SIMULATOR DEVELOPMENT OF VIRTUAL EXPERIENCE AND ACCIDENT SCENARIOS OF HYDROGEN STATIONS FOR SAFETY

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ABSTRACT

Nowadays 4 type hydrogen stations have been demonstrated in Korea for preparing hydrogen economy. This simulator is consists of virtual experience modules and virtual accident scenarios of 4 type hydrogen stations. Virtual experience modules show the performance properties through a movie or a virtual reality technology. Also they provide an explanation of hydrogen station equipment and a guide for operators immediately after the accident.

Virtual accident scenario modules show accident simulations based on modeling equations as 3D virtual reality. These modules could choose the sham accident for every kind of a station after categorizing all possible accidents in a station A Commercialized CFD program based on hydrogen dispersion model theory shows a movie of accident simulations. The result of a simulator has been developed as web applications. And will be applied to training materials and public relations for a user concerned about hydrogen stations.

INTRODUCTION

Hydrogen energy is meeting an essential condition as high efficiency, clean, infinite energy. Nevertheless hydrogen energy have a diversity of benefits, ensuring safety in the hydrogen production, storage, transportation, filling, use is important to put to practical use.

Among them, a hydrogen station is an infrastructure for supplying fuel cell vehicles. To guarantee safety of hydrogen station equipments and systems is helpful to commercialize the design technology of station equipments and to decrease an intangible awareness of danger for hydrogen. So as the method to secure safety of hydrogen stations, it simulates the virtual

experience by operating the facilities and equipments and predicts an accident that may occur. This program supplies the virtual experience that user can indirectly experience the working principles and accidents scenario simulations. Also it categorizes a possible accident by the type of a station and chooses the accident by virtual reality.

Hydrogen Station Virtual Experience Modules

A simulator is developed regarding 4 type hydrogen stations demonstrated in Korea, station type is a off-site type like city gas reforming method, LPG reforming method, naphtha reforming method and on-site type. A simulator based on the actual size is constructed virtual reality (VR) by 3D modeling. Using this module, a user can experience indirectly the station working principles by moving freely with a mouse and keyboard. For the example, off-site station system produces hydrogen by reacting raw materials with high temperature vapor in the reformer. Hydrogen is purified in the PSA(Pressure Swing Adsorption) and stored in the buffer storage vessels by using a high pressure compressor. Then it is filled to the fuel cell vehicle through the dispenser. Main installations of a hydrogen station, a hydrogen production equipment, compressor, storage vessel and dispensers, are modeling in details into 3D and building virtual reality. A user can selects the instruments and equipments and view them freely by rotating, scale up and down. The reformer is the most important equipments in the station because the capacity of reformer is a determinate factor to the quantity of hydrogen production. So reformer VR is scrutinized in this module.
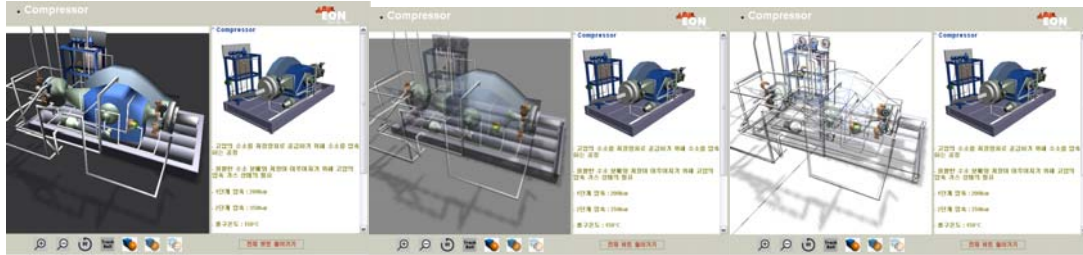
Accidents Prevention Equipments

Accidents prevention simulators consist of safety equipments, descriptions of accident prevention equipments and types, functions, properties of each device. It provides the knowledge for designing the station, operator's emergency response and safety manual after accidents. And It also offers a standard of operation procedure and emergency response plan that operator can rapidity, exactly cope with the accidents. VR shows how to use necessary safety device under emergency condition and compares a situation whether a safety device would be or not. Because hydrogen is the lightest gas, if we use the general dispersion model without a consideration of hydrogen's rising effects by buoyancy, it might produce wrong results. So we use the applied model for hydrogen's nature or adjust the data.

Accident Dynamic Simulations

A dynamic simulation is conducted by commercialized CFD program developed hydrogen accidents model. A movie or animation file offers the simulation results even though a novice could easily understand hydrogen station accidents.

The CFD data based on accidents scenario in hydrogen station which user directly construct on the program is implemented on the hydrogen simulator by using VR method and CFD results apply to the hydrogen station simulator. Description is attached for a user to understand the accidents developing process and results
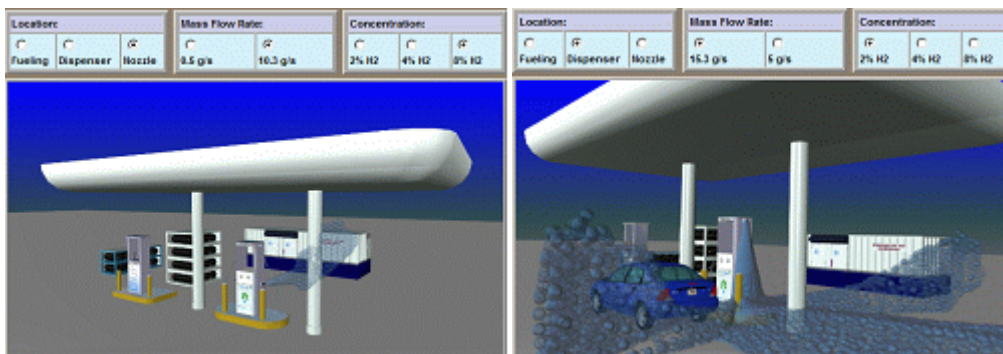
Hydrogen Dispersion model is constructed by considering hydrogen buoyancy effect and major factors concerning accidents. It implements the dynamic simulation according to the various conditions and the result is transformed to a movies.

Simulator Implementation Schemes

This simulator is serviced through the web server and offered by using virtual reality technology on the web application. The user accesses the internet address of a simulator without separately installing a program and freely experience the equipments or safety devices in the hydrogen station space. The user can easily find the necessary information because GUI(Graphical User Interface) is comprised of menu, command buttons, selection boxes, icons, etc.

Flash or movies are applied to this simulator for station's working principles, how to use the accident mitigation devices, possible accident modeling in the station, accident developing process according to safety device installation.

And it offers the knowledge of accident mitigation device, a guide and manual for a operator, the movie of a dynamic sham result, comprehensive countermeasures and precautions on the web. Developing tools is the EON Studio for 3 dimensions virtual reality of a hydrogen station simulator. The EON Studio is the virtual reality software of EON Reality, Inc. and supports the simulator to interact each other on the graphic environment.

Program organization

This program is based on EON studio to be supported from EON. Final web 3D is finally created from importing hydrogen model made by 3D MAX and inputting event by EON studio. EON studio supports 2 kinds of event nods for user's interaction on the web.

First is off-line event, it execute events that is previously defined by contacting tree on actual EON studio, Second is on-line event, it is the method for interaction on the web.
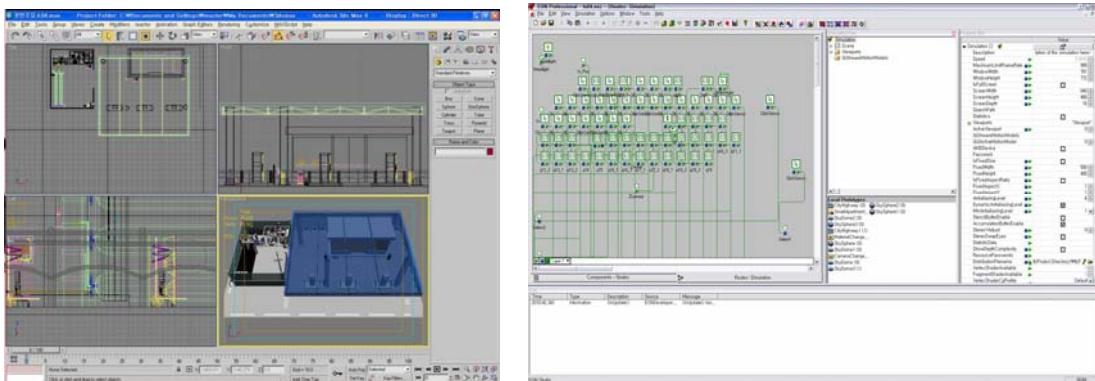
On the basis of indicated two dimensional development figures, we designed and deploy the each object adjusting actual hydrogen station size.

Off-line event is added by importing model file(*.obj) from EON studio to be made in the 3D Max.

EON Studio supports input/output node to share Boolean, Integer, Float, Vector etc. This input/output node can occure run time event by this and link JAVA script on the web. User's input data in the actual reality is delivered to the web by output node and is applied command language virtual reality by input node.

Results

3 steps accomplish the development of a hydrogen station simulator. This paper is about the 1 step contents. There are 4 contents in 2 steps which are hydrogen safety training material modules, world hydrogen station virtual reality modules, relevant standard modules of hydrogen safety. It is a 3 step that a user can directly design a hydrogen station and manufacture a simulator.

After this project is accomplished, it offers all the information and will be helpful for the general public to feel safe for hydrogen facility.

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