Ambient Intelligence at the Museum of Science Fiction

By
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Science fiction has introduced us to advanced robots and computers that possess a high degree of intelligence. Think: Gort from *The Day the Earth Stood Still* (1951) and the HAL 9000 from *2001: A Space Odyssey (1968*). These films have shown us what could be possible, given sufficient computing power and technical resources. The world of literary SF is even richer with alternatives that influence researchers in artificial intelligence today, concepts like Isaac Asimov's "Three Laws of Robotics" and other proposals for how to keep our new creations… on our side.

And hence, the question: can science fiction retain its fundamental business – of being *fun* – while using the latest, modern tools to enthrall, inspire and even teach?

What if . . .
Science fiction has always been very good at asking "what if" questions that advancements in technology later catch up with. So can a science fiction museum, make this process exciting and transparent, creating an environment that could, in turn, interact with us?

In a built environment, this is called "smart architecture." Over the past decade, these intelligent systems have slowly entered the mainstream, offering home environment controls that learn and automatically adjust to meet personal needs. Among these smart products are wi-fi enabled security systems that allow people to remotely monitor and control their homes, thermostats that learn personal preferences and responsive entertainment systems. Through seamless integration, these technologies aim to provide a personalized experience and make our daily lives easier, in a promised "Internet of Things."

These intelligent building technologies can extend beyond mere security and environmental controls. They will provide immersive and personalized, context-aware experience that serves to encourage learning and participation. They can enhance visitor experiences. Integrated with social media and mobile devices, these technologies can also facilitate social interaction. Advancements in speech recognition, robotics, and artificial intelligence have opened new doors in the way we experience our surroundings and interact with others. We are only now beginning to realize the true potential.

Which prompts a question, what if the Museum of Science Fiction in Washington, DC offered a showcase for this transition, taking smart architecture a little further to create an interactive, transformative, and educational experience for visitors?

This article discusses that possibility and the requirements involved for the Museum to create an interactive environment that can simultaneously entertain and educate – presenting visitors with easier ways to understand more challenging conceptual areas. Think: STEM here. We will do this by considering two proposed approaches – The **“amb-i”** and the **“exorarium.”**

The embedded, contextual, personalized future….
At an increasing pace, technologies once thought to be solely in the realm of science fiction are steadily becoming reality. Cloaking devices, nanotechnology, 3D printing with advanced materials, and thought-controlled instruments are all being pre-alpha prototyped and tested. As appetites and expectations for higher performance technologies increase, the mean time to reality (MTTR) will continue to drop. The next 20 years promise to be exciting as innovations build on innovations, and new technologies become ordinary more quickly. This environment presents new opportunities for institutions, such as museums, to begin exploring how best to test these concepts. One such not-so-new concept is ambient intelligence.

Ambient intelligence arose from several research areas involving pervasive networks, ubiquitous computing, context awareness, and human-centric computer interaction design. In *The Invisible Future: The Seamless Integration Of Technology Into Everyday Life (2001), r*esearchers Aarts, Harwig and Schuurmans described the concept as having the following characteristics:

1. Embedded: many networked devices are integrated into the environment
2. Context aware: these devices can recognize a person and their situational context
3. Personalized: they can be tailored to individual needs
4. Adaptive: they can change in response to a person’s needs
5. Anticipatory: they can anticipate a person’s desires without conscious mediation

The technology needed to execute these concepts in a museum setting already exists. At the Museum of Science Fiction, for example, we see the potential to embed ambient intelligence in the gallery spaces so amb-i can be aware of and recognize visitors. Using common mobile devices, Museum visitors will be able to access enhanced exhibit content by connecting to the Museum’s network.

In this case, ambient intelligence may be built into the environment to allow Museum visitors greater interactivity and learning opportunities from exhibits and display objects – creating a personalized experience that balances entertainment with education.

You Should Meet *amb-i* . . .
Designing ambient intelligence is a lot easier than creating artificial intelligence, although the final result might seem very similar.

The main objective for putting ambient intelligence into the Museum of Science Fiction is twofold: enhanced visitor experience, and to experiment with a new type of STEM educational tool. The Museum's initial requirements began with basic features and functionality and will later include more sophisticated adaptive and anticipatory behaviors.

This system is called *amb-i. amb-i* is enabled by installing and configuring software on an mobile device. The mobile software is installed by the user, who sets his or her individual preferences in a series of screen sequences and submenus. When the set-up is complete and the app is initialized, the software will stay resident in the background and wait for *amb-i* awareness and recognition.

Using a network of sensors and beacons, *amb-i* will detect and recognize individual visitors via their mobile device as they move about the exhibit spaces. *amb-i* will then welcome and personally greet the visitor, either by voice or by presenting his or her name on a display screen. A holographic projector may also present a 3D image of the visitor's favorite science fiction character, for example, with a spoken welcome greeting. The holograph may suggest a museum itinerary based on the visitor's device configuration. Individualized tours may be arranged dynamically based on *amb-i* accessing the visitor's preferences.

For another example, let us add 37 visitors to an exhibit space and have *amb-i* recognize that 11 visitors happen to like the film *Interstellar* (2014). From here, several things may happen:

1. *amb-i* can notify Museum staff for an opportunity to provide an impromptu mini lecture about an *Interstellar*-related topic, maybe something about time travel and relativity, or perhaps suspended animation.
2. *amb-i* can present information on actual technologies in development such as NASA's TORPOR project related to suspended animation.
3. *amb-i* can direct visitors to *Interstellar*-related content around the Museum so they can meet similar visitors at a designated place and time.
4. New learning opportunities can be presented about related topics, ie. relativity and black holes; faster than light travel and cryogenics, etc.
5. Visitors can communicate with each other via *amb-i* and form relationships creating new social and learning communities.

Dynamically creating like-minded visitor communities involves another concept called architectural sociability. Steven Ochs defines architectural sociability as the advance of interactive architecture attempting to integrate social communication and technology with built environments as an effective design

solution using social networks, localized data streams, ubiquitous computing, pervasive networks, and smart environments.

The potential for *amb-i* to create new communities is good, given science fiction's social aspects and STEM learning possibilities.

Besides interacting with visitors and facilitating social connections, *amb-i* will also give visitors wireless control of display objects. Once in the gallery space, visitors will be able to operate display objects and explore STEM-related content.

One such application includes the Museum's prototype trilithium photon probe. The probe will be part of an exploration exhibit highlighting field equipment technology from the television series *Star Trek* and will contain heliophysical data from a notional mission to Alpha Centauri. Visitors will be able to open the probe's access panels with their mobile device, stream the probe's data storage, and watch a video about the star's heliophysical data. The probe may also deliver information related to the following STEM areas:

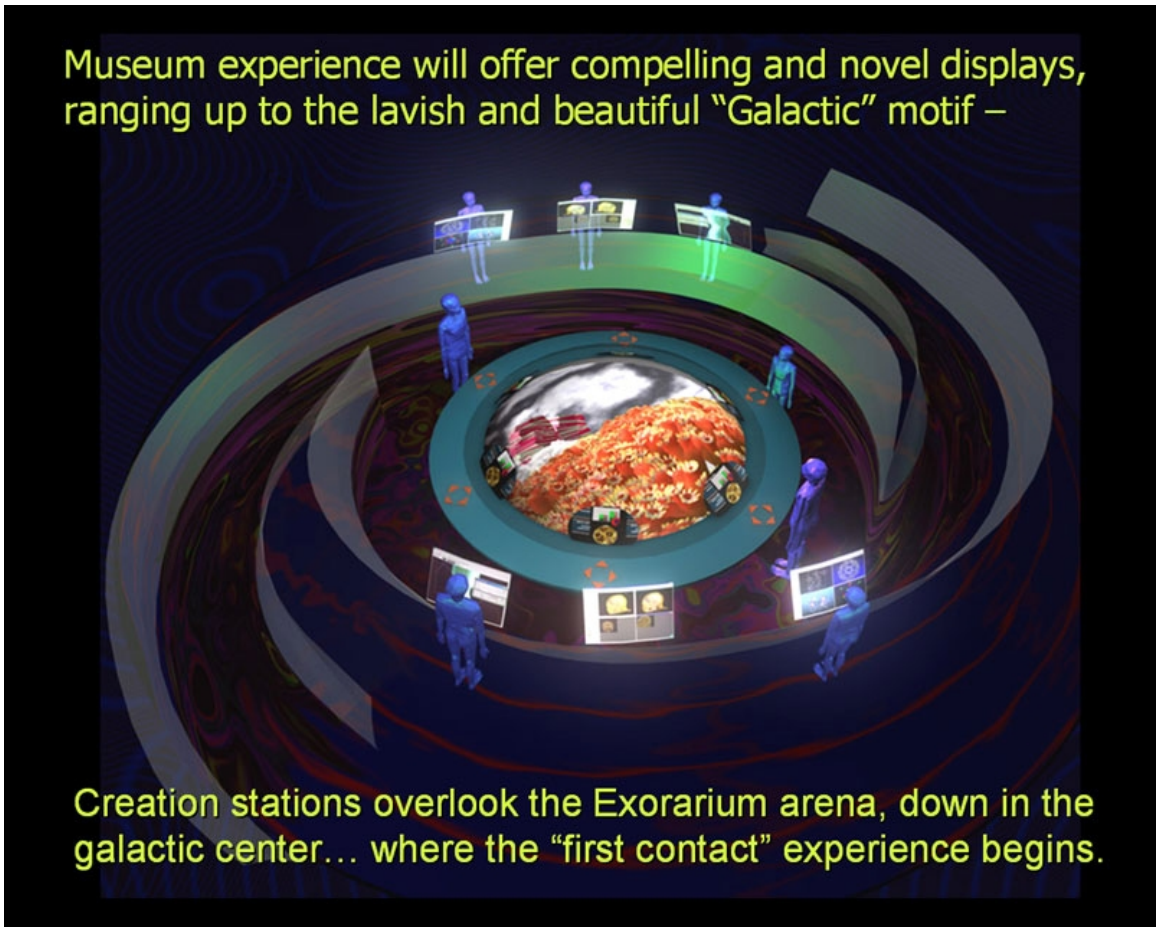
1. heliophysics and space weather data
2. robotics and autonomous systems
3. space craft systems design and subcomponents
4. computer data storage systems
5. power and propulsion systems
6. interstellar navigation and guidance data
7. signal processing systems
8. sensory equipment packages

The system could be employed in other exhibits as well. For example, in an exhibit about technology from Frank Herbert's novel *Dune*, the "stillsuit," which was used as a survival suit that reclaimed water on the fictional desert planet Arrakis Prime, could be presented and compared to real-world advances in water reclamation and purification technology. The visitor could use his or her mobile device to learn how the stillsuit functions. Animated cutaway views of the display object could glow to illuminate the stillsuit's different functional systems.

An alternative wonder… The Exorarium

Imagine a work of art that teaches… or a teaching tool that inspires and dramatically expands our horizons! Outward, to far galaxies… or inward, to the very molecules that make life tick… while always pondering the *other*. The weirdly different and fascinatingly strange.

The Exorarium Project proposes to achieve all this and more, by inviting both Museum visitors and online participants to enter a unique learning environment. Combining state-of-the-art simulation and visualization systems, plus the very best ideas from astronomy, physics, chemistry, and ecology, the Exorarium will empower users to create vividly plausible extraterrestrials and then test them in realistic first contact scenarios.



The Exorarium concept has been developed by astronomer and best-selling science fiction author David Brin in tandem with renowned tech-artist Sheldon Brown, director of the Arthur C. Clarkes Center for Human Imagination at UC San Diego. The Museum of Science Fiction is proud to be a central figure in helping to bring about this bold endeavor in combining game-design and modern effects with imagination and a grand STEM-teaching experience. (www.exorarium.com) Brin and Brown are both Museum advisory board and subcommittee members.

A departure from museums as usual . . .

The primary goal for the Museum is to provide a rapid point of departure from museums as usual and give visitors new ways to interact with STEM educational content that will provide enhanced learning and entertainment experiences.

Other *amb-i* embedded architectural functionality will evolve to include active floors and walls with way finding information and community building features to create new social and educational relationships.

Night at the Museum (of Science Fiction)
Science fiction enjoys remarkable popularity with a global community. For this reason, it is important for the Museum to bring exhibits to people that cannot physically experience in Washington, DC. The Museum will extend the exhibitions beyond the building using augmented reality. Virtual visitors will have 'round-the-clock, continuous access to the galleries and enhanced programming.

We now have the capability to go beyond just creating an exact virtual model of the physical museum. Technology like Oculus Rift can allow incredible freedom to build what might be too big, too expensive, or too fantastic for the non-virtual world.

This technology may be applied to provide students with a more engaging approach to learning anatomy or physiology. For example, imagine being a student and walking into a (virtual reality) exhibit space to browse a vast science fiction catalog containing materials related to other worlds, vehicles, exobiology, technology, computers, and robots. You sit down at a console and view *(using Oculus Rift)* the exobiology sub-catalog. Scrolling through various categories: Literature, Television, Film, Not Classified . . . you tap "Not Classified" and browse another sub-catalog of life forms you've never seen before, created by the Museum's artist community. One catches your eye. It's labeled, "Species 2112." You double tap the image on the screen. A full-size, three-dimensional life form begins to form in front of you. It looks like a cross between a gorilla and a reptile. You walk around Species 2112 to see the creature from different angles. A button on your forearm controller is labeled, "cutaway." You press it and the species disassembles showing you internal biological systems and functions.

Organs glow and shimmer, parts glisten.
You press "Cutaway" again and the body parts reassemble.

There is another button on your forearm controller labeled, "activate." You press it and the species comes to life showing you normal movement and associated sounds. If interested in further study, the visitor may press the "print" button on his or her forearm controller and a small 3D model of the species prints on a non-virtual Makerbot.

The learning objectives that go along with this example could provide students with a more interesting approach to learning high school anatomy or physiology – not just exobiology.

Scenarios like the one just described are not impossible or science fiction anymore, given the present state of technology and what will be available within the next few years.

The Museum of Science Fiction presents a unique test-bed to experiment with multidimensional learning tools using integrated technology overlays – not only to entertain, but to educate as well.

Technologies like ambient intelligence and oculus rift have the capability to provide enhanced visitor experiences – both within a physical museum and a virtual museum.

As we move forward with developing tangible learning objectives via software and programming that provides meaningful content with measurable results, we hope to disrupt current learning approaches and provide some new tools, cool tools like *amb-i* and the Exorarium.

In 1942, Asimov introduced the *Three Laws of Robotics*:

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm
2. A robot must obey orders given it by human beings except where such orders would conflict with the First Law
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law

As *amb-i* becomes self aware, rest assured that she will comply with Asimov's Three Laws at all times within the Museum. In a few years, this may not seem so funny. Einstein said it best, "Imagination is everything. It's the preview of life's coming attractions." At the Museum of Science Fiction, we could not agree more.

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The nonprofit ***Museum of Science Fiction*** *will be the world's first comprehensive science fiction museum, covering the history of the genre across the arts and providing a narrative on its relationship to the real world. The Museum will show how science fiction continually inspires individuals, influences cultures, and impacts societies. Also serving as an educational catalyst to expand interest in the science, technology, engineering, art, and math (STEAM) areas, the Museum uses tools such as mobile applications and wifi-enabled display objects to engage and entertain. For a full press packet on the Museum of Science Fiction's vision and other information, visit: www.museumofsciencefiction.org/presspacket*