Asteroid Kiosk – A SpaceGAMBIT Project, Final Report November 2014 SpaceGAMBIT Subcontract No.: 2014.002 Submitted By: Event Horizon Audiovisual LLC Address: 216 Auoli Drive, Makawao, HI 96768 Contact: Bennett Yashon

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1 Basic Description

The Asteroid Response Center (ARC) is an educational touch screen kiosk that uses video and multimedia information to introduce the NASA Asteroid Grand Challenge¹ in an entertaining and engaging form. It was implemented on a 22" Windows 8 touch screen system in an environmental enclosure, and exhibited at six venues which had over 140,000 attendees. The project online home is <u>http://www.asteroidResponseCenter.com</u> A video archive of the application can be found in the ARC Playlist on YouTube: <u>https://www.youtube.com/playlist?list=PLGI7w-dlSG4gsEcT-Df - 6WN2q LwUw5q</u>



Asteroid Response Center (ARC) in use at Cafe Art, Burning Man, August 2014

1 http://www.nasa.gov/home/hqnews/2013/jun/HQ 13-188 Asteroid Grand Challenge.html#.VHbK7mTF UI

2 Project Team:

Event Horizon, Maui Makers

The Asteroid Kiosk project was subcontracted to Event Horizons, a Maui Hawaii entertainment production company with close ties to the local maker community. Event Horizons team consisted of Bennett and Carey Yashon, Lorayne Lipps with assistance from Greg Arends, Ayden Say (graphics design contributor), Matt Brunn (music). Jerry Isdale of SpaceGAMBIT, volunteered as the primary subject matter expert, and provided venue support.

3 Project Statement of Work

The statement of work from the contract stated that the Subcontractor shall:

• Build an interactive kiosk hosting video and multimedia information regarding NASA's Grand Asteroid Challenge, asteroid science and SpaceGAMBIT projects.

- Outfit kiosk to present at least 15 minutes of video content and 3 interactive experiences.
- display kiosk at at least two venues with a combined attendance of at least 100,000 people.
- Collaborate with SpaceGAMBIT personnel on content selection, development and venues
- Provide a final technical report and accounting statement as described in Attachment 4

Content created for this project will be released under open license per Attachment 1, Section 5.

4 What was Done

The ARC concept was to create an interactive touch screen experience with educational content for all ages but delivered through a fun and "childlike " edu-tainment platform, and exhibit it where it would get significant intelligent and receptive users. The primary venue target, Burning Man, has some very harsh environmental conditions, with high heat in daytime, cold nights, severe fine dust storms (white outs) and occasional rain. Other venues (World Maker Faire NYC, etc) had gentler environments but may still include light rain, and public exposure.

Early discussions quickly divided the project into the basic application development and the display exhibit. Application development helped select the computer system but otherwise had little impact on the display exhibit. The application operates on a variety of hardware systems and could be housed in a variety of displays. We pencil sketched both the exhibit and some screen concepts, and the development teams split to get designs working.



The team briefly considered developing our own custom application, but the very tight development time until exhibition precluded that choice. We conducted a search for existing content authoring packages, both open source and commercial. Criteria included off-net operation, reboot system into kiosk application, playing video and other external content, support of touch interface User Experience. The hardware system had to have easily available and affordable hardware. After deliberating several options, we selected Intuilab Intuiface platform (http://www.intuilab.com/). It offered all the needed functionality with a user friendly interface and delivery system that would work with on the shelf hardware. Additionally the interface required minimal raw coding which would be time consuming. The IntuiLab platform was advertised as working on multiple platforms. Unfortunately this turned out to be a bit of marketing before ready, as the only supported platform in the project exhibition time frame turned out to be Windows 8.1. We had initially started working with the intent to use Android tablets, which were decently priced at about \$300 for 22" diagonal systems. Switching to Windows All-In-One systems doubled the system costs, and increased the weight/size of the machines. Fortunately, we did not start building the case until we had the final machine in hand.

Following is bullet list would be better rewritten as prose. Some points have been integrated into prose in other parts of this document.

• Several computers purchased. Original Android models assigned to other projects

• Software search found commercial kiosk software from X called Y, Developer edition cost \$X with runtime licenses of \$200/machine. Selected primarily for ease of use in creating complex product in very short timeline. Buy vs build choice was evident from start based on time frame available to deliver finished project for exhibition at events.

• Extensive hunts for online resources: videos, stills, stories to support edutainment system (list of links?)

• Artistic Concept design meetings followed two paths, one for the content system and one for the physical road display.

• Content Design - pencil sketches of screen shots, exploring what was possible using the selected software,

• Project specific videos were shot for the Meet The Asteroids segment – featured talking asteroids using eyes/mouths from local actors layered/composited onto asteroid images.

• Beta Testing night with a diverse demographic of families with children to programmers.

• Physical System

• selected Acer windows 8.1 all-in-one touch screen system w/22" screen

• packaged in environmental enclosure made of 80/20 aluminum, with acrylic side and front panels.

- Sign with ARC logo lit with 12v green led strip
- Four headphones connected via amplifier, hung on coat hook below enclosure
- mounted on 4x4 black panel with cables (power, audio) enclosed in split tubing.
- Venues Where ARC was displayed

• Cafe Art, Center Camp, Burning Man, Black Rock City NV August 22-Sept 2 (approx 70,000 attendees, plus staff)

- received Award of Excellence
- World Maker Faire NYC, September 20-21 2014, 85,000 attendees
 - <u>http://makerfaire.com/highlights/media-kit-press-resources/</u>
- Smaller Venue Exhibits
 - Demo at U.Nevada Reno library
 - TEDxMaui Sept 28 2014 (desktop system as enclosure was still on

mainland).

• Elation event on Maui Nov 21, 2014

5 Software/Content Design

The ARC concept was to create an interactive touch screen experience with educational content for all ages but delivered through a fun and "childlike " edu-tainment platform.

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After deliberating several options, we selected Intuilab Intuiface platform. It offered all the needed functionality with a user friendly interface and delivery system that would work with on the shelf hardware. Additionally the interface required minimal raw coding which would be time consuming.

- Built using IntuiLab IntuiFace² platform <u>http://www.intuilab.com/</u>
 - originally seen as free, cross platform with android system use
 - android only as display/interaction, free with major limitations
 - decided to continue use as basis as no other alternative seemed viable
- Adobe After Effects used in production of Talking Asteroids
- Most Production Effort was expent on the "Meet The Asteroids" section

Since we were very short on time we started doing the video shoot right away. In the studio we set up lights, sound and a rig to hold actor's faces steady. We then had each actor read from a video prompter a humorous yet factual monologue of the respective asteroid they were portraying. (This was harder than it sounds – keeping people's faces steady.) We then selected the best takes and used the animation software called After Effects to isolate the eyes and mouths – then we added little artistic touches by moving the mouths and eyes closer together, enlarging, slanting or varying these features. We colorized them to match and put them on to the actual photographs of the asteroids, except for a couple of the asteroids that we didn't have photos of.

Next we edited video to go play along side of the talking asteroids. This was displayed in a separate expandable box and we matched the footage as closely as possible to what the asteroid was explaining about itself. We also had a Japanese asteroid, spoken in Japanese and we have an expandable box translation page next to it. In order to make these shorts we did extensive research into a subject that was quite new to us – between shooting, editing, researching, collecting, creating the music and sound effects and learning the new software to build the touch screen content – we worked straight thru the 2

2 <u>http://www.intuilab.com/platform/features/overview/</u>

months, often times not leaving our "workroom" for days on end. Much junk food was consumed and many an all-nighter was had. We then spend the last few days with a subject matter expert to help us go through the content, fact check and add some content and images. (And we all grew neck beards)

The interface responds to many of the standard Windows 8 gestures. Touch will activate a button. Multi-touch can zoom, rotate, move some items on the screen (notably the ARC logo on most screens).

The remaining parts of this section document each screen used in the application.

5.1 Top Menu/First Screen

The top (intro) menu has 6 Choices which transition to sub areas:

- "Test Your Knowledge" Quiz
- Meet The Asteroids
- Defense Solutions
- Videos
- Save The Planet
- Space Creds
- Easter Egg video (note the voice overs, script?)



If the system is left alone for a while (about 3 minutes), from any point, it will flip to an Attract Screen that shows a series of animations to intice people to Touch...



5.2 Test Your Knowledge Quiz

The "Test Your Knowledge" section is a set of 10 multiple choice questions, each with 4 possible answers. There is music playing in background. Touching a Wrong answer display "Wrong" and sound. Correct responses give a "Correct" screen and sound, then progress to next question.

A video of the quiz in action can be seen on YouTube at <u>https://www.youtube.com/watch?</u> <u>v=23uRR05c8xg&index=8&list=PLGI7w-dlSG4gsEcT-Df_-6WN2q_LwUw5q</u>

5.2.1 Q1: Where is the Main Asteroid Belt in our solar system located?

- Between Jupiter & Saturn (false)
- Between Mars & Jupiter (correct)
- Between Earth & Sun (false)
- Throughout The Solar System (false)



5.2.2 Q2: The first asteroid was discovered by...

- Jerry Isdale 1973 (false)
- Hypatia 369 CE (false)
- Edwin Hubble 1933 (false)
- Guiseppe Piazzi (correct)



5.2.3 Q3: Asteroids are also known as?

- Minor Planets (correct)

- Moons (false)
 Comets (false)
 Space Junk (false)

Space	e Quiz
Asteroids are al	so known as ?
Minor Planets	Moons
Comets	Space Junk
TEST YOUR KNOWLEDGE W	ITH THESE 10 QUESTIONS

5.2.4 Q4: Which is the largest known asteroid?

- Vesta (false)
- Eros (false)
- Ceres (correct)
- Ida (false)



5.2.5 Q5: Scientists believe the Dinosaur-killing asteroid stuck 65 million years ago where?

- Northwest Canada (false)
- Yucatan Peninsula (true)
- Black Rock City (false)
- Czechoslovakia



5.2.6 Q6: Roughly how many NEO's or Near Earth Asteroids have been discovered to date?

- 89,000
- 8900 (correct)
- 890
- 89

	Space	Quiz	
Roughly Asteroids	how many N have been	EO's or Nea discovered	ar Earth to date?
89000	8900	890	89

5.2.7 Q7: What's the name of NASA's asteroid sampling mission due to launch in 2016?

- Dawn
- Anubis
- B612
- OSIRIS-REx (correct)

	Space	Quiz	
What's the	name of NAS	A's asten	oid compling
miss	ion due to 3	launch in	2016.
Dawn	Anubis D.	B612	OSIRIS-REX
			REFER

5.2.8 Q8: What valuable resources do many asteroids possess?

- Coal and Natural Gas
- Organic Matter
- Water and Platinum (correct)
- Uranium



5.2.9 Q9: What does the term "asteroid" mean?

- Made of rock
- Star-Like (correct)
- Metallic
- Pock-marked



5.2.10 Q10: How much asteroid and comet material hits Earth daily?

- None
- 1000 tons
- About the weight of a bus
- 100 tons (correct)



5.2.11 Thank You screen

There is a final Thank You screen:



5.3 Meet The Asteroids

"Meet the Asteroids" is one of the most popular sections of the application. It is also where most production time/effort was spent. It features Nine (9) talking asteroids giving facts about themselves, AGC and other relevant topics in an entertaining way. The main screen in the section shows 9 buttons (asteroid rocks with names). Each of these leads to a screen showing an image of the asteroid and a second panel showing video or text. The asteroid image has eyes/mouth of an actor composited on using Adobe After Effects. A rig was built using PVC pipe to hold the actors heads in place while they were reading, from a tablet mounted along side the video camera.

A playlist of videos for all the asteroids can be found on YouTube <u>https://www.youtube.com/playlist?</u> <u>list=PLGI7w-dlSG4gsEcT-Df_-6WN2q_LwUw5q</u>



5.3.1 Ida:

Well hello, I am Ida and was first seen in 1884. Being an S-type asteroid it was determined that I am made of chondrite, which is found also on earth.

For years I traveled happily in orbit when, in 1993 the space craft Galileo, moving toward Jupiter, sent back photos of something really exciting – I have my own moon and even though other asteroids have since been found to have moons – I was the first! Scientists were crazy-happy and named my moon Dactyl after creatures in Greek Mythology. And, it was found we were both made of the same material...that makes sense after all, Dactyl is my baby. (We still don't know who the father is, eh hem....)



5.3.2 Bennu:

Ha Ha Earthlings – I am coming for you, muah hahahaha – My name is Bennu, and NASA gots it right - I DO pose a threat, a fricking BIG threat – well, not until 2180. There is a 1 in 1800 chance I will collide with your planet. BOOM! This is enough of a threat that NASA is leading a mission to Me, that's launching on 2016. Ha Ha. They plan to spend 8 months on me and map my assss-troid. We'll see what happens.... Hahahaha – see ya in 116 years Earthlings..... Tootalooo



5.3.3 Chelyabinsk:

Greetings and salutations, I am amazing Russian meteorite known as Chelyabinsk, or actually what's left of me. This is the 1,442 lb. chunk of me that was found at the bottom of the Chebarkul lake. I am guy that flew over Chelyabinsk, Russia in 2013 creating a massive shock wave that shattered windows damaging over 7000 buildings and oops – I injured about 1500 people, sorry. It happens – I came in at about 43,000 Miles per hour and measured about 20 meters in diameter. My Wife would say 25. My total kinetic energy before atmospheric impact was equivalent to 500 kilitons of TNT. This is good for Russian Disco. I'm the largest natural object to hit Earth since 1908 or Stalin



5.3.4 Geographos:

"Hello I'm Geographos. I am a Mars-crossover asteroid and a Near Earth Astoeroid. Do you know what can change the orbit of asteroids? Crashing into each other – but that is more rare than winning the lottery. The Yarkovsky effect can change it too – tho slightly. This is when the sun heats up the surface of the asteroid with solar radiation, and then after a slight time delay it cools and it releases that same radiation as heat and causes a tiny thrust to the asteroid's motion. Over time – I'm talking like hundreds of thousands of years, this little thrust can move the asteroid's orbital path. Something to think about when considering how to redirect an errant asteroid perhaps....?"

There is a third element in this screen – a 3d model of Geographos. Touching this image in upper right of screen allows the asteroid to be rotated in 3 dimensions.



5.3.5 Ceres:

https://www.youtube.com/watch?v=40T1_0xhrus&list=PLGI7w-dlSG4gsEcT-Df__ 6WN2q_LwUw5q&index=1

Hey now, I'm Ceres, I am BIG! Seriously, I'm the BIGGEST! Large large large. 590 miles wide, baby! So big that when I was first discovered in 1801, I was classified as a planet – then, like Pluto, downgraded to the status of an asteroid. Sheesh. Then, Most recently I was voted to be reclassified as a dwarf planet. Ain't Nothin' dwarf about this heavenly body. Hmm, What else about me – I have ice and water on me too, H2O that is. Maybe this means I could support life. What do you think?

But either way, I'm Awesome.

Sincerely, Ceres.



5.3.6 Vesta:

Script: Hello Darlink, I am Vesta, named after the Roman goddess of hearth and home. (I was "discovered and brought to stardom" in 1807 by Heinrich Wilhelm Olbers.) What's special about me? What isn't Darlink, not only am I the second largest known asteroid, I am the brightest and the most visable to the naked eye. Why? Because I have a reflective surface. Darlink, if you want to see me right now, I am in the constellation of Virgo. Use a smartphone ap that shows constellations – you don't need a telescope to see me – however if you want to get up close and personal, and you are Burningman, sashay over to the Black Rock Observatory and tell them you want to see Vesta, Darlink! Love Ya, kisses!



5.3.7 Juno:

Sooooo, my name is Juno and I was like the 3rd asteroid to be discovered in 1804. I am one of the larger "stony" asteroids, totally. I like to kick it with my homies in between the orbits of Mars and Jupiter. That's totally called the main belt, which is totally distinguished from the others – like the near Earth objects or NEOs or the Trojan asteroids which are like waay out there, like beyond Jupiter- out there. BTW, If Jupiter was totally further out in it's orbit or didn't exist at all – We MAIN belt asteroids would have totally formed a planet the size of Mercury. Oh my gawd. Is Mercury still in retrograde?



5.3.8 B-612:

Bon Jour, I am Monsieur B612. I am the asteroid on which lived Le Petit Prince, from the childrens story by Antoine de Saint-Exupery. Some may call me fictional but I am tres significant because a very important group used my name called The B612 Foundation. This group is dedicated to protecting the Earth from asteroid strikes.

It's two main goals are to help detect asteroids that could one day strike the Earth, and find a way to divert their path in advance to avoid such collisions. B612's current goal is to design and build an asteroid-finding space telescope called Sentinel, to be launched in 2017. The Sentinel's supercooled infrared telescope, will be parked in an orbit similar to that of Venus, and will help identify asteroids and other near-Earth objects (NEOs) that pose a risk of collision with Earth.



5.3.9 Itokowa:

(NOTE: the actor reading the script was a japanese speaker who elected to read the text in japanese. The side image in this screen is the english text)

Konichi-wa, my name is Itokawa. In 2003 JAXA, the Japanese Aerospace Exploration Agency launched, Hayabusa, an unmanned space craft that made physical contact with me in 2005. Now other asteroids have been visited before – but I was the first asteroid that had a sample collected from it and sent back. Hayabusa didn't arrive back on Earth until 2010. Though it only grabbed very small particles, they were analysed under an eletron miscroscope and they found I am an S-type asteroid – which means made mostly of iron and magnesium-silicates. They also found that I am not very dense and more like a pile of rubble



5.4 Defense Solutions

The Defense Solutions section provided 10 selections describing various way we "Know What to Do About Them". Each selection brings up an overlay with an image and text describing the solution, with a bit of commentary.

Text on the top level screen states:

"There are no imminent threats- any *known* asteroids that have a reasonable chance of hitting the earth within the next few decades, and doing significant damage. However, we are still finding dozens of large asteroids each year. With more and better detection and follow up observations, we may find a potential collision soon. If we have enough notice, there are a number of ways we could deal with these."

It follows with ten (10) buttons in 3 groups:

- Kinetic Solutions: Hit It Hard
 - Nuclear Explosion
 - Alternate Impactors
 - Rocket Propulsion
 - Drag with Spacetug
- Stand Off Methods: Pus it Slowly
 - Ion Beam Engine
 - Gravity Tractor
 - Paint
 - Ablation/Solar Collector
- Ignore Them
 - Do like the Dinosaurs
 - Party!



The next sections give the text and graphics of each sub of these subsections.

5.4.1 Nuclear Explosion

Uses infographic on "Hypervelocity Asteroid Intercept Vehicle (HAIV) Mission Architecture"³ as the center piece image (link)

"This is the classic solution that Hollywood and the military would choose; a nuclear device is exploded on or near the asteroid, but blowing it to bits is not a very good solution. These pieces may still rain down on earth. This is for a smaller asteroid. This technique is would be essentially be useless at disintegrating an asteroid several miles wide.

However, using a nuclear device to alter an asteroids course perhaps remains the best solution, especially with a short warning time. A recent NASA Innovative Advanced Concepts (NAIC) project proposes a double tap hypervelocity impact. Basically hit it with a very fast moving hard projectile to create a creator, then follow up with a second craft carrying a nuclear explosive, which detonates inside the creator, giving a larger push than simply the explosive."



3http://www.nasa.gov/directorates/spacetech/niac/2012 phaseII fellows wie.html
5.4.2 Alternate Impactors

"Explosive Propulsion: (Blow up something nearby)

Impact Propulsion (hit with smaller objects)

Both of these with the intention of slightly altering the orbit of path of the asteroid.

*See NEO Sheild video in Impact Video section."



5.4.3 Rocket Propulsion

"Attach a rocket motor to the asteroid and let it push it like a rocket. This assumes the asteroid is a solid object. A pile-of-rubble asteroid would not respond well. Another problem is the rotation of the asteroid - it generally will be rotating or tumbling in multiple axis. This will make attaching anything to it very difficult, and thrust would not be applied in one simple directions (as it is in a rocket)"



5.4.4 Drag with Spacetug

"Drag it With Spacecraft

Instead of attaching a rocket motor to the asteroid, a spacecraft might be attached to the asteroid with cables and act as a tug. There are, however, some major issues with this approach. First it assumes the asteroid is not rotating. It may be difficult to despin a tumbling asteroid. Second it assumes the asteroid is solid enough that cables could be attached and pull it successfully. Third the tug would need to direct its thrust away from the cables and asteroid so as not to push on it while trying to pull."



5.4.5 Ion Beam Engine

"A spacecraft could be placed near an asteroid and direct an Ion or Plasma beam at the asteroid. The thrust exerts a low pressure on the target, while a second propulsion system keeps the shepherd craft in position."

http://en.wikipedia.org/wiki/Ion Beam Shepherd#mediaviewer/File:Ion Beam Shepherd.png



5.4.6 Gravity Tractor

"Station a spacecraft near the asteroid. Its mass would exert gravitational force on the asteroid, altering its orbit slightly. The more massive the craft, the more effect it would have, but over a long enough time, even a relatively small craft could work. The tractor craft would use thrusters to keep it at the right distance - aiming the thrust away from the target, so as not to push it the wrong way."

http://www.iampleasant.com/wp-content/uploads/2011/12/Asteroid-Deflection-Gravitational-Tractor.jpg



5.4.7 Paint

"Another simple solution would be painting an asteroid to alter its reflectivity or Albedo, which would thus increase the solar radiation pressure and alter the path of the asteroid. MIT students suggested, in 2012, paper using two clouds of paint balls to paint opposite sides of the asteroid."



5.4.8 Ablation/Solar Collector

Focus the sun's energy onto the surface of an asteroid which would cause the material to boil off and produce thrust. A 2012 study indicated this will be most effective in diverting asteroids rich in water/ice, marginal in the case of silicate-rich asteroids, and ineffective in the diversion of iron-rich asteroids. Light weight materials are being developed that could be used to create a solar sail or mirror.

There are no imminent threat hitting the earth within are still finding doz follow up observation there are a number		onable chance of amage. However, we ter detection and enough notice,
Kinetic Solution		Push It Slowly
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	Close	

5.4.9 Do like the Dinosaurs

"The Dinosaur Solution: Dinosaurs did not have an effective space program. (or Burning Man/Maker Faires)"



5.4.10 Party!

"Frankly, if there is a very short warning (days), there isnt a whole lot that can be done. Scientists could use advanced space radar systems to predict the impact zone, and *maybe* evacuate."



5.5 Videos

There are 23 videos linked under 6 Category pages. The top screen shows the category choices: Finding, Visiting, Mining, Impacts, Defence and Other Facts. Each of these categories has its own screen with a number of video thumbnails. Touching (or double touching) the thumbnails brings up a window to play the video.



(todo: find original URL for online versions of videos where possible)

5.5.1 Finding

Text: How do we find asteroids? Wide area sky surveys using large telescopes capture multiple images per night. Pan-STARRS, the Maui Hawaii based telescope, is the worlk's premier asteroid finding instrument, taking over 1TB of images each night. Humans and computers scour the image sequences looking for moving dots. Results are repotted (SIC) to the Minor Planet Center. Follow-up observations are essential to refine orbital estimates and characterize the asteroids's size and composition.

- Safe Earth From Killer Asteroids
- Asteroids in Our Solar System
- Asteroid Zoo
- 2014 DA14 Flyby (no audio



Tapping on one of the icon images starts the video player. Users may have to tap this again to play. The video opens as an overlay window mostly covering the selection screen.



Playing video: "Save The Earth from Killer Asteroids" in a popup window

5.5.2 Visiting

Text: Several spacecraft have already visited 13 asteroids to date [August 2014]. Amazing pictures and detailed geography were returned. Two craft have landed and one (Japan's Hayabusa) brought back samples of Itokawa. NASA is planning a mission to capture a small asteroid and bring it to a safe orbit in an earth-moon Lagrange point.

- OSIRIS-Rex New Frontires(SIC)
- OSIRIS-rex-Bennu



5.5.3 Mining

Text: Asteroid Mining has been the stuff of Science Fiction for decades. Now two companies, Planetary Resources and Deep Space Industires, have announced plans to actually do it. Business plans talk about returning materials to earth but much of those may actually be used in space.

- Asteroid Mining Revealed
- Deep Space Industries



5.5.4 Impact

Text: Impact Earth: There are millions of Near Earth Objects (aka asteroids), with many known and many still yet unknown. Some fraction of these will, in time, impact the earth. Recently, scientists reviewed anomolies in the nuclear blast detection data and found indications of many more asteroid impacts than previously thought.

- Impact over San Francisco
- Asteroid Impacts
- Scnee Investigation



5.5.5 Defense

Asteroids will impact the earth. How can we defend the earth against these cosmic threats?

- AIDA Impact
- B612 Gravity Tractor
- B612 Kinetic Impactor (no Audio)
- Vaporizing an Asteroid
- Killer Asteroids
- Paintballs
- NEOShield
- Sentinel Mission



5.5.6 Other Facts

Learn about the Asteroid Grand Challenge. This is the project that spawned the Asteroid Response Center.

Additionally, view the video produced by the next generation of young scientists from Maui Middle School. These kids live and learn miles from the Pan-STARRS telescope on the island of Maui. One of them ay just develop the next concept to protect the earth from asteroid strikes.

If you are currently viewing this from centercamp [Burning Man], head out to Deep Playa and visit the Black Rock Observatory. Major Tom and the Desert Wizards for demos and lectures.

- Asteroid Grand Challenge
- Maui Middle School
- Asteroid Capture
- Black Rock Observatory

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5.6 Save The Planet

The "Save The Planet" page provides a form for people to enter their own ideas for asteroid defense solutions. An on-screen keyboard appaears when users touch in any box. Responses were saved in a spreadsheet (.xls) file in the application's "InterfaceAssets" folder. Analysis of the file at the end of the perfomance period indicates that only a few had information entered, and most of those were jokes. Future versions may replace this section with links to online resources.

https://www.youtube.com/watch?v=j_VDZLv7iTI&list=PLGI7w-dlSG4gsEcT-Df_-6WN2q_LwUw5q&index=10



5.7 Space Creds

The Space Creds screen provides credits to various contributors to the application. A custom electronic with voice over musical track, which was created for the project by local talent, is played while the screen is displayed. This is the same track discussed below in the Easter Egg page

https://www.youtube.com/watch?v=r3IcmO4pUWQ&list=PLGI7w-dlSG4gsEcT-Df_-6WN2q_LwUw5q&index=14



5.8 Easter Egg

On many of the screens the ARC logo in the lower right corner invokes a special "Easter Egg" screen. This screen plays a custom audio track (music with voice over) while showing 3 posters completed by another SpaceGAMBIT project – DIY Space Exploration. These three screns can be zoomed, moved, and rotated using standard Windows 8 multi-touch gestures. The three posters are: What is the Asteroid Grand Challenge, How To Become An Asteroid Hunter, How To Detect an Asteroid.

https://www.youtube.com/watch?v=FvPtwwa3YtU&index=4&list=PLGI7w-dlSG4gsEcT-Df -6WN2q_LwUw5q



6 Physical System

The ARC physical system consisted of:

- 1. Acer Aspire AZ3⁴ 23-Inch All-in-One Touchscreen Desktop
- 2. Behringer Ha400⁵ headphone audio amplifier
- 3. Four headphones
- 4. an enclosure made of
 - 80/20 extruded aluminum
 - laser etched acrylic panels
 - vent holes laser cut into acrylic top/bottom panels with standard floor vent filters.

• Front acrylic panel cut to allow access to monitor, and etched with ARC logo and AGC motto (Find all the asteroids that threaten humanity and know what to do about them).

- 2 sets of USB powered ventilation fans
- Foam weatherstripping insulation tape around touch screen to seal monitor.
 - 1.55
 - LED tape lights
- 5. Logo box
- green plastic hexagonal cake box (trhift store find)
- hexagonal acrylic panel etched with ARC logo
- LED tape lights
- 6. 4'x4' plywood panels painted black
- 7. power and audio cables, enclosed in splt tube

The cost of the equipment is being born by the team (not charged to contract) to allow for easier reuse – and more labor time.

- 4 <u>http://us.acer.com/ac/en/US/content/model/DQ.SV9AA.004</u>
- 5 <u>http://www.amazon.com/gp/product/B000KIPT30</u>

6.1 Host Computer

The original plan had been to use a 22" Viewsonic VSD220⁶ Android tablet, which is significantly lighter weight and half the cost of the Acer Windows machine. The IntuiFace software indicated it supports Android tablets, however the reality at that time was that the player runs on windows and could use an andoid tablet as a remote display/input device. Native support for Android became available in October 2014, after most of the exhibitions. This required switching out the Viewsonic tablet for the Acer all-in-one about half way through the very short development period. Construction of the enclosure was delayed until we had the official road machine in hand and confirmed operational. We could not afford an improper fit.

6 http://www.amazon.com/gp/product/B00906HOEK

6.2 Environmental Enclosure

One of the primary venues, Black Rock City, is a very difficult environment with high heat in daytime, cold nights, severe fine dust storms (white outs) and occassional rain. The ARC kiosk would be mounted on an outdoor temporary wall under a semi-permiable suncloth. It was given there would be significant issues with 'playa dust' and a strong chance that it would at least drizzle at some point in the 10 days of operation expected of the kiosk. The team decided to build an environmental enclosure that would protect the computer from most of the dust and moisture expected. Since the system would be unattended in a public place for 10 days, we also needed to be sure it and all parts would be secure. We elected to use TORX security screws in construction of the case and mounting it to the display wall.



ARC in its most ambitious display - Center Camp, Burning Man, Black Rock Desert Nevada

6.2.1 80/20 case

The simplest approach for a custom case of this type, and tight development schedule seemed to be an extruded aluminum framings system. We chose to use the system from 80/20 Inc. based on reputation in the maker and industrial community. This turned out to be a great decision. By the time we were addressing the case issue there were barely 3 weeks until the first venue opened, so we were under very significant time deadlines. We sent a project description to the 8020.net website with dimensions for the expected enclosure. They connected us with a distributor (F&L Industries in San Diego) the next day and within 3 days we had exchanged design (CAD drawings, bill of material), a revision and purchased the custom cut parts. This included F&L sourcing the TORX security screws instead of their regular ones. The parts were cut to order and overnight shipped to Maui for assembly. Shipping took 4 days.

The box went together very quickly. We took measurements and laser cut some cardboard panels. The 80/20 catalog, and online docs showed the required 1/4" cutout to allow for corners. The cardboard let us test fit the computer and showed it would work out very well. A cardboard test piece was cut for the front panel showing the touch screen would be accessible. We added ventilation slots to the top/bottom to match the computer's vent openings. Once sizes were shown to be correct front (black) and side (clear) panels were cut from acrylic. The front acrylic was also etched with the ARC logo and AGC mission statement ("Find All The Asteroids that Threaten Humanity and Know What to Do about them"). The back side was cut from MDF to give a sold mounting surface. Additional acrylic with vent slots were cut and thin a bit of heater vent filter was sandwiched between them. This would (hopefully) keep most of the playa dust out of the computer. An small rectangular opening was cut and covered on right side to provide access to the power/reset butting. A slot was cut in the left side panel to allow cable threading. All power and audio were passed thru this, also covered, slot.

Two different types of USB fans were installed at the ventilation points. The larger fans were placed at the bottom and needed some grinding to fit between the 80/20. The smaller fans had their legs removed and were duct taped to the top acrylic. The computer fit snuggly between them. Power supply bricks for the computer and 12v power for audio amp and LED strips were plugged into an extension cord inside the enclosure. Water pipe insulating foam was used to pack the case, providing firm support for the machine.

Some 12v RGB LED tape from previous projects was wrapped around the inside of the case. Only the green LEDs were powered, giving the case a green side/back glow. Some translucent vellum was added to the inside of the side/top/bottom panels to diffuse the light and hide the inner wiring mess. 12Vdc power was brought out to the Logo Box's additional LED strip using some hacked Cat5 cable.



Detail of 80/20 case and vented acrylic.

6.2.2 Logo Box

The ARC Logo is a hexagon with the acroynym emblazoned on it. A quick hunt at the local thrift store turned up a hexagonal cake box, which was perfectly sized. A sheet of clear acrylic was cut and etched. Holes drilled thru it and the box held 4" screws that went through the back panel as well. Although the LED were not directly on the acrylic, it did glow appropriately.



6.2.3 Wall Mounting

The installation at Cafe Art (Burning Man) was one of 3 4'x4' plywood sheet mounted to a triangle of 4"x4" beams sunk into the playa. The back side (interior of triangle) was accessible, and power brought in from below. We painted some smaller 2'x4' plywood sheets black at our staging area and used these to provide quick cover on the raw 3/4ply provided by Cafe Art.

The audio amp need its own protection from elements. It was screwed to one of the small black panels under a small wooden box hacked up from scrap while working at The Reno Generator⁷. This box covered the headphone plugs as well as the amp. Holes in the front allowed the 4 volume knobs to be accesssible. A four hook coat/hack rack bar from Home Depot served as a place to hang the four headsets. These were also attached to the bar with metal cables to keep them from wandering off. The resulting 8 wires made a bit of a user experience issue, as they tangled easily in heavy use. This was unforeseen and unplanned for, as was the solution. When checking in on the installation, we found people happily untangling the wires and straightening out the exhibit.

There were four sets of wires connecting the ARC box with the other parts of the exhibit, and AC input. We wrapped these with black split tube and routed them semi-randomly on the plywood surface. The overall effect, while unplanned, worked perfectly.

7 <u>http://therenogenerator.com/</u>

7 Venues

The contract required the kiosk be displayed at at least two venues with a combined attendance of at least 100,000 people. To date the application has been shown at five events, two of which had a combined attendance of 160,000.

7.1 Burning Man

The Burning Man event (<u>http://burningman.org/</u>) is a yearly festival where "tens of thousands of people gather in Nevada's Black Rock Desert to create Black Rock City, a temporary metropolis dedicated to community, art, self-expression, and self-reliance. In this crucible of creativity, all are welcome."⁸ The 2014 event ran from August 24 through Sept 1, with approximately 70,000 attendees (not including staff).

The ARC was displayed in Center Camp Cafe as part of the Cafe Art exhibit. The Café is the largest temporary freestanding tensile shade structure in the world with almost an acre of shade, a full-service coffee shop, two stages, and interactive art installations.⁹ The Cafe provided us with a 4ft x 4ft sheet of ³/₄" plywood mounted on two 4"x4" posts with the bottom 4ft off the ground. The posts, along with a third post, supported 3 different projects arranged in a triangle. This arrangement, unlike most of the Cafe space, had no projects on the back side of our board, allowing us to bolt the ARC to the structure. The Cafe Art staff found a very appropriate tiled bench that sat two people, and placed it in front of the ARC. This made an excellent setup, providing weary travelers a place to rest their feet and expand their minds.

8 http://burningman.org/event/ as of 11/15/12

9 <u>http://burningman.org/event/black-rock-city-guide/infrastructure/center-camp-cafe/</u>



The ARC was a big hit on The Playa (as the event is known). Our staff visited the display at least once a day and found it in use at almost all hours. There were kids who dragged their parents to it multiple times to watch every video. An astrobiologist who worked with NASA remarked that it was the best asteroid outreach project he had ever seen. Another attendee related a story of a young (20something) man who announced that he had finally found a purpose and a reason to go to college.

The onsite installation team witnessed response of unexpected levels of engagement in children and

adults. Attendees shared their experience of the ARC with others as "a most incredible and creative exhibit where they had fun learning about asteroids", and having many of NASA's staff enjoy it at the NYC Maker Faire.

The ARC team received an Award of Excellence for its contribution to the culture of the burning man event. The award is highly coveted by attendees. It includes a patch, a light up badge and a poster declaring the value of the contribution.



7.2 U.Nevada Reno

The ARC team was invited to show the kiosk at the University of Reno DeLaMare Science & Engineering Library by Tod Colegrove. Tod, head of the library, had met the ARC team at Burning Man and was excited about the SpaceGAMBIT program. The library had recently been upgraded to host a makerspace, with laser cutters, 3d printers, scanners, large format printers, etc. Tod had overseen the upgrade, which also included converting much of the poorly used stack space into open study space with lots of whiteboards on the walls. The library has a host of technology items students can check out including Arduino Inventors Kits, Occulus Rift head mounted displays, and a 3D laser scanner.

Tod arranged a Friday (Sept 5) afternoon event attended by students, faculty and members of the Reno community. Attendees included XXX Reno's director of entreprenure, XYYY director of the YYY museum, and a board member from the Reno Discovery Museum. The two museum folks were especially impressed and were very interested in obtaining copies of the ARC system for display in their venues.



7.3 Maker Faire NYC



ARC Team at Maker Faire NYC

The second largest venue for ARC was the World Maker Faire (<u>http://makerfaire.com/new-york-</u>2014/), held Sept 20-21 at the New York Hall of Science with 85,000 attendees.¹⁰ SpaceGAMBIT had a booth displaying information on its projects including the ARC. To carry out the asteroid theme, showcase our booth, and control lighting, we fabricated an asteroid surface for the booth walls using found materials and spray paint. Monofliament line was used to suspend various display material. The ARC sat on a table this time rather than having a wall mounting, as the walls were simple chainlink divder walls.

The booth was located in the Makers Tent about 5 booths away from the official NASA booth, where the Asteroid Grand Challenge team were showing other projects. This gave us an excellent opportunity to show the ARC to the NASA team. Jason Kessler, the program manager, was very impressed and

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http://newsletter.makezine.com/t/ViewEmail/r/005267FD39DCC39C2540EF23F30FEDED/5D3BE112 AC0865CC6E6039C17E42EE19 happy with the ARC as well as the SpaceGAMBIT projects.



Jason Kessler of NASA Asteroid Grand Challenge enjoying the ARC.
7.4 TEDxMaui

The development team and Maui Makers exhibited the ARC at a table in the courtyard outside the TEDxMaui event at the Maui Arts & Cultural Center (MACC). Attendees were able to view and interact with the ARC during the event as well as before and afterwards. Unfortunately no pictures were taken showing the display.

7.5 Elation Event

The Event Horizons regularly teams with others on Maui to produce a variety of events. The "Elation" event was held in November at the Maui Tropical Plantation. Maui Makers had a table where attendees made LED flowers for a participatory art garden. The ARC was setup in a lounge area and proved to be quite a good conversation piece. A crew from the local public access TV station included it in their coverage of the event.



8 Lessons Learned and Future Plans

The team learned a lot about the development of an effective edutainment touch screen system, and building an envrionment case. The content development work has lead parts of the team into some expanded business roles. The experience with the 80/20 materials was very good and these will be used in furture team projects

The ARC itself is being revised and evaluated as a museum exhibit. NASA has expressed strong interest in seeing the project get distributed. We are looking into several areas that need revision before a wider release:

- review video content for licensing issues
- provide better connectivity for more information. ... a web site (asteroidResponseCenter.com) has been established to facilitate this and other future developments
- revise the idea submission (Save The Planet) page to make it easier to abort out, and explain the page itself better.