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Exploring VR with PilotEdge in a University Part 141 Environment

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NATIONAL TRAINING AIRCRAFT SYMPOSIUM

EMBRY-RIDDLE AERONAUTICAL UNIVERSITY

PilotEdge and Virtual Reality in a University Part 141 Environment

KANSAS STATE UNIVERSITY, COLLEGE OF TECHNOLOGY AND AVIATION

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Background

- Early simulators such as the Link Trainer operated pneumatically.
- As computers became more readily available, software-based simulators became more readily accessible to the general public.
- At the aviation education level, there is a serious need for Part 141 collegiate based flight school to acquire and maintain expensive full scale mockups of regional and mainline jets.
- Modern Virtual Reality (VR) systems have the potential to disrupt the typical flight simulator model of a traditional full mockup of a cockpit.

Background

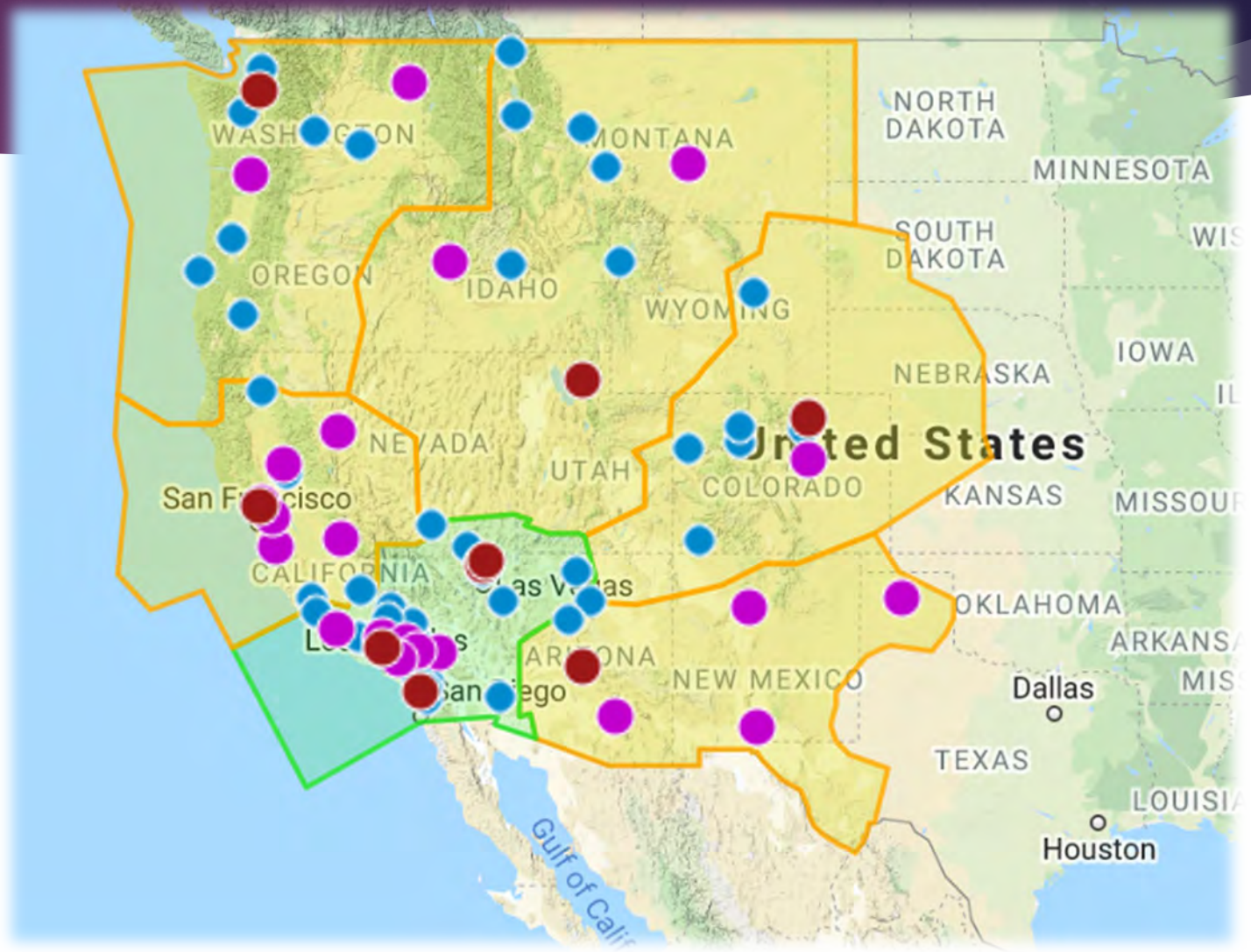
- At Kansas State University, all of our simulators became inoperative at the same time.
- Also, we need to construct new buildings for our newly purchased sims.
- As new hires to K-State (Aug 2019):
  - Dr. Pritchard brought the VR technology background
    - Assistant Professor of Computer Systems (Nerd)
  - Dr. Walden brought the Aviation & Flightsim background
    - CFI/I/MEI, 1969 Piper Cherokee Owner, Pro Pilot Faculty
- We wanted to explore the capability & applicability of the current state of Virtual Reality within a real environment.

Definitions for the Audience

- Flight Simulator
  - X-Plane 11
  - Arguably better flight model than Microsoft Flight Simulator X
  - Much more recently updated.
  - Fully compatible with VR “Steam”
- PilotEdge.net
  - Real People pretending to be Air Traffic Controllers on the internet
  - They get paid to do this!!!
  - Control Western Half of the United States.

PilotEdge.net

- Coverage Map



Research Objectives

- Exploratory Research
  - **Gauge** possible ideas for training when pilots are introduced to Virtual Reality (VR)
  - **Determine** if VR is a viable platform for Flight Simulators in 2019-2020
  - **Explore** the Realism of Air Traffic Controllers and Pilots in a Virtual Reality scenario

Observational Areas of Interest

- Ease of Getting Started
- Flight Control Effectiveness
- Visual Field of View
- Ability to Complete Training Missions
- Retention of Training Content
- Translation of Aircraft Layout
- Realism of Air Traffic Control
- Durability of Equipment
- Overall Effectiveness of VR System as a Training Aid

Student Pilot Group

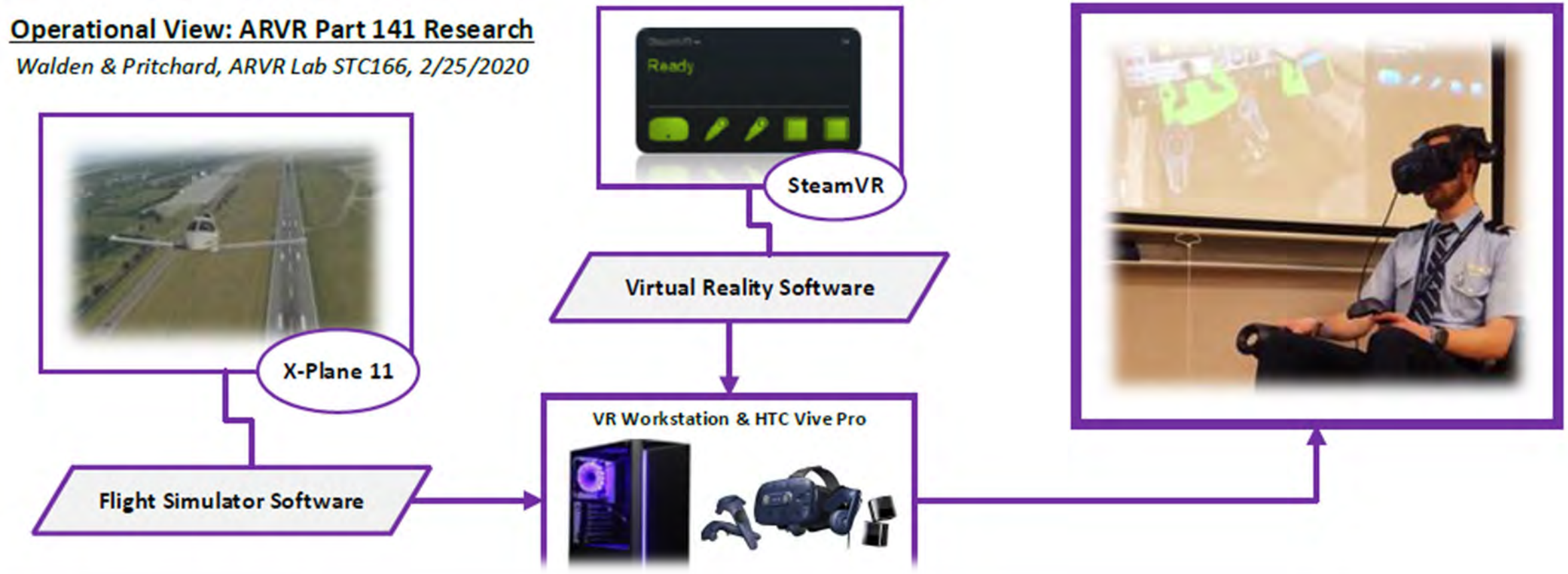
- 7 Professional Pilot Students
  - 4 Private Pilot (fixed wing) w/ Instrument Ratings
  - 3 Commercial (fixed wing) w/ Instrument Ratings
  - All from Pro Pilot Degree
  - 2 participants own an airplane
    - Cherokee 180
    - Cessna 140
  - Deliberately not looking for Student Pilots

Participant Familiarity with….

	Not Familiar	Slightly Familiar	Moderately Familiar	Very Familiar	Extremely Familiar
Virtual Reality	3	3	1	1	0
Flight Simulators	1	0	3	0	4
X-Plane 11	2	2	2	0	1
PilotEdge.net	4	2	1	0	0
Voice Command Software	2	2	1	2	0

Example: 3 Participants (Out of 7) **Not Familiar** with Virtual Reality

System Design, Part A



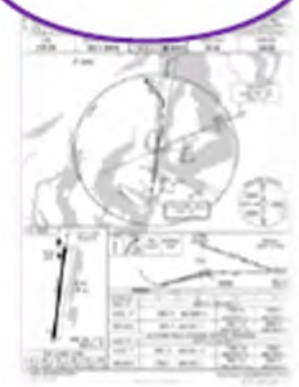
System Design, Part B

Approach Plates & Sectionals

Voice Control – Virtual Copilot

Online ATC – Live Connected Airspace

AviTab



PlaneCommand

PilotEdge

The Orientation Flight

- Participants were given **30 minutes of orientation before** connecting to PilotEdge.net
- Orientation flight consisted of introduction to:
  - VR Hand Controllers
  - VR Headset
  - Boundaries of the VR Environment (physical classroom space)
  - Operation of Yoke/Radios/Flaps
  - PlaneCommand voice control software
  - PilotEdge Push to Talk
- Students were then given “3 Laps in the Pattern” in a Cessna 172/G1000
  - Again – completely disconnected from PilotEdge.net but practicing their radio calls with their new “N172KS” callsign.

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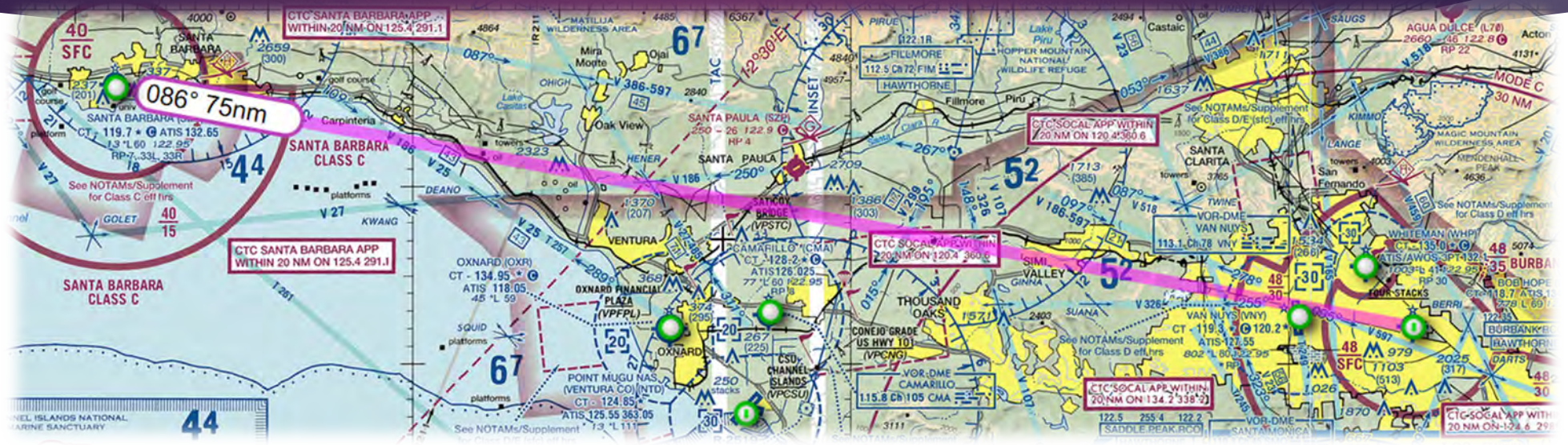
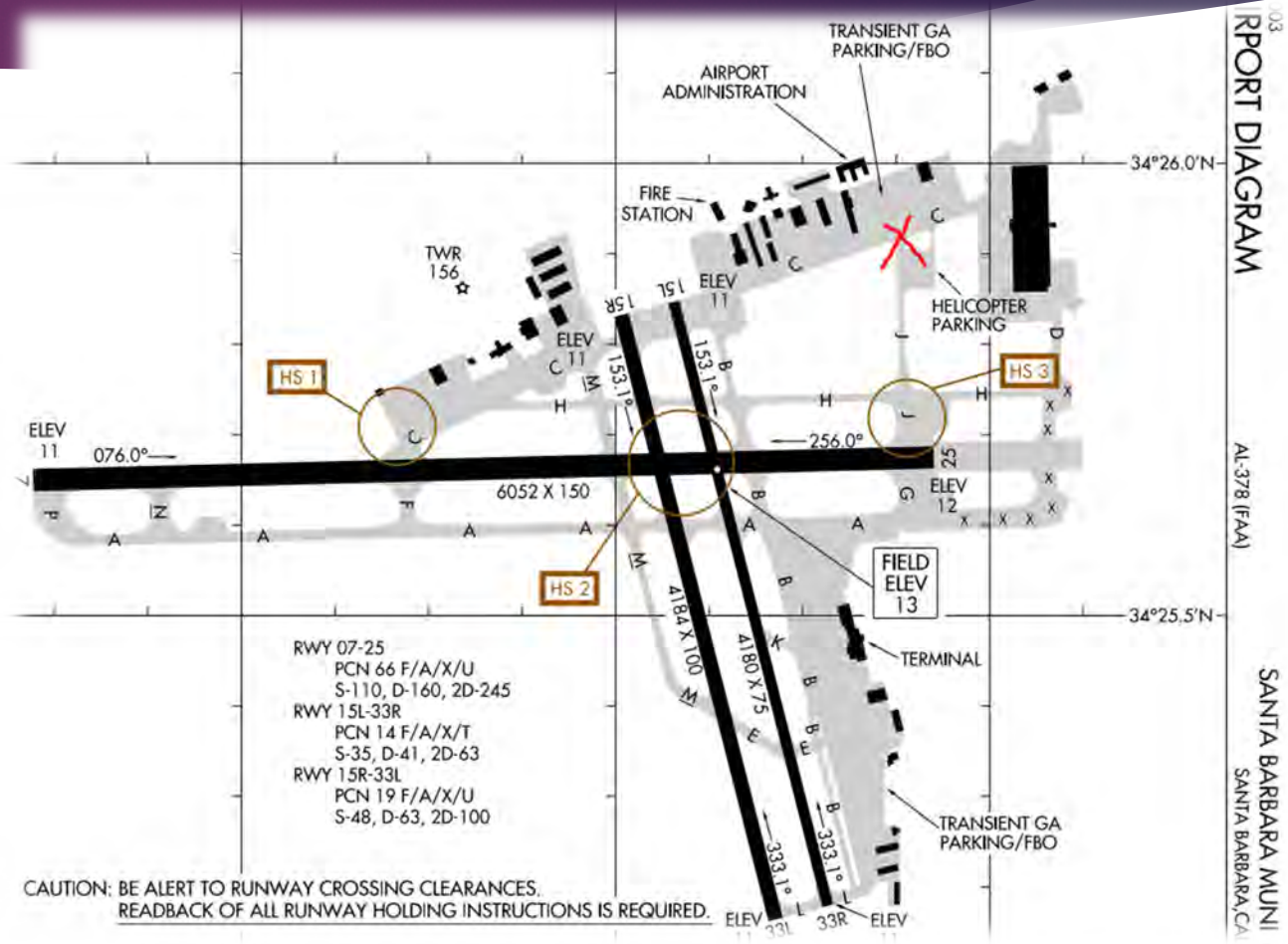
The Flight Plan!!!



- **VFR Flight Following**
  - **Why? Talk to air traffic control throughout the flight.**
- **Santa Barbara Municipal to Burbank, California**
- **Altitude: 5,500FT**

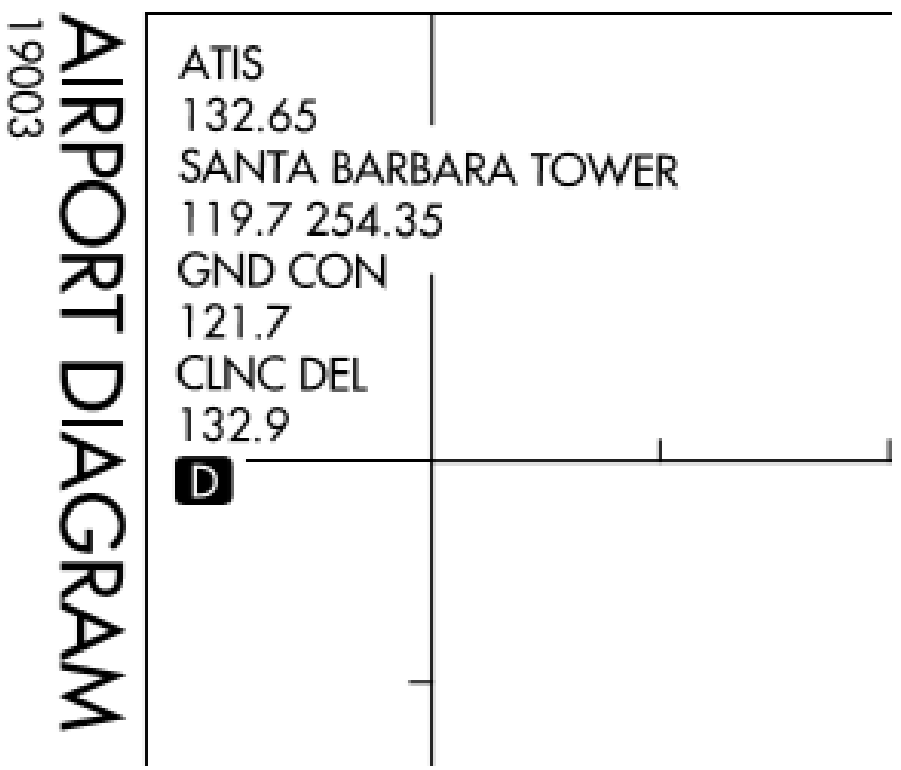
Starting the Flight

- The VR airplane was reset and given a starting position with easily recognizable locations
  - Intersection of Charlie & Juliet Taxiways
- Connected themselves “In-Sim” via the PilotEdge plugin in X-Plane
- Informed about the “seriousness” of PilotEdge.net and that the flight should be conducted as if it were real.



Getting the ATIS

- PilotEdge.net utilizes the ACTUAL AIR TRAFFIC CONTROL FREQUENCIES.
- “ATIS” – Automated Terminal Information System, is broadcast in X-Plane by actual Air Traffic Controllers



You know what?

LET’S GO LIVE!!!

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VR Lab Video

YouTube Keyword Search: “ARVR Part 141 Research”

Pilot Researcher Observations

- Participants would immediately acclimate in VR,
  - Example: Looking down for fuel selector valve, turning knobs with controllers.
- However, they would take “a minute” to adjust to live Air Traffic Controllers.
  - Would laugh awkwardly when missing radio calls.
- Even airplane owners with significant experience often disregarded instructions.
  - Due to not recognizing the new N172KS call sign?
- Simple commands to fly and maintain runway heading were often read back but ignored when flying

Pilot Researcher Observations

- The ability to write down instructions is absolutely vital.
- No moving map taxi diagram? Bad day.
- Virtual scratchpads, or “Mixed Reality” use of iPad allow pilots to make sense of the world they are in.

Researcher Observations (cont)

Keeping up in VR:

Scratchpad/Sharpie:

Digital notes:

Digital templates:

Researcher Observations

- It takes about 1-2 Hours for student pilots to get acclimated to the VR environment
- 2 Hours of being “plugged in” was not uncomfortable
- Hygiene: VR Cover Usage

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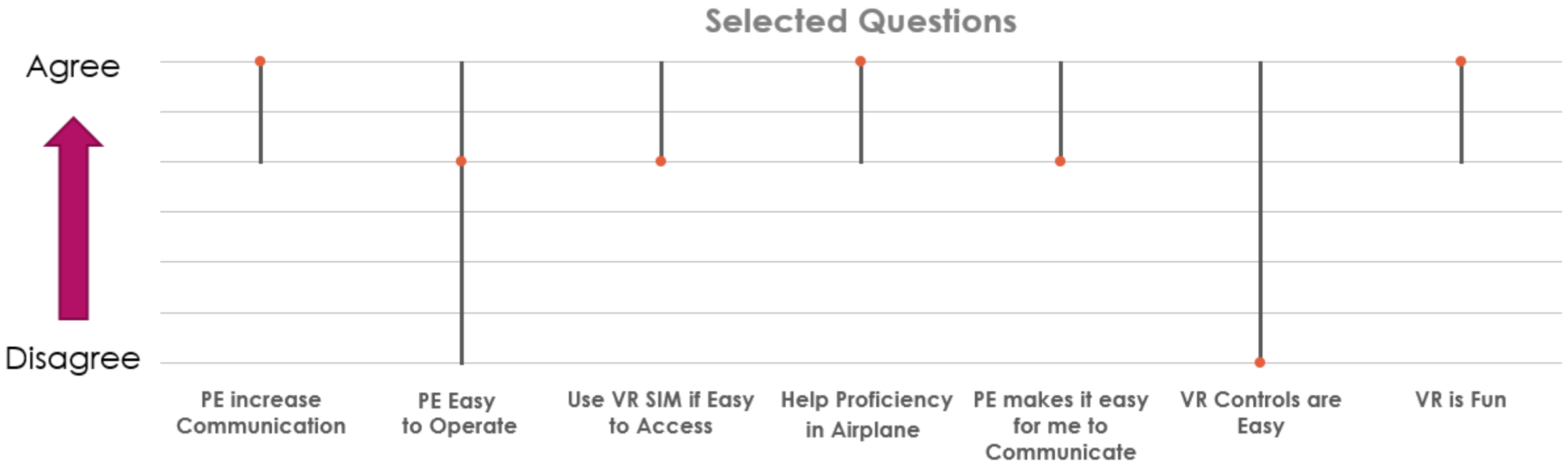
Results/Outcomes



What component of the simulator did you find the MOST useful?

- Communications and using **the avionics**
- The most useful thing about the experience was the **realistic visuals of the g1000** and getting familiar with the layout and changing things.
- **Avionics,** realistic controls
- The flight mechanics of the simulator was the most useful. Once I got used to everything and getting a feel for the simulator, it felt very real and easier to use.
- The simulator was really great at letting me communicate to ATC and following a real flight. The VR experience was great and was extremely easy to use especially once you were up in the air and flying.

What component of the simulator did you find LEAST useful?

- Audio was garbled, not clear with the VR headset and the projector speaker
- G1000 MFD
- The voice command to input frequencies was the least useful because most of the time I tried to input a frequency, it got it wrong.
- It was hard to read back a clearance to ATC after writing it down and taxiing to the proper runway was difficult too since it was hard to read any charts on paper or on my iPad. In cockpit using AviTab was easier for me.

What about the VR system impressed you?

- It was very easy to use. It was really quick to learn and get used to using. The system was very easy to use.
- Everything as a whole, it felt so real, truly enjoyed it.
- The realistic sounds and realism of the visuals was truly stunning.
- It was cool and fascinating
- The full functionality of the airplane.
- The realistic feel of everything. The motion in the simulator felt very real and responsive.
- How immersed you felt in the cockpit was great it felt like you were almost in the airplane and using flaps and throttle and tuning radio frequencies etc... was easier than I thought it would be.

Limitations

- The obvious for any scholarly work:
  - Student Pilots: Private Pilot w/ Instrument
  - Any research at a university will have a diet of undergraduates.
    - Even though we had pilots, they are still students at our university.
  - Not “diverse” enough with respect to previous VR or PilotEdge experience
  - Sample Size
  - Not generalizable: Exploratory & limited to KSU
  - “Time Boxed” the Orientation Flight.

Future Direction

- Pilot and Copilot shared cockpit
- CRJ-700 Simulator (CRM Class?)
- This study will help to standardize future studies

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Appendix

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