

Serious games for behaviour model identification in the context of electromobility

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Motivation

Electric Vehicles (EVs) are being discussed as a promising technology in improving energy efficiency for our transportation needs and reducing CO₂ emission. It is important to understand when and where the EV owner decides to go charging. This knowledge of the charging behaviour helps the charging service provider to optimise their business plan. Further, the charging behaviour affects the charging station deployment and vice versa. Utility providers benefit from this knowledge as they can adapt their power supply or may attempt to manipulate the charging behaviour by varying the charging price. Car manufacturers can also use this knowledge to adjust the battery capacity for different market regions. A Scalable Electro Mobility Simulator (SEMSim) is developed by TUM CREATE for the purpose of integrating the relevant models to explore different what-if scenarios with respect to electromobility. This includes vehicle and infrastructure models as well as driver behaviour models.

Problem

In order to build a behaviour model, user data is needed. In the context of electromobility, user data refers to preferences regarding charging station and time. Surveys offer a low cost and time effective collection of user data. However, respondents are often biased by the wording and presentation of the questions. Another disadvantage arises when the respondents consciously answer the survey questions such that the unconscious component of behaviour cannot be captured.

An alternative source of user data is data collection from the actual user by sensors, e.g. smart phones. In the current state, where the EV adoption is low, this kind of user data is limited. In addition, the charging infrastructure is still underdeveloped and most of them are subsidised, leading to the consequence that no representative pricing model exists. The charging behaviour of the user with regard to the charging price cannot be analysed.

Approach

Serious games seem to be a promising approach for

behaviour model identification. This new discipline in academia focuses on the utilization of game technologies and approaches in a non-entertainment context.

Applications of serious games can be classified into two categories. The most important category consists of games that actively try to improve knowledge, change behaviour or develop skills. In the other category, serious games assess the player for information retrieval without influencing him. Behaviour model identification falls into the latter category where the user is assessed in order to build a behaviour model with this information.

The serious games approach provides the advantage that any virtual environment can be created, especially for the situation where real user data is rare or difficult to collect. Another advantage is that serious games could allow a deeper insight into the reason why people behave in certain ways by designing games which focus on the user attributes. Compared to the actual user data approach, which treats the user more like a black box, the serious games approach is more insightful with respect to the nature of behaviour.

Project status

Regarding EV user behaviour, two user attributes show the potential for behaviour assessment using serious games, namely "range anxiety" and "price sensitivity".

Associated with range anxiety is the fear that the battery is depleted before reaching a charging station on time, due to the limited battery capacity. The prediction of the remaining range, thus the precision of the battery state of charge display, plays an important role and can affect the user behaviour. Furthermore, the density of charging stations is another factor influencing range anxiety.

The attribute price sensitivity refers to the user's respond to price fluctuations for charging service. A multi-player serious game, where the players interact with each other, could capture the dynamics of behaviour in an environment where the players fight for resources, such as energy or availability of charging stations.

Serious games addressing the user attributes above are not implemented yet.