Conceptualizing the Design and Use of Augmented Reality Within a Common Operating Picture for Incident Command Systems

Project Update and Next Steps

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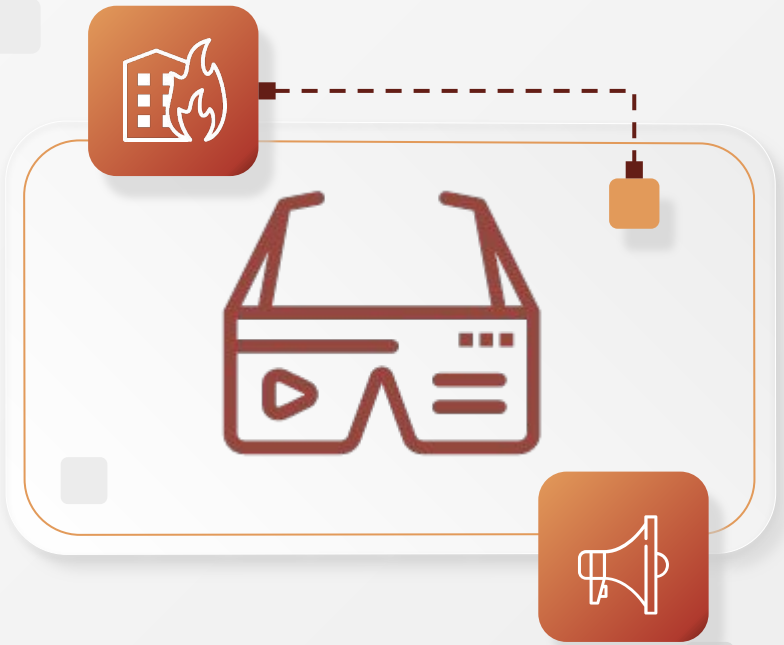


OVERVIEW

01

THE PROJECT

The project definition & introduction to research methods

02

KEY SUCCESSES

What was gained through the process

03

KEY ISSUES

Issues that arose during the research process

04

NEXT STEPS

What we are working on next

01

THE PROJECT

The Indiana University Crisis Technologies Innovation Lab (IU CTIL) is exploring the design of an augmented reality system that will help both incident commanders and other first responders.

Our team was tasked to investigate and research past, present, and future design systems that may influence user experience and expectations in a command and control application during times of crisis.

RESEARCH GOALS

Prove the value of real-time location tracking and asset management during emergency incidents.

Demonstrate how AR can improve situational awareness and decision making.

Provide user interface and experience design criteria and requirements for use in an AR interface.

QUESTIONS, QUESTIONS, AND MORE QUESTIONS

All design research starts and ends with questions.

We focused on the why, what, who, when, and how to better understand the project when finding solutions.

COMPLETED METHODOLOGIES

Persona Development

Developing the personas of potential ICs helped us better understand their needs and goals

Conduct secondary literature review

Ongoing literature review helps us determine the current state of research on the topic of improved IC

Conduct interviews with subject matter experts (SMEs)

These SMEs had a background in incident command and AR technology.

Affinity Mapping

Highlighted themes about ICs personalities, work habits, needs, values, and goals

Empathy Mapping

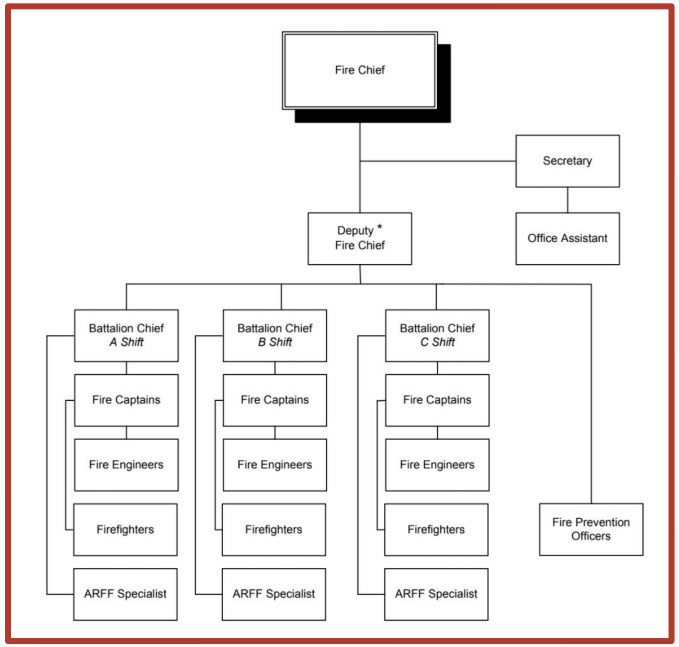
Created to focus our comprehension of future user concerns

Dale Rolfson Information Technology Manager at Indianapolis Fire Department

Interviews with Dale Rolfson

Our team conducted an initial interview with Dale and gained the following valuable insights:

- IC does ***NOT*** have a visual awareness of where firefighters are during incidents
- Learned about tools that ICs currently use (Incident Command sheet, white boards, laptops equipped with water main and hydrant maps)
- Learned about pain points that AR might alleviate (bad weather can damage laptops; they are hard to keep dry, resistance to change, etc)
- Conducted a verbal walk-through of steps that occur during an incident
- Learned more detail about crew communication patterns
- Discussed how AR could improve current process in more detail



Fire Department Organization Chart

- There is a clear **hierarchy in the command chain** and it must be followed
- Commanders have a need for **open communication**.
- Commanders are continually trying to **visualize** the details of a scenario to better direct resources.
- Commanders utilize **benchmarks** to ensure they are hitting all previously established safety outcomes.
- Augmented Reality would be most useful in commanding **large-scale incidents** that last longer than 3-4 hours, such as large fires, warehouse fires, apartment building fires, airplane crashes, etc

Kirk McKinzie
President, McKinzie Smart Technology

Interviews with Kirk McKinzie

Kirk provided our team with resources and an appraisal of the current state of location based technology.

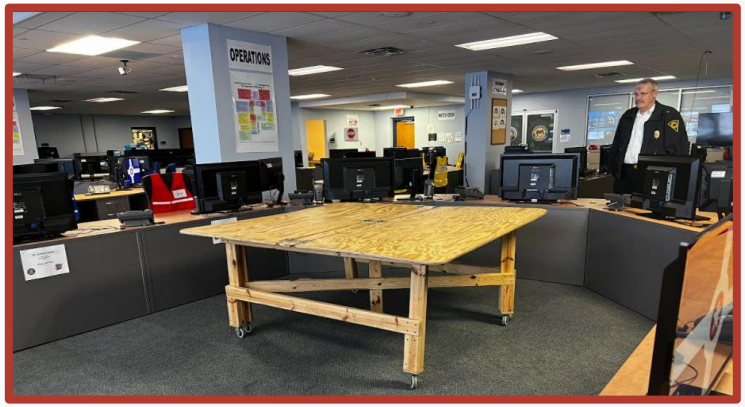
- Incident Command is employed during larger fires requiring more than one piece of apparatus (fire engine)
- Incident Command is a multi-agency task (i.e. State Police, Fire, EMS)
- Typically 30-40 employees concentrate in the IC room to monitor larger events that have the potential to become emergencies
- Believes that the Team Awareness Kit (TAK) is a key software solution for firefighting modernization
- Incident command systems should not be voice-only as they are today. Instead, a shared visual and mental model that can be shared across remote teams will be crucial for these organizations

Jacob Spence
Battalion Chief at Indianapolis Fire Department

Interview with Jacob Spence

Jacob, a battalion chief for the IFD, has served as both primary IC and liaison for large scale emergencies. He offered our team the following insights into his working life:

- IC tracks resources
- Prepares written plans for emergency response, revising as necessary in response to upcoming events
- Collaborates with other industry professionals (i.e. FEMA)
- Walked us through an event involving civil unrest in 2020
- Discussed collaboration between commanders
- Elaborated on use of current tools
- Believes that modernization efforts would need to take place incrementally



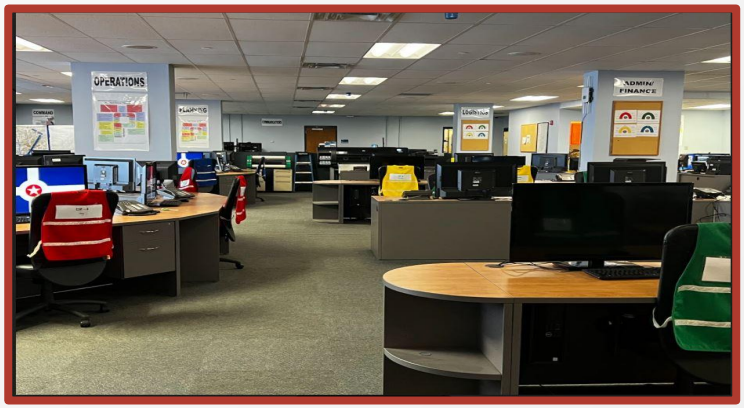
Visualization table

Site Visit with Dale Rolfson & Jacob Spence

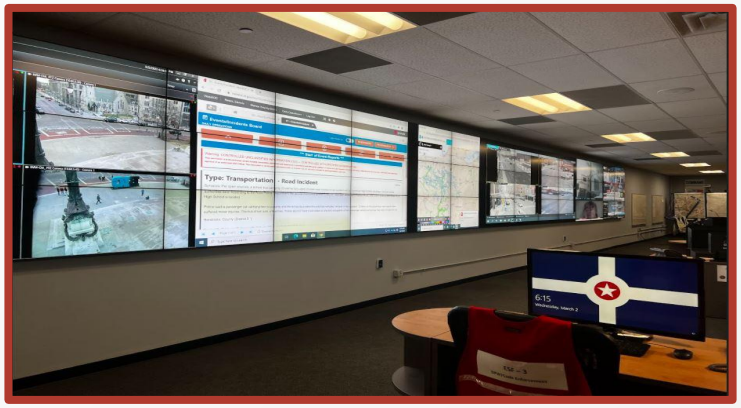
- Incident Command is employed during larger fires requiring more than one piece of apparatus (fire engine)
- Incident Command is a multi-agency task (i.e. State Police, Fire, EMS)
- Typically 30-40 employees concentrate in the IC room to monitor larger events that have the potential to become emergencies
- Using drones and aviation technology today is more useful in providing retrospective information because there is a 24-48 hour delay in processing images
- Recorded AR footage could provide valuable training resources

Pictures from Site Visit at IMPD

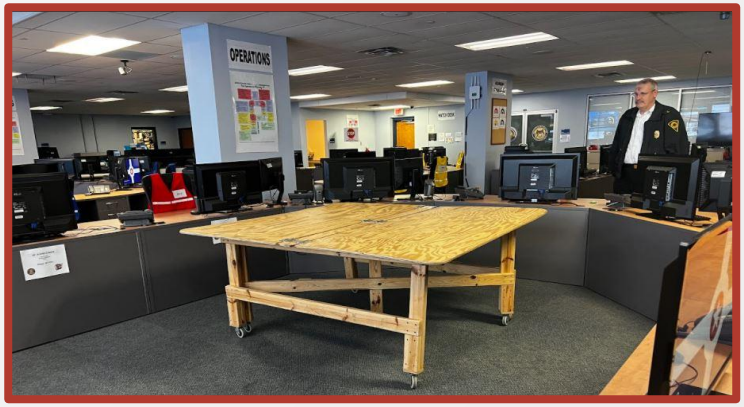
IC vest color nomenclature



IC workstations with vests



Use of current technology



Visualization table

Affinity Map

Personality

Calm and collected disposition

Prefers consistency in workflow structure

Needs are not often recognized

Values

Respect for seniority and heirarchy

rank | Highest ranking chief | chain of command | "rookie" | 25+ years of experience

Polarized affect towards technology

Goals

Commanders aim to minimize harm as quickly as possible

save more lives and property | Faster mitigation of incident | better survival | Seeing what hazards there are

They seek to gather as much situational awareness as possible

Situational Awareness | don't know exactly where they are

They are responsible for supporting large events

large-scale incidents

Approach to Work

They use various tools that support collaboration and shared awareness

Laptop / tablet | Command board | White boards w/ wax pencil

They are very process oriented

tactical decisions | Managing personnel | Go on the defensive | Two in two out rule

They collaborate with their team to coordinate and distribute resources

Needs

There is a need to form a unified mental model among remote commanders and field workers

Communication - there must always be an open line to communicate efficiently

Time - time is a valuable resource. Actions should be completed as soon as humanly possible

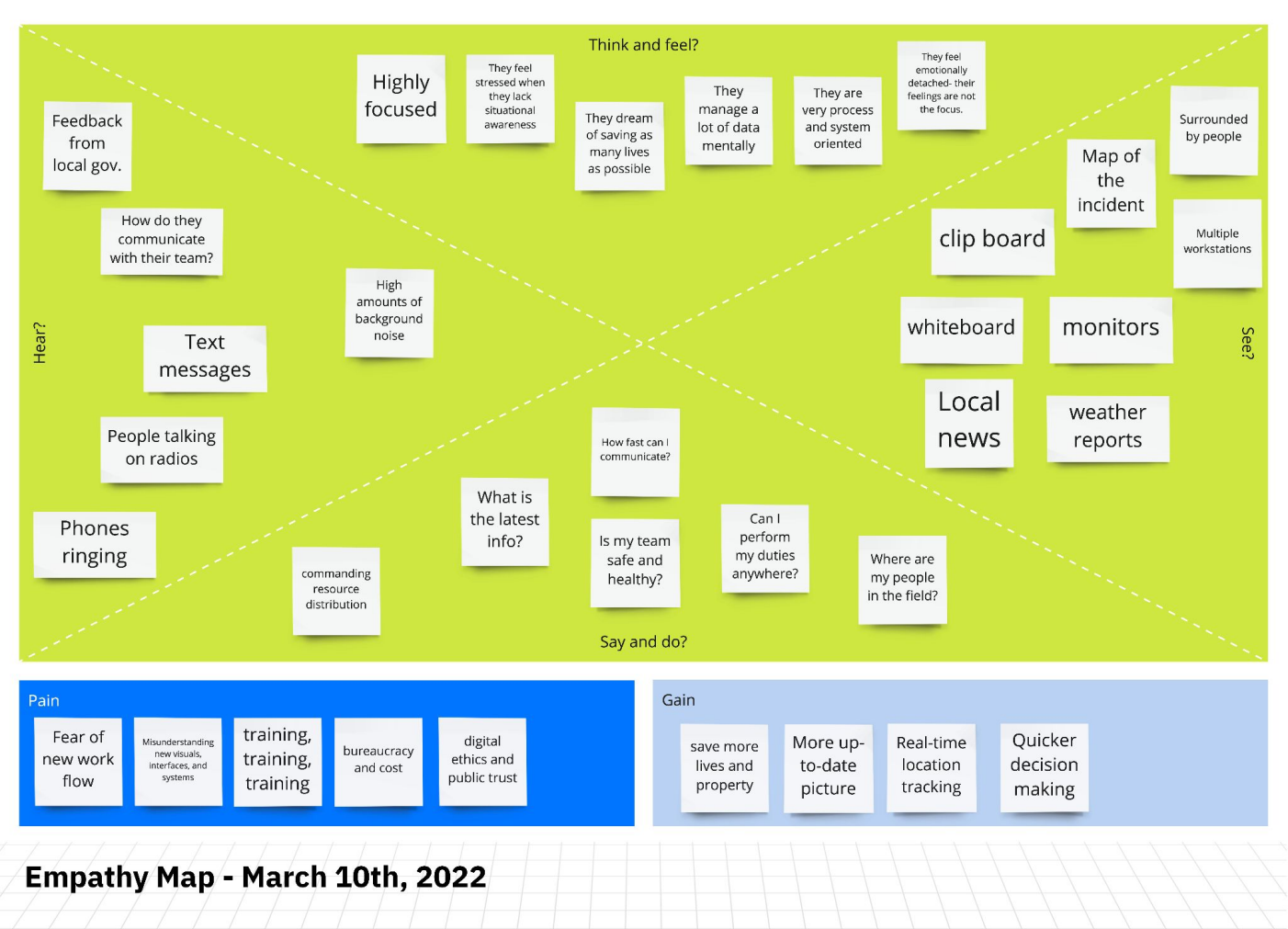
Time is key –

Visuals - Commanders rely on maps and other visual communication to inform their strategy

Data - Commanders rely on data to inform their next decision

Affinity Map - March 3rd, 2022

Empathy Map



Empathy Map - March 10th, 2022

User Personas

Norm The "New Guy"

"How can we save lives if we don't use the best technology? We need to update our systems!"

Age: 25 years old
Job Title: Incident Commander
Education: Bachelor's Degree
Experience: 6 months

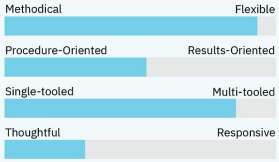
Personality:
- Level-headed
- Lively
- Alert
- Serious
- Approachable
- Kind
- Innovative

Goals:
- Minimize harm among civilians
- Communicate effectively across departments
- Acquire optimum situational awareness
- Use resources as efficiently and effectively as possible

Motivations:
- Desires to grow their skills and advance in their career
- Wants to acquire advanced tools and technologies to better response time
- Using any means possible to save as many lives as possible

Frustrations:
- Does not always feel listened to by higher-ups
- Relies on radio communication to gain a clear picture of an emergency scenario
- Delays in communication hinder situational awareness

Approach to Work:



Needs:
- Advanced Technology - tools that utilize the latest technology to enhance situational awareness
- Open Communication - seconds wasted by an occupied radio can cost lives
- Responsiveness - optimize response times

Values:
- Respect those with greater tenure but wants to push them to achieve higher standards through technology
- Wants to have confidence in the fact that he is doing absolutely everything he can for the people he is trying to help

Oliver The "Old Dog"

"Technology reliance only causes problems. We're better without it in the end"

Age: 57 years old
Job Title: Lead Commander
Education: High School
Experience: 27 years

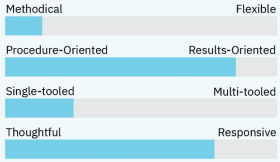
Personality:
- Composed
- Stoic
- Decisive
- Parental
- Honest to a fault
- Reliable
- Respectful

Goals:
- Doesn't want to be phased out before retirement
- Maintain confidence so they can continue to lead their team
- Passionate about saving lives and property

Motivations:
- Wants to ensure the safety of their team as they respond to incidents
- Wants their team to trust them and to appear as a strong confident leader
- Cares about saving lives and property within the community he serves

Frustrations:
- Thinks learning a new computer system will slow them down or cause harm if they make mistakes
- Doesn't like new technology. Is not convinced it is accurate, stable, or reliable
- Worried that rookie commanders will not know how to function should the new technology crash

Approach to Work:



Needs:
- Intuitive usability – needs a system that works as quickly and reliably as their brain
- Education – learning how a new system works
- Comprehension – needs proof of improve outcomes
- Confidence – lack of system failure

Values:
- Proud of their past accomplishments, but never forgets the result of a poor call
- Honors the well-established procedures as they've proven successful
- Doing things the easy way versus trying to fix what isn't broken

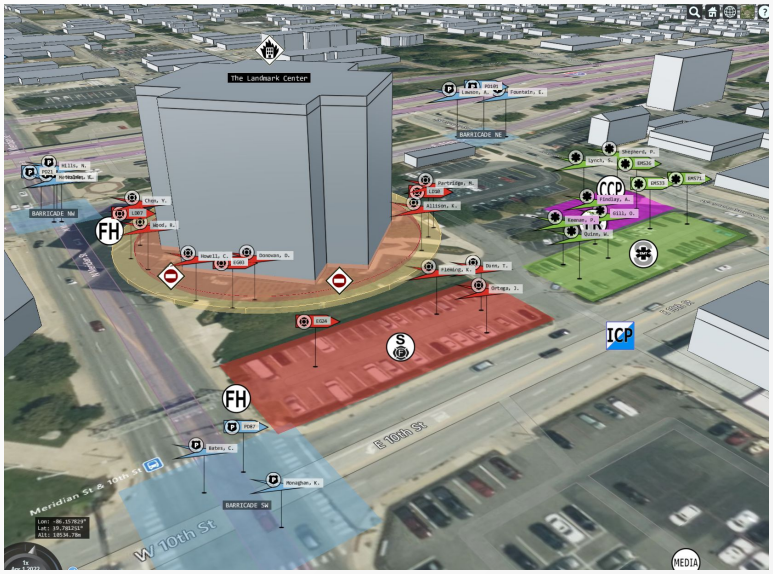
02

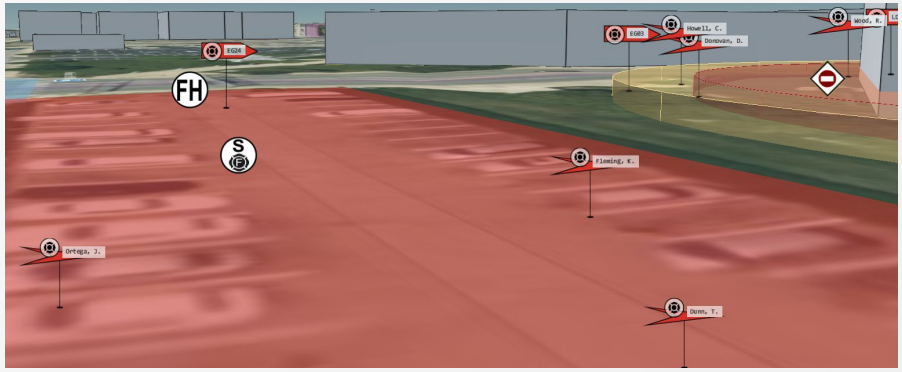
KEY SUCCESSES

Our team had the good fortune of making some enlightening connections.

We were able to gain first hand research for our project through a facility tour and several interviews.

Dynamic Prototype





WHAT HAS WORKED

- Studying the current state of incident command
- Gaining insight to current and future incident commander’s perspectives
- Gaining awareness of hierarchical chains of command
- Asking more questions! Doing so has led to introductions to other SMEs who can provide additional details

03

KEY ISSUES

Some considerations our team contends with:

- Inability to observe incident command in action during live fire event
- Not knowing enough about how incident command works currently and related to specific types of emergencies
- The sheer amount of processes and tasks that need to be completed in a timely manner during incidents which is difficult to measure
- How to visualize tracking assets and resources, especially within an indoor or underground context

KEY ISSUES continued

- Participants may confuse AR with VR; not having an AR prototyping device makes it hard to explain the difference
- Hard to discount logistics barriers; challenging to propose a system based on unavailable technology
- Why would AR benefit users when a modern upgrade for their current software is way overdue?
- Need to prove that solution saves time and assists in quick decision making
- Potential resistance towards the introduction of new technologies by existing staff members

04

NEXT STEPS

Our next step is to further our research process by continuing to focus on specific workflows and users.

GOAL

Create prescriptive documentation that demonstrates the feature requirements and UI/UX design criteria for an AR tool

PLAN

We will utilize the 3D prototype to gather further insights and continue secondary literary research into the advantages of implementing AR from an HCI perspective

FUTURE DELIVERABLES

JOURNEY MAP

Visually understand how a process can be completed using AR

SCENARIOS

Understand situations where AR can be used and why.

STORYBOARDS

Explore successful and non-successful situations using AR.

FUTURE DELIVERABLES

TREE-TESTING

Evaluate how easily testers can complete tasks with the product

UI/UX REQUIREMENTS DOCUMENT

Provide the design team with a list of specifications and requirements to use when designing the interface

Look for our updates soon!

THANKS FOR LISTENING!

RESOURCES

Annotated Bibliography

Project Definition & Scope

Interim Report #1

Interim Report #2

Affinity Map

Empathy Map

User Persona, "The New Guy"

User Persona, "The Old Dog"