Gameful Design in the Automotive Domain – Review, Outlook and Challenges

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ABSTRACT

In this paper, we review the use of gameful design in the automotive domain. Outside of vehicles the automotive industry is mainly using gameful design for marketing and brand forming. For in-vehicle applications and for applications directly connected to real vehicles, the main usage scenarios of gameful design are navigation, eco-driving and driving safety. The objective of this review is to answer the following questions: (1) What elements of gameful design are currently used in the automotive industry? (2) What other automotive applications could be realized or enhanced by applying gameful design? (3) What are the challenges and limitations of gameful design in this domain especially for in-vehicle applications? The review concludes that the use of gameful design for in-vehicle applications seems to be promising. However, gamified applications related to the serious task of driving require thought-out rules and extensive testing in order to achieve the desired goal.

1. INTRODUCTION

People like gaming, winning, comparing, and sharing [6]. This has been known for thousands of years and has been exploited in so-called *serious games* [1] in many different areas such as the military, academics, medicine, or professional training [19]. Serious games make use of the entertaining gaming effect to educate, train and inform their "players" [14].

However, applications that are not framed in game scenarios can likewise benefit from gameful design. Especially with the success of the location-based application Foursquare in 2010, which has made heavy use of game design elements in its application, the research and design community started to pay more attention to the so-called "gamification" of non-gaming applications. Since then, the buzzword "gamification" stands for *the* method for boosting the users' motivation, commitment, and participation. Deterding et al. researched the current use of gamification and proposed the following definition: "Gamification is the use of game design elements in non-game contexts" [4]. However, a discussion about the term "gamification" has recently emerged. Some researchers and game designers think that many companies abused gamification by adding an independent "game layer" to an existing application and by using extrinsic rewards to achieve short-term success. The use of game design elements in non-game contexts with the goal of achieving long-term effects based on intrinsic motivation is often referred to as "gameful design" [4]. In this paper, we opted for the term "gameful design" instead of "gamification" since we want to emphasize the fact that game elements should be part of the concept already during design and should not be added by an independent "gamification" layer. Applications equipped with game design elements we call "gamified" applications.

Since gameful design can arouse sustainable motivation and strong commitment, it has found its way into the automotive domain. In this paper, we first present the game design elements and game mechanics that are commonly used, then, we give an overview of the automotive areas in which gameful design is applied. By examining available examples in the different areas, we determine in Sections 3 and 4 which game design elements are used. The areas are divided in applications running both outside and inside vehicles (1). Based on the current state, we also explore in Section 5 which other automotive applications could be realized or enhanced by applying gameful design (2). In Section 6, we identify which challenges and limitations exist when applying gameful design for in-vehicle applications (3).

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2. ELEMENTS AND MECHANICS OF GAMEFUL DESIGN

In order to analyze the currently available applications the basics of gameful design are summarized in this section.

For creating a sustainable effect and lasting commitment, the source of motivation is important. Intrinsic motivation comes from the activity itself, whereas extrinsic motivation comes from the outside [2]. While intrinsic motivation seems to be desirable, one also has to think about the users that do not get intrinsic reward solely from the activity. In that case, extrinsic rewards can substitute the missing initial intrinsic motivation. However, there is the danger that by giving too much extrinsic reward, the intrinsic reward diminishes [3] and the person has to be kept in a reward loop forever [18, p. 27]. In order to create intrinsic motivation, according to McGonigal, four things need to be considered: satisfying work (consisting of a clear goal and next actionable tasks), the hope/experience of being successful, social connection, and meaning [12, p. 53]. Satisfying work and the experience or hope of being successful can be fulfilled by

the characteristics of games [12, p. 29ff.]:

- Goal: The sense of purpose. It focuses the users' attention and gives orientation.
- Rules: Limitations on how the goal can be achieved. They boost the users' creativity, foster strategic thinking, and help define the next actionable tasks.
- Feedback system: How close is the user to the goal? (progress bar, points, levels)
- Voluntary participation: Freedom to enter the game. Leads to acceptance of rules and feedback.

The goal of social connection can be achieved by involving friends via social networks or by teaming up people that have a common unique goal. McGonigal claims that meaning can occur when users are part of something "epic" [12, p. 61ff]. That means, for example, that they can contribute to a superior goal that is carried out and lasts for a longer time (e.g. fighting climate change). People need something to master that adapts to their progress and their skills [18, p. 29]. All of these factors make up games and, as a result, they are also important parts of gameful design. In our analysis, we concentrate on game mechanics, since these are the basic components of a game [7]. According to Zichermann, the seven primary game mechanics are points, levels, leaderboards, badges, onboarding, challenges/quests, and engagement loops [18].

In the following section, examples of automotive applications are examined. The analysis is split up in two parts: applications outside vehicles and applications for in-vehicle usage. The analysis focuses on applied gameful design elements and includes a view on the chosen type of motivation.

3. GAMIFIED AUTOMOTIVE APPLICATIONS OUTSIDE VEHICLES

3.1 Automotive Marketing with Gamified Applications

Outside vehicles, the main areas of application are marketing and brand forming. By applying gameful design, the automotive manufacturers want to create customers that are more attracted to their brands and more profitable.

An example is *Volkswagen*'s *BlueMotion Roulette*[1]. In order to promote the lower fuel consumption of their new *BlueMotion* car, *Volkswagen* created a game in which users could win the car by guessing how far it can drive with one tank of fuel. However, instead of creating a simple competition where the participants could enter their guesses, they took a real car and drove along a selected road in Norway. The route was visualized on *Google Maps* and the users could bet via their *Facebook* account on a single road segment that had not been taken by another player. On the competition day, the players could follow the car's journey live on the map and discuss it on *Facebook*. Since each user could only bet once, s/he could maximize her/his chance of winning by finding out more about the car and its fuel consumption before entering.

It can be assumed that for most users the possible extrinsic reward of winning a car was the decisive factor for joining the "game". However, the gaming experience caused by the roulette association, the easy onboarding by presenting the facts about the car and the game in a short simulation, and the challenge to beat other real players also caused intrinsic motivation for many players, which can be seen by the large amount of *Facebook likes* and comments[2].

Many applications reward users with badges, etc. just for driving around without having a clear goal. For example, the social driving application *Smileage*[3] rewards its users for meeting other vehicles that are also using the *Smileage* application. Another example is *MyFord Mobile* which rewards its users, for instance, for driving 100.000 miles with an electric vehicle. The objective of such applications can be seen in marketing, since its main purpose is sharing these badges on different social networks.

3.2 Gamified Speed Monitoring Applications

The speed camera lottery[4] was designed to reward people for doing the right thing. Instead of just taking a picture of speeding cars, a modified traffic camera would photograph all passing cars. A portion of the fines from the speeders would be pooled in a lottery in which each of the law-obeying car owners would have a lottery ticket. A demo in Stockholm lasting for three days resulted in a drop of the average speed from 32 kilometers per hour to 25 kilometers per hour.

In this example, the motivation is mainly caused by the extrinsic reward, which is the chance of winning the lottery. A deeper analysis of this application is difficult, since there are no numbers for comparing the effect against a standard traffic camera or for a longer period. However, it can be assumed that this gamified traffic camera could also lead to undesired effects. For instance, more traffic could occur on the road since people want to enter the lottery.

Gamified road signs[5] which display friendly or unhappy smilies depending on whether the speed limit is obeyed or not, are another example of applied gameful design. The effect of these signs is based on instantaneous feedback and social pressure as all passersby can see the breach of rules.

4. GAMIFIED APPLICATIONS IN VEHICLES

4.1 Navigation and Efficient Driving

A popular gamified application is the community-based traffic and navigation mobile application *Waze*[6]. It rewards its users for mapping uncharted areas and reporting traffic issues. Points and leaderboards create a competition between users. However, these points are not only used for comparing with other users, they are also used as a confidence score for a user's contribution. The top x percent of users are further upgraded from *Waze Grown-Ups* to *Waze Warriors*, *Waze Knights*, or *Waze Royalties*. The contribution to an active community that has the goal to make driving more efficient partly creates an intrinsic motivation which can cause users to diverge from their route to join in[7].

[1] http://www.bluemotion.no/, last accessed May 29, 2013

[2] https://www.facebook.com/BlueMotionRoulette, last accessed May 29, 2013

[3] http://smileage.vw.com/, last accessed June 5, 2013

[4] http://wheels.blogs.nytimes.com/2010/11/30/speed-camera-lottery-wins-vw-fun-theory-contest, last accessed May 30, 2013

[5] http://www.smileysid.co.uk/, last accessed June 5, 2013

[6] http://www.waze.com/, last accessed June 4, 2013

[7] http://www.technologyreview.com/news/422583/social-surveillance-yields-smarter-directions/page/2/, last accessed May 28, 2013

The *I-GEAR (incentives and gaming environments for automobile routing)* project aims at changing users' behavior in order to reduce traffic congestion [11]. For example, users could be rewarded for taking a later bus or going to a suburb shopping mall instead of the one in the city center with free bus tickets or discounts at a store in the selected suburb mall. In addition to the immediate rewards, users also would get points for sticking to the application's recommendations. These points could be converted into material rewards later. Drivers could also team up and gather points to win prizes like free car insurance for one year when their team has the highest score at the end of the year. This project sets a lot on extrinsic rewards.

4.2 Safe Driving

The mobile application *Driving Miss Daisy* by Shi et al. [16] performs a gamified driving style assessment. Instead of just showing a score of points, the performance is evaluated by a virtual passenger on the backseat ('Miss Daisy') who cheers or whimpers depending on the driving performance. In addition, a game summary is presented at the end of a drive. Besides the instantaneous feedback over thumbs-up and thumbs-down, the driver can earn virtual money on each drive which is accumulated over multiple rounds for comparison with other players. The application has several levels of difficulty which are increased based on the former performance. The performance of a drive can be compared to historical drives on the same route of the player him/herself (self-competition), and with the performance of other players (public competition).

CleverMiles[8] is based on an external device that has to be connected with the vehicle's on-board diagnostics (OBD) port. The device logs and analyzes the driving, and when safe driving is detected, the user gets *CleverPoints* that can be redeemed against products from different partners. In order to improve the players' driving, it displays driving style recommendations. The application further allows users to share the driving performance data with *Facebook* friends and other drivers. Since the applications is still in closed beta-trial, no information about the effectiveness is available so far.

4.3 Eco-driving

Gamified eco-driving applications can be found in many cars. An example is *Ford*'s *SmartGauge with EcoGuide*[9], which was developed for hybrid vehicles. It informs the user about the current state and efficiency level of the vehicle's drive. When the car is driven at the most efficient level, "efficiency leaves" are growing on the right part of the dashboard as a reward for the user. Other examples are the color switching eco-gauge of the *Chevrolet Volt*, or *Kia*'s *ECOdynamics* system[10] which offers different setups that challenge the driver to get the best economy rating. With *Fiat*'s *eco:Drive*[11], drivers can analyze their eco-driving-related behavior in real-time or afterwards at home. In addition to a score in form of an *eco:Index*, drivers can earn *eco:Badges* and contribute with their savings to create a better virtual place called *eco:Ville*.

The examined eco-driving applications challenge the users in a very emotional way [17]: Efficient eco-driving is indicated by green colors or by flourishing nature. In less efficient conditions, the displays are changing to the colors yellow or red and the leaves are disappearing. Thus, the user gets the feeling that something is broken or the vehicle is being mistreated. Competitive eco-driving can create a very strong intrinsic motivation. According to Deterding[12], the gamified *EcoChallenge* application by Ecker et al. [5] was so motivating that users would even go through red lights, which is an unintended behavior.

5. PROPOSALS FOR OTHER GAMIFIED VEHICULAR APPLICATIONS

Besides navigation, safe driving, and eco-driving, other gamified in-vehicle applications are imaginable. Two possible approaches are proposed in the following.

5.1 Gamified Exploration and Practicing of Automotive User Interfaces

Although many automotive manufacturers, designers, and researchers are giving their best effort to enhance automotive user interfaces, a recent study[13] revealed that cars ranging from compact to premium level are suffering from user experience problems. Misplaced or too many controls, misleading labels, deeply nested menus, and unreliable speech recognition are demotivating the drivers. In addition to the non-self-explanatory interfaces, users are often avoiding manuals for technical systems. These circumstances entail unsatisfied customers that are only able to use a fraction of their (often expensively bought) cars' functions[14]. However, it has been shown that many of these problems can be overcome by practicing [15].

Similar to classical step-by-step tutorials, a gamified tutorial with quiz mode could guide the driver through the most important functions and award points and badges with ongoing progress. The different learning units could be interrupted by randomly selected quiz questions in order to rehearse already learned functions. By answering the questions within a certain time limit (in a safe driving situation and vehicular context), the user could earn bonus points. In order to create an incentive, a high-score could be maintained for the different drivers of the vehicle. Studies performed with gamified tutorial and learning applications have been positively evaluated [9, 10]: The overall results were that users showed higher subjective engagement levels and performed faster than users trained by a non-gamified version.

5.2 Achievements and Rewards in Rental Cars and Car Sharing Vehicles

Especially when driving an unknown vehicle – as is often the case with rental cars and car sharing vehicles – drivers can be overtaxed by the operation of tertiary car functions [8]. This could, for example, be overcome with a gamified preset mode that automatically starts when the driver enters the car. A virtual guide could show the driver what could be adjusted before the drive in order to have a less stressful drive. This could contain things like seat and mirrors adjustments, choosing the desired radio station, or setting the temperature of the air conditioning. Besides the intrinsic motivation of having a more convenient drive, possible extrinsic rewards could be the reduction of the insurance deductible or free car sharing minutes.

[8] http://www.clevermiles.com/, last accessed May 20, 2013

[9] http://stanfordbusiness.tumblr.com/post/32317645424/why-gamification-is-really-powerful, last accessed May 24, 2013

[10] http://thenextweb.com/shareables/2012/09/22/can-kias-gamification-change-way-drive-cars/, last accessed May 24, 2013

[11] http://www2.fiat.co.uk/ecodrive/, last accessed August 19, 2013

[12] http://en.slideshare.net/dings/pawned-gamification-and-its-discontents, slide 41, last accessed June 5, 2013

[13] http://www.wiwo.de/7860276.html, last accessed May 13, 2013

[14] http://www.wired.com/autopia/2013/04/car-tech-failing/, last accessed May 12, 2013

6. CHALLENGES AND LIMITATIONS

Looking at the examined examples, some challenges, and limitations of gameful design can be derived which are presented in the following sections.

Games are voluntary and have no serious consequences: The voluntary nature is fulfilled by all of the applications examined here. However, when gameful design approaches areas such as electronic road pricing [13], the voluntary nature could be limited when the driver has to either take part in the game or stay out of the game area. The competitive eco-driving example showed that the seriousness of traffic regulations could be surpassed by the intrinsic motivation coming from the gaming character. Applications that can have an influence on the driving style should be analyzed and extensively tested before they are released or integrated into vehicles.

Games abstract and simplify complex processes for a better gaming experience: In order to have a clearer relationship between the actions and the goal, games often simplify complex processes. However, when gamifying a real process, the precision and accuracy has to meet the requirements of the process. For example, a safe driving assessment application that only awards the user based on a rule like "drive slowly and do not brake" would not meet the requirements of safe participation in road traffic.

Games live from instant and unambiguous feedback: To encourage desired behavior, immediate and unambiguous feedback is important. However, during driving it can be very difficult to clearly present feedback without distracting the driver from the driving task. Although little icons in the dashboard or audio feedback could reduce the distraction, these could be ambiguous so the driver might know s/he achieved something without knowing exactly what was achieved. A solution could be to shift the detailed explanation of the achievement to the next stop (e.g. at red lights).

How to phase out extrinsic rewards: When the motivation of a gamified application is mainly based on extrinsic rewards, it can be a difficult process to phase out these rewards. An approach could be to draw the "player's" attention to the intrinsic rewards s/he gets from using the application (e.g. focus on the social connection, the mastered challenges, or the learning progress). At the same time, the extrinsic rewards, which perhaps helped to attract the user, could be gradually reduced. The use and height of extrinsic rewards should be looked at in detail during the testing phase. The reward should not exceed a certain value that motivates users to execute unnecessary, rash, and unsafe driving maneuvers.

7. CONCLUSION AND FUTURE WORK

In this paper, we researched the use of gameful design in the automotive domain. By examining examples of gamified applications in the automotive domain, the different available game design mechanics have been explored. Two additional approaches for vehicular applications with gameful design elements have been proposed in order to highlight possible beneficial areas. The presented challenges and limitations could give orientation during the development of new applications.

In future work, we want to explore the effect of gameful design in the automotive domain on the perception of the seriousness of the driving task. Therefore we are currently implementing the gamified exploration of automotive user interfaces and the practicing of vehicle functions approach as a prototype.

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