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# Simplifying the complexity of driving range for electric vehicles

**Anders Lundström**

Media Technology and Interaction  
Design

KTH-Royal Institute of Technology  
SE-10044 Stockholm, Sweden  
andelund@csc.kth.se

**Ingvar Ohlsson**

Tritech Technology AB  
P O Box 1094

SE-172 22 Sundbyberg, Sweden  
ingvar.olsson@tritech.se

**Cristian Bogdan**

Media Technology and Interaction  
Design

KTH-Royal Institute of Technology  
SE-10044 Stockholm, Sweden  
cristi@csc.kth.se

**Lennart Fahlén**

SICS-Swedish Institute for  
Computer Science

Box 1263  
SE-164 29, Kista, Sweden  
lef@sics.se

**Filip Kis**

Media Technology and Interaction  
Design

KTH-Royal Institute of Technology  
SE-10044 Stockholm, Sweden  
fkis@csc.kth.se

**Abstract**

Electric vehicles pose great potential as a more environmental friendly solution to transportations in the future. But electric vehicles suffer from short range, which might cause energy anxiety. Many factors are involved and it is therefore hard for drivers to estimate their driving range. We are working to address this through the design of tools that simplifies complexity and aid driving situations through reflection.

**Author Keywords**

Electric Vehicle, Sustainability, Energy, Range Anxiety, Interaction Design.

**ACM Classification Keywords**

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

**Introduction**

Electric vehicles (EVs) have great potential as a more environmental friendly solution to transportations in our society as it is more energy efficient, do not rely on fossil fuel, and are exhaust free.

However, EVs have a driving range of about 165 km (in average) in combination with charging times of approximately 8 hours in normal power plugs and a minimum of about 2 hours in fast charging stations for

a fully charged battery, which means that running out of charge due to planning mistakes might take hours to recover from. This is mainly because battery technologies do not offer cheap manageable solutions for providing the same driving range as ordinary fossil fuel vehicles. The limited driving range is said to cause a phenomenon referred to as *range anxiety* [3], which simply is the anxiety or fear that one would not be able to reach a desirable destination.

It is a complex activity to estimate available range in an EV, as there are many factors involved. For instance weather conditions like wind and temperature, geographical properties as the slope of the road, car properties like battery condition and air resistance, as well as, usage factors like speed and driving pattern. This is ultimately about energy management, and since EVs are mobile devices dependent on access to energy resources, energy availability also becomes an important factor.

This calls for the need of supportive mobile technology, to be able to handle energy management, anytime and anywhere, in the drivers everyday life on the road in a simplified way. This might be addressed with design of more translucent technology [2] and feedback [1] for reflection.

### **Our work**

In our research we have been exploring the problem domain through the design and use of explorations tools focusing on elaborated forms of reachable range representations presented on maps. We are aiming for a continuation of that exploration by inviting people to

explore EV driving through an Internet application. We are also working with the design of an in-car version of our tool to be able to investigate our ideas '*in the wild*'.

So far in our research we have found that our map-based designs are useful in the sense that it could simplify understanding of possibilities and how EV technology work, but also as a tool for reflection of driving practices. In our design we also found an interesting design tensions related to zooming in map-based energy representations that needs to be addressed, and identified the need to see future temporalities of driving range as a support for planning as our users tended to get into trouble without this information, which is a challenge as maps tend to be cluttered with too much information.

### **References**

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