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# High speed detecting and identification for car charging on electric roads

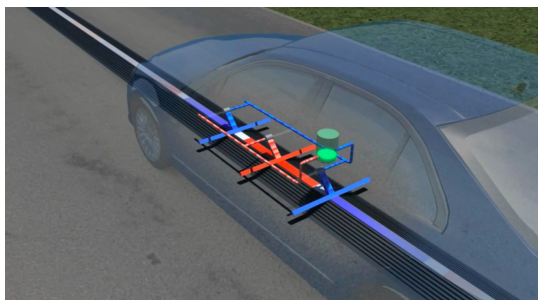
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**E**lectrical vehicles have expensive batteries that give limitations to driving range, recharging time and weight. But what if the road could give electricity to the car whilst driving? This thought made the inventor Dan Zethraeus design a road solution making this possible. But for the design to work the road needs to know exactly where cars are and keep track of each car's movement.

## EIOnRoad concept

The idea of electrified roads resulted in a company and research project called EIOnRoad. The electric road consists of a small rail track running along the middle of a traffic lane. The cars are equipped with sliding contacts that slide on this rail and pick up electricity conductively as shown in figure 1. The



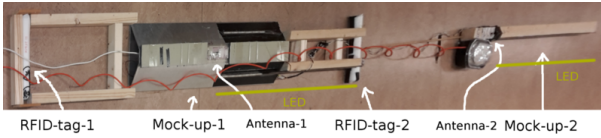
**Figure 1:** *The EIOnRoad rail track placed on top of a road and a car passing over with its sliding contacts*

rail in itself is divided into short electrical segments so that only the segment under a passing car is providing electricity. A more precise description of how the road and switching works can be found in the full rapport or on EIOnRoad's homepage <http://elonroad.com/info/>. The fact that a segment is active only while a car is driving over it makes the road safe to use. In this way there is no risk of electrocution for pedestrians. To turn the segments on and off at the right time, the road needs to know exactly when the car's sliding contacts are about to enter a segment and when they leave a segment. The road also needs to know which cars and how many cars are taking power from the road. Two problems without an obvious solution.

## A prototype approach

The solution to these problems was to build a detector system consisting of a WiFi network, resonating magnetic field detectors and RFID tags and readers. A setup of this system was built, with LED lights lighting up for each segment that was supposed to be switched on. Figure 2 shows the setup of the system.

The way this system works is that the car is equipped with an antenna sending out a magnetic field, resonating at a frequency of 140 kHz which is later used for the road to detect the car, marked with green in figure 3. The car is also equipped with an RFID reader for a car to identify the road, marked as (C) in the figure. RFID - radio frequency identification,

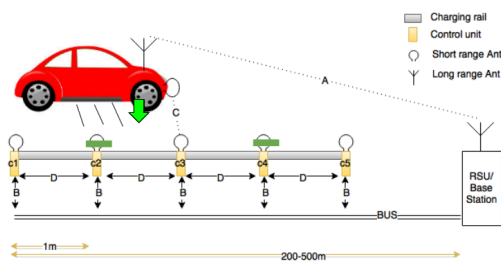


**Figure 2:** The test system with magnetic field detectors and RFID tags. The segments are connected to a wireless network router with cables. On the sides of the segments there are mounted LED lights

tells the road which road segment it is about to enter. The detection was tested successfully at speeds up to 100 km/h and analyzed with high speed cameras. A short film about the experiments can be seen at <https://youtu.be/pi7xS-64di8>

is the same system that is used in ticket machines on the train station and buses to read the identity of your commuter card when you buy fare tickets. In those systems the ticket machine has a RFID reader and your card has a small RFID tag inside it [?].

When the car is driving towards the electric road



**Figure 3:** The car connects to the wifi (A) and sends the tag information (C) to the road. The road segment detects the car's inductive resonance circuit (Green line and arrow) and switch the next rail (C4)

it connects to a specific WiFi network and sends over its speed together with some other information. The car then uses the RFID reader to read the ID of the nearest tag on the road. By sending this ID to the logic in the road, the road knows between which segments the car is located. When the car passes over a segment the segment detects the resonating magnetic field the car sends out. The way the magnetic field is constructed makes it possible to detect a specific position in the magnetic field with an accuracy of 1 cm, even at high speeds. Using this precise detection the road can detect when a car is about to enter a road segment, turn on the power during the time the car is above it and calculate for how long the power has to be on for the car to pass successfully. This process is repeated for every segment the car passes and makes a very reliable system that secures that a car actually is above a road segment before it turns on. The road knows which car is taking power from which segment and how many cars are active on the road since the car identifies itself towards the road using the wifi and