Level Crossing protection integration into connected car technologies

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Focused on Geospatial analysis

Who are we?

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García
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Problem definition
Types of LC
Distribution of accidents in LC
Focus on warning
Goals
System design
LC application
Data providers
Used tools
Final operational system
Future
The goal is to solve the problem of warning to drivers in advance to take precautions when they are approaching a level crossing.

Avoid accidents due to the occupancy level crossing for vehicles that have been stopped on the railroad.
<table>
<thead>
<tr>
<th>CLASS</th>
<th>Description</th>
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<tbody>
<tr>
<td>A</td>
<td>Protected level crossings exclusively with fixed signals.</td>
</tr>
<tr>
<td>B</td>
<td>Protected level crossings with light and acoustic signals. (S.L.A).</td>
</tr>
<tr>
<td>C</td>
<td>Protected level crossings with half-barriers, double half-barriers or barriers, Automatic or Nailed (S.B.E., S.B.A. or S.B.E./S.B.A.).</td>
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<td>Year</td>
<td>Accidents at LC</td>
</tr>
<tr>
<td>------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>Passengers</td>
</tr>
<tr>
<td>2013</td>
<td>479</td>
</tr>
<tr>
<td>2012</td>
<td>510</td>
</tr>
<tr>
<td>2011</td>
<td>447</td>
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<td>2010</td>
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<td>2009</td>
<td>493</td>
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<td>2008</td>
<td>539</td>
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Focus on warning

Most effective is replace LC, but it is expensive, so

- Signaling its location on the road by traffic signals in a passive way.
- Closing by detecting the proximity of a train by an active way.
Goals

Notify drivers a nearby Level Crossing.

Notify to Infrastructure Managers about the interception of a Level Crossing by a vehicle when the driver indicates incidents.

Notify to Infrastructure Managers about the interception of the track, at any point, by a vehicle when the driver indicates incidents.

Improve road and railways safety, reducing level crossing accident impact
Solution based on geolocation in real time of all parts of the system and notifications to drivers and infrastructure managers, not to replace actual systems

- Level Crossing facilities, regardless of type.
- Vehicles.
- Trains.
- Infrastructure managers.
Taken advantage that connected car concept begins to take shape in all countries

Collects real-time information
Central intelligent cloud
Returns information and events
System design

Context data integrated into layers

- Meteorology
- Glare
- Ramps / slopes
- Planning
- Maximum speeds
- Statistical data
- Intermodal points
- Gauge
- Bus lines
- Dangerous sections
- Cycling routes
- Incidents
- Points of interest
- Limit lines
- Ground uses
- Railways
- Urban roads
- Interurban roads
...
Actual system developed for Dirección General de Tráfico collects real time information about:

- Position
- Speed
- Vehicle type

Computes driver risk and return

Real time audio an text notifications
System design - Connected Car
Our on board vehicle solution
Singularity logic cloud distribution use
911 LC distribution on IGN Spatial Data Infrastructure
LC location application from BTN100
LC location correction application

Too much error we need reduce it to less than 5m
INSPIDE geolocation application
Updated locations

Leyenda
- PN sustituidos
- PN georreferenciados
- Líneas
- CC.AA.
GPS accuracy on board better than 5m at 120 km/h
Message per second processed
178 M transactions per day
In real time
Two kind of notifications

**Vehicle**

notifications are sent based on the vehicle speed, specifying the name of the road and where KP is located.
On board notifications

Paso a Nivel con posible tren en las cercanías a 341 metros.

30 metros
Two kind of notifications

Vehicle

notifications are sent based on the vehicle speed, specifying the name of the road and where KP is located
Two kind of notifications

**Infrastructure Manager**

The position of vehicles is computed in real time, and if its driver declares an incident, the system is able to identify if he is located within the Level Crossing.
Identified 911 Level Crossings in BTN100 within the BTN100_0617P_PASO_NIVEL layer. BTN100 and BTN25. Orthophotos PNOA. Cartociudad.
CREATE TABLE public."BTN100_0617P_PASO_NIVEL"
(
    id_0 integer NOT NULL DEFAULT nextval("BTN100_0617P_PASO_NIVEL_id_0_seq"::regclass),
    geom geometry(Point,4258),
    id double precision,
    id_bd double precision,
    id_codigo character varying(5),
    id_mod double precision,
    fecha_alta character varying(20),
    CONSTRAINT "BTN100_0617P_PASO_NIVEL_pkey" PRIMARY KEY (id_0)
)
PNOA – LC distribution

<table>
<thead>
<tr>
<th>Año</th>
<th>Número</th>
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<tr>
<td>2011</td>
<td>799</td>
</tr>
<tr>
<td>2012</td>
<td>78</td>
</tr>
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<td>2013</td>
<td>29</td>
</tr>
<tr>
<td>2014</td>
<td>5</td>
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Used tools

Linux operating system installed over the Amazon AWS cloud.
PostGIS database.
Python and Java.
Docker containers to deploy microservices
Desktop tools QGIS
Final operational system - Architecture

- EC2 cluster & Microservices
- Load balancers & perimeter security
- Monitoring
- MQTT/Rest Interfaces
- Vehicle on board and user apps
- VPN
- DGT

AWS
• More than 30000 on board devices confirmed
• National road and railways coverage
• Availability to use European cartography
• National 911 Level Crossing
• System in production environment ready to send Singularity to Car
• Ready to incorporate Infrastructure Managers and Railway Undertakers into the system
Final operational system - Results


Actually contacts with car contractors to include it on connected cars
Next steps

Improve LC location accuracy
Include train location in evaluation process
Involve Infrastructure Managers for a complete integration with their Information Systems
Improve the publication of open data about railways
Spread out the system to vehicle on board
Spread out the system to other countries
Include the logic into DGT 3,0 platform to reach 2,5 M devices
Level Crossing protection integration into connected car technologies

Thank you and improve railways and road safety