

Developing Casual Games for Mobile Touchscreen Devices

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ABSTRACT

As gaming on touchscreen mobile devices becomes more widespread there is a growing demand for a development process that incorporates usability guidelines and evaluation techniques that are specifically designed for games on such devices. We believe that the following two aspects have the biggest impact on game usability on mobile devices: the user and the usage environment. In this paper we share guidelines and experiences we learnt from the development of Naval Combat, a mobile casual game based on the paper and pencil guessing game “Broadside” which is also known as “Battleship”. Several studies have been conducted during the development of the game. In order to deal with a changing usage environment, the game has been optimized and evaluated in a public transportation context. The paper further shows how user requests such as the integration of accessibility features for visually impaired users were added to the game after it has been released.

Author Keywords

put author keywords here

ACM Classification Keywords

H.5.2 Information Interfaces and Presentation: Miscellaneous—*Human Factors, Design*

General Terms

See list of the limited ACM 16 terms in the instructions, see <http://www.sheridanprinting.com/sigchi/generalterms.htm>.

INTRODUCTION

According to IDC [7], 450 million smartphones will be sold in 2011 and the market is expected to continue growing at a rate in the double digit percentage. Most of the smartphones that are shipped offer high resolution touchscreens that support multitouch gestures, sensors sensitive to various physical aspects such as light, motion, or sound, and enough processing power to run games. In addition to the technological advances, nearly all smartphone platforms offer ways to

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easily advertise and distribute games on mobile devices [2] [4]. These aspects offer game developers exciting platforms to develop for and a give them business model.

Challenges

Developing games for mobile touchscreen devices inherits challenges mostly that differ from the ones known to conventional video game development for non-mobile devices. In 2009, a report on mobile usability by the Nielsen Norman Group [13] has shown that users find mobile devices harder to use than desktop computers. The average success rate, a simple usability metric, was 59% in their mobile studies compared to 80% when testing on a regular PC. This paper focuses on two aspects that influence game usability on mobile touchscreen devices:

1. **User dimension.** With the wide adoption of mobile devices, gamers are no longer solely “hardcore” gamers but rather casually play games on their devices.
2. **Usage Environment Dimension.** Mobile devices can and are used on the go which can lead to situations where the surrounding is noisy, shaky, or crowded with other people. These factors add additional requirements for game control and representation such as adapted gestures and colors. Additionally graphics have to be readable in the presence

Casual Games

Casual games can be seen as a direct consequence of changing demographics among gamers. Casual games often feature a simple set of rules. Popular examples include classic board games or puzzles ported for digital devices. According to a survey conducted in 2011 [19], 88% of all gamers or 141 million people in the United States play casual games including an estimated 76 million people playing on mobile systems such as a smartphones.

Case Study: Naval Combat

Naval Combat [11] is a single and multiplayer mobile casual game based on the paper and pencil guessing game “Broadside” which also known as “Battleship”. The game was developed and released for the Apple iOS platform and optimized for iPhone and iPod Touch devices. The initial version of Naval Combat has been developed in a timeframe of six month. The development process included evaluation methods that consider both, the user and the usage environment dimension. Users have been included throughout all

stages of development by conducting heuristic evaluations and studies. Regarding the usage environment, the game was optimized for daily commuters using a public transportation system. A field test have been conducted to specifically test the influence of distractions found in a subway train on game usability.

CONTRIBUTIONS

This paper gives a detailed description of the development process of Naval Combat, a singleplayer and multiplayer mobile casual game for the Apple iOS platform. The description covers how the user and usage environment dimensions have been considered in the process and how usability has been evaluated during the different stages of development. Additionally, guidelines for the development of casual games for mobile touchscreen devices are derived from the experiences of the development of Naval Combat.

RELATED WORK

In [9], Kuittinen et al. propose a definition of the term “casual games” and refer to important factors for such games besides the player. The authors analyze the different meanings of casual and provide a framework for an overall understanding of casual in the level of expanded game experience.

Research on playability heuristics [8] has shown that the small screen size, insufficient audio capabilities, or limited processing power of a mobile device itself creates additional requirements when designing mobile applications. In their paper, Korhonen et al. therefore introduce playability heuristics that specifically take mobile aspects such as the mobile device, user distraction, and higher priorities of other mobile applications into account.

When casual games are played in a public area such as in a public transportation context, further complexities arise as not only general usability but also social acceptability needs to be considered. For example, Rico et al. have shown that there is a need to thoroughly evaluate gestures in terms of acceptability for public use [15]. Uncommon movement or gestures that are considered weird or attention seeking can make the user feel uncomfortable and as such make a mobile game unusable when on the go. A public transportation which is inherently a public setting may even amplify these effects.

A study on the effectiveness of casual games in improving mood has shown that playing casual games inherits mood lifting effects [16]. The study further suggests that physiologically tailored games seem plausible in the future.

The book “Casual Game Design” [18] shows what makes casual games engaging and how designs for new casual games can be created. In [10], a framework for casual game design values is proposed. The framework takes the different affordances, user thresholds and the significance of the context into account. In this paper we propose further guidelines for the development of mobile casual games that highlight the complexity introduced by the user and usage environment dimensions.

As shown by Hoggan et al. [6], a change in context also requires a change in feedback modality. User decisions in a game largely depend on feedback modality. As such, this aspect has to be considered when designing a mobile casual game for a public transportation context. Not only must one consider multiple types of feedback but also evaluate these options in the context of the game and the surroundings it is played in.

NAVAL COMBAT DEVELOPMENT

Naval Combat has been developed using the Scrum methodology [17]. Scrum is a development process that focuses on evolutionary and agile development. The development team consisted of three members. The development effort is estimated to be approximately 900 person hours. Development took place over a six months timeframe. In the following we describe the iterations during the development process from Requirements Analysis to the final stages of the project. From a Usability Engineering perspective we focus on what techniques have been used to establish high usability, how the user has been involved to validate the quality goals of the project, and how the usage environment has been taken into account.

Requirements Analysis (Focus Group Study)

In a first step, a basic set of functional requirements were defined by the development team:

- Realization of a mobile casual game using the rules of the paper and pencil game “Broadsides”.
- Support for singleplayer and multiplayer games.

As a platform, the Apple iOS platform was chosen due to the availability of development devices to developers.

In addition to the functional requirements, a set of high-level non-functional requirements were defined to set a quality goal for the final product:

- The game should be playable in a public transportation context (noisy, shaky, crowded with people).
- It should be possible to start a game nearly instantaneously.
- Fault tolerance for multiplayer games should be provided.
- The game should be playable without any instructions by mobile gamers regardless of background and experience with games.

User Story

To better describe and reflect the ideas for the game, a user story was created that gives a high level description of how Naval Combat is meant to be played and who the intended target audience is. It further highlights the complexities that are introduced by a public transportation context. In the following, Sally, Jessica, and John are three daily commuters using the subway network. Jessica and John both know each other and often meet each other.

On a Monday morning John enters a subway train at the station that is close to his apartment. He finds a seat and starts playing Naval Combat on his mobile phone. John is tired and doesn't feel like challenging another player and starts a game against the computer. A few stations later Jessica surprisingly enters the train. John stops his game and talks to Jessica. After a while, they decide to play a multiplayer game using Bluetooth. When the inspector checks their tickets, both players pause the game. John sees an old man using crutches and offers him a seat. John is now standing in the train and continues playing Naval Combat with Jessica. John leaves the train at the main station. Jessica, who has to go a few stations further, wants to play on and looks for other players on the Internet where she finds Sally. Both start playing a multiplayer game. In the evening, John goes back home and remembers that he did not finish his game against the computer in the morning. He resumes the match and plays it on his way home.

The user story helped identify requirements that might influence the early design stages of the game such as the need for persistence to save a game and resume playing it at a later point in time. Additionally, it should be possible to pause the game at any point in time. Regarding multiplayer games, the story shows that initiating a game should be possible using Bluetooth technology because a WiFi network and cellular data might not be available in a subway train. The game should further be playable standing in a possibly shaking and moving environment which yields additional requirements on game controls.

Focus Group Study

In order to validate and extend our requirements we conducted a focus group study. To provide an incentive we offered each participant an iTunes coupon for Naval Combat which they received when the game was released in the App Store. Six participants aged 12 (1 female), 22 (1 female), and 24 (4 male) took part in the study. None of them had any prior knowledge about the game. After a short introduction of the concept of Naval Combat and our quality goals we asked the participants specific questions about the gaming environment, the gaming experience, and social aspects of mobile casual games (see Figure 1). Following the questionnaire, we asked the participants to draw a quick sketch of how they imagine the game to look like. In the end, we discussed the results and presented the sketches. The study took approximately one hour.

The questionnaire revealed that the participants are potential users of our game. All of them are regularly using the public transportation system even though only half of the respondents played mobile games in that context. The results also show that human and especially known opponents are favored. All participants further agreed that playing from face to face is more appealing than playing over the Internet. Features related to social networks have been rated as being less important. The study's results are shown in Figure 2.

The paper prototypes that have been sketched by the participants gave clues about where users expect game control

elements and what additional features are expected by potential users. An interesting finding was that all participants have drawn an unlabeled game board in contrast to a labeled board usually used to play the paper and pencil version. During the discussion the participants agreed that even though it was present on the paper and pencil variant of "Battleship" it is unnecessary for a digitalized version of the game because players do not communicate their shots. Other suggestions included a tabbed view for multiple simultaneous games, a zoomable game board, and extensions of the game's rules to include a story mode.

The study has shown that the requirements initially defined by the development team were a good starting point. However all participants agreed that the most important non functional requirement for a game was missing – there was not yet any visual design at this point and the requirement for the design to be visually pleasing was not made.

Definition of Rules

During the focus group study, even though not asked for explicitly, discussions with potential users of the target audience have shown that many variants of Naval Combat with slightly different sets of rules exist [5]. What most of them have in common is that two players compete against each other and try to sink all enemy ships before their own ships are destroyed. It turned out to be important to agree on a set of well-defined rules. The importance is reflected by the fact that the rules are an essential element of the functional requirements for Naval Combat. For the development of casual games we specifically recommend to put effort into the definition of rules during requirements analysis as variations can have an influence on the actual design of the game.

For Naval Combat the following rules apply: Each player secretly places an aircraft carrier of length 5, a battleship of length 4, a destroyer and a submarine each of length 3, and a patrol boat of length 2 on a grid of size 10 by 10. Ships can be placed horizontally or vertically, however they are not allowed to overlap and must not be placed next to each other. After ships have been positioned, the two players alternately fire a shot on the enemy's grid. Whenever a player hits a ship he can immediately fire another shot, otherwise the other player continues. The game finishes when one of the players sank all of the enemy's ships.

Throwaway Prototype

With the choice for the iOS platform being made and the requirements being verified, an initial throwaway prototype was created.

In the horizontal dimension of the prototype, a user interface that implements aspects of the development team's vision and ideas gained from the focus group study was created. A screenshot is given in Figure 3(a). Afterwards, the prototype was demonstrated to and being tested by several students. The findings indicated that the size of the buttons is a crucial point for usability and that it is difficult to fit a 10x10 grid on the iPhone screen so that each cell is selectable with a fingertip. Modifications to the prototype have shown that it

Gaming Environment	
Identifier	Question
GENQ1	When and why do you use the public transportation system?
GENQ2	Do you play games on a mobile device while using the public transportation system?
GENQ3	Do you play games on a mobile devices elsewhere?
GENQ4	Would you feel embarrassed if you were playing games on a mobile device in a crowded subway train?

Gaming Experience	
Identifier	Question
GEXQ1	Do you prefer playing against computer opponents or human opponents?
GEXQ2	Do you prefer playing against unknown opponents or people you already know?
GEXQ3	Do you prefer playing cooperatively or against each other?
GEXQ4	Do you prefer playing on the Internet or face to face?

Social Aspects	
Identifier	Question
SAQ1	How often do you use social networks?
SAQ2	Do you play games integrated in social networks?
SAQ3	Do you like the idea of your friends being informed when you win or loose a game?
SAQ4	Do you like to collect trophies?
SAQ5	Do you like to play with contacts from a social network?
SAQ6	Do you like to play against multiple opponents simultaneously?

Figure 1. Questions of the focus group study

was no problem to scale buttons to a convenient size. However it has not been possible to achieve a similar effect for the grid because of the physically limited screen size. To deal with this problem we created a concept for crosshairs that allowed for a greater click area without increasing the size of the game board.

In the vertical dimension of the prototype the team focused on the connectivity between two devices. The prototypical implementation using the iOS APIs has shown that it is possible to connect two devices either directly via Bluetooth or WiFi and over the Internet using WiFi or cellular data. Regarding Internet connections, the Game Center interface [3] was used to initialize and handle connections. Direct (or local) connections can also be created without the Game Center interface. The team decided that for backwards compatibility, Naval Combat should also support older iOS devices that do not offer the Game Center interface. Even though Internet games are not supported on these devices, local connections can still be established. In addition to handling mul-

Gaming Environment	
Identifier	Answer (#Participants)
GENQ1	Daily (4), Weekly (2)
GENQ2	Often (4), Never (2)
GENQ3	Yes (1), No (5)
GENQ4	Never (1), Only if my phone creates noise issues (4), Always (1)

Gaming Experience	
Identifier	Answer (#Participants)
GEXQ1	Computer (1), Human (5)
GEXQ2	Known (6)
GEXQ3	Cooperation (4), Competition (2)
GEXQ4	Face to face (6)

Social Aspects	
Identifier	Answer (#Participants)
SAQ1	Daily (5), Never (1)
SAQ2	Yes (2), No (4)
SAQ3	Very important (1), Less important (2), Not important (3)
SAQ4	Yes (4), No (2)
SAQ5	Yes (1), Only with friends (5)
SAQ6	Very important (1), Less important (5)

Figure 2. Results of the focus group study

tiplayer games, Game Center also allowed for the integration of leaderboards and achievements. These features were not planned to be integrated in the game initially. However, the prototype has shown that it is feasible to integrate these features and that they might add additional incentives to play Naval Combat.

In our opinion the overhead introduced by the prototype was justified as it yielded valuable results that could have led to difficulties during the implementation of Naval Combat. Two major advantages of the early prototype were:

1. An abstract version of the user interface was tested and usability constraints were introduced by the vertical prototype.
2. The vertical prototype has shown the feasibility of multiplayer gaming using the Game Center interface. It has further shown that legacy devices without the Game Center interface can be supported with little additional development effort.

First Increment (Field Test)

Following the development of the prototype and with new insights gained, the development team started to build the first increment of Naval Combat. Within the timeframe of one month, the team tried to implement as many items of the backlog as possible. It had been the goal to get a running version that offers a singleplayer mode and the ability to start a multiplayer game using Bluetooth. Game Center functionality had not been integrated in this increment. Regarding

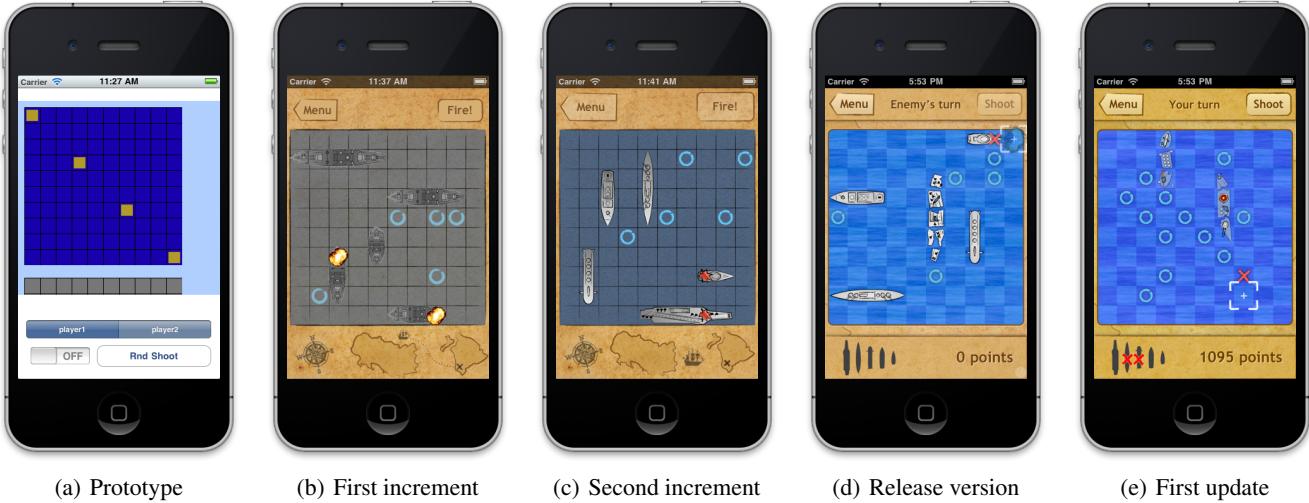


Figure 3. Screenshots of the different stages of development

usability, the focus lay on the development of crosshairs to select specific fields on a game board and to create a set of gestures that enable users to rotate and place ships on the game board. The team also followed the suggestion to concentrate on the visual design of the game. It has proven helpful to develop and visually design the game simultaneously for two reasons:

1. The visual design and placement of game controls and the visual representation of game elements are tested in various usage environments and by various users before the game is released.
2. Showing participants of studies an already visually pleasing increment had the effect that the participants valued the increment more than the prototype. As a consequence, their quality standards were higher and they were noticeably more engaged in the study.

Figure 3(b) shows a screenshot of the first increment.

Field Test

A field test was conducted using the first prototype of Naval Combat. The test was conducted in the setting of a public transportation system. A subway train had been chosen for the field test since it was easier to install cameras in this environment compared to a setting in a bus. The study was conducted at night-time in order to avoid inference with commuters. Two university students, one female (age 23) and one male (age 24), participated in the test. Both are commuters and use the local public transportation system on a daily basis. To better observe what reactions both participants show and how they use the game four cameras that simultaneously recorded the field test had been installed in the subway train. Two cameras were adjusted to record both iPhone screens. The other two cameras filmed the students head-on. In addition to the cameras, one microphone was used to record the participants' conversations and acoustic reactions. Figure 4(a) depicts the setting of the study.

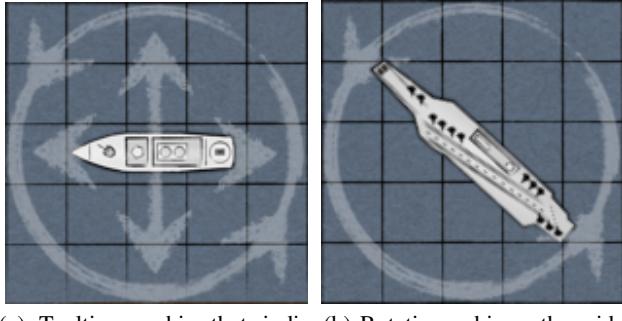


(a) Participants during the field test



(b) Participants clustering impressions and suggestions on a subway train window using sticky notes

Figure 4. Field test conducted on a subway train



(a) Tooltip graphic that indicates active gestures (b) Rotating a ship on the grid

Figure 5. Tooltip graphic for gestures

For the test, both students were given an iPhone with the first increment of Naval Combat installed. The participants were asked to perform the following tasks:

- Get familiar with the game and try to start a game.
- Start a singleplayer game and try to place ships randomly, then start the game and play it for a few rounds.
- Start a multiplayer game between the two devices and play it for a few rounds.

While the participants executed the tasks, members of the development team asked the participants at a random time to pause the game for a simulated ticket check. One student was further asked to stand up and continue to play the game while standing in the subway train. To better test the accuracy of the click areas for the buttons and fields of the game board both participants were asked to press specific buttons, place ships on specific positions, and shoot at a specific field. The study took approximately 90 minutes.

After playing the game, the participants wrote impressions and suggestions on sticky notes and clustered them on a subway train window (see Figure 4(b)). The findings suggested that the gestures for ship rotation and ship placement were difficult to get right and that it sometimes was difficult to hit a specific ship. The impressions also stated that animations felt sluggish and that the computer was shooting too fast when playing in singleplayer mode which led to the impression that the computer enemy is cheating. Feature requests included an introduction to the gestures that can be used, an indicator that shows how many enemy ships are left, and a button to randomly place ships on the game board.

Improving gestures

Following the field test it was clear that gestures for ship movement and ship rotation needed to be improved. The video recordings of the field test allowed for an in-depth analysis of the study and of how the gestures were used. The recordings suggested that gestures were difficult to use for two reasons. First, the participants did not know how to use the gestures and tried different approaches that failed to complete the tasks. Second, the active area for gestures

#	Finding	Average
1	Saving and resuming a game is not possible (for singleplayer games)	5.6
2	Interactive help, tutorial, or explanation of rules is missing	5.0
3	Consistency of the look and feel of in-game buttons is violated	4.6
4	Some gestures are unknown	4.4
5	Back button on the difficulty settings screen is missing	4.0
6	Indicator for destroyed and remaining ships is missing	4.0
7	Animations do not feel smooth enough	4.0
8	Selecting a ship by tapping it feels sluggish	4.0
9	Dragging the crosshairs is not possible	3.4
10	Button to randomize initial placement of ships is missing	3.2
11	Acoustic feedback is missing	3.0
12	Crosses on a ship should be hidden when it is completely destroyed	2.4
13	The click area of buttons needs to be larger	2.4

Figure 6. Results of the heuristic evaluation (lowest priority (1) – highest priority (7))

was too small. These insights would not have been possible with sticky notes alone but were mainly gained by the audio and video recordings. The feedback the development team got from sticky notes helped identify the problem with the gestures. However only the video recordings gave the team the chance to see how the gestures can be changed to provide better usability. The audio recordings were helpful in this context because users usually unknowingly made sounds when something did not work as expected. These sounds were used by the development team to identify the important sections of the video recordings.

As shown in Figure 5(a), a tooltip graphic that appears in the background of a ship once the user selects it was introduced. Once the user chooses a gesture, the tooltip graphic then highlights how the gesture can be used. Figure 5(b) shows how the tooltip graphic adapts to the user performing a rotation gesture. In addition to the introduction of a tooltip graphic, the active area for gestures was increased. The new gestures were developed together with the participants of the field test. The constant feedback loop helped fine tuning the settings for the gestures.

Second Increment (Heuristic Evaluation)

For the second increment, the development team mainly focused on the integration of Game Center for Internet multiplayer games, achievements, and leaderboards. It was a major goal to implement all functional requirements that had been defined at the beginning of the project by the end of this iteration. A screenshot of the second increment is shown in Figure 3(c).



Figure 7. Visual indicator where ships can be placed on the grid

Heuristic Evaluation

To receive further user feedback the development team conducted a heuristic evaluation as proposed by Nielson and Molich [14]. Six evaluators were given an iPhone with the second increment of Naval Combat installed on the device. All evaluators had a computer science background and attended a course on Usability Engineering. During the evaluation the participants first inspected the user interface without paying attention to details related to gameplay. After that, the evaluators discussed and aggregated their findings. In a second round, the participants were asked to evaluate the gameplay and discuss and aggregate their findings as well. The evaluation took about one hour of time. The aggregated set of findings was collected by the development team and sent to the evaluators. In the email, the evaluators were asked to prioritize each finding on a scale of 1 (low priority) to 7 (high priority) and send the prioritized list back to the development team. The results of the heuristic evaluation are shown in Figure 6.

Having received the results, the development team investigated each list item and discussed and estimated the amount of work to process the finding. Taking the estimation into account, the team agreed to fix every aspect related to existing features such as the animations not feeling smooth enough and to implement all feature requests besides finding #1. To realize the ability for users to save and resume saved games was estimated to take 60 person hours. The team agreed to implement this feature at a later point of time and integrate it in an update to the game.

To create an interactive help or tutorial as proposed in finding #2, the team decided to try a different approach than to design a conventional tutorial for players who play the game for the first time. Instead, tooltip graphics were more widely integrated in the game. The use of these visual indicators had already proved helpful to improve the gestures for ship movement and ship rotation and were then used throughout the game. Figure 7 shows how a visual indicator was added to indicate where ships can be placed on the grid.

Game Usability	
Description	#Participants
Audio-visual representation supports the game	2
Screen layout is efficient and visually pleasing	2
Indicators are visible	1
The player understands the terminology	1
The game gives feedback on the player's actions	1
The player cannot make irreversible errors	3
The player does not have to memorize things unnecessarily	1
The game contains help	3

Gameplay	
Description	#Participants
The players are rewarded and rewards are meaningful	3
There are no repetitive or boring tasks	2
The players can express themselves	3
The game supports different playing styles	3
The game does not stagnate	1

Mobility	
Description	#Participants
Interruptions are handled reasonably	1

Figure 8. Points of the user evaluation that had shown violations (each participant was asked if a point is violated; the table's second column indicates the number of participants (out of 4) that answered with yes)

Release Version (User Evaluation)

During the last iteration before the release of Naval Combat on the App Store, the development team mainly focused on the completion of requests from the heuristic evaluation and to create a stable version of the game. As shown in Figure 3(d), the graphical user interface was given a more vivid look and feel. Furthermore, the source code of the game was refactored in this iteration and prepared to be reused for updates and new games based on Naval Combat's foundation.

User Evaluation

One month prior to the submission of the game to the App Store, a last user evaluation was conducted with four participants, one female at age 22 and three male at ages 24–25. The study was conducted in a crowded environment with four iPhones and participants were asked to play Naval Combat without any further instructions. It was specifically important to the development team that the study was not conducted inside a laboratory. Later, the participants evaluated the game according to the playability heuristics introduced in [8].

The results had shown that Naval Combat does barely violate any of the mobility and game usability heuristics. However,

participants wished for more possibilities to express themselves during gameplay. The results of the user evaluation are shown in Figure 8. The feedback gave a hint on what future updates to the game should contain: requests included different playing styles and selectable graphic sets for the ships.

Release & Customer Feedback

Naval Combat was released on iTunes [12] on April 16, 2011 and was initially offered for free. The game was released worldwide in two languages: English and German. On April 25, the development team decided to introduce a price of \$0.99 (United States; price varies in other countries). By the end of April 2011, the game had been installed on over 100,000 devices. Customer reviews on iTunes and emails to the team provided the development team with well over 100 comments on the game. Comments mostly included feature requests regarding an extended gameplay which were already requested in the user evaluation.

Integration of Screen Reading Technology

One of the users that contacted the team hinted at an aspect previously not thought of by the development team: accessibility. The user said that she was blind and that she depends on screen reading technology to let her play the game. According to the WHO [21], 235 million people are visually impaired worldwide. The iOS platform offers the VoiceOver interface [1], a gesture-based screen reader that lets users touch the screen to hear a description of the item they touched. However, developers have to integrate this interface in their application and add descriptions of items. According to the users commenting on Naval Combat, only a small amount of applications on the App Store support VoiceOver.

The development team decided to integrate support for the VoiceOver screen reader technology. A constant feedback loop with the visually impaired users who contacted the development team helped integrate and optimize the VoiceOver support. Thereby, development versions of the game were remotely deployed on the devices of the test users. It took the team approximately 50 person hours to integrate VoiceOver in Naval Combat.

The sound debate

The initial release of Naval Combat included sounds for hitting a water tile or a ship. Several users complained that they do not want to hear sounds because they mostly listen to music while playing the game. A poll conducted among the active user base revealed that neither option, with background sounds nor without background sounds, was significantly preferred over the other. Consequently, a switch was added to the game that lets users choose if they want to activate or disable in-game sounds.

Version 1.1

Version 1.1 includes the above mentioned features in addition to new ship graphics, new achievements, a Russian translation, and background music. The update was released on the App Store on May 28, 2011. Figure 3(e) shows a

Method	Average
Focus group study	4.7
Field test	6
Heuristic evaluation	2.7
User evaluation	1.3

Figure 9. Results of the evaluation of evaluation methods (least important (1) – very important (7))

screenshot of version 1.1 of Naval Combat. After the update was released, several users sent comments and asked the team to remove the background music. On May 31, 2011 the development team released yet another update to version 1.1.1 which removed the background music from the game.

In July 2011, a German blog author who specialized in testing games for visually impaired users evaluated Naval Combat [20]. The feedback gained by the review was positive yet one blind reader responded that in-game sounds should not be disabled when VoiceOver is activated. This decision was made by the development team because it thought it improves the understandability of the screen reader. However, as stated by the reader, visually impaired readers might feel patronized. The development team decided to deal with this issue by adding a switch in the game that lets VoiceOver users enable and disable in-game sounds.

DISCUSSION OF THE DEVELOPMENT PROCESS

Retrospectively, the development team evaluated the development process used to built Naval Combat. The three members agreed that the Scrum methodology was a perfect fit for the small and dynamic team. The team further evaluated the evaluation methods and studies used to integrate potential users in the development process. The focus group study, the field test, the heuristic evaluation, and the user evaluation were each given a rating from 1 (least important) to 7 (very important) by each team member. The aggregated results are shown in Figure 9.

The results show that the findings gained by the field test were regarded the most important for the developers. Specifically the insights gained by testing the gestures under real world conditions gave a hint on how usability could substantially be improved. The video and audio recordings were thereby seen as the most valuable for the development team. The participants of the field test also seemed to have shown the highest involvement and have had the most fun during the study compared to the participants of the other studies and evaluations.

The insights gained by the user evaluation were regarded the least important by the development team. According to the team, the primary reason for this is that questions asked during the evaluation were too many and too specific which confused the participants. For future projects, the development team will use a more simplified and reduced set of questions for the user evaluation and will ask the participants to focus more on the stability and the gameplay rather than on the questions asked in the survey.

In future projects, the development team would further conduct a second field test during the last iteration before the release. The cost and the duration of a field test is comparable to other studies but yielded the most valuable results because the test was conducted taking the usage environment into account.

GUIDELINES

In this section, we share guidelines for the development of casual games for mobile touchscreen devices. The following seven rules were ranked the most important by the development team of Naval Combat.

1. **The right development process.** The choice of the right development model seems to be universally valid for any software development project. However, developers of mobile casual games are perhaps more than others faced with constantly changing requirements defined by potential users. We propose choosing an agile and evolutionary development methodology such as the Scrum model. We further recommend building a highly abstract and flexible architecture to allow for substantial changes to the game, e.g. a change to the set of rules, even in late stages of development.
2. **Early definition of rules.** The example of Naval Combat has shown that, even for a well-known game such as “Battleship”, it is important to agree on a well defined set of rules in the early stages of development because people with different backgrounds might be familiar with slightly different sets of rules. We recommend to define the set of rules together with potential users. For casual games that are not based on classic or well-known games it is still recommendable to present the game concept to potential users and find out what the users’ intuitions tell them what the rules might look like.
3. **Simplicity over feature richness.** Throughout the studies, participants valued the simplicity higher than the feature richness of Naval Combat. We recommend that, especially for games which are usually not played over a long period of time but are rather casually, it is of high importance that users are faced with a flat learning curve. Features that extend the basic set of features needed to play the game should not be required to be known to users. Furthermore, users should not suffer from any disadvantage by not knowing the existence of the additional feature. An example from Naval Combat is the possibility to optionally move and rotate a ship on the game board before starting a game. Users that do not know about this feature do not suffer from a disadvantage because ships are initially placed randomly on the game board and can be assigned a new random placement by the push of a button.
4. **Stability.** Customer reviews of Naval Combat have shown that users highly value stability and fault tolerance. Casual games are usually played over short periods of time. Users do want features to be usable without much effort. We specifically recommend that developers thoroughly test the multiplayer mode of the game under development. Various aspects such as a loss of connection or lost packages

can easily lead to instability of multiplayer modes. During the development of Naval Combat it was further important to consider the usage environment: e.g. it is possible that WiFi or cellular data are not available on a subway train and users rely on Bluetooth to initiate a multiplayer connection.

5. **Integration of potential users in the development process.** We think that it is crucial to evaluate a game in all stages of development. Findings and insights gained by the focus group study, the field test, the heuristic evaluation, and the user evaluation brought up issues and feature requests the development team would not have found or thought of as easily. We further recommend entering a feedback loop with users who requested features or found flaws with the usability of the game under development. For example, the participants of the field test were a valuable source of input for the improvement of ship placement gestures for Naval Combat.
6. **Consideration of the usage environment.** The usage environment can have a huge influence on the usability of a game. We recommend that games under development should be tested in their respective future usage environment. The development team of Naval Combat optimized the game for a public transportation context where the surroundings can be noisy, shaky, or crowded with people. The field test conducted during the development of Naval Combat helped the development team in optimizing the usability of the game. We further recommend not only to conduct a written survey after the test but rather to create a video and audio recording of the field test. The recordings helped the team to improve specific aspects of gestures and the placement of user interface elements.
7. **Integration of accessibility features.** With over 200 million visually impaired people worldwide, the integration of accessibility features such as screen reading technology opens a casual game to an even broader audience. The example of Naval Combat has further shown that the additional effort to support the target platform’s screen reading interface was comparatively small to the overall development effort.

CONCLUSION

In this paper, we have shared the lessons learnt during the development of Naval Combat, a single and multiplayer mobile casual game based on the paper and pencil guessing game “Broadsides” which also known as “Battleship”. A detailed description of each of the stages of development was provided. We have also shown how to integrate both, the user and the usage environment in the development process. Retrospectively, the development team proposed changes to the development process and which general guidelines can be extracted for the development of casual games for mobile touchscreen devices.

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