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Augmented Reality Technician Assistance Program

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Presenters

Jackson W. Volante, Kidron R. Filbrun, Jeffrey T. Deane, Andrew T. Carr, Nathan A. Harold, and Daniel J. Eckley



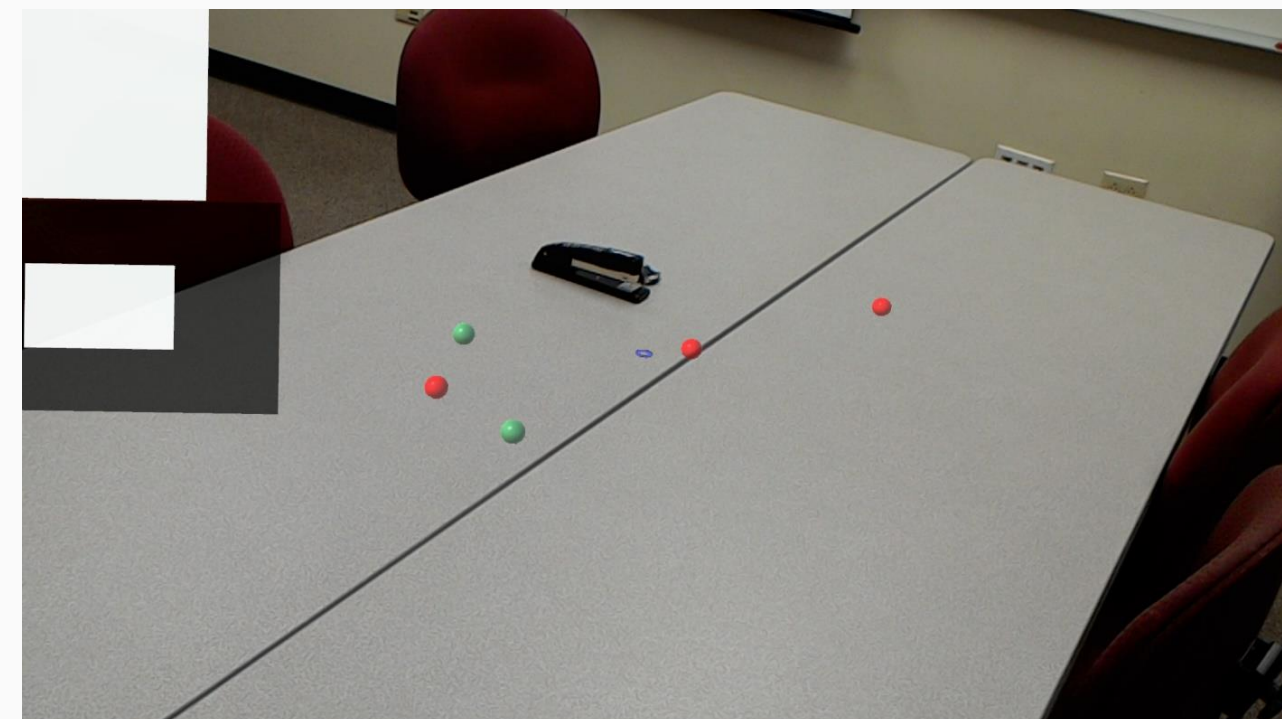
Augmented Reality Technician Assistance Program

HoloLens Application



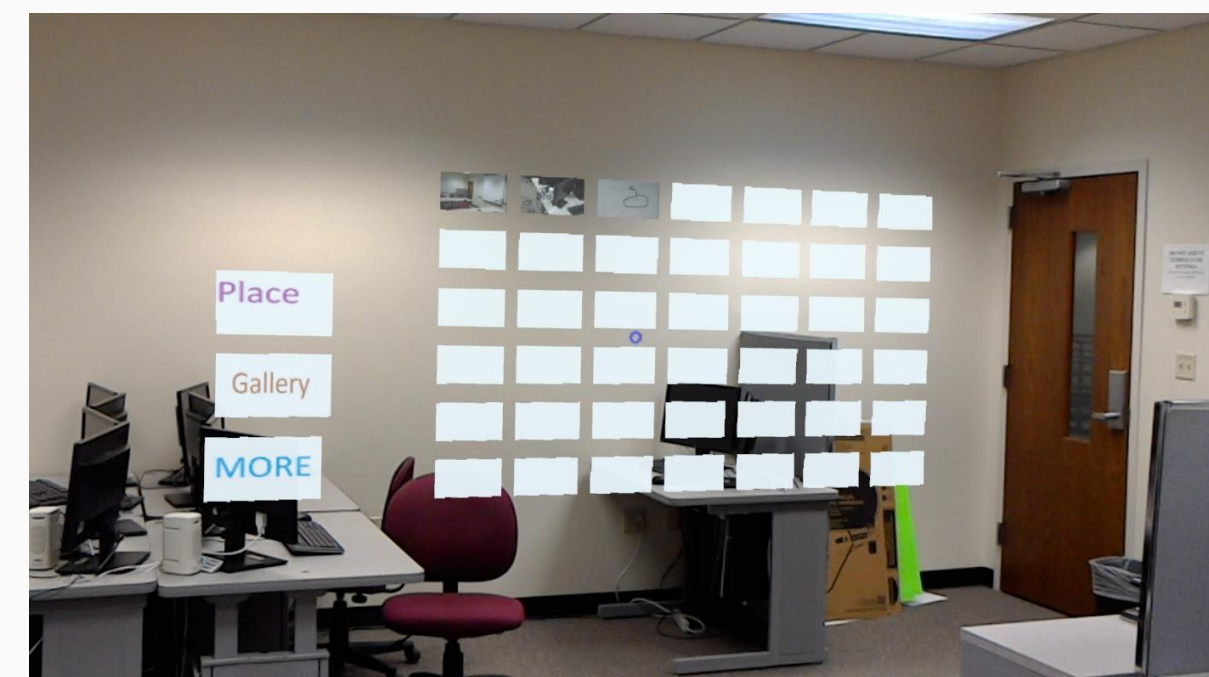
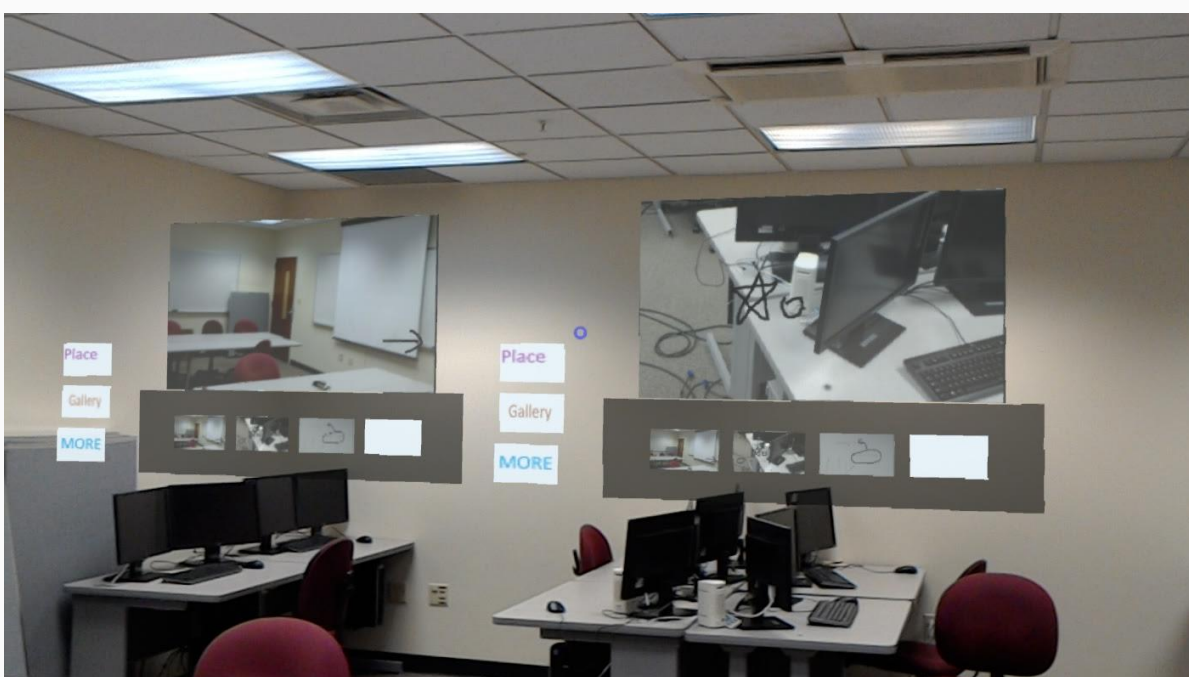
The HoloLens allows a user to carry a full computer on their head, and interact with it mostly hands free. This is useful for a technician working with tools.

When editing a screenshot from the HoloLens the expert can select a location on the image to place a marker in the 3D world. The Surface Pro sends a pixel value to the HoloLens which then uses the technician's viewpoint to trace a ray through the 3D real world geometry and place a marker where that ray intersects a physical object. The red and green balls in the image were created using this method.



Pictures are captured by the remote expert, annotated, and sent to the HoloLens so the technician can view them. Past images can be selected from a gallery, or from quick access bars below the pane displaying the most recent image. Multiple viewing panes can be created so the technician can have many pictures open at once.

The interface of the HoloLens Application was kept simple, as to not distract the technician from his or her task.

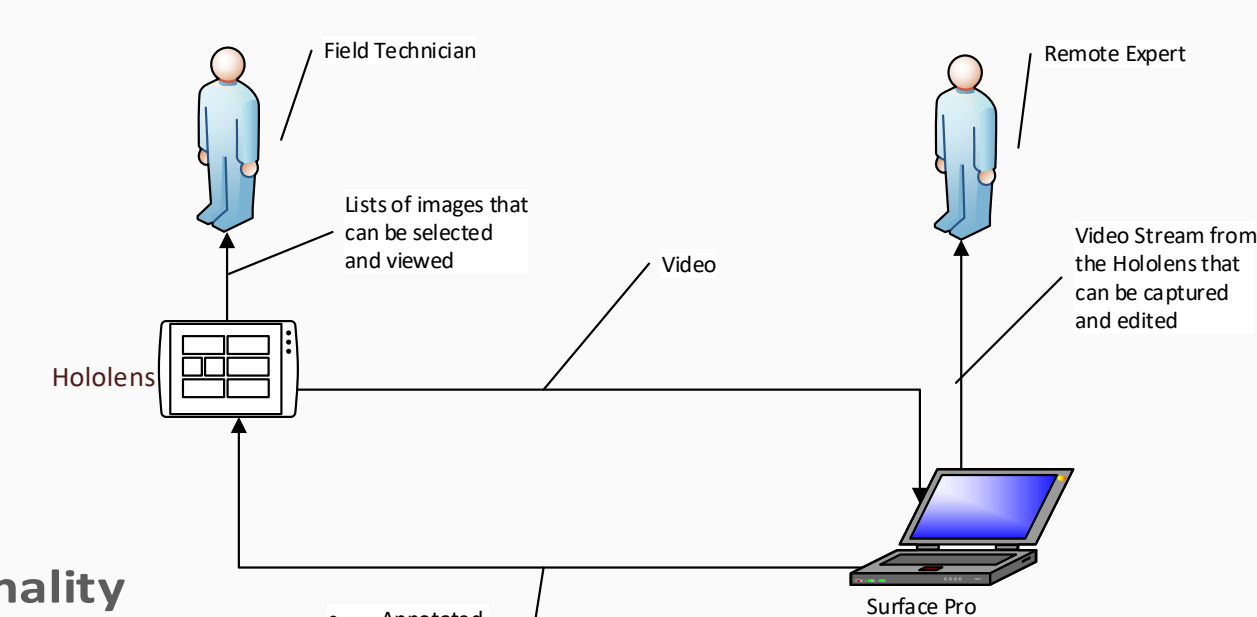


The application we are developing for the HoloLens uses 3D geometry. 3D holographic apps are supported through a pre-release version of the Unity Game Engine built specifically for the HoloLens.

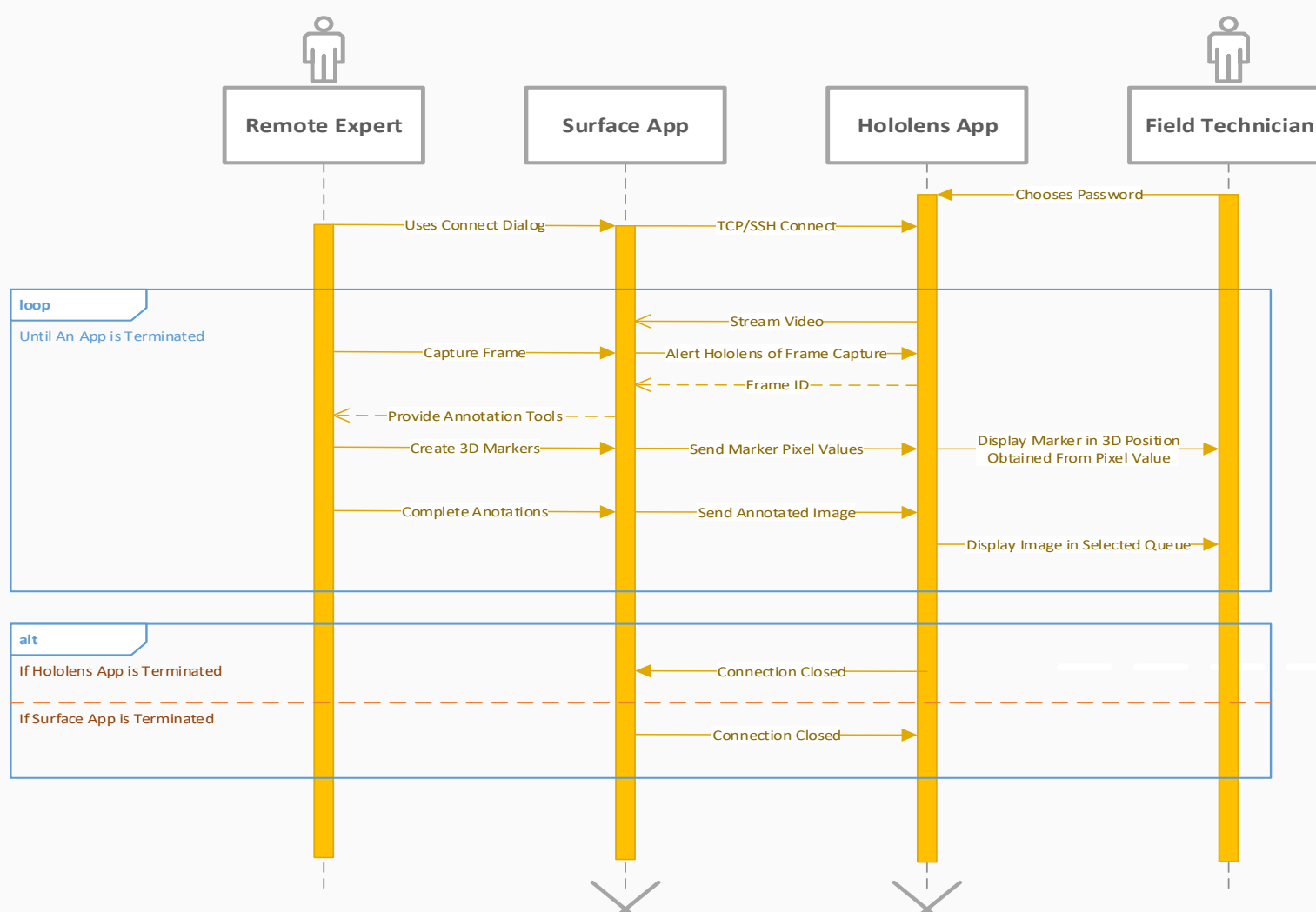


Applications of Software Diagramming

Application High Level Diagram



Message Passing For Basic Functionality



To the Left: A diagram illustrating a more detailed exchange of data. Diagrams like this are useful in documentation, and in fleshing out the details of an implementation before it is actually turned into code.

Abstract

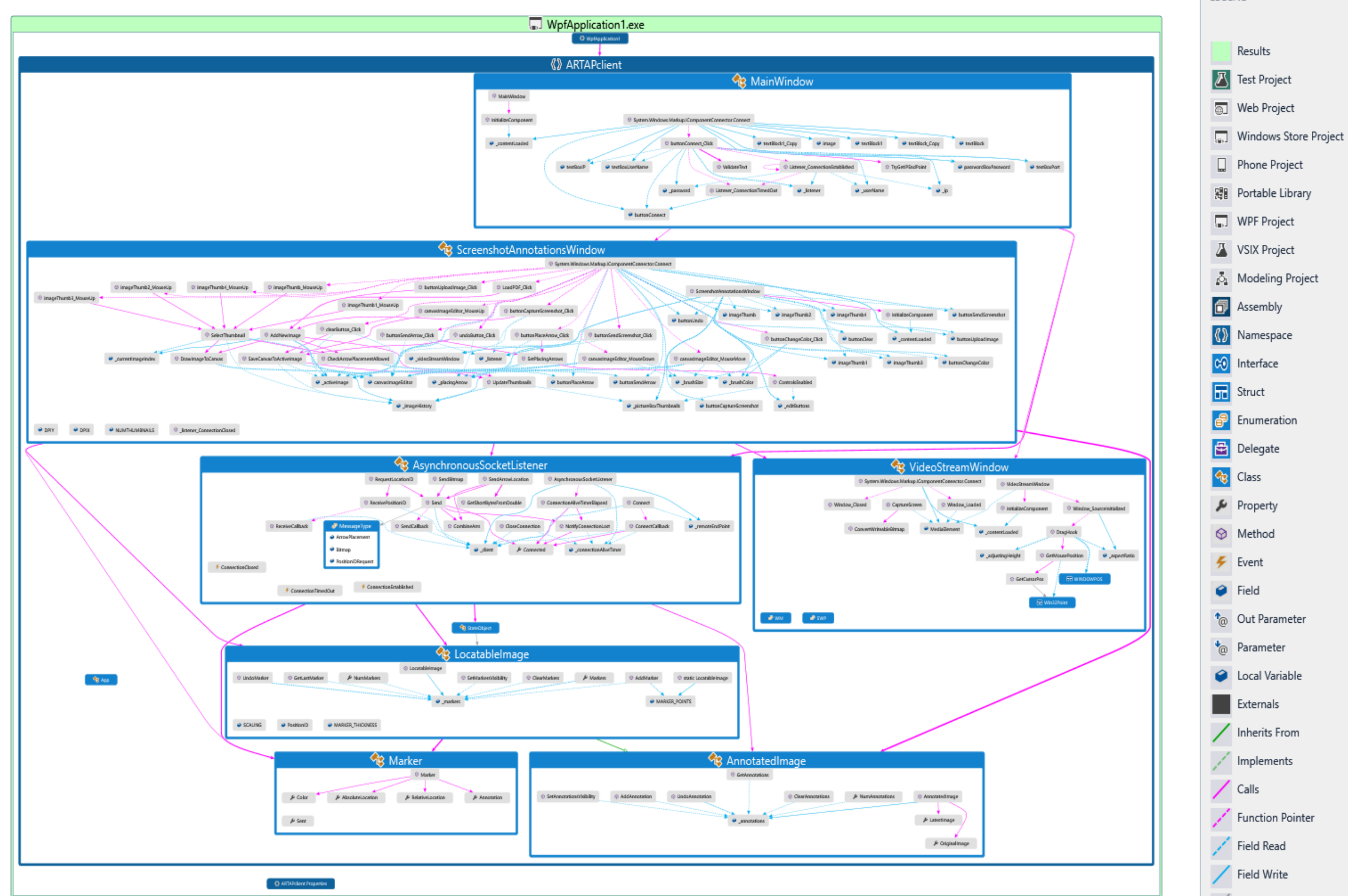
THE AUGMENTED REALITY TECHNICIAN ASSISTANCE PROGRAM is a proof-of-concept project for allowing a remote expert to both communicate with and assist a field technician in completing procedures with which the technician may be unfamiliar. For example, an expert in Navy aircraft maintenance could advise an Air Force flight mechanic about performing repairs or maintenance on Navy aircraft. The end goal of our Cedarville computer science capstone project is to create an experimental prototype to deliver to the Air Force Research Laboratory. In our prototype the expert uses a Microsoft Surface Pro tablet to communicate via marked up still images with a HoloLens-enabled field technician. As a wearable computer, the HoloLens provides the technician a hands-free advantage over traditional devices, because it's interface does not use typical input devices such as a mouse and keyboard. The advantage of the Surface Pro is that it allows the expert to markup instructional images naturally with the stylus, providing better precision for the annotations.

THE SOFTWARE DESIGN AND DEVELOPMENT PROCESS

- Background Research – Assess systems' capabilities and learn how similar problems were solved.
- Requirements Analysis – Discuss desired capabilities with the application's client.
- System Design – Decompose application into components for implementation allowing task delegation to individuals while ensuring the system remains cohesive.
- Implementation – Develop code to perform the functions of the system.
- Test – Verify the system operates properly, fixing any issues that are found.
- Iterate – Cyclically repeat this process throughout the development lifecycle of the product to incrementally improve its capabilities.

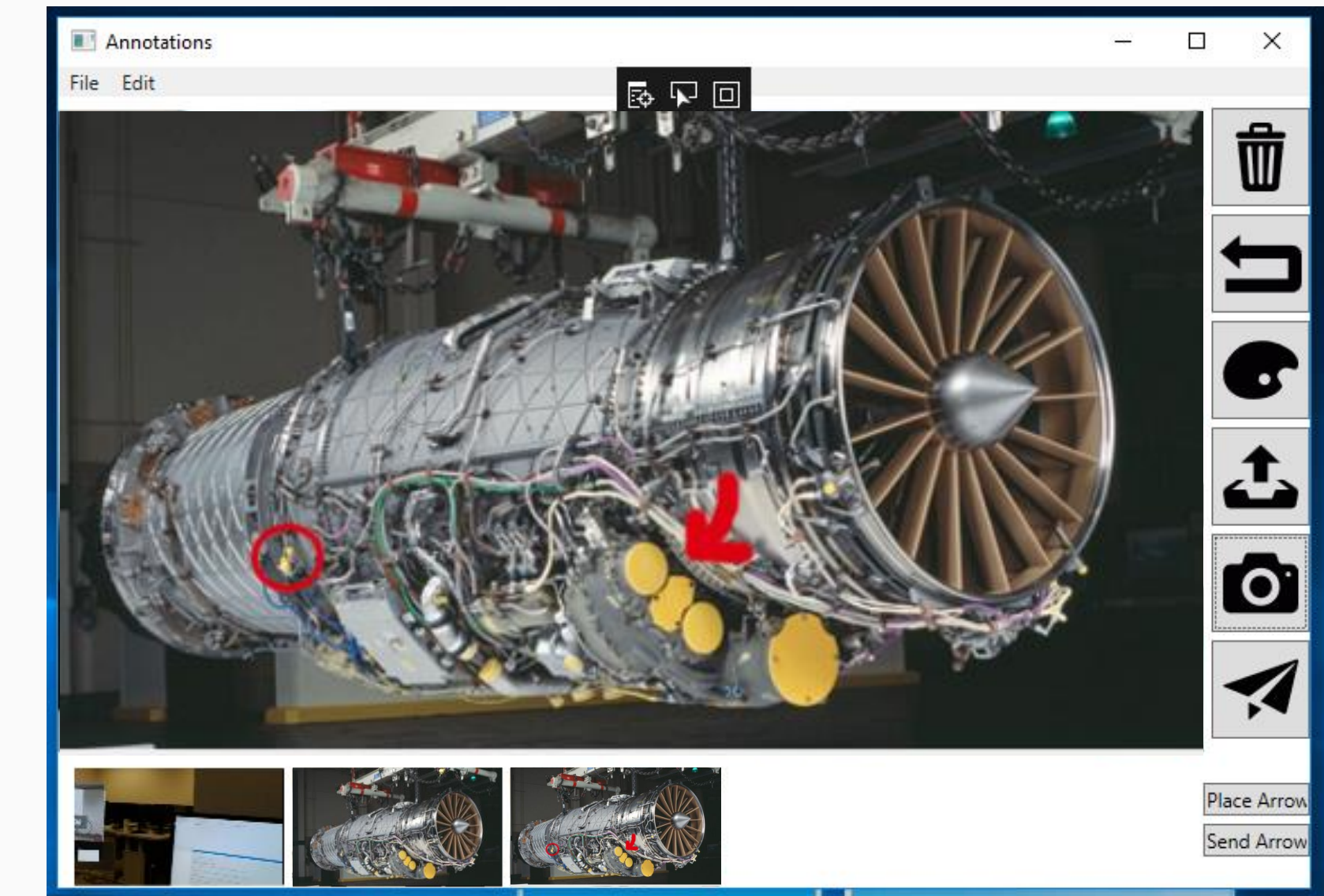
SOFTWARE DIAGRAMMING – UNDERSTANDING THE RELATIONSHIPS IN CODE

Diagrams can help programmers to visualize the relationships between parts of a project. It is important to understand the project as a whole to track down errors, and avoid duplicating functionality in different components of a large project.

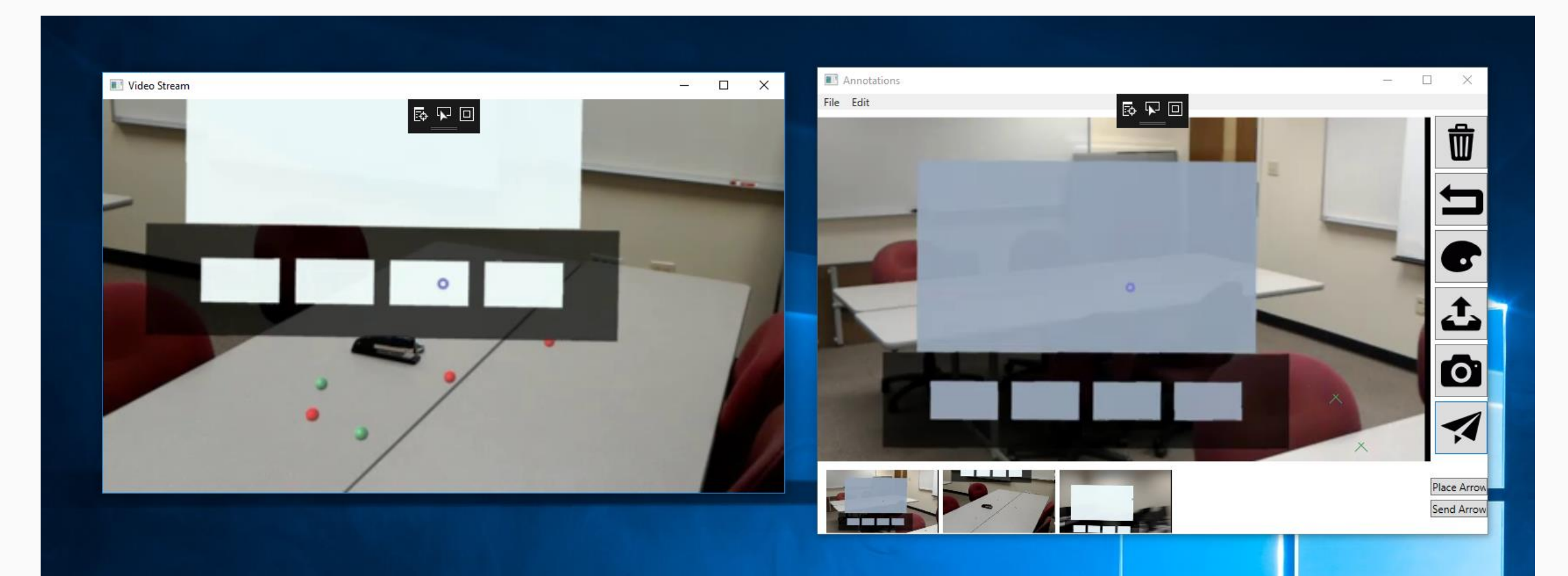


Surface Pro Application

The Surface Pro application was designed to have a similar control flow for every image. Once an image is imported into the application it is loaded into the Annotations Window for editing. The tools in this window give the expert a MS Paint like interface to draw on the image. The expert can select the brush color, size, and transparent level to highlight important parts of the image.

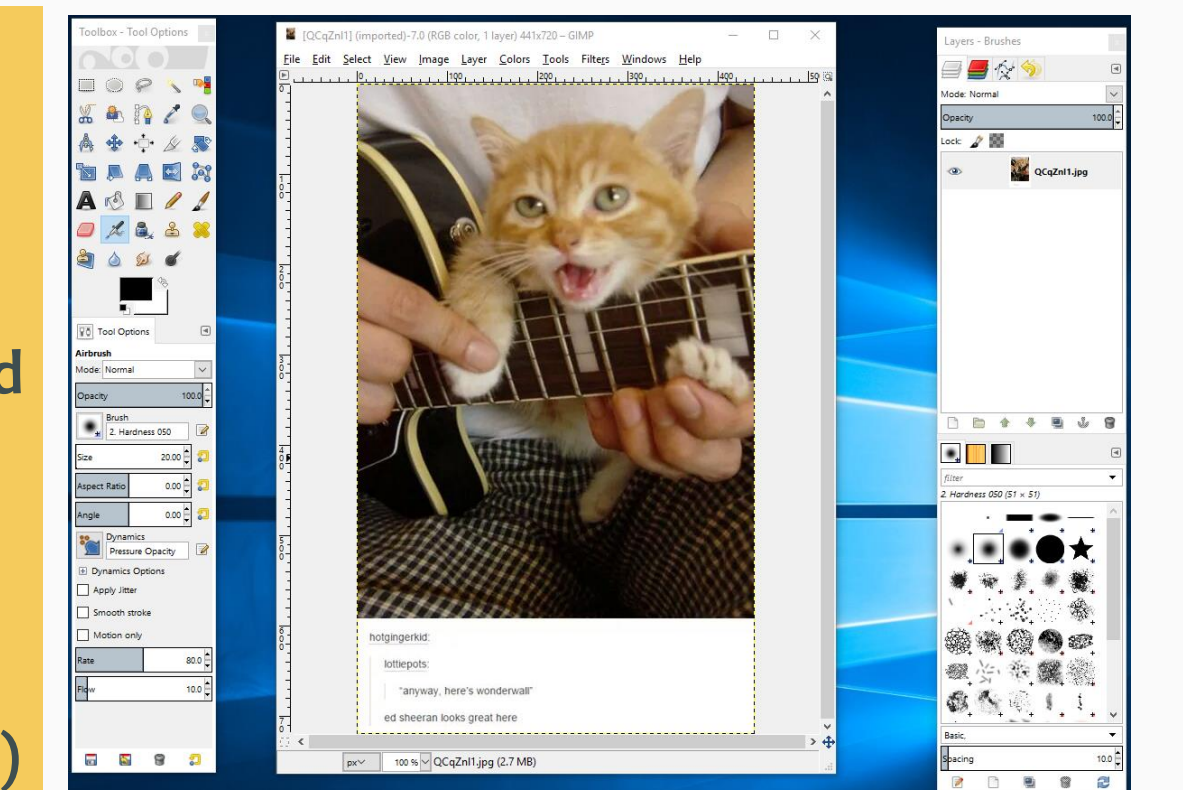


When editing a screenshot the expert can select "Place Arrow" button in the bottom right of the editing pane, then they can click locations where they want markers placed in the physical world. In the annotations window these markers are denoted as X's as seen in the middle gallery window below. When the expert clicks the "Send Arrow" button, these X's become colored dots in the HoloLens user's physical world.



When designing the HoloLens application we decided to use a more flexible, multi-windowed approach where the incoming video stream is displayed in a separate window from the annotation tools. This allows the user to resize both elements separately from each other, leading to a better user experience.

The design of the Surface application was inspired in part by the image editing program GIMP (right)



The application is capable of displaying PDF documents, specified pages of the document can be loaded, annotated, and sent to the HoloLens user for viewing.

