

Visualizations + Interactions

for

Adverse Weather Planning

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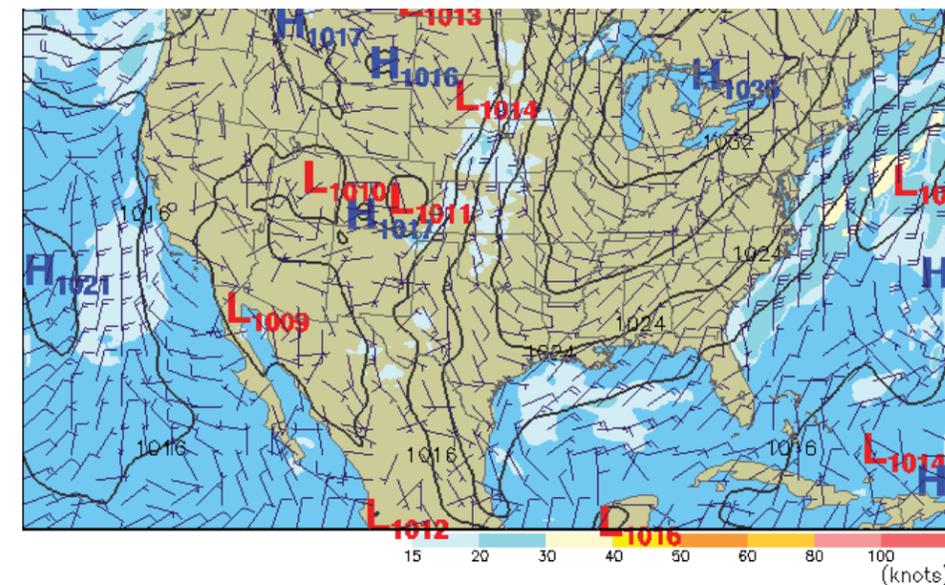
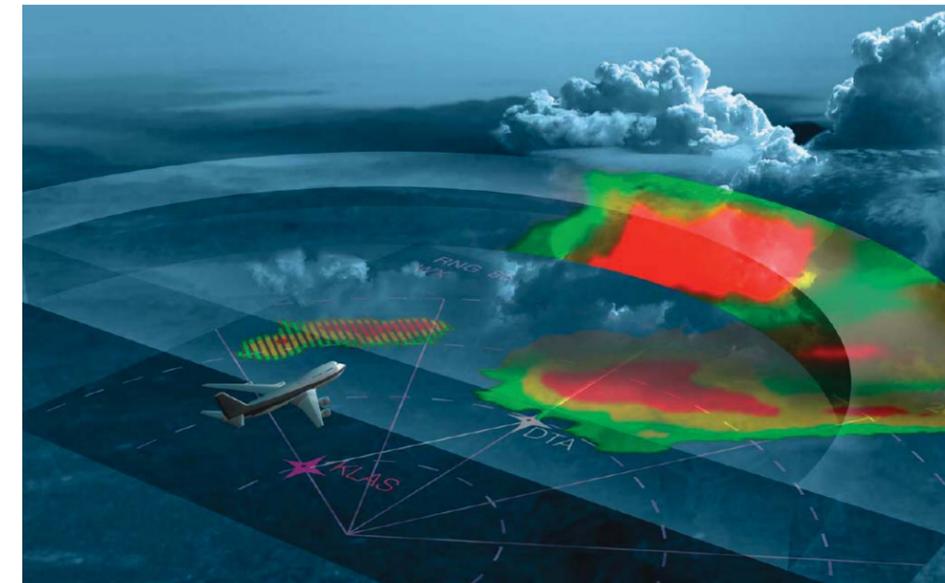
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Research

We began by examining individual tasks required throughout the flight process. Pilots are challenged with pre flight planning and we were immediately drawn to checklists. Currently, one pilot runs through a series of checks and then this information is verified by the co-pilot. No collaboration is performed or accommodated to complete these checks. The current cockpit space does not facilitate the pilot interactions we feel will lead to timely and accurate decisions being made. Implementing a system into the cockpit that encourages collaboration was of great interest to us.

“weather is one of the top three problems pilots encounter regularly.”

We found that navigation through adverse weather conditions was one of the top three concerns of a pilot during flight. Weather information - top (plan), side and even 3-D views - are currently delivered to pilots in 2-D form. There are no interactions available with the data beyond pilot presets of the equipment. New technologies such as the Microsoft Surface would give pilots much more interactive views of weather. The Microsoft Surface provides a great surface for multi-touch interactions; however, a flat surface would have difficulty in accounting for 3-D information, especially where the curvature of the earth is involved.



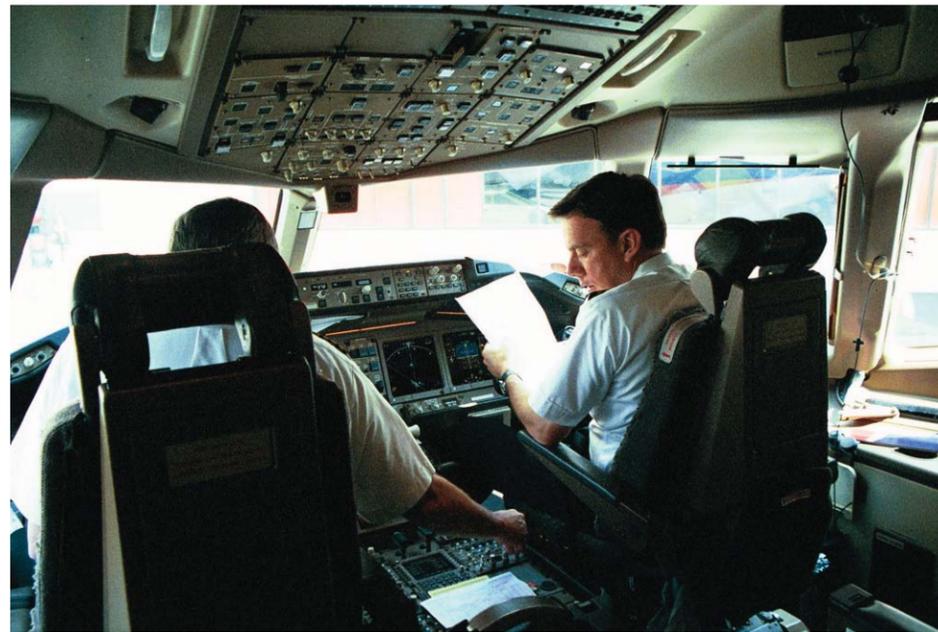
TOP TO BOTTOM:

Honeywell IntuVue 3-D Weather Radar
Microsoft Surface
Wind visualization provided by NOAA's National Weather Service

Problem Space + Goal

Goal:
To clearly display weather information in the cockpit to allow for fast and accurate recognition and response to adverse weather situations.

Pilots are currently informed of inclement weather that is ahead in flight; however, they have no tools at their disposal to aid in making tactical reroutes around such obstacles. Giving pilots all the information they need is a difficult task because weather is constantly changing, but it is important to provide them with accurate, up-to-date information in order for them to identify safe and effective route changes. Current weather detection systems only provide weather data in 2-D form for pilots. This 2-D weather information is difficult for pilots to interpret in order to make the best decisions.



We are looking to provide pilots with a 3-D model of weather in order to give pilots an opportunity to see the airplane's relative position to adverse weather. Our display will have to indicate the weather ahead in a dynamic, interactive, multiple display interface by optimizing space and time factors. It must also efficiently convey to the pilots an intuitive mental model of the weather.

Design Objective

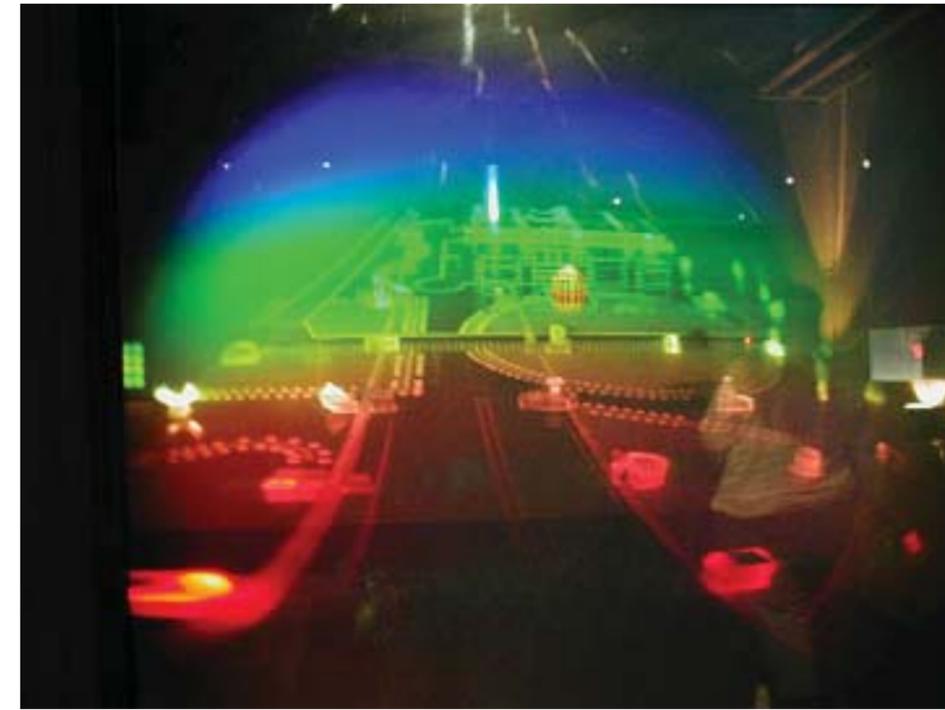
Better weather visualization system

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Better tactical re-route in free flight

Our main design objective is to allow for better understanding and reaction to weather by displaying 3-D and 2-D top (plan), side, and 1st person weather views that are more conducive to pilot-controlled route changes around weather hazards. It will also foster interactions between the pilot, the weather displays and ATC when planning re-routes in cases of turbulent weather.

We decided that allowing multiple perspectives that showed the relationship between the plane and the weather would optimize pilot-driven decisions when they are confronted with adverse conditions. With our aim to encourage collaboration between the flight crew, we suggest developing an instrument that would help facilitate partnership as well as independence. The perspectives would be shown as a 3-D hologram and 2-D views through a newly designed instrument. These views would work together by mimicking views in their respective form as weather and route options are being manipulated. We believe that our approach would allow a more intuitive approach when planning route changes around weather hazards.

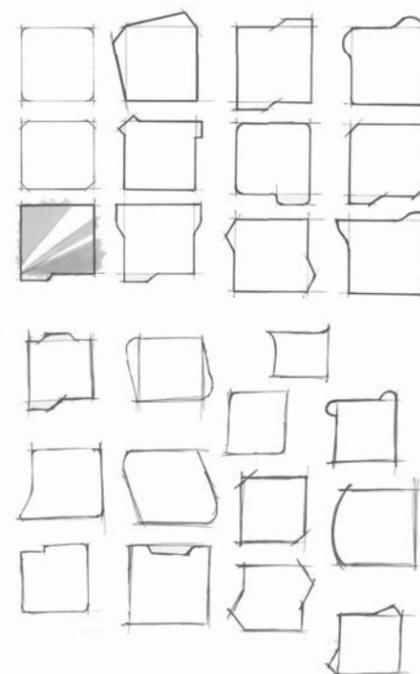
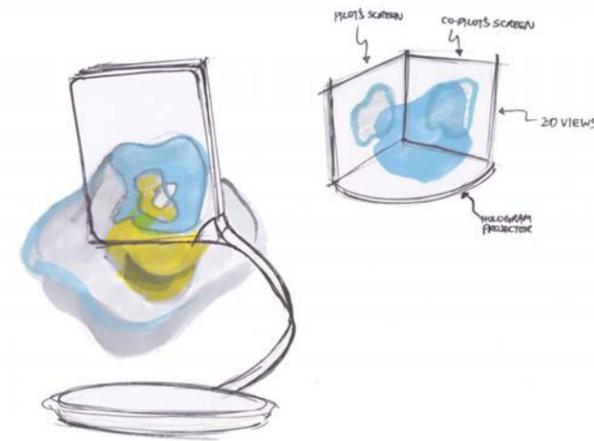
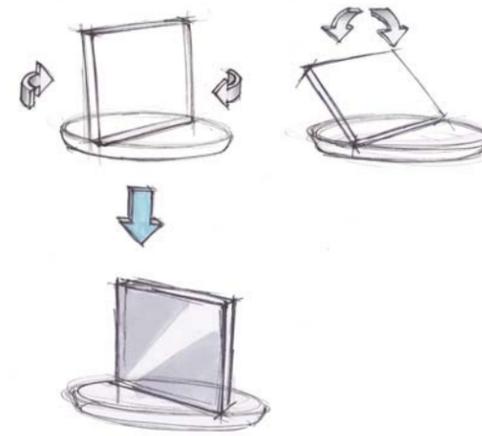
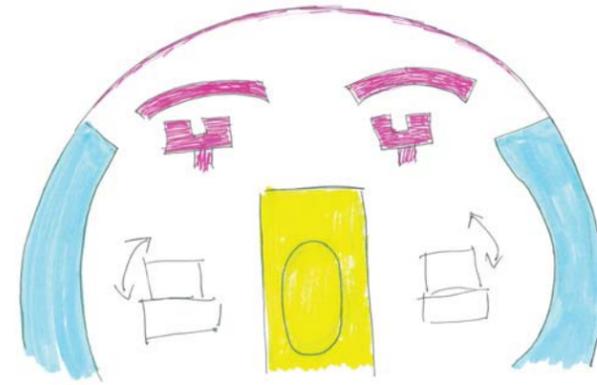
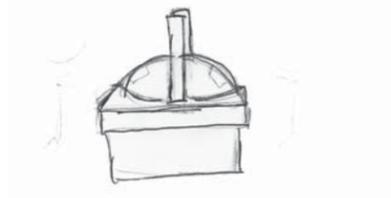
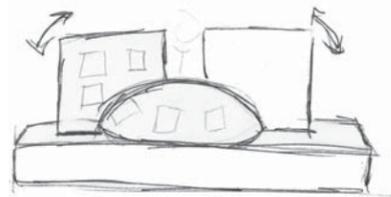
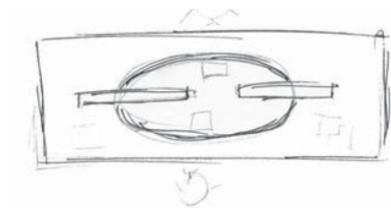


Design Process

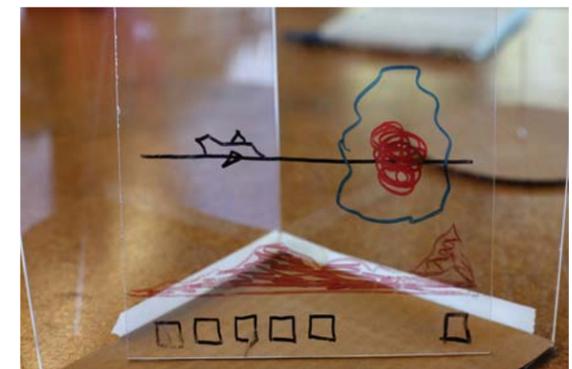
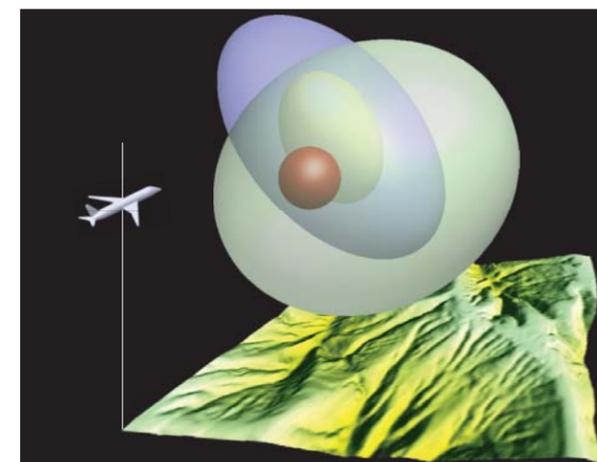
There are a number of factors that drove our design, two of the main driving factors being: that weather is hard to represent and there is already technology that we can expand upon.

Future weather is difficult to be accurately and quickly displayed for pilot operations because it is dynamic by nature. In order to gain a holistic view of weather, pilots need to be able to see how weather moves in space and time.

Yet, only a 3-D model of weather is not enough, 2-D views are important to keep as well. These views facilitate multiple modes in which to view weather, thus expanding on the information pilots have available to them.



We began by looking at spherical surfaces. However, it quickly became apparent that a physical 3-D display would interfere with pilot collaboration by obstructing views of important information. The implementation of a hologram into our system became the best option. LCDs for flat or spherical screens are terrific technology; however, 3-D, rather than "flat screen" is the ultimate display goal of our system. We sketched various forms that would allow a clear representation of the weather while leaving enough room for pilots to manipulate information as needed.



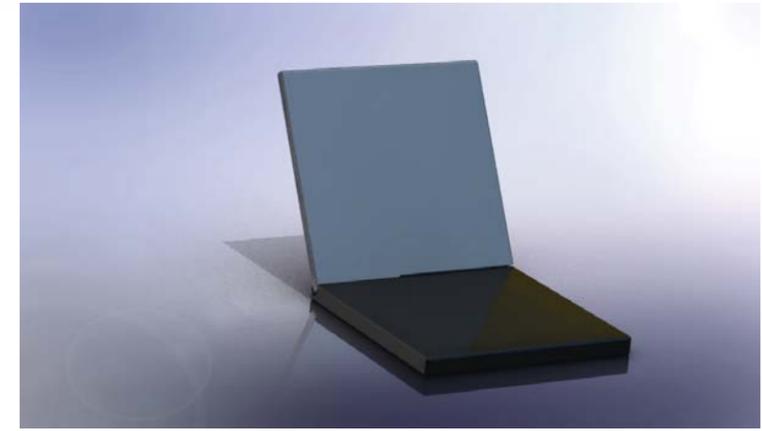
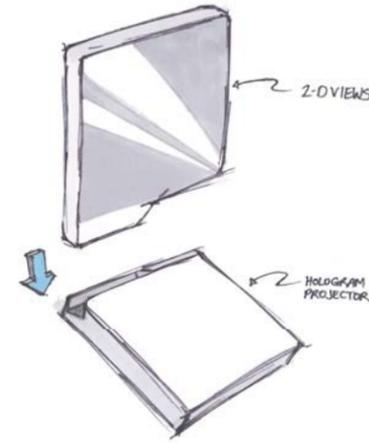
Final Design

Our final design is made up of three parts (the Hologram, Screen, and HUDs). The HUDs and Hologram connect to Screen so that any changes that are made via the Screen are reflected in both the Hologram and the HUDs. These mirrored changes let both pilots see what modes and views are being selected along with other commands.

Hologram

The Hologram is the most innovative feature in our new system. This unit is shared by the two pilots and is located between both pilots.

Information pertaining to weather systems, route, and terrain is shown in a 3D holographic view. The Hologram provides the pilots a changing 3D model of the obstacles ahead, which is currently missing from current weather displays. The Hologram is solely for observation as all manipulations to what is shown is done using "the Screen."



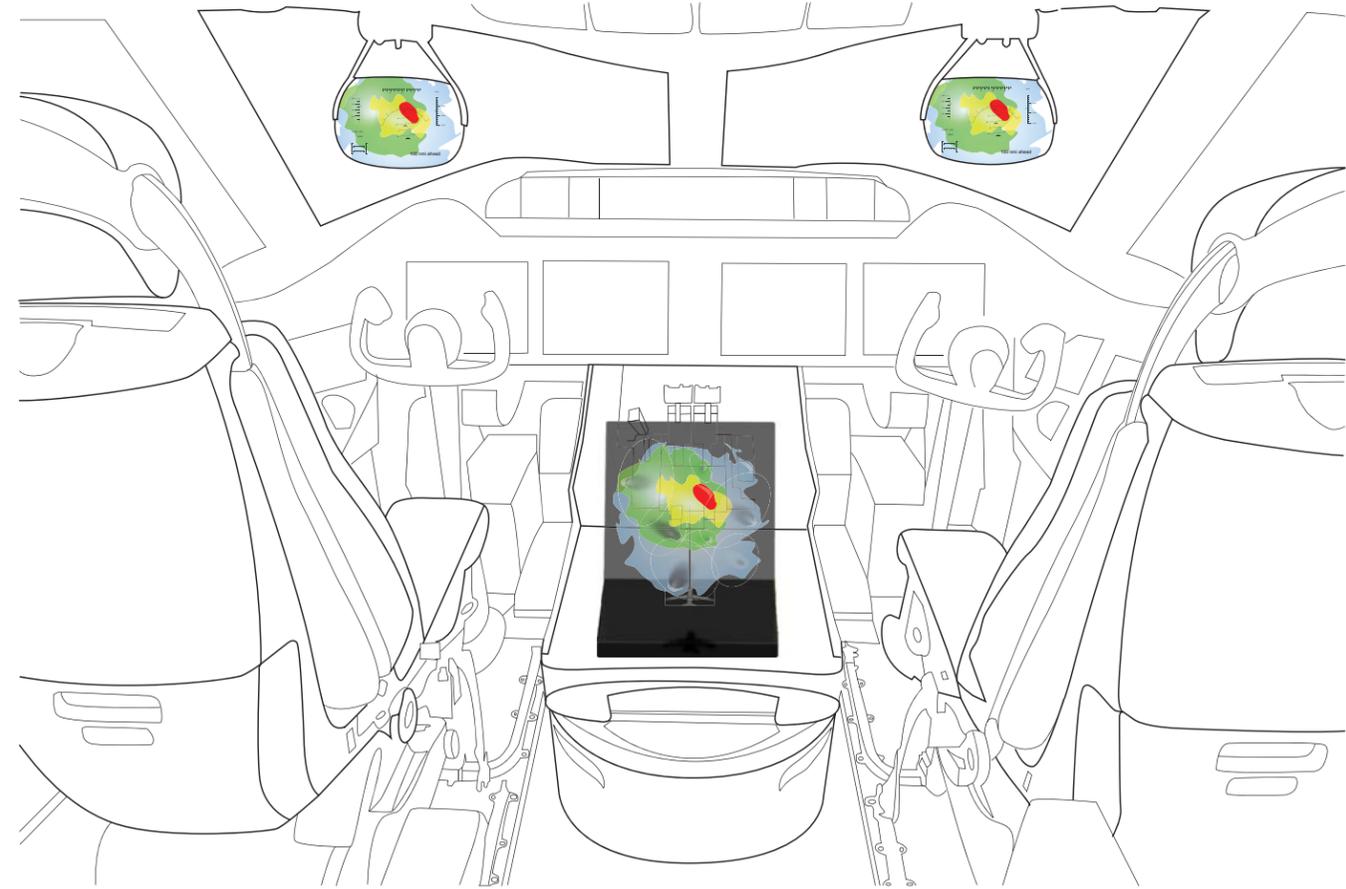
Screen

Our screen acts as a tool to interact with the larger system. The screen is used to manipulate what is shown on the hologram, as well as capture information directly from the hologram itself. Simply placing the screen into the hologram will provide pilots with the 2-D representations of that plane and weather. These views of information can then be directly manipulated by the pilots in order to reroute the aircraft.

Different weather systems views can be selected so that the pilot is always viewing the most relevant information to them at a given time. The 2-D display also shows the current route as well as the surrounding weather systems so that simple drag and drop actions can allow pilots to test alternative flight paths. Since the device is hand held, the Screen can be passed back and forth between pilots for double-checking purposes. Once a new route is confirmed it can be directly submitted to ATC for approval.

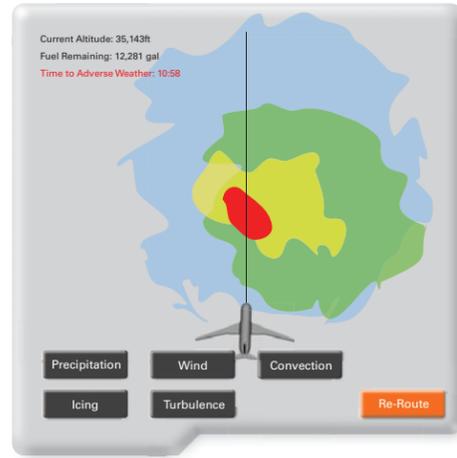
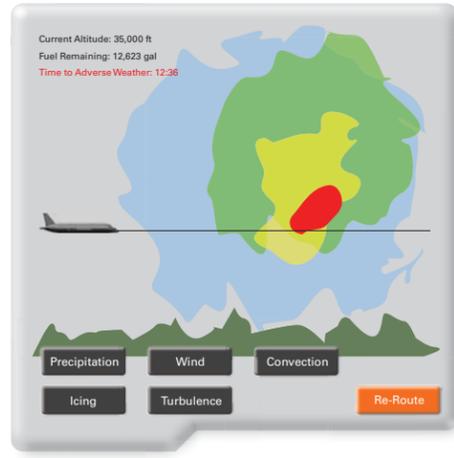
HUDs

While not interactive, the each pilots HUD shows previews of weather at chosen distances in the future. These previews are only used in cruise and display 1st person views to help pilots visualize the weather they may be encountering.

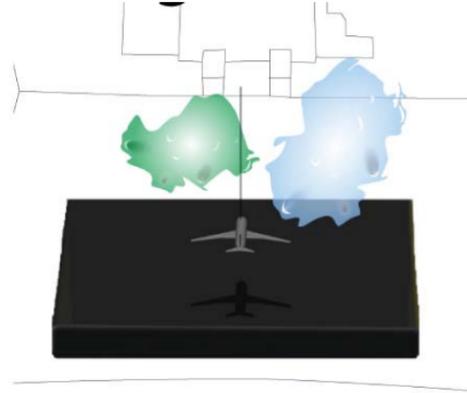


Scenario

Warning



Hologram Modes



Re-Route



Big Picture

We see our tablet system as something that can be used as a base platform for further development and research. We feel that the need for a mobile, synchronized device in a cockpit is there and once the idea is refined and further researched we feel that this could be a positive and helpful tool for pilots. Our system implicates many advance features that can be put into place after the tablet system is actually built. In the future we can imagine that our tablets are fully implemented in cockpits and we see that pilots can now quickly maneuver through weather and quickly reroute and avoid bad weather. A future possibility for our tablet could be a universal pilot device. Imagine the tablet being able to translate languages and writing so that pilots of two different nationalities can now fly a plane together. Of course this is far ahead into the future, but with our design of the tablet we believe it will be clear skies ahead!

