



## CROWD4ROADS

CROWD sensing and ride sharing FOR ROAD Sustainability

Project Number: 687959

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# D3.3 – Gamification and reward strategies and features

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**Abstract:** This report documents the work taken to plan the development and mechanics strategy for the gamification layer of CROWD4ROADS. The report will cover a background review of gamification to develop an understanding of the mechanics adopted, and provide a first version of the Gamification Design Document (GDD).

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## Executive summary

This document corresponds to deliverable 3.3 of the CROWD4ROADS project.

The document provides a background review on games and gamification, a review of current high profile gamification applications and the gamification design document (GDD) in support of Task 3.2, for the Crowds4Roads project.

The background review concerning games and gamification provides the theoretical underpinnings and understanding of the core engagement and motivations theory surrounding the use of games and game-based systems in non-entertainment environments. This review is used to justify and inform design choices for the selection of the core mechanics to be used for the gamification layer of the Crowd4Roads application.

A review of a selection of current gamification applications is detailed in the report following the general review of games and gamification. This review provides an insight into current trends and high profile gamification systems that are currently on the market. Assessment of the mechanics used in each of these apps provides an understanding of trending engagement strategies that are being adopted by other development houses.

Lastly, the gamification design document (GDD) is presented, which documents the high-level concept of the gamification layer and the core mechanics that are to be the first point of development. The GDD will serve as a reference framework for



developing the gamification strategy of the Crowd4Roads prototype application and will be updated and adjusted as the project progresses.

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## Terminology

- **Crowd4Roads app/application** - The original multi-platform mobile SmartRoadSense application upgraded as a result of project efforts to make its usage and adoption more engaging for drivers and passengers, and to further develop the technological aspects concerning the way the data are handled, processed, stored, and shared. For more details please see D3.1 Ride Sharing and Crowd-sensing Integration Plan, section 3.

# 1. Preface

Work-Package 3 (WP3) “Platform Design and Implementation” as described in the Crowd4Roads Description of Actions (DoA) aims at developing the technical requirements and the gamification layer of the Crowds4Roads prototype application.

In line with this, the aim of D3.3 has been identified to include the following main considerations:

1. To provide a comprehensive background review and analysis of literature surrounding the concepts of play, games and gamification in relation to non-entertainment enterprises.
2. To identify key theories from this review to provide a theoretical underpinning for the gamification layer’s core mechanics selection.
3. To research significant leading gamification-based applications in the current market and to provide a review to identify common gamification mechanics and strategies for creating player engagement and motivations.
4. To create and document a first draft gamification design document (GDD) that outlines the core mechanics that have been chosen for the gamification layer of the Crowd4Roads app.
5. To provide a working GDD that will be used throughout the development cycle of the gamification layer as a livable document. The document will be updated and added to at each development iteration to provide a frame of reference to all consortium partners on the intended development decisions.



The D3.3 report of the gamification strategy including rewards and features, provides a review of game-based theory and evidence alongside a practical design document to inform the start of the gamification layer's development process. This report, specifically the GDD, will be further utilized as a design and development reference for creating the prototype of the Crowd4Roads application. It is intended that the document shall be updated and adjusted during the duration of the project whenever required.

## 2. Background Review of Play, Games & Gamification

The following chapter outlines a background review of play, games and gamification. Within each section, the authors present and discuss key factors to support the use of game-based learning and gamification for education and behaviour change strategies. This review has directly informed and contributed to the selection of game mechanics and techniques that are to be used as the core systems for engagement and motivation of users to adopt the Crowds 4 Roads application.

### 2.1. Games & Play as a Cultural Identity

The academic discipline and study of play and games is firstly and fore mostly characterised from a cultural, historical and anthropological perspective, supported through a variety of targeted ethnographic writings that are cross-cultural and multi-disciplined in nature. A pioneer in developing our academic understanding of games and play, Dutch historian Johan Huizinga, examines play from a cultural and historical point of view in his seminal book *'Homo Ludens'* (Huizinga 2014) and theorizes that every social system (in its first steps) actually starts as play. He proposed one of the first definitions of play that is still extremely influential in understanding the field of play today:

***"Play is a free activity standing quite consciously outside 'ordinary' life as being 'not serious,' but at the same time absorbing the player intensely and utterly. It is an activity connected with no material interest, and no profit can be gained by it. It proceeds within its own proper boundaries of time and space according to fixed rules and in an orderly manner."*** (Huizinga 2014)

Following Huizinga's cultural investigations, French sociologist Roger Caillois, proposes in ***'Man, Play and Games'*** (Caillois, Barash 1961) a first taxonomy of playful activities, articulating a spectrum going from "paidia" (free, uncontrolled play) to "ludus" (rule based games), and highlighting four different, often overlapping typologies: Competition, Luck, Mimicry, Vertigo. These typologies are found time and time again not just within play, but within the core makeup and mechanical structuring of games and gamification systems. Furthering the examination of play's core importance in all living systems, British biologist and anthropologist Gregory Bateson, in his essay ***'A Theory of Play and Fantasy'*** (Bateson 1955) discusses his observations of animal and human play. He argues that play stands at the very root of our own abilities to abstract and communicate concepts and meaning:

***"In ordinary parlance, "play" is not the name of an act or action; it is the name of a frame for action. We may expect, then, that play is not subject to the regular rules of reinforcement. Indeed, anybody who has tried to stop some children playing knows how it feels when his efforts simply get included in the shape of the game."*** (Bateson 1955)

Following the above discussed transdisciplinary interest in play and games, recently, the formal discipline titled “game studies” has emerged at the crossroads of many other subjects, among which anthropology, psychology, literary criticism, human-computer interaction is included. The first example of this hybridization is Espen Aarseth’s discussion of games in *‘Cybertexts: Perspectives on Ergodic Literature’* (Aarseth 1997), providing an approach to digital games that, for its close links with literary criticism, was contrasted by Danish game designer and educator Jesper Juul and Brazilian game designer Gonzalo Frasca, who argued for the necessity of “ludology”, a separate field of studies with its own independent criteria and categories (Juul 2011). These theoretical quandaries are well synthesised by Finnish game scholar Frans Mayra, who in his *‘An Introduction to Game Studies’* (Mäyrä 2008) advances the value of “the study of games for games’ own sake”, suggesting a possible “ludic turn” in contemporary media theory, as games become more and more widespread, pervasive and culturally relevant. In their *‘Manifesto for a Ludic Century’* (Zimmerman 2013), Zimmerman & Chaplin highlight this rising relevance of games as a strong force of change and an opportunity to blur the lines between creators and consumers:

***“Game design involves systems logic, social psychology, and culture hacking. To play a game deeply is to think more and more like a game designer - to tinker, retro-engineer, and modify a game in order to find new ways to play. As more people play more deeply in the Ludic Century, the lines will become increasingly blurred between game players and game designers.”*** (Zimmerman 2013)

With the rise of play and games in terms of perceived societal value comes the rise of manufactured games concurrent with the diffusion of digital media, the figure of the

game designer acquires more and more cultural relevance. Famous game designers, such as Will Wright (*Sim City*), Chris Crawford (*Eastern Front*), Greg Costikyan (*Paranoia*) have proposed influential definitions of what a game and game design is, mainly highlighting the value of possibility and iteration (Costikyan, Words et al. 1994, Crawford 1984).

Formalising for the first time the field of game design studies as a transdisciplinary enterprise, Salen & Zimmerman's '*Rules of Play*' (Salen, Zimmerman 2004), proposes a transdisciplinary perspective on play, games and game creation, going from information science and system thinking to psychology, anthropology and narratology. Particularly interesting for the field of games as learning and engagement strategies, is drawn from the books introduction to the concept of meaningful play, and of its "double definition", pertaining both description and evaluation.

***"Meaningful play in a game emerges from the relationship between player action and system outcome; it is the process by which a player takes action within the designed system of a game and the system responds to the action. The meaning of an action in a game resides in the relationship between action and outcome."*** (Salen, Zimmerman 2004)

Meaningful play is described as what occurs when the relationships between actions and outcomes in a game are both discernable and integrated into the larger context of a game. Meaningful play is now often used in the discussion surrounding the concepts of serious games and gamification meaning that the motivational activity of 'play' also has additional benefits such as learning, health or behavior change outcomes.

In following years, many influential books on the theory and the craft of game design have emerged, most notably Jesse Schell's '*Game Design: A Book of Lenses*' (Schell 2008) and Tracy Fullerton's '*A Game Design Workshop* (Fullerton 2014)', both of which highlight the multifaceted and iterative nature of the practice of game design. More recently, with the rise of the “punk-like” indie games movement, critical perspectives on game design as an opportunity for aesthetic expression and social change have emerged. Relevant examples of this tendency are Mary Flanagan's '*Critical Play: Radical Game Design*' (Flanagan 2009) and Anna Anthropy's '*Rise of the Video Game Zinesters*' (Anthropy 2012), in support of the rise of the '*Games for Change*' Movement.

## 2.2. Play & Games for Education & Behaviour Change

Observation and theorisation surrounding the relationship between play and games for learning and behaviour change, have always constituted a core of psychology and pedagogy, starting from its origin as a formal field of study at the time of the ancient Greeks. With the emergence of modern scientific psychology and education theories, constructivist approaches to learning have highlighted the very active role that play and games have had in the development of children's (and adults') faculties.

Already in the first half of 20<sup>th</sup> century Swiss psychologist Jean Piaget, throughout all his works, linked playing games with the “child-as-scientist” experimental attitude, focusing particularly on the ideas of rule-based gameplay (and the creation of games by children) for learning self-regulation and ethics. Foundational to modern education psychology's understanding of play and games is also Leon Vygotsky's '*Play and its Role in the Mental Development of the Child*' (Vygotsky 1967), where he discusses the role of



play and games in a child's ability to socialise, and its subsequent supportive role (scaffolding) in the learning of new tasks and abilities. Successive constructivist approaches that emphasize the value of play and games in education and behaviour change, can be found in Jerome Bruner's '*Play, Thought and Language* (Bruner 1983)', which focuses on the creative and narrative side of play and games, and Seymour Papert's "constructionist" approach discussed in '*Mindstorms*' (Papert 1980), notable for its emphasis on the playful appropriation of technological artefacts.

In the context of the study of play and games as related to player engagement and happiness, psychologist Csikszentmihalyi introduces the concept of '*Flow*' (Csikszentmihalyi, Nakamura 1979), as a definition of the optimal state of absorption, awareness and intrinsic motivation that comes from being completely engaged in an activity, a state which is most often and easily experienced through play and challenge. It is also notable, in this context, how Csikszentmihalyi does not focus on children's play as the authors before him, but acknowledges and reclaims the value of play and of an "autotelic" personality (that is, self-motivating) to an interest in lifelong learning and healthy functioning as an adult individual, founding the field of "positive psychology".

Continuing the thread of "fun studies", and highlighting the close link between learning and pleasure, American game designer Ralph Koster, in his '*A Theory of Fun for Game Design*' (Koster 2013), proposes a learning oriented theory of what we call "fun" in common parlance, defining it as "*the act of recognizing and mastering a pattern*", therefore bringing the theme of mastery to the foreground of game and engagement studies.

As the panorama of games for learning grows exponentially in the first years of the 21<sup>st</sup> Century, Katie Salen, curating the collection of essays *'The Ecology of Games'* (Salen 2007), gives the reader a multifaceted tour of the manifold realities and connections between play and learning, and the variety of ways in which games allow for the implementation of experiential and problem based learning (PBL) activities in more engaging and grounded ways.

In partial contraposition with “edutainment” and “serious games” approaches, American educator James Paul Gee, in his *'What Video Game can Teach us on Learning and Literacy'* (Gee 2003), turns the table on the widespread “use” of games (purposefully designed) to teach and change behaviour, and looks instead into how (well designed) games of any kind can actually inform our teaching. In the author’s perspective, a characteristic of games most relevant for education is their nature as “affinity spaces”, locations (be them real or virtual) of strong, shared interest around a topic, which are themselves conducive to deep informal learning. Following this thread, Gee also lends a particular focus to the theme of community based literacy, defined in the tradition of critical pedagogy as not simply the ability to comprehend text, but also to actively produce new ones. A similar “literacy” focus also constitutes the core of Zimmerman’s *essay 'Gaming Literacy: Game Design as a Model for Literacy in the 21<sup>st</sup> Century'* (Zimmerman 2009), a far-reaching perspective inclusive of systems thinking, design and playfulness.

American educator Kurt Squire brings forward and into the field the theories of his mentor Gee, proposing, in his *'Video Games and Learning: Teaching and Participatory Culture in the Digital Age'* (Squire 2011), a collection of theoretical essays and case

studies which further the opportunity for digital games to enter the classroom, not simply as tools but as an integral part of learning environments and institutions. Relevant from a pedagogical standpoint is also Squire’s critique “effectiveness”, as a criterion in which it is fundamentally incompatible with many experiences of game-based learning:

*“The kinds of instruction that can be tested with these methods are limited. Anything where the teachers rework materials is out, because the “treatments” have to be standardized and compared to controls along predefined objectives. Anything that involves differential learning outcomes is out, because you are testing for sameness in outcomes in groups. In short, most of what works best through games (interest-driven learning, differential expertise, learning by design) is thrown out, because it cannot be tested under these methods.”* (Squire 2011)

Furthering the research on the weaving of formal and informal learning through play, Mizuko Ito’s Connectivist learning theories (Ito, Baumer et al. 2009), have highlighted the great importance of the “meta-game” (the cultures, narratives and social systems that develop around playing a specific game) in creating powerful learning ecologies and dynamics, not necessarily in formal settings but “simply” by **‘Hanging out, Messing around and Geeking out** (Ito, Baumer et al. 2009)’.

Synthesising the diversity of points of view and approaches to game based learning, Nicola Whitton in her **‘Digital Games and Learning: Research and Theory’** (Whitton 2014), proposes a wide spectrum review of the perspectives on the role of digital games in education, discussing four main perspectives to categorize research and practices in

the field, and their respective constructions of games: Games as Active Learning Environments, Games as Motivational Tools, Games as Playgrounds, Games as Learning Technologies. Throughout her review Whitton contrasts behaviourist and constructivist learning approaches, highlighting how games can be a paradigm of the second, and can promote the development of capacity for synthesis, creativity, teamwork, evaluation and critical thinking, all of which are hard to foster under traditional learning institutions' structures, being resistant (or even oppositional) to standardised formal assessment.

Finally, collating data, reflection and evidence from all the above literature and beyond, and widening the scope of the possibilities of play and games for a wider societal impact, the EU report '*The Potential of Digital Games for Empowerment and Social Inclusion*' (Stewart, Bleumers et al. 2013), offers a multifaceted picture of how all of the approaches discussed in this background review (and particularly “meaningful play”) can be weaved to promote societal progress. The themes and the possible interventions discussed are not strictly limited to learners, youth or formal education, and range from deployment of ad-hoc games, to the establishment of gaming communities in public spaces, to the promotion of game design practices, all of which can work in parallel and synergistic ways to enhance civic participation, media literacy, accessibility and inclusion in all sectors of public life.

## 2.3. The Rise of Serious Games and Gamification

The increasing use of games in non-entertainment contexts, also known as Serious Games (SG) and the use of Gamification (using game mechanics, dynamics and

technologies for learning or behavior change), is transforming everyday lives and most importantly injecting more fun in everyday contexts (McGonigal 2008). The use of SG's and gamification techniques has risen in recent years to promote the study and the development of specific games (or game-like structures) for specific purposes aside from leisure or entertainment, independently from already existing or established games and communities thereof. Although games that have been used for training and behaviour change is not a new idea (a relevant example of which is Germany's 19<sup>th</sup> century "Kriegsspielen", war games used for military training), the first mention of such "serious games" in modern scientific literature comes from American engineer Clark Abt's '*Serious Games*' (Abt 1987), discussing mostly the educational potential of board games and card games, but acknowledging the opportunities that the "computer age" was going to bring forward in this sense. In following years, SG's have been established as a general category of purposive games, including not only educational games but games addressing advertising, healthcare, policy and training. Taking this wider perspective into account Mike Zyda in '*From Visual Simulation to Virtual Reality to Games*' (Zyda 2005) defines serious games as:

*"a mental contest, played with a computer in accordance with specific rules that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives."* (Zyda 2005)

Given the enormous width of the field, and the difficulties in evaluating and assessing their impact (Connolly, Boyle et al. 2012, De Freitas 2006) and the lack of a coherent design framework, Arnab et al. (Arnab, Clarke 2016) have proposed pedagogically driven frames to reconnect learning and game mechanics.

Another branch of the paradigm that is the use of games and play for education and behaviour change is that, that is defined as “gamification”. This term was coined in 2002 by a programmer; Nick Pelling who defined gamification as **“applying game-like accelerated user interface design to make electronic transactions both enjoyable and fast”** (Pelling 2011). However, this term did not become widespread until 2010, when Bunchball’s White Paper defined gamification to mean it as **“integrating game dynamics into your site, service, community, content or campaign, in order to drive participation”** (Bunchball 2010).

With gamification’s rise in prominence particularly within the business and enterprise sectors, came other definitions, among which the more widely accepted definitions include **“the process of engaging people and changing behaviour with game design, loyalty, and behavioural economics.”** (Zichermann, Cunningham 2011), **“the use of game design elements in non-game contexts”** (Deterding, Dixon et al. 2011) and “the craft of deriving all the fun and addicting elements found in games and applying them to real-world or productive activities” (Chou 2013)

Furthering this line of research, American game designer Jane McGonigal, in her book (McGonigal 2011) argues that advancing a “gameful” mind-set in the real world can produce effective and measurable change, leaning on modern research in positive psychology, to promote games as an integral factor contributing to human happiness, motivation, meaning and community development. Despite becoming with this book “the public face of gamification”, McGonigal has distanced herself from the denomination (favouring the notion of “gameful design”) and its then emerging negative connotations. Indeed, with more and more scientific research and data

complexifying the field after the initial (marketing oriented) enthusiasms, gamification is, as of now, a contested field of studies, raising objections from three main directions: 1) efficacy 2) ethical acceptability and 3) techno-determinism.

The first objection is addressed by Hamari & Koivisto, in *Does Gamification Work?* (Hamari, Koivisto et al. 2014) which presents a review of empirical studies, highlighting both the basic fact that gamification can indeed work, and the methodological issues that persist in many studies (most of which underestimate the impact of social and organisational context), and that needs to be addressed by future research. The second objection is articulated in much depth by Steffen Walz & Sebastian Deterding in their book *'The Gameful World'* (Walz, Deterding 2015), which discusses the accusations of manipulation by inquiring into the roots of the enjoyment we draw from games, and highlighting how “good” gamification (just like good games) must emphasize the intrinsic human motivation toward competence, autonomy and relatedness. The third objective is addressed by Sylvester Arnab (2016), who proposes that gameful design should base itself upon a holistic model for gamified and pervasive learning design, and highlights the necessity to shift the focus away from a current strong overemphasis of technology in the field, instead prioritising the value of context, pedagogy and basic game design.

## 2.4. Gamification for Mobile Technologies

As previously discussed, educational and behaviour change games and gamification structures, often adopt a constructivist philosophy (Dewey, Dewey et al. 1899, Piaget



1970) that promotes student active learning through the engagement of social and interactive experiences. For this reason, serious games and gamification structures that are well designed; have clear learning/behavioural objectives and engaging game-play, are believed by many (Zimmerman 2013, McGonigal 2011, Karsan, Kruse 2011, Kapp 2012) to have the capacity to motivate, engage and inspire target users. The adoption of game-based-learning in training and business applications has since seen a gradual increase in the application of Gamification techniques used in mobile applications over the last five years (Kapp 2012).

Although the term “Gamification” is now a widely known and accepted practice, its meaning is still often disputed, especially in the games community (Deterding, Dixon et al. 2011), term gamification has been used to describe a number of different applications and as such the meaning varies from person to person (Zichermann, Cunningham 2011). However, it is not just the term that produces criticism of gamification but also the way in which it is applied to non-game contexts. Over-application of ‘easy’ game-based functions such as scoring systems that include points, badges and leader boards (PBL), have led critics to question whether player motivation and engagement is gained through use of these simple systems or whether it is a marketing ploy to jump on the gamification trend. Robertson (Robertson 2010) suggests that the use of PBL as a way of gamification is “taking ***the thing that is least essential to games*** and representing it as the core of the experience”. Whilst PBL’s are certainly important functions of games as a way of communicating to a player their progress and status throughout play, the functionality of PBL’s, do not contribute to



the core make-up of games that rely on development of player challenge, curiosity, meaningful choice and emotional connection to motivate and engage a player.

To move forward from this view of exploitation and create 'meaningful Gamification' (Nicholson 2012) and to support educational/behaviour change ventures, practitioners and professionals must look to utilise the interesting features of games such as curiosity, challenge or narrative to increase their target player's performance (Kapp 2012). In order to do this, we must consider player fun and engagement to be the central goal in creating higher-level gamification and utilise game mechanics and techniques that reflect this purpose, particularly addressing the combination of game & play based motivations and location-based technologies.

The central role of Gamification within mobile technologies is to ultimately promote experience motivation in customer/learner engagement with a product or it is utilised for educational/behavioural purposes. In the support of gamification for m-learning (mobile learning which includes behaviour change), mobile technologies create an opportunity for teachers to develop innovative and flexible learning scenarios beyond institute walls and schedules (Liu 2007). One purpose of m-learning is to extend the use of digital media to the outside world, situating users in a real rather than virtual environment, where physical structures and social protocols are pre-defined (Leonard, Durrant-Whyte 2012). Outside influences such as weather, people, structures, noise and other events cannot be controlled by the player and/or the developer and can add to, or detract from, the overall experience and/or service (Finkelstein, Adams et al. 2005). M-learning is typically reliant on using location-based data, gathered through the use of location-based services and/or sensors such as a GPS module, Base ID or



through local Wi-Fi connection scanning (Buisson, Easton et al. 1978). As mobile technology and these capabilities continue to develop and improve, user location pin-pointing has become more accurate, accessible and real-time based, leading the way for more fields such as business, education, banking, economy and tourism to enhance user engagement of their product or service through the use of location-based experiences (LBE's).

Location-based services, when considered as a subset of context-aware services, can adapt their behaviour through filtering information to one or several parameters in relation to the context of a user. These parameters include both primary context, defined by sensors; Time, Location, Identity and Activity and secondary context information, refined through combination and filtering; Personal Context, Technical Context, Spatial Context, Social Context and Physical Context in order to achieve high user profile and context data (Küpper 2005). High-level user data gathered this way is used by organisations' in various fields as an economical way of targeting and providing users and consumers with details on new or existing products or raising awareness and attractiveness of their services. For this reason, the use of personalised data and/or location awareness monitoring provides opportunities for both organisations and target users to benefit from information and/or services that may not have been available or known previously. In light of these developments, some fields of education have begun to recognise the potential benefits of using and adapting mobile learning to suit their purposes, with a progressive rise in the number of mobile technologies and hand-held devices such as 3G, mobile phones, pocket personal computers and notebooks adopted and used for educational purposes in

educational settings (Hsu, Hwang et al. 2013). One such benefit of using LBE's for educational purposes is that they facilitate ubiquitous learning (Zurita, Nussbaum 2004), and provide a natural learning environment that favour's constructivism and collaboration in order to achieve new knowledge acquisition. These types of innovative learning environments can be used effectively to promote social development and communication skills that are vital for creative and collaborative learning/behaviour change.

Listed below is a number of techniques that can be adapted into gamification strategies for use in promoting learning and behaviour change.

#### 2.4.1. Learning/Behaviour Change Objectives and Personalisation

In order to create 'meaningful Gamification', it is essential to have some understanding of the target demographic of the product. A Needs Assessment can determine from the offset, player type, preferences and likely play habits that can be used to develop higher level gamification techniques. An example; Women players age 30-45, have less time to play mobile games than men at a similar age (Apt, Grieco 1998). This indicates that play time could be a leading consideration when developing the gamification techniques targeted at this user group. A game/gamification app that requires a significant amount of time to play or has a steep learning curve would not fit the needs or time requirements of the demographic and would be reflected in the design of the gamification. Considerations of needs of the demographic lead the way into the development of Learning Objectives of the product. Learning Objectives are needed to ensure that the desired learning experience is created alongside the requirement to

create an effective evaluation model. Learning Objectives can be tailored to be embedded as part of the gamification experience by using game-like objectives to track the learning progress.

### 2.4.2. Narrative

A powerful motivator in any game/gamification strategy, and one that is usually a consistent theme in any game whether it fits into the RPG, Sandbox or Casual market, is the implementation of an engaging story. Narrative-based gamification in m-learning is a particularly effective motivator due to the idealistic nature of location-based experiences. Story can be used to explore and embellish surroundings for the purpose of creating a meaningful experience that players engage with. The combined use of narrative, player control and real world game pathways could seek to provide the learner with a playful yet informative space, featuring both virtual and real interactive elements in which student-led learning and reflection are nurtured and encouraged. Narrative can be built to be a standalone feature within the game or triggered by random player events/location exploration.

### 2.4.3. Challenge

Challenge is believed to be a very strong motivator in successful learning/behaviour change strategies in games and gamification (Malone 1981, Schlechty 2003, Jones, Lucas 2012). It allows the player to engage in a difficult, but achievable task to explore the meaning behind the activity. Game-based outcomes can be challenging because of the variability depending on the use's actions, multiple goals, hidden information and

randomness (Wilson, Bedwell et al. 2009). Challenge is correlated with both intrinsic motivation and motivation related to fostering competence and student efficacy (White 1959) and therefore is essential for creating an efficient m-learning application. Challenge-based gamification can be realised through content, missions, challenges or quests to achieve the desired effect of motivation in the player. Location-based services can be used to create challenges based in a variety of locations and foster explorative learning/engagement in services.

#### 2.4.4. Competition vs Collaboration

Competition is used for users “constrained from impeding each other and instead devote the entirety of their attentions to optimizing their own performance.” (Crawford 1984). In gamification terms, this is usually a technique that is based on the adoption of a points and leader board system. However, there are many ways of inspiring competition within games Gamification-based competition can be utilised if students are initially reluctant to learn content, they have a good social relationship with each other or if the students are initially hesitant to engage with the content (Kapp 2012). Cooperation is the act of working with others to achieve a mutually desirable and beneficial outcome. Primarily used in content gamification, working together to overcome a challenge or solve a mystery is a method of adding game elements to instruction. This is the social aspect of gamification that many students enjoy. The more individuals work together, the more they are able to achieve. It has been found that serious games are more effective when played in groups for learning (Kapp 2012). With gamification, group cooperation could be more effective than solo

gamification but more research is needed on this specific aspect (Wouters, Van Oostendorp 2013).

## 2.5. Mobile Technologies & Gamification Elements

This section lists some of the adaptable mobile technologies that can be utilised whilst considering mobile-based gamification systems. Current mobile games and apps use a range of the features listed below to deliver usability and enhance a game/app experience. (Pokémon Go: Utilises AR and Location Based Services to allow users to play in the ‘real world’).

### 2.5.1. Embeddable Widgets

Embeddable widgets can make a class catalogue available anytime to people who are on the road – even when they aren’t logged-in to an LMS (Location Management Server). A manager or administrator can share an actionable catalogue listing through email or web pages (like an Intranet or group collaboration site). These can be used by players to share additional resources.

### 2.5.2. Accelerometers & Gyroscope

In mobile phones, accelerometers and gyroscopes are used to detect the orientation of the phone. The gyroscope, or gyro for short, adds an additional dimension to the information supplied by the accelerometer by tracking rotation or twist. This feature



can be used to track a player's movement behaviours and is particularly useful for games that involvement complex movement (racing or endless running).

### 2.5.3. AR

Augmented Reality is a term that refers to a technology that superimposes computer-generated content over live images viewed through cameras. The technology, which has been used in gaming and in military applications on computers, has been around for years. But thanks to more sophisticated devices, faster wireless broadband networks, and new developments at the chip level, it has become inexpensive enough to put into Smartphone's and tablets. This feature can be used in gamification to enhance what the player sees and interacts with on screen.

### 2.5.4. Location Based Services

Location-based services, when considered as a subset of context-aware services, can adapt their behaviour through filtering information to one or several parameters in relation to the context of a user. These parameters include both primary context, defined by sensors; Time, Location, Identity and Activity and secondary context information, refined through combination and filtering; Personal Context, Technical Context, Spatial Context, Social Context and Physical Context in order to achieve high user profile and context data. Access to player data can be used in a range of gamification techniques including location-based learning scenarios and data tracking for evaluation.





### 2.5.5. Beacons

Beacons use Bluetooth to communicate with a mobile device and a Wi-Fi or Ethernet connection to connect to the Internet, serving as an information way station. They can be used to provide custom interaction related to a specific area. For example, a walking tour, zoo, or museum could use them to know what you're looking at and provide links to relevant details or to play an audio or video for that tour segment.

## 3. Gamified Apps – A Research Perspective

While, as a general field of study, academic research in the area of gamification has explored broad theoretical design considerations particularly in the fields of business, marketing and education (Hamari & Koivisto, 2014), research about specific Gamification Apps has mostly focused on three areas of implementation: gamified crowdsourced location based services, gamified fitness applications and gamified mobile health self-management (Lister et al., 2014). These specific, “most researched” applications’ design approaches, and the research interest and evidence they have elicited can give us precious and well-grounded insights toward developing our own gamified platform, also supported by the broad infrastructural overlaps between many of the below discussed Apps and the final, intended outcome of our design.

### 3.1. Gamified Crowd-Sourced Location Based Services

With a strong overlap of intents and overall infrastructure between the intended outcomes of the Crowd4Roads project, crowdsourced location based services constitute a core reference for research and design inspiration, with their emphasis on leveraging and sharing community knowledge and feedback. One of the earliest examples of this dynamic is *TripAdvisor* (2000) not itself strictly a gamified app, but a travel website relying on user generated data, and employing a basic gamification layer with reputation points, levels and badges to confirm the validity and value of individual

users' participation within the community, therefore providing a guarantee for coherence and integrity in contributions (Sigala, 2015).

**FourSquare** (2009) is a local, gamified search-and-discovery service, leveraging the community to provide information on local attractions and services (bars, restaurants, shopping areas, museums, parks, etc.). The App provides users with social networking tools for circulating evaluations and feedback of specific venues, but also provides rewards (PBLs) for correcting or completing information, and enables in-App challenges for status through repeated check-in at locations or scavenger hunt-like challenges (Lindqvist et al., 2015). At a later point, many of these gamified functionalities were detached from the main **FourSquare** App (which retained the mapping and feedback system), and shifted into the “companion app” **Swarm** (2014), highlighting the possibility of sustaining a gamified ecosystem across different platforms, and the opportunity of more targeted App implementations for those who prefer not to engage with gamification (Wilken, 2016).

**Waze** (2009) is, from an interface and data management point of view, probably the closest existing app to our intended final outcome: a road map which is actively crowdsourced in real time by its community of users (though with no particular focus or integration with road sensing). **Waze** asks its users to participate in specific challenges, usually to complement the data base or update some of the older sections of the map, offering rewards in the shape of PBLs for contributing to the mapping, with the distinctive trait of offering more and more expressive avatars based on the position of the user in a national leaderboard. **Waze** also offers well integrated social

networking functions, automating both tweets and check-ins on **FourSquare** (Hind & Gekker, 2014).

Research on these Crowdsourcing Apps tends to highlight some common characteristics, as in the focus on motivation dynamics to encourage users to provide data, as filling in voids in the database and particularly correcting mistaken or fraudulent data confers particular benefits and status (McKenzie, 2011). The dynamics employed in the design provide therefore diverse approaches to a hybrid between competition and cooperation, in that the most valued users are those contributing the most to the community as a whole, generating a helpful sharing climate even in the presence of usually competitively framed elements such as PLBs (Glentis et al., 2014).

### 3.2. Gamified Fitness Apps: FitBit, Nike+ & Zombies, Run!

The general category of mobile, gamified fitness applications finds its earliest and most researched examples in **FitBit** (2006) and **Nike+** (2007), two similar bundles of mobile applications and activity tracker devices that detect routes, distances, speed, time and calories, as to shape a personalised fitness plan with real time feedback in the form of both data and PLB gamified reviews. These apps were also among the first fitness technologies to also include social networking functions to allow social recognition of user efforts from peers and therefore enable motivation enhancement through both positive feedback and competition. Both are notable for including in their data ecosystem wearable devices (a wristband for **FitBit**, a piezoelectric sole for **Nike+**) that allow the app to gather physiological data on users, therefore providing them with

improved data. Both bundles, while demonstrably showing impact in improving their users' fitness and health (Guo et al., 2013), have been criticised for excessive quantification and surveillance and emphasis on competition (Whitson, 2014), therefore falling into a common criticism toward gamified applications, that is trying to substitute intrinsic motivation with extrinsic.

As an answer to these critiques, a more recent example of gamified fitness apps, **Zombies, Run!** (2012) is a paradigmatic example of the general refinement and evolution of gamification applications and approaches, standing out from its competitors for its extremely strong narrative component, with its main designer, Naomi Alderman, a novelist, describing it as “**more role-playing than gamification**”. In **Zombies, Run!** the player takes the role of “**Runner 5**”, the survivor of a zombie apocalypse scenario running around a fictional town to gather similarly fictional supplies, and build and protect a safe community, in a story that develops interactively depending on the activities of the player.

Research on these apps focuses on a variety of specific mechanics that seek to enhance motivation in regularly engaging in exercise, and contrasts the very different approaches of the designers, appealing to different demographics and psychological profiles. While **FitBit** and **Nike+**, with their quantitative, competition oriented approach, appeal strongly to already active people looking to enhance their competitive edge in sports-minded users (Stalnacke, 2013) **Zombies, Run!**, with its more qualitative, narratively oriented approach has shown the most impact in engaging and modifying behaviour in traditionally more sedentary segments of the population (Southerton, 2013)

### 3.3. Gamified Mobile Health Self-Management

Finally, a rigorously researched area of gamification, making use of health research “gold standard” approaches, is that of mobile health self-management apps, that is applications that support the users in complying with chronic disease treatment (Bargen et al., 2014).

**Mango Health** (2016) is a generic nutritional supplement manager, where users can input their own medication schedule and dietary needs, rigorously track them, and obtain both PLBs based and real world monetary rewards. An interesting feature of **Mango** is the endeavour to complement this strong extrinsic motivation strategy (which is a strong way to instill initial compliance with new medication) with intrinsic motivation and competent self-management supported by curiosity, as its internal database can instruct users in real time about the effects of medication, dosing information and potential contraindications.

A similar but more specific implementation of gamification for health is **mySugr Companion** (2014), a diabetes self-management application, allowing extensive annotation and documentation of dietary habits, and in turn providing suggestions and general dietary health facts. Going beyond simple PLBs, complying with the app’s suggestion and tackling daily challenges oriented to raising awareness of diabetes fill a progress bar that will “tame” an in app “pet”, the “diabetes monster”.

Again, the core design insight that we can gain from these applications is related to motivation and compliance, as, similarly to the environmental concerns tackled di the



C4Rs Project, the behaviours fostered by these apps, while inherently beneficial, are not easy to sustain without external support. Strategies in this field can benefit from the heavy-handed extrinsic rewards dynamics (even getting into real world prizes) to promote onboarding, but also highlight a need for raising awareness of the core issue that prompts their use, therefore slowly moving toward intrinsic motivation and informed self-management (Alhaivala et al., 2016).

## 4. Gamification Design Document

This chapter outlines the core mechanics of the gamification strategy for Crowd4Roads contained within a Gamification Design Document (GDD). Based on the concept of a traditional entertainment Game Design Document, the document acts as a central hub to connect and list every aspect of a games intended systems and

structure for development. The GDD is generally made up of written descriptions, visual representations and lists of information contained under relevant headings such as game features. Essentially the GDD provides a roadmap for developers, designers and other stakeholders to understand the essence of the gamification layer and the planned scope of its impact. It also allows for one well-organised document that can help the designer to easily convey the proposed vision of the gamification layer to the rest of the team while also helping to pinpoint weaknesses or missing components that the system may require.

The GDD listed below will serve as the master checklist for the core components of the Crowd4Roads gamification layer. Parts of the GDD will be changed, modified and added to throughout the entire development process. This is a typical development cycle, and changes are expected as testing and usability studies are carried out within the pilot phases.

## 4.1. Core Gamification Mechanics

In this section is listed the core mechanics and understanding of the system of the gamification layer for the Crowd4Roads application.

### 4.1.1. High Level Concept of Gamification Layer

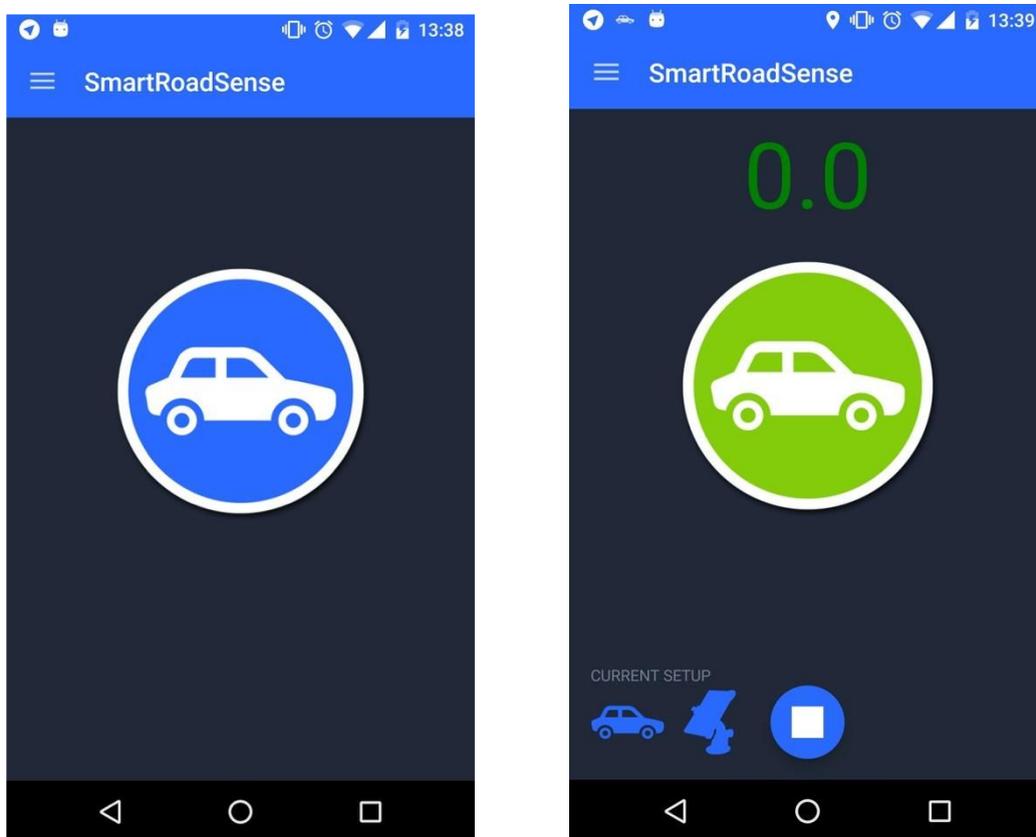
The gamification layer for Crowds4Roads will be based on the genre of Role Playing (RP) game systems with elements of interactive narrative fiction games. The core concept is that the player will take on a semi-customisable character (player choice

from a few pre-defined characters), and complete game missions to level up their character's reputation and gain in-game collectable items. The theme of the game will be a cross combination of space travel (sci-fi) and adventurer (western) or traditionally known as 'space cowboys'. The blending of the themes has been chosen to appeal to a wide player audience and these themes are usually very popular amongst all ages and both genders (although slightly higher with male audiences). Justification of using the chosen themes and mechanics comes from the research conducted in D2.1 Socio-economic analysis and sustainability threat and D2.2 Representative Scenario and Use Cases. Following the outcome that our targeted users for the Crowd4Roads app will likely be a very varied user group with no discernable connected interests, it is intended to make the gamification layer as open to different tastes and preferences as possible in a similar development style of a MMORPG (Massively Multi-player Online Role Playing Game) such as World of Warcraft. Players will be tasked with completing missions in 'space' using different real world locations as unlockable areas for new in-game world quests. The game will use narrative, humor and player choice to encourage player investment and drive story. In-game items are connected to the quest story's and are given a value system based on rarity, encouraging players to try and retrieve higher value in-game items for character reputation and re-sell for real world rewards.

#### 4.1.2. Quest/Story Difficulty & Unlocks: Road Distance Traveled

As described in the high-level concept, game quests are unlocked and are assigned a difficulty level through travelling around in the car in the real world. Much like

Pokémon Go, location-based services will be used to track the distance a player has travelled in the car with the Crowd4Roads app on.



*Figure 1 Crowds4Roads App Deactivated and Activated Tracking State*

Once a user has tracked a journey with the Crowd4Roads app and has pressed the button to stop tracking, the data of the journey is sent on to the Crowd4Roads sever.



The server will send an immediate response back to the player's account that will, based on the distance of the journey tracked, will unlock certain quests that are stored within a quest log section of the application for the player to access at a later date. The metric of 'road distance travelled' is transferred into a quest difficulty level within the application. This level is used to determine what difficulty level quests are rewarded/unlocked to the player. Higher difficulty quests = higher reward potential in terms of rarity of items for collecting in-game. This mechanic is used to encourage players to travel for longer distances whilst utilizing the app so that the application can access higher levels of data concerning the quality of the roads. Please see below table for concept of distance travelled versus quest levels difficulty.

Quest Difficulty	Start	End Distance Tracked (Km)
Easy	0	3.21
Medium	3.22	8.04
Challenging	8.05	16.09
Hard	16.10	32.18
Epic	32.19	80.46

Table 1 Quest Difficulty Measured by Distance Travelled

Additional to the distance travelled for quest difficulty mechanic, there will be another travel/location based mechanic of unlocking new/special quests through players tracking information to places that are less well travelled in the real world. Less known places will offer special quests that will automatically have a higher than average



chance of receiving rare items. This mechanic will be used to encourage players to travel on less known roads for higher gain quests and to feed-back data on areas that little is known about.

Quests that are assigned a difficulty level could either be unlocked at random via the app or the player can choose to unlock which quest they want via a token system. A token exchanged with each successful transfer of tracking data to the Crowd4Roads system that equals the quest difficulty level.

These mechanics that are connected to the tracking system of the Crowd4Roads application, use scarcity through item rarity, collecting, chance and narrative to drive player engagement. Primarily, players should be motivated through their desire to gather and complete collections of in-game items to travel greater distances using the application and to explore routes of travel that they may not normally have considered. These mechanics should appeal to the collector, explorer and social player types. Competition could also be a driving factor of motivation for players as once items are gathered into a player's collection, player's main gain 'social recognition' for acquiring these items amongst friends.

Initially, the team considered using the road roughness level data to equal the games quest difficulty score, however, after much deliberation it was decided that distance travelled may help gather more quality data due to issues surrounding ability to stop players cheating. The team was concerned that players could alter the data more easily in relation to the road roughness and therefore the game rewards could be open to manipulation from players, skewing the data that the Crowds4Road server received. In light of this, the team decided that it was much easier to track and control

manipulation of distance travelled, than to control the road roughness level of the application.

To formally set distance parameters to the quest difficulty gauge, the team will look at pre-pilot data already available on the Crowd4Roads server to determine average travel distances. We shall also highlight less travelled areas and use this as a basis to develop a prototype of a ‘special quest’.

#### 4.1.3. Quest Packs

Quest packs are selections of similar quests, in this case made up of between 3 to 8 quests, that follow a similar theme. For example, an opening quest pack could consist of 3 quests; 1 easy, 1 medium and 1 challenging. Each of these quests would be based around a similar plot premise such as ‘locating a new base’. Once a player has completed all quests assigned to a quest pack they will receive a ‘completion item’ unique to that quest pack. Quest packs act as story point progression elements and allow players to feel a sense of mastery and achievement when they complete a set. This type of mechanic can also be a powerful player motivator using the psychology of ‘completing sets’ to encourage engagement. Certain personalities often feel a need to complete sets (See collectable cards and collectables in general). Adopting a mechanic that relies on this motivation, could see an increase in player participation and will appeal to the player types that find ‘completion’ a rewarding game-play factor.

Unlocking quest packs could be done via three primary routes:

1. The player character levels their reputation: As a player's character accumulates new items, explores the game world and completes quests, they will gather character reputation. Reputation which is explained later in the document is linked to a leveling up scheme similar to tradition RP games with progressive characters. Once a character reaches a reputation level, in this example level 5, a new quest pack could become available to them. Quest packs connected to reputation level means that there is always a quest pack available to a player, regardless of whether they travel to remote locations or 'buy' new packs using in-game items of value.
2. New quest packs could be discovered as a reward for travelling to new or remote areas as defined by absence of tracking data connected to the Crowds4Roads server. This can encourage player movement and exploration of unexplored areas on their maps.
3. Players may exchange some of their in-game items for new quest packs. Players who may have duplicate items, low rarity or undesired items, may trade these in for new quest packs. This allows the in-game items to have a greater value in the overall system of the game, allowing for more player-choice and control over their game-play.

Story progression for the player will be a key theme within each quest pack. Each quest pack will contain an opening back story to situate the player and set the scene of each quest. Each quest will carry through the main quest packs themes to tie them all together. Story progression will be used to engage players who are interested in



interactive fiction and curious to see how the games scenarios progress in relation to their character developments.

#### 4.1.4. Player Choice (Quest Stories & Outcomes)

Players are presented with various difficulties of quests throughout the game. Each quest starts with a background scenario which will be presented as a written screen with the potential for a voice over/audio option. The background scenario will present the player with a scenario in which they have a choice of how they may respond. Players are then given the option of what they would do in that scenarios situation. Choosing from one of two/three options, players are then rewarded/penalized based on their choice. This mechanic is often used in board games and referred to as a 'crisis deck' (examples of these board games include Battlestar Gallactica and Dead of Winter).



Figure 2 Board Game examples of Player Choice/Narrative Mechanics

By using non-linear narrative mechanics to support the motivations of player choice, players feel a greater sense of involvement in the games story and players can control how they are developing their character. Players also feel a greater sense of achievement when rewarded with a higher value item due to the fact that they have had a direct input into acquiring that item. Players who make poor decisions through the quests offered, may learn from their previous decisions and start to choose options that they would not have previously considered.

#### 4.1.5. Player Character Progression

Players can receive character reputation points for completing quests, completing a set Quest Pack, exploring areas and gaining in-game items. Reputation points are used to gain character levels and to progress their character to gain access to higher level quest packs and rarer items. Higher character reputation is also connected to the player motivation mechanic of social competition. Character progression can be made available to share on social media sites to tap into the social motivation of competition between friends and unknown players. The reputation mechanic could either be a one-way progression system similar to World of Warcraft, in which players can only gain reputation, or, it could be a two-way system in which players can be rewarded or deducted reputation based on choices associated with their quests. This two-way system could work in a similar way to the game Fable's morality bar. Character Reputation level and Reputation XP Bar would be displayed within the player's character's profile page for easy access and viewing.

#### 4.1.6. Core Reward Systems

Listed below is a set of perceived core rewards systems that will engage and reward the player for interacting the Crowd4Roads application.

1. Treasure In-Game Items: Items are awarded from quests and completing quest packs. Each Item will be assigned a rarity factor and a value factor. The rarity factor will be connected to quest difficulty. Rarer Items can also be located through completing quest packs and exploring unknown areas. Items are also

assigned an item value for an in-game monetary system. Items can be traded in or exchanged with other game rewards based on the value of the item. A concept of this rarity and value system is shown below in Table 2.

Quest Difficulty	Item Rarity	Item Value
Easy	Common	10 Coins
Medium	Uncommon	50 Coins
Challenging	Rare	100 Coins
Hard	Epic	250 Coins
Epic	Mythic	500 Coins

*Table 2 Concept of Item Rarity and Item Values*

Items are the core reward system within the Crowd4Roads gamification strategy, targeting collectors (completing sets, gathering items), merchants (players interested in financial/monetary systems in games) and social exhibitors (social media sharers).

2. Geo-Coins: Geo-Coins is an additional idea for supporting the transfer between in-game rewards to real world rewards. It was suggested that items could be turned into a value of Geo-Coins that would be stored in another separate application known as a 'wallet'. Geo-Coins could then be traded for real world

rewards such as free parking or vouchers. This would all be dependent of collaboration with external stakeholders and interested parties for providing these real-world rewards. In-game Items gathered from quests can be sold if the player does not want to retain specific items or has multiples of same item. This may provide an extrinsic motivation for players who are not interested in the in-game rewards system.

3. **Pets:** Pets are another in-game item that is used by many RP games. Pets are collectable items that often grant bonuses to a character or provide an aesthetic value for the player. Pets could be included as rewards on certain quests, completing quest packs or exploring unknown areas. Much like treasure items they add another level to the collection mechanic.
4. **Social Media Sharing:** To ensure that any in-game items have extra external value and promote the sense of competitive collection in players, all items/pets once gained, should be made available to be shared on most social media platforms. This will help promote competition elements within the gamification layer and encourage social acceptance in player motivations.

#### 4.1.7. Inventory System

The Inventory System will house and provide easy access to all in-game and transferrable items and rewards. From the inventory system, the players can easily

keep track of their items/pets/Geo-coins, they can sell their rewards for in-game value or Geo-Coins and they can share their rewards to social media sites. The Inventory System will be locked whilst the application is tracking movement and can only be accessed by a player once the car is motionless. This is to ensure that players do not get distracted and discourages interacting with the application whilst they are driving.

#### 4.1.8. Navigation System

The Navigation System is essentially a real-time map of the road networks, similar to using a Sat Nav. This System will be used to indicate to players where they have travelled and identify new undiscovered areas that they have not yet explored. A 'Fog of War' system usually used for Real Time Strategy games could be implemented here to indicate undiscovered areas on the map. There is a possibility of using icons to visually represent roads that may have access to higher rewards for the players to encourage them to certain areas of the terrain. This Navigation System is intended to be the only screen that the players can see whilst they are tracking data/driving. Since most drivers are comfortable/familiar with the concepts of using Sat Nav technology to follow a route, this should not be a major distraction for the players.

#### 4.1.9. Guilds

To promote the idea of social interaction within the game world, the use of guilds could be applied. A guild is a 'club house' in which players sign themselves up to. Players often gain access and are rewarded for being a part of a guild, and friendships between other players are usually formed and maintained through playing of the game. This



mechanic appeal to the social psychology of players and many large games such as World of Warcraft, rely on interactions between players in order for the game to be 'fun'.

#### 4.1.10. Multi-Player Mode

It has been discussed that there are to be two modes within the gamification system, single player and multi-player. Single player mode will function with the core mechanics as discussed above. Multi-player mode will require some additional mechanics in order to function.

To ensure that we encourage more people to car share and in order to try and get more quality data from each journey that has been tracked, multiple people who are sharing a car journey will be able to play the Crowd4Roads app together. The driver's handset will act as a master in which all players shall firstly be required to connect to via a Bluetooth/Wi-Fi connection. Once all available players are connected, the game will start a series of mini-games that the passengers in the car can play on their handsets. Mini-games will consist of short games that require players to use the gyroscopes and various other methods to track road data whilst trying to complete an objective. The idea behind this is that more players all tracking one journey's data, will allow for higher quality data to be obtained.

Described above are the core mechanics that are planned in the initial prototype of the gamification layer of the Crowds4Roads application. As the project progresses this



document will be added to and more mechanics added through each iteration of the app.

## 5. Conclusions

The Gamification and Reward Strategies and Features as outlined in this report provides the Crowd4Roads project with an informed plan to develop an engaging gamification layer for the Crowds4Roads application.

A thorough background review has been presented on play, games and gamification that specifically reports on the psychological, cultural and educational theories. The review intends to highlight and provide a foundation for the Crowd4Roads project on why games and play engage players and how these methods have been adapted across multi-disciplines for non-game purposes. Alongside the review, the authors present a general review of some of the highest grossing gamification applications. The review of the gamification apps presented in this report, highlights key mechanics used within each app to inform current trends in the gamification market.

Educational and behavioural change games/gamification methods have been found to be extremely effective in motivating users in a variety of ways. The review and the research surrounding existing gamification based applications has been used as a basis to inform the final selection (alongside technical considerations) of core mechanics for the gamification layer. Based on the information provided in the review, technical requirements and the review of socio-economic considerations, the core mechanics have been chosen to appeal to the largest player base possible.

Finally, the report documents the first draft of the gamification design document (GDD). This document lists and describes each of the core mechanics that are to be used in the development of the gamification layer of the Crowd4Roads application. The GDD's listed mechanics are the base mechanics that will be developed first and form the proposal for the prototype of the gamification layer. Some of these mechanics may be adjusted or removed throughout the development cycle of the prototype due to technical issues, constraints or un-suitability after in-house testing. Following each



iteration of core mechanics, the GDD will serve as a working, livable document that will be updated to reflect the current developments status. Each consortium partner will have access to view the GDD for consulting purposes. This report provides a central point for the justification and preparation of the gamification development approach of the prototype version of the application. It provides a clear approach forward for the next step of the technical development of the gamification layer, providing clear objectives via each of the core mechanic strategies as laid out in the GDD.

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