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## VIRTUAL ENVIRONMENTS FOR SMART HOUSE SYSTEM STUDY

These days, virtual, augmented and cross-reality technologies are used not only in the gaming industry. They also allow organizing 3D learning environments that provide the effect of immersion and user interaction with the objects and processes being studied.

In particular, various applications have been created to study Internet of Things (IoT) technologies as well as Smart House (SH) systems. This area of study is interesting and useful for people, as it allows us to make our lives more comfortable, safer and provide resource saving [1, 2].

Various virtual environments have been developed for virtual reality (VR) helmets and personal computers. They are Multi-purpose SH simulation system, OpenSHS, Electronic House, Live Home, PlanerVR etc. [3].

For instance, a virtual reality environment (VRE) allows a person in the Oculus Go VR helmet to gain experience with a virtual model of SH, both outside and inside the building, and interact with sensors and devices [1].

The application runs on the Android mobile platform and provides the functions of character control, helmet calibration, and interaction with the interface using a controller. The developed VRE allows studying such subsystems as Lighting control, Security control, Climate control, Irrigation control, etc. This enables students to gain knowledge about the structural and functional features of the SH system, as well as the principles of its control [3].

An interactive virtual model for Smart House & IoT remote laboratory was developed on the WebGL platform with HTML5 and JavaScript. Unity 5 game engine and Autodesk 3ds Max 3D environments were also used during the design process. Users can interact with the proposed virtual model and receive data from the model components such as temperature, humidity, soil moisture sensor, solar panel, etc. using control panels of a remote laboratory [4].

The developed virtual model allows: obtaining useful information about the components of SH system; running simulation of various SH subsystems. Thus, it motivates users to create their own home automation system based on the rewarding experience with this remote laboratory and its virtual model. The practical value lies in the fact that the created virtual model allows studying the behavioural characteristics of residents to build

patterns of their activities, on the basis of which it is possible to develop scenarios for efficient consumption of resources in SH [4].

Smart House Virtual Environment (SHVE) is a project that expands the basic functionality of hybrid (remote and virtual) laboratory GOLDi [5]. The developed system consists of two parts. They are the server and the graphical representation of the simulation process. The server can be considered as a message router connecting the users' clients to the SHVE. Communication between the server and SHVE/clients occurs via sockets using the MQTT data transfer protocol [5].

The presented SHVE is a new educational tool, with interesting possibilities of moving a character around the house and interacting with equipment in order to study the basics of control and design of home automation systems. This VR environment provides students with the ability to create scenarios of working with the main subsystems of SH such as lighting and climate control, based on the activities of the SHVE character [5].

The usage of SHVE, which is similar to the role-play game, is of interest to students, as they know the mechanics of computer games well. This environment is intended to train students in developing software (clients) for SH system control. However, students have the opportunity to use the free MQTT client to work with the developed SHVE without programming.

The usage of SHVE allows lecturers to create different realistic tasks related to the functioning of SH systems based on human behavior. Students have the opportunity to solve these tasks and gain practical skills in the development of home automation systems and technologies [5].

In such a way, the development and practical usage of virtual environments opens wide opportunities for experiments in various fields of learning and improves the results of the educational process.

The implementation of virtual experiments in the field of home automation systems provides an interactive learning environment that allows students to participate in the active learning process and increases their motivation to study modern information technologies and processes.

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