VALOR

VIRTUAL AND AUGMENTED LABORATORY FOR OBJECTIVE REALITIES

YEAR ONE REPORT

07.2019

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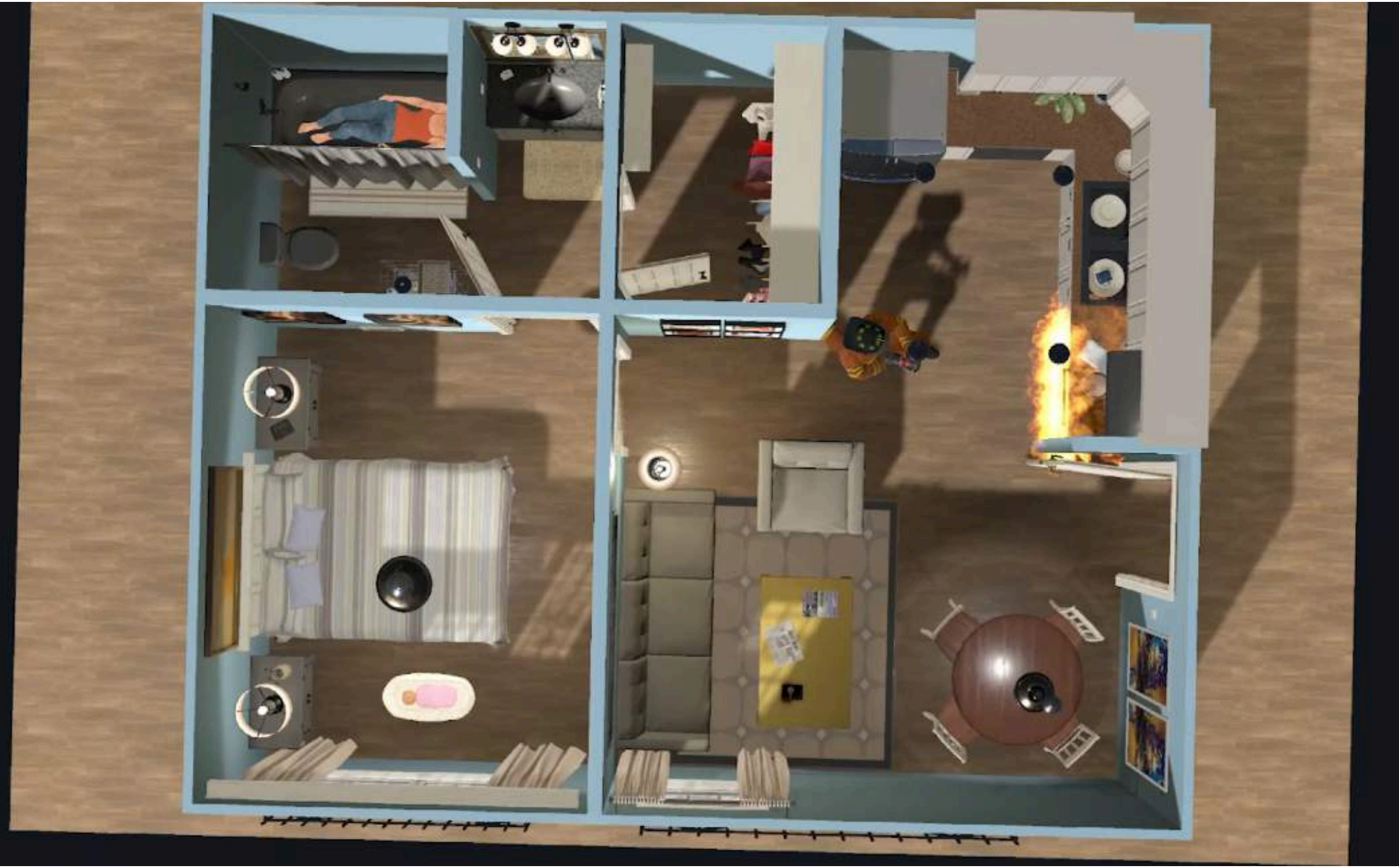
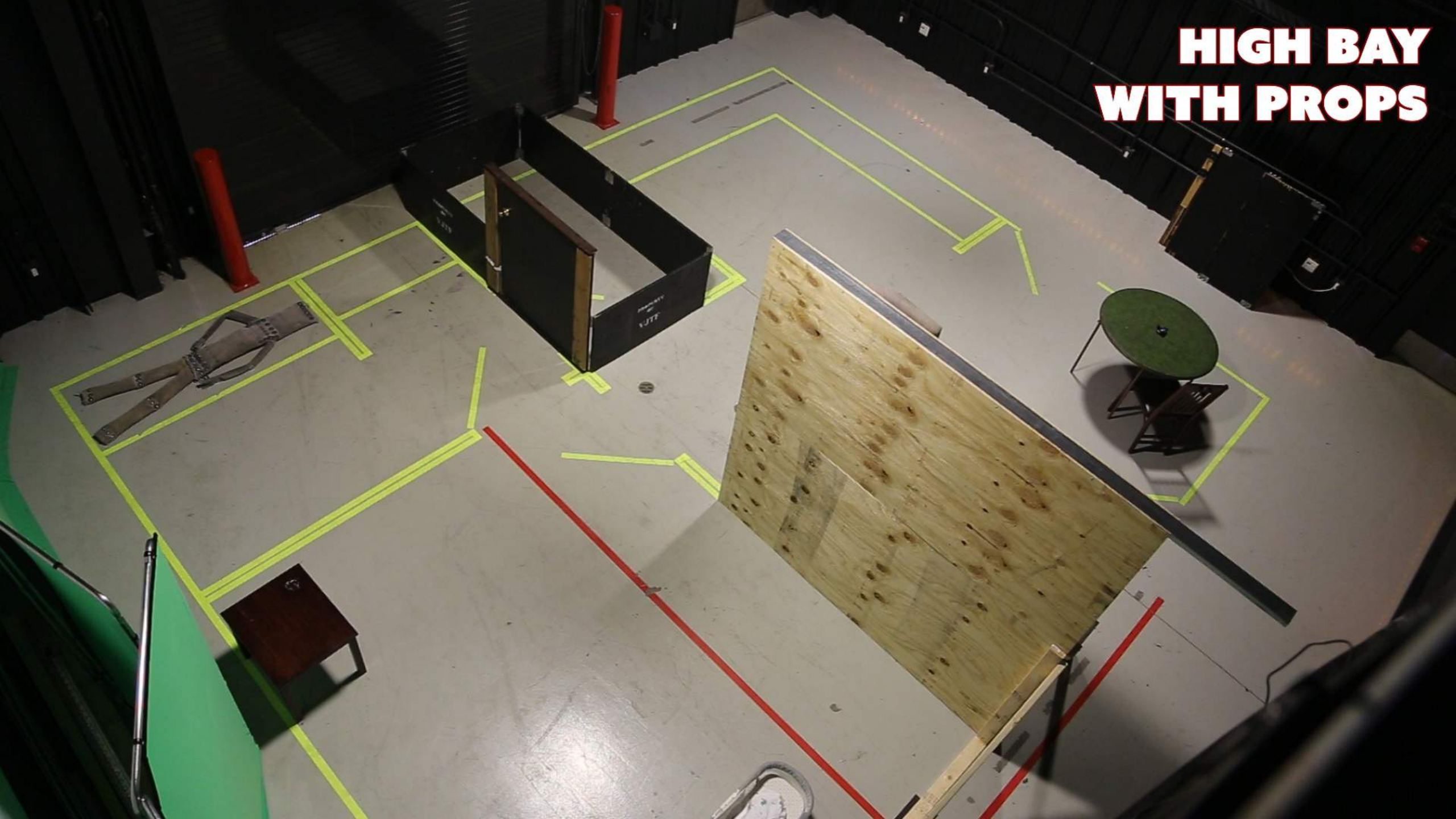
Val Jahnke Training Facility

TIMELAPSE
TAPING APARTMENT LAYOUT
ACCURATE TO 1/16"




HIGH BAY
WITH PROPS

VIRTUAL
APARTMENT
INSIDE HIGH BAY

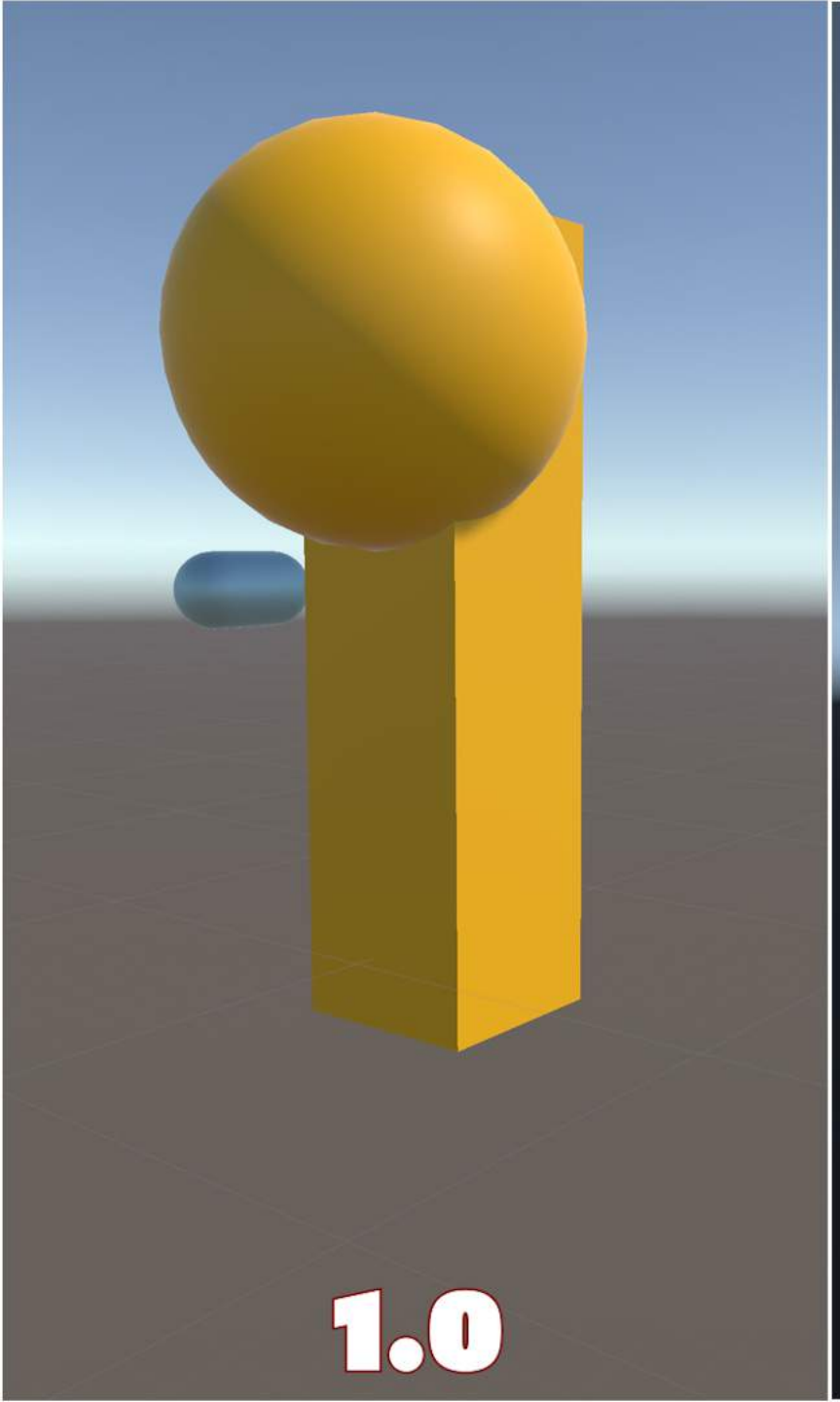
ALIGNMENT POST
ANCHORS POSITION AND ORIENTATION
OF THE VIRTUAL APARTMENT

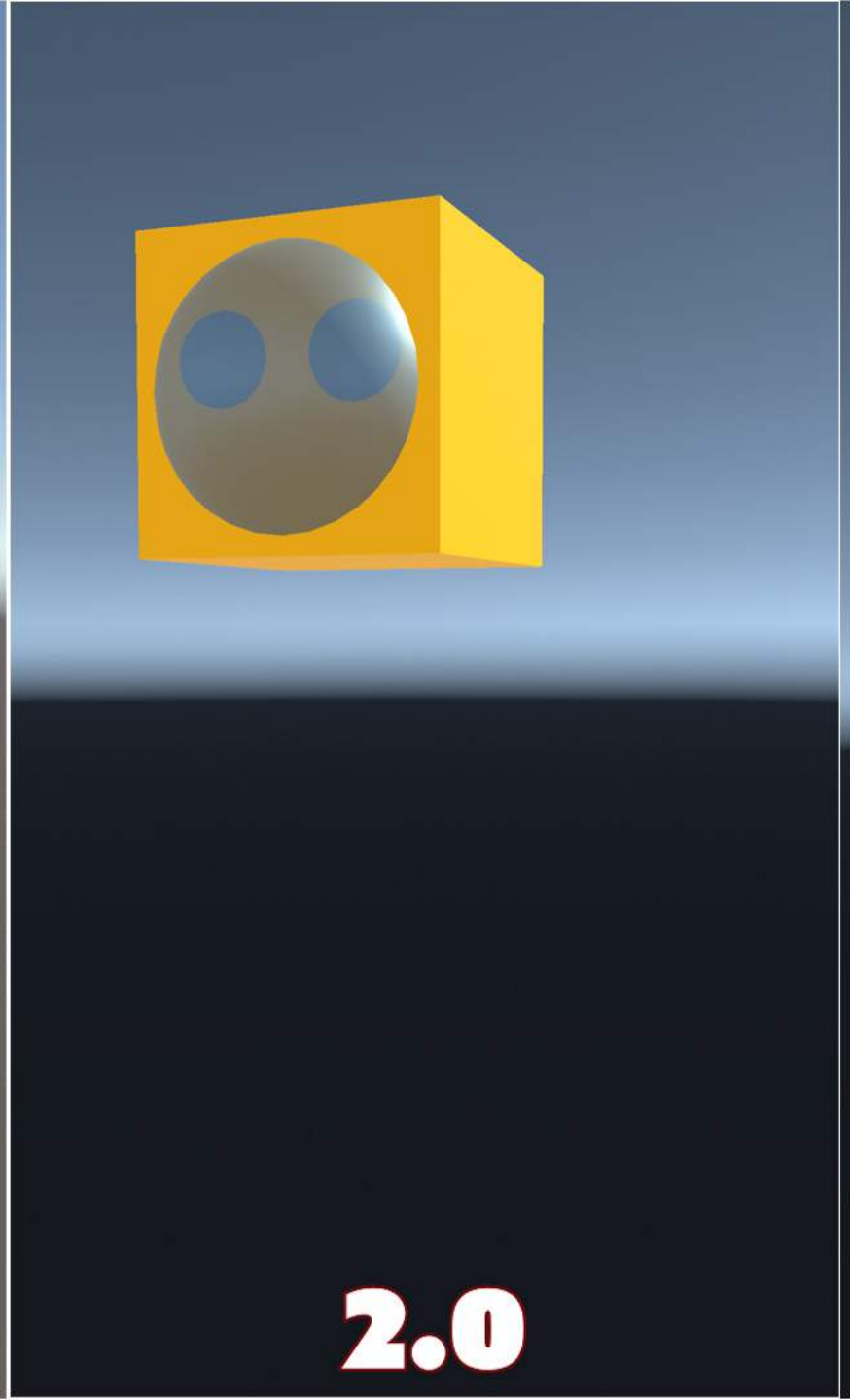
EACH COMPUTER
REQUIRES ITS
OWN TRACKER

THE FREEDOM TO EXPLORE
SAFELY IN THE VIRTUAL WORLD

TRACKED OBJECTS MOVED
IN THE REAL WORLD
UPDATE IN THE VIRTUAL

VIRTUAL UPDATES ARE
FLUID AND PERCEPTUALLY
INSTANTANEOUS


1.0


2.0

AVATAR
3.0

FULLY ARTICULATED AND TRACKED AVATAR

Motion Capture

Our state-of-the-art motion capture system records and tracks body position and movement

Integrated skeletal and 3D kinematic motion capture tracks human body interaction within the virtual training environment. This capture is essential to the delivery of correctly placed haptic experiences, and allows for professionals to lay down baselines users can compare against. Using motion capture in training improves motor skills by enabling haptic guidance and error augmentation based upon baselines from professionals or a user's own past tracked actions.

TESLASUIT

Biometrics

Our biometrics system monitors multiple vital data signals- enabling advanced health and performance data analysis

Teslasuit's integrated biometric system gathers real-time data from users while training - which can be used to relay emotional state, stress level, and key health indicators. This enables interactive VR/AR training content that adapts to the trainee for personalized experiences, and measurement of key baselines to understand improvement or degradation over time.

Haptic Feedback

Touch and force feedback, helping define actions and develop reflex

Teslasuit's full body haptic feedback system is built into the suit and can be engaged on actions, on demand, or in response to motion capture comparison. This feedback provides users with sensation and a sense of touch in virtual and augmented reality. This electro-stimulation improves the learning experience by increasing immersion, fostering 360-degree awareness, and engaging muscle memory.

TESLASUIT

THERMAL REGULATION
UP TO 104 DEGREES FAREHEIT (40C)

TESLASUIT

ELECTRO STIM SIMULATION OF A BULLET THROUGH THE SHOULDER

TESLASUIT

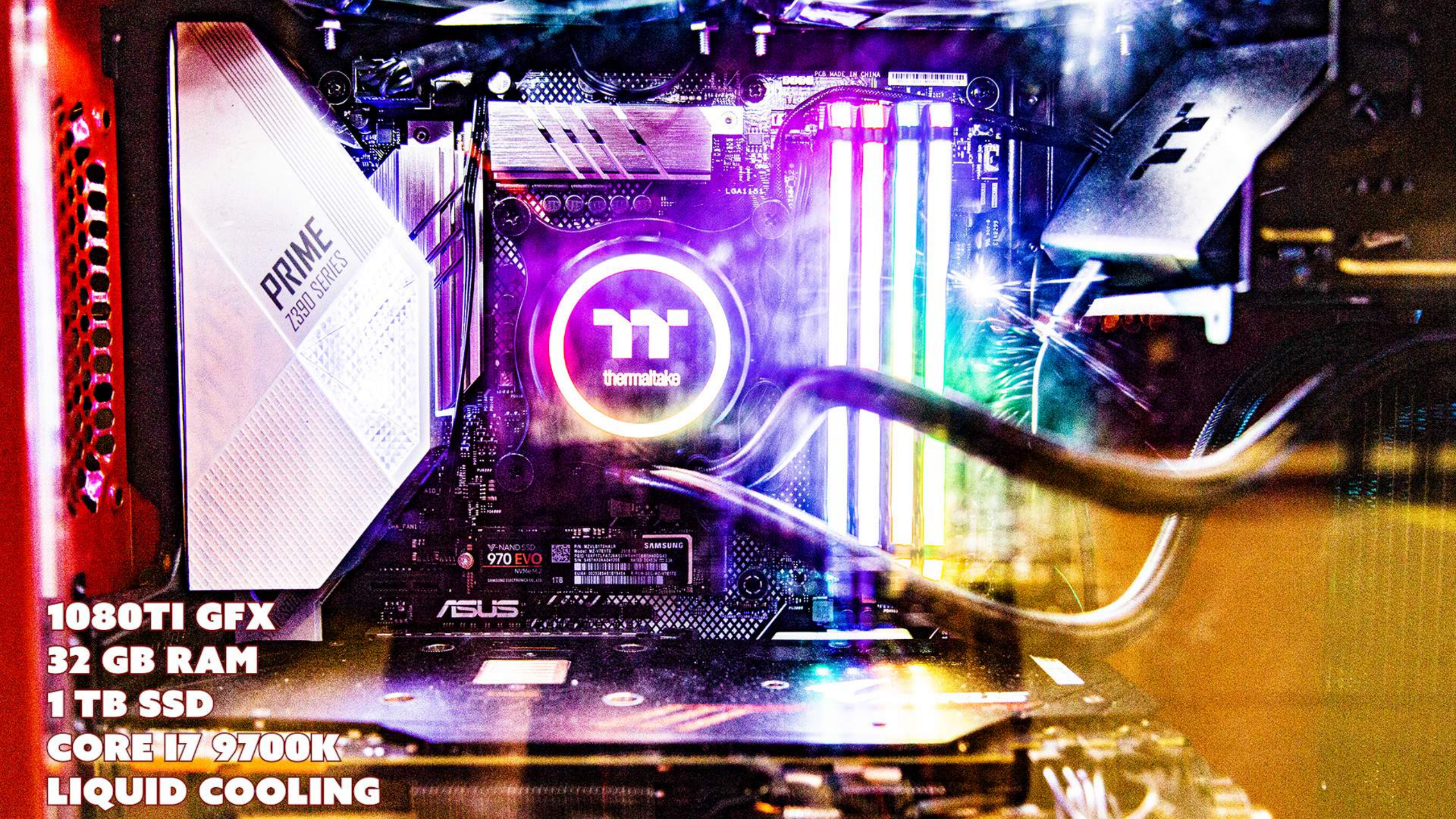
SLOW MOTION

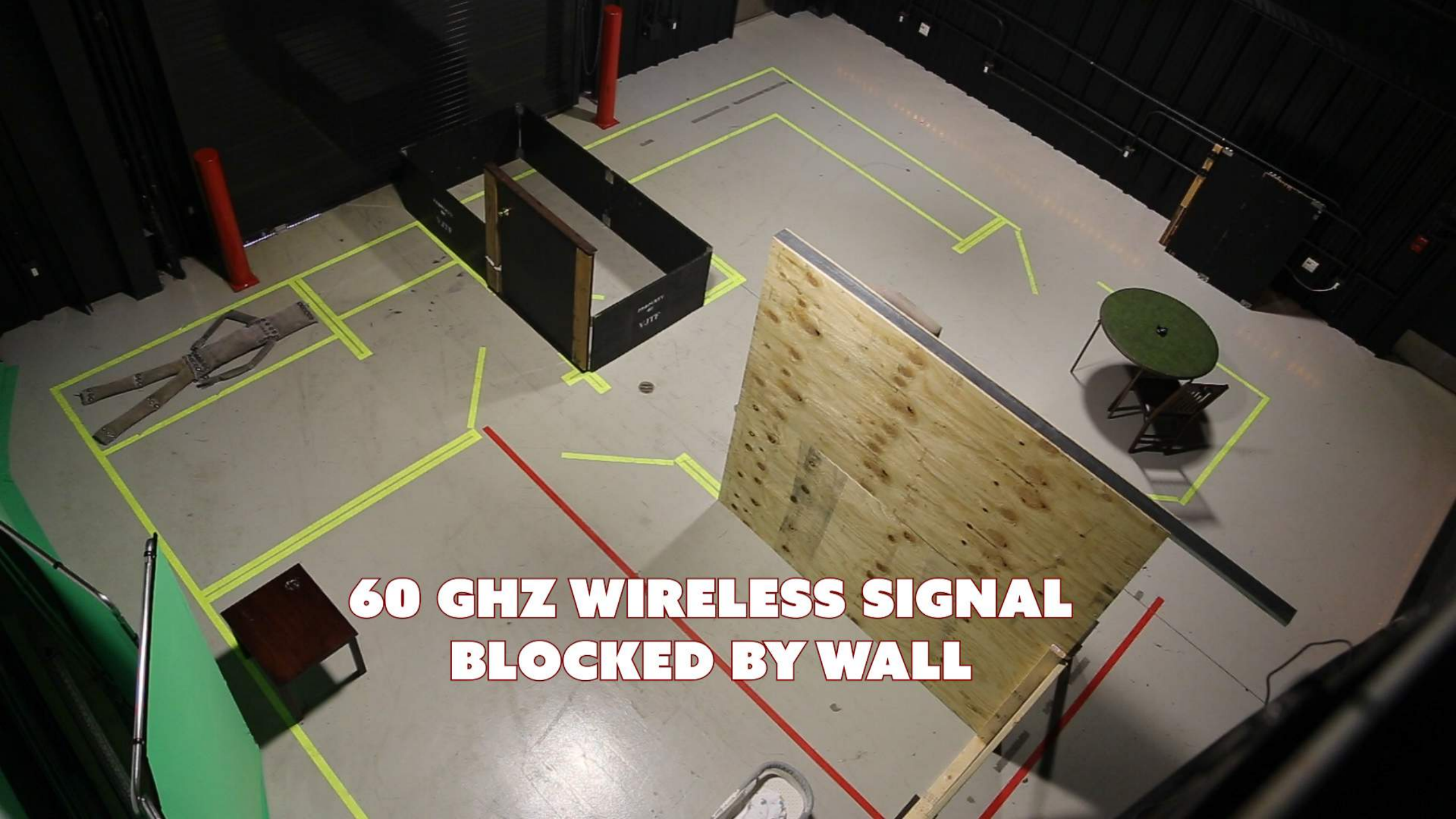
TESLASUIT

HARDWARE ACCESSORIES

WIRELESS VIVE PRO 2.0

NETWORKED HIGH PERFORMANCE COMPUTERS


PRIME
Z390 SERIES
thermaltake
ASUS
SAMSUNG
970 EVO
1080TI GFX
32 GB RAM
1 TB SSD
CORE I7 9700K
LIQUID COOLING


60 GHZ WIRELESS SIGNAL
BLOCKED BY WALL

TOO MANY DEAD ZONES IN
FULLY BUILT APARTMNENT

11 LBS
8 LBS
BACKPACK COMPUTER TO BE BUILT ON AIR TANK FRAME

TOOLS IN VR
VIVE CONTROLLER

TOOLS IN VR

CHICAGO
CUBS
FIRE STARTER

EXIT
TOOLS IN VR
THERMAL IMAGING CAMERA

TOOLS IN VR
HOSE NOZZLE

AKRON 1723
TRACKED HOSE NOZZLE

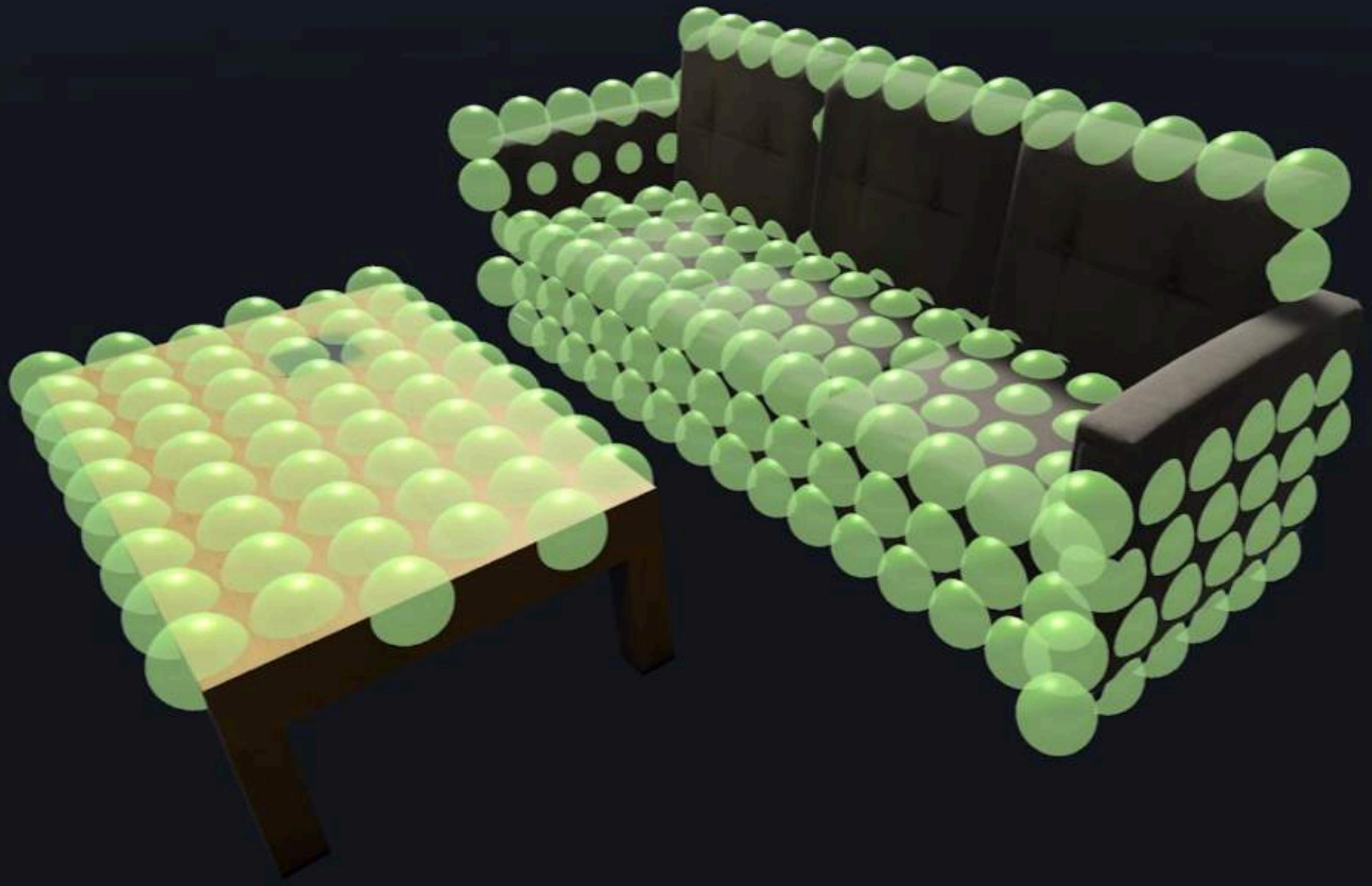
AKRON 1723
TRACKED HOSE NOZZLE

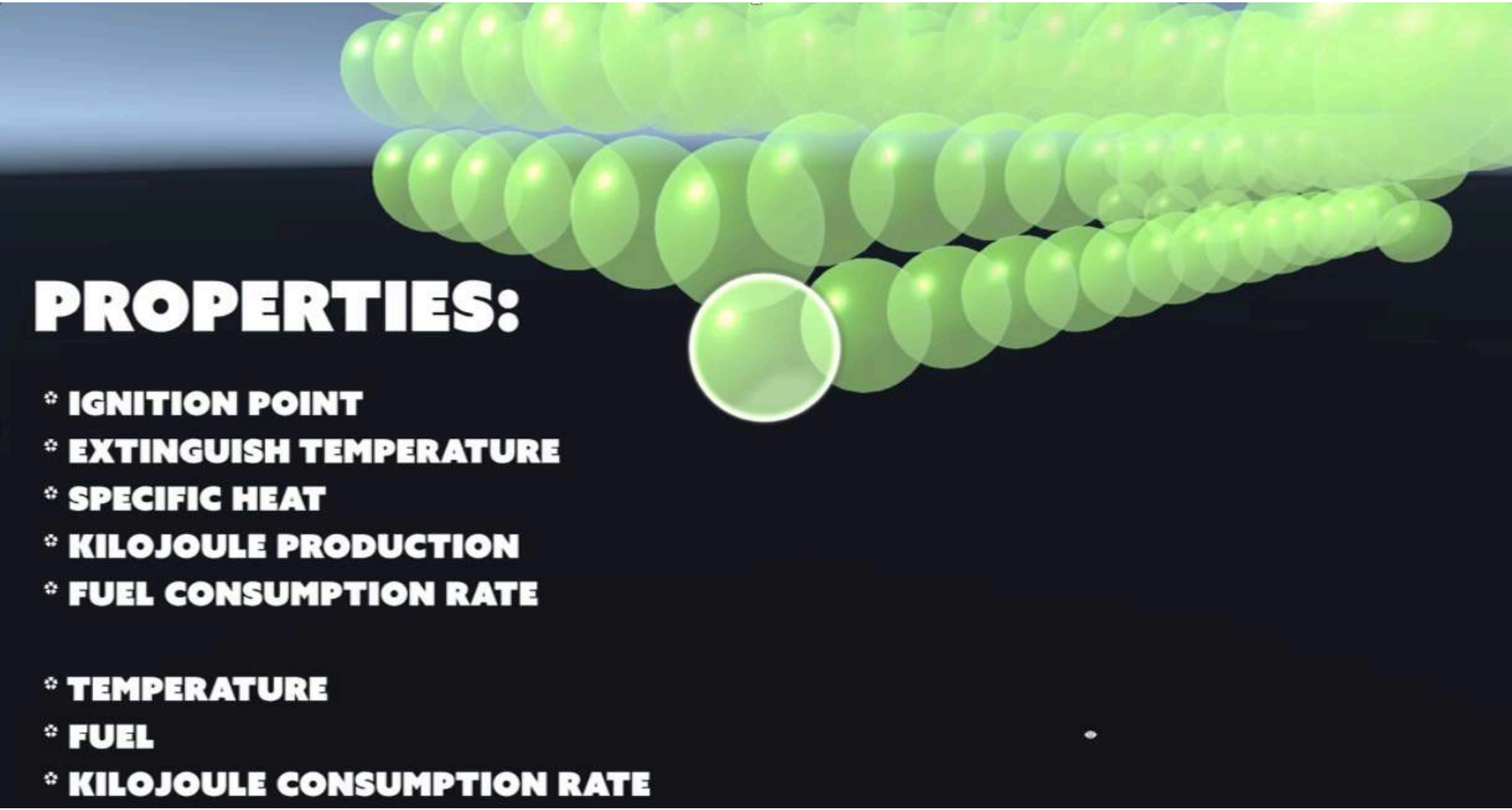
EARLY PROTOTYPE TESTING

DEBUG MODE
FLAMMABLE OBJECTS

DAILY NEWS
DEBUG MODE
FLAMMABLE SURFACES

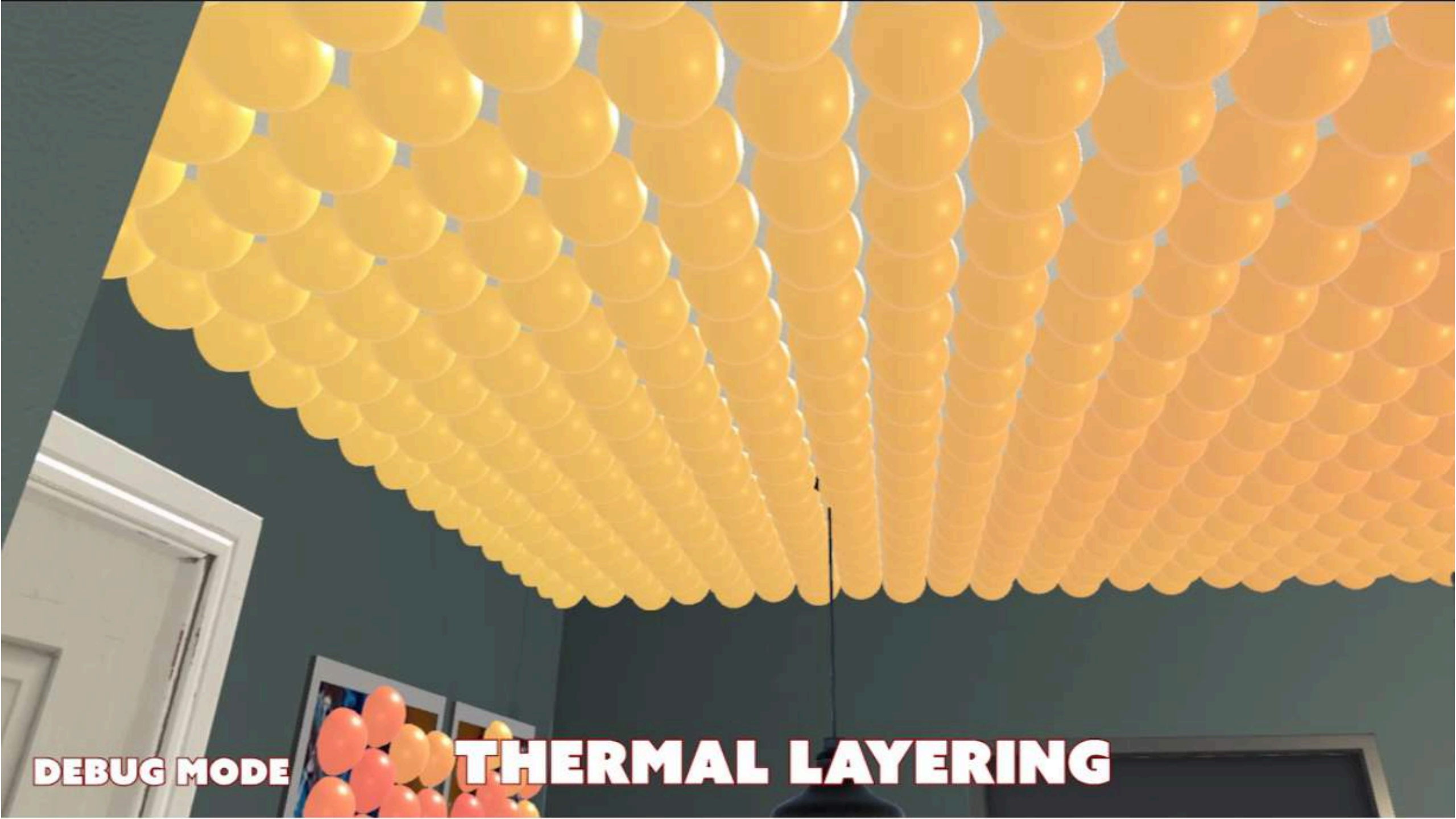
DAILY NEWS
DEBUG MODE
FLAMMABLE SURFACES




PROPERTIES:
IGNITION POINT
EXTINGUISH TEMPERATURE
SPECIFIC HEAT
KILOJOULE PRODUCTION
FUEL CONSUMPTION RATE
TEMPERATURE
FUEL
KILOJOULE CONSUMPTION RATE

FLAMMABLE CONNECTIONS:
CONDUCTIVE
RADIANT
CONVECTIVE
DEBUG MODE

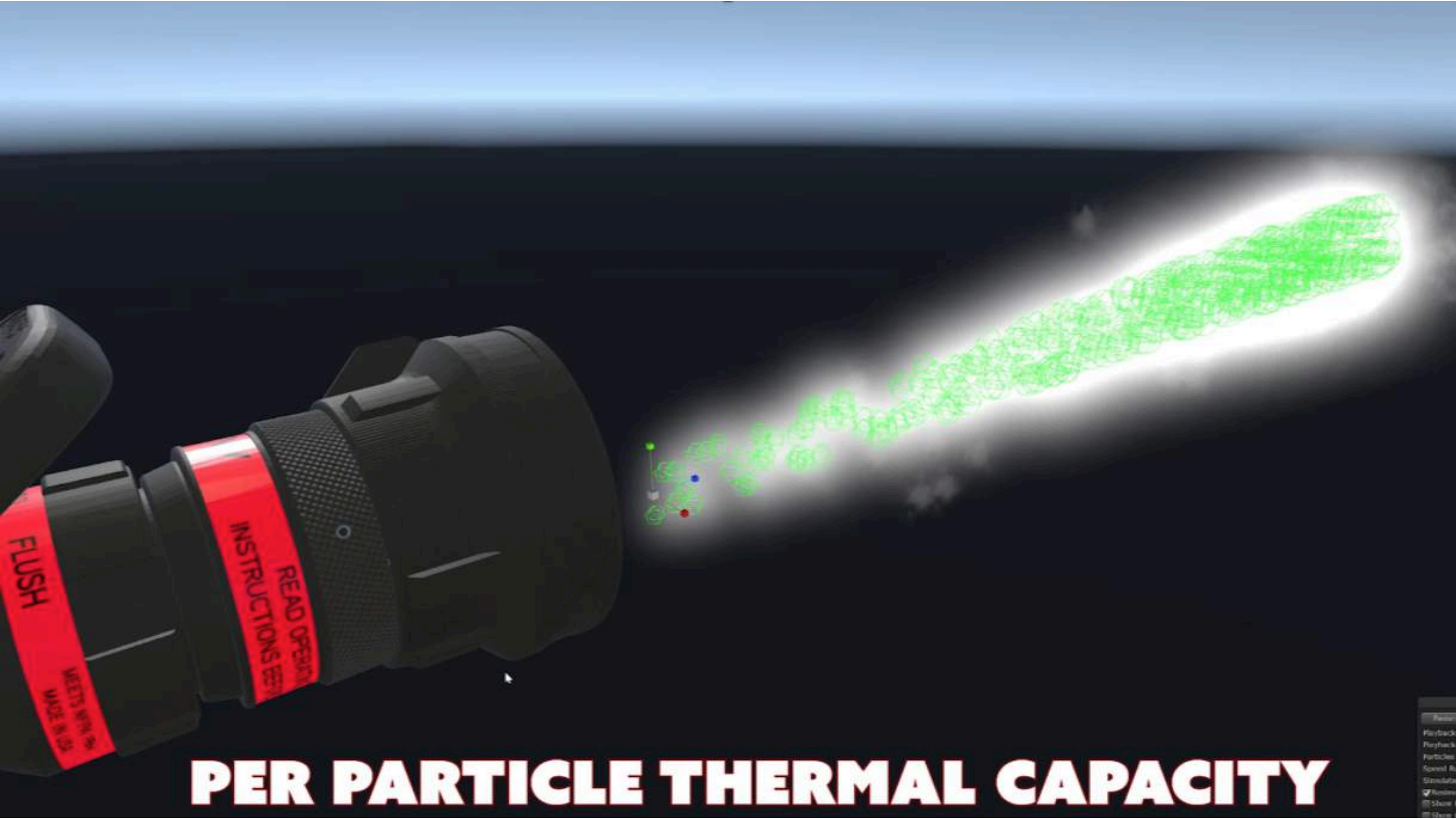
DEBUG MODE
FIRE PROPAGATION


DEBUG MODE
THERMAL LAYERING

FLASHOVER

SMOKE SIMULATION

RECORDING SIMULATIONS


FLUSH
READ OPERA
INSTRUCTIONS BEF
PER PARTICLE THERMAL CAPACITY

DAILY NEWS

DB Browser for SQLite - F:\Project_Files\VALOR\Reports\2019AnnualConference\DatabaseFiles\06-20-19_16-10-10_VALOR_Session.sqlite

File Edit View Help

New Database | Open Database | Write Changes | Revert Changes

SQLITE DATABASE TRACKERS

Database Structure | Browse Data | Edit Pragmas | Execute SQL

Table: TrackerDataDB

	Key	Frame	IsLocalPlayer	Name	XPos	YPos	ZPos	XRot	YRot	ZRot	WRot	IsSer
	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter
1	62756	0	NULL	Camera (eye)	-1189.0	1523.0	-4432.0	85	135	118	8	0
2	62757	0	NULL	DeviceTrackerRight	-1127.0	1142.0	-4199.0	105	119	71	238	0
3	59268	1	NULL	MRCameraTracker	-1870.0	1143.0	-5086.0	127	127	127	254	1
4	59269	1	NULL	Camera (eye)	-1877.0	1607.0	-3040.0	133	64	126	237	1
5	59270	1	NULL	DeviceTrackerRight	-1893.0	1227.0	-2644.0	81	97	108	240	1
6	59271	1	NULL	DeviceTrackerLeft	-2270.0	1284.0	-2869.0	81	77	109	232	1
7	62758	1	NULL	Camera (eye)	-1180.0	1525.0	-4430.0	85	129	119	7	0
8	62759	1	NULL	DeviceTrackerRight	-1093.0	1154.0	-4193.0	99	122	66	235	0
9	59272	2	NULL	MRCameraTracker	-1870.0	1143.0	-5086.0	127	127	127	254	1
10	59273	2	NULL	Camera (eye)	-1878.0	1607.0	-3040.0	134	64	127	237	1
11	59274	2	NULL	DeviceTrackerRight	-1893.0	1223.0	-2645.0	81	97	109	240	1
12	59275	2	NULL	DeviceTrackerLeft	-2269.0	1276.0	-2868.0	81	78	110	233	1
13	62760	2	NULL	Camera (eye)	-1176.0	1529.0	-4432.0	87	127	120	7	0
14	62761	2	NULL	DeviceTrackerRight	-1078.0	1153.0	-4191.0	95	126	79	240	0
15	59276	3	NULL	MRCameraTracker	-1870.0	1143.0	-5086.0	127	127	127	254	1
16	59277	3	NULL	Camera (eye)	-1877.0	1605.0	-3038.0	135	65	127	237	1
17	59278	3	NULL	DeviceTrackerRight	-1894.0	1220.0	-2647.0	81	97	109	240	1
18	59279	3	NULL	DeviceTrackerLeft	-2267.0	1278.0	-2871.0	79	78	111	233	1
19	62762	3	NULL	Camera (eye)	-1178.0	1536.0	-4434.0	90	128	121	6	0
20	62763	3	NULL	DeviceTrackerRight	-1048.0	1149.0	-4199.0	85	136	100	243	0
21	59280	4	NULL	MRCameraTracker	-1870.0	1143.0	-5086.0	127	127	127	254	1
22	59281	4	NULL	Camera (eye)	-1879.0	1603.0	-3037.0	136	65	127	237	1
23	59282	4	NULL	DeviceTrackerRight	-1895.0	1217.0	-2648.0	81	97	109	240	1
24	59283	4	NULL	DeviceTrackerLeft	-2262.0	1281.0	-2875.0	77	80	111	233	1

Table: FireNodeArrayDataDB

	Key	Frame	FireNodes
	Filter	Filter	Filter
1	9084	1	*BLOB*

SQLITE DATABASE
FIRE NODE BIT ARRAY

Edit Database Cell

Mode: Binary | Import | Export | Set as NULL

```
0000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0010 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0020 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0040 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00a0 00 00 00 00 00 00
```

Edit Database Cell

Mode: Binary | Import | Export | Set as NULL

```
0000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0010 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0020 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0040 00 00 00 00 00 00 00 00 00 00 08 00 00 00 00 00
0050 00 00 00 00 00 00 00 80 60 00 00 00 00 00 00 00
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00a0 00 00 00 00 00 00
```

Edit Database Cell

Mode: Binary | Import | Export | Set as NULL

```
0000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0010 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0020 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0040 00 00 00 00 00 00 00 00 00 00 20 00 08 00 06 80
0050 00 00 00 00 00 00 00 e7 f1 00 00 00 00 00 00 00
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00a0 00 00 00 00 00 00
```

Edit Database Cell

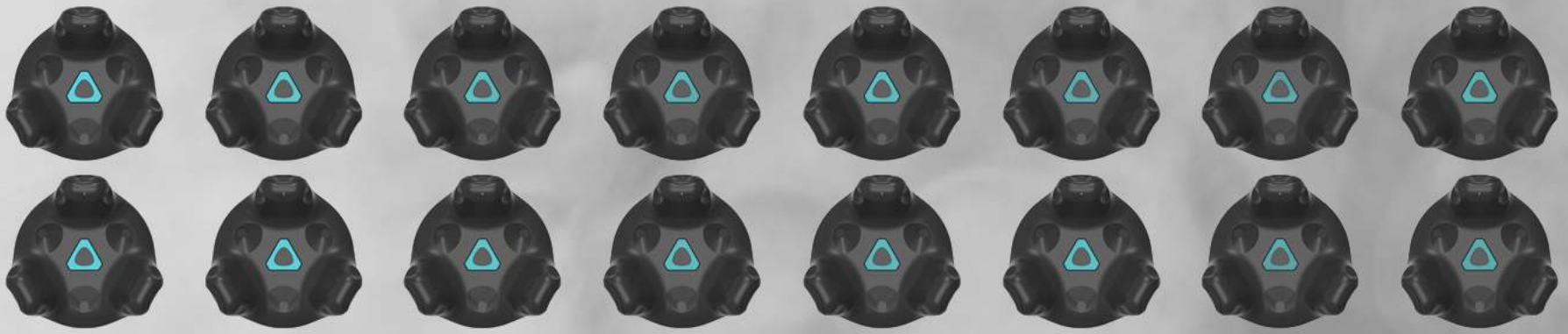
Mode: Binary | Import | Export | Set as NULL

```
0000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0010 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0020 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0040 00 00 00 00 00 00 00 80 01 e0 00 18 00 06 80
0050 00 08 00 00 00 00 be ff f3 01 00 00 20 00
0060 00 00 00 00 40 00 00 00 00 00 00 00 00 00 00
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00a0 00 00 00 00 00 00
```

Edit Database Cell

Mode: Binary | Import | Export | Set as NULL

```
0000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0010 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0020 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0040 00 00 00 00 00 00 00 80 0f e0 03 f8 00 7e 80
0050 03 78 00 00 00 00 fe ff fb fd 80 1f e0 03
0060 3b 01 10 00 fe ff ff 01 00 00 00 1c 84 30
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00a0 00 00 00 00 00 00
```



TRACKERS, HEADSETS, CONTROLLERS (POSITION & ORIENTATION)

DATA POINTS

- TIME STAMPED
- STORED 10 TIMES PER SECOND

FULL BODY IMU TRACKING DATA

EYE TRACKING

BIOMETRICS

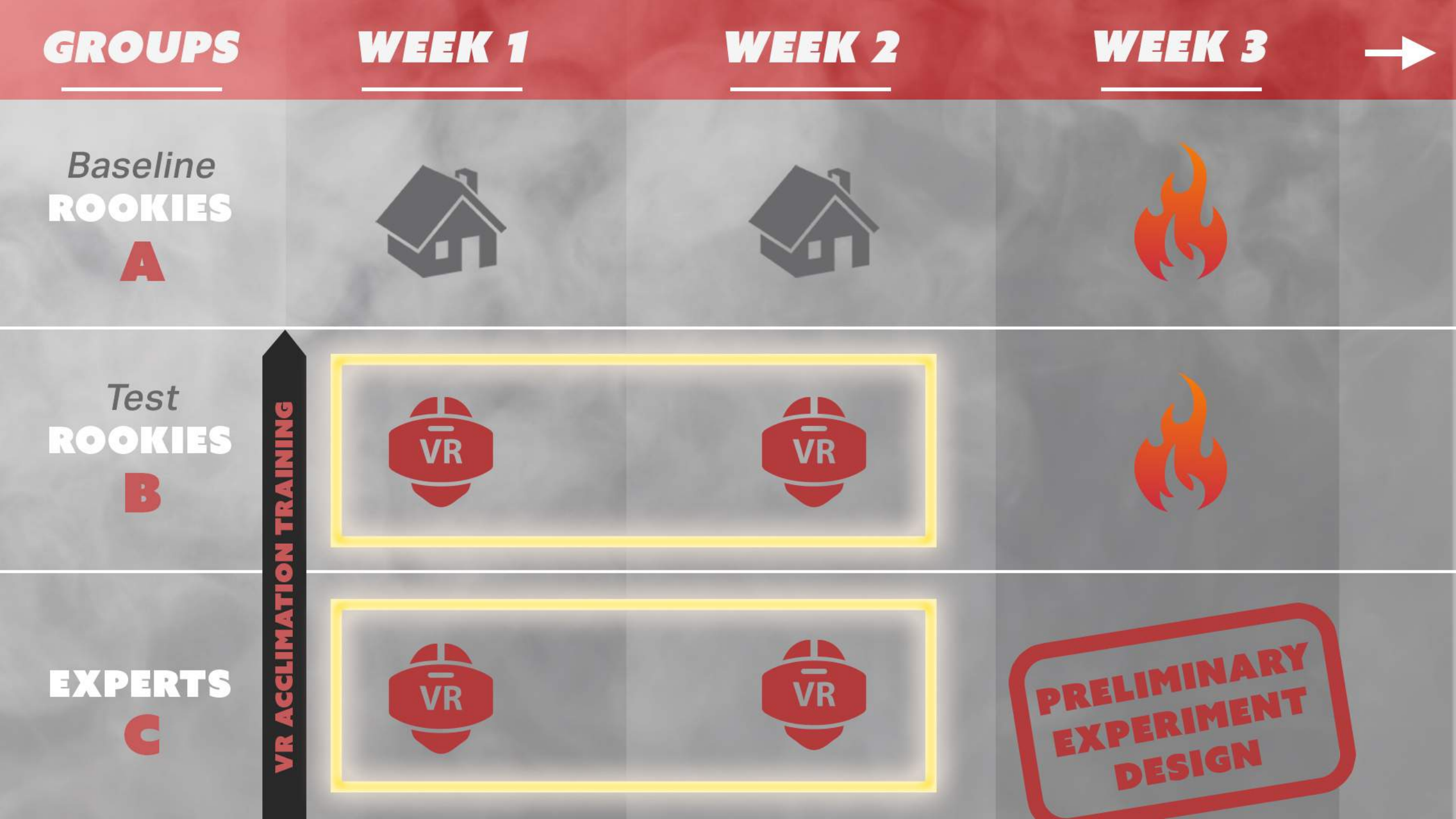
FIRE STATUS

EVENTS

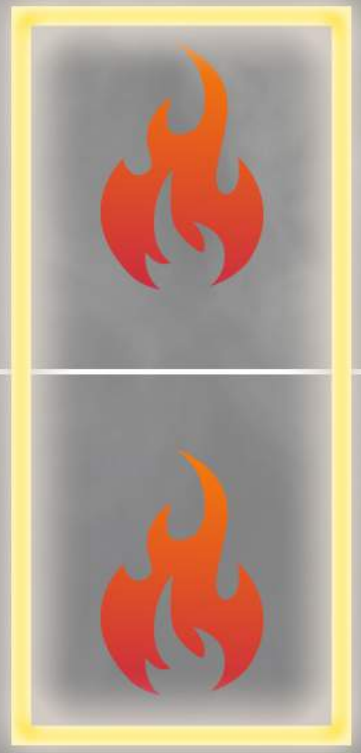
GROUPS	WEEK 1	WEEK 2	WEEK 3
Baseline ROOKIES A			
Test ROOKIES B			
EXPERTS C			PRELIMINARY EXPERIMENT DESIGN

VR ACCLIMATION TRAINING

GROUPS
WEEK 1
WEEK 2
WEEK 3
Baseline
ROOKIES
A
Test
ROOKIES
B
EXPERTS
C
VR ACCLIMATION TRAINING
VR
VR
VR
VR
PRELIMINARY EXPERIMENT DESIGN


GROUPS
WEEK 1
WEEK 2
WEEK 3
Baseline
ROOKIES
A
Test
ROOKIES
B
EXPERTS
C
VR ACCLIMATION TRAINING
VR
VR
VR
VR
PRELIMINARY EXPERIMENT DESIGN

GROUPS
WEEK 1
WEEK 2
WEEK 3
Baseline
ROOKIES
A
Test
ROOKIES
B
EXPERTS
C
VR ACCLIMATION TRAINING
VR
VR
VR
VR
PRELIMINARY EXPERIMENT DESIGN

GROUPS	WEEK 1	WEEK 2	WEEK 3
Baseline ROOKIES A			
Test ROOKIES B			
EXPERTS C			

VR ACCLIMATION TRAINING

PRELIMINARY EXPERIMENT DESIGN

DEFINITIONS

32 ROOKIES <

- 16 BASELINE
- 16 TEST GROUP

5

PRELIMINARY EXPERIMENT DESIGN

16 EXPERTS >

20

=

5 SCENARIOS

3 MIN. EACH

SCENARIO MANIPULATORS

DEMOGRAPHIC DATA

PRELIMINARY EXPERIMENT DESIGN

- AGE
- GENDER
- # OF YEARS ON THE JOB
- # FIRES MADE
- # MULTI-ALARM FIRES
- FORMAL EDUCATION LEVEL
- FIRE FIGHTER TRAINING LEVEL
- PRIOR EXPERIENCE WITH VR

PRIMARY
PERFORMANCE MEASURES

TASK COMPLETION TIME

TASK ERRORS

COGNITIVE LOAD

SITUATIONAL AWARENESS

- PERCEPTION
- COMPREHENSION
- PROJECTION

PRELIMINARY EXPERIMENT DESIGN

TEAM PERFORMANCE

PHYSICAL EXERTION

FATIGUE

STRESS

EMOTION AROUSAL

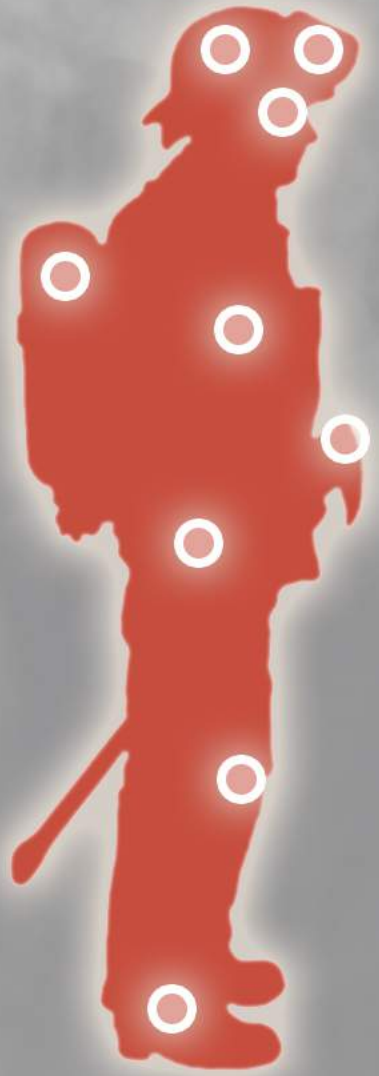
PRELIMINARY EXPERIMENT DESIGN

SECONDARY PERFORMANCE MEASURES

DATA COLLECTION

- DEBRIEF
- SURVEY/SELF REPORT
- EVENT SEQUENCE TRACKING
- EYE TRACKING
- PUPIL DILATION
- LOCATION/POSE
- GROSS MOTOR MOVEMENTS
- HEART RATE
- BLOOD/MUSCLE OXYGENATION
- RESPIRATION RATE
- SKIN CONDUCTANCE
- CORE BODY TEMP
- SKIN TEMP
- BLOOD PRESSURE

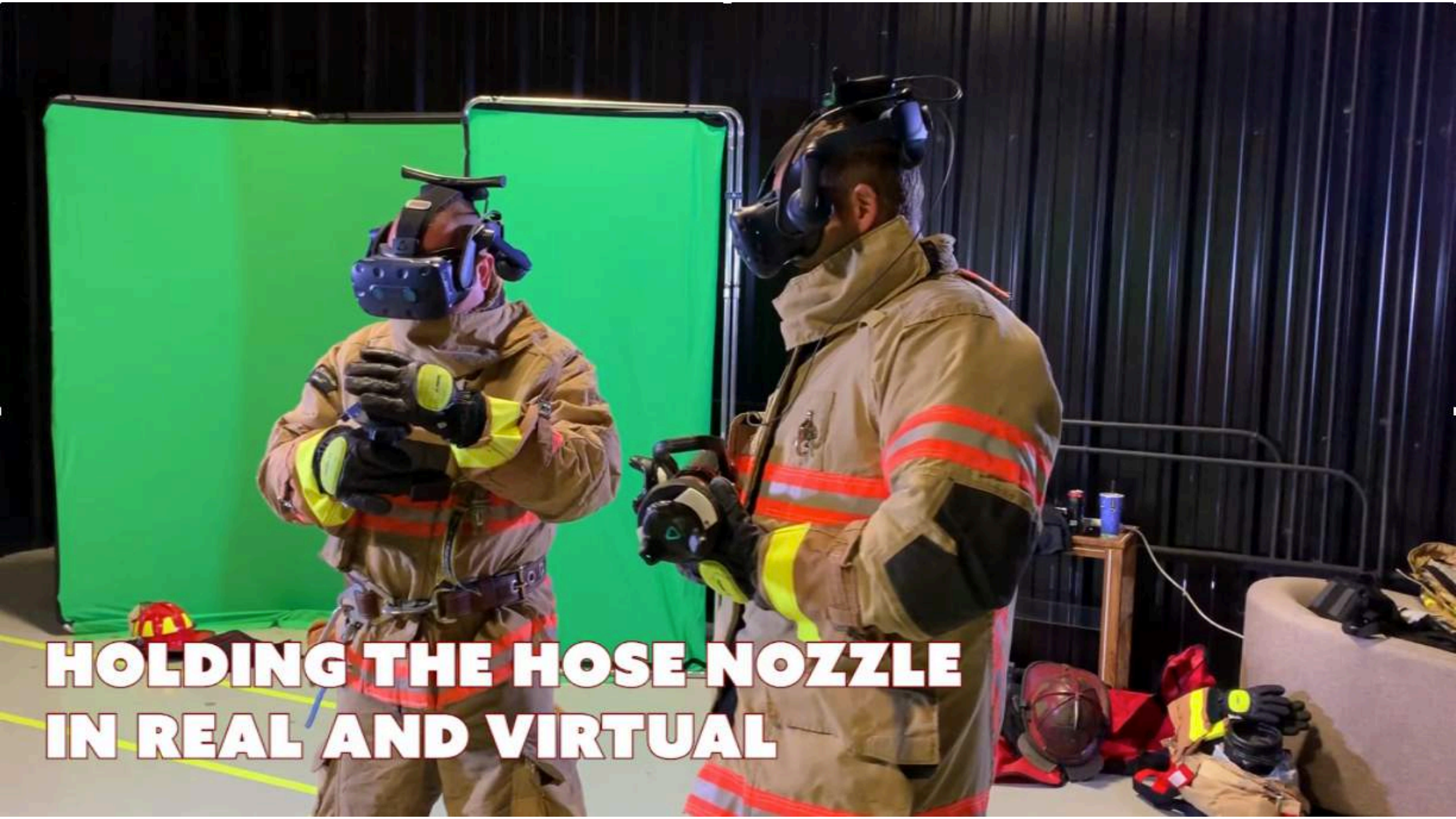
PRELIMINARY EXPERIMENT DESIGN



GOING LIVE
TESTING THE SIMULATION

PUTTING ON THE HEADSET
FOR THE FIRST TIME

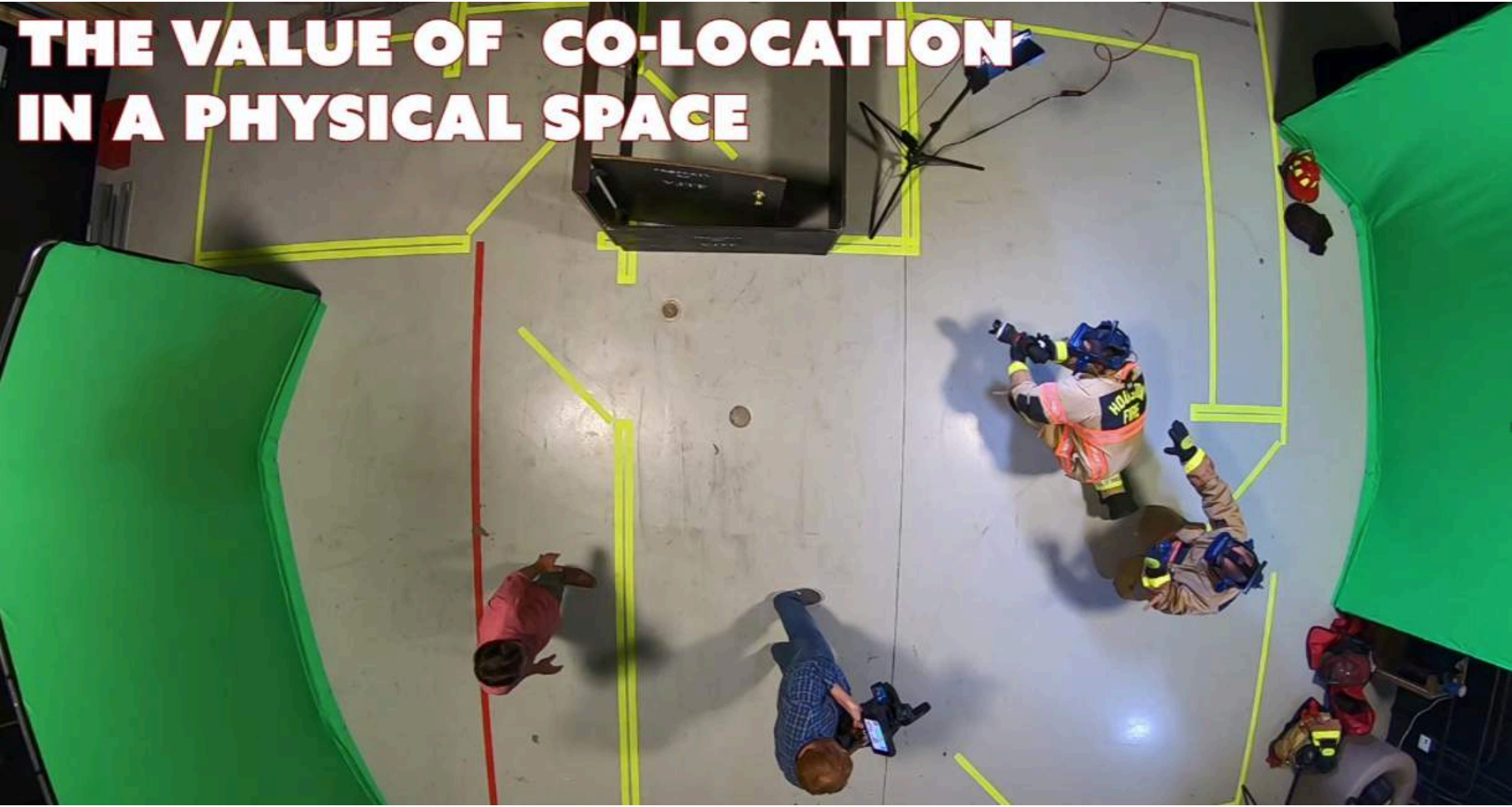
LOOKING AROUND AT
THE VIRTUAL WORLD


HOLDING THE HOSE NOZZLE
IN REAL AND VIRTUAL

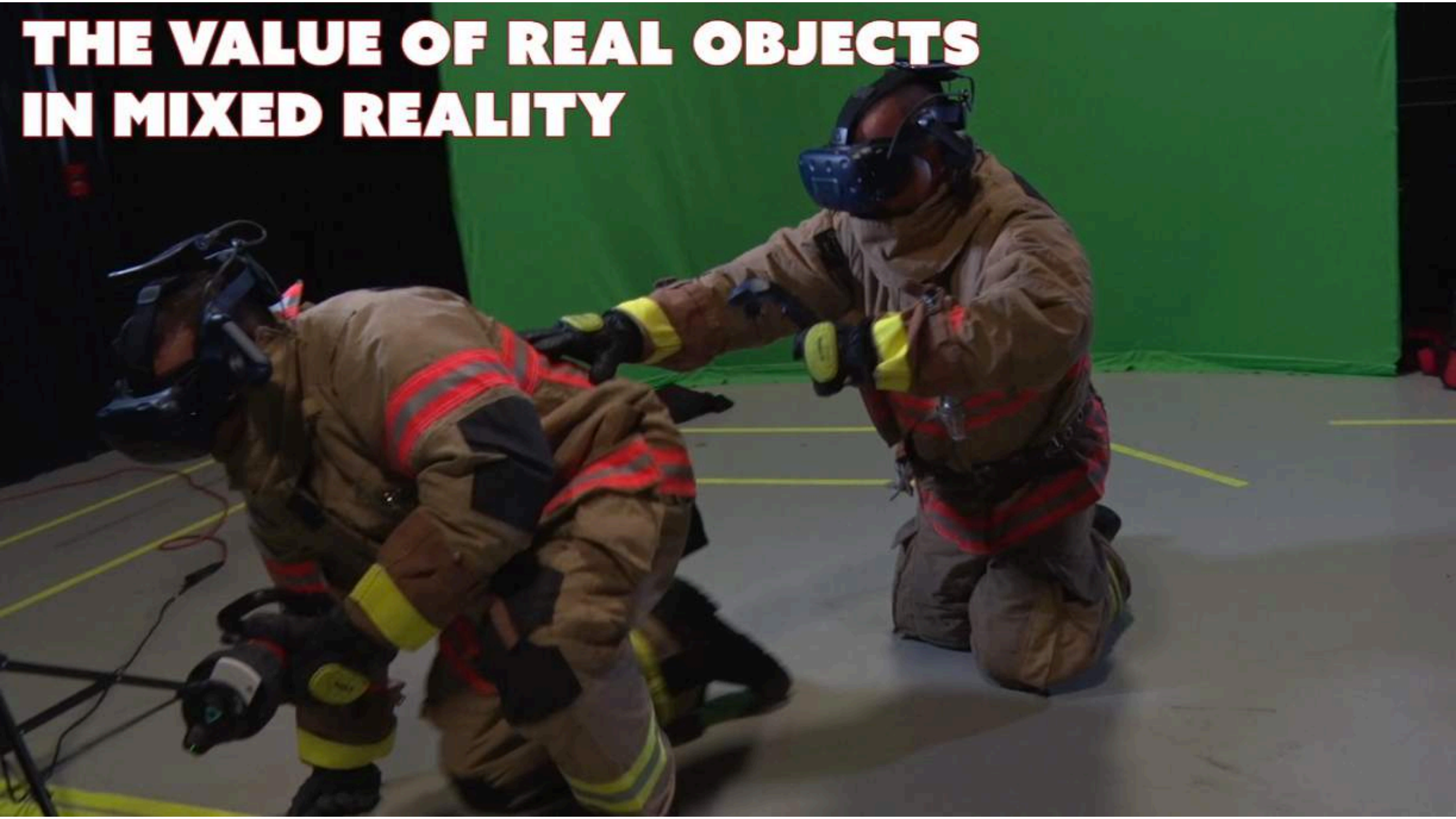
EXIT
LEARNING THE
HOSE NOZZLE CONTROLS

LIVE SIMULATION

THE VALUE OF CO-LOCATION IN A PHYSICAL SPACE



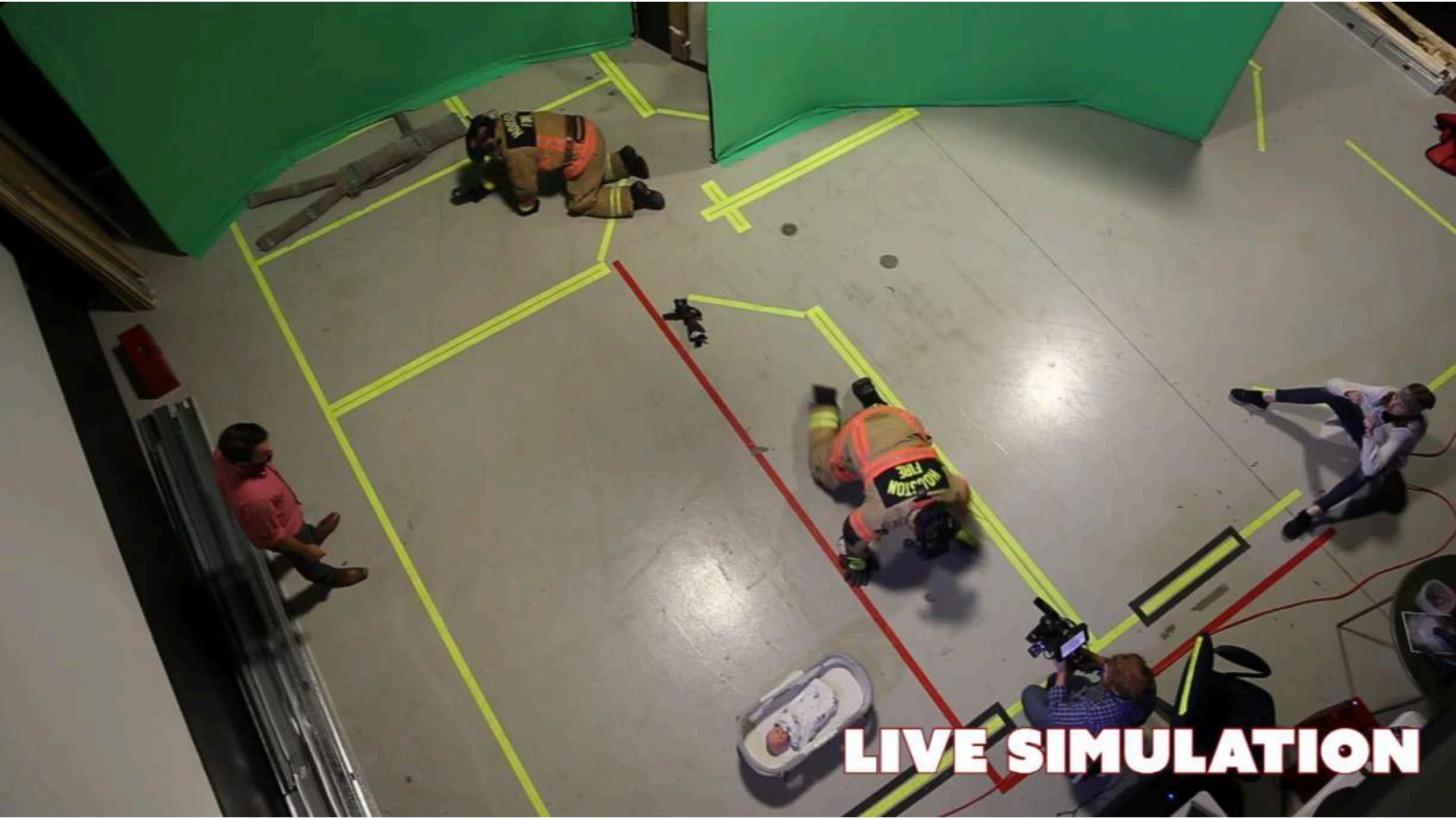
THE VALUE OF REAL OBJECTS IN MIXED REALITY

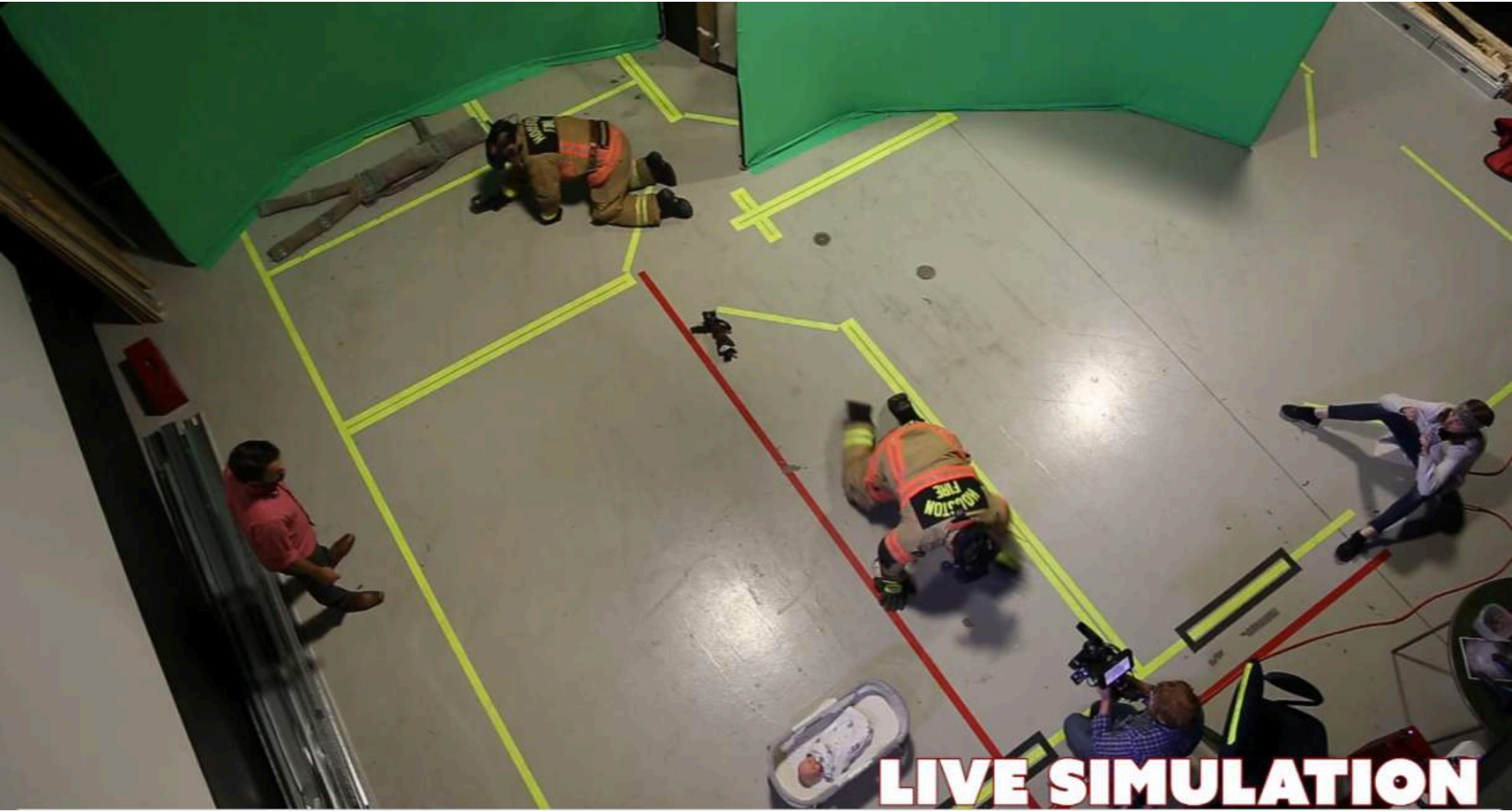


THE VALUE OF REAL OBJECTS IN MIXED REALITY

PROPERTY OF
VJTF
PROPERTY OF
VJTF
LIVE SIMULATION

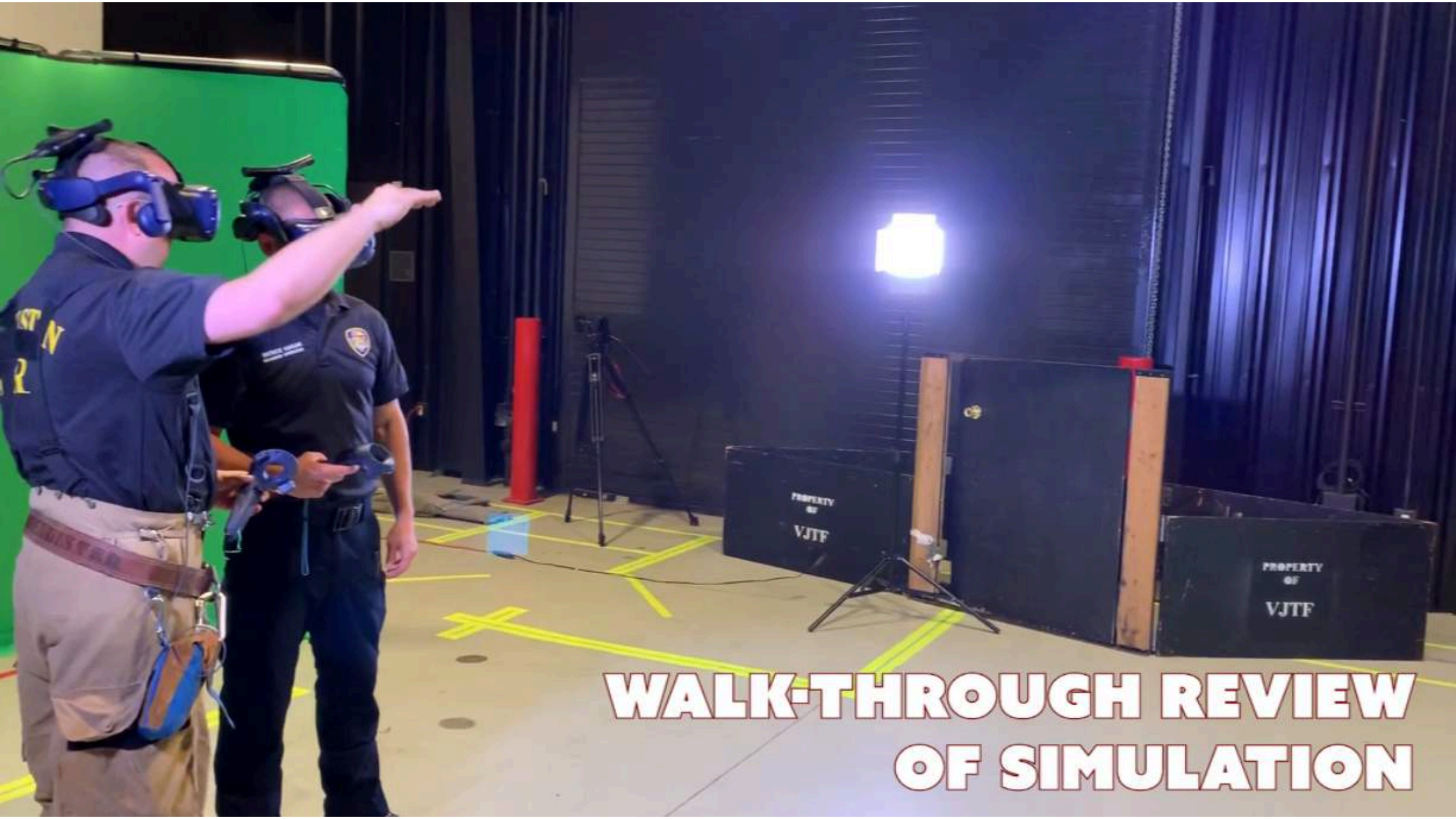
PROPERTY OF
VJTF
PROPERTY OF
VJTF
LIVE SIMULATION


LIVE SIMULATION

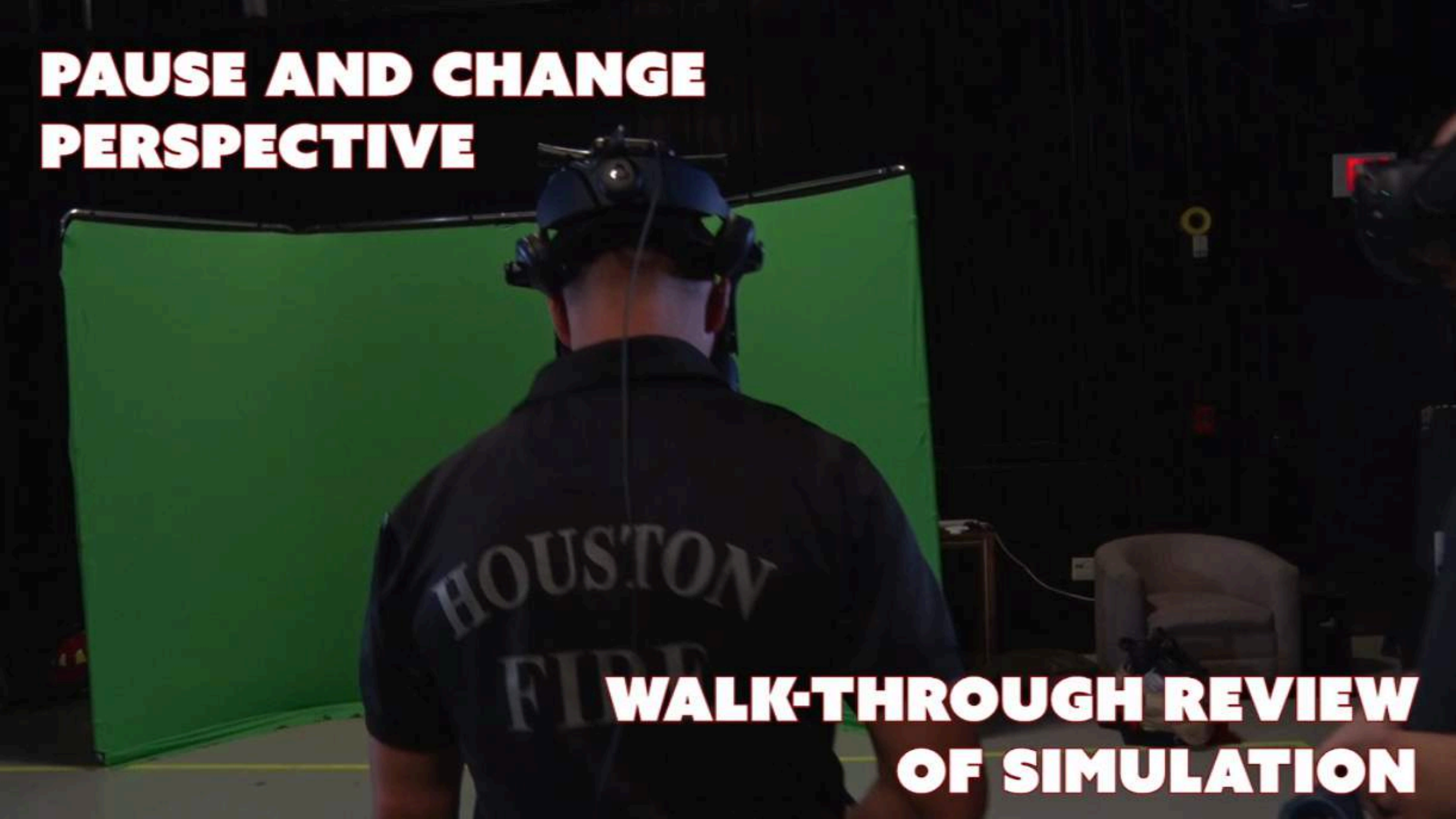

LIVE SIMULATION

RESCUING IS
A PHYSICAL ACTION
LIVE SIMULATION

INDUCING PANIC



WALK-THROUGH REVIEW OF SIMULATION


PAUSE AND CHANGE PERSPECTIVE
HOUSTON
WALK-THROUGH REVIEW OF SIMULATION

CLASS A BURN BUILDING

ALPHA (CAPTAIN)

NOTE

Example external life safety need: humans hanging out of windows

☐ 2 Report hazards, fire location and immediate external life safety needs

3 Any external life safety needs? ○ Yes ○ No

If YES then do the following?

☐ 1 Perform 4536 Process External Life Safety Need

▼ **Step 2. Assemble**

☐ 1 Wait for team to assemble at doorway

▼ **Step 3. Ingress dwelling**

☐ 1 Verify hose operational and water available

⚠CAUTION

caution: opening door can provide oxygen to heated inside air, causing a backdraft

BRAVO (FF 1)

▼ **Step 1. Assess the property**

☐ 1 Wait for Alpha to complete the external scan.

2 Any external life safety needs? ○ Yes ○ No

If YES then do the following?

☐ 1 Perform 4536 Process External Life Safety Need

▼ **Step 2. Assemble**

☐ 1 ● *Wait for operator to open the water supply lineinstruction here to coordinate*

☐ 2 Secure hose and nozzle

☐ 3 Pull line to doorway

☐ 4 Bleed line as necessary

▼ **Step 3. Ingress dwelling**

☐ 1 Wait for TIC scan by Alpha

CHARLIE (FF 2)

4 Human detected? ○ Yes ○ No

If YES then do the following?

☐ 1 Perform 1890 Rescue Human From Dwelling Charlie (firefighter 2)

▼ **Step 4. Advance to hallway**

☐ 1 Follow Alpha to hallway

2 Human detected? ○ Yes ○ No

If YES then do the following?

☐ 1 Perform 2755 Rescue human from dwelling Alpha (Captain)

▼ **Step 5. Advance to kitchen**

☐ 1 Follow Alpha to kitchen

▼ **Step 6. Exit Dwelling**

☐ 1 Follow Alpha

PRIDE: TASK PLANNING, TRACKING, & CONTROL

BASIC AR HUD OVERLAY FROM PRIDE

LIVE PRIDE TASK MANAGEMENT

PRIDE Procedure

Exit Procedure | Run Automation | Mark Automation | Set Line Status | Other | Print | Hide

0186 – AR_Vive_proc

Owner:

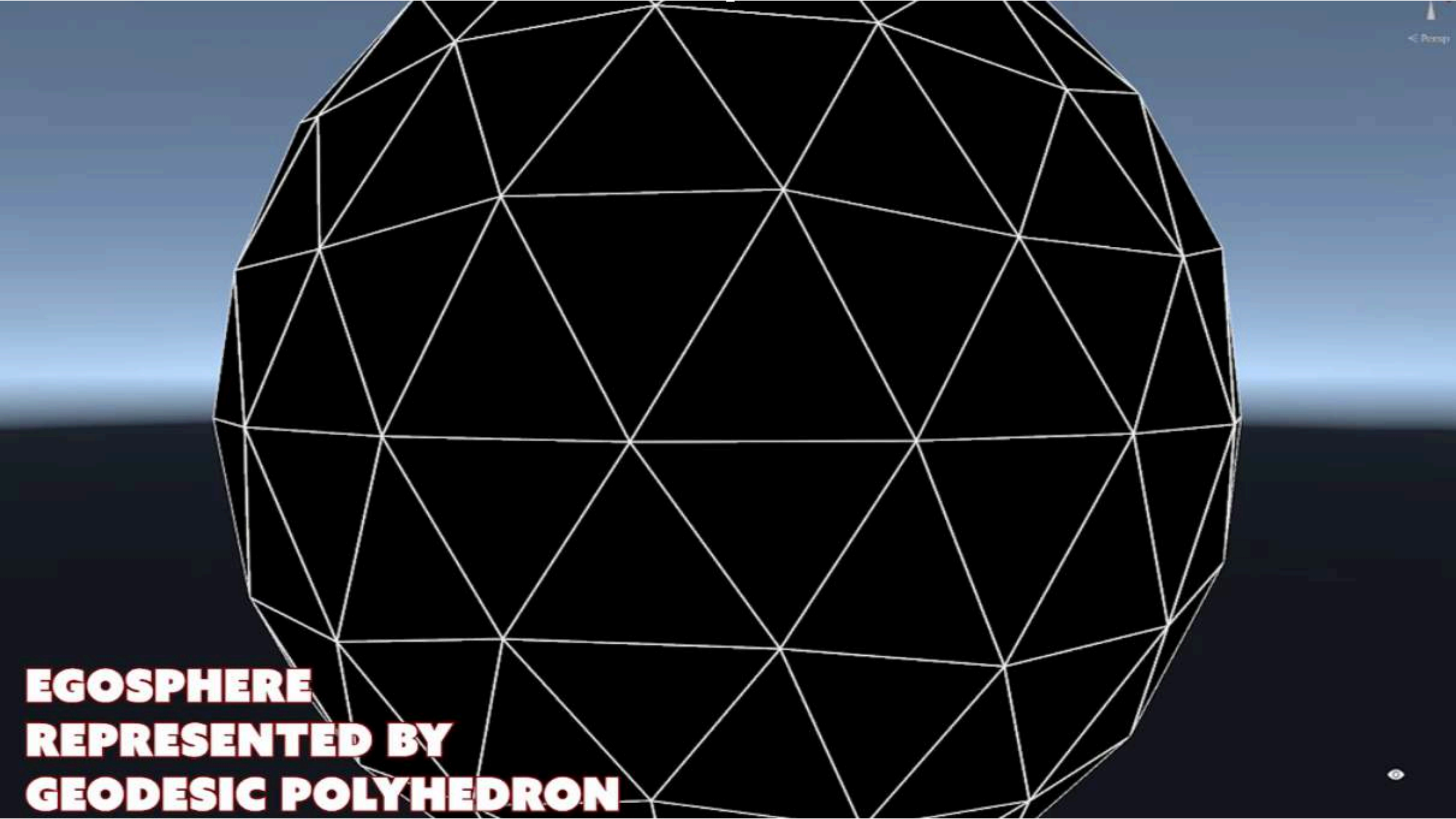
▼ Step 1. Vive Step

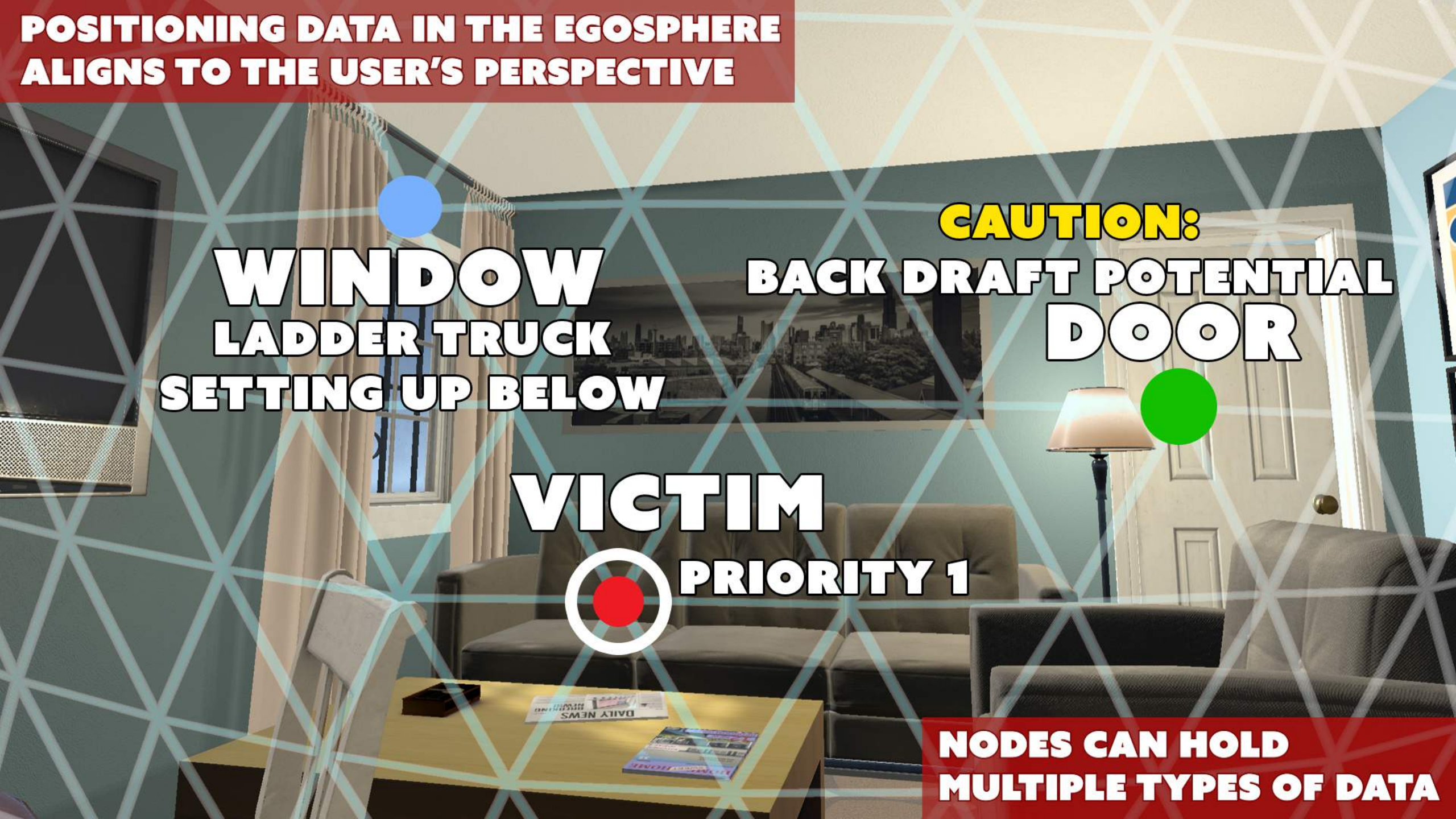
- [x] 1.1 approach the red_cube
- [x] 1.2 touch the red_cube
- [x] 1.3 approach the blue_cone
- [x] 1.4 touch the blue_cone
- [ ] 1.5 approach the green_sphere
- [ ] 1.6 touch the green_sphere
- [ ] 1.7 approach tankA
- [ ] 1.8 touch tankA at the desired water level
- [ ] 1.9 accept tankA's water level by pulling the trigger on the controller
- [ ] 1.10 wait for tankA's water level to achieve the desired level
- [ ] 1.11 approach tankB
- [ ] 1.12 touch tankB at the desired water level
- [ ] 1.13 accept tankB's water level by pulling the trigger on the controller
- [ ] 1.14 wait for tankB's water level to achieve the desired level

TRANSLATING DATA BETWEEN COORDINATE SYSTEMS

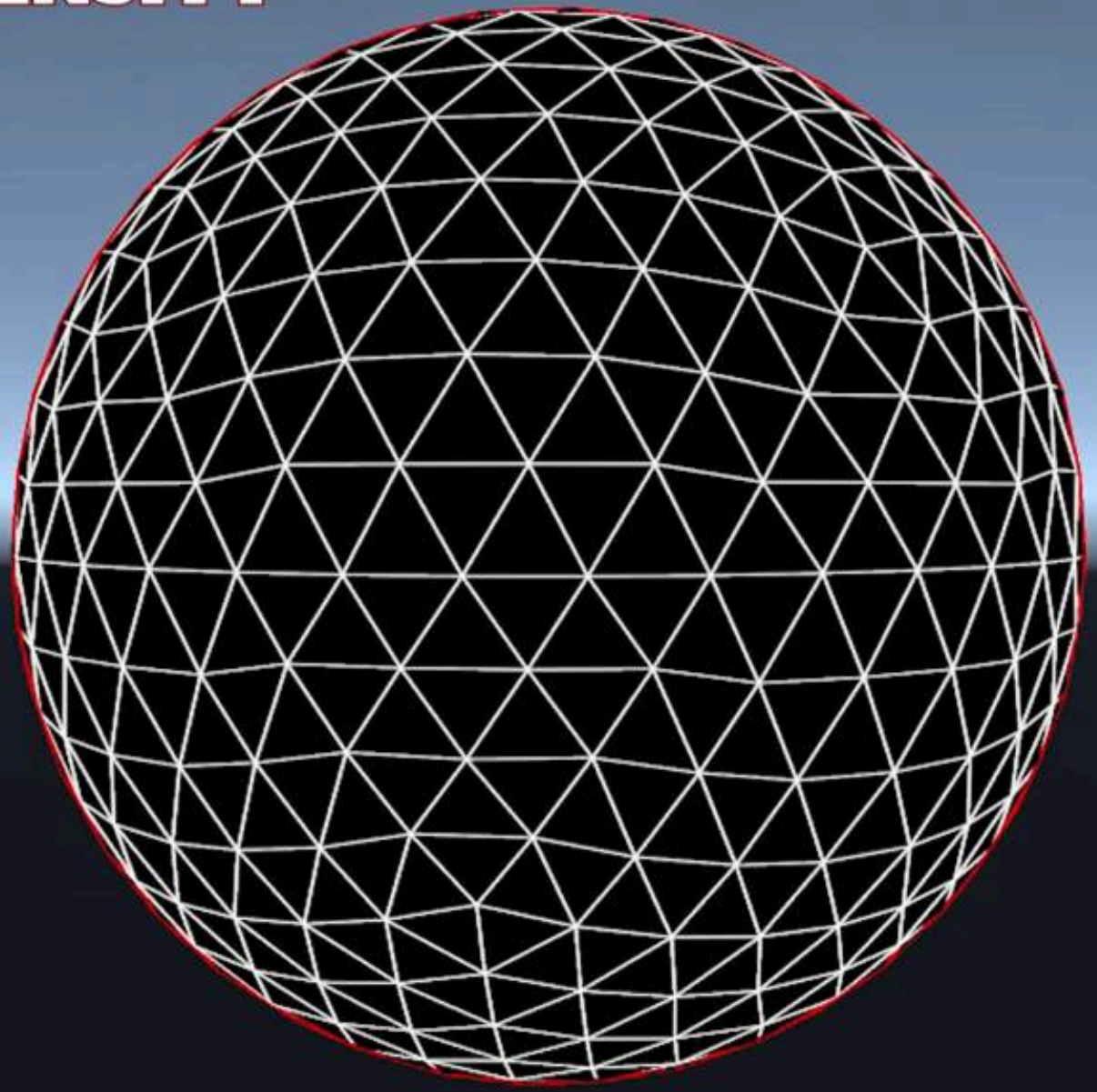
EGOSPHERE

CARTESIAN

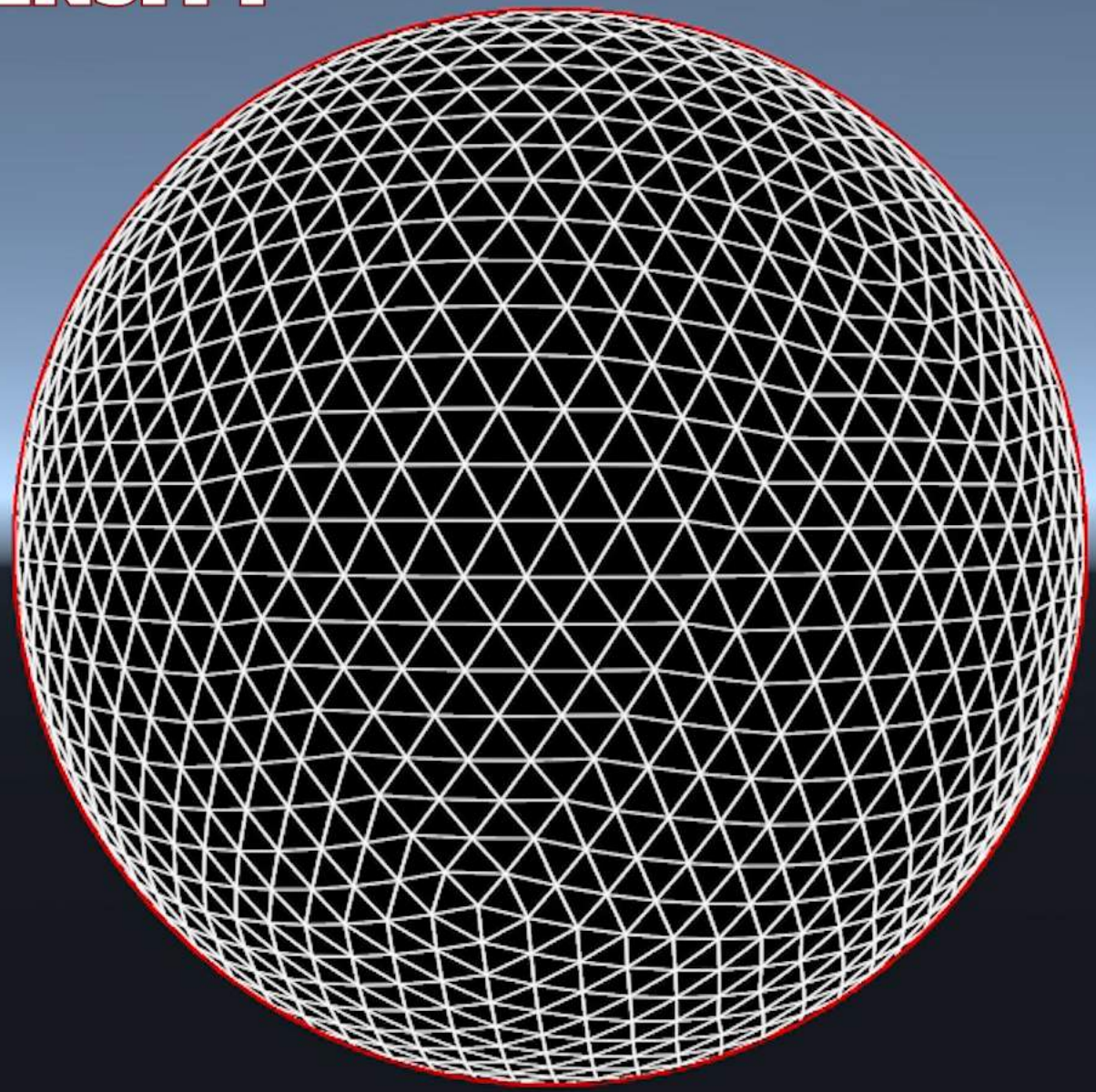

EGOSPHERE
REPRESENTED BY
GEODESIC POLYHEDRON


POSITIONING DATA IN THE EGOSPHERE ALIGNS TO THE USER'S PERSPECTIVE
WINDOW
LADDER TRUCK SETTING UP BELOW
CAUTION:
BACK DRAFT POTENTIAL
DOOR
VICTIM
PRIORITY 1
NODES CAN HOLD MULTIPLE TYPES OF DATA

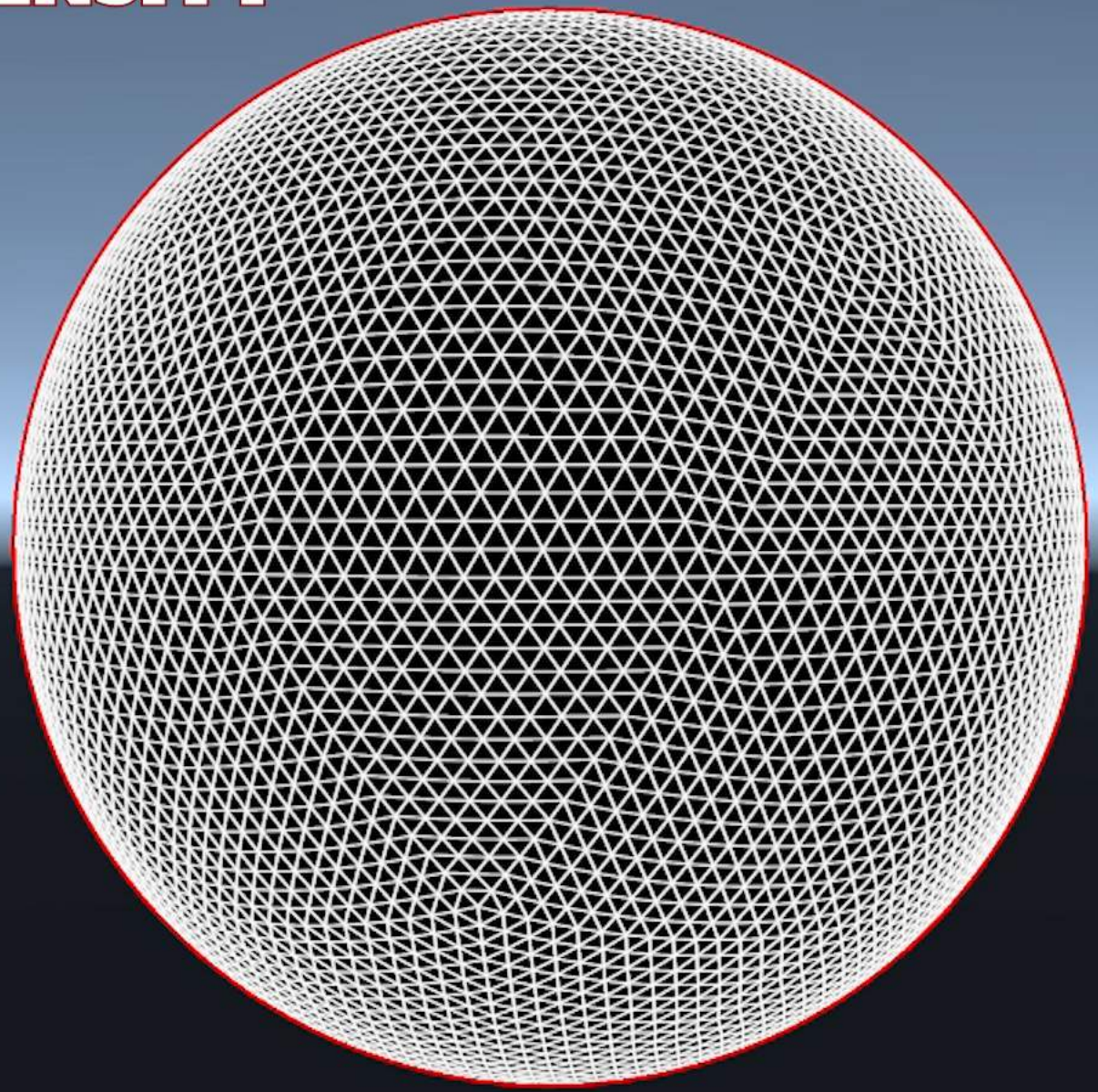
ADAPTABLE DENSITY



ADAPTABLE DENSITY



ADAPTABLE DENSITY



VIRTUAL WORLD

unity

ROBOTIC ASSETS

SENSORS & COMMS

INFORMATION DISPLAY

ROS BRIDGE

REMOTE PROCESSING

REAL WORLD

ROBOTIC ASSETS

SENSORS & COMMS

INFORMATION DISPLAY

ROS BRIDGE

REMOTE PROCESSING

FIRE POINT OF ORIGIN
SIMULATION BEGINS

9-1-1 RECEIVED CALL AT 15:17
FIRST ON SCENE ARRIVED 15:28

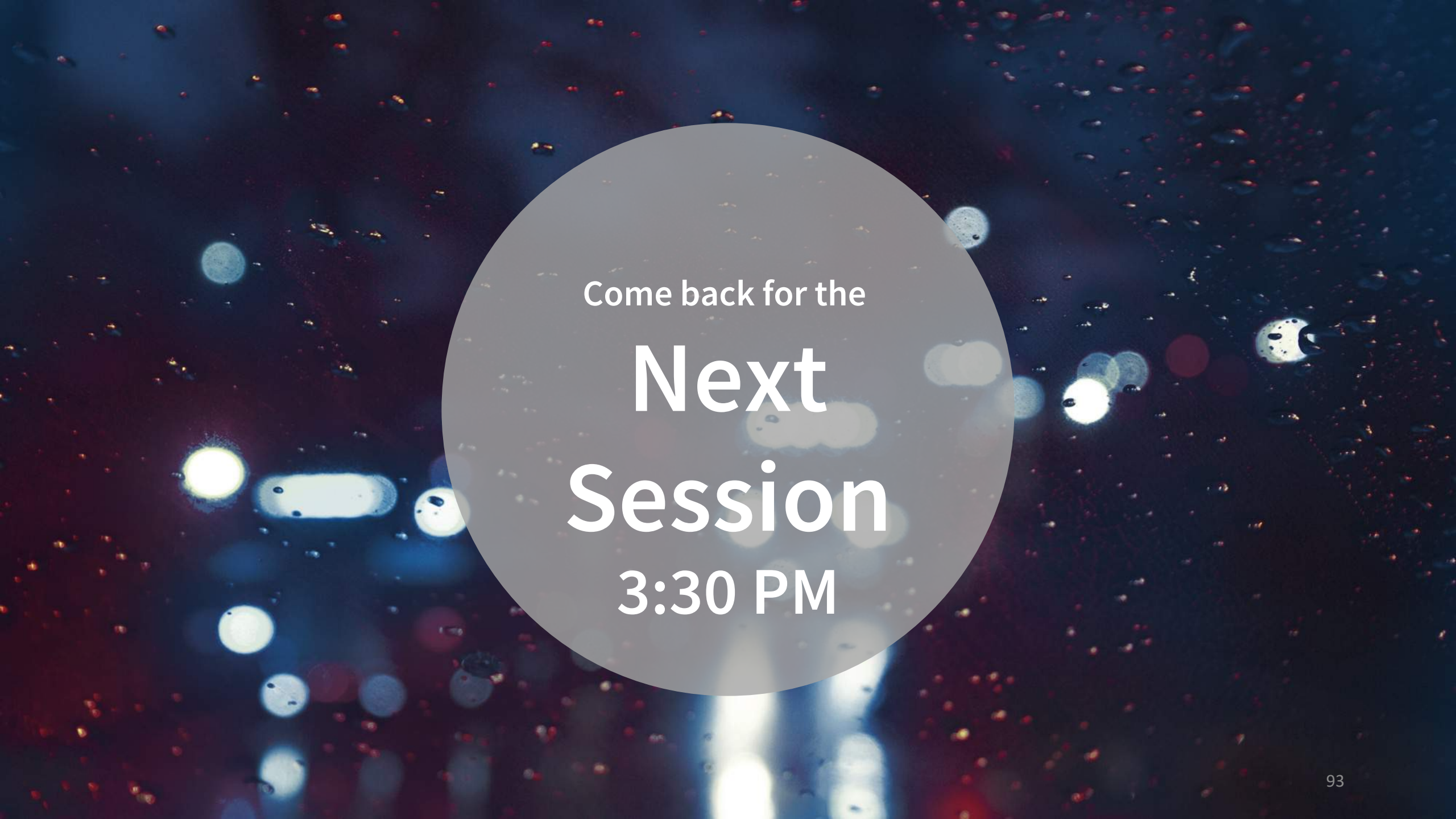
AR HUD RESEARCH
WHAT, HOW, WHERE, WHEN, WHY?
USER INPUT MODALITIES?

VALOR

VIRTUAL AND AUGMENTED LABORATORY FOR OBJECTIVE REALITIES

YEAR ONE REPORT

07.2019


Come back for the
Next
Session
3:30 PM