

Blender and Immersive Gaming in Hemispherical Domes

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Introduction: Stereoscopy vs peripheral vision

- How to increase engagement and immersion in games?
- Many games support stereoscopic 3D projection. Stereoscopy is difficult to present with low eye strain in a budget conscious environment.
- Argue that the gaming advantage from stereoscopy is minimal. Rarely do games present depth accurate stereoscopy.
- A sense of immersion is better achieved by engaging the users peripheral vision.
- Peripheral vision evolved to enable earlier threat detection, hence likely advantages for game play (at least for certain genres).
- No eye strain and often credited with our sense of “being there” (presence).
- Often a strong sensation of 3D depth perception arising from :
 - Motion cues.
 - An invisible screen surface.
 - Nothing from the real world (picture frame) is visible.
- Most common hemispherical viewing environment is a planetarium.
- We have developed the “iDome”, a small personal hemispherical projection system.

iDome

- Similar systems in the past were developed by Elumens, called the VisionStation.
- iDome jointly developed by iCinema (UNSW) and WASP (UWA).
- A single person immersive environment.
- Does support 2-3 persons comfortably without undue image distortion.
- Designed to fit in a standard height room. 3m wide and truncated to be 2.7m high.
- Used at UWA for science visualisation and virtual environments.



Application examples



Science education



Remote operations (mining)



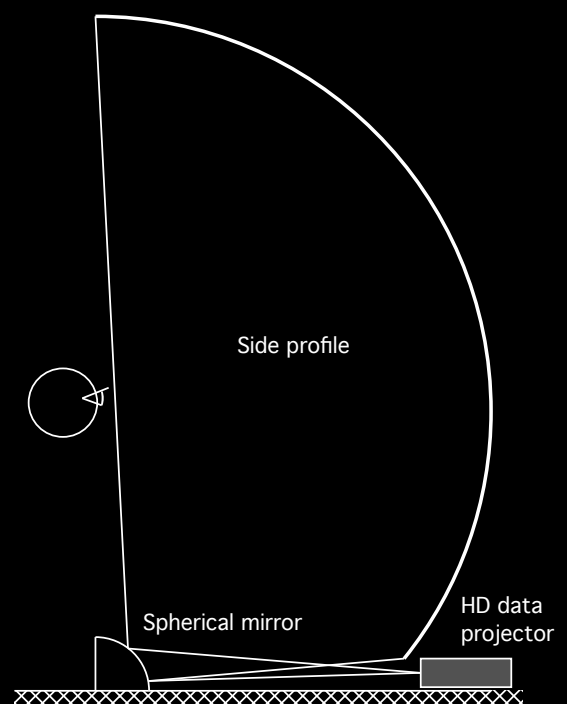
Science visualisation



Virtual heritage

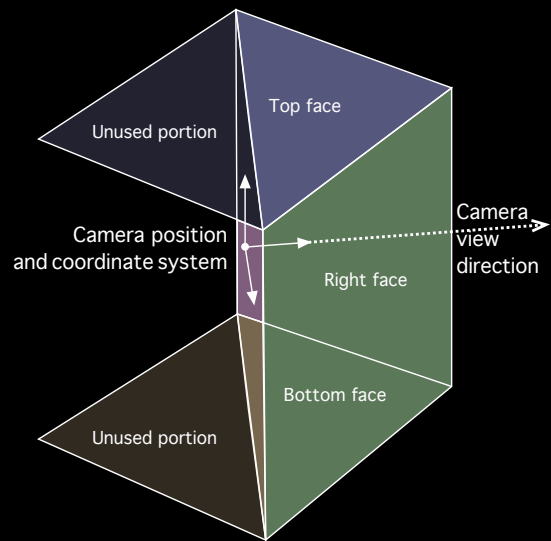
Projection optics

- Employs a single high definition data projector.
- Traditional approach uses a fisheye lens attached to a data projector. Has a high associated cost and the projector/fisheye occupies the best position, the position where the human should sit.
- Uses a projection technology developed by the author based upon a spherical mirror.
- Conveniently separates the projection hardware from the optics.
- The projection system is out of the way, often not noticed at all.
- Capable of image quality that rivals the fisheye option.
- Requires an image warping to compensate for the distortion introduced by the mirror, performed in realtime.

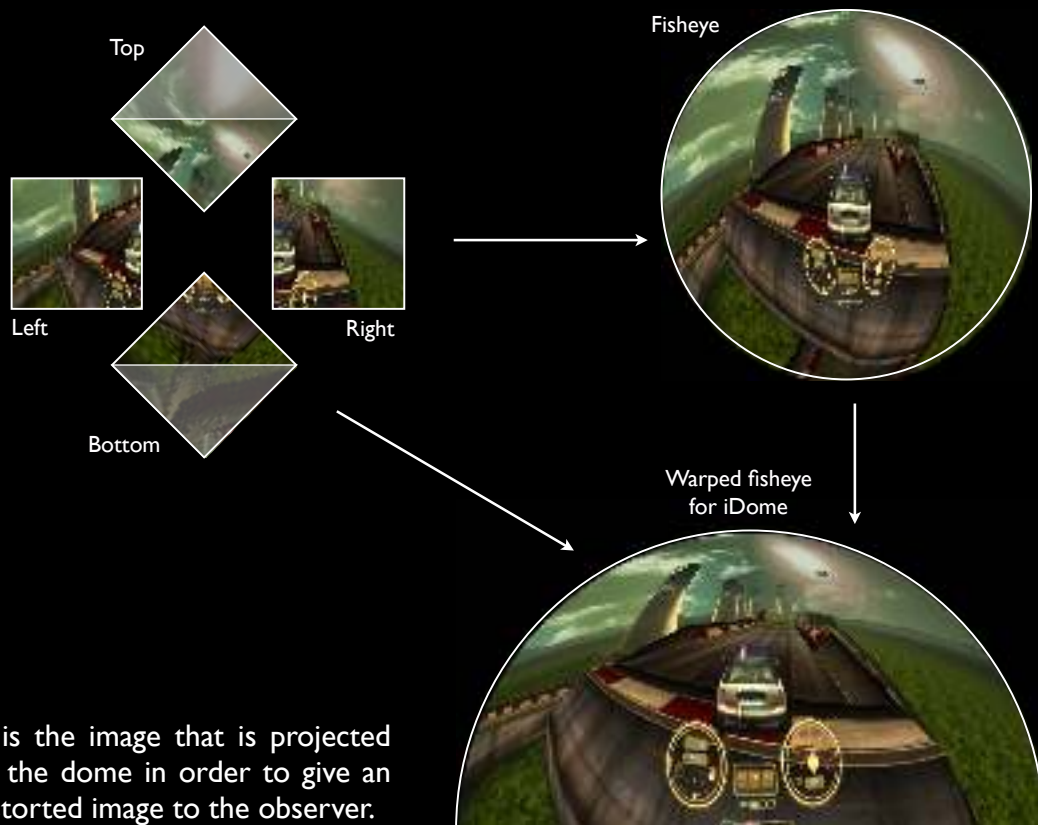


Realtime fisheye generation: Multipass rendering

- A single perspective projection is insufficient to create the field of view (FOV) required for a dome. The limit is about 120 degrees, the iDome requires 180 degrees FOV.
- Approach used here is to render 4 views, frustums through the vertices of 4 faces of a cube centred at the camera.
- These 4 images are applied as textures to form either a fisheye image (for fisheye lens projection system) or warped fisheye (for spherical mirror based projection system).
- The image transformations required are derived from simulation software that is based upon the geometric/optical configuration.
- Relatively straight forward to integrate into an existing rendering pipeline.



Rendering pipeline overview



Implementation in BGE (Blender Game Engine)

- Many are familiar with the Blender modeller/render/animation package, less so with the game engine.
- Features
 - Leverages Blender's existing modelling front end.
 - Open source (hence the possibilities demonstrated here).
 - Cross platform (Linux, Mac OS-X, MSWindows).
 - Physics engine.
 - Pervasive Python scripting.
 - Audio.
 - GLSL shader 2.0.
 -
- Dome support
 - "Mode" includes support for fisheye, truncated fisheye, environment (cube) maps, and spherical panorama.
 - "Tilt" rotates the camera to locate the sweet spot in the right place for tilted domes.
 - "Tessellation" and "Res" provide a performance/accuracy tradeoff.



Blender examples



ClubSilo by Luma Labs

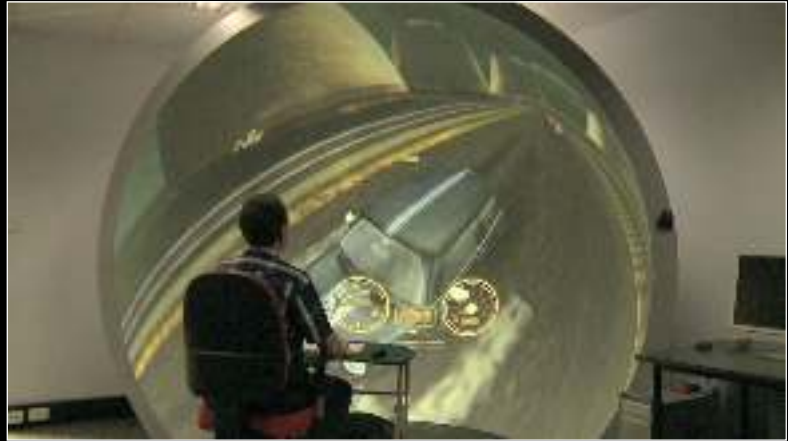
Yo Frankie



- Integrated into Blender 2.49.
- Employs the same warp mesh file format used by other spherical mirror based projection software.
- Subsequent development will also include an integrated mesh calibration tool.

Performance

- Performance hit is approximately a factor of 2.5
- On current graphics cards the texture passes are negligible.
- Important to match the resolution of the 4 rendered textures to the final fisheye and/or warped fisheye resolution.
- Care must be taken at every stage of the pipeline to optimise image quality.



Summary

- Support for more exotic projections, as required for immersive environments. In particular, fisheye projections for planetariums and hemispherical domes based upon fisheye lens projection.
- Additionally, warping for hemispherical domes employing the spherical mirror projection technique (very common among small dome installations).
- This is now included in the standard distribution of the Blender Game Engine.



Questions?

Further reading material by the author

- Using a spherical mirror for projection into immersive environments.
<http://local.wasp.uwa.edu.au/~pbourke/papers/graphite2005/>
Proceedings of the 3rd international conference on computer graphics and interactive techniques in Australasia and South East Asia, pp 281-284, 2005.
- Low Cost Projection Environment for Immersive Gaming.
<http://local.wasp.uwa.edu.au/~pbourke/papers/jmm/>
JMM (Journal of MultiMedia), Volume 3, Issue 1, pp 41-46, May 2008.
- iDome: Immersive gaming with the Unity game engine.
<http://local.wasp.uwa.edu.au/~pbourke/papers/cgat09b/>
Proceedings of the Computer Games & Allied Technology 09 (CGAT09), Research Publishing Services, ISBN: 978-981-08-3165-3, pp 136-143, 2009.



