360 VR at Yahoo
Hello!

Satender Saroha

VR Enthusiast at Yahoo

satender@yahoo-inc.com
Virtual reality is a technology that could actually allow you to connect on a real human level, soul-to-soul, regardless of where you are in the world.

Chris Milk
Outline

- 360 Streaming Workflow
  - Stitching
  - Player Rendering
- Mobile VR
- Challenges
360 Streaming Workflow
Stitching

3 Step Process
- Raw frame image processing
- Calibration
- Optical Flow

Softwares
- Vahana VR
- Surround 360
- Radeon Loom
Player Rendering - Steps

- Equirectangular video as source
- Create sphere and apply equirectangular video as its texture
- Create camera and place it in the center of sphere
- Build user interactions and device motion to control the camera
Player Rendering - WebGL/Metal Concepts

- GL renderer
- Scene
- Camera
  - PerspectiveCamera
- 3D object
  - Geometry
  - Material
  - Geometry + Material = Mesh
- Vector3 position
  - A point in 3D space (x, y, z)
Demo

http://codepen.io/ssaroha/pen/oWWbLx
Mobile 3D VR Experience

- Enable 3D VR room scale experience for all videos (not just 360)
- Uses DayDream VR + Unity SDK
Challenges
Problem 1: Motion to Photon Latency on mobile
Solution: Motion to Photon Latency on mobile

Double Buffered Rendering

Single Rendering
Challenge 2: 360 Support in Safari mobile web

CORS Bug
- Safari does not respect CORS headers with webgl
- Unable to draw content to Canvas

Fix - Server Side
- Embed player in iframe on same domain as CDN
- Reverse proxy mobile-web traffic to CDN through own server
Challenge 3: Enormous Data

- True immersive experience needs 8K per eye
- Need > 100 Mbps
- Avg Wifi in US 20 Mbps
Solution: Compression

- Cubemap vs Equirectangular - 30% BW reduction

- HEVC, VP9 vs H.264 - 40% reduction
Solution: FOV Adaptive Streaming

- FOV Adaptive Streaming
- Spatially divide videos into multiple tiles
- MPEG-DASH SRD
Solution: FOV Adaptive Streaming (Cont’d)
Challenge 4: Achieving 6 DoF

http://stanford.edu/~jingweih/papers/6dof.pdf
Solution: 6 DoF by Adobe Research

- Enhances existing monoscopic 360 videos with 6 DoF
- Infers camera path and 3D scene geometry using structure-from-motion techniques
- A novel warping algorithm synthesizes views on the fly by warping original content
Summary

- Successful 360 streaming of the Presidential inauguration
- Production ready 360 iOS player using Metal
Thanks!

More questions?

Twitter: https://twitter.com/ssaroha
Email: satender@yahoo-inc.com