Traffic Management Platform

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Context

- This project is part of PASMO - Plataforma Aberta para o desenvolvimento e experimentação de Soluções para a MObilidade.
- Intelligent mobility support.
- Road safety.

Clients / Stakeholders

- Common User
  - Generic Data
  - Real Time
- Public Entity
- Traffic Managers
  - Historical Data
  - More specific

Motivations and Objectives

- Improve traffic classification in Barra and Costa Nova.
- Provide useful generic data about traffic to the common population.
- Provide more detailed statistics to traffic managers.
  - Weekly, daily and per hour.
  - Classification and density.

Features

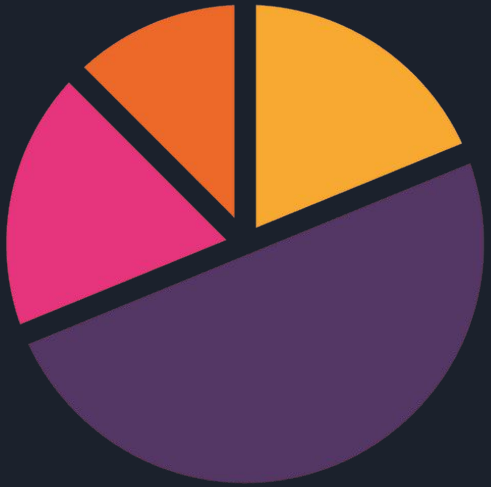
- Visualization of charts related to some functions.
    - Traffic Density
    - Traffic Classification

- Visualization of in/out flow in real time and in different time intervals.

Features

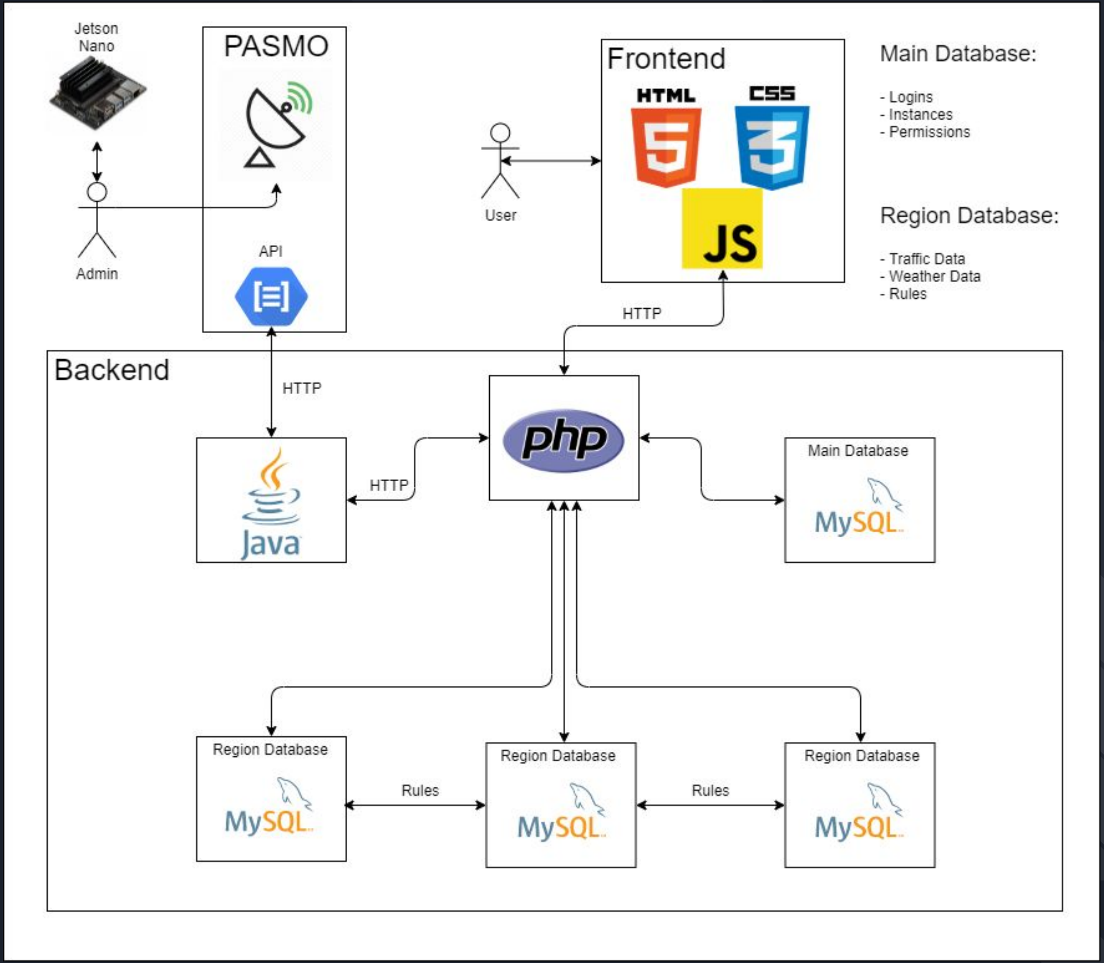
- Direct comparison of values between different time intervals.

- Fusion between data from radars and cameras.
  - Considering that the vehicle classification and tracking will serve as a tool to calibrate radars.



The System

Architecture



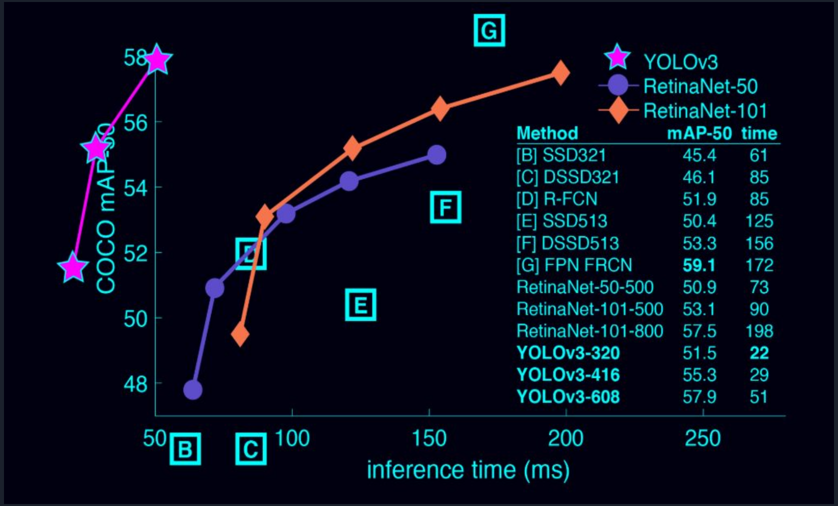
Used Tools

- Client Side
  - HTML, CSS and JavaScript: Used to control the interface and the application flow.
  - Chart.js: Used to create the application charts.
  - Leaflet: Used to get and customize the maps.

- Server Side
  - PHP: Used to establish the connection between the web application and the database.
  - Java: Used to access data from the PASMO API, process that data and inject it in our database.
  - MySQL: Used to create the database, store and access the processed data.

Used Tools

- Python
  - Used to create the application that classifies and counts the vehicles.
- Darknet
  - Used to create and train the neural network to categorize the vehicles.
- YOLO
  - Uses neural network to categorize vehicles.



Method	mAP-50	time
[B] SSD321	45.4	61
[C] DSSD321	46.1	85
[D] R-FCN	51.9	85
[E] SSD513	50.4	125
[F] DSSD513	53.3	156
[G] FPN FRCN	**59.1**	172
RetinaNet-50-500	50.9	73
RetinaNet-101-500	53.1	90
RetinaNet-101-800	57.5	198
YOLOv3-320	51.5	**22**
YOLOv3-416	55.3	**29**
YOLOv3-608	57.9	**51**

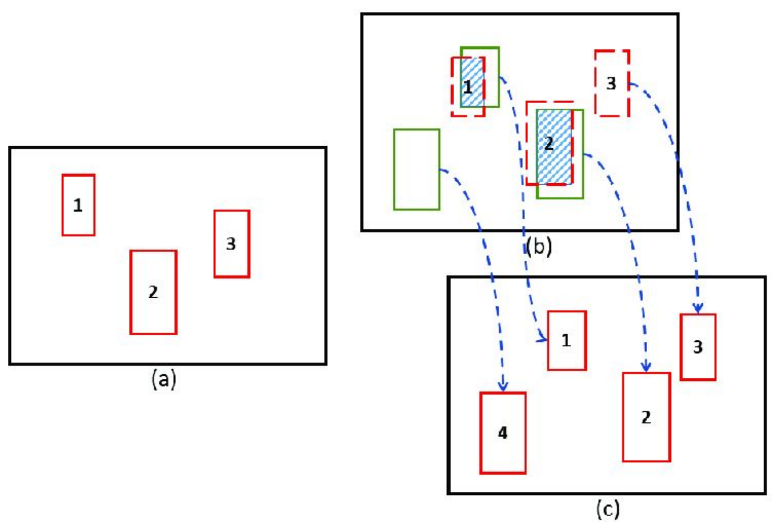
Used Tools

- Deep Sort Algorithm
  - Used to track vehicles.

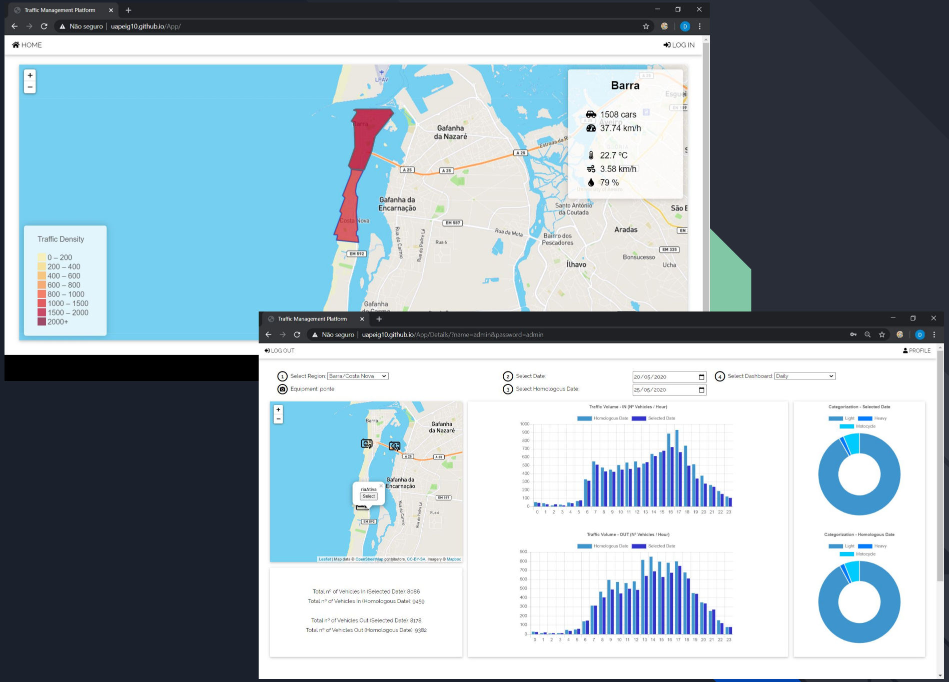
- Jetson Nano
  - Board with powerful GPU.

Deep Sort

- Track an object through an entire video.
- If there are 3 detected cars, the tracker identifies 3 separate detections.
- The tracker needs to track them across subsequent frames (with the help of an ID).



Web Application



Traffic Management Platform

Não seguro | uapeig10.github.io/App/

HOME

LOG IN

Barra

1508 cars

37.74 km/h

22.7 ºC

3.58 km/h

79 %

Traffic Density

Traffic Density
0 – 200
200 – 400
400 – 600
600 – 800
800 – 1000
1000 – 1500
1500 – 2000
2000+

Traffic Management Platform

Não seguro | uapeig10.github.io/App/Details/?name=admin&password=admin

LOG OUT

PROFILE

1. Select Region: Barra/Costa Nova

Equipment: ponte

2. Select Date: 20/05/2020

3. Select Homologous Date: 25/05/2020

4. Select Dashboard: Daily

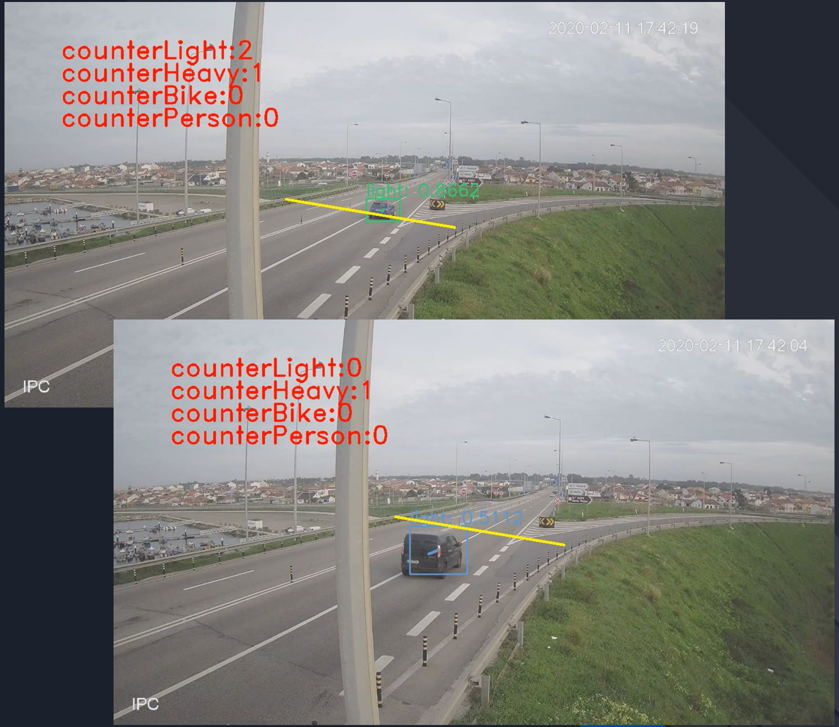
Total nº of Vehicles In (Selected Date): 8086

Total nº of Vehicles In (Homologous Date): 9459

Total nº of Vehicles Out (Selected Date): 8178

Total nº of Vehicles Out (Homologous Date): 9382

Object Tracking and Classification

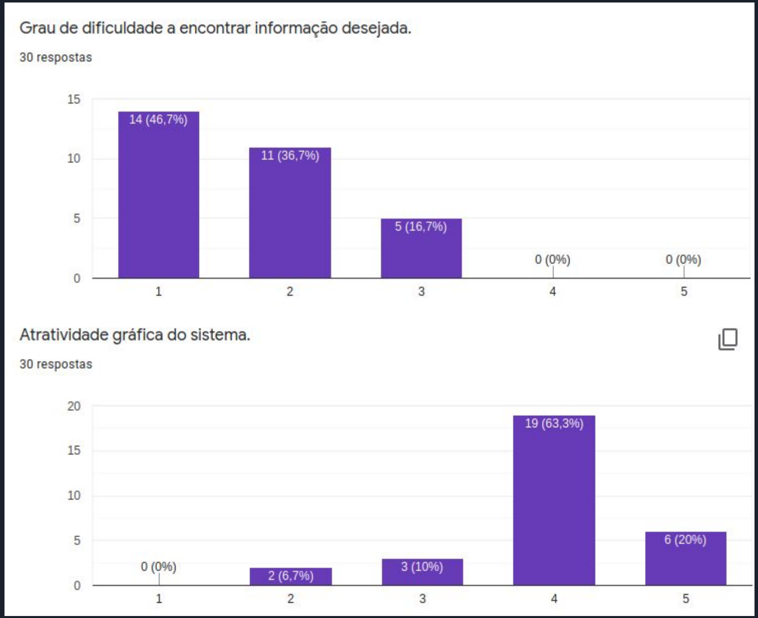


Usability Tests

- User centered design.

- The graphic shows part of the answers of the usability tests made.

- Note that the tests were performed by regular users, giving us some information that lead to light changes in the appearance of the application.



Grau de dificuldade a encontrar informação desejada.

30 respostas

Atratividade gráfica do sistema.

30 respostas

Conclusion

Requirements Revision
High Priority

- Visualization of charts related to some functions. ✓
- Visualization of in/out flow in real time. ✓
- Information efficiently updated. ✓
- Equipment selection should be done through a minimap. ✓
- Distinction between users on viewing permissions. ✓
- Database updates in 15 minute intervals. ✓
- YOLO utilization to categorize vehicles. ✓
- 10% increase in success rate of vehicle categorization. (?)

Requirements Revision
Medium Priority

- Direct comparison between different zones. X
- Direct comparison between different time intervals. ✓
- Visualization of in/out fluxe in different time intervals. ✓
- Selection of 1 or more radars do analyze data from. ✓
- Database Security. X
- Exhaustive documentation. ✓
- Database updates in 10 minute intervals. ✓
- 15% increase in success rate of vehicle categorization. (?)

Requirements Revision

Low Priority

- Visualization of meteorological data. ✓
- Database updates in 5 minute intervals. ✓
- 20% increase in success rate of vehicle categorization. (?)

Challenges

- Social Confinement.
  - Also an opportunity.
- Jetson performance issues.
- Dealing with a fully deployed system:
  - Occasional radar malfunctions.
  - Occasional changes to the availability of the API.

Future Improvements

- Automated fusion between radar and camera data.
- More options to view the information (chart types).
- More dashboards (meteorology, speed).
- SSL Certificate to make the connections secure.
- Mobile application.