

Cross-Device Augmented Reality Systems for Fire and Rescue based on Thermal Imaging and Live Tracking

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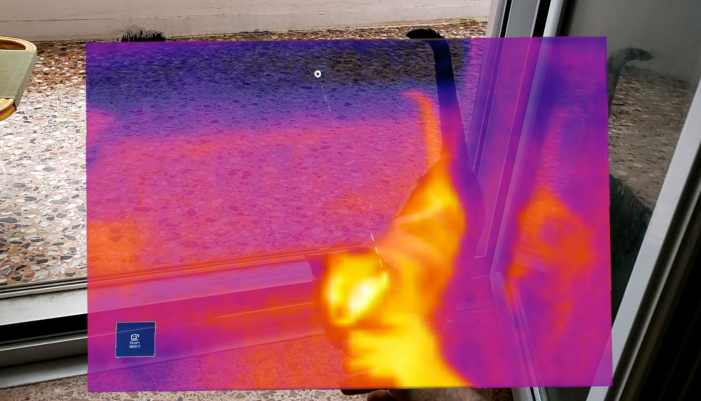
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Goals

- To develop a system for urban operations that offers thermal vision to the operator of the AR headset without impairing their ability to use their hands.
- To develop a system for wildfire operations that can track the location of each firefighter in operation and show that location on a map in real time for the firefighters operating from a distance.
- Locations are being forwarded to an Augmented Reality (AR) headset worn by the captain who is operating on site.

Thermal System, Live Tracker System



Systems & equipment used in Fire and Rescue



Thermal Cameras

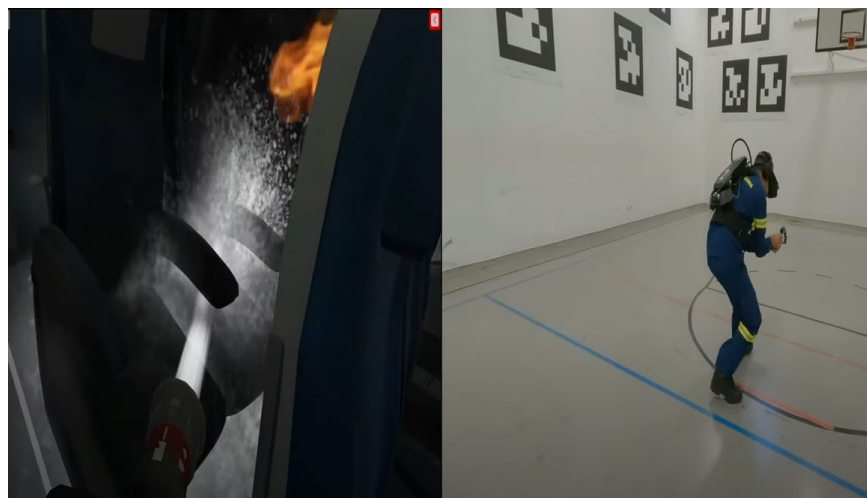


Engage IMS/CAD

- Incident Management System (IMS) and Computer-Aided Dispatch (CAD) software solution.
- Streamlines and automates the management of incidentsReal-time communication and collaboration.
- Geospatial visualization capabilities.
- Accessible via mobile devices and web browsers.

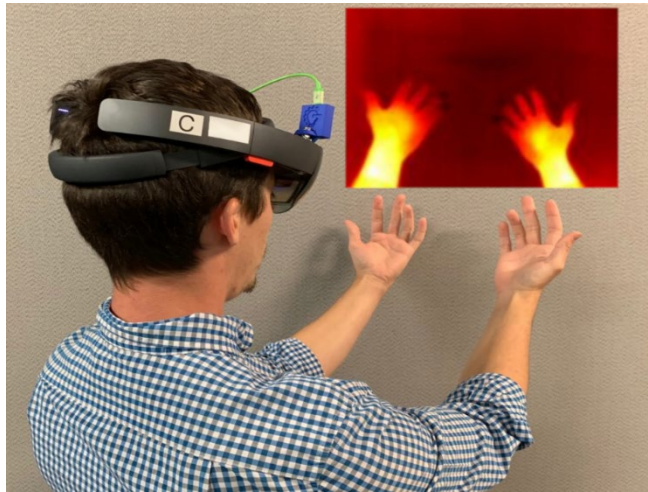


Past research - AR/VR used in Fire and Rescue



BRIDGES European project (VR), <https://www.bridges-horizon.eu/>, Athens international airport

Past research - AR/VR used in Fire and Rescue



Erickson, Austin, et al. "Is it cold in here or is it just me? analysis of augmented reality temperature visualization for computer-mediated thermoception. *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*. IEEE, 2019.

Stearns, Lee, et al. "Augmented reality magnification for low vision users with the microsoft hololens and a finger-worn camera. *Proceedings of the 19th International ACM SIGACCESS Conference on Computers and Accessibility*. 2017.

Guarese, Renan Luigi Martins, and Anderson Maciel. "Development and usability analysis of a mixed reality gps navigation application for the microsoft hololens. *Computer Graphics International Conference*. Cham: Springer International Publishing, 2019.

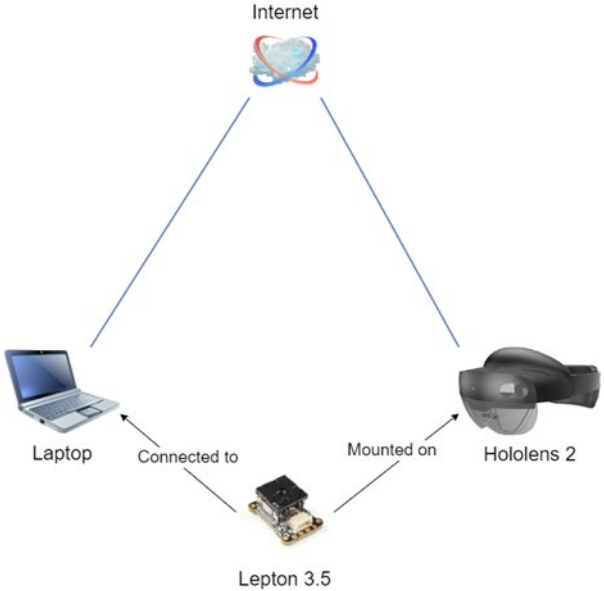
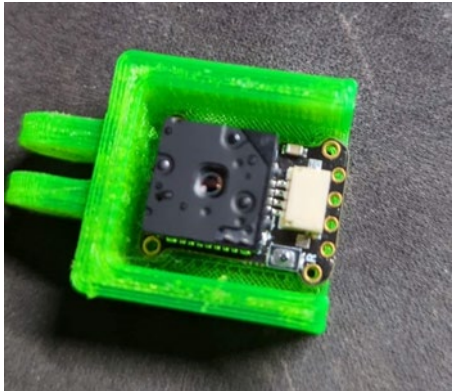
Systems implementation components



User requirements

- Hands-free user interface (Gaze driven).
- Enhance the operators' ability to visualize through smoke by presenting infrared data in the visible spectrum.
- Display relevant information to the operator's field of view without impeding their vision.
- Visual signals to enable operators to easily ascertain the whereabouts of individual team members.
- Emergency signal.
- Alleviate radio channel congestion by minimizing the necessity for vocal communication.

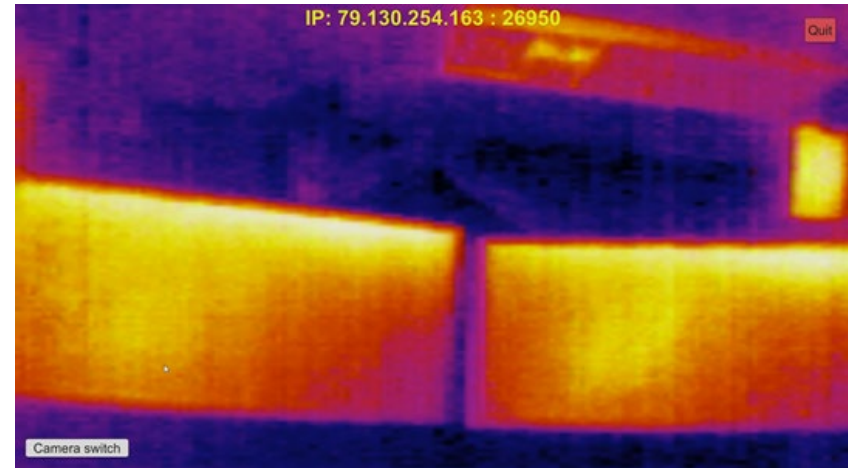
Thermal Imaging System



Thermal Imaging System

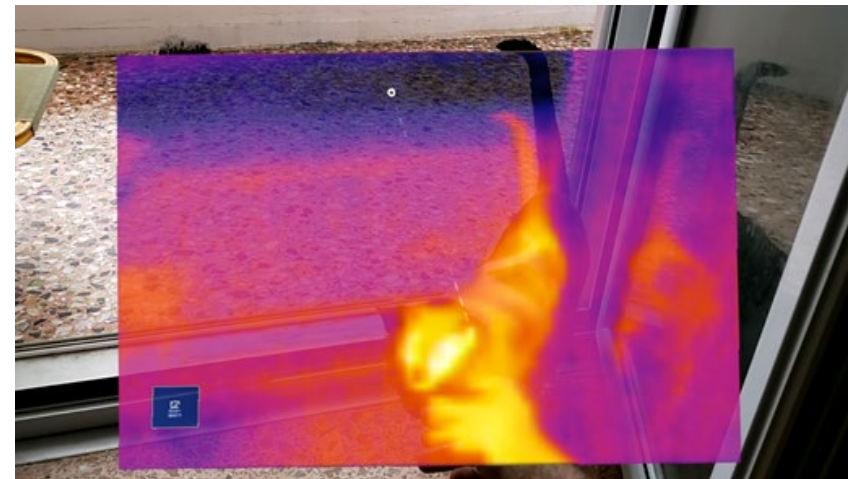
PC app (Server)

1. Connect Thermal Camera to Server
2. Choose camera to stream
3. Initialize Server

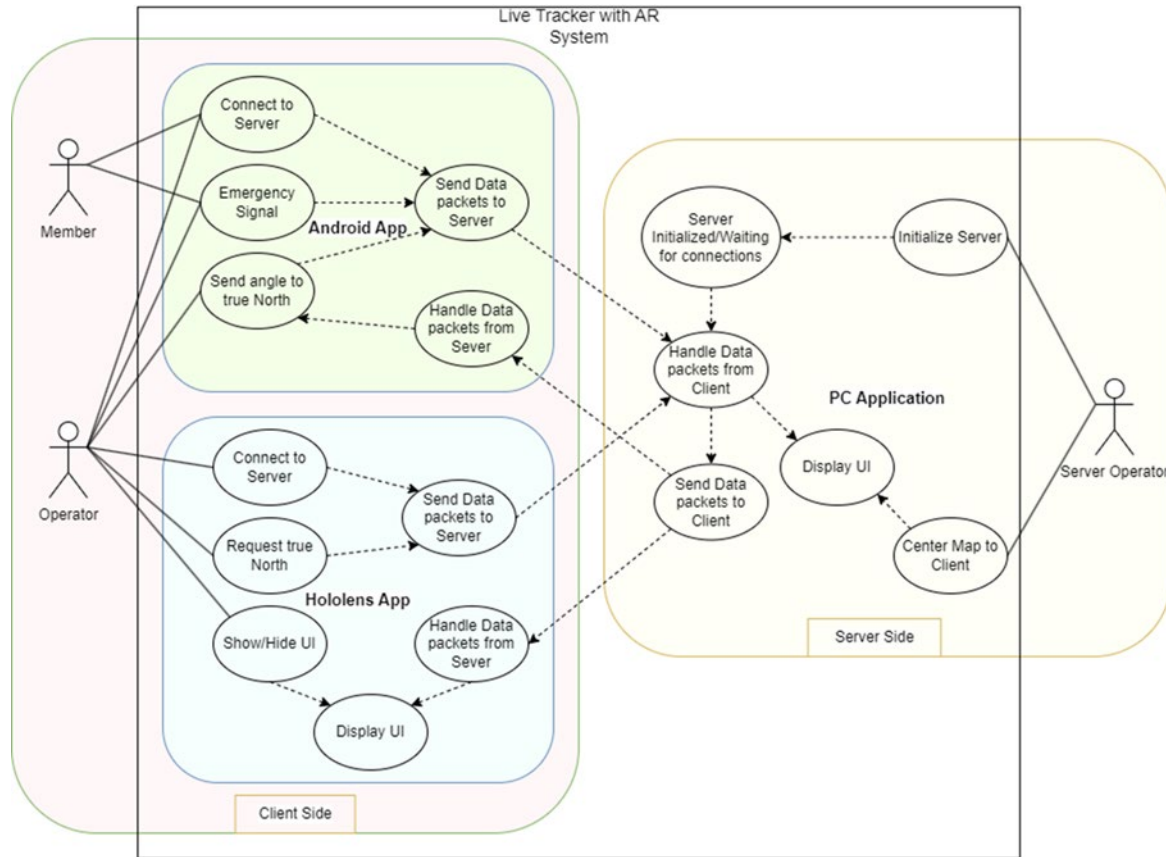


Hololens 2 app(Client)

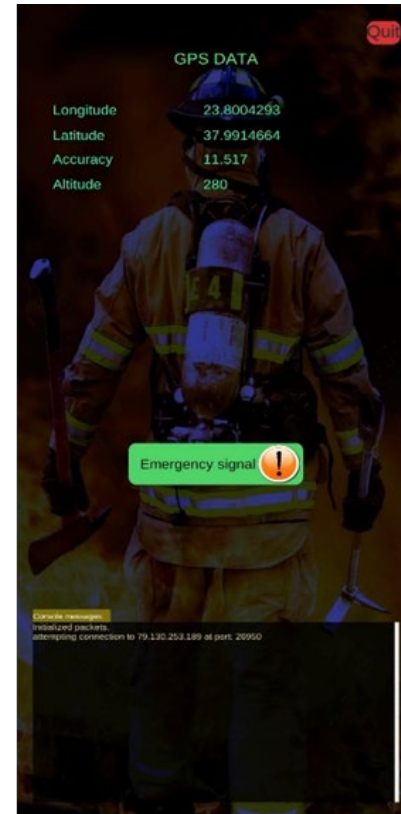
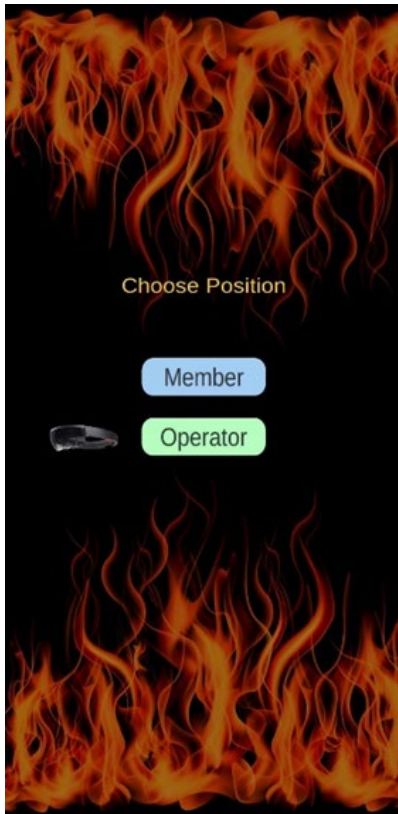
1. Connect to server
2. Turn ON/OFF thermal
3. Stream (Eye tracking)



Live Tracker System



Live Tracker System



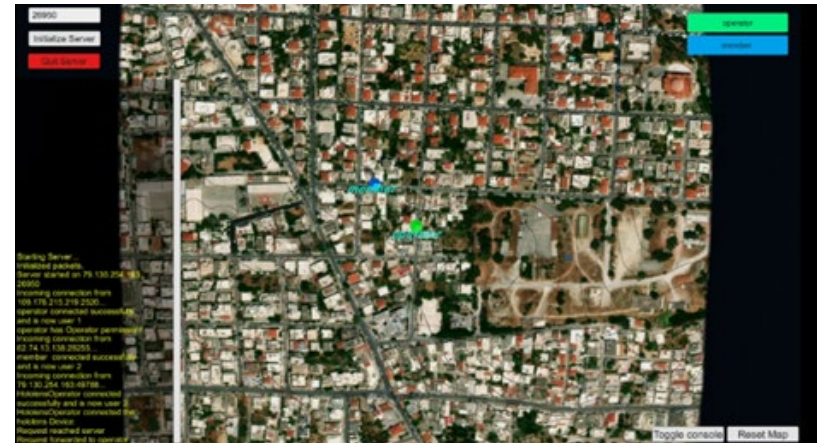
Android App(Client)

1. Choose role
2. Connect to Server
3. Emergency Signal
4. Exit

Live Tracker System

PC App (Server)

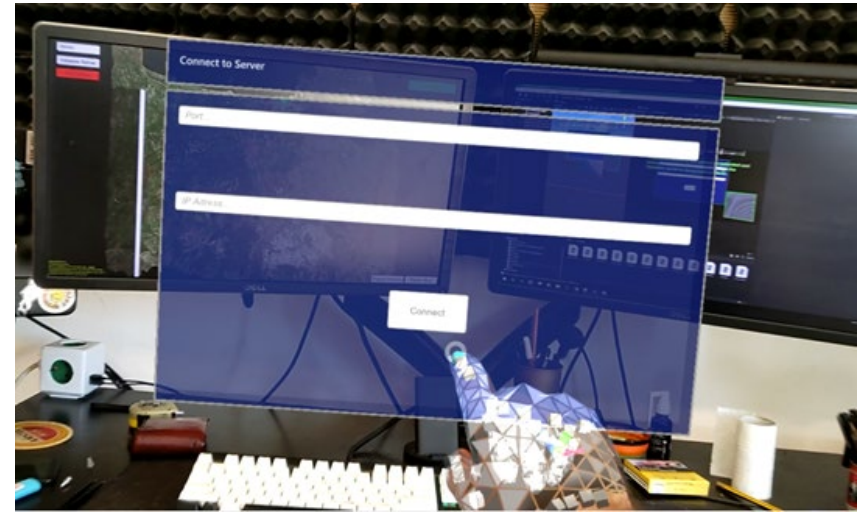
1. Initialize Server
2. Wait for Connections
3. Zoom in/out
4. Rotate Map
5. Focus on any Connected Member



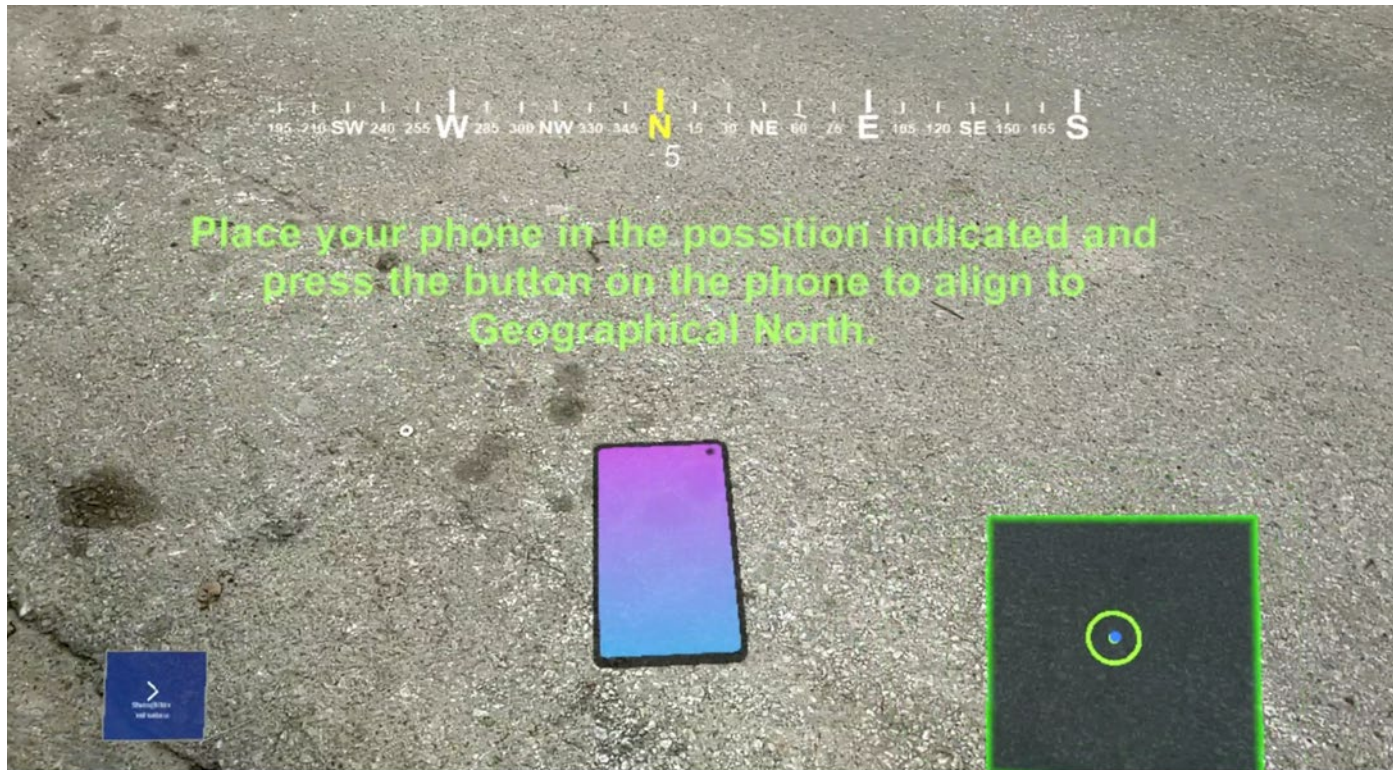
Live Tracker System

HoloLens 2 App(Client)

1. Connect to Server
2. Use Phone to get true north
3. Disable/enable Arrows (Eye tracking)



Live Tracker System



Testing & Evaluation



Conclusions

Strengths

- Thermal Imaging is effective.
- Hands free (during operation).
- Real time location tracking.
- Visual indicators are effective.
- Intuitive.

Weaknesses/Limitations

- Network connection.
- Device limitations.
- Latency.
- Lepton 3.5 image quality limits effective distance.

Future Work

- AR headset designed for firefighters.
- Smartwatch can replace smartphone and add functionality.
- Network infrastructure to ensure connection.
- Software updates.

Questions?