

serious games, educational games, firearm handling game

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THE USE OF UNITY 3D IN A SERIOUS GAME DEDICATED TO DEVELOPMENT OF FIREARM HANDLING SKILLS

Abstract

The paper presents the model of the serious game designed to develop firearm handling skills. The game is dedicated to act as an educational tool. Its aim is to teach how to disassembly and assembly weapons. The main aim of the paper is to present and discuss educational value of this kind of serious games. Detailed results were obtained after end user examination. What is more, the aspect of ergonomic and usability is also covered. The paper presents also the game design and development process.

1. INTRODUCTION

Serious games are currently very popular. Furthermore, this popularity is continuously rising. However foundations for serious games had been laid before computer games gained popularity. The term serious games in its current form was mentioned for the first time by Clark Abt in a book “Serious Games” (Abt, 1970). He defined serious games as games which have educational use instead of being used only for entertainment. There were some other important publications after that (Jansiewicz, 1973), but real popularity of the topic came with 21st century. Besides works like Michael’s and Chen’s (Michael & Chen, 2006) which tried to comprehensively discuss the serious game topic there were many articles and scientific papers focusing on one chosen area of this kind of games. Studies on serious games included education, medicine, military and many others. Treating depression might be one of the examples (Plechawska-Wójcik & Rybka, 2015; Weina, Gromala & Tong, 2015; Fleming et al., 2014).

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There are also applications made for medicine purpose, for example for diabetic people (Diehl et al., 2015). Educational games could be successfully used in schools (Fisser, Voogt & Bom, 2013) and for employee skills development (Corrigan et al., 2015). They are used for military training as well. A good example is a French game which teaches combat casualty care (Pasquier et al., 2016). American army also uses games that teach battlefield behavior, as well as encourage future adepts to join the army (Alvarez & Michaud, 2008).

When it comes to research papers related directly with firearms handling skills there are also many positions available. Article “LVC interaction within a mixed-reality training system” (Pollock et al., 2012) presents foundations, usage and problems connected with development of battlefield simulator called Veldt. It mixes real elements like rooms, foyers and doors with virtual reality. It is made using video projectors, sensors and purpose-built weapons. Game Virtual Battlespace 2 is the main part of the system. The work is summarized by a survey conducted among system users. Thereby it was possible to distinct positives and negatives of the system and discuss possible improvements.

Quite similar but simpler simulation is presented and elaborated in another research work (Bhagat, Liou, & Chang, 2016). Presented game is made mainly for military shooting range simulation. Thanks to laser technology shots made using special weapons are transferred to virtual world with very high precision. The article is summed up by a survey conducted among high school students who played the game. According to the survey results both game reception and educational effects were positive.

Market research show that serious games connected with development of firearm handling skills focus mostly on shooting. It seems that there is a lack of games teaching how to disassembly and assembly firearms. It seems that this topic is not popular. This is one of the reasons why this paper addresses mentioned topic. Gun disassembly and assembly is one of the potential subjects that could undergone scientific research.

The aim of the paper is to present the gameplay of the serious game focusing on disassembly and assembly firearms and to evaluate educational value of this kind of games. The rest of the paper is structured as follows. The section 2 presents the idea of the game, the section 3 presents the details of the survey used for research. The section 4 presents obtained results. The section 5 concludes the work.

2. THE IDEA OF GUN DISASSEMBLY AND ASSEMBLY GAME

2.1. Game design

The aim of the presented game is to teach potential players partial assembly and disassembly of AKMS assault rifle. The target platform is personal computer with Windows operating system. The game consists of two main modes:

learning mode and time trial. The aim of the first mentioned mode is to teach a player how to assembly and disassembly weapon. It is realized in the form of step by step tutorial. The second mentioned mode is to polish up skills gained in previous mode. A player tries to achieve the best result. Achievements that could be collected in this mode give a player additional motivation. There are also statistics which allows a user to keep track of his/her progress. What is more, there is information about weapon used in game, so as to satisfy players curiosity when they search for detailed knowledge.

The learning mode is made in a tutorial like form. There are instructions shown on the screen telling a player which actions should be performed at the moment. There are also many tips. Gun parts connected with current game point are highlighted. Also labels with gun parts names are shown. Gameplay is divided into two stages: gun disassembly and gun assembly. Figure 1 presents sample actions performed by the user during gun disassembly. Underneath them there are messages displayed to a player.

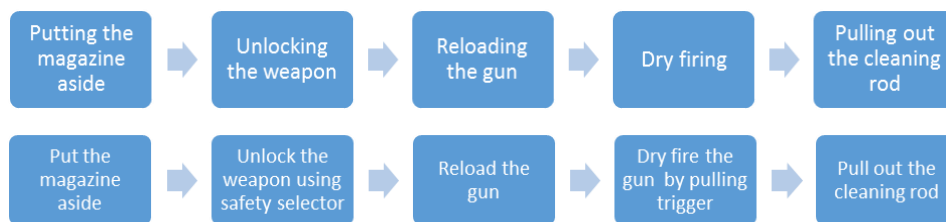


Fig. 1. Sample actions performed in the learning mode

The time trial is in many aspects quite similar to learning mode. One of the biggest differences is the lack of instructions in this mode. Moreover, both disassembly and assembly time are measured. The aim of this mode is to disassembly and assembly weapon in the shortest possible time. Player mistake results in a time penalty. Figure 2 shows mechanics of time trial game mode using BPMN schema.

2.2. Game implementation

The game was implemented using various tools. Gun model was created in Blender. In general game was made with use of Unity 3D development tools. C# was the language used in the process.

Making model was probably the most time consuming task during implementation phase. AKMS assault rifle model was made with great attention to details and with division to single gun parts. It was textured with accordance to reality.

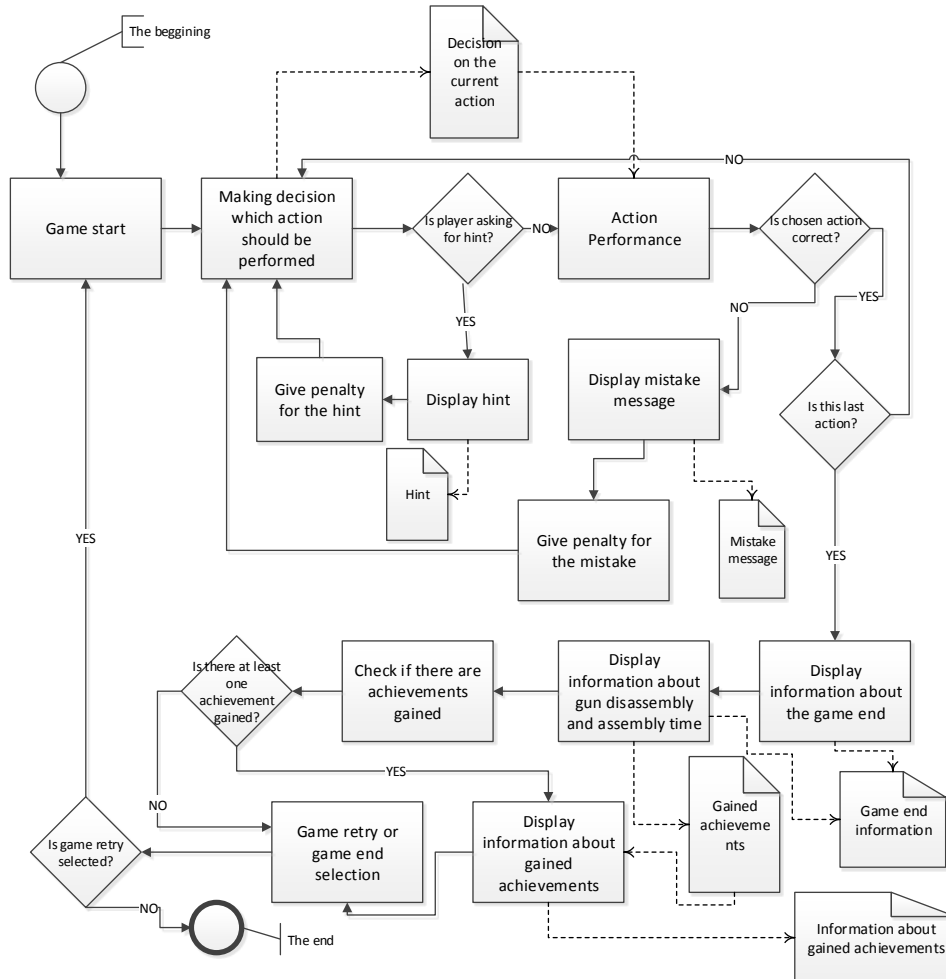


Fig. 2. The time trial BPMN schema

Animations are very important part of the game. All animations were defined using C# delegates. Third-party library called GoKit Tween was used to simplify and speed up animation development process.

There are achievements which player can gain for performing tasks well. Information about them is stored in an NoSQL database. The same is made for the statistics. One important thing to note is that gained statistics are used in achievement awarding process. Some of the statistics are shown to the player, so he/she can keep track on his/her game progress.

Hint system in the game consists of two parts: highlighting weapon elements and their name labels. Highlighting was made using custom shader. Highlighted weapon elements are visible even if they are behind other objects.

A special class was developed to show element name labels in appropriate places. It was used to translate 3D coordinates to 2D coordinates. Such operation was necessary because label hints (2D GUI elements) are to be shown where 3D elements are presented.

Final step of the implementation process was game balancing. Like in any other computer game it was necessary to properly adjust difficulty level. Animations duration was changed in order to match reality. Achievements were redesigned in order to give a player more motivation. It was hard and time consuming process, as it consisted of many retests of the game. Figure 3 shows the screenshot of the game learning mode.



Fig. 3. Learning mode screenshot

3. THE SURVEY

A special survey was conducted in order to examine educational value of the game as well as its usability features. Before filling the questionnaire respondents had to play the game at least 30 minutes in total. They had to spend at least 15 minutes in the learning mode and the same amount of time in the time trial. Questions about educational values of the game were divided into three groups: questions checking gained knowledge, questions related to playing time, questions about subjective game effects estimation. The first group included five questions asking about things like weapon elements assembly order or elements used in the disassembly process. Its aim was to check in an unbiased manner what players have learned. The second group consisted of questions about time spent both in the learning mode and in the time trial. The third group asked respondents about their own opinion about game and effects of playing it. Usability examination was made in order to check how GUI design affects the player experience.

People who took part in the research didn't have experience in disassembling or assembling AKMS rifle. They also had small or none firearm handling experience. It was checked in survey using special questions. The group consisted of 20 people. They were on average 25.6 years old, standard deviation of their age was 6.35 years and median was 24. Exactly 80% of the responders were man and 20% were women.

4. RESULTS OF SURVEY

Survey showed that the game is regarded as a good educational tool. Both verifying questions and responders subjective opinion show that game taught players how to disassembly and assembly guns. Maximum number of points which could be scored from questions checking gained knowledge was 5. On average interviewees scored 3.95 points, whereas standard deviation was 0.94 points and median 4 points.

70% of responders declared that after playing they are able to disassembly and assembly the gun presented in the game. 30% told that they could do it partially. In contrast, 85% of them declared that before playing the game they were totally unable to disassembly AKMS. Figure 4 shows comparison between ability to disassembly and assembly AKMS rifle before and after playing the game.

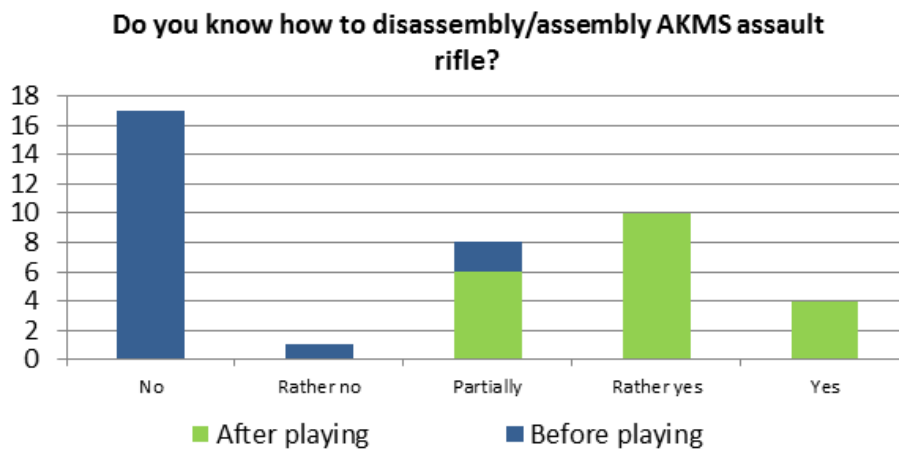


Fig. 4. Ability to disassembly/assembly rifle before and after playing the game

50% of the people declared that the game is very useful, whereas 45% told that it is useful. One person thinks that it is only partially useful. Those results shows that the game has very positive reception among interviewees.

Some questions were made to check whether game impacts people to get interested in guns and shooting. All of them had only two possible responses: “yes” or “no”. Results are as follows:

- All responders (100%) after playing the game declared that they would like to retry doing the same things in real life,
- 95% would play the game one more time if there were new guns added,
- 85% declared that the game encouraged them to go to a shooting range,
- Half of the responders (50%) admitted that they would like to search for additional information about firearms in external sources.

It could be easily seen that the game enhances players to take part in activities connected with firearms.

Usability examination showed good readability of the main menu. However, its appearance rating was slightly worse. It means that outlook of the main menu should be improved.

Further questions were about fonts size, contrast between elements and selection of colors. According to answers, font size is proper and contrast is quite good. Although colors should match better. Game elements like navigation, instructions placement and prompt readability are proper.

The biggest issue is that there are moments in which a player doesn’t know what to do next. What is more there are also situations where after clicking on some object there is no expected reaction. There should be further study performed on this matter. It is important to determine what is the reason of such opinions and improve the game afterwards.

5. CONCLUSIONS

The main goal of this paper was to present and discuss the results of examination of educational value of the serious game and its usability. Performed study shows that developed game meets users expectations. The game has high educational value. Responders surely developed firearms handling skills using it. Usability of the game is good, although there are elements which should be improved. Game itself might be used as an educational tool. Not only by individuals but also by institutions.

REFERENCES

- Abt, C. (1970). *Serious Games*. USA: Viking Press.
- Alvarez, J., & Michaud, L. (2008). *Serious Games: Advergaming, edugaming, training and more*. France: IDATE.
- Bhagat, K., Liou, W., & Chang, C. (2016). A cost-effective interactive 3D virtual reality system applied to military live firing training. *Virtual Reality*, 20 (2), 127–140.
- Corrigan, S., Zon, G., Maij, A., McDonald, N., & Mårtensson L. (2015). An approach to collaborative learning and the serious game development. *Cognition, Technology & Work Journal*, 17 (2), 269–278.
- Diehhl, L., de Souza, R., Gordan, P., Esteves, R., & Coelho, I. (2015). Effectiveness of a serious game for medical education on insulin therapy for diabetes: randomized controlled trial. *Diabetology & Metabolic Syndrome Journal*, 7 (1), Supplement. doi:10.1186/1758-5996-7-S1-A163
- Fisser, P., Voogt, J., & Bom, M. (2013). Word Score: A serious vocabulary game for primary school underachievers. *Education and Information Technologies*, 18 (2), 165–178.
- Fleming, T., Cheek, C., Merry, S., Thabrew, H., Bridgman, H., Stasiak, K., Shepherd M., Perry, Y., & Hetrick S. (2014). Serious games for the treatment or prevention of depression: A systematic review. *Journal of Psychopathology and Clinical Psychology*, 19 (3), 227–242. doi: 10.5944/rppc.vol.19.num.3.2014.13904
- Jansiewicz, D. (1973). *The New Alexandria Simulation: A Serious Game of State and Local Politics*. USA: Canfield Press.
- Michael, D., & Chen, S. (2006). *Serious Games: Games That Educate, Train, and Inform*. Canada: Thomson Course Technology PTR.
- Pasquier, P., Mérat, S., Malgras, B., Petit, L., Queran X., Bay, C., Boutonnet, M., Jault, P., Ausset, S., Auroy, Y., Perez, J. P., Tesnière, A., Pons, F., & Mignon, A. (2016). A Serious Game for Massive Training and Assessment of French Soldiers Involved in Forward Combat Casualty Care (3D-SC1): Development and Deployment. *Journal of Medical Internet Research Serious Games (JMIR Serious Games)*, 4(1), 48–57. doi:10.2196/games.5340.
- Plechawska-Wójcik, M., & Rybka, J. (2015). A Serious Game Raising Awareness And Experience Of Depression. *The 9th International Technology, Education and Development Conference (INTED 2015)*, Spain, Madrid.
- Pollock, B., Winer, E., Gilbert, S., & de la Cruz, J. (2012). LVC interaction within a mixed-reality training system. *The Engineering Reality of Virtual Reality 2012*. USA Burlington.
- Weina, J., Gromala, D., & Tong, X. (2015). Serious Game for Serious Disease: Diminishing Stigma of Depression via Game Experience. *Games Entertainment Media Conference (GEM)*. Canada, Toronto.