Incident

Fire

Interface

Virtual

Reality

iFiVR

A concept of immersive interactive search and rescue training.

IFIVR (Incident Fire Interface VR)

Guardian Airwaves, LLC   1/29/2018

Project Summary

Guardian Airwaves proposes two concepts of a graphical integrated system of live streaming fire fighting factors displayed on a VR Headset for survivability, maneuverability, and efficient communication across the network of Teams and/or Incident Commander & subordinate branches, divisions, groups, or company members. While fulfilling the VR HUD Navigation Challenge required tools of UE4, VIVE headset, Guardian Airwaves will also utilize graphic production tools, Maya, Photoshop, Marui. The proposed tools for real-time factor/data streams are Pupil Lab's 120hz Binocular Eye Tracking, PASS (Personal Alert Safety System) Kate Remley of NIST, Assisted GPS receivers by HTC Tilt2, Thermal Imaging Drone (RQCX-3 "Raven"), Haptics & Biometrics Suit by TeslaSuit, Data Acquisition System Service. The desired insight: "It [smart firefighting] will revolutionize firefighting by collecting data globally, processing the information centrally and distributing the results locally." - Casey Grant, executive director of NFPA's Research Foundation. -Smart Firefighting Workshop Summary Report March 24-25, 2014 Arlington, Virginia (NIST Special Publication 1174) .

Guardian Airwaves' **IFIVR HUD navigation** working with a Data Acquisition System to ensure Survivability, Maneuverability and Efficient Communication across the network of Teams and/or Incident Commander & subordinate branches, divisions, groups, or company members.

Participant Summary

- **Lisa Revelli** is a product designer. Lisa has over 12 years of design & production experience in various media and platforms. Lisa has worked in Tokyo for Milai Corporation as a product designer and as a technical director for Speed, Hideaway(Sony Imageworks), Oscar award-winning Geri's Game, Monsters (Pixar), and Matrix Revolutions (ESC). She also was a Sr. Designer on Microsoft's first Xbox title, BloodWake – a naval combat video game, as well as a project manager for 3D simulations for Boeing's Future Combat Systems (InHance).

- **Herb Love** is a retired Cal Fire Division Chief who held ICS qualifications including Branch Director, Division Supervisor, and Safety Officer 1. He developed an on-the-ground version of a USFS staff ride at the Rattlesnake Fire site (Glenn County CA, 1953) for CAL Fire and other Fire Department personnel who are involved in wildland and interface firefighting. In the staff ride, participants immerse themselves in the technology, terrain, weather of that fire, and the thought processes of those whose actions and reactions affected the fire's outcome.

Technical Outcome

- Guardian Airwaves hopes to deliver a comprehensive VR HUD to be further tested & developed using a multi-channel database that is securely networked with LBSs, live data streams of fire incidents and made available to the network of Firefighters as requested via HUD. This is the goal of the IFIVR HUD (Incident Fire Interface Virtual Reality, pronounced "Eye-Fiver").

- **In the given scope, time-frame, lack of funding for Stage 2 of this challenge, the fire fighting factor data will be simulations of fire incidents and not in real-time.**

'IFiVR' HUD Data Content

IFiVR HUD (Module 1-Wildland Fire)

- Oxygen Levels

- Ambient Temperature/Internal Body Temperature

- Wind Speed, Direction of Wind, Relative Humidity

- Aerobic exercise recovery rate comparison to current rate

- Position Tracking of Firefighter & Team Members in Fire Incident Location

IFiVR HUD (Module 2-High Rise Fire)

- Oxygen Levels

- Ambient Temperature/Internal Body Temperature

- Wind Speed, Direction of Wind, Relative Humidity

- Aerobic exercise recovery rate comparison to current rate

- Position Tracking of Firefighter & Team Members in Fire Incident Location

New:

- Floor Plan Mapping

- Victim Location

'IFiVR' HUD Capabilities

UI/UX Capabilities

- Selection of Graphic Preferences in respect to font, color size, icon size in consideration to low light and night operations.

Navigation Capabilities

- Options for Map Mode (top down, 3D map)

- Navigation Mode (Breadcrumbs, Waypoint)

- Route Calculation capabilities that adapt to changes in the environments

- Infrared Camera Vision Mode - Thermal Seeking

- Risk Level Modes :
  - Operational Situations
  - High Risk Situations
  - No Go Situations

'IFiVR' HUD Capabilities

Management of Risk Level

Risk Level Modes

- Danger zones – Hazardous Materials, High heat
- Boundaries if you go pass, screen goes gray and audio sounds "go back to missions"
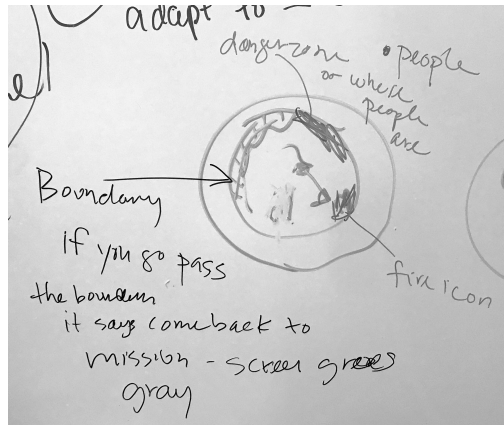
Navigation Capabilities

- Options for Map Mode (top down, 3D map)

- Navigation Mode (Breadcrumbs, Waypoint) to retrace steps or go back

- Route Calculation capabilities that adapt to changes in the environments

- Route Calculation to victims

'IFiVR' HUD Capabilities

Environmental Applications

Wildland

Rural

Urban

Suburban

Inside Corporate Office Buildings

House Fire

Apartment buildings

School Campuses

Shopping Malls

Communication Capabilities within Teams and to Battalion Chief

- VR-HUD that can calculate, recalculate, and communicate multiple routes to the user.

- **Missions**: Location & Recovery of Victims, Number of Victims – Adults and Children – Responsive and nonresponsive, Fire Containment, Extinguishing

- **Situations:** Structural Building Assessments, Hazard Assessments, Wind Speed, Victims

- **Safety of Firefighters:** Oxygen for Firefighters, Firefighters Biometrics of Fatigue/Stress (Heart rate, internal body temperature,

'IFiVR' HUD Capabilities
Prioritizing Information/Organizing Info

Sections of 'IFVIR' HUD Data

Situation Awareness

1. Reveal Location & Number of Victims

2. Call Up Aerial Feeds by Drones: Infrared, Night mode, Temperature Heat, victim location

3. Call Up Wind Directions & Speed Factors

4. Call Up Location & Number of Victims

Survivability of Firefighter and Team Members

Check Readiness of Firefighter - Equipment

1. Call Up Location of Team Members (via PASS tracker)

2. Call Up Oxygen Levels of Firefighters and Locations

3. Call Up Ambient/Internal Body Temp

4. Call Up Heart Rate or Biometrics representing fatigue.

Maneuverability

1. Call Up Location & Number of Victims

2. Call up Floor Plans

3. Call Up Updated Safe routes, No-Go routes to target point based on Ambient Air Quality, Gas, Heat (what other factors?)

Existing Emergency Visual Communication Graphics

Goal: Simple, Universal Visual communication which All Emergency Response Teams can understand using an universal graphic symbology and color palette.

Currently, National Fire Protection Agency has initiated Standard for Fire Safety and Emergency System Symbols in their NFPA 170_Standard for Fire Safety and Emergency Symbols document. It is unknown that these symbols are mandated in the training of All US education for Public safety Training.

Structure Assessment
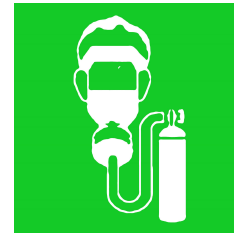
EMERGENCY CODES

Code Red – Fire
Code Black – Severe Weather
Code Silver – Person with Weapon/Hostage
Code Gray – Combative Person
Code Orange – Hazardous Material Spill/Release
Code Yellow – Bomb Threat
Code Pink – Infant Abduction (<1 year-old)
Code Purple – Child Abduction
Code Blue – Adult Medical Emergency
Code White – Pediatric Medical Emergency
Code Brown – Neonatal Medical Emergency
Code Evac – Evacuation of Patients Required
Code Violet – Radiation Incident
Code Triage Internal – Internal Disaster
Code Triage External – External Disaster
Utility Alert (utility) – Utility Alert

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Situation Awareness

1.   Reveal Location & Number of Victims

2.   Call Up Aerial Feeds by Drones: Infrared, Night mode, Temperature Heat, victim location

3.   Call Up Wind Directions & Speed Factors

4.   Call Up Location & Number of Victims
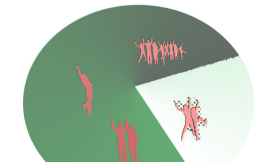
The User selects their age category and then the blue iFiVR button to start. The selection of one of the 3 age categories call up Biometric Presets used within the HUD. The biometrics used in this VR demo are GA's calculations based on researched firefighter's biometrics during training. Heart rate and internal body temperature are represented in this current demo.

In the next version of the iFiVR, live streaming biometrics of the user will be implemented.
(see page 8)
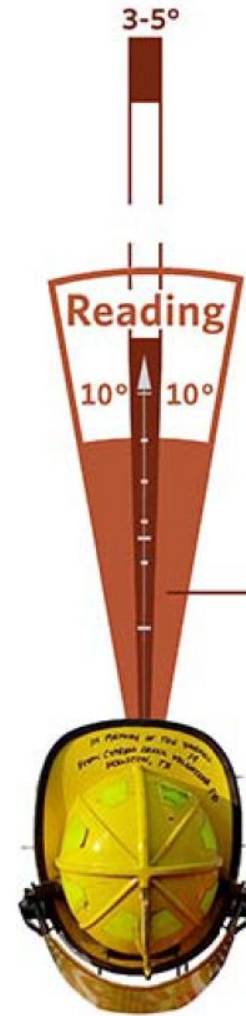
The age category graphics is placed within the 10° span that is comfortable to the eye for reading.
It is also place below the horizon line to eliminated the tendency for the user to look up and to keep a comfortable forward gaze.

We have established that the font size in the HUD should be set by the developer and not the user.

Its z space placement is placed at 1dmm – 2dmm. The user may toggle back and forth to a larger sized graphics. (Dmm is Google's world space vr position)

(Age Presets) Represented by Age	100% Max Heart Rate (MHR) = 220-Age	Exceeded Heart Rate (EHR) = MHR x 110%	No Smoke Scenario Ambient Temperature 85 degrees	Smoke Scenario Ambient Temperature 120 degrees	Heavy Smoke Scenario Ambient Temperature 350 degrees	Air Usage 30 min capacity 100% Air in Tank = 3 minutes After 25 minutes, warning icon goes on for 5 min exit. 30 Min – Game Over All this is based on a "normal" use of air.
(< 36) AGE 30 Years	220-30 = 190	EHR = 209	Working Heart Rate 140 Core Body Temp 98.6	Working Heart Rate 170 Core Body Temp 98.8	Working Heart Rate 175 Core Body Temp 99.2	If 100% of tank = 30 minutes, then 33% = 10 minutes, and 3.3% = 1 minute
(37-47) AGE 40 Years	220-40 = 180	EHR = 198	Working Heart Rate 130 Core Body Temp 98.6	Working Heart Rate 160 Core Body Temp 98.8	Working Heart Rate 165 Core Body Temp 99.2	At the end of each minute (on our "standard use" model for the demo), 3.3% is used. Rates as Follows: 1 min...3.3% air used 6 min...19.8% 2 min...6.6% 7 min...23.1% 3 min...9.9%, 8 min...26.4% 4 min...13.2% 9 min...29.7% 5 min...16.5% 10 min..33% Air alarm goes off at 25 minutes 25 x 3.3 % = 82.5% air used
(48>) AGE 50 Years	220-50 = 170	EHR = 187	Working Heart Rate 120 Core Body Temp 98.6	Working Heart Rate 150 Core Body Temp 98.8	Working Heart Rate 155 Core Body Temp 99.2	(continued)

Situational Awareness	Survival Ability	Maneuverability

Goals:

- **Prevent Information Overload & Stress by organizing the information into sets to be called up to be displayed by user's FOV.**

- **Keep It Simple, Information is called up by Firefighter or IC.**

- **Hands-free Selection through Eye-tracking selection to allow for future training with hand-held wands or haptic VR tools.**

Overloaded & Stressed!!!

The 'IFiVR' HUD data is organized into 4 sections

which can be called up and displayed in his/her VR HUD's FOV as the user accesses the VR fire incident environment.

Situational Awareness (SA): Assessment of ever-changing conditions of fire incident environment.	**Vitals (V) of Firefighter and Team Members:** Self-monitoring of Firefighter's own vitals for survivalbility.
Map (M) – Location reference and route determination is key in manuverablity to find victims and exit points.	**'IFiVR' HUD Preferences:** Readability and Visibility is key in threatening dynamic environments.

'IFiVR' HUD Capabilities
Prioritizing Information/Organizing Info
Sections of 'IFVIR' HUD Data

The 'IFiVR' HUD data is sectioned into 4 sections which can be called up and displayed in his/her VR HUD's FOV as the user accesses the VR fire incident situation.

Situational Awareness (SA)

1. Call Up Visual Feeds by Drones (UGVs) Infrared, Night mode, Temperature Heat, victim location

1. Call Up Wind Directions & Speed Factors

1. Call Up Location & Number of Victims (updated map)

1. Call Up Ambient Temperature

Vitals (V) of Firefighter and Team Members
Check Readiness of Firefighter – Equipment

1. Heart Rate

1. Call Up Air Consumption Levels/Remaining Air in SCBA of Firefighters

1. Call up Internal Body Temp

1. Call Up Heart Rate or Biometrics representing fatigue.

Map (M) – The mapping has to stay up most of the time – upper right of FOV placement.

1. Call Up Location of FireFighters, Team Members, Exit Points, Air Re-supply Stations For Firefighter SCBA.

1. Call up Floor Plans

1. Call Up Updated Safe routes, No-Go routes to target point based on blocked potential access routes, ambient air temperature, toxic chemicals.

'IFiVR' HUD Preferences offers it Users preferences when viewing the HUD for better readability

1. 3 Luminance Settings are offered for the simplicity of this demo.

1. Icon Size

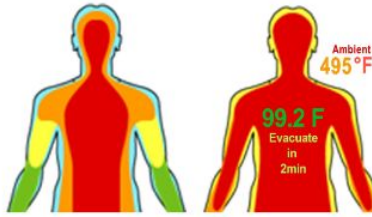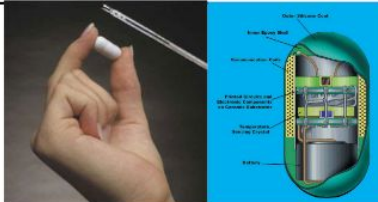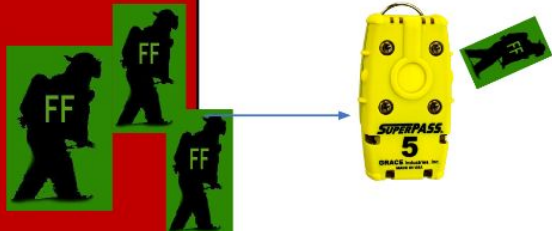# 'IFiVR' HUD Capabilities
Prioritizing Information/Organizing Info
Situational Awareness of 'IFVIR' HUD Data

Situational Awareness

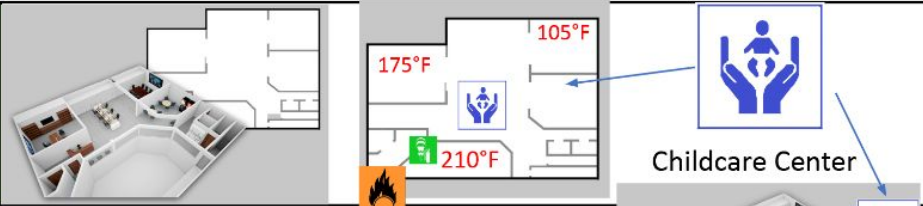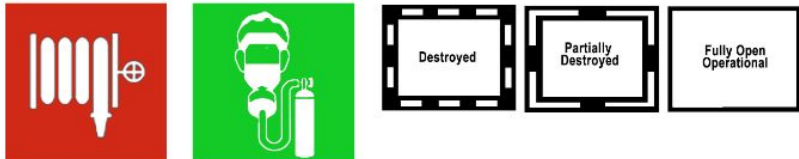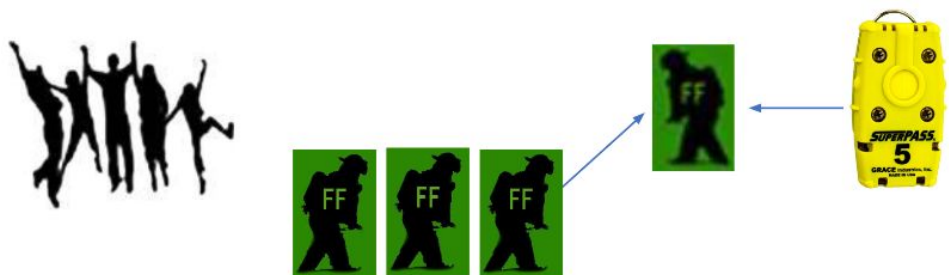|	
1. Call up visual displays of standard camera, Infrared, and Night Vision views of environment. Source: Helmet camera, Unmanned Ground Vehicles	
2. Call up data feeds of standard, Infrared, Night Vision imaging. Source: (UGVs)	
3. Call Up Wind Directions & Speed Factors. Source: Anenometers & Weather Apps	
4. Call Up Locations of Firefighter, Team Members, Victim Locations, Exit Points. Source: 2D/3D Maps, cell phones (wi-fi enabled)	
5. Call Up Ambient Temperature, Humidity Source: Firefighters, UGVs, Building Stats, NEST-type office thermometers, C2O monitors, etc	**Ambient 495°F** Structure Assessment Markings: Destroyed, Partially Destroyed, Fully Open Operational

Vitals (V) of Firefighter

1. Heart Rate – Comparison of historical BPM and current
   Source: Reference to BPM recorded in training exercises. Real time
   BPM gathered from App: **Cognitive VR/Galvanize Skin response**

Safety of Firefigh ... trics of Fatigue/Stress Heart rate, internal body te

160

Go To Fill Station

Oxygen 5% remaining

2. Call Up Air Consumption Levels showing remaining AIR in SCBA of Firefighters
   - Flashes red light when icon shows 0 to 35% cylinder AIR Remaining, Firefighter must route to Air re-supply locations.
   - Call Up Map
   Source: Oxygen Tank Gauge

3. Call up Internal Body Temperature Icon which turns red as internal body temperature rises.
   Source: Internal Body Temperature Pill

Ambient **495°F**

99.2 F Evacuate in 2min

Internal Body Temperature Pill Developed by the Johns Hopkins University Applied Physics Laboratory worked closely with Goddard Space Flight Center

4. Firefighters:
   - Biometrics
   - Oxygen Level (pulse oximeter readings)
   - Location of Team Member

FF FF FF

SUPERPASS 5

'IFiVR' HUD Capabilities
Prioritizing Information/Organizing Info
Situational Awareness of 'IFVIR' HUD Data

2D/3D Map (M)

2D Floor Plans, Engineering Plans are called up as assessment and route planning takes place. Source: Property Management Company, Building Engineer, Architect	175°F 105°F 210°F Childcare Center
Call up for **3D Floor Plans** allow for detailed structure assessments (type of door, wall, window) with Route Path Visualization RPV. Source: CAD files from Architects	Dotted line & Solid line Icon of path
Call Up for **Updated Safe routes and No-Go routes** to target point based on blocked potential access routes, ambient air temperature, toxic chemicals. Routes also for Firefighter Resources – Stairwells, Fire Dept hose connections, air re-supply stations, building communications locations. Source: Firefighters, PASS, NEST-type office thermometers, C2O monitors	NFPA Symbols Destroyed Partially Destroyed Fully Open Operational
Call up **Location of Firefighters and Pinpoint Location of Victims** represented by dots on 3D map. Location of FireFighters (usually team of 3-4) Real-time & updated information on Incident and Incident Environment to Minimize Risk Levels. Source: Pings from Victims' cell phones (wi-fi or cell phone towers)	FF FF FF FF SUPERPASS 5

'IFiVR' HUD Capabilities
Prioritizing Information/Organizing Info
UXHUD Data

Selecting **Luminance**
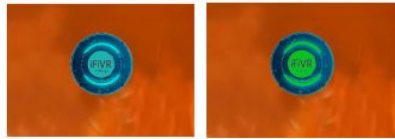
Engage Eye tracker selection tool by looking at the Center Icon. Match the transparent circle.

Selected Bold Font, Look at Center iFiVR Settings Button to Confirm.

Selected Bold Font, Confirmed.
File:
 002fiVRSettings.psd
Layers unmerged
002afiVRSettings.psd
Flattened
Layers Merged

'IFiVR' HUD Capabilities
Prioritizing Information/Organizing Info
Situational Awareness of 'IFVIR' HUD Data

'IFiVR' HUD Settings takes into account the varying light conditions of firefighting.

3 Luminance Settings are offered for the simplicity of this demo.
The FirehawkM7XT specs* reveal the dynamic conditions of firefighting incidents which the iFiVR notes for future iterations of this HUD.

*"The I-HUD shall incorporate a photoelectric sensor that senses ambient light conditions, automatically adjusting the display to one of 16 pre-programmed light intensities." - FirehawkM7XT
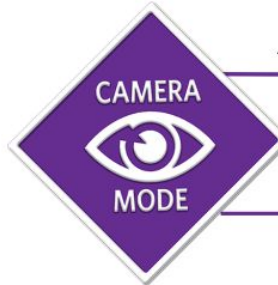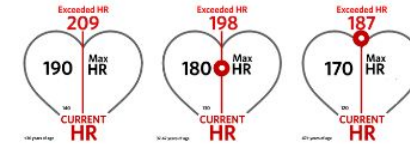
Brighter Normal Luminance Darker iFiVR Settings

Picture in Picture -
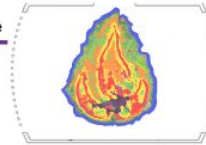Camera sends live feeds into the HUD while having display of building plan..

The air tanks have approx.30 minutes of supply which may be used within 15-20 minutes depending on the respiration rate of the fire fighters.

When 5 minutes of air is remaining the user will be warned and must retreat or find a SCBA refilling station.

30 min
5 min
AIR   AIR

VITALS

Exceeded HR 209 Exceeded HR 198 Exceeded HR 187
190 Max HR 180 Max HR 170 Max HR
CURRENT HR CURRENT HR CURRENT HR

Heart reate data sests_Reference Chart

CAMERA MODE

Thermal Vision Mode

Night Vision Mode