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The Design of VR-CATS for Power Plant Simulator using Virtual Reality

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3

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navigation

가

3

P&ID,

LAN

stand-by

, 가

malfunction

가 가

가

가

가

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, 가

P&ID, ISO

, 가

가

(Cyber Glove, FastTrak,

HMD)

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Abstract

In Hadong fossil power plant simulator project (1998.1 ~ 2000.7), KEPRI applied virtual reality to the simulator. To provide more efficient operator training, KEPRI further developed the virtual reality technology into VR-CATS (Virtual Reality Computer Assistance Training System), a web-based multimedia training system with virtual reality technologies, in KNPEC-2 projects.

By visualizing nuclear power plant system with stereoscopic 3-D graphics in this project, VR-CATS enable trainee to navigate whole nuclear power plants including high radiation areas and other restricted areas. In addition, instructors can train the local operators to operate the local valves and other equipment in the local area of the plant. It aims at helping trainees understand system locations and system functions more easily. And, by reproducing main control room with stereoscopic 3-D graphics and linking it with P&ID, operating procedures, and plant components, virtual panels maximize training effects. During the classroom training, the instructor can access the stand-by host computer of the simulator through a network. This enables the instructor to can operate the simulator with only soft-panel. With the soft-panel, the instructor can activate any malfunction that he wants to instruct, show the trends of major parameters to the trainee and discuss with them. This desktop simulator function helps trainee to understand basic symptoms of the accidents. With CBT, operators can easily understand why some parameters are increasing or decreasing and what they should to make the system stable. The VR-CATS for Uljin equips with much stronger and higher level virtual environment. First, all components of the virtual plant are linked with P&ID, ISO drawings, and engineering database. In addition, virtual MCR provides much immersive environment with such virtual reality equipment as HMD and data glove. Operators can also do collaboration work in the network through avatar, real-time chatting, and multi-user collaboration function.

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2.

[1] . [1]
 , 가 Navigation 가
 , 가 3

. CBTS (Computer Based Training System)
Interface)
Based Training System)

가 2 MMI (Man Machine
가 . WBTS (Web

가 가



[1]

H/W 가 , 가 Web
Server, Motion Tracking Device, Data Glove, HMD (Head Mounted Display),
5 , LCD , ,
LAN S/W ,
Windows 2000 OS , 3D CAD Micro Sation, 3D Studio MAX , 가
EON Software , SQL Server, , Flash

3.

3.1 3 CAD
2 , ,
Station 3D Studio MAX 3 Micro
. 3 3 800MB
가 . 3 CAD
3 CAD 3

CAD

가

Navigation

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가

Event

Event/Action

■ 2

Containment Bldg., Primary Auxiliary Bldg., Secondary Auxiliary Bldg., Turbine Bldg., Fuel Bldg., Access Control Bldg. Navigation

■ Reactor Vessel, Steam Generator 가 가

■ Reactor Coolant Pump seal , ,

■ CEA Drive (LG,UG,LL,UL)

■ Pressurizer, Charging Pump, (MSIV, MFIV, MFCV), Turbine (HP, LP), MSR (Seperator, #1,2 Reheater), Condenser

■ Cask Handling Crane, Refueling M/C, CEA , , SFP

가 가

■ (Main Heat Transport System), (Chemical & Volume Control System), (Safety Injection System),

(Containment Spray System / Dousing System), (Main Steam Supply System),

(Main Feed Water System), (Auxiliary Feed Water System for N/P),

(Spent Fuel Pool Cooling & Purification System),

(Spent Fuel Pool Cooling & Purification System),

(Fuel Transfer System for PWR), (Fuel Handling System for PWR),

(H.P. Turbine Exhaust & Reheated Steam, System),

(Condensate Transfer & Storage System), (Condensate System),

(Steam Supply System) 21

■

■

AAC , CVCS GAS STRIPPER, BACESW DEBRIS, CPP,

IPB Cooling Fan, RSP, Non-1E DG, Travel Screen Control Panel, DPS Panel, MG SET(),

CEDMCS Cabinet(graphic)

■ EER (Electric Equipment Room)

VMS / TBN VMS(graphic), PPS (Paint Protect System), LPMS / RCP VMS, Electrical

Protection Ready PNL, ESFAS Ready Cabinet(ARC), RSP Isolation PCS Cabinet, NSSS Control

Panel, Safety SRPC Start-Up Channel

B/D

가 (,)가 3

P&ID(PDF) , ISO (PDF), Logic ,

3.2 가

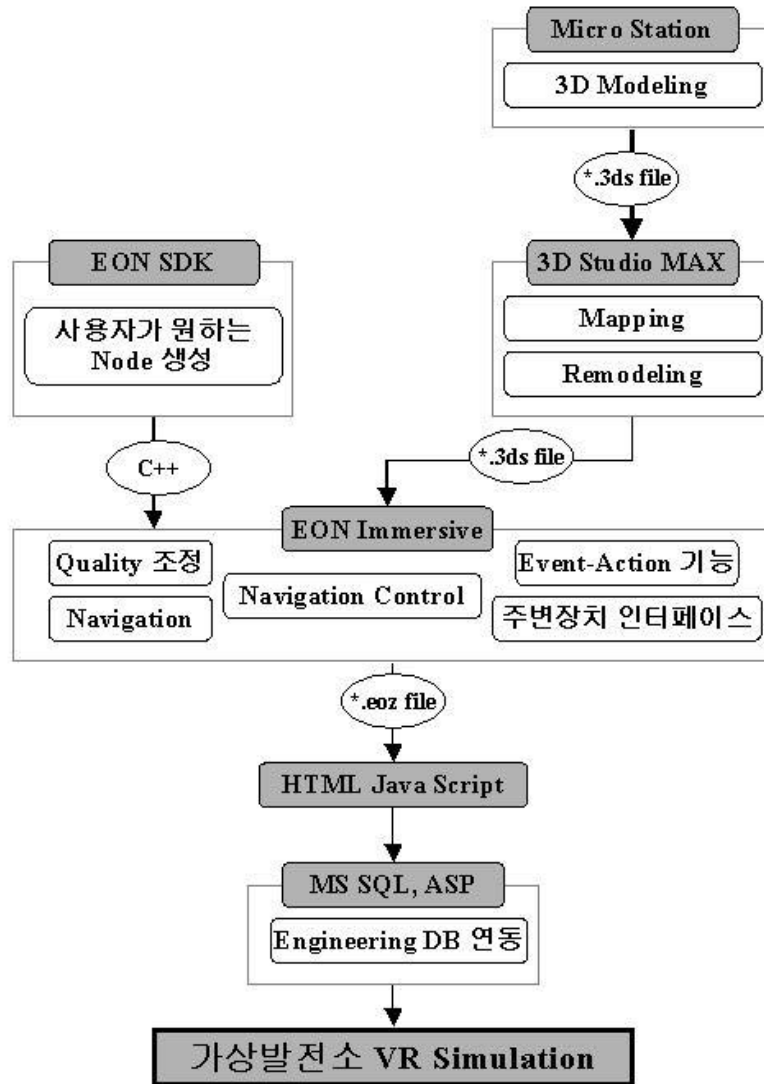
가 가 Quality , ,
 가 가 가 .
 . 가
 , . 가
 3 CAD 가
 Event/Action , Navigation, Walk-
 Through, . 가
 가 가

(1) 가 (Virtual Plant)

가 [2]
 . Micro Station 3D Studio Max ,
 3 VR Tool EON . ,
 Quality Polygon HMD (Head Mounted Display) 가
 . HTML Java Script, SQL Server, ASP
 가
 , Navigation, Walk-Through ,
 Window가 / Event-Action 가 , Navigation Control
 P&ID P&ID 가
 가

2) 가 (Virtual Panel)

가 , , EER .
 EER (,) 3 ,
 , Texture Mapping , EER Navigation Walk-
 Through가 가 , 가 .
 , Tag 가 (Cyber Glove, FastTrak, HMD)
 가 가
 가
 , EON Colosseum Module 가 Avatar
 가
 3 (Collaboration) . 가



[2] 가

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3/4

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[3]

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Data Server

가

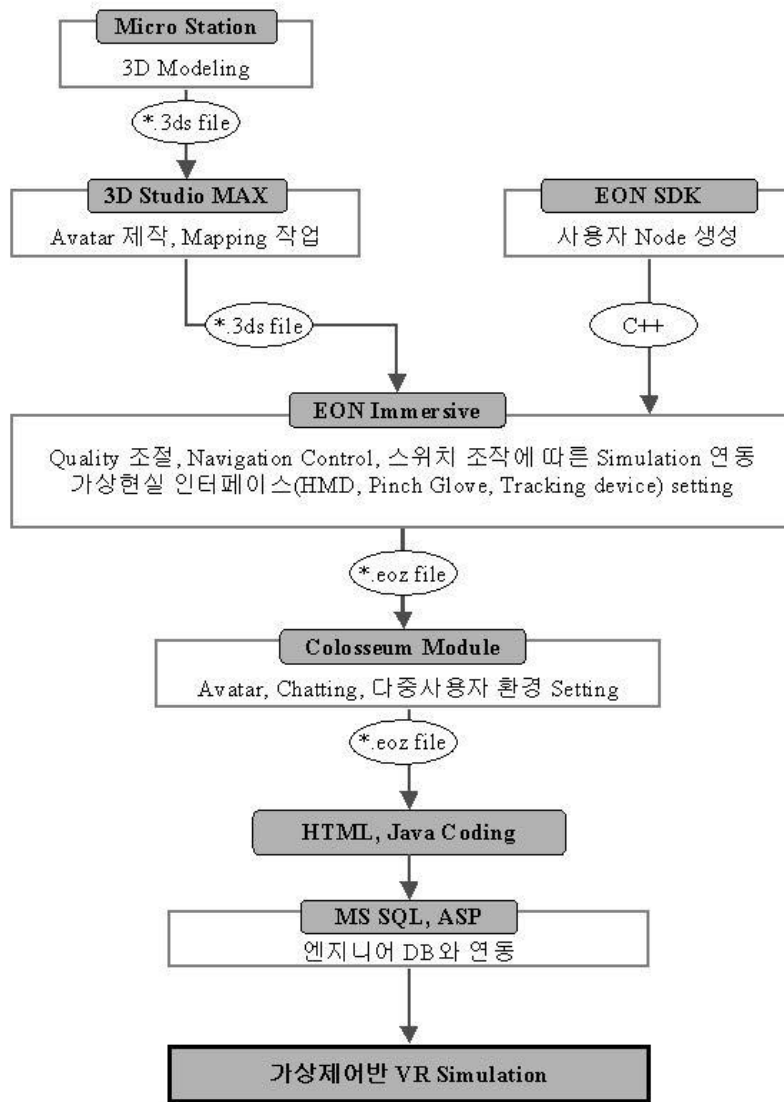
Data

Server OPC (OLE for Process Control)

Data Acquisition 가

Server

가



[3] 가

[4] [5]

Data Server

가

가

CMD LOAD - isd rtxmm1

Wed Mar 14 16:24:59 2001 status: RUN 164:37:19.05

Name	Index	Value	Name	Index	Value
01 opc int	< 1)	203	21 opcdouble	< 1)	212.12
02 opc int	< 2)	204	22 opcdouble	< 2)	213.12
03 opc int	< 3)	205	23 opcdouble	< 3)	214.12
04 opc int	< 4)	206	24 opcdouble	< 4)	215.12
05 opc int	< 5)	207	25 opcdouble	< 5)	216.12
06 opc int	< 6)	208	26 opcdouble	< 6)	217.12
07 opc int	< 7)	209	27 opcdouble	< 7)	218.12
08 opc int	< 8)	210	28 opcdouble	< 8)	219.12
09 opc int	< 9)	211	29 opcdouble	< 9)	220.12
10 opc int	< 10)	212	30 opcdouble	< 10)	221.12
11 opcreal	< 1)	202.00	31 global_opc	<1,2)	303
12 opcreal	< 2)	203.10	32 global_opc	<2,2)	304
13 opcreal	< 3)	204.60	33 global_opc	<3,2)	305
14 opcreal	< 4)	205.30	34 global_opc	<4,2)	306
15 opcreal	< 5)	206.40	35 global_opc	<5,2)	307
16 opcreal	< 6)	207.90	36 global_opc	<6,2)	308
17 opcreal	< 7)	208.00	37 global_opc	<7,2)	309
18 opcreal	< 8)	209.30	38 global_opc	<8,2)	310
19 opcreal	< 9)	210.60	39 global_opc	<9,2)	311
20 opcreal	< 10)	211.90	40 global_opc	<10,2)	312

isd > _

[4]

RSI - OPC Test Client - [~DataPlant.NmsSvr.1]

File Server Group Item Log View Window Help

gg (Actual Rate: 250)

ItemID	Sub Value	Sub Quality	Sub Updates	Update Rate	Run_Avg
OPC_0.0:0	222	Good	220	1	0.882677
OPC_0.0:1	224	Good	220	1	0.882677
OPC_0.0:2	226	Good	220	1	0.882677
OPC_0.0:3	228	Good	220	1	0.882677
OPC_0.0:4	230	Good	220	1	0.882677
OPC_24.10:0	221.3	Good	220	1	0.886707
OPC_24.10:1	222.5	Good	220	1	0.886707
OPC_24.10:2	223	Good	220	1	0.886707
OPC_24.10:3	224.5	Good	220	1	0.886707
OPC_24.10:4	225.6	Good	220	1	0.886707
OPC_48.20:0	231.12	Good	220	1	0.886707
OPC_48.20:1	232.12	Good	220	1	0.886707
OPC_48.20:2	233.12	Good	220	1	0.886707
OPC_48.20:3	234.12	Good	220	1	0.886707
OPC_48.20:4	235.12	Good	220	1	0.886707
OPC_72.30:0	On	Good	3	0	0.012091
OPC_72.30:1	On	Good	3	0	0.012091
OPC_72.30:2	On	Good	3	0	0.012091
OPC_72.30:3	On	Good	3	0	0.012091
OPC_72.30:4	On	Good	3	0	0.012091
OPC_72.30:5	On	Good	17	0	0.068518
OPC_72.30:6	On	Good	3	0	0.012091
OPC_72.30:7	On	Good	3	0	0.012091
OPC_72.30:8	On	Good	3	0	0.012091

Event Time

Item added -- (Item) OPC_48_20:1 16:21:10

Item added -- (Item) OPC_48_20:2 16:21:10

Item added -- (Item) OPC_48_20:3 16:21:10

Item added -- (Item) OPC_48_20:4 16:21:10

Ready NUM

[5] Data Server Client

3.3. CBTS

CBTS (Computer Based Training System)
Computer)

(Stand-by

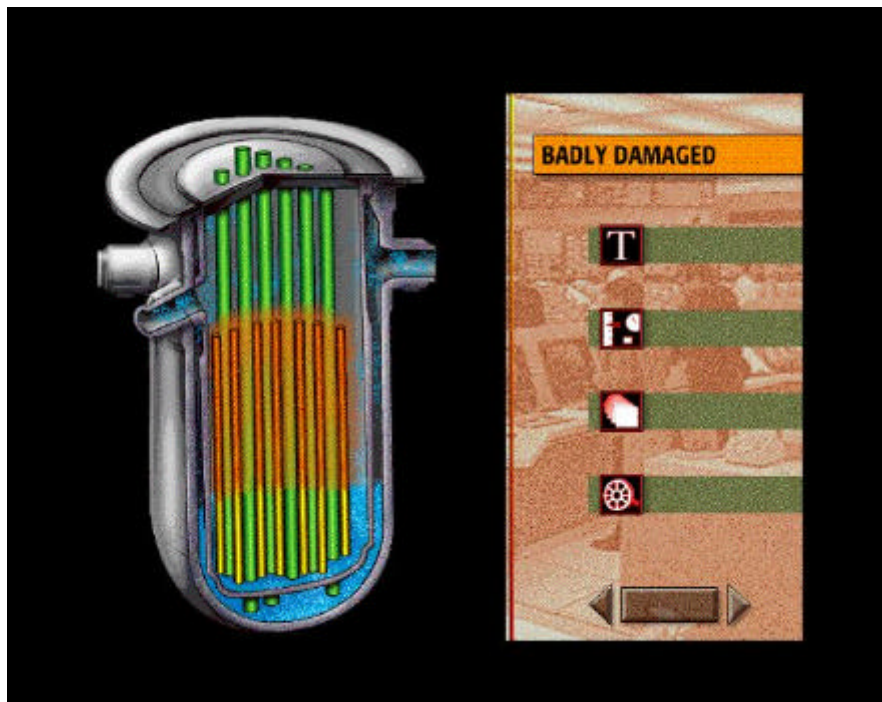
(Malfunction)

(Remote Control)

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- 가
- 1 , 2
- 1 2
- 1 2 가



[6]



[6]

3.4 WBTS

WBTS (Web Based Training System)

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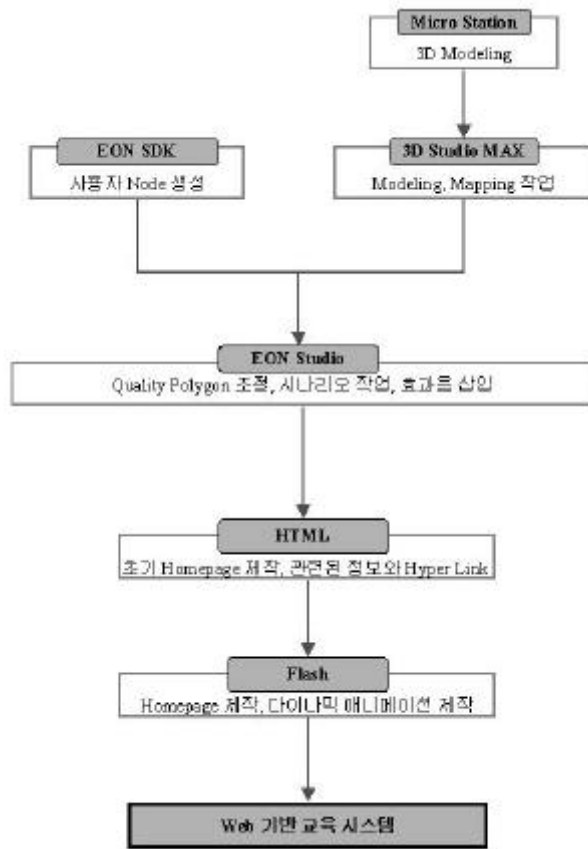
가

CBT

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[7]

-
-
- Dynamic Animation
-
-
- (, , ,) Hyper Link
- Interactive



[7]

3.5

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Simulation System

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EON Immersive, EON Viewer, Web Browser

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VR Tool

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[8]

LCD

LCD Shutter Glass

Passive Stereo Glass

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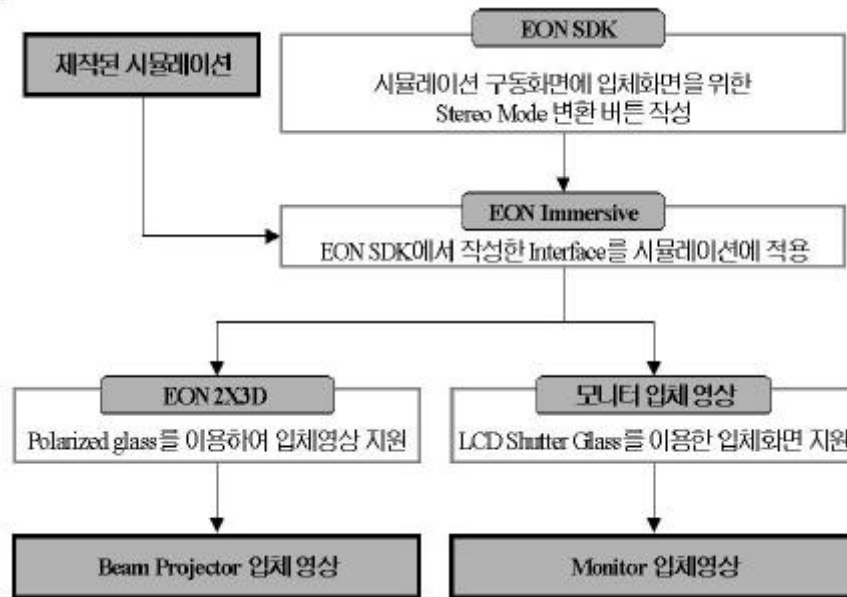
가

[9]

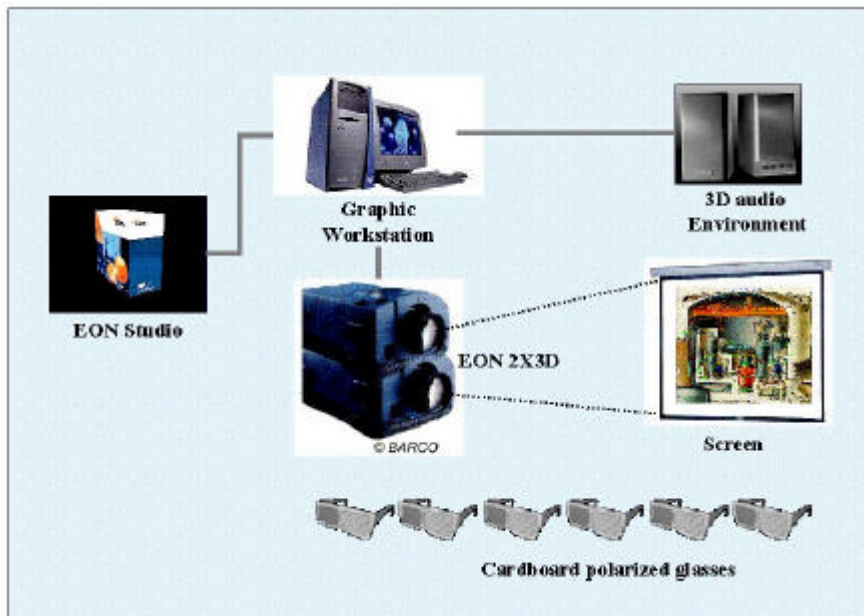
150°

LCD

2



[8]



[9]

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HMD

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가

가 가

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[1] , " ,
 , January 2001.

[2] , "EON " , EverSoft , February 2001.

[3] , " , , September
2000.

[4] , " , , February 2000.

[5] , " 2 3 CAD
 , June 2000.

[6] , " , SDS,
June 2000.