New England Healthcare Engineering Society Fall 2016 Conference

Virtual Reality & the Design of Healthcare Environments

e4h morrisswitzer ENVIRONMENTS FOR HEALTH ARCHITECTURE

iris

Mike Bennett, AIA, Boston, MA

Ailyn Mendoza, ASLA, New York, NY

- Overview of VR Technologies

- Real World Applications of VR

- Benefits

Mike Bennett

Healthcare Architect, AIA EDAC
E4H Architecture

Georgia Institute of Technology, *Digital Design and Virtual Environments*
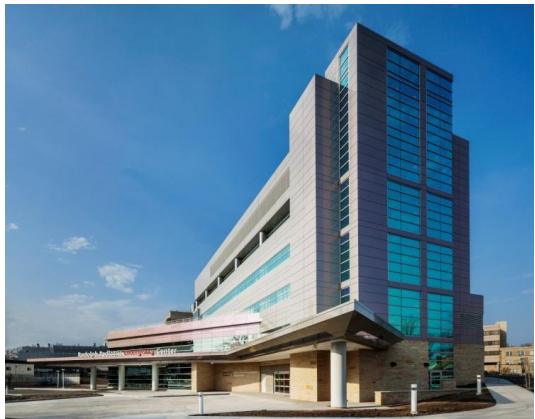Florida International University, CARTA

VAMC Providence
Intensive Care Unit

VAMC Providence
Neurology Prosthetics Lab

A.O. Fox Hospital
Oneonta, NY
Acadia Hospital
Bangor, ME
Addison Gilbert Hospital
Gloucester, MA
Adirondack Medical Center
Saranac Lake/Lake Placid, NY
Albany Medical Center
Albany, NY
Alice Hyde Medical Center
Malone, NY
Alice Peck Day Hospital
Lebanon, NH
American Healthcare Investors, LLC
Carlsbad, MA
Barnabas Health
West Orange, NJ
Bassett Medical Center
Cooperstown, NY
Baylor Healthcare System
Denton, TX
Baylor Scott & White Health
TX
Baylor Medical Center Frisco
Frisco, TX
Baylor Orthopedic Surgical Hospital
Arlington, TX
Baylor Medical Center Trophy Club
Trophy Club, TX
Bayonne Medical Center
Bayonne, NJ
Baystate Franklin Medical Center
Greenfield, MA
Bellevue Woman's Hospital
Schenectady, NY
Bergen County Medical Center
Paramus, NJ
Berkshire Health System
Pittsfield, MA
Beverly Hospital
Beverly, MA
Blue Hill Memorial
Blue Hill, ME
Blythedale Children's Hospital
Valhalla, NY
Bridgton Hospital
Bridgton, ME
Bronx Psychiatric Center
Bronx, NY
Brooklyn Children's Psychiatric Center
Brooklyn, NY
Brownwood Medical Center
Brownwood, TX
Canton-Potsdam Hospital
Potsdam, NY
Carlos Otis Stratton Mountain Clinic
Stratton Mountain, VT
Cary Medical Center
Caribou, ME
Catholic Healthcare West
Phoenix, AZ
Central Maine Medical Center
Lewiston, ME
Central Texas Rehabilitation Hospital
Austin, TX
Central Vermont Medical Center
Berlin, VT
Champlain Valley Oral Surgery
South Burlington, VT
Champlain Valley Physicians Hospital
Plattsburgh, NY
Charles A. Dean Memorial
Greenville, ME
Children's Medical Center of Dallas
Dallas, TX
Children's Medical Center Plano
Formerly Children's Medical Center at Legacy
Plano, TX

Children's Health Pediatric Group
Formerly MyChildren's
TX
Children's Health HMO/Call Center
Irving, TX
Clifton Fine Hospital
Star Lake, NY
Cobleskill Regional Hospital
Cobleskill, NY
Colorado Plains Medical Center
Fort Morgan, CO
Community Counseling Center
Portland, ME
Cedar Park Regional Medical Center
Cedar Park, TX
Community Health Systems
AK, AR, AZ, LA, NM, OK, TX, WA, WY
College Station Medical Center
College Station, TX
ConciER Medicine
Sanford, MI
Cook Children's Health Care System
TX
Cook Children's Healthcare System
Clinic at Trophy Club
Trophy Club, TX
Cook Children's Healthcare System
Clinic at Southlake
Southlake, TX
Cook Children's Healthcare System
Clinic at Lewisville
Lewisville, TX
Cook Children's Healthcare System
Clinic Pediatric Clinic at Heritage Trace
Keller, TX
Cooley Dickinson Hospital
Northampton, MA
Copley Hospital
Morrisville, VT
Cottage Hospital
Woodsville, NH
Crouse Hospital
Syracuse, NY
Dartmouth-Hitchcock Hospice
Lebanon, NH
Dartmouth-Hitchcock Nashua
Nashua, NH
Deaconess Medical Center
Oklahoma City, OK
Deaconess Medical Center
Spokane, WA
Down East Medical Center
Machias, ME
Duke Realty
Plano, TX
Eastern Maine Medical Center
Bangor, ME
Eastern New Mexico Medical Center
Eastern, NM
Elizabethtown Community Hospital
Elizabethtown, NY
Elliot Health System
Manchester, NH
Ellis Hospital
Schenectady, NY
Elmhurst Hospital Center
Queens, NY
Fairview Hospital
Great Barrington, MA
Fanny Allen Hospital
Winooski, VT
Forest Park Medical Center Dallas Master Plan
Dallas, TX
Forest Park Medical Center Southlake
Southlake, TX
First Choice Emergency Room:
CO, TX
Franklin Memorial Hospital
Farmington, ME
Funderburgh Realty Group
Arlington, TX

Gables at East Mountain
Rutland, VT
Gerald Champion Medical Center
Alamogordo, NM
Gifford Medical Center
Randolph, VT
Glens Falls Hospital
Glens Falls, NY
Goodall Hospital
Sanford, ME
Grace Cottage Hospital
Townshend, VT
Gracie Square Hospital
New York, NY
Hallmark Health
Medford, MA
Harvard Medical School
Boston, MA
Health Source Saginaw
Saginaw, MI
Healthcare Building Solutions
Richardson, TX
Healthcare Realty
Denver, CO
Healthcare Realty Trust
Frisco, TX
Herkimer Health Center
Herkimer, NY
Hospice of Southern Maine
Scarborough, ME
Hospital for Special Surgery
New York, NY
Inland Hospital
Waterville, ME
Inter-Lakes Health
Ticonderoga, NY
John T. Mather Memorial Hospital
Port Jefferson, NY
Kingston General Hospital
Kingston, Ontario, Canada
Lahey Hospital & Medical Center
Burlington, MA
Lake Area Medical Center
Northfield, VT
Mayo Regional Hospital
Lake Charles, LA
Lakeridge Health Oshawa
Oshawa, Ontario, Canada
Land Plan Development Corporation
Fort Worth, TX
Lantheus Medical Imaging
North Billerica, MA
Lawrence General Hospital
Lawrence, MA
Lawrence Memorial Hospital
Medford, MA
Lehigh Valley Health System
Allentown, PA
LHP Hospital Group
Pocatello, ID
LifePoint Hospital Palestine
Palestine, TX
LifePoint Hospital Vernal City
Vernal City, UT
Lincoln County Healthcare
Damariscotta, ME
Little Falls Hospital
Little Falls, NY
Little Man Real Estate
Hurst, TX
Little Man Real Estate
Lewisville, TX
Littleton Regional Hospital
Littleton, NH
Long Island University
Brooklyn, NY

Long View Regional Medical Center
Long View, TX
Maine Behavioral Health
South Portland, ME
Maine General Medical Center
Waterville, ME
Maine Hospital Association
Augusta, ME
Maine Medical Center
Portland, ME
Maine Medical Center - Scarborough Surgery Center
Scarborough, ME
Maine Mental Health Partners
Portland, ME
Mansfield Orthopedics at Copley
Morrisville, VT
Mary McClellan Hospital
Boston, MA
Massachusetts General Hospital
Boston, MA
Mat-Su Valley Regional Medical Center
Palmar, AK
Mayo Healthcare
Northfield, VT
Mayo Regional Hospital
Dover-Foxcroft, ME
Medical Center of Dallas
Farmers Branch, TN
Medical Partners of America
Mansfield, TX
Medifacts
Hurst, TX
Memorial Medical Center Las Cruces
Las Cruces, NM
Memorial Sloan Kettering Center
New York, NY
Memorial Sloan Kettering Center Sleepy Hollow
Sleepy Hollow, NY
Mercy Health Partners
Scranton, PA
Mercy Tyler Emergency Department Renovation
Scranton, PA
Mercy Hospital
Portland, ME
Mercy Medical Center
Springfield, MA
Merrimack Pharmaceuticals
Cambridge, MA
Mid Coast Hospital
Brunswick, ME
Mid-Hudson Regional Hospital
Poughkeepsie, NY
Miles Memorial Hospital
Damariscotta, ME
Millinocket Regional Hospital
Millinocket, ME
Mimbres Memorial Hospital
Deming, NM
Moffitt Cancer Center
Tampa, FL
Monmouth Medical Center
Monmouth, NJ
Moses Ludington Hospital
Ticonderoga, NY
Mount Ascutney Hospital
Windsor, VT
Mount Desert Island Hospital
Bar Harbor, ME
Mount Sinai School of Medicine
New York, NY
Mountain View Regional Medical Center
Las Cruces, NM
Navaro Regional Medical Center
Corsicana, TX
New London Hospital
New London, NH

New York City Health and Hospitals Corporation (HHC)
New York, NY
New York-Presbyterian Hospital
New York, NY
New York-Presbyterian Hospital Westchester
Westchester, NY
New York University / Langone Medical Center
New York, NY
New York University / Lutheran Medical Center
Brooklyn, NY
Newark Beth Israel Medical Center
Newark, NJ
Newport Hospital
Newport, RI
Newton-Wellesley Hospital
Newton, MA
North Country Hospital
Newport, VT
North West Medical Center
Tucson, AZ
North York General Hospital
North York, Ontario
Northeastern VT Regional Hospital
St. Johnsbury, VT
Northern Berkshire Campus
North Adams, MA
Northern Maine Medical Center
Fort Kent, ME
North Westchester Hospital
Westchester, NY
Northwell Health
Formerly North Shore-LIJ
New York, NY
Northshore University Hospital
Manhasset, NY
Cohen Children's Medical Center
New Hyde Park, NY
Northwestern Medical Center
St. Albans, VT
OASIS Hospital
Phoenix, AZ
O'Connor Hospital
Delhi, NY
Oneida Nation Health Center
Oneida, NY
Palo Pinto General Hospital
Palo Pinto, TX
Parkland Hospital
Dallas, TX
Pediatric Assoc. of Salem
Salem, MA
Penobscot Bay Medical Center
Rockport, ME
Penobscot Valley Medical Center
Lincoln, ME
Planned Parenthood
VT, NH, NY, MA
Portneuf Medical Center
Pocatello, ID
Porter Medical Center
Middlebury, VT
Portsmouth Regional Hospital
Portsmouth, NH
Presbyterian Hospital of Denton
Denton, TX
Prim Construction LLC
Fort Worth, TX
Promise Hospitals
FL, LA
Miami Lakes Medical Center
Miami, FL
Promise Hospital of Florida at The Villages
The Villages, FL
Promise Hospital of Miss Lou
Vidalia, LA
Promise Hospital of Bossier City
Bossier City, LA

SUNY Farmingdale State College
Farmingdale, NY
SUNY Upstate Medical Hospital
Syracuse, NY
Surgical Care Affiliates
TX
Surgical Center Flower Mound
Flower Mound, TX
Tenet Healthcare
TX
Texas Health Surgery Center Cleburne
Cleburne, TX
The Aroostook Medical Center
Presque Isle, ME
The Atrium Alzheimer's Facilities
New England
The Neal Richards Group
TX
Titus Regional Medical Center
Mt. Pleasant, TX
York Hospital
York, ME
Yorkshire Realty Advisors
Dallas, TX
Trammell Crow Company
TX
Tri-Town Regional Hospital
Sidney, NY
Texas Health Resources
Denton, TX
Texas Orthopedic Specialists
Bedford, TX
University of Connecticut Health
Farmington, CT
University of Massachusetts Memorial Medical Center
Worcester, MA
United Surgical Partners International
AZ, CA, CO, FL, MO, MT, OK, TX
University of Vermont Medical Center
Burlington, VT
Upper Connecticut Valley Hospital
Colebrook, NH
Veterans Administration Medical Center
Northport, NY
Veterans Administration
MA, ME, NY, RI, VT
Valley Health Services
Herkimer, NY
Veterans Administration Medical Center Northampton
Leeds, MA
Vermont Children's Hospital of
University of Vermont Medical Center
Burlington, VT
Village at Farm Pond
Framingham, MA
Waldo County General Hospital
Belfast, ME
Weill Cornell Inpatient Psychiatry Unit
New York, NY
Wentworth-Douglass Hospital
Dover, NH
Wesley HealthCare
Saratoga, NY
Westview Meadows
Montpelier, VT
William Osler Health Centre
Brampton, Ontario, Canada
Windsor Regional Hospital Metropolitan Campus
Windsor, Ontario, Canada
Winkler County Memorial Hospital
Kermit, TX
Women & Infants Hospital
Providence, RI
Woodlawn Commons
Saratoga Springs, NY
Wynmark Commercial
Mansfield, TX

Queens Hospital Center
Queens, NY
Rabin Medical Center
Tel Aviv, Israel
Regional Medical Center
Abilene, TX
Rendina Healthcare Real Estate
AK, AZ, ID, TX
Retreat Health Care
Brattleboro, VT
Ridgeland Capital Partners
Houston, TX
Rockwall Hospital Corporation
TX
Lakeside Hospital at Bastrop
Bastrop, TX
Patients Medical Center at Pasadena
Pasadena, TX
Regional Medical Center
Sunnyvale, TX
Rumford Community Hospital
Rumford, ME
Rutgers University
Rutgers, NJ
Saint Andrews Hospital
Boothbay Harbor, ME
Saint Barnabas Medical Center
Livingston, NJ
Saint Mary's Hospital
Lewiston, ME
The Sanders Trust
Birmingham, AL
Scarborough Terrace
Scarborough, ME
Schneider Children's Medical Center of Israel
Tel Aviv, Israel
Schuyler Hospital
Montour Falls, NY
Seacoast Mental Health
Exeter, NH
Sebasticook Valley Hospital
Pittsfield, ME
Select Health Services
Grapevine, TX
Seton Medical Center Harker Heights
Harker Heights, TX
Soroka Medical Center
Beer Sheva, Israel
South Shore Hospital
Weymouth, MA
Southside Hospital
Bay Shore, NY
Southwestern Vermont Medical Center
Bennington, VT
Specialty Care Center at Richardson
Richardson, TX
Spring Harbor Hospital
Westbrook, ME
St. Ann Home
Dover, NH
St. Joseph Healthcare
Bangor, ME
St. Joseph's Children's Hospital
Tampa, FL
Stony Brook Medical Center
Stony Brook, NY
Sugar Hill Retirement Community
Wolfeboro, NH
Sugarland Surgical Hospital
Sugarland, TX
Sunbury Community Hospital
Sunbury, NJ
Sunbury Primary Care
Bangor, ME
Sundance Behavioral Healthcare
Fort Worth, TX
Sundance Psychiatric Hospital
Fort Worth, TX
Sunnybrook Health Sciences Centre
Toronto, Ontario
SUNY at Stony Brook
Stony Brook, NY

client list
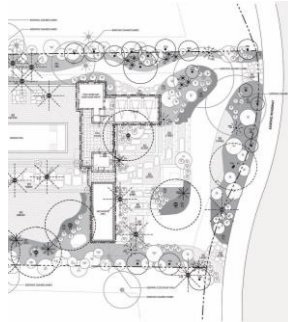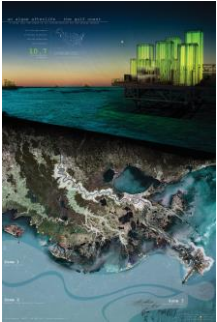
Ailyn Mendoza

Director of Client Experience

Prior:
Dland Studio
Michael Van Valkenburgh Associates
SWA Studio

Harvard University, Graduate School of Design
Florida International University, CARTA

iris

At IrisVR we tackle the frustration that comes from designing and working in 3D but experiencing spaces in 2D formats.

By developing software tools which leverage VR, AR and gaming technology for professional workflows.

2014

Established

HQ in NYC
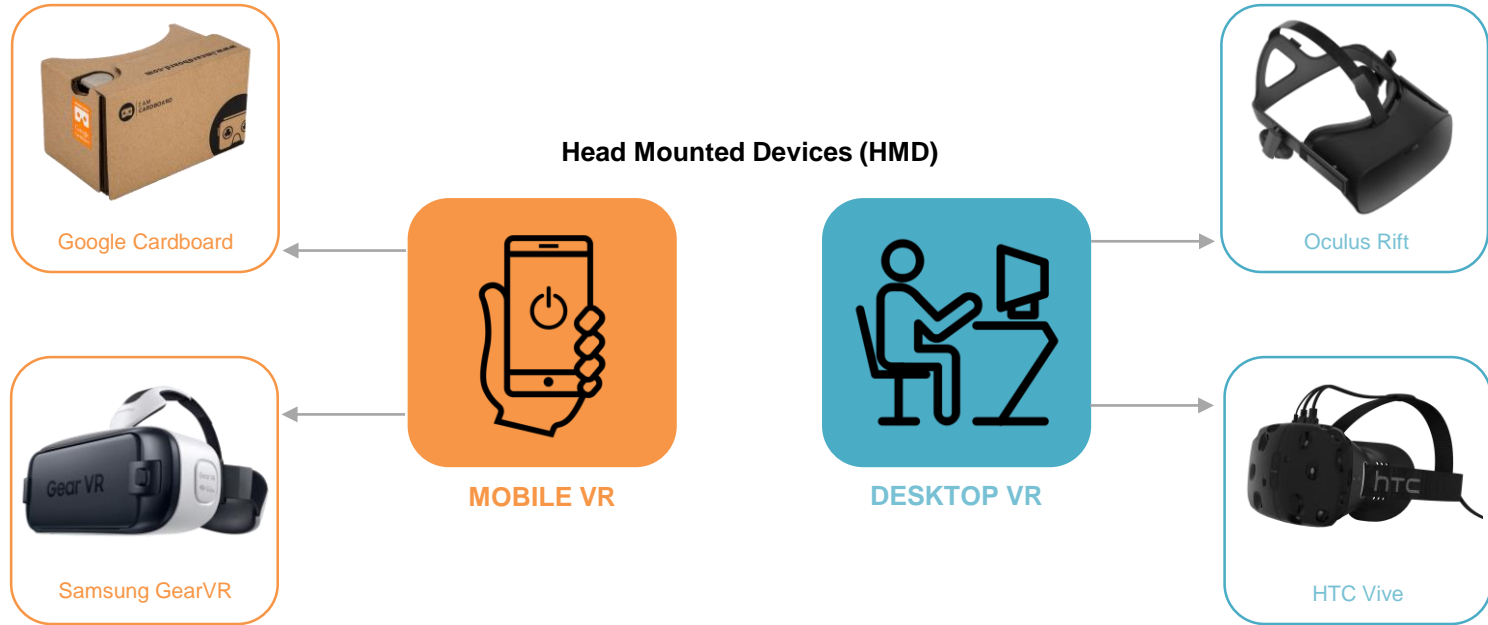
Software Products
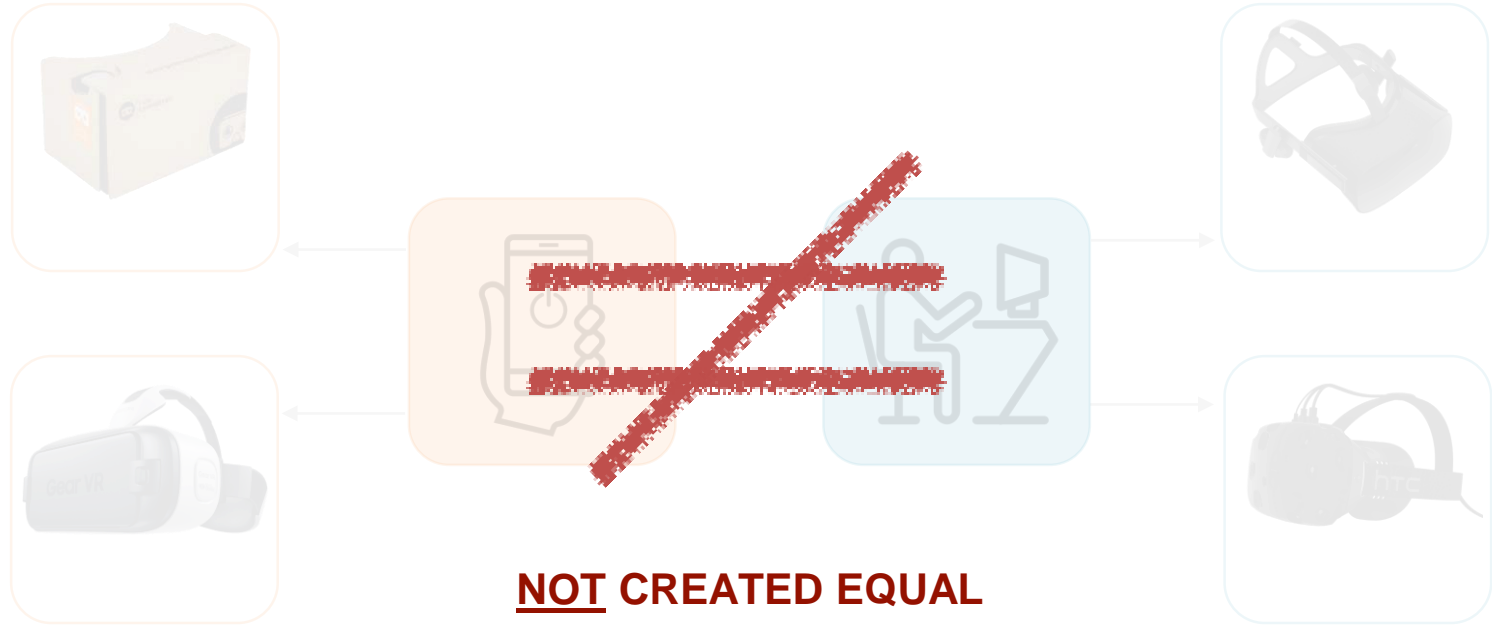
16 Team Members

Daily Coffee Intake

"the computer-generated simulation of a three-dimensional image or environment that can be interacted with in a seemingly real or physical way by a person using special electronic equipment, such as a helmet with a screen inside or gloves fitted with sensors."

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VR PRIMER : TYPES OF HMD's

Head Mounted Devices (HMD)

Google Cardboard

Samsung GearVR

MOBILE VR

DESKTOP VR

Oculus Rift

HTC Vive

NOT CREATED EQUAL

Google Cardboard

MOBILE VR

Samsung GearVR
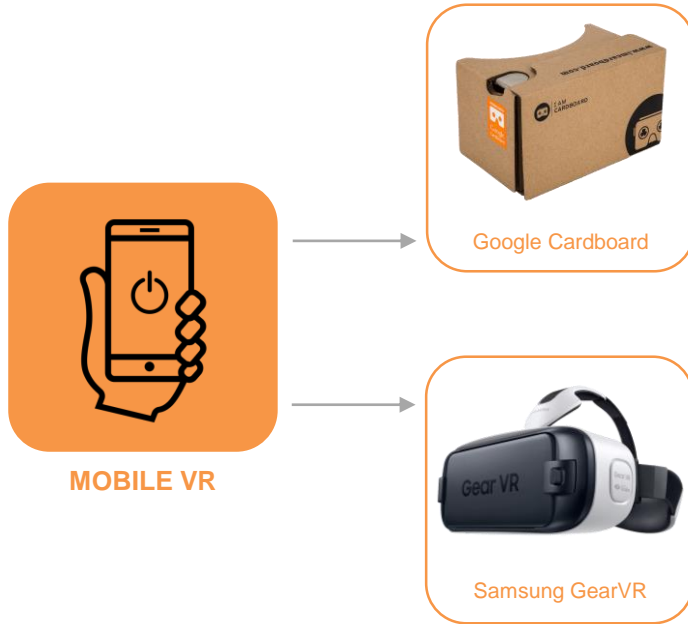
Hardware: Untethered Headset + Smartphone

Content: Image/JPEG (rendered from 3D model)

Pros:

- Inexpensive headset (~$100)

- Accesible on smartphone
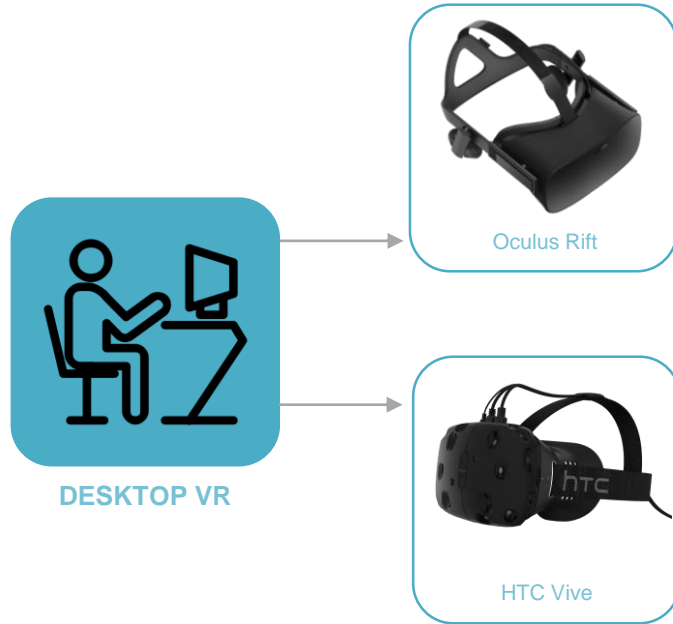
- Easily to travel with

Cons:

- Single fixed view point

- Requires 360 full rendering to be made

- Not for quick iteration

Oculus Rift

DESKTOP VR

HTC Vive

Hardware: Tethered Headset + Powerful Computer

Content: 3D Model (Revit, Rhino, Sketchup, OBJ)

Pros:

• Fully immersive experience

• User can freely explore

• True to scale environment

Cons:

• Requires hardware

• Not "briefcase" friendly

• Mac does not support headsets

University of Vermont Medical Center

Newton Wellesley Hospital
Ambulatory Hub

NEWTON-WELLESLEY HOSPITAL

LeggatMcCall
PROPERTIES

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ENVIRONMENTS
FOR HEALTH
ARCHITECTURE

SCOPE

Newton-Wellesley Hospital recently began construction on a new Ambulatory Care Hub with Primary Care, Specialty Clinics, Phlebotomy, and X-Ray. VR was used as for user feedback during design meetings. Doctors, nurses, and staff were able to review the layout of equipment and furniture in the standard exam rooms, eliminating the need for building a mockup.

RESULTS

Users gave real time feedback using in-iris tools

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Lawrence General Hospital
Surgery Center

"Users were blown away with this feature. A lot of the decisions made using this will help with the Hybrid room. Should have everything wrapped up next week."
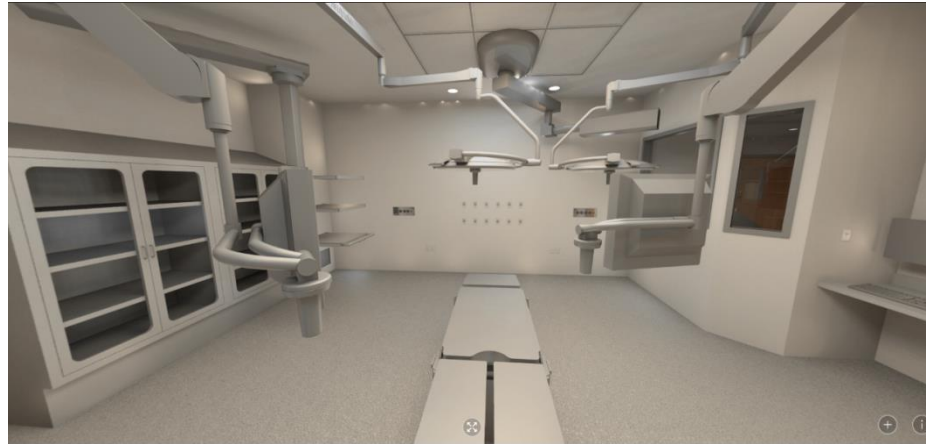
- Ray Boudreau,
  Project Manager

SCOPE

Lawrence General Hospital is building a new $50 million Surgery Center, and E4H leveraged VR to build virtual mock-ups during construction to make decisions about equipment locations, outlet layouts, and staff work area placement. They were able to avoid physical mock-ups saving lead time and construction cost.

RESULTS

Users reviewed the BIM model in the field and made decisions without needing to build a physical mock-up.

Loyola University Medical Center Renovations

SCOPE

Mortenson Construction is the leading a **$20 million dollar** renovation at LUMC in Maywood, IL, focused on modernizing the gastroenterology suite, observation unit, neurophysiology unit, and interventional radiology procedure suite.

In addition, the hospital is modernizing the heating, water, cooling and electrical systems for several buildings on the medical campus.
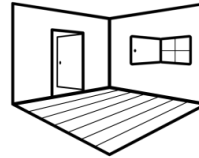
$20m

Construction Budget

CHALLENGE
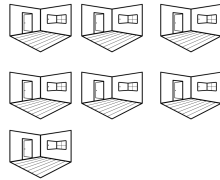
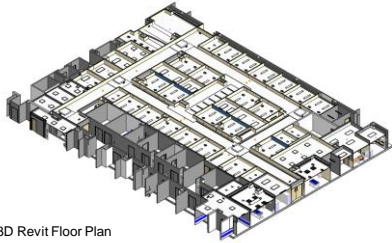Had **seven** various designs with complex MEP

Budget and time restrictions only allowed for **one** physical mock up

Too much of the client's resources where being spent on team's Q&A plus visiting other locations

Mortenson construction

Loyola University Medical Center Renovations

3D Revit Floor Plan
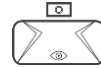
DESIGN WORKFLOW

The team modeled all 21 rooms and additional staff workspaces, such as the Nurses' Station, with the required equipment, for the users to review.

Revit ▶ Iris Prospect w/ Oculus

3D Model of Patient Rooms

Nurse evaluating hallway sight lines and clearances

Physician reviewing layout of patient room

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CASE STUDY

Loyola University Medical Center Renovations

"With IrisVR, we can now utilize VR faster and on a larger scale.

It's a game changer.

*Not only are we **saving time and money** but we are also making our **customers happy** and improving the final product with less resources on our end."*

- Jennifer Suerth,
Integrated Construction Manager

KEY BENEFITS

Quick design iteration process, made easy by importing directly from Revit into VR without Unity.

User First - users instantly understood the space and were able to provide constructive feedback.

Prevented costly on-site errors by helping to detect them earlier in the construction phase.

UP NEXT

After the success with IrisVR and the VR mockup, the design and construction team agreed to build a VR mockup for the Interventional Radiology (IR) phase to confirm with the users.

MarmonMok
ARCHITECTURE

University Hospital Pediatric & Adult Infusion Center *(name confidential)*
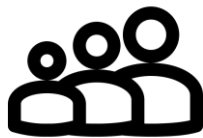
SCOPE

MarmonMok is leading the renovation of an existing cancer center in San Antonio, TX.

The design of the new infusion centers must account for the varying treatment durations and frequencies while maintaining clinician access to patients.

CHALLENGE

Sizes of stations vary greatly from Adult to Pediatric services
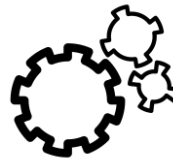
Greater technological and **equipment requirements** than original

Accommodating for patient **privacy and practicality** for staff

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MarmonMok
ARCHITECTURE

University Hospital Pediatric & Adult Infusion Center *(name confidential)*

DESIGN WORKFLOW

The team began with a floor plan of the area, then moved to renderings and built one physical mock of the space. Then the models where used as a VR component to the built mockup.

Sketchup   Revit   ▶   Iris Prospect w/ HTC Vive

KEY BENEFITS

Verification of critical site lines from nurses to each patient.

Increase engagement and sense of ownership between end users and their spaces.

NEHES | e4h marmonmok ENVIRONMENTS FOR HEALTH ARCHITECTURE | iris

Applications for VR exist at every phase of a project, from the moment the contract is signed to the key turn over.

Schematic Design

Quickly **explore** concept options

Develop Client <u>Trust.</u> What you see, is really what you get.

Bridge gaps in <u>communication</u> between stakeholders and design team

VR Benefits in AEC

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Schematic Design

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Develop Client <u>Trust.</u> What you see, is really what you get.

Bridge gaps in <u>communication</u> between stakeholders and design team

Design Development

<u>Facilitate</u> internal reviews in True-To-Scale environment

Reduce built mock up costs

Receive critical <u>buy-in</u> and feedback from stakeholders

Quickly generate 360 panos to <u>share</u> progress reports through mobile devices

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Construction Documentation

Solve complex coordination issues by placing everyone within VR space

Evaluate the implications of value engineering in 3D

Identify collisions, conflicts and mistakes in an intuitive manner

Test modularized systems prior to fabrication for accuracy

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### Construction Administration

Onboard construction team to project design and intricacies with VR walkthroughs

Reduce change orders throughout the entire construction phase

Reduce time spent on-site solving minor coordination issues

Increase on-site safety by testing phases and maneuvers prior to implementation

Real World Phase Application & Benefit
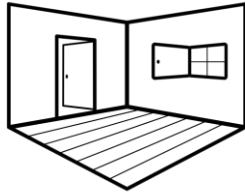
Scenario

Client requested **four** physical mocks up of the various **patient rooms** be constructed at scale.

Costs

Typical cost of physical mock up, range from $50,000 and higher.

Four rooms would cost $200,000.

VR Savings

VR can reduce the need for built mock ups.

If VR **reduced half** of the mock ups needed, it would **result in a savings of $100,000.**

NEHES | e4h | iris

VR Benefits in AEC

Real World Phase Application & Benefit

Scenario

Every project phase requires several team wide meetings.

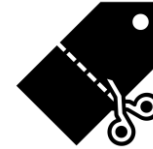For each consultant, the meeting is attended by 2 representatives.

If each phase has 3 meetings, lasting 4 hours…

Costs

At a rate of $150/hr per representative, each meeting is costing $1,200 to each consultant.

Over the course of 4 phases, a **minimum of $19,200 spent on meetings.**

VR Savings

VR can increase productivity during meetings and decrease their frequency.

If VR reduces meetings by half, **each consultant decreases spending by $9,600.**

- Overview of VR Technologies

- Real World Applications of VR

- Benefits

Virtual Reality & the Design of Healthcare Environments

Send us your thoughts & questions:

Mike Bennett, AIA - Boston, MA
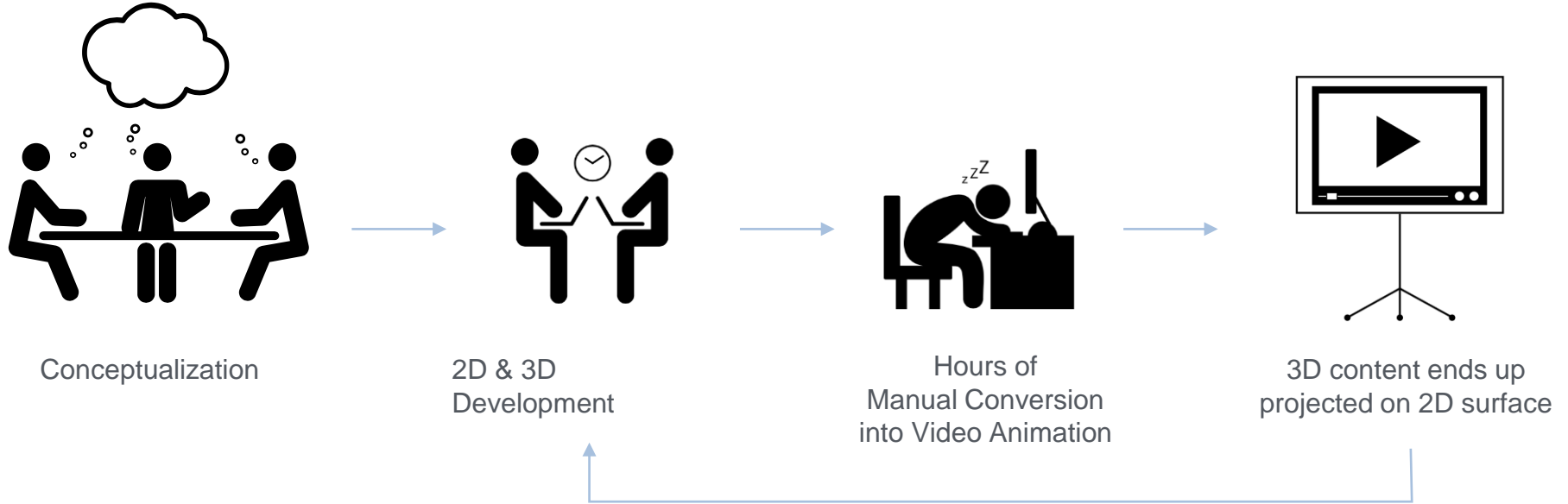**mbennett@e4harchitecture.com**

Ailyn Mendoza, ASLA - New York, NY
ailyn@irisvr.com

Image Credits: E4H Architecture, HMC Architects, Mortenson Construction, Marmon Mok HDR Minneapolis

Appendix

AEC Custom Workfow
Share, edit, and explore 3D files in VR

Conceptualization

2D & 3D
Development

Hours of
Manual Conversion
into Video Animation

3D content ends up
projected on 2D surface

NEW AEC Workflow
Share, edit, and explore 3D files in VR

Conceptualization

2D & 3D Development

~~Hours of~~
INSTANT AUTOMATIC
Conversion
into Virtual Reality Experience

3D Content seen as it is meant to be experienced