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DISSEMINATION OF PREDICTED NOISE LEVELS IN A 3D VISUALISED INTERACTIVE ENVIRONMENT THROUGH THE INTERNET FOR 3D EIA AND PLANNING PROJECTS (HONG KONG)

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Abstract

It is a global trend that public demands for environmental noise information from the Authority on where they live, where they work or places of interest. Predicted noise data presented in the form of noise maps, 3-Dimensional (3D) photo-realistic model and virtual reality have become more and more popular. However, such models usually present only the noise levels predicted for the worst-case scenario. In other words, changes in noise levels over time with varying traffic conditions are not shown. There is thus a demand for temporal, i.e. time-varying, noise data presentation. This paper presents the results of a demonstration project where time-dynamic noise levels can be visualised while a viewer navigates a 3D model. Also, a brief introduction of the key features of a web-based platform specifically designed for disseminating multi-project time-varying 3D models to engage stakeholders in informed discussions on major proposals and facilitating a better understanding of road projects and issues in Hong Kong through the use of 3D electronic visualisation tools is provided.

1. INTRODUCTION

In Hong Kong, public consultation is a key component in infrastructure planning projects. In order to communicate more effectively the noise information relevant to a particular project to residents and stakeholders, there is a strong demand for noise information to be presented in a more intuitive way. Predicted noise data presented in the form of noise maps, 3-Dimensional (3D) photo-realistic model and virtual reality have become more and more popular.

Supported by the current technology of Internet services, such noise information can be disseminated through a web browser and facilitates viewers to become "immersed" in the virtual community neighbourhood. Viewers can have a visual experience of the potential environmental impacts as well as the proposed mitigation measures. For example, public can see photo-realistic environment with or without noise barriers of different forms simply by

clicking buttons of their choice. In addition, they can hear the simulated noise levels before and after the provision of mitigation measures. To tour around the project site, they can drive through, fly through, and walk through the 3D Virtual Reality Modelling Language (VRML) Model [1-3] or use different viewpoints. However, such models usually present only the noise levels predicted for the worst-case scenario [4,5]. In other words, changes in noise levels over time with varying traffic conditions are not shown. There is thus a demand for temporal, i.e. time-varying, noise data presentation.

This paper presents the results of a demonstration project in which time-dynamic noise levels can be visualised while a viewer navigates the 3D model. Also, a brief introduction of a user-friendly web-based platform specifically designed for disseminating multi-project time-varying 3D models to engage stakeholders in informed discussions on major proposals and facilitating a better understanding of road projects and issues in Hong Kong through the use of 3D electronic visualisation tools will be provided.

2. PRESENTATION OF TIME-DYNAMIC NOISE LEVELS IN 3D MODEL

A demonstration model was created where time-dynamic noise levels could be visualised while a viewer navigates a 3D model.

2.1 Temporal Noise Panels

All data necessary to build traffic noise assessment models (e.g. traffic data, road surfacing, noise sensitive receiver locations, etc) were collected. Noise models for unmitigated and mitigated scenarios were developed by noise assessment software. While each building façade comprised a number of mini façade panel units, the predicted noise levels for unmitigated and mitigated scenarios were obtained such that a noise level can be used to characterize the noise exposure at each mini façade panel unit under various conditions. The predicted noise levels were set to different ranges and a specified colour (in RGB) was selected to represent each range of noise levels. For VRML with animation functions, the colour data (in RGB) and the time parameter, together with programming on time sensor and colour change function were included in the VRML.

2.2 Click Buttons

In order to customize the VRML models presenting different scenarios, click buttons were created using VRML 2.0 [6] with JavaScript for users to switch between the scenarios (Existing, barrier and enclosures scenarios).

In order to fix the buttons at specific locations in the screen, VRML 3D layers were created. Customization buttons for switching between different scenarios were also designed by using JavaScript. Users can switch from one to another scenario and associated noise prediction result by pressing the customization button.

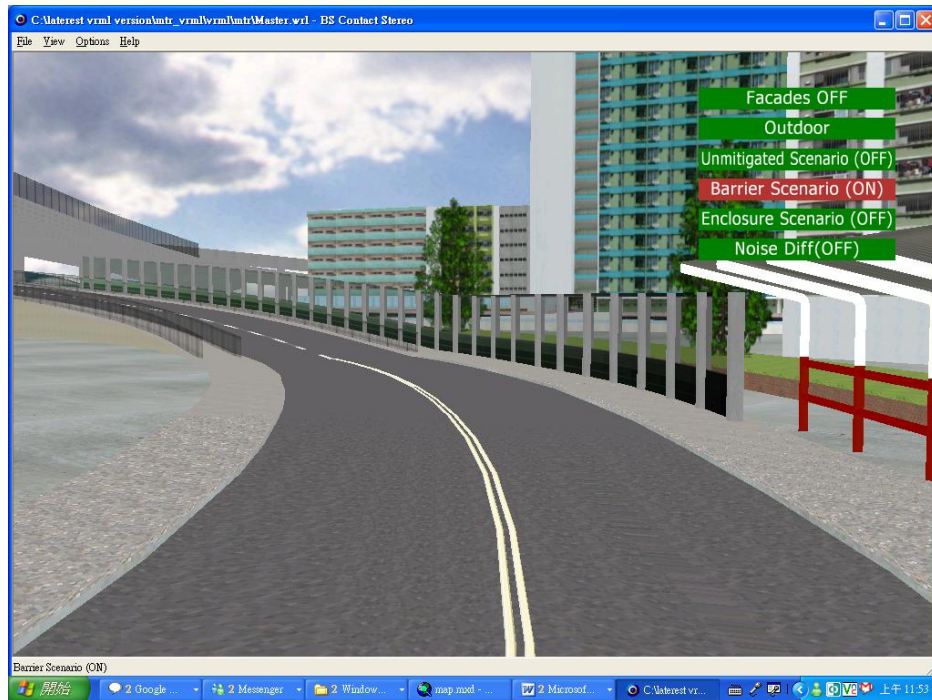


Figure 1. Barrier Scenario.

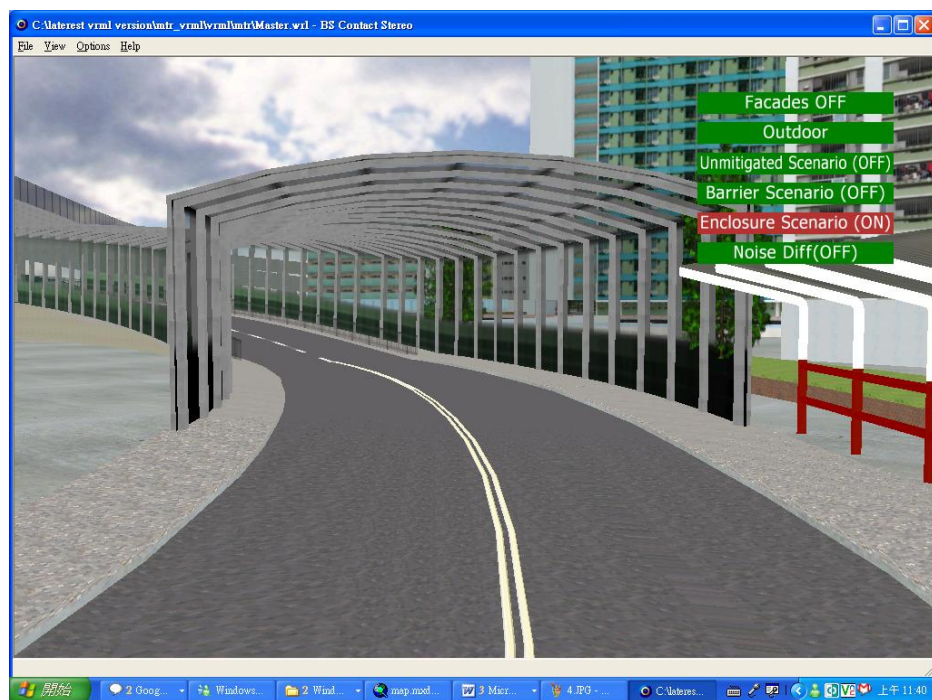


Figure 2. Enclosure Scenario.

2.3 Noise façade – 3D

With reference to the coordinates (x, y and z) of the mini façade panels prepared in the noise, 3D noise façade plate could be generated by using ArcGIS or 3D Studio. Those panels should be in line with the coordinate system of the existing 3D VRML model. Having created the noise façade panel, we should identify the colour pattern for different noise level ranges, e.g. yellow colour for noise level ranged from 66 to 70 dB(A) and red colour for noise levels ranged from

71 to 75 dB(A). While traffic flow varied, the predicted noise impacts also varied. The colour pattern of each façade is supposed to be changed according to the calculated noise levels. Customisation of VRML by programming will implement this animation effect and the VRML model will, therefore, illustrate the colour change of façade varied with the time-series.

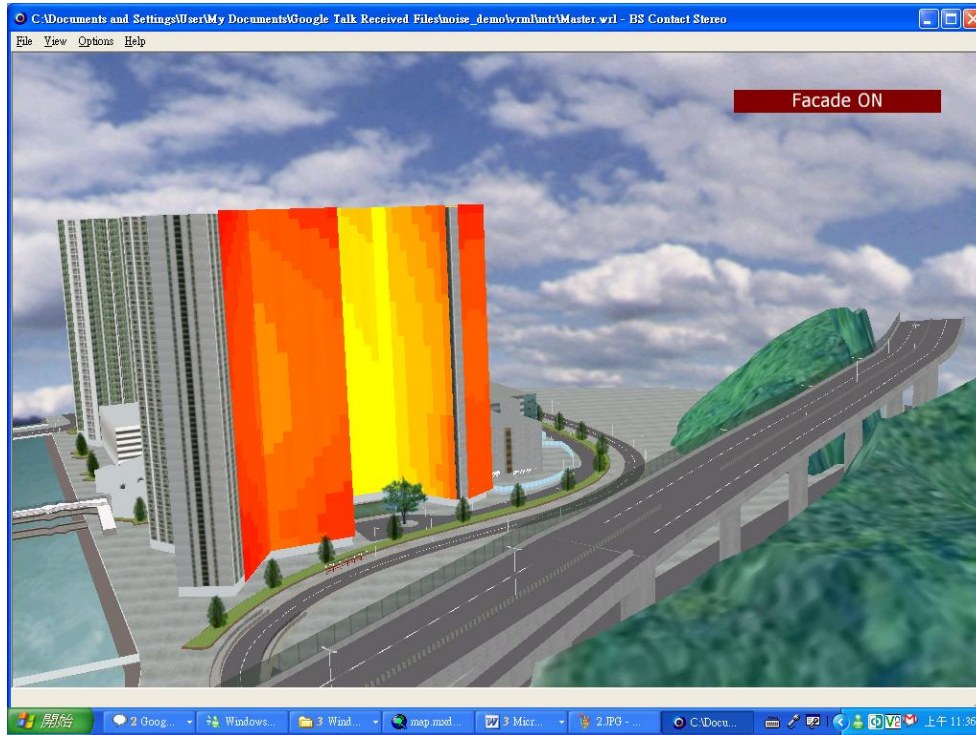


Figure 3. More “red” facades as the traffic flows increased in the peak hour (8:00am -9:00am).

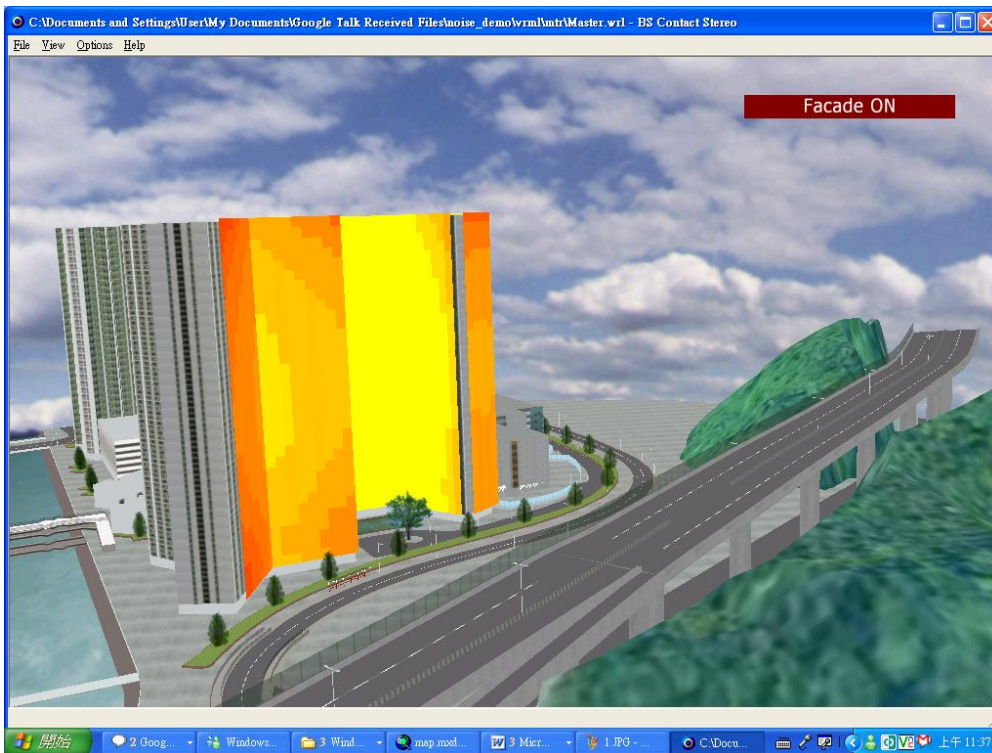


Figure 4. More “yellow” facades as the traffic flows decreased in the off-peak hour (2:00pm -3:00pm).

3. WEB-BASED 3D VRML DISSEMINATION TOOL

3.1 Multi-Project 3D Model Dissemination Interface

A web-based platform was specifically designed for disseminating multi-project time-varying 3D Models to engage stakeholders in informed discussions on major proposals and facilitating a better understanding of road projects and issues in Hong Kong through the use of 3D electronic visualisation tools. The platform comprises an entry page where a user will be authenticated before he/she can access the project models and a project selection page.



Figure 5. Entry Page.



Figure 6. Project Selection.

3.2 Customised Navigation Button

There is also a project specific VRML viewing page where customised buttons are provided for ease of navigation.

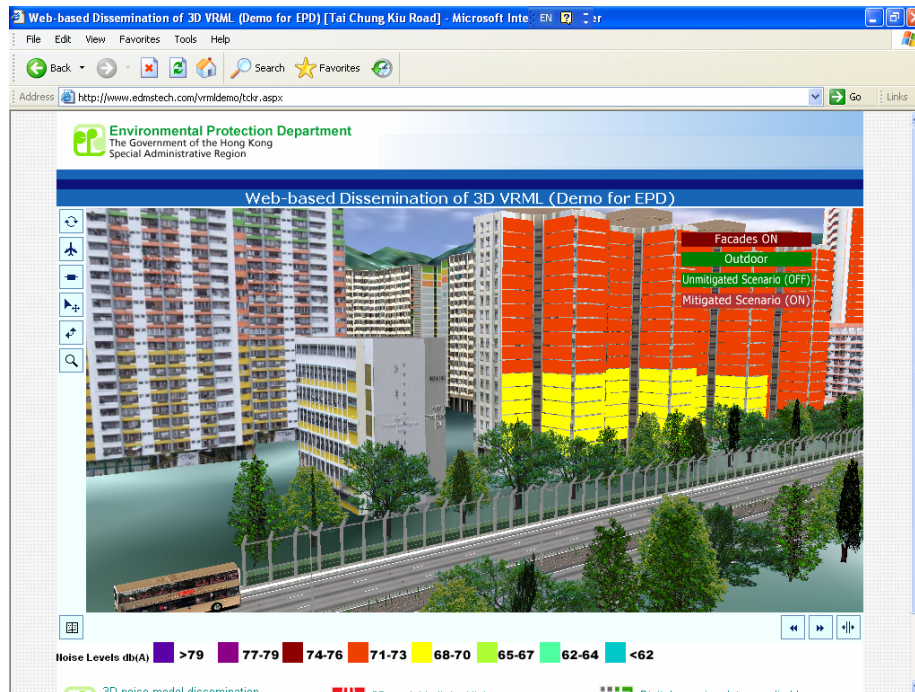


Figure 7. VRML viewing page.

Buttons on the left include:

- WALK mode: it allows one to walk around in a similar way as people do in real live.
- FLY mode: it behaves the same as WALK mode with the exception that it does not keep the user on the ground. Therefore the user can fly. Use the mouse wheel to rise or lower while moving forward, or press the CTRL key while dragging the mouse to directly move up or down.
- PAN mode: the user can easily look around. Moving is still possible but requires pressing the CTRL key while dragging the mouse.
- SLIDE mode: the user can move sideways and forwards without changing the direction of where the user looks.
- JUMP mode: it allows the user to click on an object and get moved there automatically. Nevertheless the user can move around by dragging the mouse like in WALK mode or in PAN mode.
- EXAMINE mode: it allows the user to rotate an object and examine it from different locations.

Button on the bottom left:

- Avatar: An avatar is displayed for the user. The user view into the Virtual Reality scene is from behind the avatar. The user sees his/her own avatar as a part of the scene. It is possible to adjust the viewing position relative to the avatar by pressing keys on the num pad.

Buttons on the bottom right:

- View point (Previous & Next): Jumps to the previous or next view point. This jump is

animated in order to have the user not get lost.

- Viewpoint Tour: Starts an animated tour through all viewpoints from the first to the last one.

4. CONCLUSIONS

Environmental noise assessment is a valuable planning process for assessing how the impact of changes in the built environment can affect quality of life. Unfortunately, town planners, architects, consulting engineers, and government officials often find that it is not easy to get their conceptual ideas and analytical results across to public. This paper described a new 3D visualized interactive environment for noise assessments. Unlike most traditional 3D photo-realistic models that only project the worst-case scenario under a specific condition, we purposely developed a 3D visualization methodology that incorporates temporal characteristics of environmental noises. The then developed 3D model (VRML) browser was customized in order to maximize the compliance of VRML model and reduce the complexity of the traditional 3D model formation.

REFERENCES

- [1] Bitters, B. (2004) "An Open-Source Virtual Object Model for 3D GIS", Proceedings of the 2004 ESRI International User Conference, 9-13 August 2004, San Diego, USA.
- [2] Lakhia, A. (2004) "Efficient Interactive Rendering of Detailed Models with Hierarchical Levels of Detail", Proceedings of the 2nd International Symposium on 3D Data Processing, Visualization and Transmission, 6-9 September 2004, Greece, pp.275 – 282.
- [3] Deligiannidis, L. and Jacob, R.J.K. (2005) "The London Walkthrough in an Immersive Digital Library Environment," Proceedings of the 2005 International Conference on Modeling, Simulation and Visualization Methods, 27-30 June 2005 Nevada, USA.
- [4] Richa, C and Carvalho, A. (2005) "Social Acoustic Survey and Noise Mitigation Solutions on a Portuguese Urban Highway", Proceedings of the 2005 Inter-noise, 7-10 August 2005, Brazil.
- [5] Murphy, E., Rice, H.J. and Meskeel, C. (2006) "Environmental Noise Prediction, Noise Mapping and GIS Integration: the case of inner Dublin, Ireland", Proceedings of the 8th International Symposium on Transport Noise and Vibration, 4-6 June 2006, St. Petersburg, Russia.
- [6] Stiles, R., Tewari, S. and Mehta, M. (1997) "Adapting VRML 2.0 for Immersive Use", Proceedings of the 2nd Symposium on Virtual Reality Modeling Language, 24-26 February 1997, California, USA, pp.75-81.