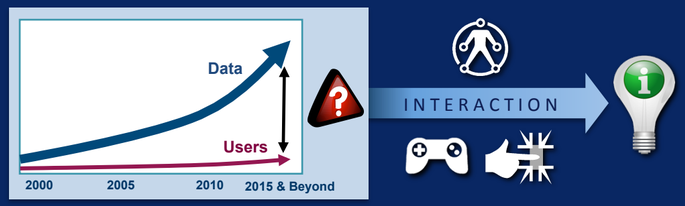
Novel Methods to Visualize and Interact with Big Data

Andrew Moran, Manuela Caicedo-Santiago, Zach Weber, Matt Hubbell, Vijay Gadepally, MIT Lincoln Laboratory

Project Overview

The unprecedented growth in the rate at which we collect data hampers the ability to visualize this often-unstructured, non-homogeneous data. The recent growth in popularity of novel tools such as video games and 3D printing ushers in new ways to interact with big data. In this poster, we describe the process of visualizing big data in the physical and virtual domains by displaying Twitter data on a physical and virtual 3D mockup of the Massachusetts Institute of Technology (MIT) campus.



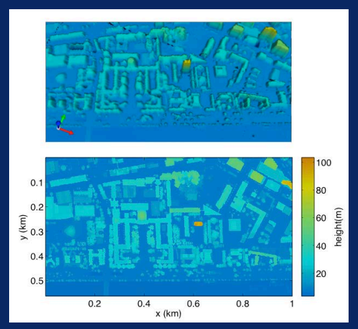
The gap between data volume and user interaction can be bridged through immersive technologies and lead to better problem solving.

Data Extraction

Data Process Pipeline for Twitter data

```
MIT_campus_tweets
lat|_042.3595666200
lon|-071.0918748400
timestamp|2014-08-13T19:49:34.000Z
text|"I'm at MIT"
(Cambridge, MA) http://www.mit.edu/
username|mobileMIT
language|en
friendscount|8986
followercount|1575
...
```

TSV

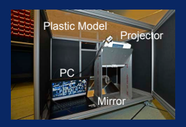


LADAR data formatted for 3D printing

```
1101010010101
0101010101001
0101010101011
0010101010101
0101010101010
1010...
```

FBX

Translucent Plastic Model



Optical Configuration for Image Projection

Mission/Goals

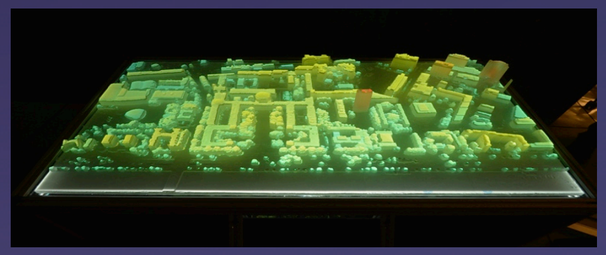
- **Visualize and manipulate live data** to ease the decision making, planning, and analysis representative of Situational Awareness (SA).
- **Enhance user experience** and interactive gameplay via emerging technology such as gesture-based controls and virtual reality.
- **Digest massive datasets** collected from Geographic Information Systems (GIS) layers in a more intuitive and effective way.

Physical

Virtual

User Experience

PERCEPTION



LuminoCity illuminated from projector base; display determined by measured height above ground level (data generated by LADAR).

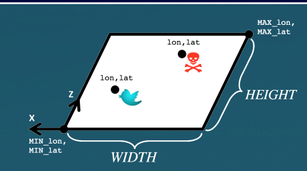
Simulated view of MIT's campus by embedding LADAR data as 3D models overlaid on top of bounded Google Maps image. Utilizes the Unity3D Game Engine.

CONFIGURATION

Accessing Google Maps API provides live traffic data.

Actual + *Crop, Rotate* = *Desired*

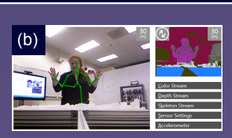
Accurate depiction of campus coordinates requires the use of programatically manipulating the image.



$$\{x,z\} = \frac{MAX\_\{lon,lat\} - \{lon,lat\}}{MAX\_\{lon,lat\} - MIN\_\{lon,lat\}} \times \{WIDTH, HEIGHT\}$$

Projecting 3D models of tweets on 2D representation of campus requires calculating the percentage of longitude, latitude coordinates from actual range and multiplying by game image dimensions.

INTERACTION



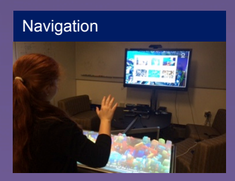
(a) Kinect for Windows allows for natural user interface capability. (b) Hand Tracking and (c) Skeleton Stream provides improved calibration and functionality for gameplay.

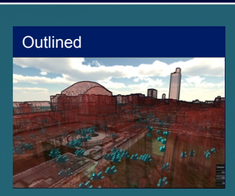
(a) Oculus Rift SDK with Unity3D plugin allows for a complete virtual reality experience. (b) Users control game camera with input from the computer and rift. (c) Screen for the rift shows dual camera display.

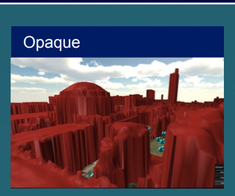
EXPLORATION

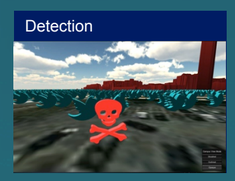
Campus

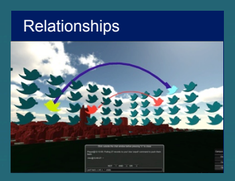
User











This work is sponsored by the Assistant Secretary of Defense for Research and Engineering under Air Force Contract #FA8721-05-C-0002. Opinions, interpretations, recommendations and conclusions are those of the authors and are not necessarily endorsed by the United States Government

LINCOLN LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY