VSML; Web Based Virtual Structures Modeling Language

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Introduction

This paper presents a new method to help structure engineers and architects to design structures and communicate to customers in intelligible language using computer graphic technology and virtual reality (VR) based on VRML (Virtual reality modeling language) [1]. CAD plays a vital role in the design of structures whose complexity defies the imagination. As this complexity increases we will require even more sophisticated software tools for one step further visualizing these structures. Today, with the benefit of CAD, it can be designed in fraction of the time, and also visualized as a 3D object. But VR takes us one step further.

Analyze

VSML's analyze part is a FEM program to analyze structure in both static and dynamic case, and gives proper output as 'event In' field for VRML part of VSML. Updating this part can update the other parts automatically.

VSML nodes

New nodes should be defined to define structure with all its elements in VRML. The new nodes are *bridge*, *building*, and *vibration* at the moment. Each node has sub-nodes including their own 'fields'. Nodes should be unique and clear. Fuzzy theory can help to find the best language system to make nodes.
These nodes can use to define the initial pose for structure. Bridge and building are static nodes and can use vibration node's 'event Out' to display vibration data produced by numerical analyze. Using *route* method *bridge* and *building* nodes can be affected by *vibration* node.

Universal applications

Engineers can use it to analyze the structure and see the result in VR. Using GIS (geographic information system) and CAD data, structure can be located inside virtual environment and also test under environmental effects such as sound effects. Architects can use it to navigate in designed structure. The public can use it to know about their structure design and analyze even though they don't know anything about analyze concepts. Finally companies can show the customers how precise their design is. VSML's objects are based on *compatibility*, *flexibility*, and *simplicity* principles.

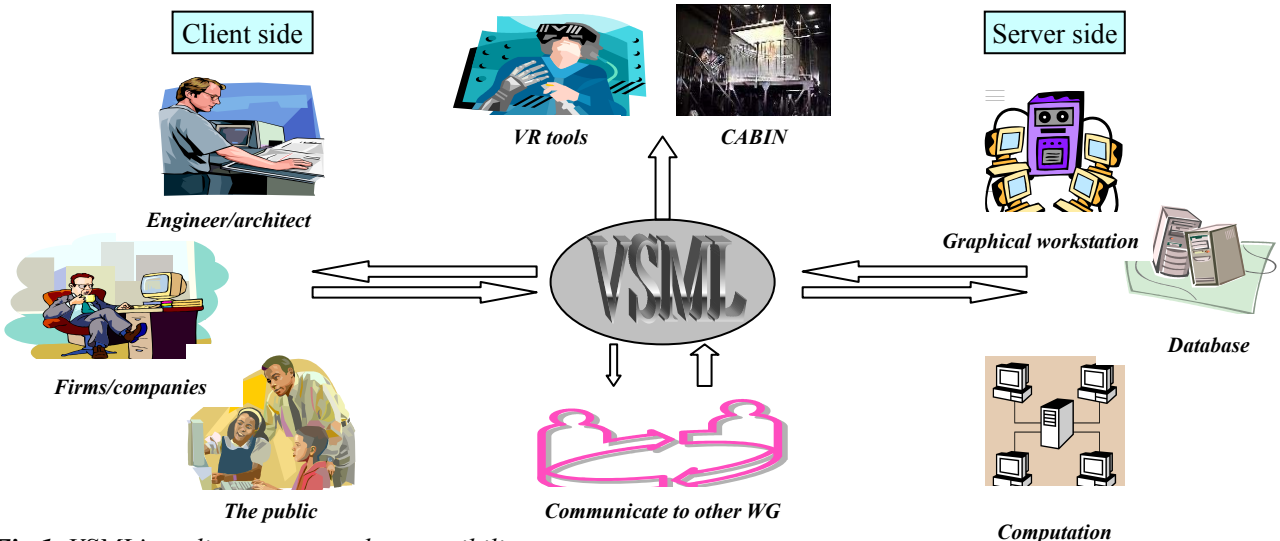

Fig 1. *VSML's outline, power and compatibility*

Keyword: VRML, CAD, Virtual reality, FEM, Structure design.
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Figure 1. shows an overview of VSML. Users can communicate to each other, to server side, and to other working groups (WG). As there are some groups working on risk analyze and risk communication using virtual reality, VSML might be useful for risk communication of hazards related to structures such as fire, earthquake, overloading and so on.
VSML is based on VRML and inherits its traits. Therefore developing VRML to X3D entails VSML developing too. The X3D[2] Graphics Working Group is designing and implementing the next-generation Extensible 3D (X3D) Graphics specification. They are expressing the geometry and behavior capabilities of the VRML 97 using the Extensible Markup Language (XML).
In the other hand attractive virtual reality tools (such as cyber glasses, 3d mouse, joystick, cyber gloves and 3d speakers) and CABIN, which are compatible with VSML, can be used to show engineers and firms efforts in a simple and attractive virtual world to the public and customers in demonstrations and exhibitions.

DEF TODA bridge			
pier	girder	cable	rubber bearing
sub nodes(s.n.)	s.n.	s.n.	s.n.

DEF TODA vibration		
earthquake	wind	pedestrian
s.n.	s.n.	s.n.

Fig 2.a. *Hierarchical structure*

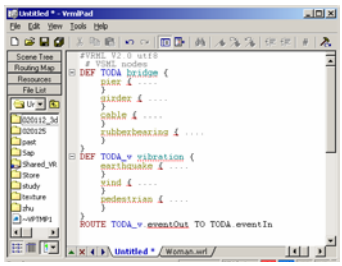

Fig 2.b. *VSML codes*

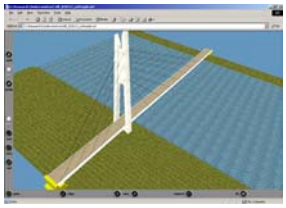

Fig 2.c. *VSML model*

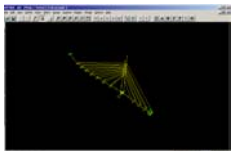

Fig 2.d. *Present models*

Fig 2 shows an example, TODA Bridge in Saitama prefecture and a hierarchical structure of this VSML object. Fig 2.b. shows how easy is VSML because of its intelligible language. Fig2.c. and fig 2.d give idea about difference of new design method and former one using present software which are neither compatible with internet nor VR. Objects are defined separately and using *route* method user can apply nodes effects on others.

Advantages

1) It is first time that user can navigate and examine the structure even during vibration in real time,
2) User can change the structure graphically (such as applying active controls) in real time and see the result I a fraction of the time,
3) Super graphic quality,
4) It is first time to get design and analyze together and communicate to the public in VR,
5) VSML is compatible with VR tools such as CAVE (Cave Automatic Virtual Environment),
6) It is compatible with Internet and can be published on Internet easily. Therefore user can use server-side's processing power and storage capability and other Internet programming advantages,
7) It is compatible with future generation of screens (3d screens) [3]
8) Easy to collaborate with other working group (WG) such as H-anim (humanoid animation).

Conclusion

VSML, a web based modeling language for structures is conceived to have analog of VRML for structures based on VRML. It is expressed the geometry and behavior capabilities of the VRML 97 using the numerical method in c++ and web design in HTML.

References

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