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Design and Development of a Virtual Facility Tour Using iPIX™ Technology

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Abstract

The capabilities of the iPIX virtual tour software, in conjunction with a web-based interface to create a unique and valuable system that provides users with an efficient virtual capability to tour facilities while being able to acquire the necessary technical content is demonstrated. A users guide to the Mechanics and Durability Branch's virtual tour is presented. The guide provides the user with instruction on operating both scripted and unscripted tours as well as a discussion of the tours for Buildings 1148, 1205 and 1256 and NASA Langley Research Center. Furthermore, an in depth discussion has been presented on how to develop a virtual tour using the iPIX software interface with conventional html and JavaScript. The main aspects for discussion are on network and computing issues associated with using this capability. A discussion of how to take the iPIX pictures, manipulate them and bond them together to form hemispherical images is also presented. Linking of images with additional multimedia content is discussed. Finally, a method to integrate the iPIX software with conventional HTML and JavaScript to facilitate linking with multi-media is presented.

Introduction

Accurate, comprehensive and expedient information transfer is a key element to the success of any organization. NASA, like other government agencies and corporations, shares information about the capabilities of their facilities. In addition, a virtual tour of the test facilities, wherein information on those included facilities is contained, can provide a better understanding of the capabilities within those facilities. Over a decade ago, accurate and comprehensive information transfer required face-to-face visits, hours in the library researching a topic and the hardcopy transmittal of voluminous documents.

The Internet has created a revolution in the availability and efficient transfer of digital information. The relative ease at which individuals, corporations and government agencies can integrate new information onto their web pages provides an ever-increasing quantity of information accessible by nearly everyone. The Internet has provided a unique media for information transfer by facilitating virtual tour of buildings, laboratories and other facilities. The Internet Pictures Corporation (iPIX) software is being used widely for such a purpose. Real estate marketing of residences and commercial buildings is a widely used application. Perspective buyers when conducting their initial search can virtually view (tour) the building across the Internet using their computer.

The objective of this document is to provide a users manual for the Mechanics and Durability Branch (MDB) Virtual Laboratory Tour of The Structures and Materials Laboratory (Building 1148), The Materials Research Laboratory (Building1205), and The Combined Loads Test Systems Facility (Building 1256). In addition, this document includes general insight and guidance for those interested in creating their own Virtual Tour. This manual is intended to be used in conjunction with all existing iPIX provided documentation and literature. This manual contains: a general discussion of a virtual tour and details how to navigate through the tour, in particular the three aforementioned buildings. Also included is an in-depth discussion on how to develop a Virtual Tour together with some valuable insights based on the development work done for MDB.

Description of Virtual Tour and Users Guide

This section contains the users guide for the Mechanics and Durability Branch Virtual Laboratory Tour. This section will aid the user in navigating the virtual tour website and in understanding the navigational controls of the virtual tour. The subsections describe the virtual tour main web page and general layout, navigation through unscripted and scripted tours, and a description of the three virtual laboratory tours.

Layout

The general layout of the Mechanics and Durability Branch (MDB) Virtual Tour, as depicted by the tour's main web page in Figure 1, is built using a common four-frame architecture. The first frame, the main navigational frame, contains the title and the main navigation buttons. Each main navigation button provides links, as depicted by buttons in the second navigation frame, to various sites pertaining to MDB and the Virtual Tour. For instance, when the virtual tour navigation button is pressed the second navigation frame buttons change to buttons linking to the tour home, and the virtual tours for Buildings 1148, 1205, and 1256. Similarly, under the Multimedia section, links to various animations and videos are provided. The reference button links to various papers and publications and the facility maps button links to images of each of the three facilities.

The third frame is a multi-purpose navigation and media frame that is blank at the main web page but within a virtual tour contains individual building navigation maps, support documents and animations. The fourth frame in the Main Web Page contains links to the different tours. Within a tour, this frame contains the iPIX content pages.

Unscripted Tour

An unscripted tour allows one to manually move through the facility by using links from discrete iPIX images as a means of navigation. It is also possible to link to technical information about most of the test equipment in the facility. The user may maneuver within each image, displayed in the Main Content Frame, in order to traverse the virtual tour. A navigation map in the multipurpose navigation and media frame facilitates navigation between positions. The iPIX images themselves are linked to one another in a viewable order (i.e., as a user would move through a laboratory, the images are sequential). As a user manually advances throughout a laboratory, the position map located in the Multipurpose Navigation and Media Frame, as seen in Figure 2, advances with the user to provide position location to the users viewing of the laboratory. However, the user may use the position map as a means of navigation by clicking on different 'X' locations in the map. The current location is denoted on the map by a blue circle containing a bold red X. At each location, an iPIX image is displayed in the Main Content Frame. Within each of the images one is able to pan, tilt and zoom providing almost an entire viewable hemisphere. An example of manually moving from Position 7 to Position 9 is shown in of Figure 3. Initially the user is at Position 7(#1 of Figure 3). The user then clicks the mouse on an 'X', such as Position 9 in the navigation map (#2 in Figure 3) and the navigation map and main content window are updated to reflect the new Position (#3 in Figure 3).

Movement within an iPIX image is controlled by the computer interface (e.g., mouse, trackball, keyboard, or other input device). Three different icons will appear within an iPIX image: the zoom icon, a zoom link icon, a navigation icon, or a link navigation icon as depicted in Figure 4. The zoom icon is located approximately at the center of the image and is hidden from view until the cursor moves to that position. The positive zoom icon is located slightly above the negative zoom icon. When either of these icons appears, depressing the mouse button will cause the image to zoom in the appropriate direction. The Zoom Link Icons behave much like the Zoom icons, except when the user double clicks on an area, their display will change to

reflect the linked content. The hand icon is used to Pan/Tilt across the image. Moving the mouse right, left, forward or backwards changes the direction the finger on the hand is pointing. When the mouse button is depressed, the view pans/tilts in the designated direction. The Link Navigation Icons have the same link properties as the Zoom Link Icons, except when the arrow appears they allow the user to Pan/Tilt the current image like the Navigation Hand Icon depending on the direction in which they move the mouse.

As the icon moves across a test machine or other piece of equipment contained in the iPIX image, a textual message on the screen may appear relative to information about that piece of equipment. Double clicking at that location will display technical information about the corresponding piece of equipment.

Scripted Tour

The MDB scripted virtual tour is similar in design to the unscripted tour. With respect to navigation, the scripted virtual tour has all the manual controls and capabilities of the unscripted virtual tour. Additionally, it automates the movement within and between iPIX images, allowing for a hands-free tour by the user. A scripted virtual tour allows the developer to insure that a user's view is focused on the important items within a tour. When a user initiates a scripted tour, it immediately starts navigating the user through the laboratory. For example, the scripted tour may start, in a laboratory zoomed in on the 'MDB' in the tripod cap image followed by a slow zoom out that orients the user toward the laboratory entrance from the main building. Continuing on the scripted tour navigates the user down the steps, up the walkway to the main path through the laboratory and slowly moves past various test machines. This automated tour proceeds until it reaches the end, or until the user interrupts the process. If the user is using the PC Web Browser plug-in, they may interrupt the tour and later resume the scripted path by right clicking and selecting the resume command. If a user selects a location on the navigation map, then the map in the navigation media frame will adjust its position in the tour to the selected location as in the unscripted virtual tour. In the scripted tour, however, the automated walk through will resume from the newly selected location.

Building 1148 Laboratory Virtual Tour

The Building 1148 Laboratory Tour starts at the steps coming from the door leading from the office area to the laboratory. Proceeding down the steps the user approaches the main walkway of the laboratory. Next, the tour takes the user to a cluster of displays and articles near the backstop, where a 5-meter lenticular antenna hangs (Figure 5). As the tour continues back onto the main walkway, it proceeds toward the 1,000-Kip Southwark-Emery Test Machine. The tour first stops at a cluster of test machines to the left of the user's view, including some MTS hydraulic test machines with environmental chambers installed to conduct mechanical property tests at cryogenic and elevated temperatures and a 600-Kip Satec/Instron test machine. As the tour turns to the right of the viewer the user's view is now centered on a blue and silver test frame, as the user moves closer they will observe the Y-joint test machine and a specimen that was tested in it. Continuing on the tour, the user then arrives at the 1,000-Kip test machine. As the tour proceeds around the 1,000-Kip test machine the user is positioned with a view of the 100-Kip Tinus-Olsen and 300-Kip test machines located behind the 1,000-Kip test machine

(Figure 6). As the tour proceeds forward, the user is maneuvered back from behind the 1,000-Kip test machine. Passing the Y-joint test frame the tour follows the path across a yellow striped floor with the words 'Keep Clear' on it. As the user reaches the end of this path the view changes to the front of the Bending, Torsion and Shear Loading Test Machine. After a moments view of this test machine the tour continues. Following a path to the left of the machine around the corner the user faces a flight of steps. The tour continues up the stairs. Upon reaching the top, the user turns and proceeds through the door, finding themselves positioned on the balcony, viewing down at the laboratory (Figure 7). As the tour scans across Building 1148 laboratory, the virtual tour is complete.

Building 1205 Laboratory Virtual Tour

The user begins Building 1205 Tour facing the ramp and the entrance to the offices located in Building 1205. Proceeding down the ramp one will arrive in the main laboratory of Building 1205. Looking around one would face a wide variety of mechanical test machines with many side laboratories containing additional test equipment. Upon turning to the right the tour enters a well-lighted room containing specialized testing machines such as the 100-Kip hydraulic test machine and the Axial Tension and Bending (ATB) Test Stand, as depicted in Figure 8. Leaving this room the tour enters a combined work and test room containing a dozen computers, a few line printers and four test machines. Exiting the room the tour proceeds up a small walkway between a 20-Kip and 50-Kip test machine and back to the laboratory's main aisle way. Continuing down the main aisle, the tour passes the Biaxial Tension Load Frame to the right and a line of small test machines to the left. Entering a small room at the top right of the main laboratory the user sees the 5-Kip material characterization test machine, shown in Figure 9. After a scan of the remainder of the room and some test specimens, the user is directed back out to the main walkway where they move toward the back of the laboratory. As the viewer enters the back half of Building 1205 Laboratory, they see two rows of mechanical test machines with environmental chambers. Their view is currently focused on the Long Term Durability Testing Facility, and the creep-testing machines are located on opposite sides of the main aisle. Finally, the tour maneuvers around the aisle into a few more rooms with durability test machines. At the end of the tour the user is taken back to the front of the lab and enters the door at the top of the ramp, finding themselves looking out upon Building 1205 Laboratory.

Building 1256 Laboratory Virtual Tour

The Virtual Tour of the Combined Loads Test Systems (COLTS) Facility in Building 1256 Laboratory begins in the control room (Figure 11) at the front of the building. Equipment, such as the Modcomp data acquisition system and the camera and video control unit, can be seen in this control room. The tour proceeds to the high bay area next. As the tour enters the high bay area which is used for the preparation of large fuselage like test articles and for specimen storage. Toward the back of the bay are two large fuselage like structures. The metallic structure is positioned on its end while the carbon composite structure is on its side, as shown in Figure 12.

As the tour continues out the side door of the high bay area, one can proceed either to the COLTS test area or the specimen preparation laboratory adjacent to the COLTS test area. The

COLTS test area, shown in Figure 13, consists of metal grill floors, load reacting steel framework, the test machine, and removable ceiling panels. All around the inside of the chamber are fluorescent lights, and four very large fans positioned close to the ceiling. In the back center of the chamber lies the main structure of the COLTS machine that is used to load the test specimens. The tour enters the specimen preparation area next. A large noncircular structure known as the D-Box test fixture (Figure 14) is located in the center of the room. After a quick look around, the tour navigates inside the D-Box test fixture. The tour concludes, at the top of this fixture.

How to Develop a Virtual Tour

Developing a Virtual Tour is a multi-step process, consisting of designing the general layout of the tour, taking pictures, processing images, and building the web interface. After developing a general design of the tour and supporting graphics, each facility in the Mechanics and Durability Branch's Virtual Tour required approximately 50 work-hours per facility to take the pictures, process the images, script the tour and develop the page. The following sections address important issues related to the development of a virtual tour. This document is not intended to be all-inclusive, but should be used in conjunction with iPIX literature as well as other resources on web page and graphics design. Furthermore, it is assumed in the remainder of this document that the developer has experience with raw HTML, use of a graphics editing program, a simple understanding of JavaScript, and familiarity with digital photographic equipment.

A cornerstone of the virtual tour is the iPIX system. A brief discussion of this photographic system will be presented. Next network and computing issues relative to developing a virtual tour will be discussed. Taking the iPIX pictures and their processing into hemispherical images will be described. A brief discussion of tour implementation including tour scripting and development of necessary HTML code will be presented. A flow chart that outlines the following sub-sections is shown in Figure 15 and maybe useful for reference during the development of a Virtual Tour.

Overview of The iPIX System

IPIX images produced with the builder and Wizard software can be linked to photographs, animations, and other iPIX images. They can be enhanced with audio or other types of files, or even incorporated into other applications. iPIX images consist of two 185° hemispheric images that are seamed together to generate an immersive whole image in which a user can look up, down, left, right, as well as zoom in and out, or link to other content.

The iPIX system has different levels of complexity. The average developer will most likely prefer to use the iPIX Wizard interface due to the ease of its use. The iPIX Corporation's other interface, the iPIX builder agent, tends to be for users requiring more flexibility to build the 360° images, especially if they want to run the image through a filter to fit the image to the faces of a cube, and other aftermarket filters. The builder agent's image license keys tend to be more expensive than wizard license keys.

Network and computing issues

During the implementation of a virtual tour different network and computing issues may arise. For example, in the MDB Virtual Tour one such issue pertained to in-house network regulations. The server where the virtual tour resides is behind the NASA Langley firewall, therefore no external sites may access the tour. Since access to the tour is then limited to on site computers network bandwidth issues are generally not a problem, which allows for more and higher resolution iPIX images to be incorporated in the tour.

Some iPIX images can be rather large. A high-resolution iPIX image can be between 250KB to 300KB in size, a medium resolution image can be around 200KB and a low-resolution image can be as low as 90KB. Obvious differences exist between high and medium-resolution images. Pixilated images can occur when an image is zoomed to an extent where the individual pixels can be observed. Due to the decrease in aesthetic value of the images with lower resolutions it is recommended that projects use high-resolution images where considerable end user navigation and zooming might take place. However, the use of these rather large images puts considerable strain on network bandwidth use. Users of analogue dialup modems may experience rather undesirable delays in navigation, especially if they plan to navigate a page with multiple images.

More difficulties arise out of compatibility with user's Operating Systems and browsers. For example, whether to use the iPIX browser plug-in or the Java Applet must be decided at the beginning. The differences between the plug-in and the java applet are in fact very significant. The Java Applet does not support any of the 'Scripting' contained in the iPIX TV-Studio files. The Java Applet does however allow some spin speed and type parameters to be passed to it, allowing the image to be spun 360° in either a flat or a wave shaped spin. The plug-in however allows for use of linked images, scripting and media additions to the iPIX documents. One drawback with the plug-in is that it is only available on the Microsoft Windows or the Apple Macintosh OS and only for Microsoft Internet Explorer and Netscape communicator browsers. This combination of operating systems and browsers cover the vast majority of the current market. However, there is an established Unix and a growing Linux user base especially in the technology areas that may not be able to view the web page. On the other hand, the Java applet is available on all platforms supporting Java. Clearly, one must understand their viewing audience and what viewing features are important during the initial design phase of the tour.

iPIX image processing speed is an important development issue. The iPIX minimum computational requirements for their software are a Windows 95 machine running at 133MHZ or higher clock speed. Unfortunately, with this machine the initial calibration for the camera can take more than an hour and binding pictures into 360° hemispheres images can take between 25-40 minutes on such a system. Although it is not an iPIX requirement, having a USB port on ones computer can also help speedup the down-loading of pictures from the camera's memory to the computer. The majority of digital cameras supported by the iPIX software have either Compact Flash ™ or some other memory card. These memory cards generally have a USB interface to the computer.

Tripod cap

In taking the pictures that will be processed into hemispherical iPIX images, the camera tripod is frequently captured in the image. The tripod cap, as nebulous as the name sounds, is an image that is 250x250, 300x300, 350 x 350 or 400x400 pixels in size. This image is placed over the area at the bottom of the images where the tripod appears, hiding the tripod from view. The cap CAN be kept in the shape of a square, but it is recommended by iPIX that it is made as a circle. In order to make the image into a circle, the border area around the circle must be marked with solid green (RGB value 0, 255, 0). However, this can be annoying to accomplish. Most modern graphics editing programs tend to fade colors even a few pixels around the edges of the image, leaving slight variations of green up to the color on the edge of the logo. An example of this is Green, RGB (0,255,0), in one pixel and the next pixel is RGB (0,254,0) and so on until the green and the next color, for instance gray are close in shades. A tripod cap image of 250 x 250 pixel covers the tripod from view without consuming much of the hemispherical image area. Tripod Cap sizes of 400 x 400 pixels is rather large, and consumes a large portion of the viewing area. One thing that may be noticed in Figure 16 is that both 250 x 250 pixel images are not exactly of the same size; this is because of the green space added for the iPIX logo and name on the border of the image. In fact, the actual size of the image doesn't have to be square, and there can be text floating in the green space as shown by the iPIX logo.

Other Important features

Prior to development of a virtual tour, clear goals need to be established. If the goal is to make a general overview of a large area, displaying the entire lab versus a specific machine needs to be determined early on. If the user will be just going down a hallway to give the user the feel of actually walking to some location then there is no need to be as concerned with the surroundings in the unimportant areas as would have been otherwise necessary. A good way to accomplish the defining of important objects is go to the site and walk through it, walk through it from the user's point of view from the website, and tour the facility from that prospective. If when walking around it is found that lighting is poor, or some objects seem to be in the way, measures may need to be taken to fix these problems. One other important item to remember in a tour is that objects large and small that are in a busy environment tend to move. Some objects, papers, some small tools, may not be of concern when they move a few feet. However, when large objects are moved by several feet, they can be noticed by the user in a tour.

The final feature for the tour is an overview navigation system. A navigation system where a user can select to jump to specific images. It can be very annoying to a user to navigate through 30+ images to go look at one detail far from their starting position and it can be very bothersome for the developer of the tour to have to navigate through the whole tour again to reach one specific image. Therefore adding a large-scale navigation system tends to be helpful to both the developer and the user. More details on how the MDB navigation map was developed together with other examples will be presented in the later sections of this document.

Photography

The iPIX Corporation recommends using one of the digital cameras and kits supported by them although they state that any digital camera (equipped with a 185° fisheye lens and the ability to turn off flash), fisheye lens, rotator and tripod will work. Unfortunately, iPIX will not support non-recommended cameras. In addition, the higher the maximum resolution of the camera the higher the quality of the images produced. For the Mechanics and Durability Branch tour, the Nikon CoolPix 990 was used with a 48MB flash card.

Another important factor with the camera is proper calibration. iPIX recommends using windows, large X's and various non-complex patterns for alignment. It was found that the use of a clean chalk board with several non-overlapping white X's on it, ceiling drop tiles, a large white box on dark carpet and even lighting in an otherwise empty room created good calibration images. The difficult aspect of calibration is achieving uniform lighting in the field of view.

Lighting is one of the most difficult problems to overcome in any iPIX image, either for calibration or for an actual picture. Uniform lighting in the interior of a building is usually achievable only with the addition of lights. Otherwise one must rely on the natural lighting in the building and hope that the camera and computer software do the necessary adjustments. When taking a picture, center the important object. If lighting is poor, such as a bright light source, adjust the position of the lens to allow front and back shots to include the same bright light source. For example, if there is one light, or window that is significantly brighter than the surrounding lights, orient the lens to the center of this light so that the camera will expose and adjust the total shot relative to that light source. When both images are processed they will both be based upon the bright light source. The end result will be better than one pale image and one muddy image spliced together. Sometimes it is impossible to move the camera shot to include the bright light source in both images. In these cases, use a software method to adjust lighting problems (Figure 17 & Figure 18). Common problems with lighting that are difficult to resolve are typically associated with large mercury vapor and halogen lights, which cause a ghosting effect in the form of a ring around the light source (Figure 19).

When positioning the camera, in addition to dealing with lighting, one must also keep in mind the important features of the object. The image seam should not be placed through an important feature in the picture. If there are multiple complex/important objects within a shot, the camera should be placed so that as many of them are in either the front or the back shot and as few of them are in the seams. These are common sense ideas when taking pictures, however, sometimes they are difficult to accomplish.

An important yet difficult objective in building a tour is to achieve fluid navigation between hemispherical images. When building a scripted tour with the iPIX TV-Studio ™ software, unlike unscripted navigation, it becomes very apparent to the user when the tour abruptly jumps between locations with poor transition. The scripting appears jumpy, and does not represent fluid motion as one would try to make for a 'walk through' of a facility. To achieve this fluid motion in a tour one needs to keep the camera positions appropriately spaced. One should consider positioning pictures 8-feet to 10-feet apart in places where large amounts of

detail are not located. When important objects contain significant detail, it is usually best to keep positions at least 5-feet away from each other.

One of the more difficult tasks to accomplish in the photography of a tour is maximizing distance for taking a picture without losing quality. Theoretically it does not matter how far away an object is, the user can zoom in. However, when there is excessive zooming in an iPIX image, it gets overly pixilated. This is acceptable if one does not mind this pixilation with large distances. However, it is very unsightly and can detract from smooth or fluid transition between pictures. In order to achieve this, one should try not to use distances of more than 50-feet between pictures.

The final photography issue that needs addressing is avoiding clutter and placement of the tripod with respect to the tripod cap. Ground clutter in some tours may be unavoidable, but one can frequently work around it. In scripted tours, it is possible to avoid clutter by navigating the user away and around it. The next issue to deal with is the tripod cap. Not only does it cover the tripod from being seen by the user, but it will also cover *anything else* that may lie underneath it. Some items that are not always the most aesthetically pleasing to lose portions behind the tripod cap are; railings from ledges, ledges and edges of raised platforms, large chunks of wall, and doors. However, like clutter, it is sometimes unavoidable to lose things behind the tripod cap. Keep in mind the size of the tripod cap by taking some pictures before hand to learn the diameter of the circle obstructed.

Processing Images

Processing the images requires the developer to sequence, verify, align, and create iPIX images from their images. However, the tasks associated with processing can be daunting, unless some steps can be followed to simplify this. The first step is to take all the pictures that have been transferred from the camera to the computer and pair them up front and back. For example, in Figure 20, the file DSCN0102 and DSCN0103 will go together. The next step is to insure that the photos align. It is best to visually inspect each hemisphere for quality, and alignment and consistently numbering them in a sequence. Without this visual inspection, one could subsequently invest considerable effort and ultimately produce nothing of value. For instance, while adjusting the position of the camera, it may have timed out and shut itself off resulting in not taking a picture when the button is pressed. Another problem, which can occur, is that when the camera is rotated, the tripod is accidentally moved and the images will no longer align properly. No matter the case, it's always best to visually inspect each image. The following example will go through the steps of a simple visual inspection of a hemisphere. This shot is normal for pictures taken with the iPIX system. When visually inspecting the picture, it is best to have both images on the screen simultaneously to compare them side-by-side. In #1 of Figure 21, on the left of the image a yellow work fence is present. On the second image, on the extreme right edge, a small portion of that fence, and the continuation of the fence should be visible. In #2 of Figure 21, a gray chair with a brownish-red toolbox placed behind it is also a key alignment object. In the second image to this pair these same objects or portions of them should be visible on the left side. Similarly in #3 of Figure 21, the white stripes of the aisle are present. In the second picture similar lines should be present. If any of these items do not match up in both images, the images may not belong together.

Now that the picture has been visually checked with its mating picture, it is recommended to rename them as 'pair01-1' and 'pair01-2', respectively. With each successive image in an individual tour, increment the '01' variable or incorporate a different numbering scheme. In the event that missing pairs are found, or shots came out bad, there are only two viable options. If the image quality is poor, try enhancing it with a graphics-editing program like Adobe Photoshop ™, Jasc Paint Shop Pro ™, or The Gimp ™ making adjustments to a pictures levels, brightness and contrast, hue and saturation, gamma correction, as well as other filters and color adjustments. It is readily possible to improve a muddy washed out image using these adjustments. However, if graphics manipulation cannot correct the problem, the only other alternative is to retake the picture(s).

After the pictures have been visually inspected, matched with their mate and enhanced, the next step is to move onto combining the pictures into a hemispherical image. The following steps assume the use of the iPIX Wizard software on a PC; the Wizard for the Mac should also be similar. The steps for building a 360° viewable image with the Wizard start with selecting the images. If image pairs are named as described in the previous paragraph in some sort of sequential order, the iPIX wizard software will automatically load the second image after the first has been specified. Next, select the image quality for the preview. High resolution is usually the best, but this is a good time to experiment with lower resolution images. Background music or narration can be incorporated at this stage. It can also be added later by using the multimedia upgrade kit. Incorporating the tripod cap into the image is performed next. The next field is the pan, tilt and rotation fields, where one may insert their own values. For reference, this can also be done later. Binding the seams of the two pictures together is done next. The second to last option given is for blending the images. IPIX suggests that the blend seam option be selected which keeps the seam in good order in most images. A setting from 5-10 pixels should be adequate. However, experiment to find what seems best for the image. The Color Balancing for hemispheres option is necessary. It does an excellent job of balancing even some of the more difficult to adjust color differences. It would also be wise to keep image smoothing checked and image auto alignment unless it is found that nothing else will work with finalizing the image. Finally, the Camera Configuration option is only relevant if one wishes to load or change cameras that images were taken with. Make sure that new calibrations are taken for any camera changes; new lenses and cameras should be recalibrated to adjust for their discrepancies. To calibrate a new camera or recalibrate an existing camera, click on the iPIX icon on the title bar and select preferences and then select calibrate camera.

Tour Implementation

In the implementation of a Virtual Tour, it is helpful to allow users to manually navigate. For example, a user may not want to start at Image #1 and navigate for some period of time to Image #37. Although this might be more convenient to the developer, a user may need a better capability. In order to expedite user navigation around a tour, the addition of a navigation map can help. In the Mechanics and Durability Branch implementation of the iPIX Virtual Tour system, a simple map as depicted in Figure 22 was used. In the MDB tour, once each hemisphere was created and then a little red 'X' (#1 in Figure 22) was placed on the map. Over each of these red X's a blue circle with a large red X (#2 in Figure 22) is overlaid on the users

current location in the tour. An individual image is created and saved for each possible position on the laboratory floor.

The next step in building the tour is linking the bonded hemispheres. A program called ILinker ™ within the Multimedia upgrade kit for iPIX ™ allows the linking of multiple iPIX images together as well as interfacing iPIX images with other multimedia content and media. When an image is loaded up in the ILinker, one may navigate using the hand to the position where they want to create a link. Then from the tool bar select either the Rectangle or Freehand selection tool as seen in #1 of Figure 23. Notice if the mouse is moved back over the image, the large hand has gone away and the standard mouse cursor has returned. One can now drag select an area with the rectangle tool or draw an area with the free hand tool. When this area has been drawn it will be in an inversed color block as seen in #2 of Figure 23. Once the linked area in the iPIX image has been defined, one can then proceed to define what kind of media they wish to link it up to. In the Mechanics and Durability Virtual Tour, all hemispheres link directly to another HTML page on the VTour site, these individual pages contain the next content. However, one may wish to link their defined regions to other iPIX bonded hemispheres, Wave, VOX ™, and MIDI Sound files, IPScript which is the iPIX TV-Studio scripting files, executables, set it to exit an application, a custom reference, the undefined default, or a Text popup that will appear over the selected region (Figure 24). The Executables option is meant for standalone iPIX viewers only on the local machine. The Exit Application and custom reference are depreciated/unused features at the time this document was written; iPIX either removed their functionality in an earlier release or is planning to re-implement a portion of this function at a later time. Many of these non-current features are also present in the iPIX TV-Studio program that will be covered in a later subsection. In most cases, the best route for any multimedia is making it a URL link type and put the content on a separate page. Be warned, however, that the iPIX applet and software at its current time does not support the HTML *target* command, and does not support passing of variables or java scripting within its link. It expects a new page to load. However, if one desires to change multiple frames of content or windows of content, this can be done using java script imbedded in the page itself. Overall, the easiest thing to do in the ILinker when one wants to send the user to various media, is to simply use a URL link type and do further customizations on the next page.

Building iPIX™ TV-Studio Scripting

To create a virtual tour of a building that needs no user intervention or interaction, it requires using multiple images that smoothly advance the user through a building using a combination of zoom and movement between successive images. Scripting is probably the preferred approach. The iPIX-scripting agent supports the same media types of the ILinker agent does. However, within an iPIX file it allows for additional navigation and movement commands. The iPIX TV-Studio documentation provides an excellent explanation of the commands, and the interface. This documentation is only included with the multimedia upgrade kit from iPIX Corporation. Again as, with the ILinker application, URL link types were used for external actions, and mostly the Set View Command for changing views. A typical iPIX script file might look like the one shown in Figure 25.

The first line signifies the start of the script, its '*Start* ' including trailing space before the right brace. The second line starts with the '*Preload* ', which instructs the iPIX viewer engine to preload the iPIX image hemi09_hires.ipx, of the iPIX file type. The third tag instructs the viewer to launch the hemi09_hires.ipx, of the iPIX file type, with initial viewing position of the given pan, tilt and zoom. The fourth, fifth and sixth tags are movement tags, they move the view to the given coordinates of the pan tilt and zoom variables, with a given amount of time in seconds in a given direction. In the second to last field of the sixth tag there is a 'R' and this Flag sets the rotation of the image during this phase of the script to turn right. However, the RIGHT option was set in the field 2 before this one. The only explanation for this is that some versions of the software want the full text, and some want the flag. The seventh flag is a launch statement commanding the script to launch hemi12.html of media type URL. The final statement is an end statement, which ends the script. Another important tag, although not shown in Figure 24, used in the iPIX script is the Dwell tag. Dwell causes the script to pause its movements and actions for a specified period in seconds. The aforementioned features were most commonly used during implementation of the Mechanics and Durability Branch's virtual tour. Other features are available and the reader is encouraged to review the iPIX documentation for additional details.

Navigation with the setview tags in an iPIX TV-Studio script is time critical, too short of a time and the user has insufficient time to view any important details or interact with the tour. If an excessive amount of time is set, the user will not have the sense that they are touring the facility. Unless one is moving to an adjacent area within a few degrees of the current location, a pause time setting of 5 or 6 seconds is reasonable and to pan the entire image a period of between 9 to 12 seconds is reasonable. However, there is no set time that is right for any script, its best to experiment. For example initially set all times to 5 seconds and independently adjust each setview until it "feels" right. Zooming within an image is another effective way to enhance a tour. As an example, start zoomed out to the default level, and then provide 5 seconds to zoom in to a detail in the image. After reviewing the tour it may be desirable to adjust this time. To transition the user to an adjacent object a few feet away, set the next setview to the original zoom level one-half the way between both objects providing sufficient time to zoom and turn. Then make the final viewpoint at the next object at the desired zoom level, again adjusting the time to make a smooth transition. When implemented with the ability to manually stop and navigate, it gives the user the feeling of touring an area as if they were physically there. Using these techniques in conjunction with moving the setview to higher or lower elevations, one can easily avoid clutter and certain objects that might otherwise appear unsightly.

Creation of the HTML Interface

In creating the HTML interface to a website, it may be desirable to have scripting interaction with individual pages, map interaction with pages, interaction with HTML frames, interaction from linked iPIX images, and others. All of these capabilities are available to the developer in the creation of a Virtual Tour. However, due to certain limitations in the iPIX software an alternate approach must be taken to provide some of this functionality through he use of JavaScript. Alternate approaches to providing the interface and interaction that are not present in the iPIX system could be through the use of Macromedia Shockwave and Cold Fusion, Java, CGI forms, or various other technologies.

Interaction with HTML is present from linked iPIX images and scripting, although as of iPIX Viewer version 5.8, Browser Plug-in version 6.2 and TV-Studio version 1.231, it consists of opening a new HTML file in the current frame. Therefore, one option when media content needs to be open in a separate window or popup window is using JavaScript. An example of how to proceed is: Have script running, have script call HTML, have HTML call loading actions in frames, have remaining page call script, script resumes at current location in tour in a separate script file. In order to implement this, some simple JavaScript is needed.

Between the <HEAD> and </HEAD> tags the following code would be placed:

```
<script language="JavaScript">
<!-- ;

    function openindex()
    {

        parent.frames[1].location='map/pos4.html';

    }

// end hide -->
</script>
```

In the <BODY … > tag, the following statement would be placed:

```
onLoad="openindex()"
```

Between the <BODY …> and </BODY> tag there will also be the standard iPIX loading statements:

```
<OBJECT ID="IpixX1" WIDTH=520 HEIGHT=440
 CLASSID="CLSID:11260943-421B-11D0-8EAC-0000C07D88CF"
 CODEBASE="http://www.ipix.com/viewers/ipixx.cab#version=6,2,0,5">
 <!-- For MSIE 3,4+ -->
 <PARAM NAME="IPXFILENAME" VALUE="hemi04_hires.ipx">
 <!-- For Netscape 3,4 -->
 <embed src="hemi04_hires.ipx" border=0 width=520 height=440
 palette="FOREGROUND" type="application/x-ipix"
 pluginsPage="http://www.ipix.com/cgi-bin/download.cgi">
 </embed>
 </OBJECT>
```

Note: Please checkout the posting images section of the iPIX support pages for updated information on the proper current body statements at http://www.ipix.com/support/ipiximages/postimages.shtml

In the above listing, first look at the statements that go in the <HEAD> section of the HTML. The first two lines are standard to JavaScript and this document will assume that the developer has some experience with JavaScript. The first statement is a standard JavaScript declaration telling the HTML parser to expect the next snippet of code to be java script. The statement on the second line, is a comment. This is, however, inserted to fool older browsers that don't

support JavaScript, and to reduce errors. The fourth line with the statement " *function openindex()* " tells the JavaScript interpreter that the following set of statements between the '{' '}' braces on Lines 5 and 9 is a function called openindex. The statement on Line 7 " *parent.frames[1].location='map/pos4.html';* " says when the function openindex is called by the page, in item parent of the current page, frames[1] (the second frame referenced in the frameset of that parent), change the location to map/pos4.html. If changing more than one frame is needed, more statement lines similar to this one can easily be added, changing the frames[1] to frames[0] or frames[2] if it exists and changing the location will provide the page change commands. If there is a need for more complex JavaScript, there are many valuable resources available. In the development of the MDB Virtual Tour O'Reilly's book *"JavaScript: The Definitive Guide"* was used for reference. The author will walk one through the development of much more complex commands than this document is intended to.[1] The Statement '*onLoad="openindex()"*' that was placed in the body statement just tells the HTML interpreter as to when the page has loaded to launch the openindex function. Finally, between the <BODY> and </BODY> tags lies the simple declaration that launches the iPIX images in its current frame. The only options that needed to change per image is the file name "*hemi04_hires.ipx*" in the example, and the size "*WIDTH=520 HEIGHT=440*". Remember, iPIX TV-Studio script files are designated with the .ips extension and iPIX images have the .ipx extension.

There might also be the possibility that one would want some Map interface with their tour. The easiest way to go about doing this is with HTML Image maps. There are a variety of tutorials across the web and many quality freeware, and shareware programs that will accomplish this task, so this report will not go into details on how to make an image map. In the MDB Tour, the image map's template and coordinates were the same for each map. However, during each image, a new position was loaded. In essence, a new page, each with the same coordinate information was generated for each position on the map and a new image was loaded to reflect this. It may be possible to create the image map with a shockwave flash, or some other media format. Due to simplicity of design, the Image map approach was decided the easiest to start with. In order to get the map to affect the images, one just has to have each location on the map make its page change as a HTML target.

Summary

The capabilities of the iPIX virtual tour software, in conjunction with a web-based interface can be used to build a unique and valuable system that provides users with an efficient virtual capability to tour facilities while being able to acquire the necessary technical content. A users guide to the Mechanics and Durability Branch's virtual tour is presented. The guide provides the user with instruction on operating both scripted and unscripted tours. Furthermore, an in-depth discussion has been presented on how to develop a virtual tour using the iPIX software interface with conventional HTML and JavaScript. Also included is a discussion on network and computing issues associated with using this capability. Approaches to take the iPIX pictures, manipulate them and bond them together to form hemispherical images are presented. Linking of images and linking of images with additional content was discussed. Finally, ways to integrate the iPIX software with conventional HTML and JavaScript to facilitate linking of multi-media are presented.

References

1. Flanagan, David.: *JavaScript: The Definitive Guide*. Third ed., O Reilly & Associates, Inc., 1998.

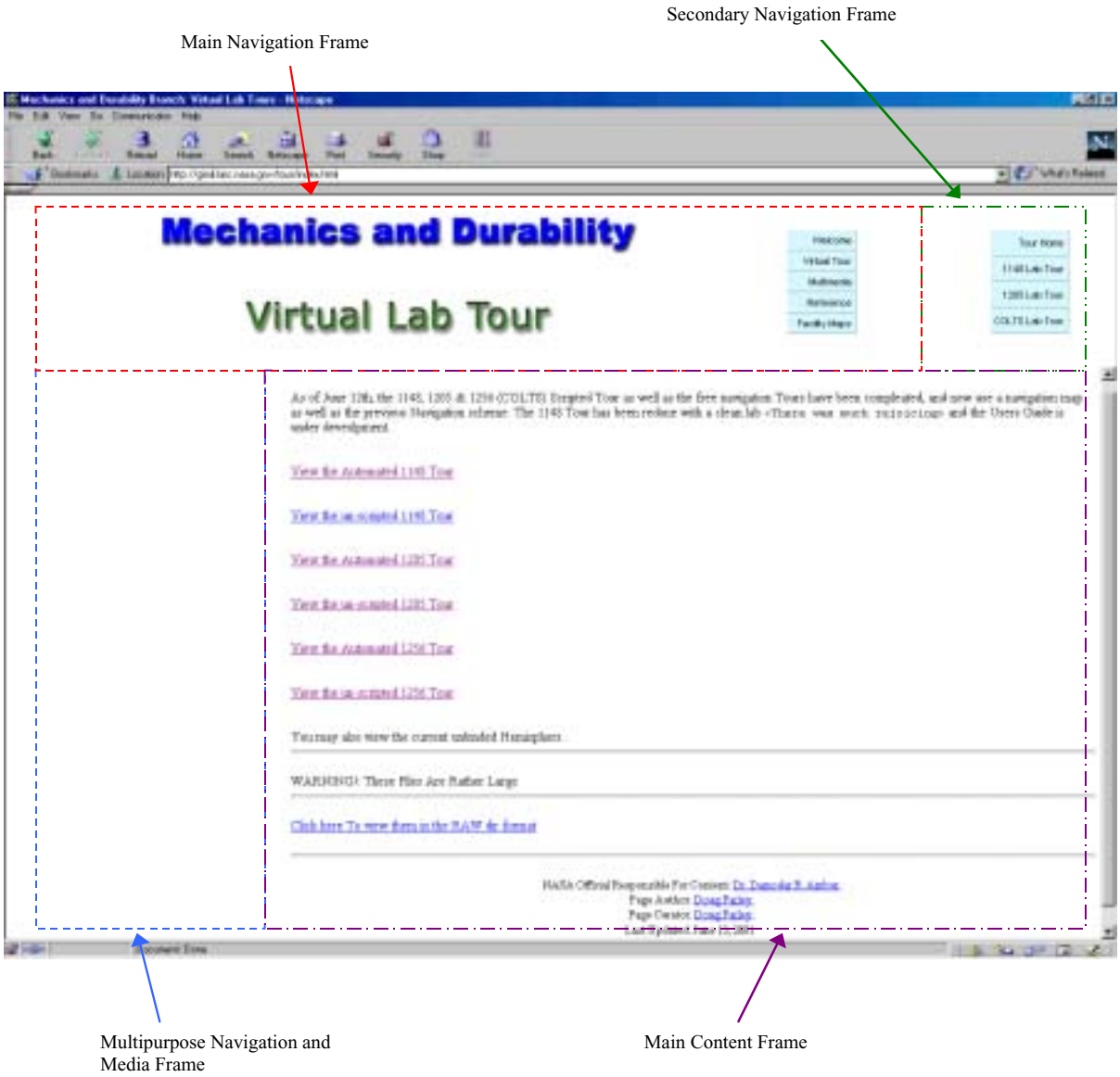
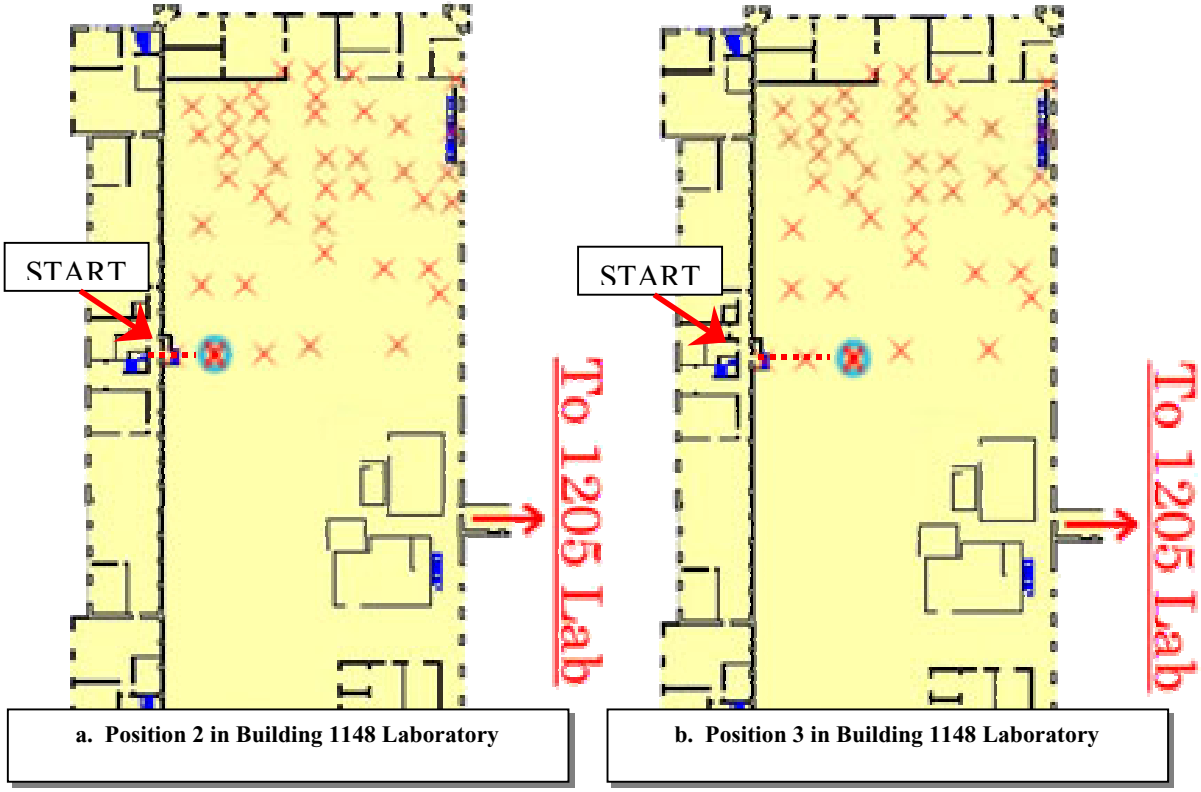


Figure 1. Mechanics and Durability Branch Virtual Tour Web Page.

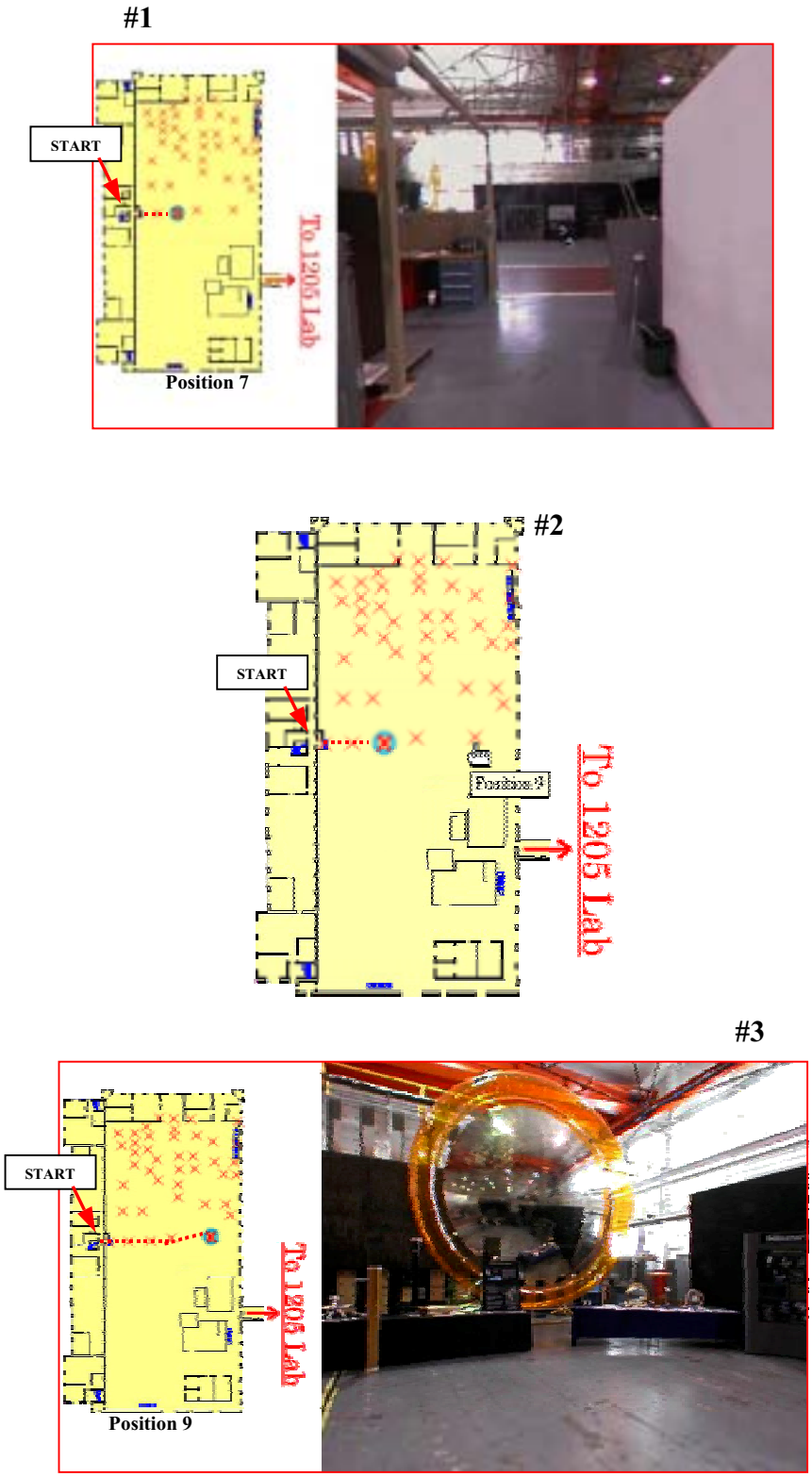


a. Position 2 in Building 1148 Laboratory

b. Position 3 in Building 1148 Laboratory

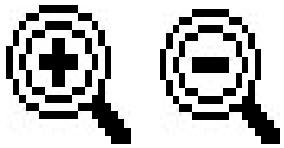
Note: The dashed line from the labeled start location identifies the navigated path of the user.

Figure 2. Building 1148 position map.

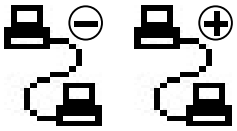


Note: The dashed line from the labeled start location identifies the navigated path of the user.

Figure 3. Building 1148 — User executed navigation from Position 7 to Position 9 by clicking on position map

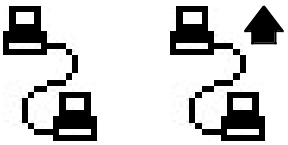


Zoom Icons



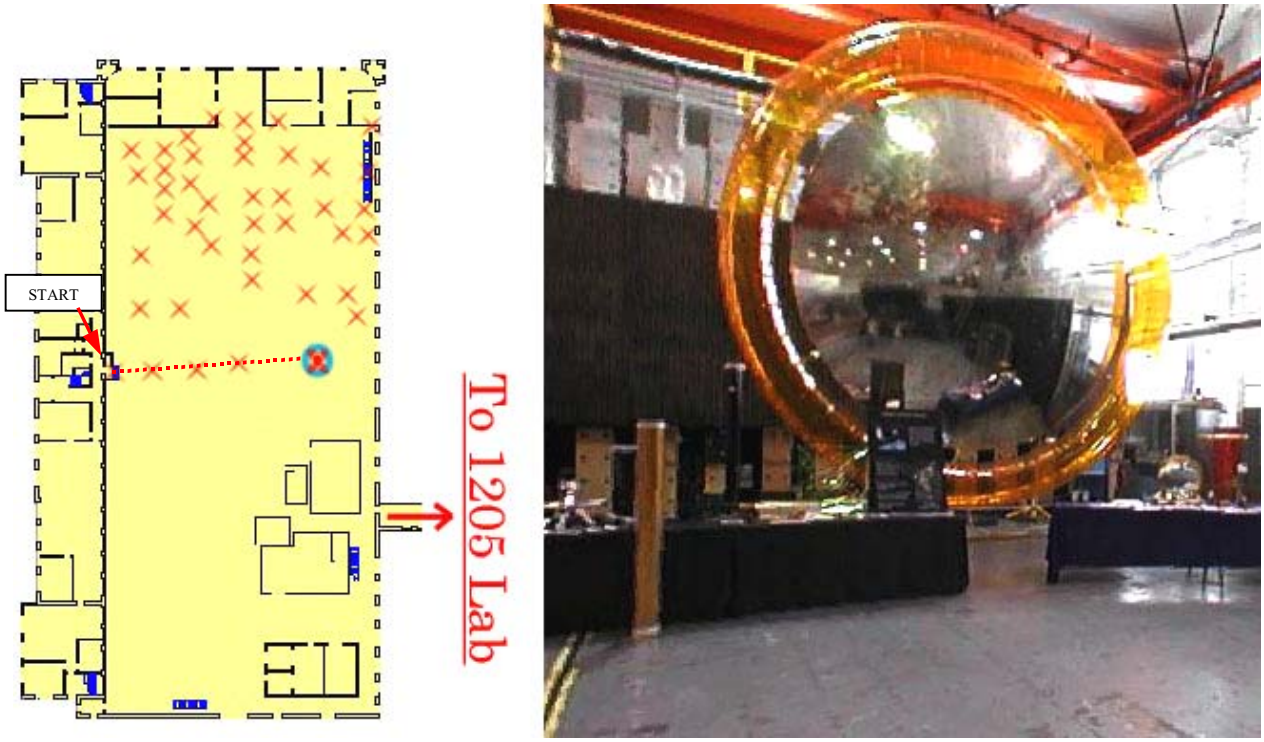
Zoom Link Icons

Navigation Hand Icon



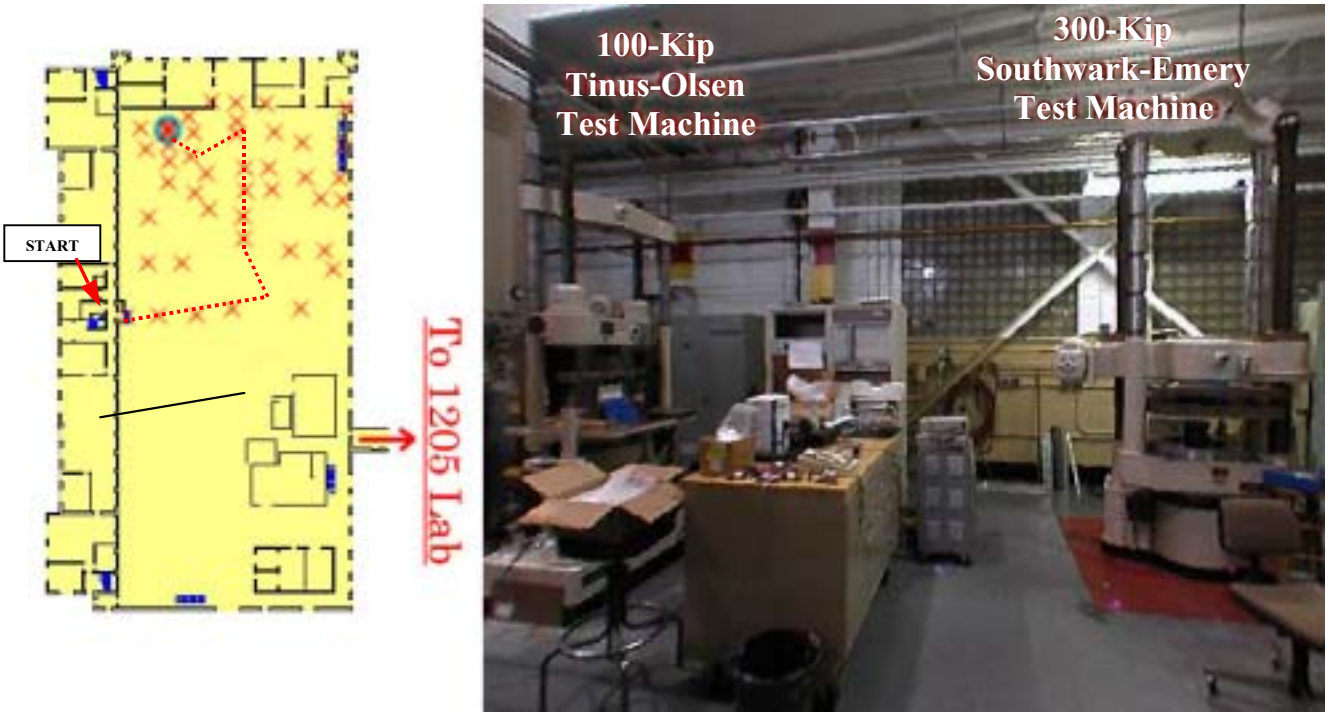
Link Navigation Icons

Figure 4. Zoom in/out, linking and navigation Icons for iPIX Navigation.



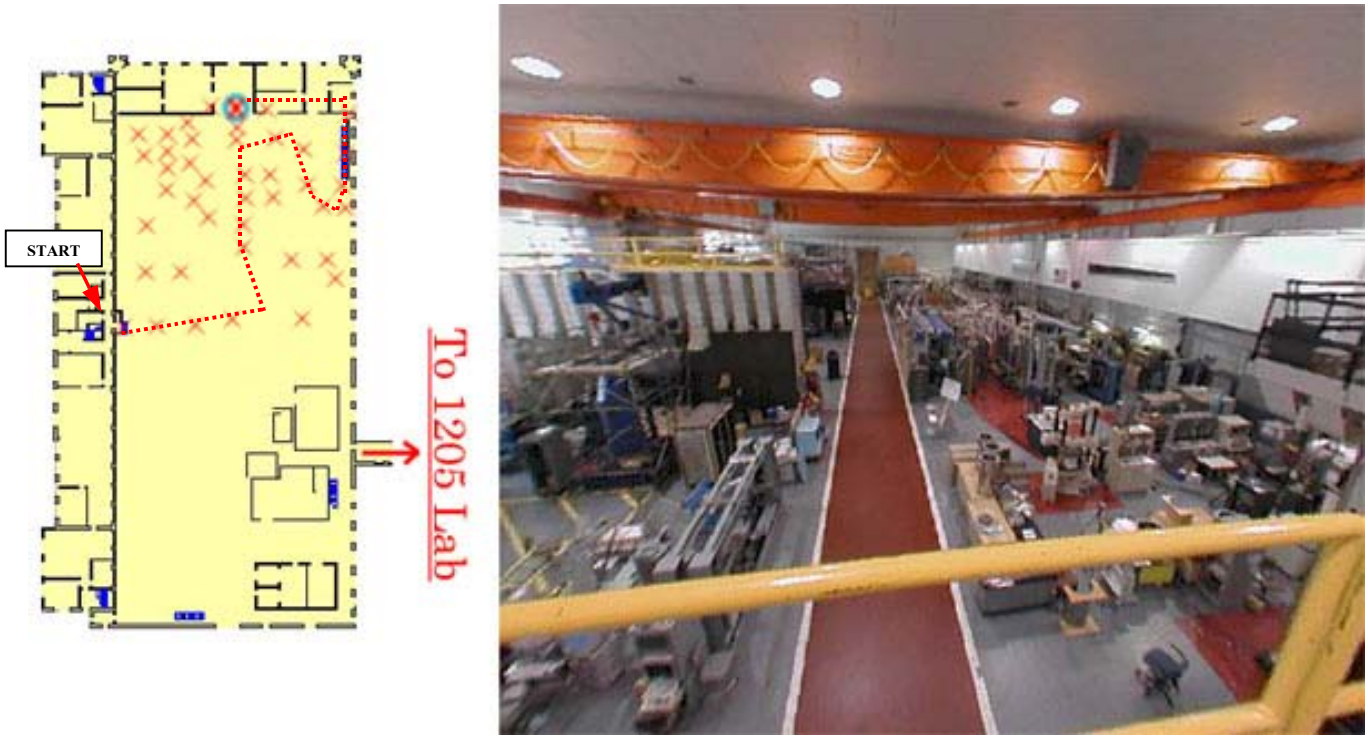
Note: The dashed line from the labeled start location identifies the navigated path of the user.

Figure 5. 5-meter lenticular antenna hanging on backstop of Building 1148, viewed from Position 7.



Note: The dashed line from the labeled start location identifies the navigated path of the user.

Figure 6. The 100Kip and 300Kip test machines behind 1,000Kip Test Machine in Building 1148 Laboratory viewed from Position 27.



Note: The dashed line from the labeled start location identifies the navigated path of the user.

Figure 7. Looking down upon the toured Building 1148 Lab from Position 40.

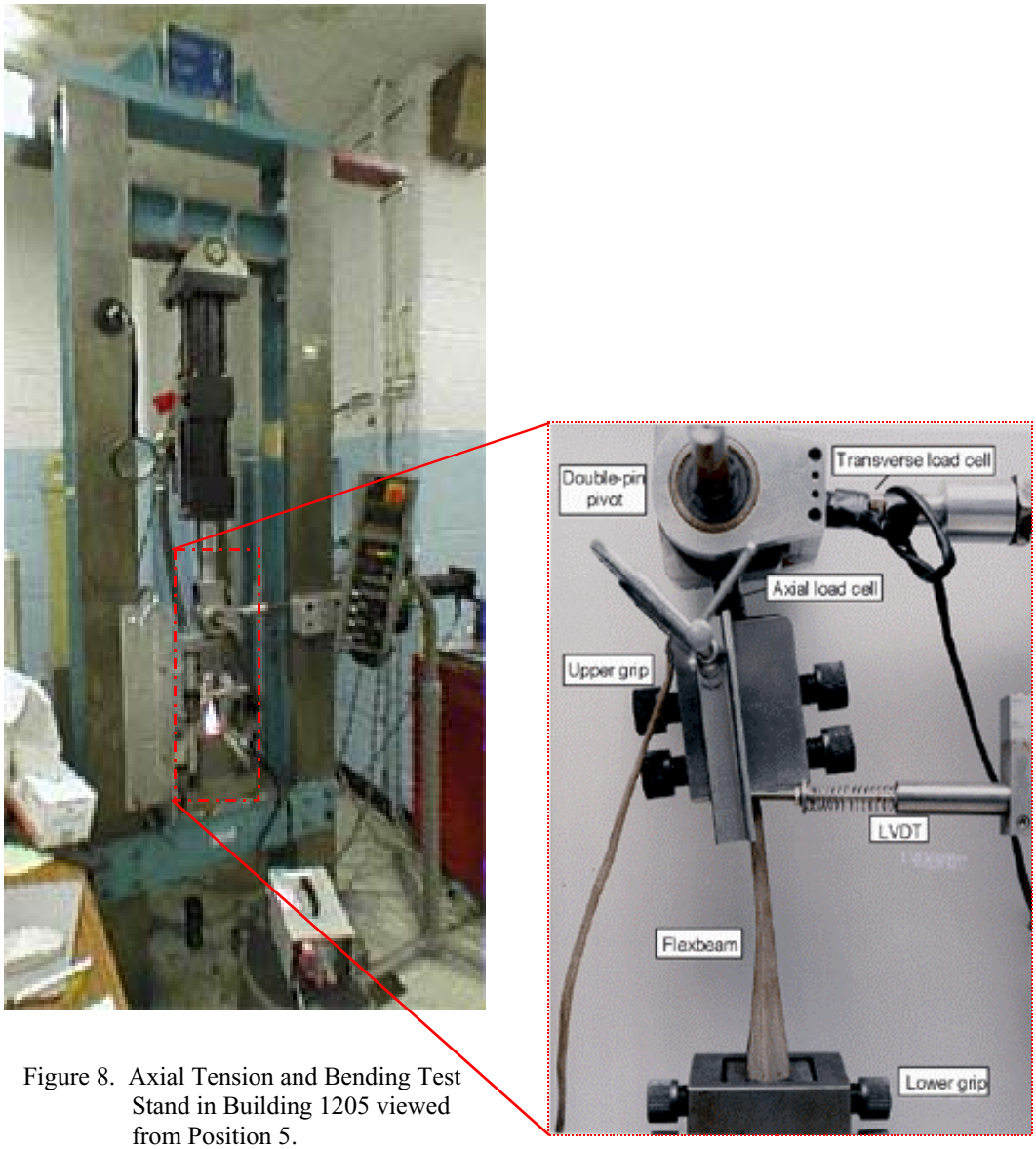


Figure 8. Axial Tension and Bending Test Stand in Building 1205 viewed from Position 5.

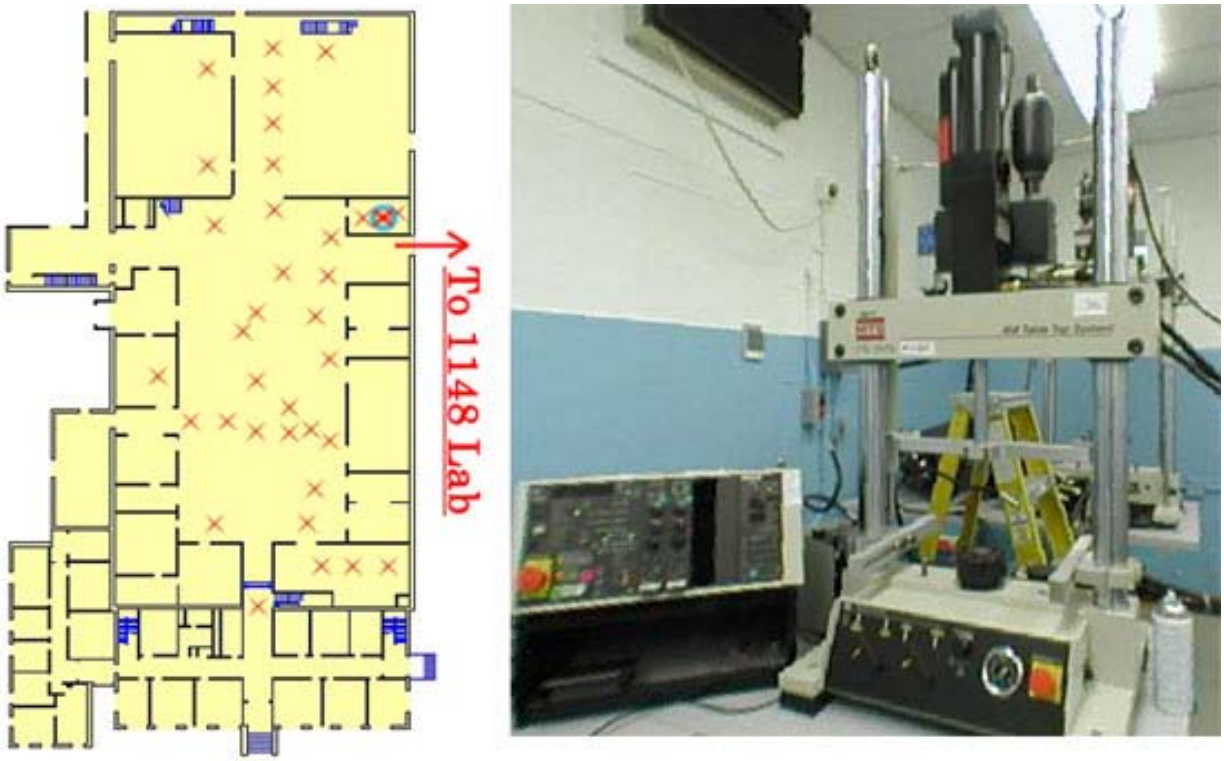


Figure 9. 5-Kip Small Load Material Characterization Equipment viewed from Position 24.

Figure 10. View of Building 1205 Laboratory from the balcony from Position 36.

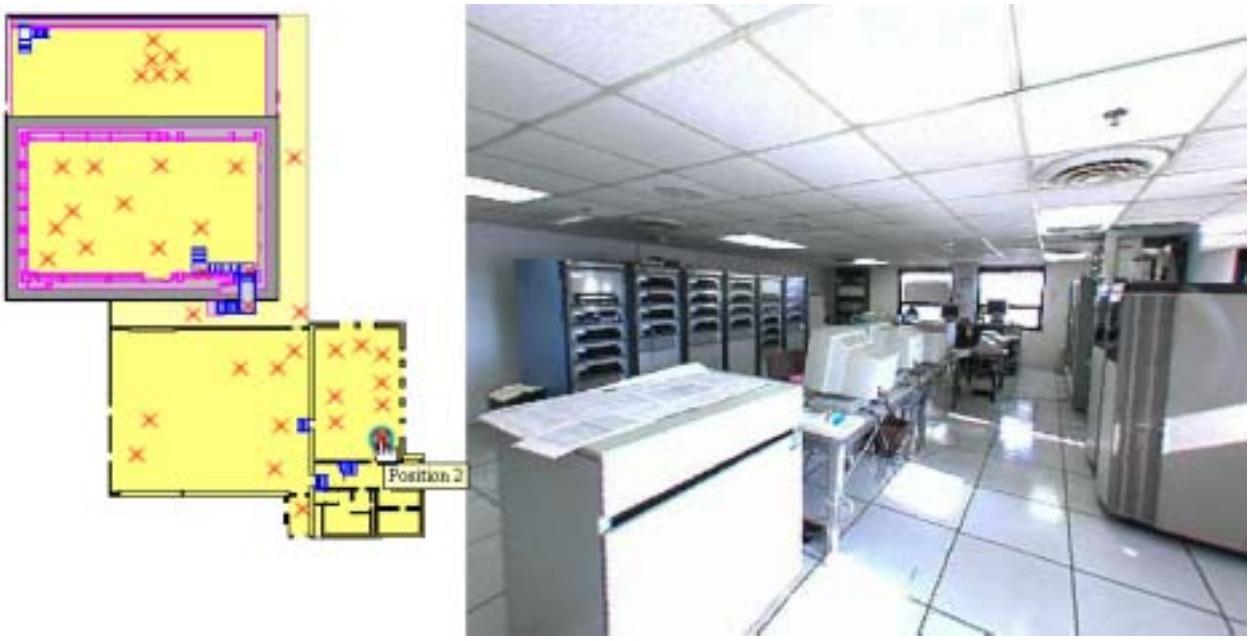


Figure 11 —Building 1256 Control Room Viewed from Position 2.

Figure 12. Fuselage specimens in the High Bay Area of COLTS.

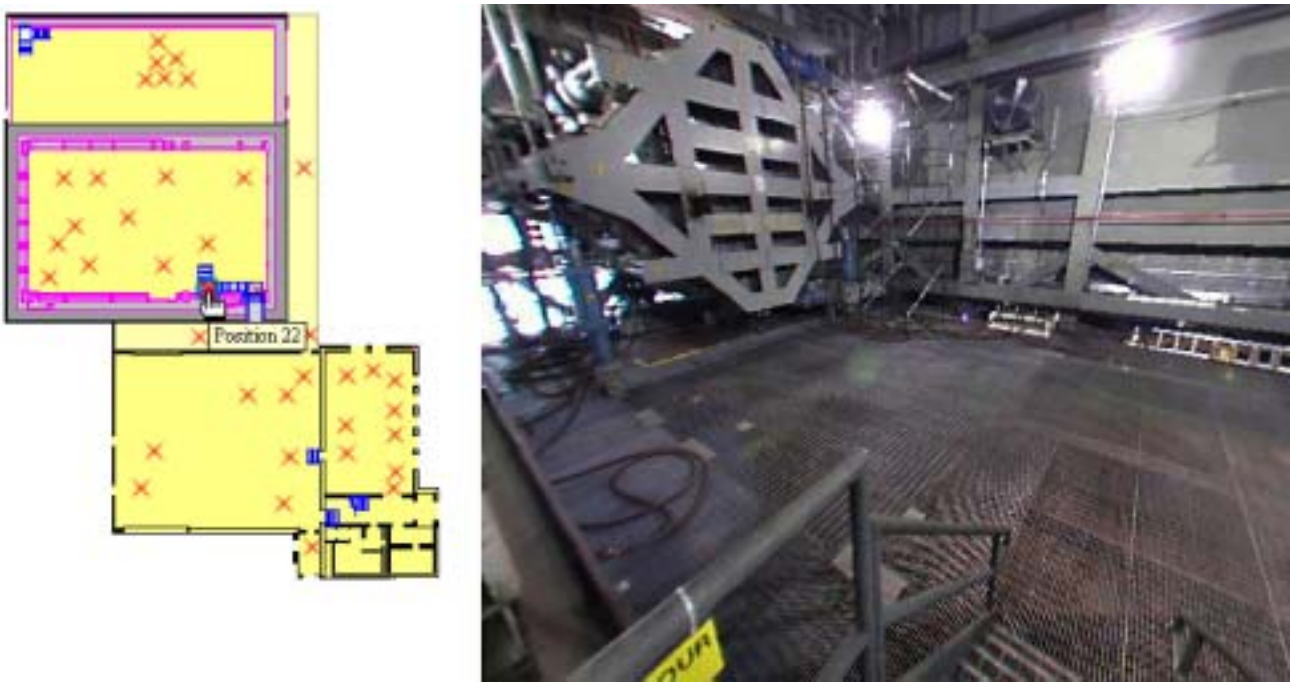


Figure 13. Building 1256 COLTS Test Machine and Pit Area viewed from Position 22.

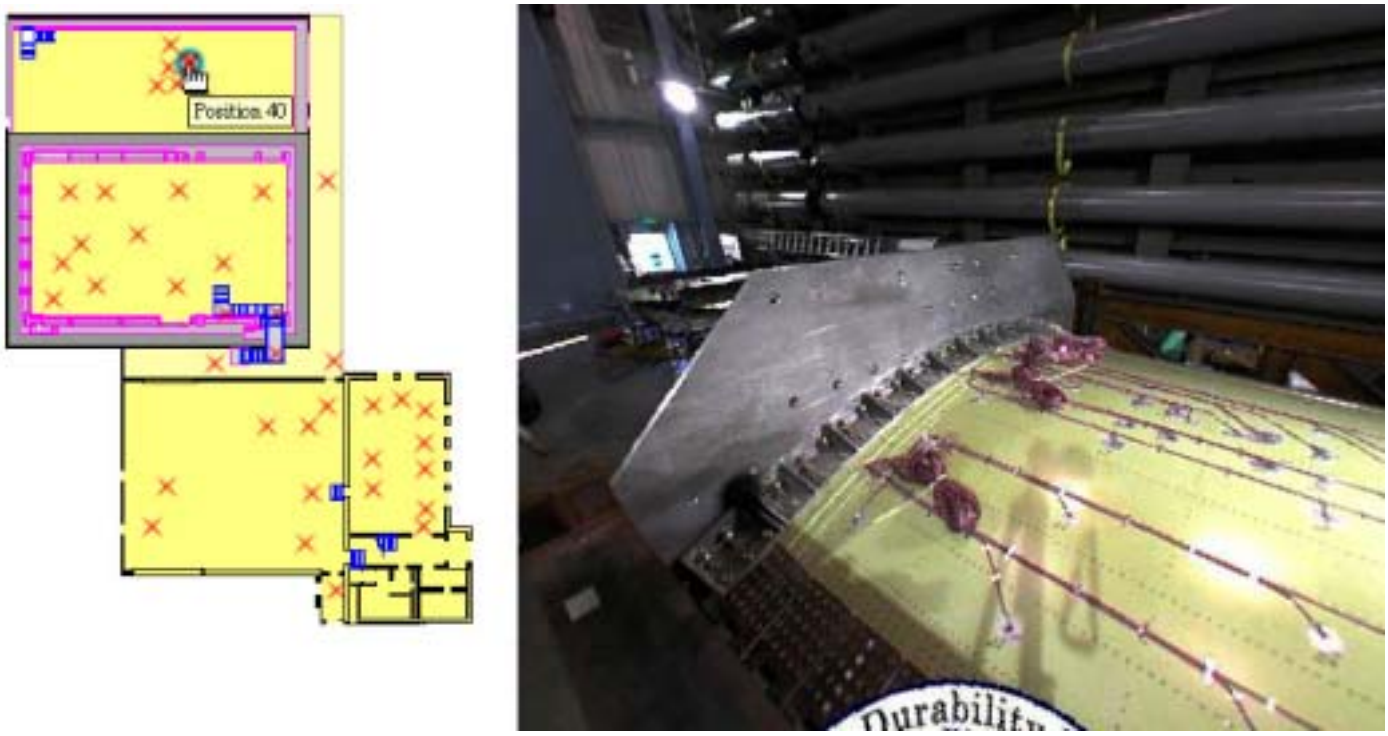


Figure 14. Building 1256 COLTS D-Box located in Specimen Preparation Area viewed from Position 40.

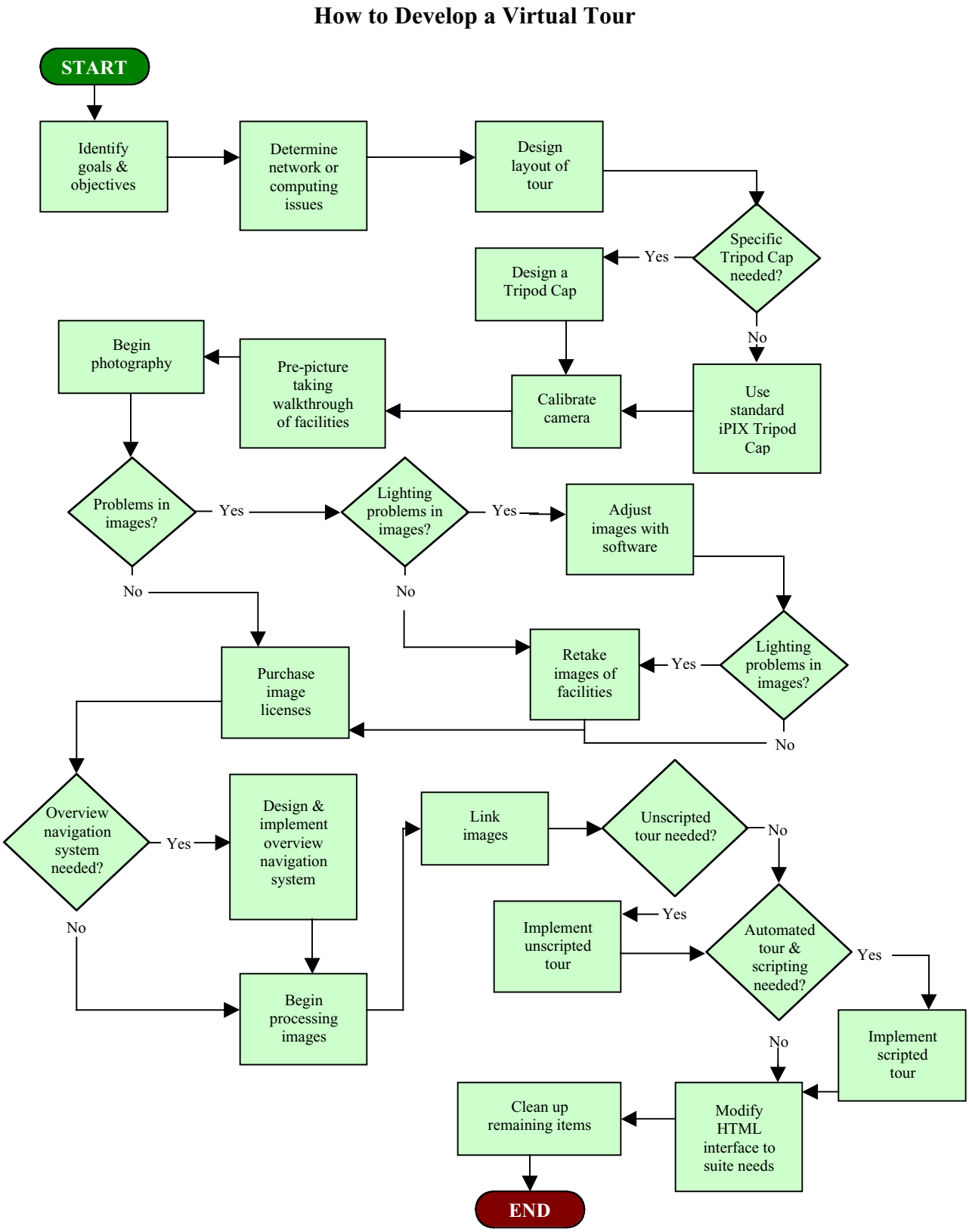


Figure 15. Flow-chart outlining the development process for a Virtual Tour.

Note: MDB Tripod Cap designed by
Jeane Husch

Figure 16. iPIX and MDB Tripod Caps.

Figure 17. Poor Overall Lighting created a dull muddy picture, helped only by software correction.

Figure 18. Poor Uneven Lighting Caused Over And Underexposure In Both Hemispheres Making The Finished Image Not Evenly Colored.

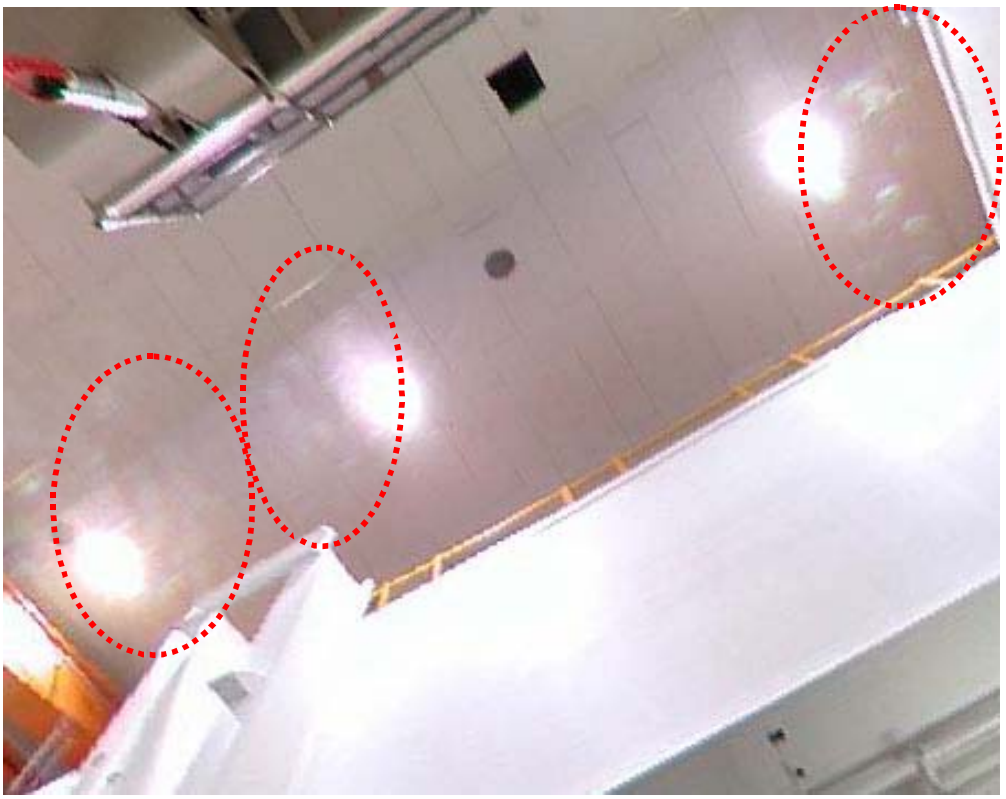


Figure 19. Ghosting Effect of Halogen Lights.

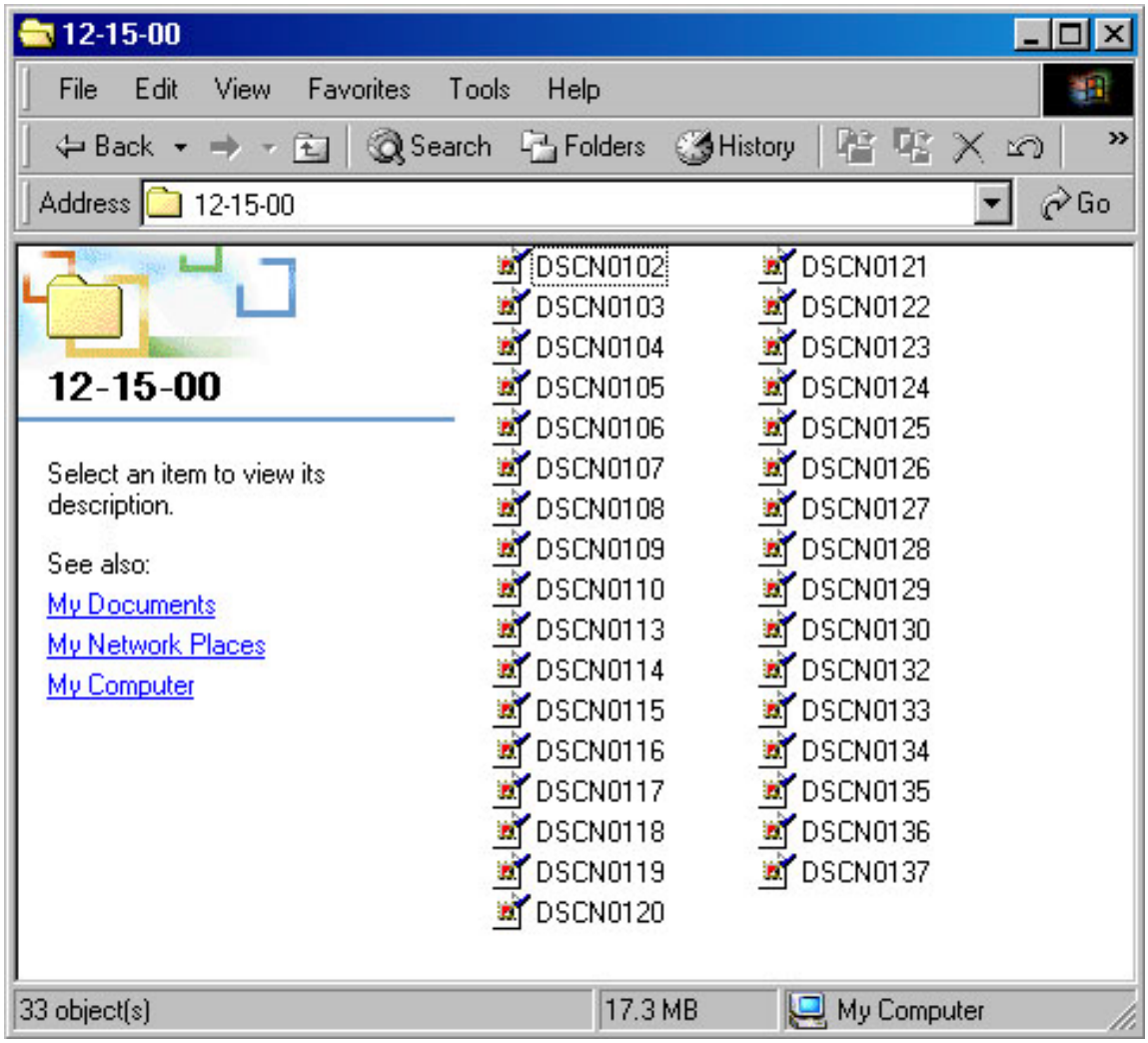


Figure 20. Directory Listing of New Camera Images.

Figure 21. Example of a Hemisphere from the Building 1148 Laboratory.

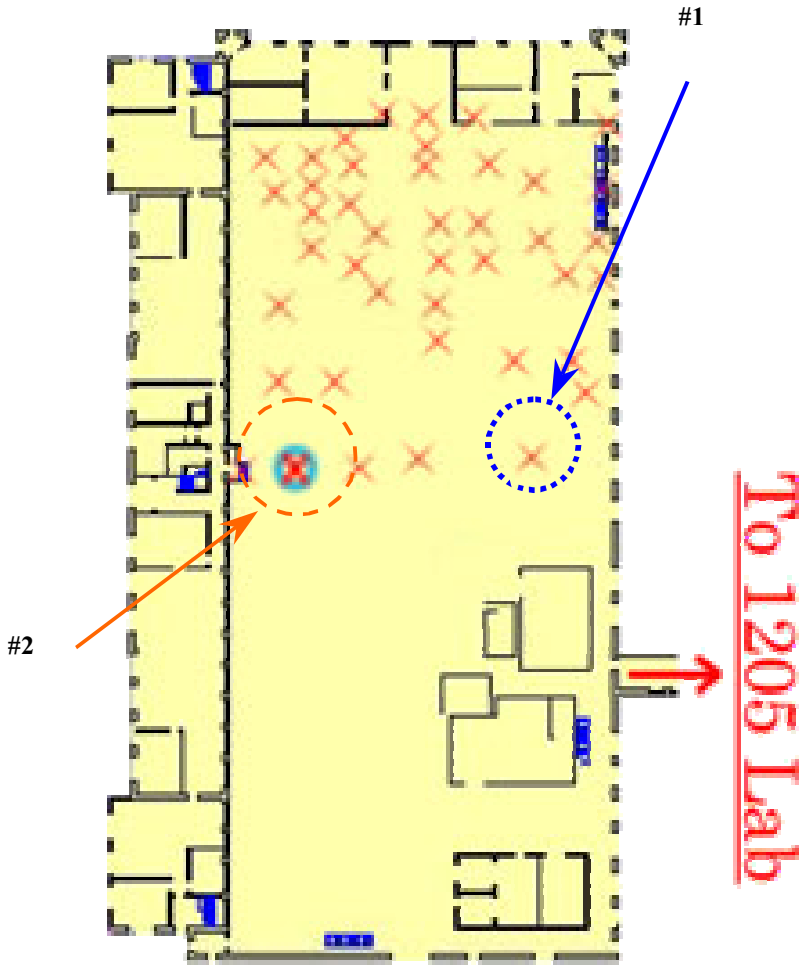


Figure 22. Navigation Map of Building 1148 Laboratory.

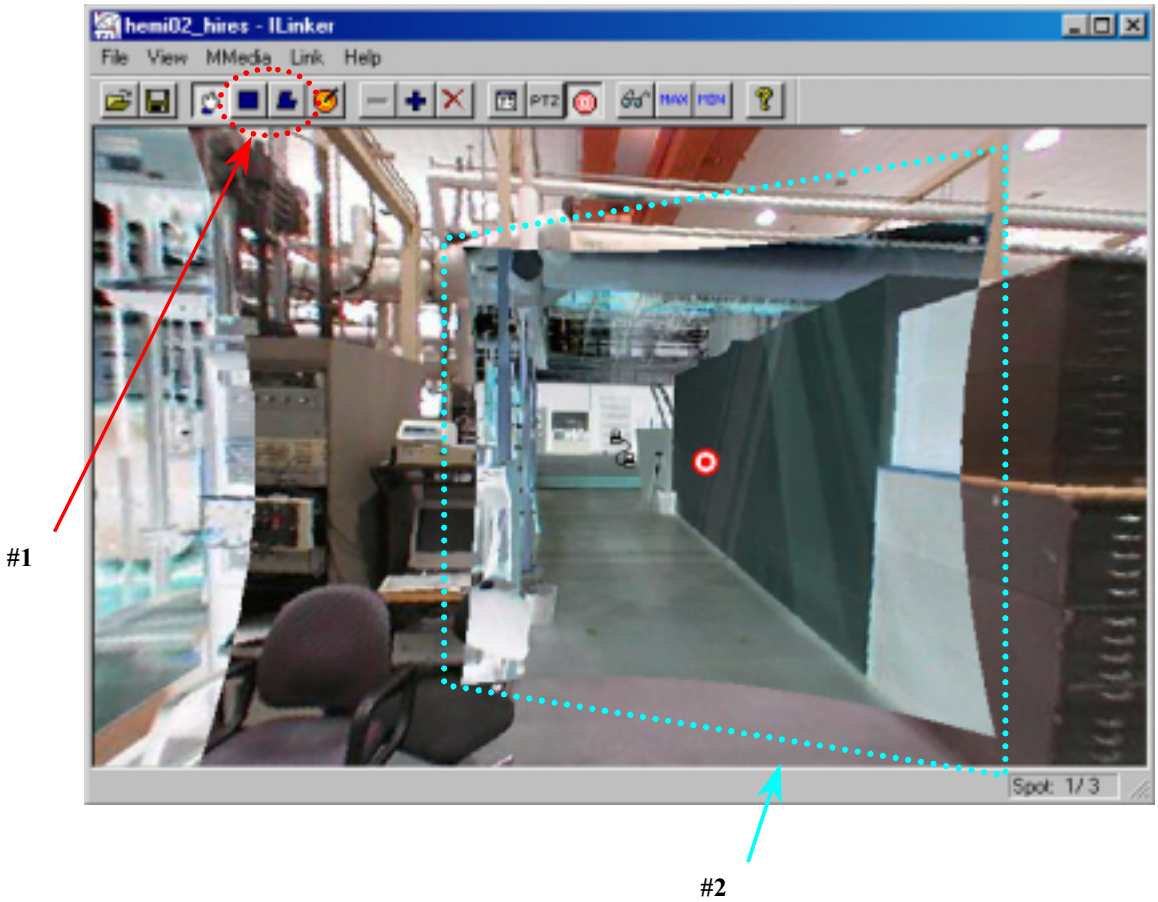


Figure 23. – ILinker ™ Program Screen – Link Creation.

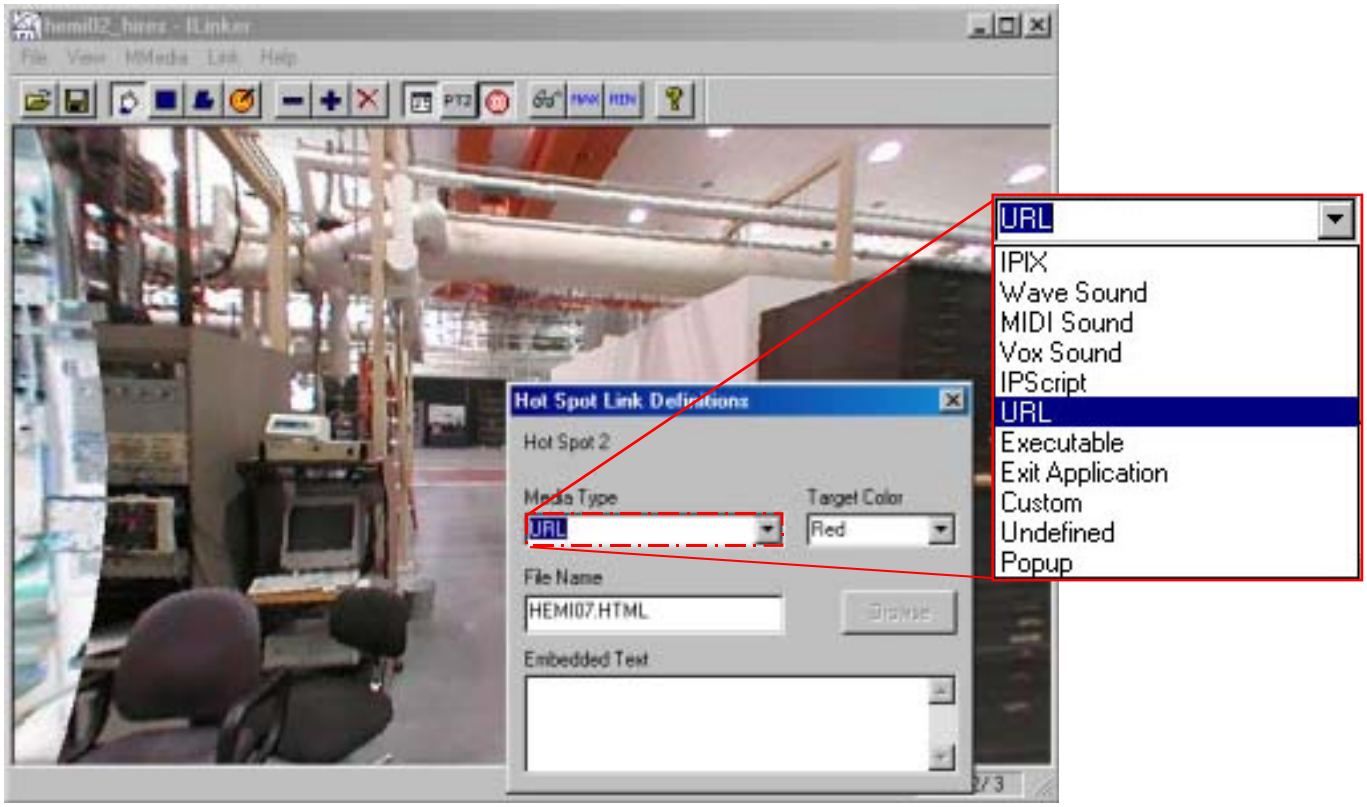


Figure 24. ILinker ™ Program Screen – Link Definition.

```
[START   ][                        ][      ][      ][      ][      ][      ][      ][    ][      ][              ][]
[PRELOAD ][HEMI09_HIRES.IPX                ][IPIX   ][      ][      ][      ][      ][      ][    ][      ][              ][]
[LAUNCH  ][HEMI09_HIRES.IPX                ][IPIX   ][      ][PAN:   61][TILT:    0][ZOOM: 0.49][      ][    ][NONE   ][              ][]
[SETVIEW ][                        ][      ][      ][PAN:    4][TILT:   -7][ZOOM: 0.49][TIME:   4][LEFT ][      ][              ][0, 0]
[SETVIEW ][                        ][      ][      ][PAN:  -17][TILT:   -8][ZOOM: 0.61][TIME:   5][LEFT ][      ][              ][0, 0]
[SETVIEW ][                        ][      ][      ][PAN:   42][TILT:    5][ZOOM: 1.01][TIME:   5][RIGHT][      ][R             ][0, 0]
[LAUNCH  ][HEMI12.HTML                     ][URL    ][      ][      ][      ][      ][      ][    ][      ][              ][]
[END     ][                        ][      ][      ][      ][      ][      ][      ][    ][      ][              ][]
```

Figure 25. iPIX TV-Studio script file.

REPORT DOCUMENTATION PAGE

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The capabilities of the iPIX virtual tour software, in conjunction with a web-based interface create a unique and valuable system that provides users with an efficient virtual capability to tour facilities while being able to acquire the necessary technical content is demonstrated. A users guide to the Mechanics and Durability Branch's virtual tour is presented. The guide provides the user with instruction on operating both scripted and unscripted tours as well as a discussion of the tours for Buildings 1148, 1205 and 1256 and NASA Langley Research Center. Furthermore, an indepth discussion has been presented on how to develop a virtual tour using the iPIX software interface with conventional html and JavaScript. The main aspects for discussion are on network and computing issues associated with using this capability. A discussion of how to take the iPIX pictures, manipulate them and bond them together to form hemispherical images is also presented. Linking of images with additional multimedia content is discussed. Finally, a method to integrate the iPIX software with conventional HTML and JavaScript to facilitate linking with multi-media is presented.

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