PRODUCT DIFFERENTIATION AND USER ENGAGEMENT WITH AR BATTLESHIP GAME BASED APP

Dănuț VÂSC, Șerban Nicolae MEZA, Aurelia CIUPE, Aurel VLAICU
Technical University of Cluj Napoca, Cluj-Napoca, Romania
Memorandumului Street Nr. 28, Tel +4 0264 401 200

Abstract: This paper reviews the concept of augmented reality (AR) and proposes an innovative use of it in digital marketing. The purpose is to present the steps required for developing an AR app using state of the art resources and then validate its usage as a tool for product differentiation and user engagement. Approaches to user interaction and engagement stemming from the gamification area are also considered and introduced in the app design and implementation. Results regarding the proposed strategy and user feedback on the implemented app are discussed.

Keywords: *Augmented Reality, digital marketing, gamification*

I. INTRODUCTION TO AUGMENTED REALITY

Digital technology and its increasing prevalence impacted human life dramatically in the past decades. From the advent of the digital society, with the invention of the computer, to the present day, digital technology and computing have worked their way into more areas of life, from communications to finance to social interaction. Recently, the availability of modifying our physical world with virtual elements is just showing off in a large-scale manner [1], – generating what is named the AR world (e.g. "augmented reality"). Augmented reality (AR) allows virtual objects to be overlapped onto the real world in real-time, experience achieved through a wide variety of devices. To understand the concept of augmented reality one must grasp the concept of virtual reality (VR) and the difference between these two. Virtual reality is a computer-generated environment that lets the user experience an alternative realistic world. Therefore, it creates an entire new environment whereas in augmented reality, virtual objects are placed into the real world, considering a targeted image or a tracked real world object.

As the digital technology had and has an impact on human life, AR technology is expected to be one of the next important milestone in this process. The area where the AR could be used varies from entertainment to marketing and social media, or even to medical care where applications may help improve human life and education [2], [3].

In marketing, [1], AR is perceived to differentiate a product and a brand and engage a user outside the classical physical channels (e.g. a store, paid adds, etc.). It can also be used as means of increasing the social responsibility of the company by providing interactive content that foster responsible conduct and behavior. For instance, nowadays, most applications that are being used by children are not suitable for their age, and are usually made for profit only, without any desire to improve thinking or long term vision. Such, for instance, the use and understanding of cardinal coordinate system which is one of the bases of geometry and strategic thinking, abstract vision, relative positioning and the ability to reposition oneself in different perspectives (a stable target image and a moving camera vs a moving target image and a stable camera) that are found in Battleship like games [4], [5]. A lot of people are familiar with the play scenario, or similar versions, and it makes an ideal candidate for gamifying[6], the learning experience with the afore mentioned benefits to mental development.

Taking this idea further, the paper proposes a product differentiation and user engagement strategy for a paper notebook manufacturer and seller based on the use of an AR Battleship game like app.

The paper is structured into 5 parts, starting with a brief enumeration of companies that have innovatively used AR apps to differentiate themselves on the market and gain user engagement as such, followed by a description of the available technology for experiencing AR; it follows the presentation of the implemented AR application and considerations regarding its use by the parties involved. Finally, the last part is dedicated to conclusion.

II. AR USE CASE EXAMPLES

Even though VR and AR were initially perceived as being for niche users (gamers, special prototyping and design engineers, etc.), application developers and market trends prove that these concepts could be used in various ways and gain wide market penetration. AR is being used by retailers of all sizes, offline or even in stores to blend the boundaries between online, mobile and real world as it is shown in some examples presented hereafter.

- Ikea: an AR "catalog like" application that allows users to see how different objects would fit in different places in their house. The

Manuscript received June 10, 2017; revised June 29, 2017

basic scenario addressed is that of visualizing how a piece of furniture (e.g. a couch) would fit in the user's room [7].

- Uniqlo: an AR application that lets customers try on new outfits without putting them on; instead of using a mirror, a LCD screen allows choosing a piece of apparel for trying out and then it overlays the outfit over the person in front [8].
- Lego: one of the earliest AR applications available allows customers to see the final model of a Lego toy just by holding the box in front of the kiosk camera [9].
- Disney: an AR coloring book application designed for children that animates characters just by filming the book. The mobile phone's camera detects the sketch of the character in the physical book and augments them in 3D allowing the user to paint it [10], [11].
- Google Translate: an AR translation app that detects text and language in an image and replaces it with the translated version of it [12].

III. TECHNOLOGY SUPPORT FOR AR APPS

From the hardware point of view, VR and AR can be experienced with commercially available devices, such as Google Cardboard [13], Occulus Rift [14], or Microsoft Hololens [15]. Google Cardboard [13], allows customers to experience virtual reality in a simple, fun and affordable way, by using a headset made of cardboard which holds a smartphone as a screen. Oculus Rift [14], is also a gadget that allows experiencing virtual reality, but it is deemed more complex. It can offer better graphics and creates an even more "realistic" experience with included controls and advanced tracking. Microsoft Hololens [15], is the first self-contained, holographic computer, enabling the user to engage with the digital content and interact with holograms in the world around.

For developing VR and AR applications, there are many stand-alone platforms, and platform extensions and plugins. Some of the best-known platforms to create applications that include AR features are Unity 3D [16], Android Studio [17], Droid AR [18]. Services for AR development include Vuforia [19], Metaio SDK [20], Wikitude SDK [21], ARLab [22].

IV. AR BATTLESHIP GAME APP IMPLEMENTATION

Variants of the BattleShip game have been implemented before as computer games, devices or even AR applications [5]. The proposed implementation focuses on providing experience available to users through their smart phone, a device readily available to the targeted audience and market. More, it distinguishes from other implementation by providing a point of use / play that is connected to the desired market scenario, that is "while interacting with the physical hard cover notebook", a novelty in the field, building on existing trends of mixed realities.

The implemented user experience can be summed up by the following process:

"As a student, I use my smart phone camera to "look" at my physical notebook hard-cover picture. If the cover image is the "right" one, the student gets on overlay of a virtual grid on top of the cover picture, on which battle ships can be placed (anywhere on the grid, occupying different number of grid cells, according to the ship's size); this can be termed the "friendly" army. After the placement step, a secondary virtual grid is displayed on the smart phone's screen, near the one containing the placed ships. This is considered the "enemy" map, consists of a "hidden" set of enemy ships placed on top (by the opponent), and the student may launch "torpedoes" on each of the grid cells in order to "destroy"/discover the position of the ships placed on this grid. Each "shot" is replied to by a similar trial of "sinking"/discovering the ships placed on the "friendly" army map. Game ends when either side has all ships "sunk"/discovered."

The process of creating the Battleship AR app can be streamlined intro the following steps:

- Creating the image target;
- Register the image target with the image detection and tracking service (e.g. Vuforia [19])
- Creating the relevant 3D objects and graphics elements
- Setting up the virtual scene and placing the virtual objects (by using the Unity3D platform [16]);
- Implement interaction and gameplay rules

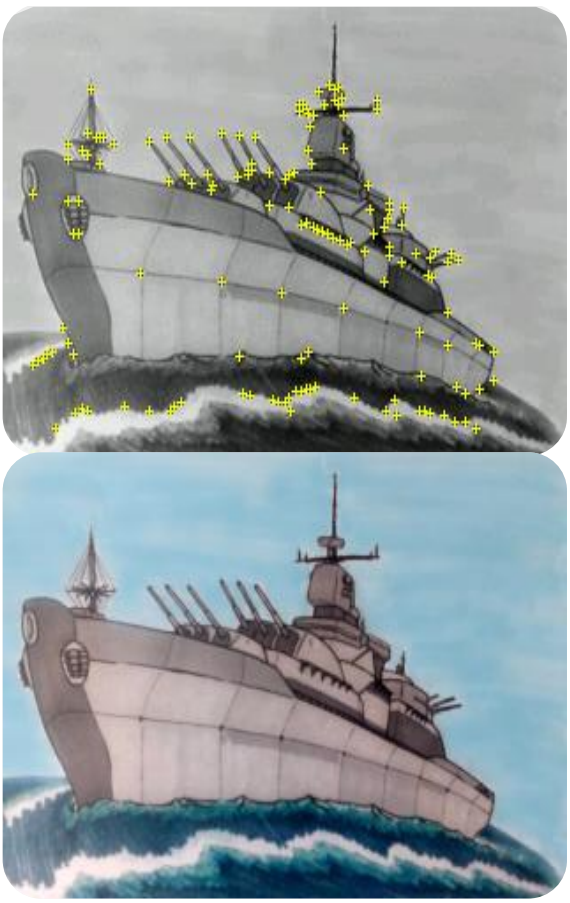

Figure 1 a) Image target b) Key image features used for detection and tracking

In order to create the image target, a suggestive image was chosen, representing a military ship in the middle of the ocean. Figure 1a depicts the chosen target

image. This was registered with Vuforia's augmented reality service [19], for detection and tracking by uploading the image on the online portal and converting it into a relevant dataset. The proprietary algorithm selects key feature areas from the picture, as shown in the Figure 1b, the device camera can readily detect and make tracking viable in different types of environment that are encountered in reality (e.g. exposure to different types of light of the image target, small obstacles that occlude some of the image areas).

For creating 3D graphics and effects the Unity3D platform and standard Unity assets were used [16].

The entire app was structured into 3 scenes: the main scene, MainMenu, that allows the user to start a new game play, the read the instructions scene and the exit the game scene. Figure 2 depicts the main application window.

Figure 2 Main Battleship app window

When starting a new game play, a window asks for choosing the difficulty level: Easy, Medium or Hard. Each level of difficulty is based on the chance to be hit by the computer in a one on one play scenario. Next, the game play starts by asking the user to place the boats on the game map as presented in Figure 3. Each boat object has a fixed point, called head, with the size of 1 by 1, and initially is being placed on the right side of the map. Any boat can then be selected and placed on the map and/or rotated around its head (0, 180, +90, -90) in its final position.

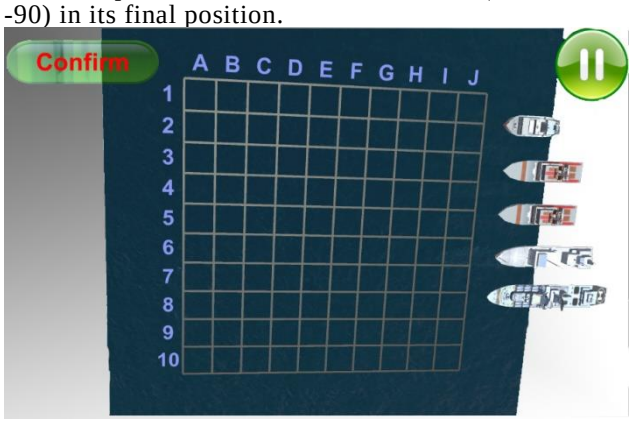

Figure 3 Boat placement phase

After all boats are placed, the "*confrontation*" phase starts by allowing the user to hit first on the enemy map that appears on the bottom right side of the screen. This has the opponent's boats automatically placed. For better user interface, the size of the opponent's map changes, and it becomes smaller when the computer hits, and larger when the user must decide upon his next hit.

The algorithm for the computer player implements a straight forward approach based on random number generation and probability estimates. Like-wise, the map is partitioned into two sets of point coordinate: one containing the actual position of the boats and the other, the rest of the points. Given a difficulty level selection, there are more chances for the computer to hit / select a random point from the first set of coordinate points.

$$rand(\square) > diff_{level}, choose\ point\ from\ HitPoints$$

$$else, choose\ point\ from\ rest\ of\ the\ Grid$$

$$where\ total\_grid\_points = 100\ and\ \max\ \_HitPoints = 20$$

Figure 4 Basic algorithm for the computer player

If by any reasons the user wants to quit during the game play, in the upper left corner a button is present that allows access to a menu saying the game play is paused. At the end of the game play, a message pops out informing that the game play is over and announces the winner.

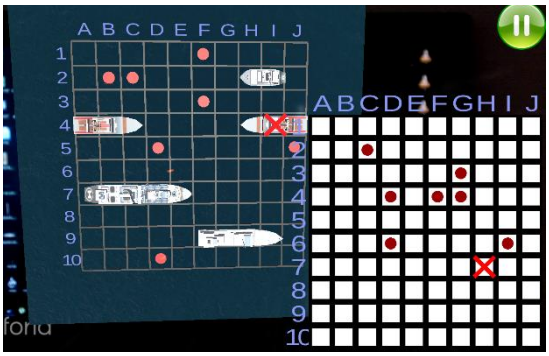

Figure 5 Regular game play screen

The implementation of the application intended for strategy validation and user acceptance requires the use of any device supporting Android OS V4.1 (or newer), wide screen only layout and mandatory access to a camera (for image target detection and tracking). Three different level of difficulty were implemented: Easy (with a chance of computer to hit of 10%), Medium (with a chance of computer to hit of 20%) and Hard (with a chance of computer to hit of 40%).

V. STRATEGY FOR PRODUCT DIFFERENTIATION AND USER ENGAGEMENT WITH AR

The implemented AR app is considered as a tool for product differentiation and user engagement in a marketing strategy for a paper notebook manufacturer and seller. Likewise, appealing to messages that encourage the use of paper for study not play, but offering a "linked" alternative online in communicating with the user (e.g. pupils and students), the manufacturer wants to differentiate its hardcover notebooks from the competition. More, introducing the

idea of "using a notebook can also be fun" the manufacturer expects a more reliable and lasting relationship with its clients. Also, attaching and online channel of communication enables a personal relation with each consumer and, thereafter, a larger pool for decision making and market planning. In addition, the content can be more easily updated, without the need for the manufacturer to change the physical cover design for every notebook batch just to maintain the client engagement. From the point of view of the application and its use, the following objectives were considered as critical to further development:

- Increasing notoriety and downloads by updating the application graphics options (e.g. different themes for the ships, etc.) and making the app available for other platforms (e.g. iOS);
- Increasing app play satisfaction by implementing an achievement system combined with new notebooks acquisition
- Increasing social interaction and product recognition by introducing a multiplayer option.

By analyzing the current market, the objective is to validate the strategy as soon as possible and benefit from the momentum AR has gained lately among users [23].

Not only that the image target gives the notebooks a better look, but, by placing it on the covers, it allows support for augmentation, giving a clear edge in product differentiation and user engagement.

VI. CONCLUSION

The proposed prototype Battleship AR application was demoed to different kind of people to test their reaction and impressions. Everyone was impressed, from children to adults, by the level of engagement that app offers (characteristic to the gaming world) but also by the innovative use and association with the real world.

Some, without testing the app argued about "Why AR, when we can add effects in a photo editing app (like Photoshop)?". The answer could lie in the comparison of old phones (with buttons) with the later ones using touch-screens: technology is always contested, but, in the end, it just makes things easier, more attractive, and companies that decide to differentiate themselves have always done this by embracing and promoting the latest breakthroughs in terms of both products / services and the way they decide to market these.

REFERENCES

[1] Alimamy, Saifeddin, Kenneth R. Deans, and Juergen Gnoth. "Augmented Reality: Uses and Future Considerations in Marketing." *Leadership, Innovation and Entrepreneurship as Driving Forces of the Global Economy*. Springer International Publishing, 2017. 705-712.
[2] Akçayır, Murat, and Gökçe Akçayır. "Advantages and challenges associated with augmented reality for education: A systematic review of the literature." *Educational Research Review 20* (2017): 1-11.
[3] Chen, Peng, et al. "A review of using Augmented Reality in Education from 2011 to 2016." *Innovations in Smart Learning*. Springer Singapore, 2017. 13-18.
[4] Silva, Daniel Castro, and Vasco Vinhas. "An Interactive Augmented Reality Battleship Game Implementation." *Proc. Learning with Games* (2007): 213-219.
[5] Bidwell, Nicola J., and Jason Holdsworth. "Battleship by foot: learning by designing a mixed reality game." *Proceedings of the 3rd Australasian conference on Interactive entertainment*. Murdoch University, 2006.
[6] Weng, Shiau-Chi, et al. "Using Augmented Reality to Assist Learning Geometry Concepts." *E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education. Association for the Advancement of Computing in Education* (AACE), 2014.
[7] Truong, A. "*Today's most innovative company: IKEA uses augmented reality to show how furniture fits in a room*." Fast Company 26 (2013).
[8] Ross, Heather F., and Tina Harrison. "*Augmented Reality Apparel: An Appraisal of Consumer Knowledge, Attitude and Behavioral Intentions*." System Sciences (HICSS), 2016 49th Hawaii International Conference on. IEEE, 2016.
[9] Robertson, A. "*Augmented reality Lego is actually pretty cool*", 2014, The Verge (online version https://www.theverge.com/2014/6/19/5821476/augmented-reality-lego-fusion-hands-on)
[10] Cheng, Kun-Hung, and Chin-Chung Tsai. "*Children and parents' reading of an augmented reality picture book: Analyses of behavioral patterns and cognitive attainment.*" Computers & Education 72 (2014): 302-312.
[11] Jamieson Cox, "*Disney is using augmented reality to bring coloring books to life* ", The Verge (online version https://www.theverge.com/2015/10/5/9453703/disney-research-augmented-reality-coloring-books)
[12] de Andrade, Rajiv Augusto Santos Galvao, Lucas Goncalves Franco, and Christopher A. Robbins. "Method for enhanced location based and context sensitive augmented reality translation." U.S. Patent No. 9,092,674. 28 Jul. 2015.
[13] https://vr.google.com/cardboard/ (checked May 2017)
[14] https://www.oculus.com/rift/ (checked May 2017)
[15] https://www.microsoft.com/en-us/hololens (checked May 2017)
[16] https://unity3d.com/ (checked May 2017)
[17] https://developer.android.com/studio/index.html (checked May 2017)
[18] https://bitstars.github.io/droidar/ (checked May 2017)
[19] https://www.vuforia.com/ (checked May 2017)
[20] http://www.metaio.eu/ (checked May 2017)
[21] https://www.wikitude.com/ (checked May 2017)
[22] http://www.arlab.com/ (checked May 2017)
[23] Rese, Alexandra, et al. "*How augmented reality apps are accepted by consumers: A comparative analysis using scales and opinions*." Technological Forecasting and Social Change (2016).