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INTERACTIVE VISUALIZATION OF THE MINE ATMOSPHERE PARAMETERS

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In recent years an essential progress has been made in the field of excavator machines and the methods of measuring and recording of the working environment factors. The changes concern long-wall excavations, in which the natural hazards such as methane, rockburst and high temperature occur because of significant depths. The improvement of safety is achieved by removing the workers from the dangerous zone. It is possible thanks to the use of the remote control system of the mining machines. Moreover complex systems of measuring and recording the atmosphere parameters are used. The methane monitoring systems alarms the crew and turns off the electricity in the endangered area of a mine.

In the presentation the results of the research carried out in the Geometry and Engineering Graphics Centre will be shown. This research concerns an interactive visualization of the mine atmosphere parameters. The visualization has been commissioned by the Institute of Innovative Technologies EMAG and it presents the connections between the speed of excavation and the values of methane concentration, the temperature and the humidity.

The visualisation simulating the influence of the excavating machine on the atmosphere parameters has been created as a 3D real time programme based on DirectX library. A model of long-wall machinery complex consisting of an excavator, transporter and powered roof support has been put it the 3D simulator. The machinery in the programme is operated by the remote controller RSO-25 [Fig. 2]. The current values of methane concentration, the temperature and the humidity are presented on the detectors which are stable elements of the screen [Fig. 1, 3].

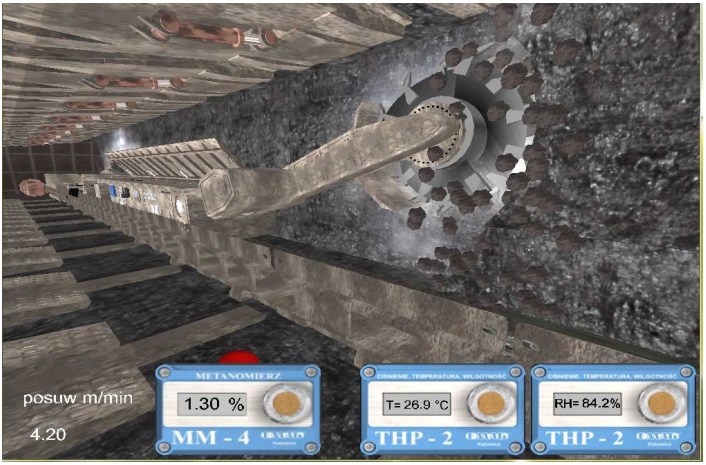

Fig 1. Interface of simulator

The graphics layer of the simulator consists of spatial models of machinery. These models were created on the basis of technical specification and photographs of the real machines [Fig. 4]. The textures are important elements of the realism of the virtual scenery. The quality and the matching of the textures have a big influence on the authenticity of the scenery. In most cases the textures were obtained in the natural mine environment. It is easier to take a photo of the coal in real mine than to produce this texture using Material Editor in 3ds max or Photoshop.

Fig. 2 Remote controller

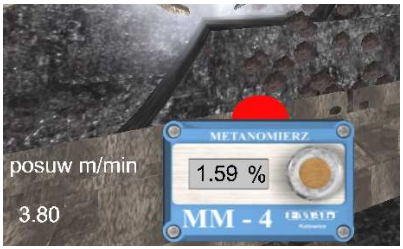

Fig.3 Light indicator of exciding methane concentration

The picture in simulator is generated in real time. That is why different compromise solutions between the quality of graphics and the speed of rendering have been used during the process of creating the models. Being geometrically complicated the scene demanded the use of the simplest machinery models at the same time providing the authenticity usually shown in the details. The models are characterised by maximally limited amount of curves and surface because of the used different techniques of mesh optimization. The rendering technique called “Nature Painting” implemented in the Quest 3D programme

was used. It uses the originally created picture for all copies of the same objects. All the textures were created and assigned using the Material Editor of 3ds max. It enabled the use of high definition pictures as textures. The final appearance of the objects, ready to be exported to Quest 3D, was prepared using a technique called "Render to Texture".

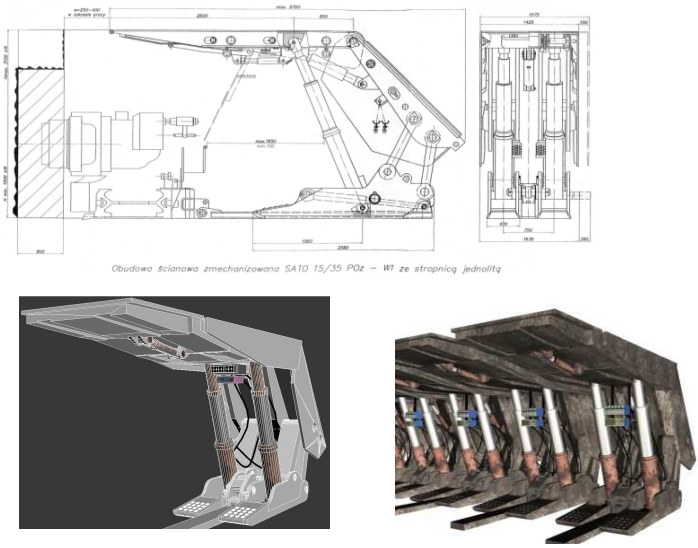

Fig.4 Model of powered roof support.

The creating of interactions and movement In real time graphics was discussed at the previous conferences [1,2,3] that is why only the basic characteristics of the simulator is presented below:

The tools used in creating the simulator:

- 3 D program created in Quest 3D (game engine, objects programming),
- Modeles and textures created in 3ds max, Corel Photo-paint,
- Audio processing made in Audacity.

3d programme features:

- Two rendering Loops (two cameras): main scene and the detectors,
- 4 timers measuring the delay,
- techniques of mesh optimization: "nature painting" and "level of details",
- textures optimization – „baked textures" – "render to textures",
- Several detections of collision,
- several dozen of logical requirements and algorithms,
- 6 particle systems (sprinkler, excavated coal).

Conclusions

Such simulators will be used more often in training systems and as a method of informing workers of the hazards. Mistakes on simulator have no consequences and the acquired habits will generate profits in the future. The simulator created in Geometry and Engineering Graphics Centre includes only the basic functions of the excavation machine. The development of mine hazard visualisation is planned In cooperation with EMAG.

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