



Interactive Museum Media: Camera & Gesture Interaction

SPRING, 2020

As part of RLMG's continuing efforts to anticipate and respond to potential Covid-related impacts on visitor experiences in museums, we're creating a series of reports on exhibit interactivity, technology, and related topics. While the future is unpredictable, we're hopeful we can offer information that will help you adapt to a range of possible changes in your institutional policies and visitor expectations.

The first of these reports offers a broad overview of alternatives to conventional touchscreen exhibits. Here, we take a deeper dive into one of those alternatives, gesture and camera tracking. Specifically, we investigate:

- [Hand tracking](#)
- [Face tracking](#)
- [Full-body gesture tracking](#)
- [Position & movement tracking](#)
- [Using camera imagery](#)

We draw this information from our own experience employing these tools in interactive exhibits, as well as from a survey of the available technologies, discussions with our partners, and reviews of existing case studies from museums and beyond.

Many institutions are considering touchless exhibits as part of their reopening strategy, and these technologies offer a wide range of possibilities — each best suited to particular kinds of visitor experiences. Given the uniqueness of these interfaces, we generally recommend them for new exhibits designed with camera tracking in mind, though it may be possible to retrofit some existing exhibits.

We hope you'll find this overview useful. Of course every institution, and every project, faces its own set of challenges, and we're certainly available to provide further technical details and insights, or to answer any questions.

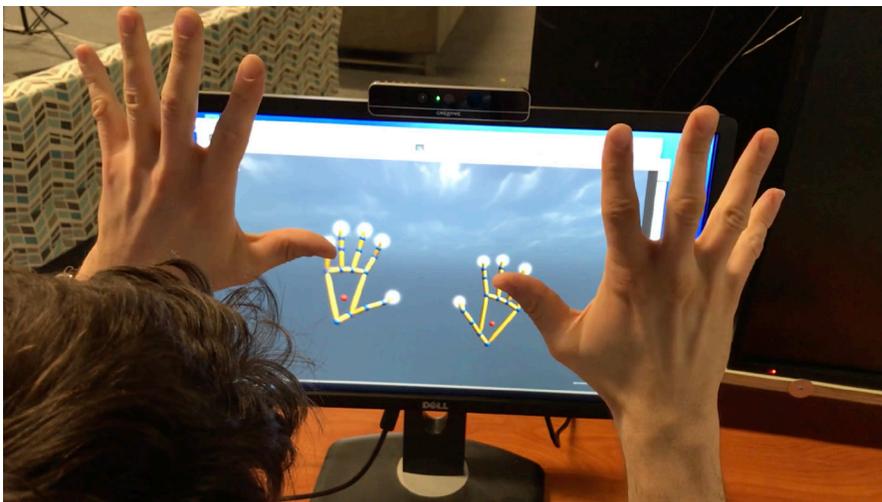
Hand Tracking

Hand-tracking systems detect the position and movement of visitors' hands and fingers in high fidelity 3D. Small, consumer-level devices (from Ultramotion, Intel, and others) combined with custom software can translate mid-air swipes, flicks, or other gestures into familiar interactions including clicking, scrolling, or novel actions such as drawing, sculpting, or orchestra conducting.

While not widely adopted in museums, hand tracking uses proven technology and integrates well with many standard production tools. Until now, it didn't provide a benefit over standard touch input for most experiences, but as an alternative or addition, it can now make exhibits accessible to visitors who are otherwise reluctant to interact. For the right experience, the novelty of touchless interaction might offer an extra sense of wonder. On the more experimental side, it can even be combined with ultrasound haptics systems which create tiny vibrations in the air against a user's hands, creating a sense of "virtual touch" and a form of tactile feedback.

Because hand tracking is less familiar than touch, there is a learning curve, and a few best practices should be heeded:

- A small set of simple gestures works best (such as swiping and "pinch to zoom").
- Explicit, on-screen prompts and immediate feedback are crucial.
- Consistency across exhibits is key so visitors don't need to re-learn the system.
- Hand-tracking works best in new exhibits designed with it in mind. The level of effort involved in retrofitting an existing program with the new technology and modified interface will vary depending on the complexity of the original program.



This RLMG prototype shows a test with an early generation of hand-tracking technology.

Face Tracking

With standard and specialty cameras, we can make software responsive to visitors using only their facial expressions. Cameras can, for example:

- Detect the presence and position of visitors' faces to trigger media or snap a photo.
- Identify emotional expressions to generate personalized feedback, or to trigger media (e.g. "Smile to start!").
- Track visitors' eyes (eg. duration of gaze or blinking) as an alternative input device.
- Provide live-tracked transformations of visitors' faces to alter their features in real-time or provide puppeteer-like control over an avatar.
- Recognize visitors' faces to personalize information or interaction.

It is worth noting that masks will limit the capabilities of some of these systems, and may impact their accuracy. There are also privacy considerations around storing or sharing any identifying information.



At the Early Human Face Swap station, visitors see themselves reflected as one of their prehistoric relatives. Detailed 3D models follow along with visitors' movements and expressions in real time (Perot Museum of Nature and Science).

Full-Body Gesture Tracking

Body-tracking camera systems translate visitors' position, movement, and gestures into software input, and are an excellent way to make spaces or programs responsive. Body-tracking (or "skeleton-tracking") systems give a reasonably precise reading of a visitor's pose and broad movements, and can be used to, for example:

- Track arm, hand, or head positions to interact with on-screen elements.
- Control an on-screen avatar or character.
- Apply filters that "reflect" visitors in interesting ways, e.g. superimposing uniforms, anatomical systems, or other graphics on a live silhouette.
- Track poses to initiate a search of imagery or collection.
- Challenge visitors to copy distinctive poses and prompts.
- Follow along with key movements, like dance steps or athletic maneuvers.

The newest versions of these tracking cameras offer higher resolution and better performance than the original and well-known Microsoft Kinect, but these experiences still work best in defined spaces with some control over lighting conditions, backdrop, etc. And they are generally geared towards a small group or single user for the highest level of precision, though expanded multi-camera systems are possible.



Body Moves guides visitors through three activities, measuring their position, activity, and range of motion. Pose challenges visitors to match a series of yoga-like positions. Balance measures how still they can remain while standing on one foot. Bounce evaluates visitors' expended energy as they jump up and down. (Tech Museum of Innovation)

Position and Movement Tracking

Position tracking uses cameras to measure visitors' movement through space and overall level of activity, and is sometimes (uncharitably) known as "blob detection." The input it generates is not as fine-grained as full-body, or skeleton, tracking, but provides more detail than basic motion or proximity sensors.

Position tracking can cover large areas and numbers of visitors, making it especially effective for larger-scale installations. For example, imagery or audiocapes can change as visitors move through a lobby, gallery, or down a hallway. We sometimes say this technology makes an exhibit "responsive" to visitors, rather than "interactive". It can create a sense of immersion into an environment, and provides an open-ended invitation for visitors to play and experiment, but it does not track specific actions to associated tasks.



Visitors to the Robins Nature Center encounter a 9-foot wide, vibrantly animated riverscape that responds to visitors' activity level. Visitors learn to be still and quiet to observe animals up close, or risk scaring them off. (User testing for Maymont Foundation, The Robins Nature Center)

Using Camera Imagery

We've left the most straightforward use case for last: using a camera as a camera! Interactive exhibits can incorporate visitors' video or still images in a number of delightful and thought-provoking ways. While not as cutting-edge as the tracking systems described above, these experiences can be very effective, and offer a high degree of interactivity without requiring touch. These systems can:

- Let visitors incorporate their image as a signature, or a mark they leave on the exhibit.
- Focus visitors' attention on a surprising detail through slow motion, cropping, or unconventional camera perspectives.
- Composite visitors' images into new environments.
- Alter or distort visitors' imagery through digital masks, "dress-up", color effects, or other transformations.
- Use infrared, UV, or other filters to process visitors' images and give them unexpected views of their own bodies -- as heat signatures, silhouettes, etc.
- Use multiple cameras for "volumetric capture" to fully immerse visitors in 3D scenes.

There are privacy and curation considerations involved with any exhibit that displays visitor-generated content, but thoughtful approaches to storage and management during design can help navigate these issues successfully.



Visitors add their own images, along with a personal message, to a tapestry of historic and contemporary Colorado changemakers in the What's Your Story exhibit. (History Colorado Center)

Please let us know if you have thoughts on experiences or technologies you've seen, or ideas you'd like to explore together. Our team at RLMG is ready to continue the conversation and help you adapt existing experiences or invent new ones.

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