**Broad research topic:** Exploring new ideas in human centered computing/human-computer interaction via virtual reality. Emphasis on the human aspect of integrating and successfully being receptive to virtual reality cues in addition to completing normal non-VR tasks.

**Important Considerations**

* A CHCI system ultimately should provide an advantage over a traditional system
* Training may be required to produce said advantages
  + Ie, getting used to a new CHCI system

**Ideas**:

**Interactive User Interface for Teaching Tasks**

* User interface that helps determine ideal conditions for learning/accomplishing a task (ie, flying an aircraft)
* User interface that utilizes VR  to teach a simple flying technique with an adaptive interface
  + Simple techniques may involve taking off, turning, flying a pattern, landing
* Different scopes of interface assistance and cues
  + No cues
  + Minimal cues based on user experience (positive and negative feedback)
  + Increased cues (potential for analyzing the burden of having too much information)
* Finds optimal combination of user interface interference and user independence for most successful learning experience
  + Measured by success in accomplishing a task, rate of improvement, user experience/satisfaction, other biological responses (heart rate, brain waves, etc)
* The interface may be an add-on to traditional interfaces (ie, a flight simulator)
  + The add-on = a VR glass with visual, audial, and potentially mechanical feedback
* May not necessarily have to do with aircraft; potentially use other avenues as long as the result provides increase of knowledge concerning user learning
  + Driving
  + Walking a route on a map
  + Other simple tasks (learning to play the piano, typing on the computer, etc)

**Multitasking**

* Interface that allows user ease of multitasking
* ie) F-35 pilots controlling drones while flying their aircraft
  + Primary task - piloting the F-35
  + Secondary task - directing the drones
* Think about: is there an efficient way to maintain the traditional flying method/technique of an F-35 and add an intuitive, easy way of controlling the drones around it
* Assumption: drones are autonomous enough to maneuver and fly with the F-35

**Computer Vision-guided Navigation System with AR**

* Person uses a headset display that provides dynamic information about the environment around them
* Information:
  + Map
  + Direction/heading
  + Obstacles around person
* AR may be used to provide cues in the user's peripherals to indicate an obstacle coming toward them
  + Ie, blinking lights and sounds
    - Red = danger, yellow = caution, green/white = normal (light not displayed)
* Scenarios:
  + Scenario 1:
    - Person walking from A to B will be able to watch out for cars and other obstacles moving at relatively fast/dangerous speeds
  + Scenario 2:
    - Person riding a bike
  + Scenario 3:
    - Person operating a motor vehicle
    - Attach additional sensors on the vehicle's side and rear to allow for a 360 degree POV
* Co-Adaptive Aspect:
  + System will keep track of user interaction, learn user's habits, and modify the amount of assistance needed
    - Ie) a regular jogger may not need an alert every couple seconds as opposed to an elderly user who has a consistent and much slower pace
* End goal:
  + To provide a safe tool for drivers to operate their vehicles for the purpose of avoiding traffic accidents
  + Additional goal: to provide users with a safer, easier method of utilizing map navigation while driving

**AR with Smart Phones**

* Nothing too specific, but perhaps, shape my research to take advantage of the relatively new, and unexplored aspect of utilizing AR via smart phones

Tool for group collaboration

* Separate individual user notes with group activity screen
  + Half of the screen: individual, private notes
  + Other half: shared group screen where all members can dynamically edit
* Allow ease of transferring notes between individual to the group

Sight Enhancement via Machines

* Situation 1:
  + Blind people need assistance to navigate around unfamiliar environments
  + Machine takes sensor data and provides user with information on their immediate environment
  + Possible ways to implement
    - 1
      * Video camera records the environment in front of the user
        + Walls, objects
        + Emphasis on avoiding
      * Data is analyzed real time to view results
      * User receives data via
        + Haptic feedback (certain patterns may mean certain things, situations, etc.)
        + Sound (audible explanation/words/phrases provided to user)

* 2
  + Does it have to be a video input?

User modeling

* Model user interaction with a program
  + Ex 1:
    - Various mouse inputs can tell whether user is left handed or right handed
  + Ex 2:
    - User's mouse controls are analyzed and show that user might be stressed, so add in a stabilizer for the mouse input?
      * Adapt the stabilizer conditions based on how user's behavior changes
  + Ex 3:
    - User pilots an aircraft via simulator
      * User attempts a steep turn
      * The steep turn is too shallow, so the program adapts by providing indicators to increase left or right stick input
      * Essentially, the program takes user input and provides output to user until user fixes the problem
    - User is inexperienced at flying simulators
      * The program adapts to user experience by auto-flying certain aspects of the controls
      * Ie, a user might struggle with a turn
        + Program would control the pitch and yaw, while the user would control the roll
  + Ex 4:
    - User uses a spinning dial to write words
      * The system analyzes the user's errors and provides haptic feedback for when the user should stop spinning the dial to land at the letter where they really want to land

* Ex 5:
  + Teaching a route to a person
  + Person goes from point A to B via a particular route
  + The program keeps track of user position and provides directions
    - The program adapts to user's compass heading and provides more feedback when needed

* Ex 6:
  + Take user's heartbeat
    - The level of stress/excitement can be measured and adapt to the user's task at hand
  + Ie, flying an aircraft simulation
    - More or less data will be available depending on the stress level
    - More or less user interference for autonomous flying will be available depending on the stress level
  + What other tasks can the user be doing based on heart beat levels?
    - Controlling a drone
* Ex 7:
  + Eye-gesture recognition
    - Figures out when user is closing their eyes or gazing away and predicts if they are focused on the task at hand
    - Potentially automates a task if user is not attentive and simultaneously alerts user of attention deviation
  + Possible to integrate this with AR or VR
  + This contains the user modeling aspect via adapting to user interaction with a task monitored by a program that keeps track of task progress and user attentiveness
    - Computer constantly adapts to user's attentiveness and adjusts its level of cues to gain back human attention
  + This contains the computer vision aspect by recognizing patterns of the person's eyes/gaze
  + Possible task at hand:
    - Taking a class
    - Watching a video to learn something but also needing to write something down on a piece of paper or needing to look at a different monitor for other information
      * Potentially, the program can alert the user of something important coming up in the video that they should pay attention to
  + Question to consider:
    - Does it matter what task it is? It might not. We might just care about identifying when someone is attentive or not.
    - Ie, when someone is speaking to you but you're not really paying attention
  + Experiment:
    - Give a task to user via computer screen in a certain amount of time
    - Measure user's eye movements and patterns
    - Record effectiveness of task