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Evaluation of Mobile Games using Playability Heuristics

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ABSTRACT
Mobile games currently occupy a very large market share amongst mobile applications. The success of these games depends on how well they appeal to their users. In this paper, four mobile games have been analyzed based on playability heuristics from the literature study. The results give us a glimpse of the success of these games in creating a positive user experience. Results of the analysis were then compared with the market statistics of the individual games to understand whether success of the games in the market can be attributed to the judicious following of the playability heuristics.

Categories and Subject Descriptors
H.5.2 **[User Interfaces];** Evaluation/Methodology, Graphical User Interfaces (GUIs), Screen Designs (e.g. text, graphic, colors), User Centered Design.

General Terms
Design, Human Factors.

Keywords
Mobile Games, heuristic evaluation, Playability

1. INTRODUCTION
Mobile games have increased drastically in popularity over the last few years due to a rise in the number of smart phone users. In fact, statistics show that around 70-80% of all mobile downloads is composed of mobile games [1, 14]. Such a large craze for ludic engagements in mobile environment has made it an industry of high scope and visibility. As such, survey reports predict a rise of up to $54 billion in revenue by 2015 [1, 14].

The primary characteristics of a mobile game that make it enjoyable are its content, storyboard, rewards, graphics, sound effects and user-experience. While designing such a game, a designer should accommodate these characteristics in order to create an engaging experience that can attract more gamers, leading to the success of the product. Literature suggests various heuristics that are referred to by designers while creating mobile games with an effective and efficient gaming experience, and while evaluating such games. In this paper, we have evaluated four mobile games based on playability heuristics [7] in order to understand how they differ in creating a positive and engaging experience for the users.

The success of the mobile games is generally judged on the basis of a number of market statistics such as the number of downloads, gamer reviews, game ratings and pay-per downloads. It has been reported that "Angry Birds" has been the most successful mobile game so far with more than 200 million downloads as of 2011 [2, 11] whereas games like "Counter strike ground force" and "Sonic CD" were given ratings of only 1 out of 5 stars by half the raters [12, 13]. What makes some mobile games so popular that they clearly stand out in the market against their competitors? Why do some mobile games appeal more to gamers than other games? To deal with these questions, we have carried out heuristic evaluation of four mobile games using playability heuristics [7], through which we intend to find out what needs to be improved in the existing designs to make them more appealing to users.

2. SETUP USED
Four Android games were chosen for the study. These games fall in the sports category and specifically in the context of car racing. The context, category and platform (operating system) of all the games are same so that the comparison becomes unbiased. The selection of the games was done on the basis of the user reviews and ratings available on their respective Android Market pages. The four games chosen are "Drag Racing" [3], "Raging thunder free" [4], "Outlaw Racing" [5] and "SpeedCar" [6]. Figure 1. depicts the number of ratings and downloads of these games from the "Android Market".

To evaluate the games an android phone namely "HTC Wildfire S A510e" was used. The specifications of the phone are given below:

Chipset:	Qualcomm MSM 7227
CPU:	600 MHz ARM 11
GPU:	Adreno 200
Platform:	Android 2.3.5 with HTC sense 2.1
RAM:	512 MB
Screen:	HVGA (320 x 480) – 3.2" diagonal

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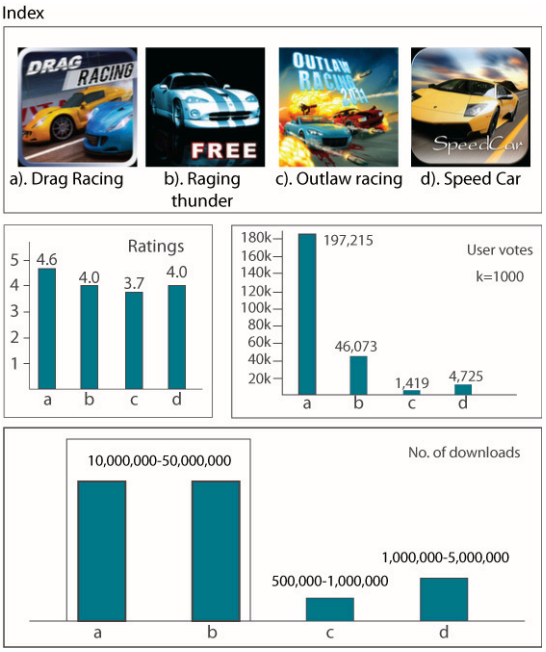

Figure 1. Selected games for evaluation and usage statistics in brief [3, 4, 5, and 6]

3. METHODOLOGY

Korhonen & Koivisto [7] have defined heuristics termed as "Playability Heuristics" to evaluate mobile games. These heuristics are divided into three major categories: "Game play", "Mobility" and "Game Usability".

Game play consists of:

1. Game mechanics: Includes the rules of the game, the scoring mechanisms etc [8].
2. Player interactions: Includes the structure of the players and their interaction with other players and aspects of the game [9].
3. Story: Storyboard and the role of the characters of the game .[10]

Mobility deals with the characteristics of mobile phones and their context that can influence the design of games. Screen size, processing speed, battery power, physical interactions and adjustment with the environment are some of these characteristics [7].

Game usability talks about the interface features of the game and its controls through which user interaction occurs [7]. Though mobility and game usability appear to be different, a correlation does exist between them [7].

The final playability heuristics discussed by Korhonen & Koivisto [7] have been shown in Table 1, Table 2 & Table 3.

Table 1. Game usability heuristics [7]

No.	Game Usability Heuristics
GU1	Audio-visual representation supports the game
GU2	Screen layout is efficient and visually pleasing
GU3	Device UI and game UI are used for their own purposes
GU4	Indicators are visible
GU5	The player understands the terminology
GU6	Navigation is consistent, logical, and minimalist
GU7	Control keys are consistent and follow standard conventions
GU8	Game controls are convenient and flexible
GU9	The game gives feedback on the player's actions
GU10	The player cannot make irreversible errors
GU11	The player does not have to memorize things unnecessarily
GU12	The game contains help

Table 2. Mobility heuristics [7]

No.	Mobility Heuristics
MO1	The game and play sessions can be started quickly
MO2	The game accommodates with the surroundings
MO3	Interruptions are handled reasonably

Table 3. Gameplay heuristics [7]

No.	Gameplay Heuristics
GP1	The game provides clear goals or supports player created goals
GP2	The player sees the progress in the game and can compare the results
GP3	The players are rewarded and rewards are meaningful
GP4	The player is in control
GP5	Challenge, strategy, and pace are in balance

GP6	The first-time experience is encouraging
GP7	The game story supports the gameplay and is meaningful
GP8	There are no repetitive or boring tasks
GP9	The players can express themselves
GP10	The game supports different playing styles
GP11	The game does not stagnate
GP12	The game is consistent
GP13	The game uses orthogonal unit differentiation4
GP14	The player does not lose any hard-won possessions

Two evaluators were used for the evaluation process. The evaluators were first given an overview of the heuristics defined in the literature. They were then asked to the play the games and evaluate them using the heuristics. Table 4 shows the results of the evaluation performed on the four games which has evolved from rigorous discussion between the evaluators. If a particular heuristic is followed by the game, 'Y' is assigned. Otherwise, 'N' is assigned. Note that the heuristic GP7 about game story has not been considered in the evaluation, as it is not applicable in the context of racing games.

Table 4. Results of heuristic evaluation

No.	Drag Racing	Raging Thunder	Outlaw Racing	Speed car
GU1	Y*	Y	Y	Y
GU2	Y	Y	N**	Y
GU3	Y	Y	Y	Y
GU4	Y	Y	Y	Y
GU5	Y	Y	Y	N
GU6	N	N	Y	Y
GU7	N	Y	N	Y
GU8	N	Y	N	N
GU9	Y	Y	Y	Y
GU10	N	Y	N	Y
GU11	Y	N	Y	Y
GU12	N	Y	Y	Y
No.	**Drag Racing**	**Raging Thunder**	**Outlaw Racing**	**Speed car**
MO1	Y	Y	N	Y
MO2	N	N	Y	Y
MO3	N	Y	Y	Y
No.	**Drag Racing**	**Raging Thunder**	**Outlaw Racing**	**Speed car**
GP1	Y	Y	Y	N
GP2	Y	Y	Y	N
GP3	Y	Y	Y	N
GP4	Y	Y	Y	N
GP5	Y	Y	Y	N
GP6	Y	Y	N	Y
GP7	NA	NA	NA	NA
GP8	N	Y	Y	N
GP9	Y	Y	Y	N
GP10	N	Y	Y	N
GP11	Y	Y	N	Y
GP12	Y	Y	Y	Y
GP13	N	Y	Y	N
GP14	Y	Y	N	Y

*Y: Yes, **N: No

Based on this evaluation, percentage of heuristics satisfied in each category was calculated (Game usability, mobility & game play). Percentage values were then compared against the user statistics obtained from the "Android Market" to verify whether the playability heuristics provide us with any clue about the ratings of the games. Table 5 shows the results of above calculations.

Table 5. Percentage of heuristics satisfied by the mobile games

	Rating	User Votes	Downloads (millions)	Game Usability (%)	Mobility (%)	Game play (%)
Drag Racing	4.6	207,039	10 – 50	58.33	33.33	76.92
Raging Thunder	4.0	50,589	10 – 50	83.33	66.67	100
Outlaw Racing	3.8	1,382	0.5 – 1	66.67	66.67	76.92
Speed Car	4.0	3,452	1 – 5	83.33	100	30.77

4. RESULTS AND DISCUSSIONS

Heuristic evaluation shows that even some highly rated games fail in some sections of playability whereas some games with lower ratings satisfy the playability heuristics adequately as indicated by drag racing and raging thunder. By analyzing the results of the evaluation (see Table 4), the game designers can identify the areas in which the game needs improvements as with Drag Racing, which has a large scope for improvement in game mobility and usability. Similarly, Speed car can improve its gameplay by a large margin.

This case study has highlighted that not all games, which follow the playability heuristics, are successful, nor do all successful games follow all the playability heuristics. The results of the heuristic evaluation do not exhibit any discernible pattern, neither between user ratings and percentages of heuristics followed in each category, nor between the number of downloads and their corresponding percentages (see Table 5). This observation raised several research questions, which are as follows:

1. Generally, following heuristics produces acceptable and usable designs but in this case-study, Drag Racing is the most popular game in spite of satisfying fewer

heuristics as compared to Raging Thunder and Outlaw Racing. This further raises two questions:

a. Do the playability heuristics hold for racing games?

b. Are the playability heuristics weighted in the sense that some of them play a more significant role in evaluation than others?

2. Mobility issues do not seem to affect the perception of users in determining the quality of a game as in case of Drag Racing in this study. Does this imply that there is more scope for research in defining mobility heuristics for mobile games?

3. This study has been conducted using only three major categories (Game usability, mobility and game play) of game evaluation criteria but the results seem contradictory to expected results. Does this mean that researchers need to find new categories to judge how well the mobile gaming community will accept the mobile games?

We believe that these research questions will assist researchers and game designers to come up with a more effective framework that can be used to design and develop more appealing games with higher success rates. Through this case study, we have also projected the potential areas in which the game designers can focus upon and make necessary improvements in their games.

5. CONCLUSIONS

With the rising popularity of mobile games, large investments are being made to produce and promote mobile games so much so that the competition is rising drastically. Practitioners working in the field of Human Computer Interaction, Usability Engineering, User-Interface-Designing and Consumer application developments need to focus on both the aspects of the system, Users and the applications (Mobile games in our case) in order to ensure the success of the developed products in the market. This case study has identified flaws in the current perception of game developers as to what features in a game will lead to its success. We have presented a case study on evaluation of four mobile games based on playability heuristics and have shown the key areas in which these games can improve their quality and attract more gamers. Several research questions were raised in this paper after the heuristic evaluation, which will need to be answered to ensure that a game will be successful and will yield profits in this huge arena. These research questions also put forward some key areas of research, which the researchers in this field can work upon and establish some new frameworks or metrics for game evaluation.

6. LIMITATIONS

Although this case study has presented some strengths and drawbacks of the chosen games, it still has some limitations. In this study, we have considered only four mobile games. Considering a larger set of games can help in understanding whether a correlation exists between user ratings and percentages of heuristics followed in the evaluation. Statistical analysis can then guide researchers in finding the relationship between the success of the game and its design considerations. Such a relation can assist designers in identifying tradeoffs between various features that constitute a mobile game.

Overcoming these limitations of this study can produce more flawless research contributions.

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