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APPLICATION OF VIRTUAL REALITY TECHNOLOGIES
FOR PRACTICING HUMAN BEHAVIOR SKILLS IN EMERGENCY SITUATIONS

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This article describes the principle of operation of the software and hardware simulator created using virtual reality technologies and represents virtual reality as a technology for the effective development of specialized human skills. It also shows the importance of projects created for similar purposes.

Introduction. The goal of the project is to teach its users to independently prevent household hazards at the initial stages on their own and to behave appropriately, without panic.

Task Statement. The designed simulator satisfies the following necessary conditions:

– all movable objects and all sounds should either help to get out of a dangerous situation or serve to immerse the user in virtual reality. They are specially selected to keep the player's attention and stimulate him;

– all immovable objects should not create obstacles to the user or distract him;

– the user's interaction with objects should be close to reality;

– the feedback from objects and situations to the user's actions should be close to reality;

– the user should be able to interrupt, continue or replay the game;

– the user should be able to find out the reason for the loss and his mistake;

– the user should intuitively understand where an emergency will occur and how to get out of it.

The advantages of VR technologies in the project are:

– easy implementation of any complex situations;

– practical training of repetitive algorithms of actions remains in the muscle memory of the trainee;

– in the game format a person trains himself or herself and acquires skills faster;

– the player can handle specific situations after training, because he or she has successfully overcome it.

Project implementation. The software is created in a game engine called Unreal Engine 4 and based on UX – user experience. The environment was made with the use of models made in a professional program for creating three-dimensional computer graphics - Autodesk 3ds Max. The training equipment is a VR headset of the HTC Vive system.

In VR development there are no environment building templates yet, because each environment serves a unique purpose. This simulator looks like an average apartment with two locations: a kitchen and a living room. There are dangerous household situations in each location which are designed to be solved by a player.

Fig. 1. – Apartment view from above

Mostly, electrical appliance fires are presented as emergencies, because today every household has a minimum set of devices and gadgets which can catch fire due to a short circuit, network congestion or disregard for operating rules. Also, the situation of oil ignition in a frying pan is included, because if the stove is turned on and left unattended it may be dangerous. Attention is also paid to gas leak and water pipe breakout, which can occur due to poor quality of the equipment and overdue service life.

As a result, 6 dangerous situations were implemented. Each of them is possible in a residential area and each has a clear solution algorithm.

Simulator training is structured the following way: various objects are placed around the source of the danger within eyeshot. These objects are located about half a meter away from the user so that they can be easily noticed. They can be used to eliminate the hazard. There are right and wrong ways out of situations. The correct solutions can be variable, for example, they can differ in the methods of firefighting or have a certain order that is made up of several actions. The incorrect solutions are implemented in order to give the user the opportunity to make a mistake and correct it in virtual reality without damaging his health.

All situations are constructed in the same way: the use of a combination of correct actions leads to new situations and, as a result, to a successful completion. If the actions are not correct or there are no actions at all the player sees an error message with the opportunity to replay the game.
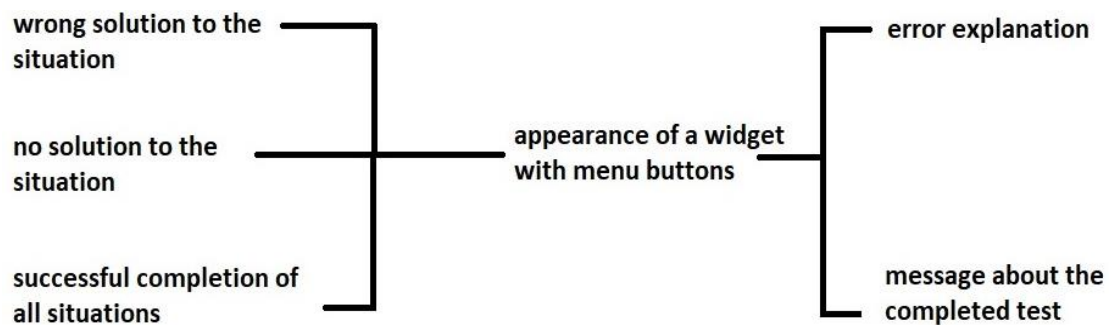

Fig. 2. – Project operation scheme

Results, discussion and perspectives. The significance of the work: the software and hardware complex based on VR technologies for developing skills of behavior in emergency situations was put into work at the Educational Center of the Ministry of Emergency Situations and is being actively used there. This center was opened in Novopolotsk on August 7, 2020. The Center aims at educating all segments of population of any age the basics of health and life safety using innovative technologies and modern equipment by immersion in a virtual environment that simulates emergency situations. This allows users to practice actions not only theoretically, but also practically. The software and hardware complex was developed under contract No. 2082 dated July 08, 2020, by order of the Representative Office of the United Nations International Children's Emergency Fund (UNICEF).

Forward-looking suggestion for development of VR: the capabilities of the simulator allow to increase training modes in order to practice actions in accordance with the rules of conduct in an emergency that may occur at the facilities of various industries. Currently it is possible to develop a simulator for practicing behavior skills in emergencies at the industrial facilities using the created software and the hardware platform. The new simulators can be used at JSC "NAFTAN" in Novopolotsk. There is also a prospect of expanding the set of emergencies in residential areas or outside them. For example, in a city, on a roadway, in a forest, near water reservoirs, and so forth.

Conclusion. The VR complex automates and gamifies the process of training in life safety and fully satisfies the requirements of the task. The user intuitively understands where to look for emergency and how to get out of it safely. If for some reason this does not happen, the player can find out about his or her mistake and try again.

The user's interaction with game objects is based on the physics simulation already existing in Unreal Engine 4 and it is close to real so a person understands how the system behaves.

The basic principles of user testing were applied to improve the product and to make it more understandable and convenient for the target audience.

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