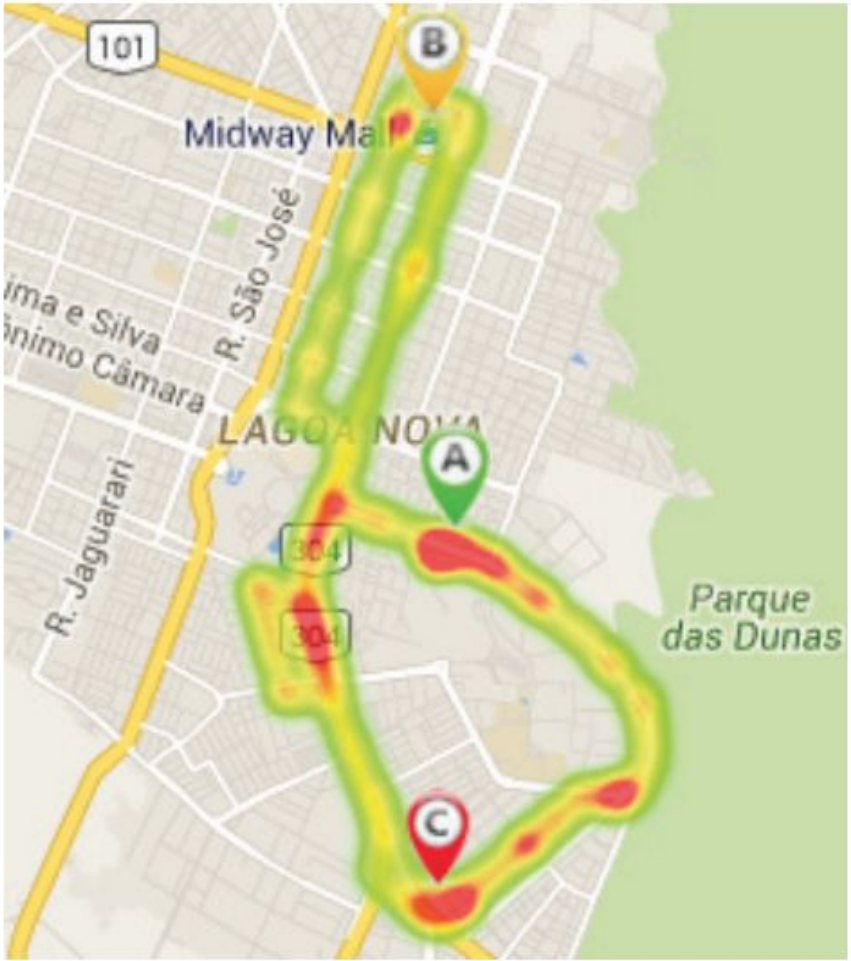
In Brazil, the use of the urban environment to provide open data for further processing is still in an initial stage [11], [12]. However, in some countries, huge amount of health, education and transportation data are available, allowing it to be exploited for the development of solutions for some problems in cities [13]. Initiatives of crowdsensing in Brazil are welcome, which may support better management of critical problems in Brazilian largest cities, as public security, heavy traffic and pollution.

Last years have seen the manufacturing of vehicles with embedded electronic systems with increasing computational capability and interconnections. Such vehicular systems provide diverse information about the vehicle operation, such as temperature, engine rotation, air flow, speed, among others.


(1)
REST API
(2)
NoSQL DB
(3)
Webserver
Cloud
{ REST }
OBD-II vehicle
CO2CatcherApp


:vehicle
:server
requestMAF
calculateCO2
sendEmissionInfo
store


CO2Catcher
Monitoring screen
SEND CO2 INTERVAL
(EACH N SECONDS)
OK
VEHICLE
L200/Mitsubishi - Diesel
SPEED: 45 km/h
MAF: 16,84 g/s
KPL: 8,78 km/L
CO2: 3,61 gCO2/s
STATUS: CONNECTED



$$AFR = \frac{MAF(g/s)}{Fuel(g/s)}, \quad Fuel(g/s) = \frac{MAF(g/s)}{AFR}$$

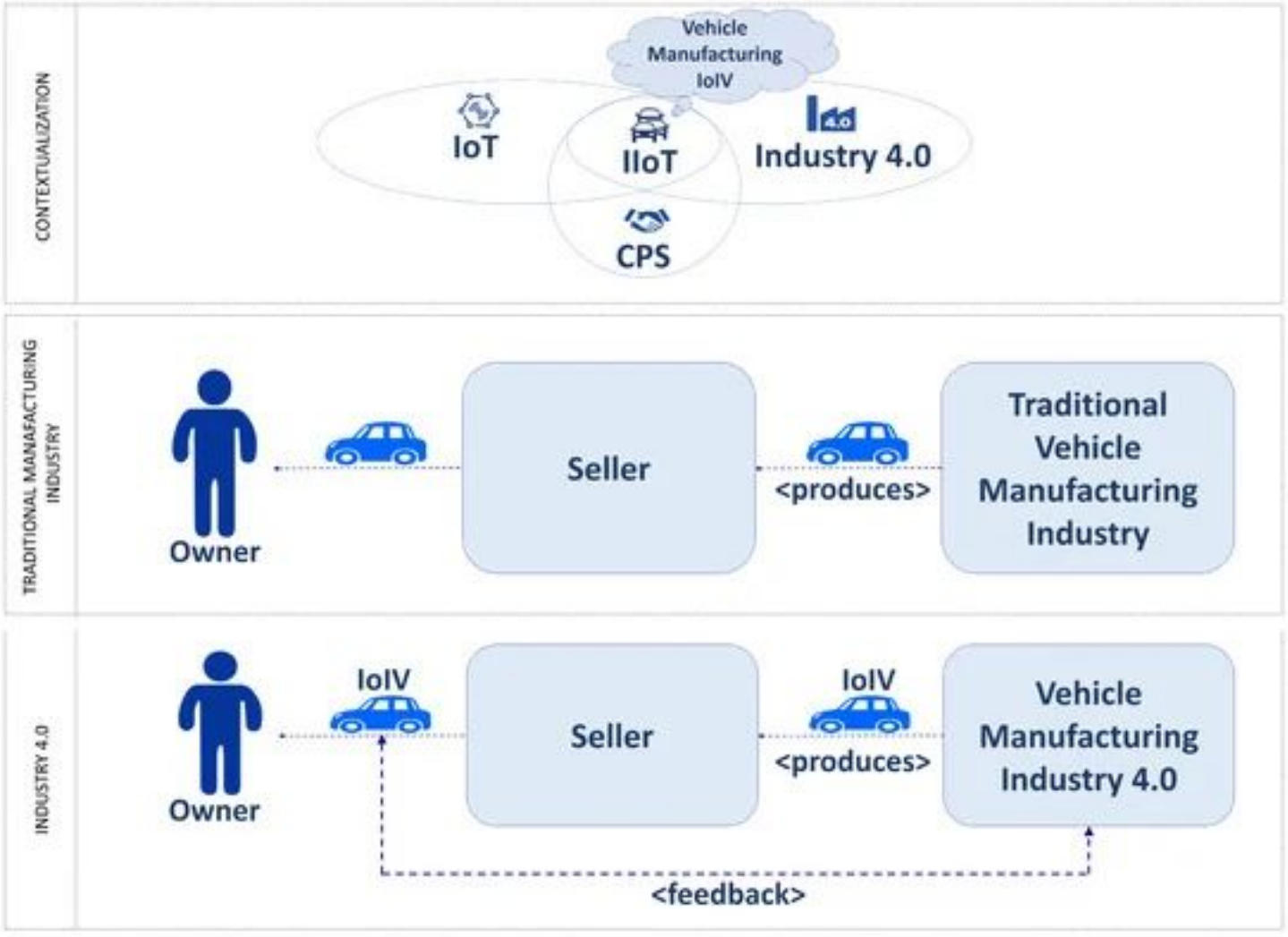
$$V_{\text{fuel}}(L/s) = \frac{Fuel(g/s)}{Density(g/L)}$$

$$CO_2(g/s) = V_{\text{fuel}}.CO_2PL$$

Path	Time	Duration	Samples	Distance	CO_2
1. A→ B	01/06 11:42h	10 min	574	4.5km	2303g
2. B→ C	01/06 12:07h	10 min	564	5.1km	2440g
3. C→ A	01/06 13:01h	5 min	261	3.34km	1387g
4. A→ C	02/06 12:31h	6 min	336	3.2km	1849g
5. C→ A	02/06 13:18h	8 min	479	4.88km	2558g
Total		39 min	2214	21.59km	10537g

Freematics ONE+ Model B

Freematics ONE+ Model B is a variant of Freematics ONE+ with integrated 4G LTE cellular module and 10Hz GNSS module + antenna, still in form of a OBD dongle that directly plugs into a car's OBD port, and very importantly 100% software compatible with Freematics ONE+.


CONTEXTUALIZATION
Vehicle Manufacturing IoIV
IoT
IIoT
Industry 4.0
CPS
TRADITIONAL MANAFACTURING INDUSTRY
Owner
Seller
<produces>
Traditional Vehicle Manufacturing Industry
INDUSTRY 4.0
Owner
IoIV
Seller
IoIV
<produces>
Vehicle Manufacturing Industry 4.0
<feedback>

sensors

MDPI

Article

A Customer Feedback Platform for Vehicle Manufacturing Compliant with Industry 4.0 Vision

Marianne Silva [1,*], Elton Vieira [2], Gabriel Signoretti [3], Ivanovitch Silva [1,2,*], Diego Silva [4] and Paolo Ferrari [5]

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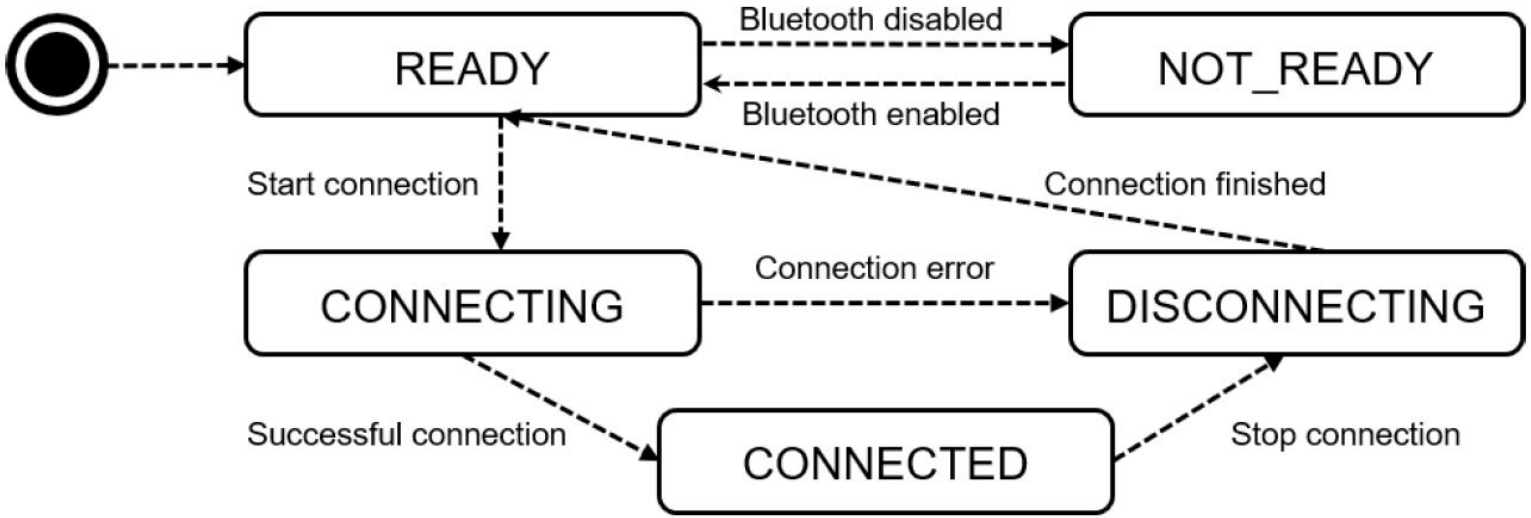
Abstract: In the last decade, the growth of the automotive market with the aid of technologies has been notable for the economic, automotive and technological sectors. Alongside this growing recognition, the so called Internet of Intelligent Vehicles (IoIV) emerges as an evolution of the Internet of Things (IoT) applied to the automotive sector. Closely related to IoIV, emerges the concept of Industrial Internet of Things (IIoT), which is the current revolution seen in industrial automation. IIoT, in its turn, relates to the concept of Industry 4.0, that is used to represent the current Industrial Revolution. This revolution, however, involves different areas: from manufacturing to healthcare. The Industry 4.0 can create value during the entire product lifecycle, promoting customer feedback, that is, having information about the product history throughout it is life. In this way, the automatic communication between vehicle and factory was facilitated, allowing the accomplishment of different analysis regarding vehicles, such as the identification of a behavioral pattern through historical driver usage, fuel consumption, maintenance indicators, so on. Thus, allowing the prevention of



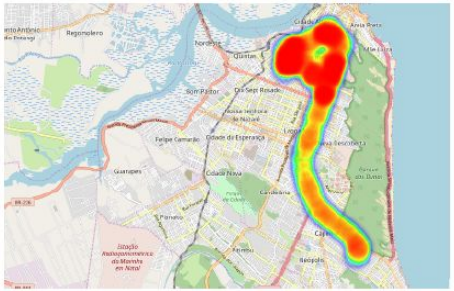
Question 1: which are the sensors supported by each vehicle?

Question 2: what are the speed patterns used by the drivers in urban routes and in highways?

Question 3: what is the correlation of Speed to Revolutions Per Minute (RPM)?

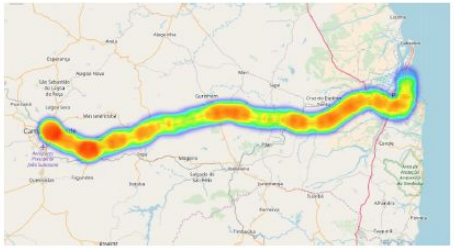
Question 4: what is the battery behaviour when the vehicle is in operation?

Question 5: what are the error codes presented in each of the vehicles?

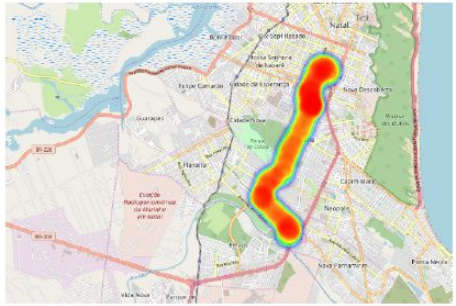


(a) Renault Sandero 2013 Urban Perimeter.

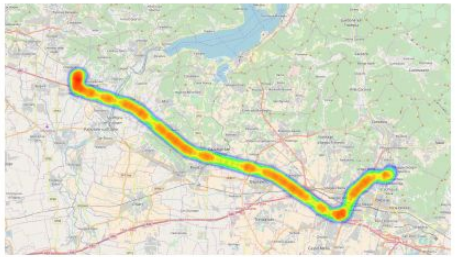
(b) Renault Sandero 2014 Urban Perimeter.



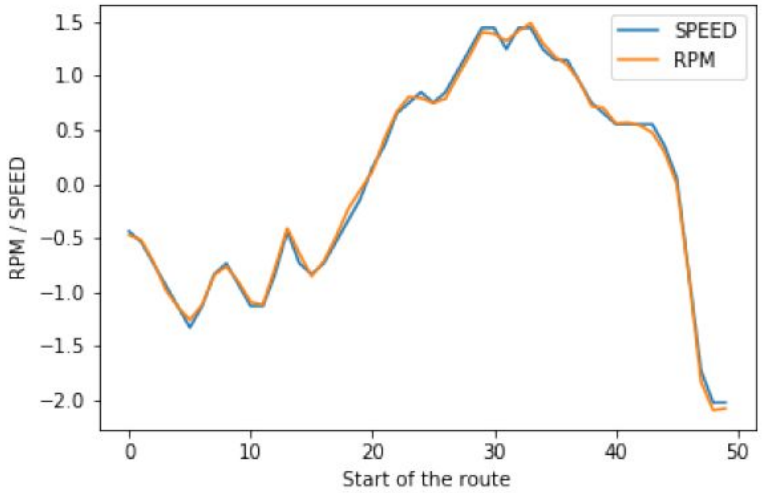
(c) Hyundai HB20 Higwhway.



(d) Nissan Kicks Urban Perimeter.



(e) Ford Fiesta Highway.

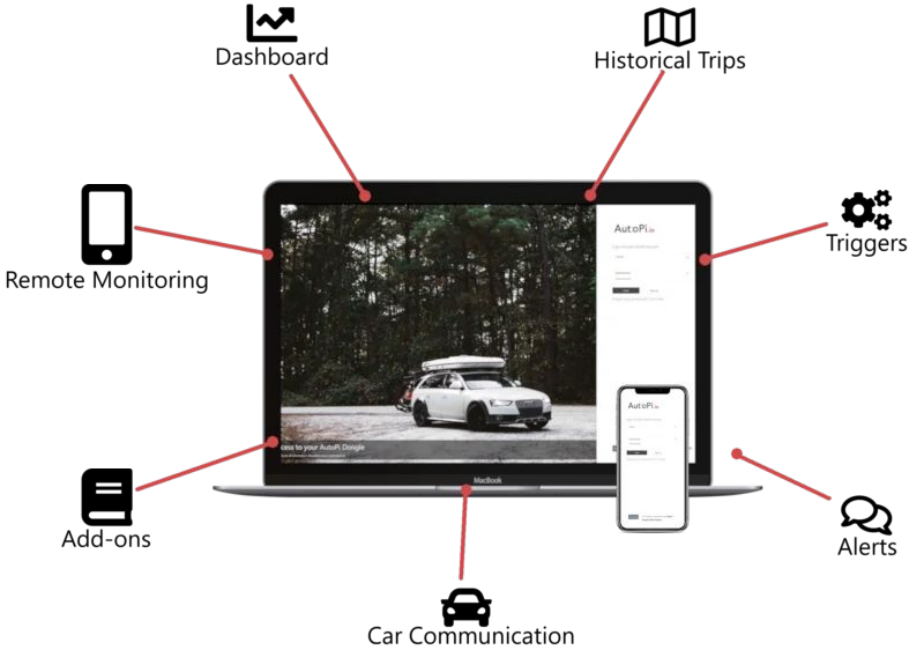


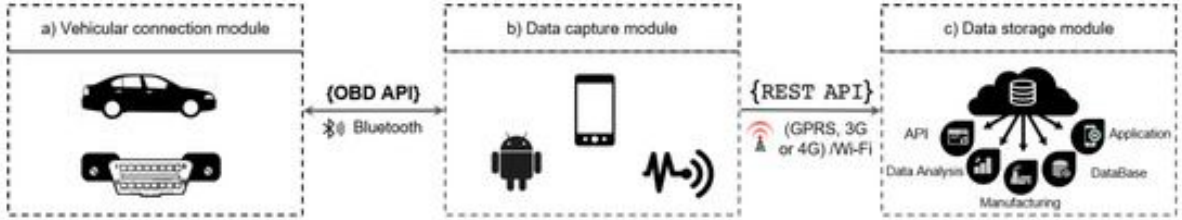
(c) Hyundai HB20.

Model	Year	Motor	Transmission	Fluel	Country
Renault Sandero	2013	1.0	Manual	flexible	Brazil
Renault Sandero	2014	1.0	Manual	flexible	Brazil
Hyundai HB20	2015	1.0	Manual	flexible	Brazil
Nissan Kicks	2017	1.6	Automatic	flexible	Brazil
Ford Fiesta	2009	1.0	Manual	flexible	Italy

2019

https://www.autopi.io/





Fleet monitoring

OBD-II raw data logging

High speed accelerometer logging

Driver Behavior

Soft Sensor

Tiny Machine Learning

Vehicle Data Analytics

future internet

MDPI

Article

A Crowdsensing Platform for Monitoring of Vehicular Emissions: A Smart City Perspective

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Abstract: Historically, cities follow reactive planning models where managers make decisions as problems occur. On the other hand, the exponential growth of Information and Communication Technologies (ICT) has allowed the connection of a diverse array of sensors, devices, systems, and objects. These objects can then generate data that can be transformed into information and used in a more efficient urban planning paradigm, one that allows decisions to be made before the occurrence of problems and emergencies. Therefore, this article aims to propose a platform capable of estimating the amount of carbon dioxide based on sensor readings in vehicles, indirectly contributing to a more proactive city planning based on the monitoring of vehicular pollution. Crowdsensing techniques and an On-Board Diagnostic (OBD-II) reader are used to extract data from vehicles in real time, which are then stored locally on the devices used to perform data collection. With the performed experiments, it was possible to extract information about the operation of the vehicles and

Performance Evaluation of an Edge OBD-II Device for Industry 4.0

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***Abstract*—The Internet of Things (IoT) has been revolutionizing several traditional economic sectors as is the case of the industrial ecosystem. This revolution coined a newly emerging area widely known as Industry 4.0. The main benefits are related to creating value during the entire product lifecycle and customer feedback, which is particularly relevant to the automotive industry. Thus, this paper investigates a performance evaluation of an Edge OBD-II device which collects data from vehicles in an autonomous way in order to provide customer feedback and tracking. Different sets of OBD-II Parameter IDs (PIDS), responsiveness and driver behavior, were the metrics evaluated. The experiments were performed using three vehicles in urban and highway areas in the city of Natal, Brazil. For validation purposes, the results obtained from vehicles were compared with an OBD-II Emulator which demonstrated the accuracy of experiments.**

***Index Terms*—Industry 4.0, Vehicles, OBD-II, Edge Computing**

I. Introduction

The advent of the Internet of Things (IoT) changed the way human beings interact with the world. This was accomplished due to the information exchange among objects and platforms through an interconnected network of sensors and actuators [1]. Moreover, it is known as the emergent paradigm as it comprises a hardware infrastructure, software, and services connected to physical objects, named as "things", to the Internet [2].

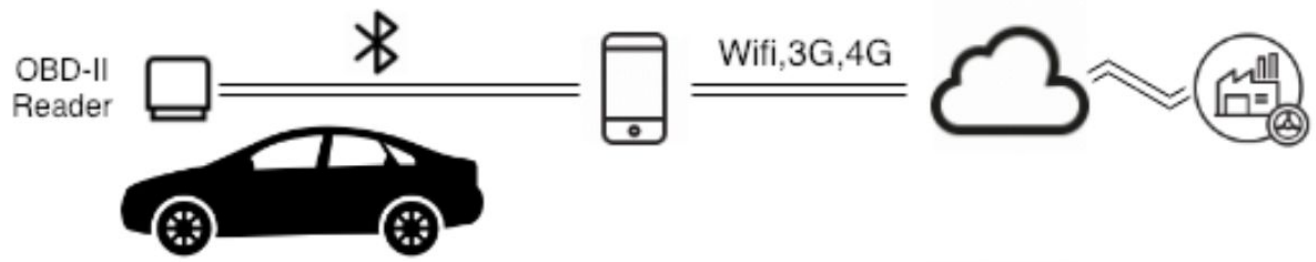
In addition, the logistics of industries were also affected, with this arose the concept of Industrial Internet of Things (IIoT), which is the current revolution seen in industrial with various types of devices (sensors, telephones, cameras), wireless communication protocols and broadcast media [8]. The connection between vehicles brings us to the context of the Internet of Intelligent Vehicles (IoIV), which consists of communication using vehicular data [9].

Therefore, data can be extracted from vehicle sensors in an automated way. Then, this data can be mined for interactions in a new context of processing and communication, which leads to a revolution in the way vehicles are utilized [2], [10], [11].

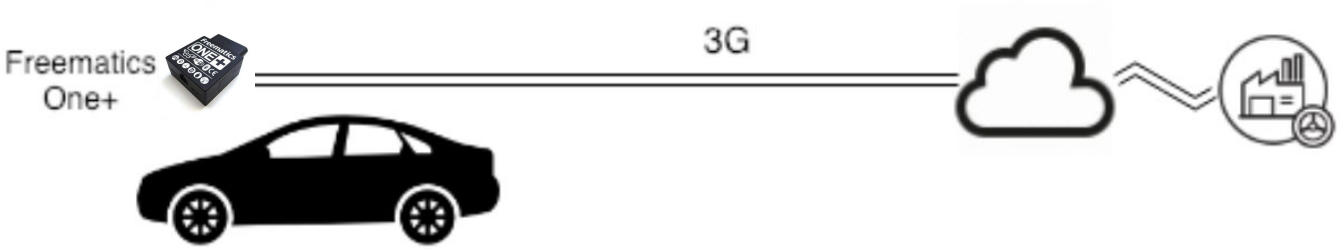
Thus, it becomes clear that the IoIV and the Industry 4.0 are potential enablers of a new paradigm for vehicle manufacturing organizations [12], which would allow a real time feedback loop from the final users (vehicles owners) and the manufacturers. Furthermore, Industry 4.0 is focused on exchanging and collecting information throughout the entire product life cycle [13]. Industry 4.0 is all about feedback which allows decision-making in a more effective and precise way [14].

In order to enable services like the ones previously mentioned, some solutions are available in the literature such as [2], [10], [15], that promote a feedback platform for vehicles in the IoIV context. This proposed platform uses a smartphone as the communication module to perform the communication with the OBD-II. In this work, it is used the Freematics One+[1] device which does not depend on a smartphone to communicate with On Board Diagnostic (OBD-II) as shown in Figure 1. The device operates autonomously with access to the vehicle's ECU.

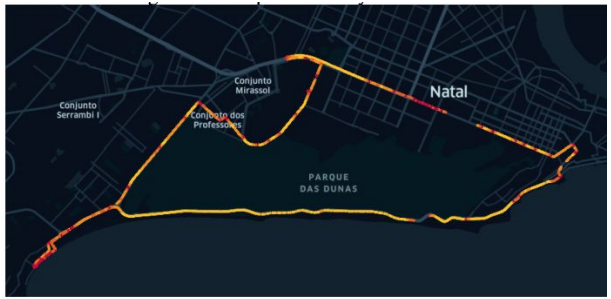
First Generation



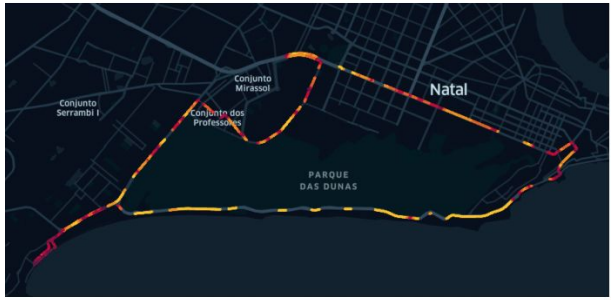
Second Generation



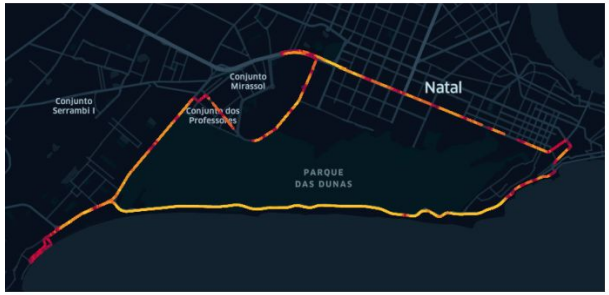
Model	Year	Motor	Transmission	Fuel	PIDs
Ford Ka	2019	1.5	Automatic	flexible	21
Nissan Kicks	2017	1.6	Automatic	flexible	22
Chevrolet Onix	2015	1.4	Automatic	flexible	22



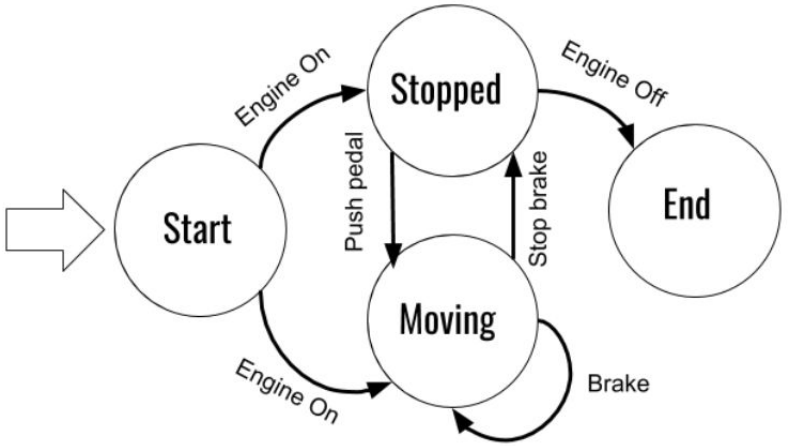
(a) Ford Ka.



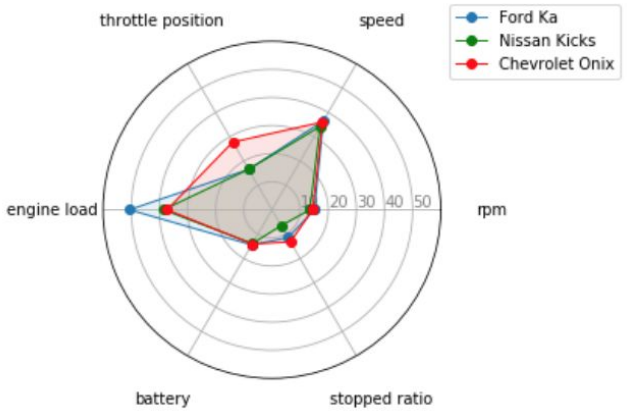
(b) Nissan Kicks.

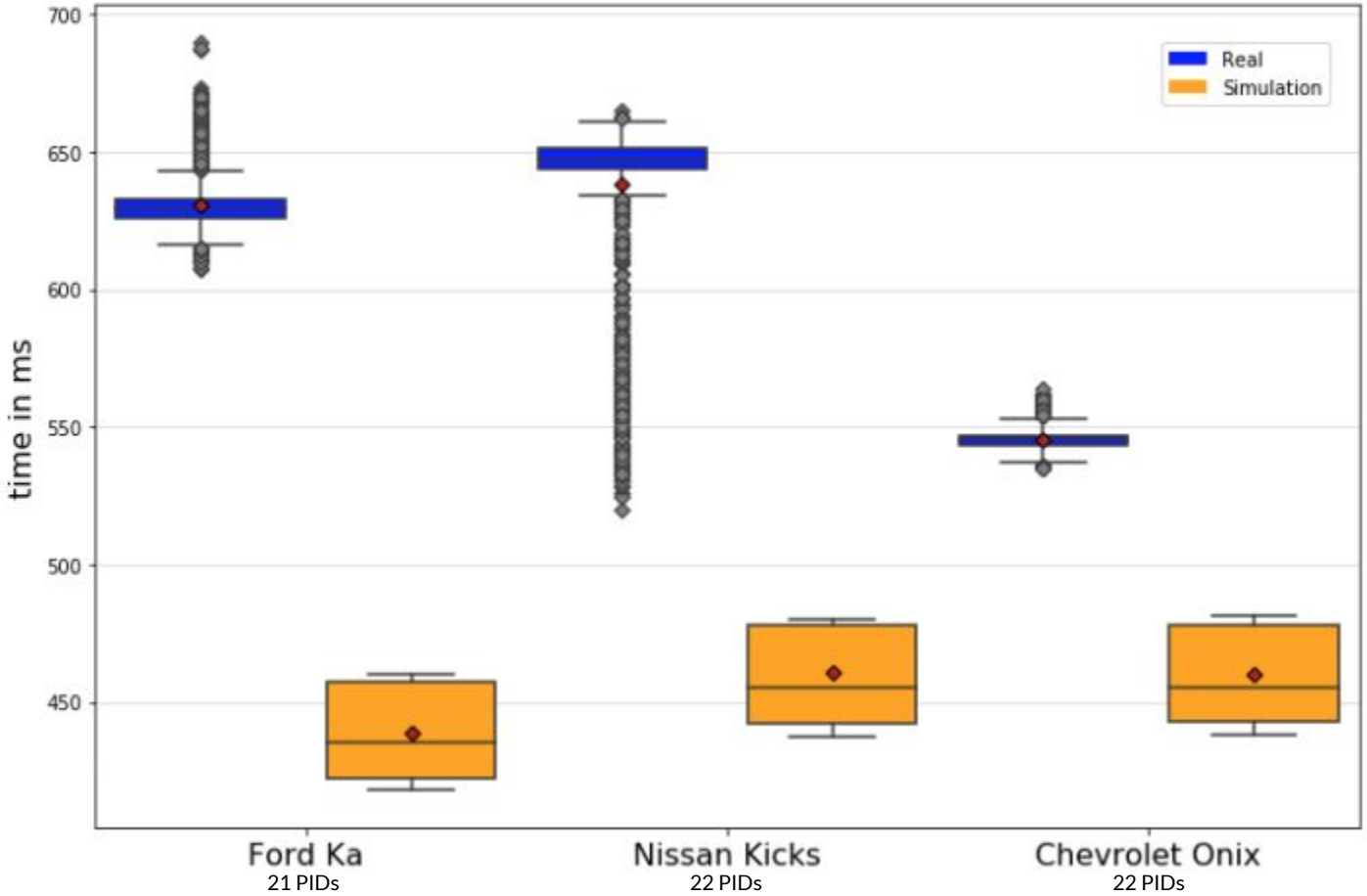


(c) Chevrolet Onix

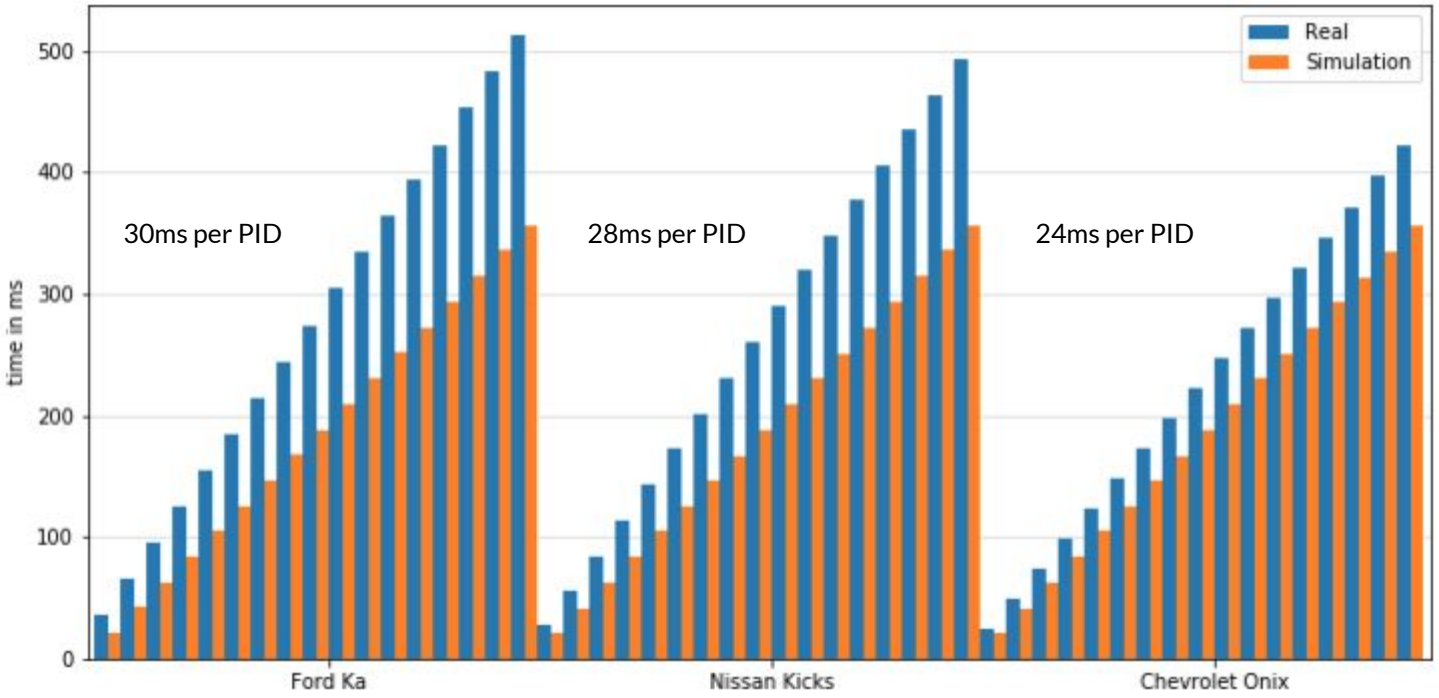


State Machine modeling the driver behavior during experiment.





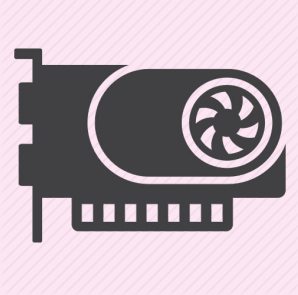
Response time to collect all PIDs



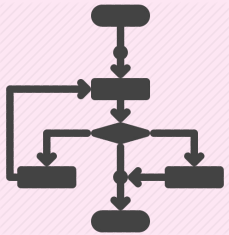
Cumulative distribution of response time for PID set intersection among Ford Ka, Nissan Kicks, and Chevrolet Onix

DATA

INTERNET



HARDWARE



TOOLS/ALGO.

2020

How am I driving?

- Driver behavior modeling
- Eco-Route
- Personalized maintenance
- Automatic road quality detector
- Event data recorder (vehicle black box)

ARTIFICIAL INTELLIGENCE

ARTIFICIAL INTELLIGENCE

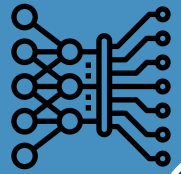
Any technique which enables computer to mimic human behavior

MACHINE LEARNING

AI techniques that give computers the ability to learn without being explicitly programed to do so

DEEP LEARNING

A subset of ML which make the computation of multi-layer neural network feasible



TinyML

GNN

DATA SCIENCE

1950 - 1980

1980 - 2010

2010 - **2021**

Your Pathway

Vector & Matrices

Matrices & Vector Arithmetics
Types, Operations
Factorization

Calculus

Derivatives

@ivanovitchm/imd0033_2019_1

Exploratory Data Analysis

Measurements of Centrality (mean, mode, median, variance, std, z-score)

Data Pipeline

Collect, clean, preparation, model, analysis, interpretation, viz
Deploy, monitoring solution

@ivanovitchm/ppgeecmachinelearning2020.2

Linear Algebra & Math	Probability & Statistics	Data Science	Machine Learning

Probability

Conditional Probability
Distributions
Bayesian Probability

Statistics

Data Viz, Central Limit Theorem
Hypothesis Tests, Correlation
Resampling Methods

@ivanovitchm/datascience2020.6

Supervised Learning

KNN, Linear regression, Logistic Regression, Decision Tree, Random Forest, Ensemble, XGBoost, MLP

Unsupervised Learning

K-Means, PCA

Deep Learning
@ivanovitchm/eec2003

MetroInd40IoT 2020 https://ieeexplore.ieee.org/document/9138270

Performance Evaluation of an evolving data compression algorithm embedded into an OBD-II edge device

Gabriel Signoretti*†, Marianne Silva*†, Jordy Araujo†, Luiz Afonso Guedes*†, Ivanovitch Silva*†, Emiliano Sisinni‡, Paolo Ferrari‡
* Postgraduate Program in Electrical and Computer Engineering (PPgEEC)
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*ivan@imd.ufrn.br and ‡{paolo.ferrari, emiliano.sisinni}@unibs.it

***Abstract*—The new industrial revolution, known as industry 4.0, aims to create value throughout the product life cycle into all industries sectors. In the automotive industry perspective, data can be obtained throughout the life cycle of vehicles if they are appropriately instrumented with an On-Board Diagnostic scanner (OBD-II). Communications interfaces (3G/4G/LoraWan/Wi-Fi) assume essentials rules in order to relay all collected data to services in the cloud. Challenges emerge when using the Low Power, Wide-Area Network (LPWAN) protocols, as the case of LoRaWAN. This article aims to evaluate the feasibility of embedding a data compression algorithm driven by a light-weight evolving real-time approach in order to reduce the amount of data to be transmitted periodically. The proposal was embedded in a low-cost, low-power system on a chip microcontroller based on Edge OBD-II Freematics ONE+™. Results have shown the feasibility of the proposal and indicated compression rates of up to 98% without impact the primary operation of the edge device.**

***Index Terms*—Industry 4.0, Connected Vehicles, Edge OBD-II, Data Compress, Evolving real-time algorithm.**

I. Introduction

Industry 4.0 is a concept that has been changing the vision and value chain of companies. Besides, several modifications have been emerging since the advent of the Internet of Things an automated way, digital information through the sensors and communication protocols present in the vehicles [7].

In this manner, the extracted data can be used for interactions in a new processing and communication context, which leads to a revolution in the way vehicles are used [7], [8]. Thus, this panorama enables the communication between vehicles — Vehicle-to-Vehicle (V2V) — Vehicle-to-Personal devices (V2P) — and between vehicle and local mobile network infrastructure — Vehicle-to-Infrastructure (V2I) —, consisting of the Internet of Intelligent Vehicles (IoIV) [9], [10].

Therefore, the interconnection of vehicles in a network makes it possible to implement numerous new services for Industry 4.0, such as personalized maintenance, vehicle black box, efficient energy/fuel consumption, among many others. These approaches contribute to promoting a vehicle feedback loop: constructive feedback from the vehicles to the Industry [7]. Thus, it is clear that IoIV and Industry 4.0 together can allow for more effective and accurate decision-making processes [11].

To enable services such as those mentioned above, some solutions are available in the literature, such as [7], [8] and

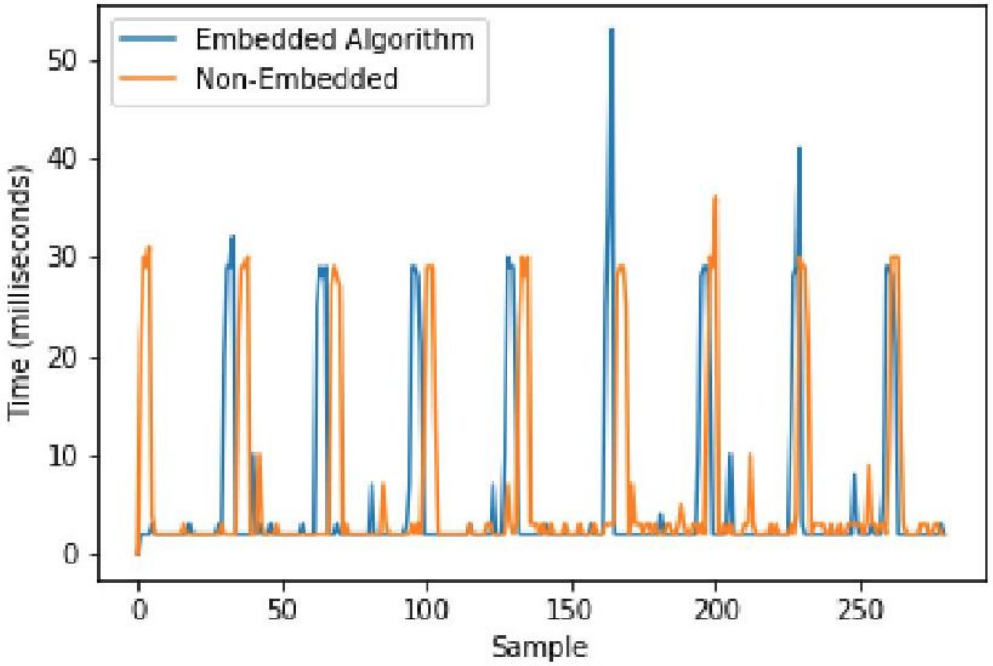
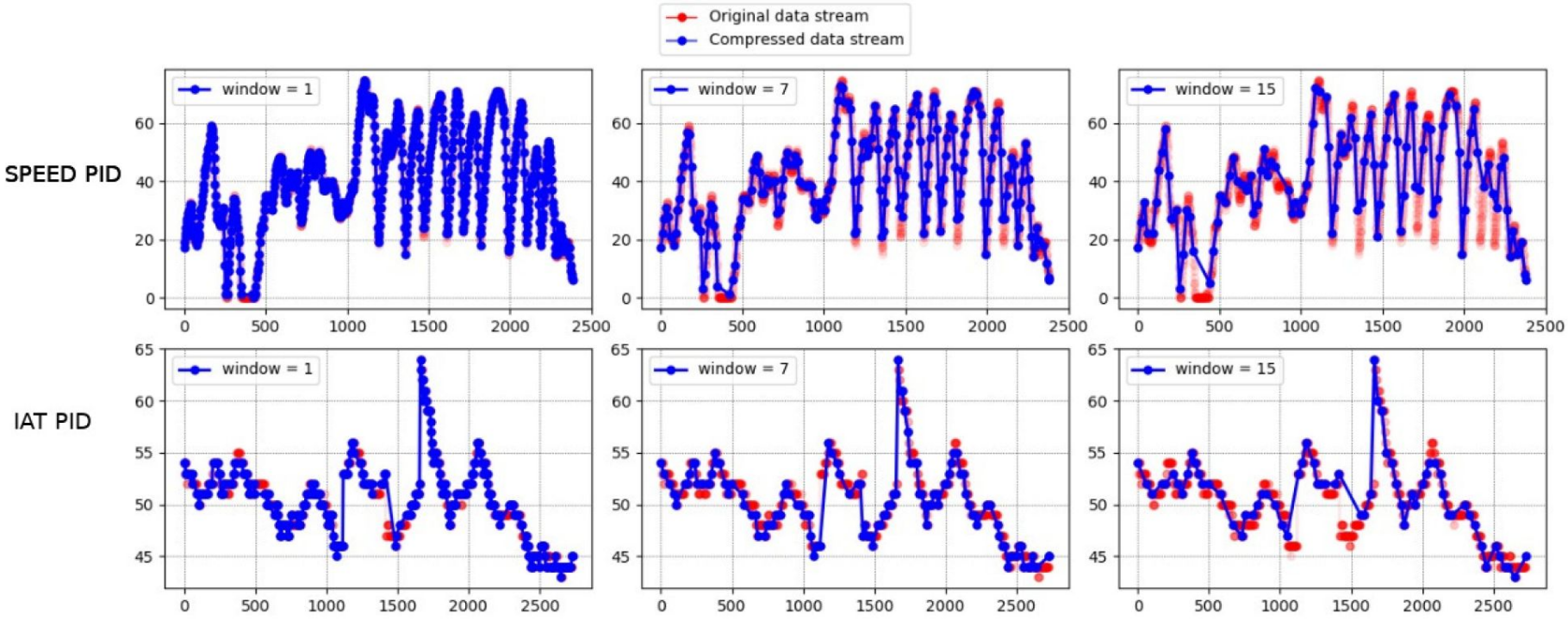


TABLE II
DATA COMPRESSION

Parameter	Compression Ratio Speed	Error Speed	Compression Ratio IAT	Error IAT
1	76%	0.34	87%	0.53
3	86%	0.63	93%	0.77
5	90%	1.38	94%	0.70
7	92%	2.51	96%	0.62
9	93%	6.14	96%	0.99
12	95%	11.39	97%	2.94
15	96%	18.25	98%	1.94


Original data stream
Compressed data stream
SPEED PID
IAT PID
window = 1
window = 7
window = 15

FEDERAL UNIVERSITY OF RIO GRANDE DO NORTE

An agnostic platform for vehicle monitoring and data visualization

by

Rodolfo Natan Silva Queiroz

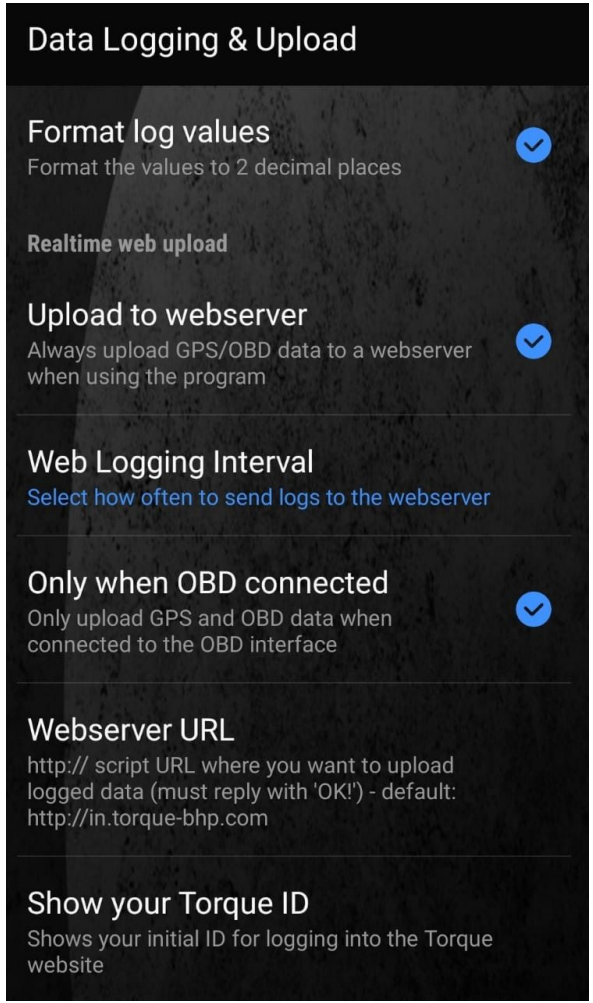
A monograph submitted in partial fulfillment for the Bachelor of Engineering

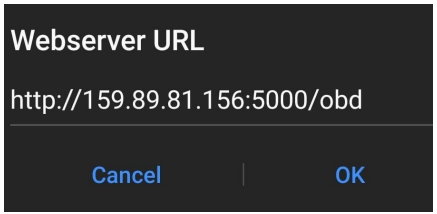
in the

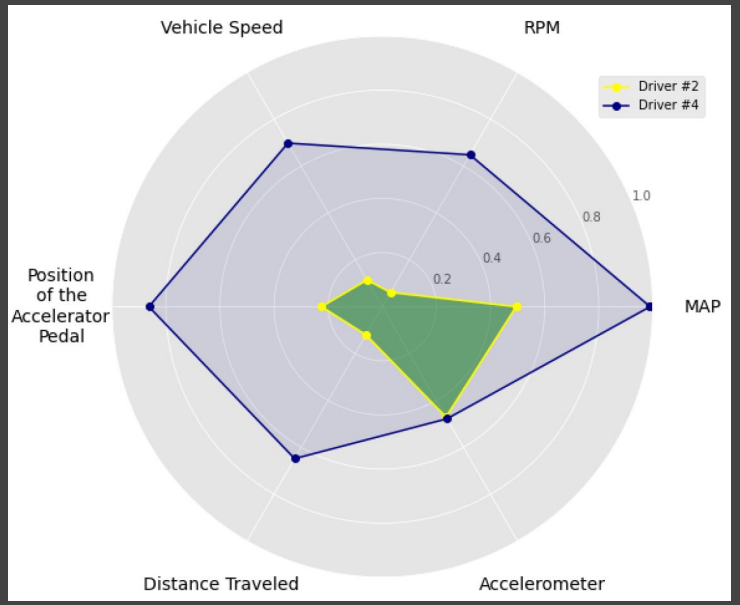
Technology Center
Department of Computer Engineering and Automation

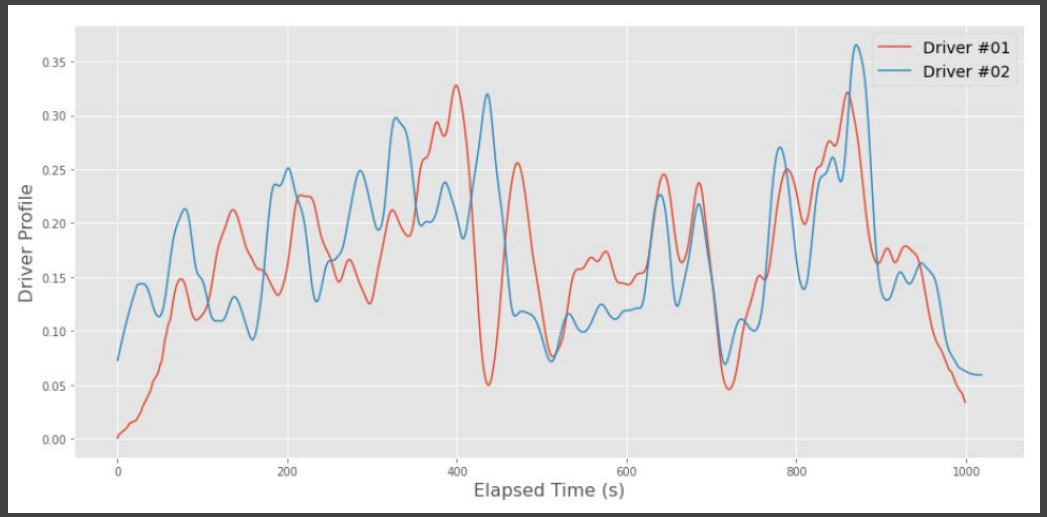
May 2021

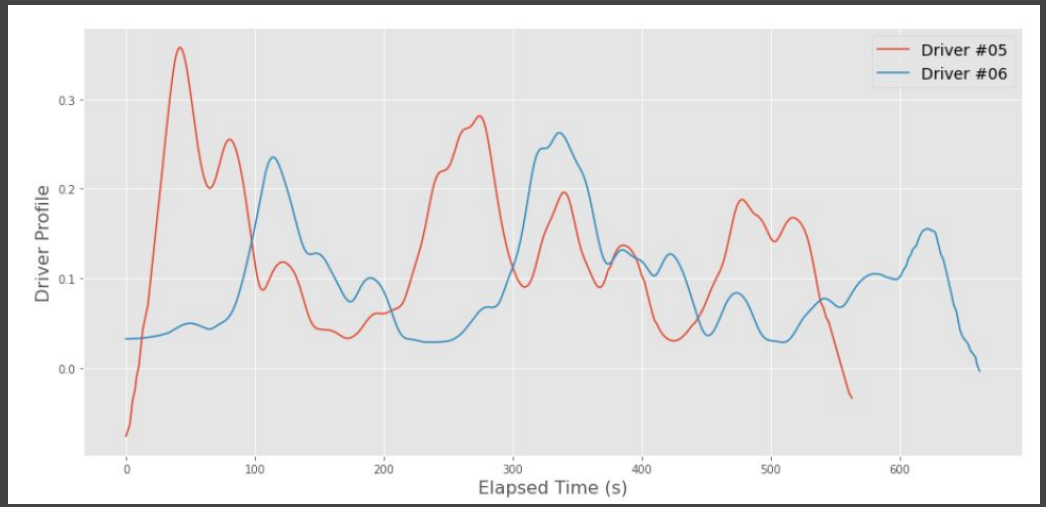
https://github.com/rqroz/obd-dashboard











Driver Behavior Indicator

Pavement Condition Monitoring

Pavement Identification

An Unsupervised TinyML Approach Applied for Pavement Anomalies Detection Under the Internet of Intelligent Vehicles

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***Abstract*—Vehicles have been endowed with new technologies in the last years, mostly influenced by an increasing in the instrumentation level and availability of smart devices for embedded processing. In this scenario, which has paved the way for the construction of Internet of Intelligent Vehicles, the edge computing paradigm emerges with the primary role to promote the processing of raw data streams in their early stages, as close as possible to their origins. Therefore, this paper proposes the processing of data streams based on an unsupervised tiny machine learning approach to detect anomalies on the roads, exploiting for that a microcontroller and an embedded accelerometer on vehicles. The obtained results through real experiments were promising: the f_1 score mean was 0.76 for the first driver and 0.78 for the second. This indicates that the classifier model reached significant performance in the defined scenarios.**

Keywords: TinyML, Edge Computing, Vehicles, Anomalies Detection, Internet of Intelligent Vehicles, Unsupervised Machine Learning.

I. Introduction

The establishment of the Internet of Things (IoT) paradigm and the emerging of cyber-physical systems have provided the amount of carbon dioxide expelled into the atmosphere by vehicles. When many vehicles are using that platform, it is possible to monitor the air pollution produced by vehicles. In [11], a feedback platform within the context of Industry 4.0 was implemented. That platform aims to return the sensor data to the automotive factory. With data acquisition from vehicles being used by consumers, manufacturers can study the vehicle's behavior and develop new measures to identify problems and better manage maintenance actions.

For such applications, data processing is a mandatory requirement. Currently, IoT platforms use machine learning techniques based on the cloud computing paradigm. This way, raw data is streamed to the cloud, or some pre-processing is performed before transmission. However, with the high growth in the use of IoT devices, it becomes more difficult for the central cloud to manage the massive amount of received data. The increase in the amount of data influences the transmission infrastructure, energy consumption, and system reliability. Therefore, a new trend has been to adding intelligence to IoT devices, promoting data processing and decisions making

Voice Interaction As a Human Machine Interface For Industry 4.0

Evaluating Human-Machine Translation with Attention Mechanisms for Industry 4.0 Environment SQL-Based Systems

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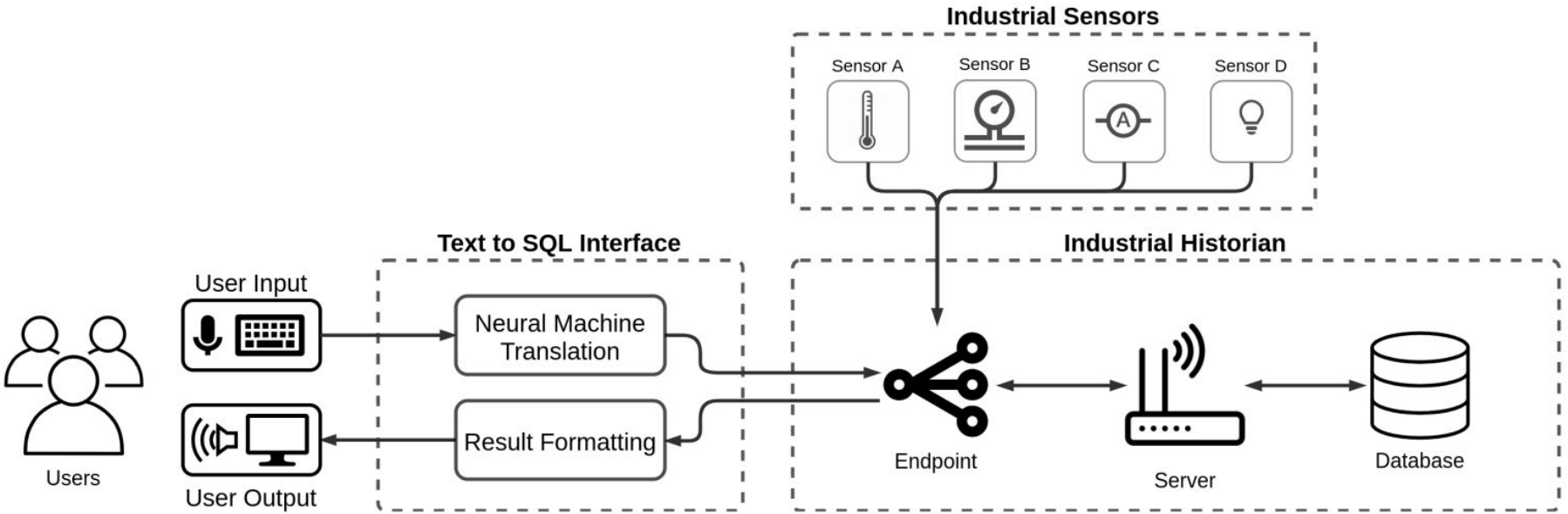
***Abstract*—The use of relational databases is increasingly present in the industry. Applications in medical, IoT and industry 4.0 are examples of this. Despite the large capacity and efficiency in storing and retrieving data, this type of database requires technical knowledge in specific query languages to access this information, which distances these types of application from the lay public. In this work, we propose an application of recent models in natural language processing that use neural networks, as well as attention mechanisms for the translation of natural language in English to SQL applied in an SQL database of a system to store data from sensors, focused on the concept of Industry 4.0. Paired examples of natural language phrases were generated with their corresponding SQL query to be used for training and validation. By training the neural network, we obtained a language model with an accuracy of approximately 99% in the validation set.**

***Index Terms*—NLP, Attention, Industry, IoT, Measurement, SQL, Deep Learning.**

I. Introduction

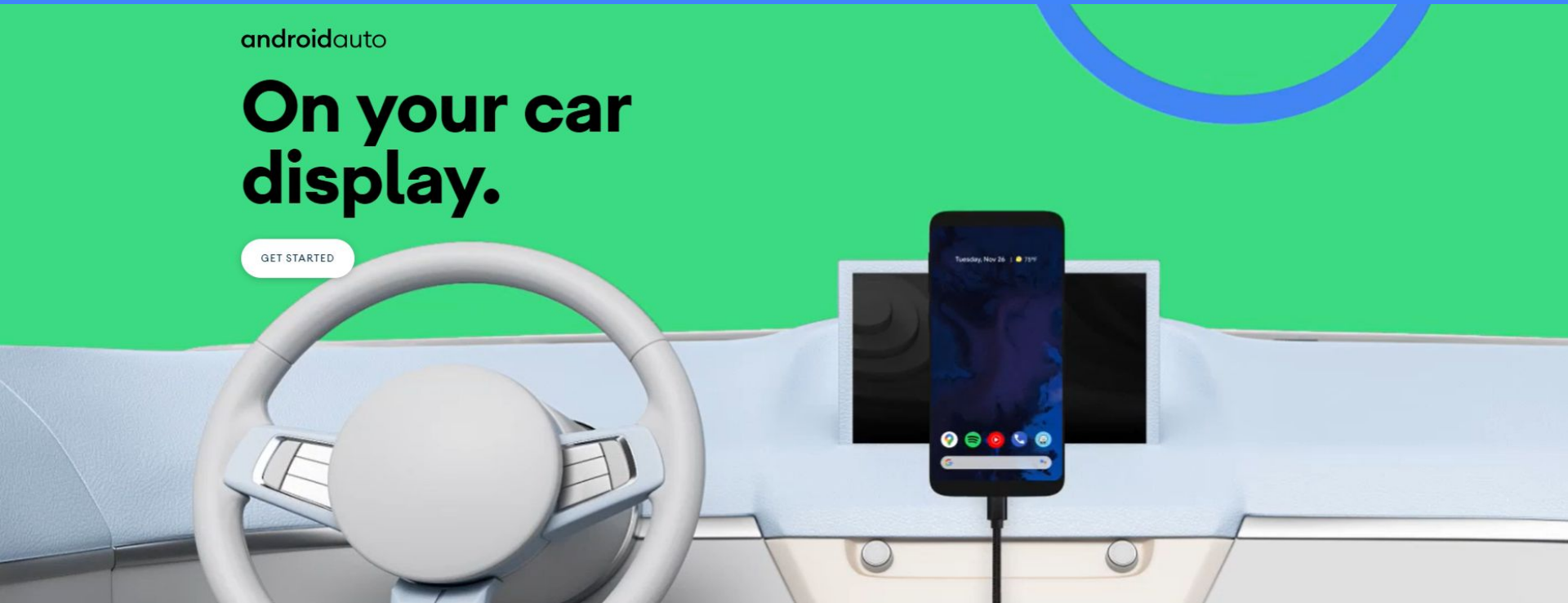
In a scenario where the industry is positioned as one of the main pillars of economic growth, the emergence and development of new technologies that allow the improvement in the quality and efficiency of production in these environments have a significant impact in both economic and social aspects. equipment throughout the environment, and in many cases can prevent accidents, detect failures and assist in increasing production efficiency [4]. This integration refers to the concept of IoT (Internet of Things) as the larger volumes of data in industrial environments is related to Big Data [3].

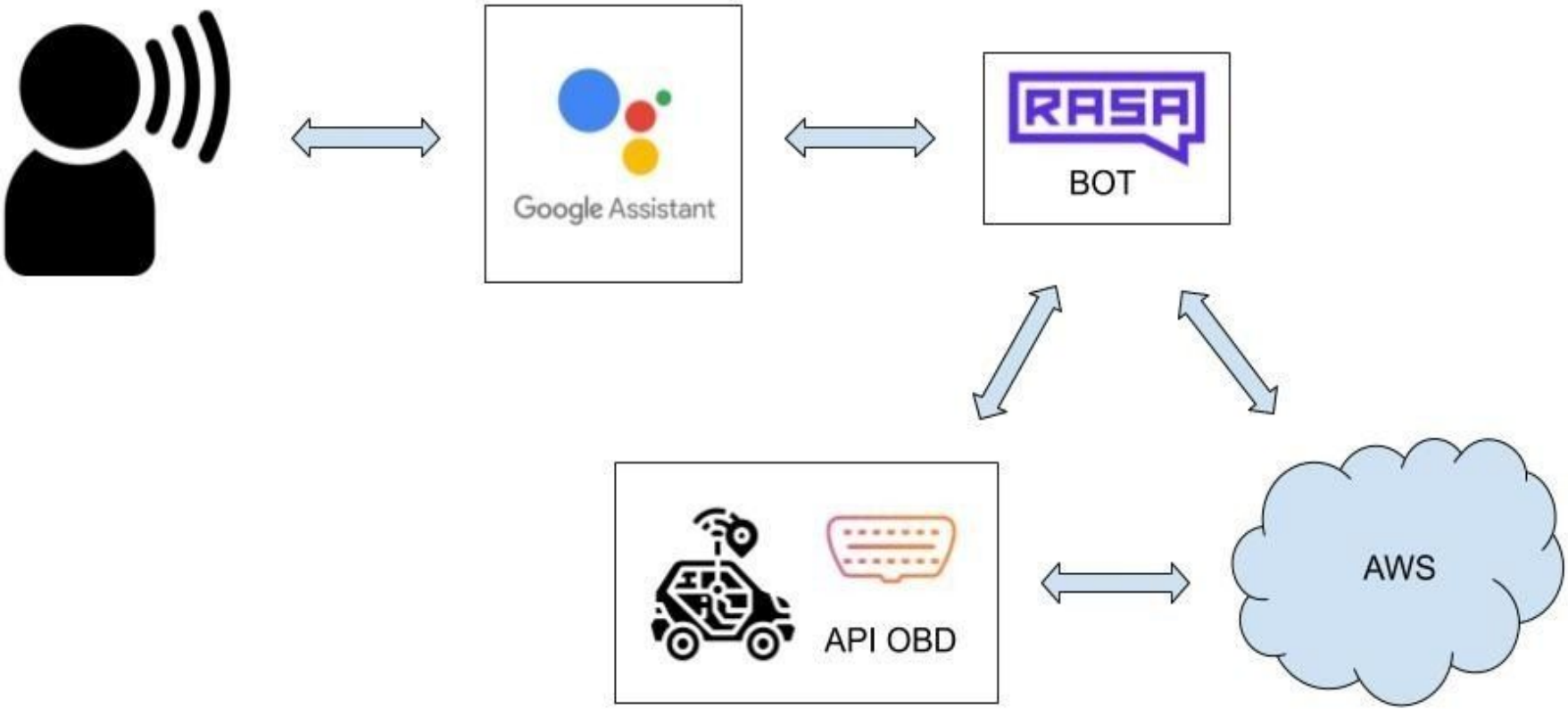
The data from factory such as temperature, pressure, density sensors, among others, are interconnected and communicating with a central or cloud, responsible for analyzing and collecting data generated every second. Thus, it is known that the way in which these data are handled depends on a specific language for the type of database used. Sometimes data historians are used to eliminate islands of information and integrating with other factory and storage systems [6]. These historians are very common in industrial environments [6], having a specific database that can allow access through different interfaces [7]. And even with the increasing use of non-relational databases [8], it is still quite common to use relational databases [9] in applications by industrial historians, such as PI Systems®. A high-level interface to a widely used database system is Structure Query Language (SQL), which was designed at IBM Research. The execution of the query on these systems is done by the database management system. However, despite



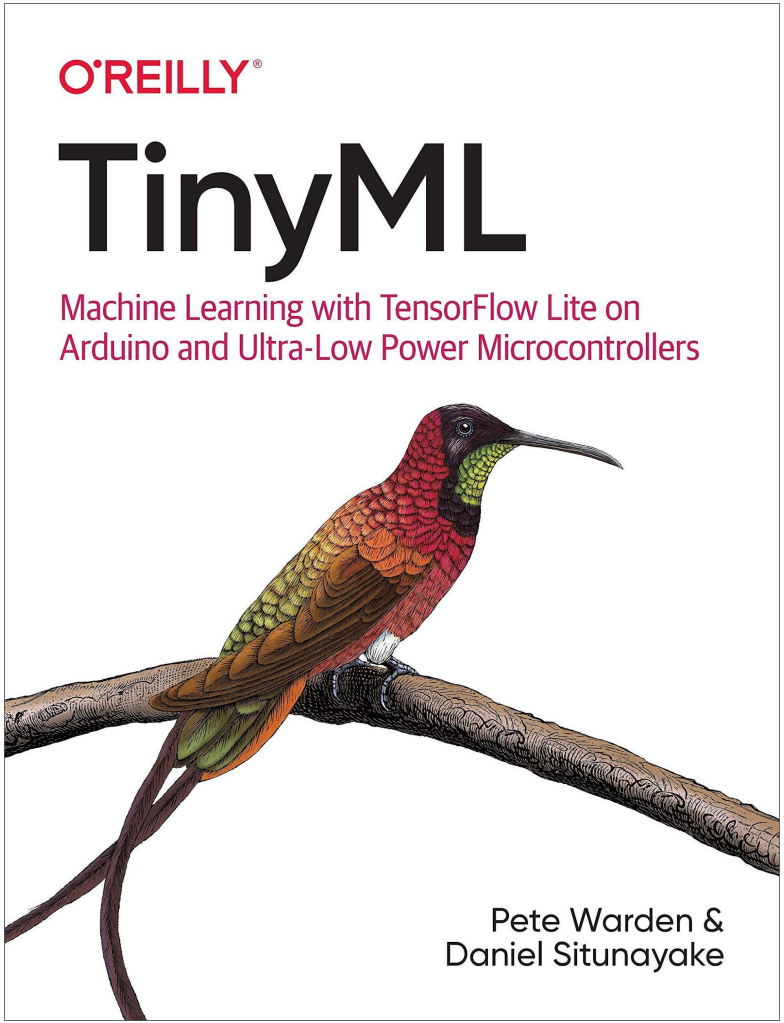
Input Sentence	Generated Query
give me the average pressure on boiler in march 27 between 2am and 4pm	select avg(registers.value) from registers,sensors,plants where registers.sensor=sensors.id AND sensors.name='pressure' and registers.created_at between '2019-03-27 02:00' and '2019-03-27 16:00' and sensors.plant=plants.id AND plants.name='boiler'
what was the maximum temperature in the motor from jan 2nd to feb 3rd?	select max(registers.value) from registers,sensors,plants where registers.sensor=sensors.id AND sensors.name='temperature' and registers.created_at between '2019-01-02 00:00' and '2019-02-03 23:59' and sensors.plant=plants.id AND plants.name='motor'
temperatures on motor yesterday	select * from registers,sensors,plants where registers.sensor=sensors.id AND sensors.name='temperature' and registers.created_at='2020-02-17' and sensors.plant=plants.id AND plants.name='motor'

Vehicular Personal Assistant?

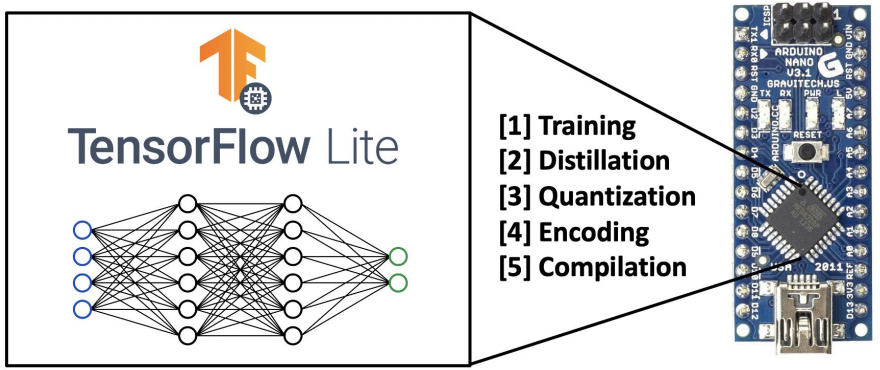




https://github.com/eltonvs/kotlin-obd-api



https://abre.ai/tinhml



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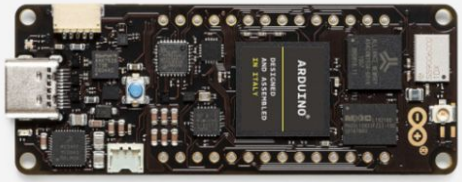
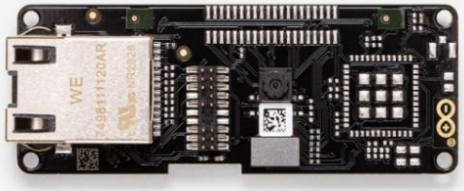
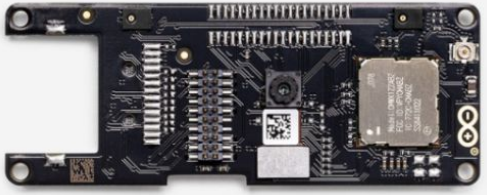


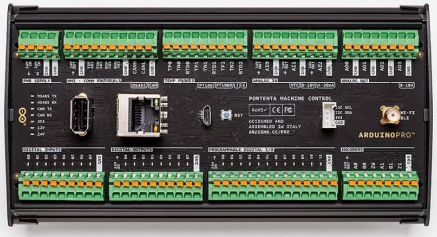
Portenta H7



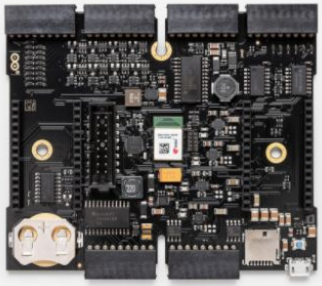
Portenta Vision Shield Ethernet



Portenta Vision Shield Lora

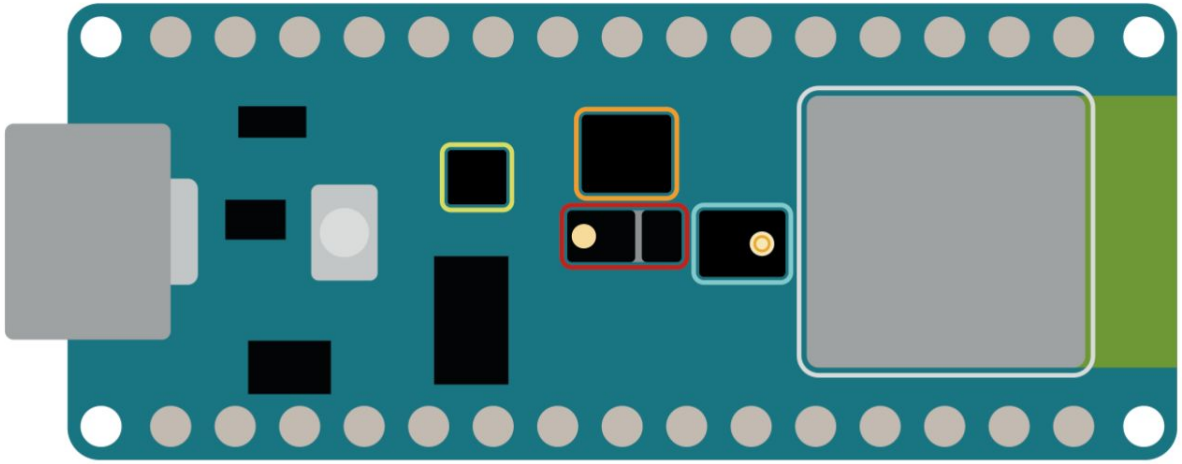


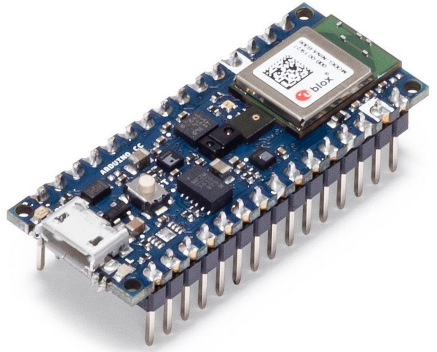
Portenta Machine Control



Edge Control

https://store.arduino.cc/usa/new-home/pro





Nano 33 BLE Sense

- Color, brightness, proximity and gesture sensor
- Digital microphone
- Motion, vibration and orientation sensor
- Temperature, humidity and pressure sensor
- Arm Cortex-M4 microcontroller and BLE module

Bring the power of AI to your pocket with Arduino's tiniest form factor.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3. Edge Computing
4. Future is Tiny
The Internet of Intelligent Vehicles and Their Applications

LABORATÓRIO DE INFORMÁTICA INDUSTRIAL

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