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MEANS OF MOVEMENT OF THE USER MODEL IN THE VIRTUAL REALITY APPLICATION

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In this paper, we examine different means of movement of the user model in the vr application and explore how they can effect human player.

The effect of staying in virtual reality. To this day, the most urgent issue of developing virtual reality applications is minimizing the discomfort associated with the dissonance of the organs of the audio-visual attitude and spatial orientation organs during the use of virtual reality applications.

The basis of this discomfort is the player's movement in the virtual world. In total, five movement options are distinguished: natural movement, teleportation, physical movement, artificial movement and vehicles.

Teleportation, in fact, transfers the entire fixed game space to the place indicated by the player, otherwise the player, as with natural movement, is limited to the physical space registered by the sensors. Vehicles help limit motion sickness by allowing the player to have a visual anchor in the form of a virtual object within which the player moves in the virtual world. Physical movement allows the player to move themselves with some physical actions, such as flapping wings, which leads to the expected result for the player and reduces the motion sickness effect [1][2].

Artificial movement gives the player more freedom than other options and is suitable for creating action games and quest-labyrinths, it is controlled with the minimum movements for the player (pressing a button on the controller), which is familiar to most users and makes it easier to transfer existing games in VR [1].

During the development of the application, three of the five types were implemented, namely: teleportation, physical movement and artificial movement. Natural movement is inherent in the very essence of detecting virtual reality equipment with sensors, so that it consists of the project initially. Transport movement was not implemented due to the inappropriate artistic theme of the project.

Engineering of the application. Application was implemented using Unreal Engine 4.

Based on the characteristics, requirements and standards of the structure of such projects, a functional diagram was compiled, consisting of the modules presented below:

1. MotionControllerPawn - a player model containing a camera, collisions, additional objects and part of the logical structure of the player's actions.
2. BP_MotionController - a model of the player's controller that contains the logic of the player's interaction with the outside world.
3. BP_ClimbObj - an object for the physical movement of the player.
4. BP_Button - the parent object of the button.
5. BP_Portal - a child of the button responsible for teleporting the player to a specific point.

Implementation of movement. The most common type of movement in virtual reality applications is teleportation. In the basic template project of virtual reality of the Unreal Engine 4 engine, there is an implemented system of teleportation, which is the main system for moving the basic project. This type of teleportation transfers the player's model to the point indicated by the player on the playing field.

This project implements a different type of teleportation. Unlike the type indicated above, the player does not control the exact position in which he will move. Moving by pressing the button object (BP_Portal) in the virtual world and has a fixed value. At the same time, during the movement itself, the image is darkened, which can significantly reduce the motion sickness effect.

The BP_Portal function, shown in Figure 1, performing the movement is called Event Button Action, and has, in addition to the Add Actor Local Off-set, which moves the player to the teleportation endpoint, the Start Camera Fade function blocks at the beginning and end of the movement, which darkens the image, returning it after the end of the movement.

To implement the player's movement in a horizontal plane with voiced steps, a solution was developed, shown in Figure 2.

A position value is read from the joystick (for Oculus) or the touchpad (for HTC Vive), which changes from -1 to 1 along the X and Y axes. This value is passed to the Moving Forward function for the Y axis and Moving

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Right for the X axis. Also, these values are compared to zero, as they are read continuously, and if at least one of them is not equal to zero it changes the value of the boolean variable Is Moving to True, if both values are zero, Is Moving becomes False.

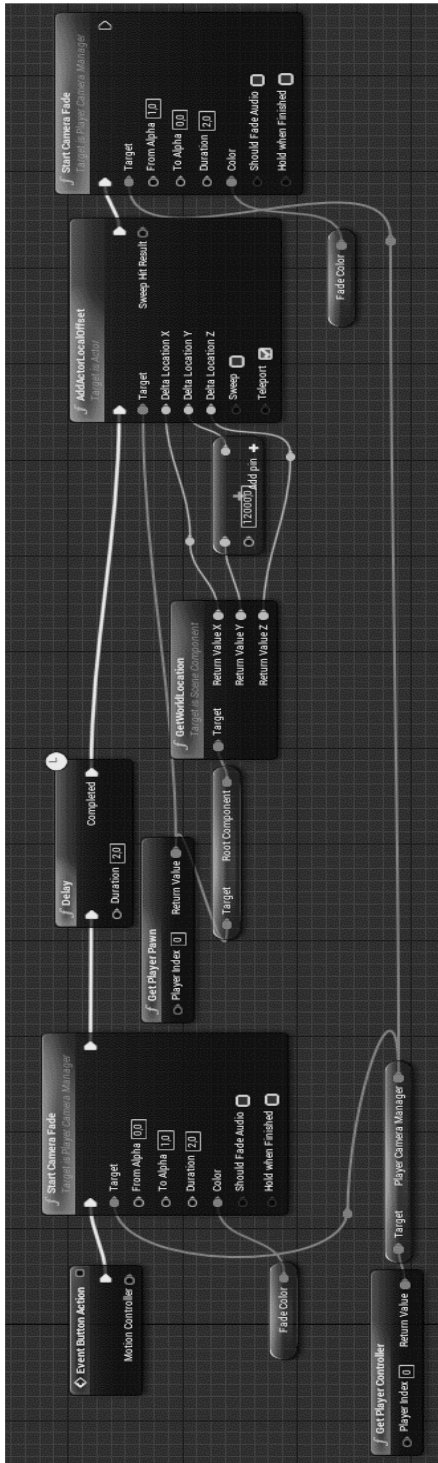


Figure 1. – Implementation of the fixed-point teleportation

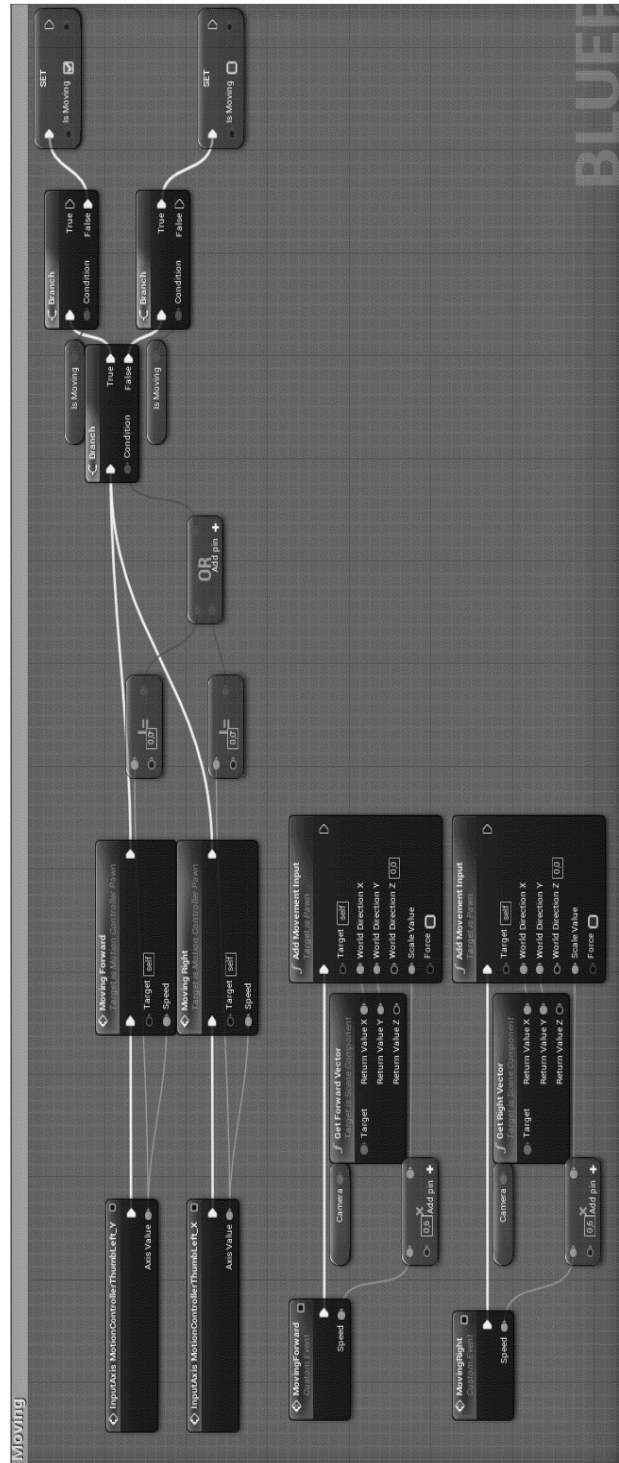


Figure 2. – Implementation of the linear movement

In functions, the values of the axes are multiplied by a constant equal to 0.6, identified experimentally as the most comfortable for this type of movement. Further, this constant, by means of the built-in Add Movement Input function, is summed up with the direction of the camera looking forward for Move Forward and right for Move Right.

At such a speed of movement, during testing, the average time of a game session before the onset of disorientation was checked. According to the testing data obtained at the first game session, the average value of its duration is 6 minutes. When repeated, the time can increase up to 30 minutes without the occurrence of a simulator disease.

Physical movement is implemented by the interaction of several modules: a controller component that stores the 3D model of the controller and its animation BP_MotionController, a component of the MotionControllerPawn player that stores all the basic user functionality, the interface that connects the player and the components with which it interacts, and a component of surfaces for vertical movement BP_ClimbObj, which stores a model of a surface primitive for vertical movement, as well as specially created material for a simplified perception of objects of that type. In addition, the BP_ClimbObj component stores the logic of movement along vertical surfaces.

The logic of such a movement is as follows: the player has two controllers, each of which interacts with an object of a certain type (a special wall for moving). At the moment the interaction begins, the entire player's model begins to move relative to the point at which the interaction of the controller and the object began, this movement occurs with the help of the controller, the model of which is fixed at the above point.

Conclusion. Any given type of movement can be used in virtual reality application. Nevertheless, it depends on the specific genre or goal of the project. And, of course, it is important to understand the effect of virtual interactions on the organism of the user. Summing up, one of the most crucial things in vr project is to choose accurate type of movement and implement it carefully.

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