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# Integrating the 1st Person View and the 3rd Person View Using a Connected VR-MR System for Pilot Training

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# Integrating the 1st Person View and the 3rd Person View Using a Connected VR-MR System for Pilot Training

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# Background

- 1st person view (egocentric view): point of view of a pilot, landmark knowledge and route knowledge are egocentric (Wickens & Hollands, 1999).
- 3rd person view (allocentric view): point of view of flying bird, survey knowledge (e.g. traffic condition, shortcut) is allocentric (Wickens & Hollands, 1999).
- People depend more on egocentric view for spatial navigation (Fabroyir & Teng, 2018, Kallinen et al., 2007; Fillimon, 2015; Kosslyn, 1994; Millar, 1994)
- Allocentric view has it own intrinsic advantage (Milner & Goodale, 2008; Christian, Miles, Parkinson, & Macrae, 2013) and the combined egocentric and allocentric view will have many potentials for human spatial perception (Burgess, 2006; Ruotolo, van Der Ham, Iachini, & Postma, 2011).

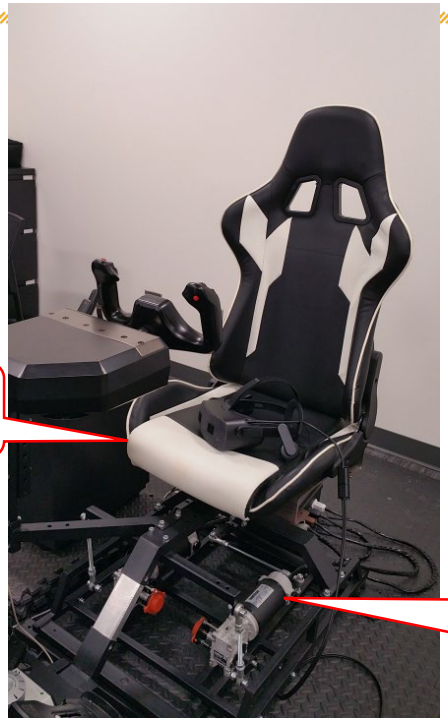
# Research Motivation

- Virtual reality(VR) / mixed reality (MR) technologies can be applied to flight training effectively.
- Most of research and development focus either on VR or augmented reality(AR) only.
- VR flight simulator provides pilot's egocentric view effectively.
- MR-based 3D graphics can be utilized for instructors' allocentric view for flight evaluation.
- VR and AR(or MR) can be integrated in computer systems
- Applying VR for flight operation and MR for regenerating 3D situations
- Objective design of a comprehensive flight training system applying both egocentric + allocentric view

# Project Outlines

- Integrating VR flight simulator and Microsoft HoloLens 3D graphics application
- VR simulator adopts X-Plane 11 (Cessna 172 for Part 141 flight school), HP Reverb VR headset, motion platform, and yoke/throttle/rudder pedal.
- HoloLens application development using Unity3D game engine and relevant toolkits to show 3D terrains and airplane movement above the terrains
- Connecting the two components via UDP network and synchronization
- While a pilot flies in the VR simulator, an instructor can monitor his/her flight from the bird-eye view (allocentric view) using HoloLens 3D graphics and the cloned cockpit view of X-Plane.

# VR Simulator Component

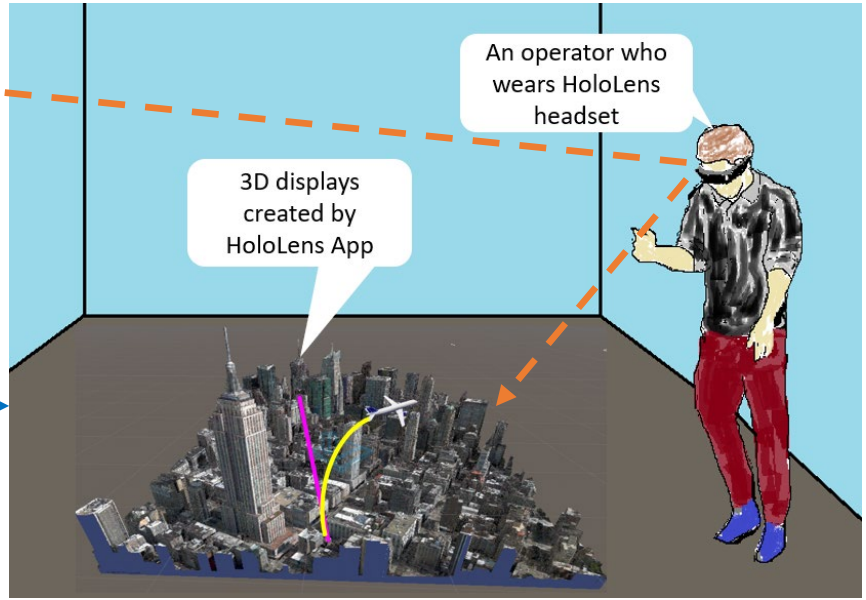
# System Structure

VR flight simulator

Cockpit view

UDP
connection

MR 3D graphics display (HoloLens)



# MR Flight Monitoring and Debriefing System (real-time monitoring mode)

- Video can be seen on the NTAS site Metadata page found here, https://commons.erau.edu/ntas/2020/presentations/43/ . Or it may be viewed directly on YouTube here, https://www.youtube.com/watch?v=CVbvO_DxPXY.

# MR Flight Monitoring and Debriefing System (replay mode)

- Video can be seen on the NTAS site Metadata page found here, https://commons.erau.edu/ntas/2020/presentations/43/ . Or it may be viewed directly on YouTube here, https://www.youtube.com/watch?v=EtnvwII9ESw.

# Empirical Test: Interview with Flight Instructors

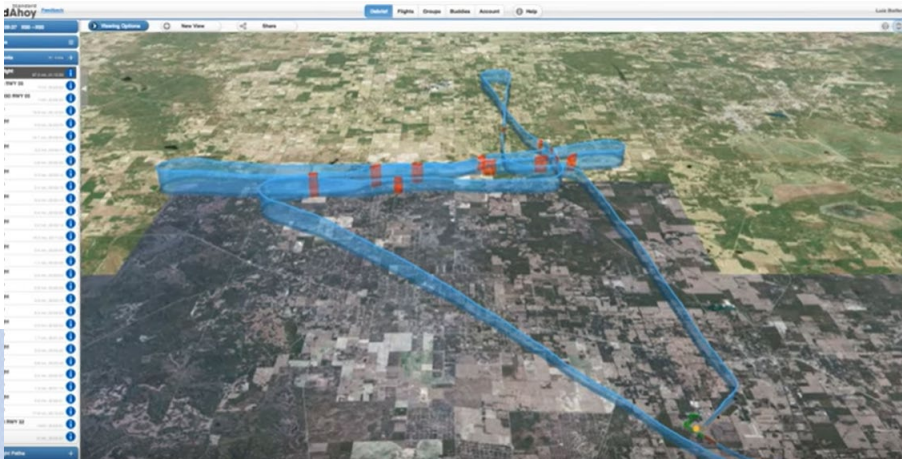
- 6 flight instructors were interviewed after experiencing the beta version of MR application connected to a VR simulator; the MR functionalities were not very accurate yet.
- Instructors' flight hours: 7300, 5500, 2700, 780, 730, 300
- Older senior instructor group had negative perceptions about the beta version due to the incompleteness of the functionalities, inaccuracies, and their own preferences of conventional debriefing and training scheme used for a long time (focusing on the cockpit view only).
- Comparatively, young instructors had good perceptions on the beta version due to the flexibility and more potentials of the MR technology use to point out more weaknesses of student pilots.

# Design Recommendations by Instructors

- **Additional MR components**
  - creating the recorded cockpit view video in a plat frame and placing it on the empty wall; enabling watching two references at the same time (cockpit view + 3rd person 3D view)
  - Adding alphanumeric information of altitude and heading to the airplane ID near the airplane graphics
  - Adding graphics of external factors including bad weather clouds, severe cross wind (arrow lines), and other airplanes.
- **Rescaling the airplane graphics depending on the magnification/demagnification function**
- **Adding eye tracking trajectories on the VR cockpit view for the sake of instructor**

# Comparison with An Existing 3D Application

- Google Earth provides a 3D-based flight trajectory function that may be helpful for flight debriefing (Cloudahoy is a software product)
- It visualizes 3D graphics on the 2D screen with a lot of flight information.
- Might have limitations of time for situation awareness and maintaining the frame of reference



# Discussions

- The effectiveness of MR-based real time monitoring and post debriefing system for flight training is yet to be clear.
- To show the clear effectiveness, the functionalities and graphics of MR system are accurate enough to compare with conventional schemes.
- Young instructors (may be more open to new technology use) perceived that the MR system had potentials for flight training.
- MR technologies are still flexible for additional augmented graphics and 3D functionalities.
- The MR system can be prospective for better perceptions by instructors with a more matured version.

# Future Directions

- MR application improvement: adding required information for flight operations in the proximal to interested airplane component
- Software development: the graphics in the animation effect should be more accurate for the professional use
- HoloLens capability: Interactions should be easier, and the viewing angle should be larger
- More study is needed to prove that the allocentric view can be helpful for the evaluation of flight training

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# Thank you!