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BOSTON 2017

Scenario:

In March 2011, a magnitude 9.0 earthquake struck off the coast of Japan generating a devastating tsunami that resulted in $220B in damage and over 16,000 deaths. In support of the recovery effort the US armed forces launched Operation Tomodachi, which involved 24,000 servicemembers, 189 aircraft, and 24 ships. Working alongside over 160 countries and 40 international organizations, they provided much needed aid and disaster relief. However, the relief efforts were hampered by a lack of infrastructure and a nuclear disaster, which rendered traditional relief activities requiring humans nearly impossible in some areas.

The Navy now has technological tools with the potential to revolutionize humanitarian and disaster relief, including autonomous underwater vehicles and immersive environments. Using the Tohoku disaster as a proving ground, can you:

- Create an immersive environment to improve human-human and human-machine collaboration in complex environments?
- Use an immersive environment to build trust between humans and help plan and execute complex missions?
- Demonstrate how humans can most effectively team and interface with autonomous vehicles to augment the relief efforts?

Humanitarian assistance and disaster relief (HADR) is a key element of the Navy's mission; your challenge is to use immersive environments to improve the way relief agencies, governments, the military, and citizens work together to reduce human suffering.

Challenge:

It is the day after the Tohoku tsunami and you are responsible for planning and executing autonomous submarine missions in support of the HADR effort. Under your control is a fleet of Extra Large Unmanned Underwater Vehicles (XL-UUV) and several other marine assets. Your team needs to build an immersive (VR/AR) tool to plan and/or oversee the XL-UUV work. In these types of situations, when there are so many different groups trying to contribute, there is often confusion when it comes to the command control paradigm. In this scenario there is not only human to human teaming, but also human to machine teaming. How might we use immersive technology to empower operators and machines to better work together, particularly when considering the questions listed below.

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General Questions Of Interest:

What just happened?
During disaster events there are many groups coming on to the scene as the situation evolves. How might we use immersive technology to better illustrate the disaster that has just ensued to get a stakeholders up to speed quickly?

What is the lay of the land?
During disaster scenarios knowing how things stand is half the battle. How might we use immersive technology to illustrate the current situation (i.e. where are their casualties, radiation, people in need, etc.).

Human To Human Teaming Questions:

Which subs/ships will do which tasks?
When there are several tasks that need to happen simultaneously and operators in different locations or even different countries how can we use immersive technology to make planning seamless. Could the environment model concepts like “fog of war” or uncertainty?

Who is responsible for mission priorities?
With multiple stakeholders involved in mission planning how can we empower operators to plan submarine mission paths seamlessly while working together?

What collaborative tools might be added to the immersive environment to track assets or other critical resources?
When many stakeholders are involved in mission planning, assets and resources can add to confusion in a time crunch.

Human To Machine Teaming Questions:

How might we get an autonomous submarine into deep water safely?
XL-UUVs are launched from ports and controlled by operators in close proximity to the submarine while they navigate out to the open water.

How can immersive technology be used to mediate the transfer of control from the operator to the autonomous submarine?
A Human needs to trust the machine before they hand over control. How could immersive Technology contribute to the operator trusting the machine?

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How can we use immersive technology to monitor submarine mission progress when we only have sporadic contact with the sub?
Due to the constraints of operating in an underwater environment, we do not have consistent contact with autonomous submarines. While contact with a sub will occur only once every few days, could we use VR to give operators a better picture of what is happening?

How can immersive technology help operators better convey mission priorities and decision points to the submarine?
Autonomous submarines often have to make the decisions to reroute mid mission due to unexpected obstacles. For instance, after an earthquake that causes a Tsunami, the ocean floor can be left looking very different that it did previously. When should a submarine divert from its original plan? When should it abort the mission and come home?

Evaluation:

Solutions will be evaluated first and foremost on whether they facilitate building trust between the human-to-human teams and/or human-to-machine teams. Think about all of the ways trust-based ideas have been implemented on the Internet (i.e. reputation score, validated user profiles, data accuracy, authenticated access, etc.) and then imagine what those ideas or other new ones might look like in this challenge. Below we've listed the four specific judging criteria on which you be evaluated on a scale of 1-10. Below each criteria are example of how you could score highly in each of these categories.

Technical Value:

- Code Quantity
- How well did you document your code
- Did you solve a hard problem

Mission Relevance:

- Did you approach the problem from an interesting angle?
- How unique was your concept?
- Did you solve the problem we asked?

Immersive Experience:

- Does your solution include a natural UI?
- Does it integrate/allow for the integration of sound and/or Haptic Feedback
- Does VR/AR add considerable value to your solution?

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Aesthetic Quality:

- Did you create additional world objects or game pieces (e.g. ships, submarines etc.)
- Is what you made beautiful?
- Is it of artistic value?

Overall we encourage participants to deeply explore particular elements of the challenge with their solution vs. a shallow exploration of the entirety of the prompt. Bonus points will be awarded if solutions can be implemented in low bandwidth environments. High scoring solutions may not be fully implemented in the short duration of this challenge, so a good storyboard of the concept with a minimum viable proof of concept implementation in the AR/VR SDK will still score.

Resources:

To kickstart development, the HACKtheMACHINE team has put together several resources that we think you may find helpful. You are not obligated to use any of these and may develop in whatever AR/VR medium you choose (e.g. Hololens, Vive, etc.).

Hardware

We will have many Hololens devices, workstations configured with development software for Hololens, Vive Devices, and Vive tracking units. It is highly recommended that you bring your VR enabled development device if you own one.

Raw Data

To set the stage, we've collected real data from the 2011 disaster. You can find links to download the raw data below:

- Final Damage Data: https://aka.ms/htmfinaldamage
- Fukushima Radiation: https://aka.ms/htmfukushima
- Ocean Depth Data: https://aka.ms/htmoceandepth
- Water Heights Data: https://aka.ms/htmwaterheights

We've provided an explanation of the various datasets here.

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Data integrated with Mapbox

To speed up development, we preloaded data into a mapbox account. You can access the data by creating your own free Mapbox account. Once you have set up your mapbox account you can link to the data sets using the following Mapbox references:

Tileset	Map Id	Key (Tileset Name)	Example Style
Final Damage Data:	hackthemachine.8xd96no8	Final_Damage_Data-ab93yj	mapbox://styles/hackthemachine/cj7qfo5th0pz92spcqwle5j8k
Fukushima Radiation:	hackthemachine.2upw6wno	Fukushima_radiation-cvgaiw	mapbox://styles/hackthemachine/cj7qfovfvd0z22rrp545t3q68
Ocean Depth Data:	hackthemachine.8zt36p8x	oceandepth500mesh-3gjazz	
Water Heights Data:	hackthemachine.8swy4rke	WaterHeights-7use4w	

We have provided a quickstart guide around one particular way you could visualize the data within unity here.

Base Unity Environment

In Unity we've started a sample project with several tools that may find useful including connecting the Mapbox data to Unity with the Mapbox Unity sdk, a locomotion UI, and several boats and submarine you can use during development this weekend. You can find documentation on how to get started using the base environment here. You can download the base environment itself in its entirety or particular elements that you would like to use; Please note that it is compatible with the most recent version of Unity. If you need to download this version you can do so here. (Release date 4 Sep 2017 Version 2017.1.1).