3D Visualization Using the Pocket PC

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ABSTRACT: The recent introduction of Windows CE-based Pocket PCs has changed the role of handheld devices from a PDA with basic functions to a miniature extension of the personal desktop computer. A major advantage of Pocket PCs is mobility. They fit in the user's pocket and can be easily carried anywhere. The continuously increasing processing power embedded in these devices allows Pocket PC users to develop and run many applications that were, at one time, only available for the desktop platform.

Up till the early 90's, Virtual Reality (VR) and 3D visualization applications were envisioned to run only on desktop platform and highly powered graphics workstations such as the Silicon Graphics Octane. VR technology allows for real-time interactive visualization and walkthroughs [1]. In construction projects, it can be used to visualize walkthrough, interaction, modification in real-time a facility and its components and also testing what-if scenarios for various construction alternatives. The ever evolving development of microprocessors, 3D graphics and chips, and 3D software have made it possible for VR and 3D visualization applications to migrate to the desktop PC, and most recently to the Pocket PCs.

This paper explores the use of the Pocket PC platform coupled with multiple VR applications for visualization of design components and assemblies of building projects. It summarizes the proposed development of the framework needed to bring visualization environment into the realm of Pocket PC which could eventually be used as a visualization tool in construction. We used an iPAQ Pocket PC with 64 Mb of memory installed from Compaq.

1 INTRODUCTION

Since the introduction of Apple's Newton, handheld devices have evolved from a mere personal digital assistant (PDA) to more powerful computing platforms with high processing power. At the beginning, PDAs had limited capabilities and were only able to perform basic functions such as scheduling meetings and appointments and saving address book information.

The recent introduction of Windows CE-based Pocket PCs has changed the role of handheld devices from a PDA with basic functions to a miniature extension of the personal desktop computer. A major advantage of Pocket PCs is mobility. They fit in the user's pocket and can be easily carried anywhere. The continuously increasing processing power embedded in these devices allows Pocket PC users to develop and run many applications that were, at one time, only available for the desktop platform.

Likewise, up till the early 90's, Virtual Reality (VR) and 3D visualization applications were envisioned to run only on desktop platform and highly powered graphics workstations such as the Silicon Graphics Octane. During the 90's, we have witnessed this traditional VR inclination changing due to continuous price-drops of high powered desktop computers that makes it more affordable to the home-users. Thanks to the ever evolving development of microprocessors, 3D graphics and chips, and 3D software made it possible for VR and 3D visualization applications to migrate to the desktop PC, and most recently to the Pocket PCs.

This paper will explore the use of the Pocket PC platform coupled with multiple VR applications for visualization of design components and assemblies of building projects. A framework needed to bring the visualization environment into the realm of Pocket PC which could eventually be used as a visualization tool in construction is proposed. The paper will also discuss current benefits and limitations of the Pocket PC and their potential use as a stand alone visualization platform.

2.0 VR USE IN DESIGN/CONSTRUCTION INDUSTRY

Currently, the AEC industry relies heavily upon 2D drawings (featuring only length and width) to communicate design and construction information. Information conveyed in 2D drawings cannot be easily interpreted because of the lack of the 3rd dimension (depth). As a result, errors, miscalculations, misrepresentation, and miscommunication of information are common.

VR technology allows for real-time interactive visualization and walkthroughs [1]. Valuable benefits can be gained during design and pre-construction from utilizing VR technologies to walkthrough and interact in real-time with a facility and its components to understand and criticize the design. During construction, additional benefits can be achieved from using VR techniques for testing what-if scenarios for various construction alternatives.

3.0 PROPOSED FRAMEWORK

Figure 1 depicts the proposed framework to utilize the Pocket PC as a portable 3D visualization tool to aid construction personnel. The development of the framework involves the following major tasks.

Task 1: Develop several 3D CAD models for selected designs of construction assemblies

Since most construction companies use AutoCAD or 3D Studio to develop their 3D CAD models and to ensure compatibility with the proposed system we have decided to use 3D Studio VIZ for our 3D modeling purposes. Two very distinct 3D models in term of their complexity and functionality were developed (see Figures 2 and 3). Model 1 represents the structural wood frame for a house and Model 2 shows components of a wall and floor assemblies.

Task 2: Identify existing VR applications for 3D visualizations and walkthroughs that support the Pocket PC platform

Currently, very few VR applications exist for the Pocket PC. Referring to Figure 1, we considered to use a panorama 3D viewer (e.g. QuickTime VR and Deep Exploration), a VRML viewer, and a 3D Game environment.

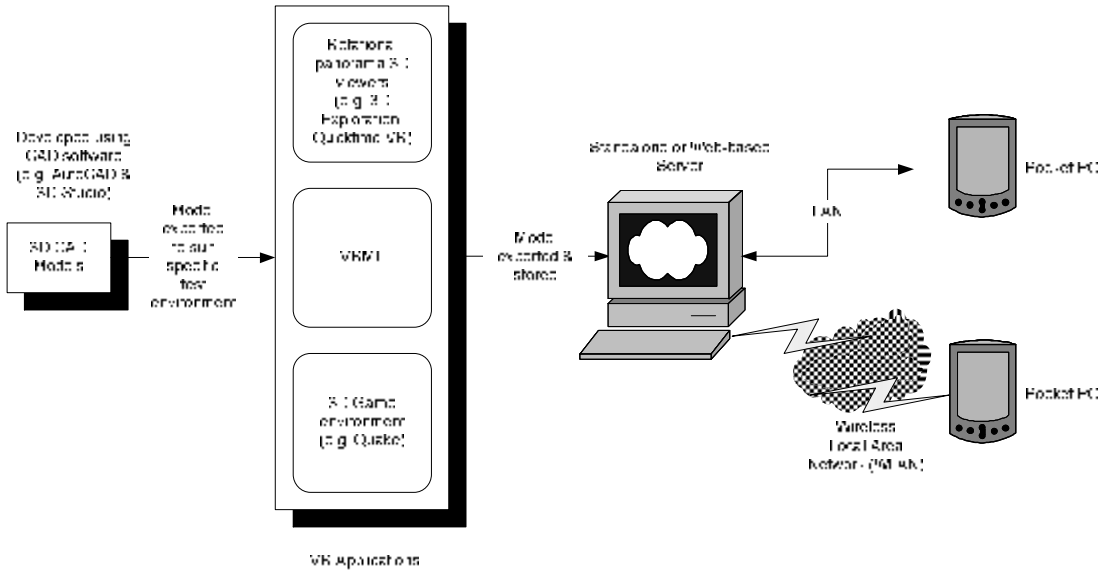

Figure 1: Proposed framework for integration of Pocket PC with 3D visualization tools

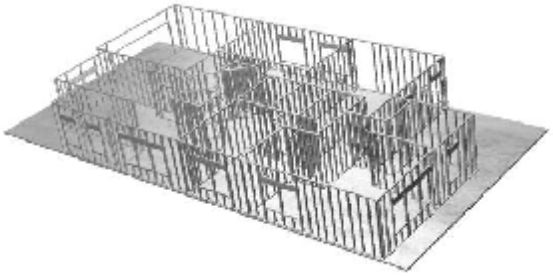

Figure 2: Model 1

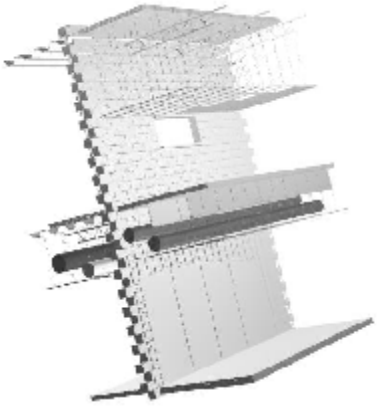

Figure 3: Model 2

There are a number of software that can do 360° panoramic image and object, and then save it to Quicktime VR (QTVR) format, however Quicktime VR is not yet available for the Pocket PC (Quicktime VR is developed by Apple at www.quicktime.com). We also tried to use Deep Exploration from Right Hemisphere (www.righthemisphere.com) but discovered there was no Pocket PC version available. Therefore the intention to use 3D panoramic object on the Pocket PC is not ye possible.

The VRML viewer for the Pocket PC is called Pocket Cortona developed by Parallel Graphics. It supports VRML files and can do various similar functions (see Figure 4) as the desktop version. We converted (from *.3ds file type to VRML file type) and loaded our models into Pocket Cortona and tested its functionality. For smaller to medium sized models the loading process was somewhat faster than larger models. This is also true for all VRML standard files that are transmitted and viewed using a desktop Internet browser such as Internet Explorer and Netscape Navigator. The navigation through the 3D model however was still slow and cumbersome. It is seen that the computing power of the Pocket PC can be improved to support a smoother movement to view the 3D models using Pocket Cortona.

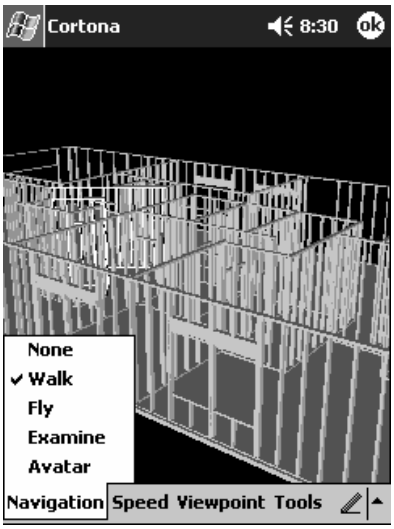

Figure 4: One of the example models and some of the functions available in Pocket Cortona

We also tested a beta released 3D Game environment for the Pocket PC. The game environment was based on a highly acclaimed 3D first-person shooter game i.e. Quake from id Software. A smaller and compact version of Quake was ported to the Pocket PC [4] and is called Pocket Quake. Using Pocket Quake, users are able to walkthrough a 3D virtual environment that is fully lighted and textured. Since id Software has made it Open Source, users can create new 3D VRs using various third party 3D level editor for Quake [5]. More information on how to create these levels is available at http://planetquake.com. We tested one of the 3D level editors for Quake called QuARK (Quake Army Knife) [6] to import our models. This was not possible due to the current limitations of QuARK. It was evident that in order to use Pocket Quake the 3D model had to be created using its editor. We then created a new VR and tested Pocket Quake's functionalities. Navigation and walkthrough using Pocket Quake were smoother than Pocket Cortona. It also supports good lightings and texturing.

Task 3: Using 3D CAD models and VR applications, develop VR environments on the desktop in a standalone or web-based format.

The system will comprise of a stand-alone and also a network based system. We plan to setup three types of network system i.e. a peer-to-peer, client-server and also web-based connectivity.

Task 4: Test the implementation of the VR environments on the Pocket PC using two modes of connectivity; wired connection through LAN, and wireless connection using a WLAN.
We are testing the communication mode of Pocket PC using both wired and wireless LAN. Pocket PC comes preinstalled with Pocket Internet Explorer (P-IE) which makes it possible to be used as an internet device. However there are still limitations in P-IE that we are now investigating. Our initial observation saw that P-IE is not yet at par with its' desktop IE cousin. A wireless card and access point is used for the implementation of the wireless connectivity.

4.0 CURRENT BENEFITS AND LIMITATIONS OF THE POCKET PC

From our investigation, we summarized in Table 1 and Table 2 the benefits and limitation of Pocket PC in general [7, 8, 9, 10] and as a 3D visualization device.

Benefits	
Software	The number of software developed for it is increasing. Its operating system is developed by Microsoft hence synchronization with popular applications such as Microsoft Word, Excel and PowerPoint is much easier.
Size	Compact. Previously, to design a more feature-rich device will cost more with a far bigger form factor. But as technology improves, more functionality is added yet, acceptable form factor is retained.
Data input	Uses a stylus for data input. However, detachable keyboards can be added for data entry. These add-ons generally cost between $50 to $100 and can dramatically increase the speed of data entry.
Expandability	Because expansion slots allow adding e.g. memory and accessories, the functionality can be increased over time with out having to replace it. The important factors to consider with respect to expandability are the cost and selection of expansion modules.

Table 1: Benefits of the Pocket PC

Limitations	
Battery life	Color screen would exhaust the batteries more quickly. The iPaq does not have a replaceable battery.
Speed	Streamlined design provides quick response time yet tend to be a little more sluggish as the processing required to produce full-color, graphic intensive images is high. The speed on the newer models is dramatically improved over the older models and will likely continue to get even better.
Very few 3D visualization applications	Due to the limitation in processing power as compared to a notebook or a desktop computer, currently very few applications support 3D visualization on the Pocket PC.

Table 2: Limitations of the Pocket PC

5.0 CONCLUSION

The Pocket PC as a portable 3D visualization device is possible and highly probable. But in its current state with very few 3D applications and limited 3D graphics support we are not likely to see it happening just yet. As demonstrated in this paper, Pocket Cortona was the only VRML viewer that we found for the Pocket PC. The use of Pocket Quake showed some potential applications that can be further developed as 3D visualization tool but more is needed as it was never meant to more than just a 3D game. With the current trend of computing advancements, it can be anticipated that more applications that are closely related to both 2D and 3D visualization be ported to the Pocket PC. We feel this will greatly complement its desktop counterpart due to its compact design and mobility.

6.0 REFERENCES

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