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VIRTUAL REALITY OPERATOR TRAINING SYSTEM FOR CONTINUOUS CASTING PROCESS IN STEEL INDUSTRY

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ABSTRACT

Steel Production Process is divided into iron making, steel making, continuous casting, rolling process. The continuous casting process that makes the slab, bloom or billet from the molten steel, is very important to determine the quality of the steel product. There is much tacit knowledge in the steel industry. So it takes a long time to transfer the know-how to new operator. And the senior operators don't allow the new operators to manipulate the equipment because of the high accident risk by mistake. Therefore it needs an environment that can be trained safely and accurately. We introduce the 3D drawings, HMI based VTS(virtual reality operator training system) that can train the new operator by e-learning program and training simulator in the continuous casting(CC) process.

1 INTRODUCTION

Operation mistakes can cause accidents at the moment and decrease the productivity because the operation is very dangerous to deal with the hot molten steel in steel industry. So the senior operators don't allow the new operator to manipulate the equipment. They need the 3D simulation to train the operator accurate and realistic in short period and the environment to be learned and trained simultaneously for increasing the educational effectiveness.

There are many education and training examples of using virtual reality technology. For example, Steel University's simulator can simulate the steel production process using 2D flash player from iron making to rolling process. But it is not enough to train the situation in the field of actual production (Steel University 2012). (Hiroshi Kitada 2012) proposed the simulator focusing emergency situations around mold in continuous casting process. It can generate the emergency mold status on the screen and the trainee can control the pendant same as one in the field by pushing the button. But the simulator is limited by its scope focusing only around the mold. (Lee et al. 2012) proposed the converter simulator. But the converter equipment is simple comparing the continuous casting process in terms of movement. Also converter process just deals with molten steal whereas continuous casting equipment does not.

Presented in this poster is virtual reality operator training system, which is being used at continuous casting process at POSCO in Korea.

2 E-LEARNING FOR CONTINUOUS CASTING PROCESS

Continuous Casting Equipment Structure Animation contains the explanation of equipment layout and shape such as Ladle Turret, Tundish, Mold, Segment and Torch Cutting Machine.

Continuous Casting Process Animation contains the explanation of CC process such as tundish preheating, dummy bar insertion, mold sealing and primary slab cutting by professional narration. It can be understand the whole continuous casting process easily.

Continuous Casting HMI Screen based operating procedure contains the explanation of each HMI function and configuration. It also has interactive method between learner and learning program such as clicking the mouse button or entering value by keyboard. And some pages in the contents are combined with HMI screen, control panel screen and process animation on only one screen so that the trainee can understand easily watch the process animation following the clicking button on the HMI screen or control panel.

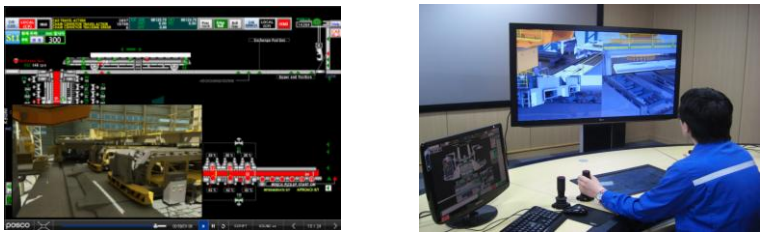

Figure 1: e-Learning and Training Simulator for Continuous Casting Process

3 TRAINING SIMULATOR FOR CONTINUOUS CASTING PROCESS

Virtual Machine was based on the Kwangyang 3-2 new slab caster at POSCO in Korea. The optimization work was performed with 3D CAD model for the real-time simulation. The mathematical model could calculate the discharge rate of molten steel by the tundish slide gate open/close position and ladle slide gate open/close position. Several texture and colors were used on 3D model for realistic scene and effect sound was also used. During the simulation, the trainee was evaluated by the virtual operation data. This simulator is able to create an emergency situation such as the failure of ladle open, breakout and bleeding so that the trainee can prepare that situation.

HMI system was developed by the Kwangyang 3-1 slab caster's HMI system. It was modified the differences between 3-1 and 3-2 slab caster. The interface between virtual machine and HMI system was implemented with TCP/IP interface instead of PLC interface.

Control Panel was implemented with C# language under the .NET environment. After analysis all of the control panel in the field, the control panel required on operation such as main control panel, ladle operation, tundish car operation and torch cutting operation was developed

The manipulation lever for shroud nozzle manipulator was developed to use to plug the shroud nozzle for ladle collector nozzle on the casting position of ladle and tundish. The moving range and speed of shroud nozzle manipulator depends on the degree of tilting lever.

4 CONCLUSION

We proposed a virtual reality operator training system for training in the safety and realistic environment and introduced the case applied in continuous casting process at POSCO. Through this real-time operator training system, the time it takes between 3 and 5 years to become a senior operator will be reduced by one year. And we have a plan to develop other processes in the steel production process such as iron making, rolling process. Then the final plan is to build the system that can be trained the whole steel production process.

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