Use of Exploratory Data Analysis and Visualization for identification of Commingled Human Remains

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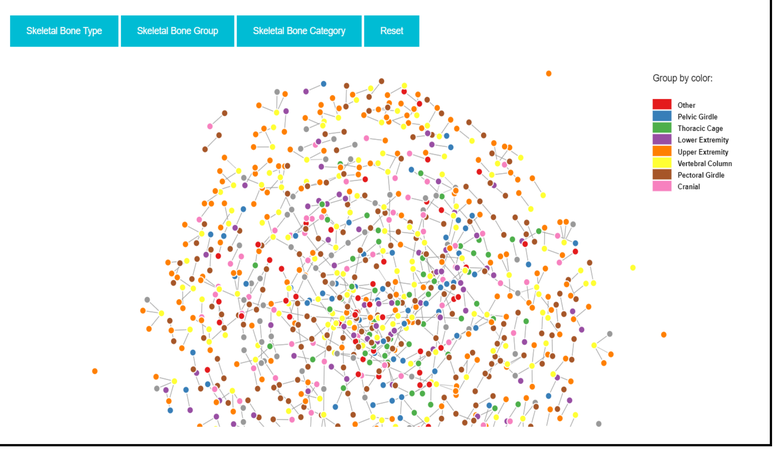
Introduction

Recording systems for human remains are based on the recovery of a complete individual in an isolated context. These systems do not easily lend themselves to the fragmentary human remains that are often encountered on archaeological sites, let alone in many forensic contexts, where postmortem events, including dismemberment and subsequent animal scavenging, result in scattered, disarticulated and fragmentary human remains.

Problem Definition

The general procedure in identifying a human skeleton would be to carry out a DNA analysis and match it with records that the Anthropologist have or measure every aspect of the skeletal bone and find an equivalent match based on the dimensions of the bone. This process is not only time consuming, it is cost intensive as well. The project was carried out to identify and implement a solution that would work along side the existing methods to identify a skeletal bone from commingled remains.

Skeletal specimen-Force Directed Graph



Proposed Solution

The proposed solution involved use of exploratory data analysis and visualization to quicken up the process of identifying the skeletal bones. Also, to leverage the ability of human cognition and perception when it comes to visualizations. The solution can be broadly divided into two parts, a force directed graph between skeletal specimens and an interactive dashboard built to keep track of the progress.

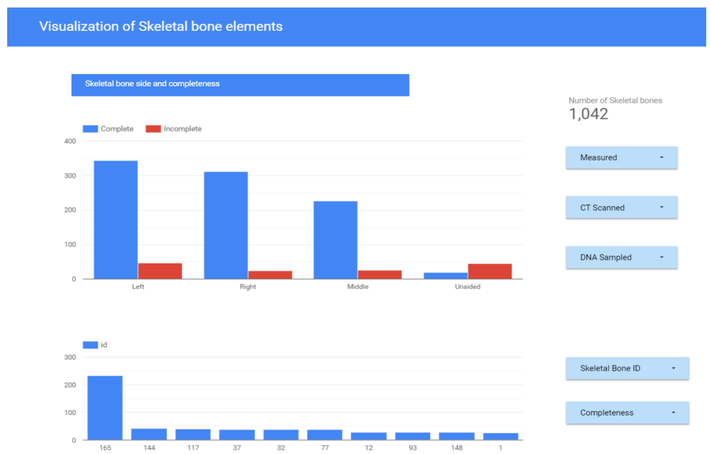
Research Method/Tools

The research method adopted was based on the Graph theory algorithms which is used to model pairwise relations between objects. As nodes and edges constitute a graph, skeletal specimen represent nodes and articulations denotes edges in this project.

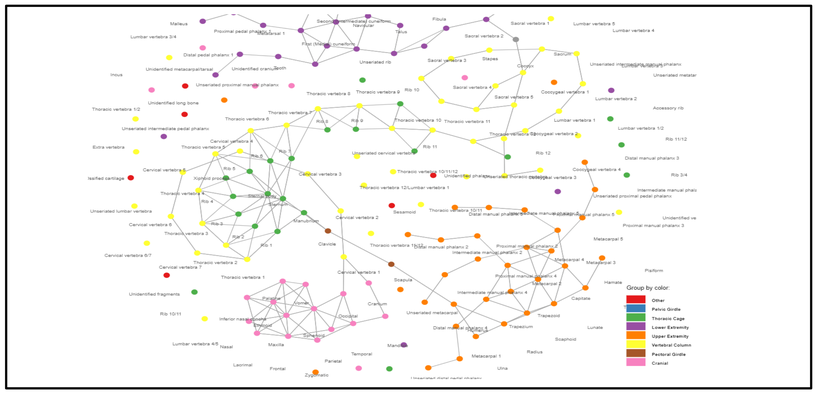
To materialize this, we adopted a visualization library of D3.JS on a web application that is built on Python Django framework.

Additionally, we built a dashboard using Google data studio to give the numbers at a glance.

Dashboard



Skeletal Bones- Force Directed Graph



Conclusion

- Exploratory analysis and visualization can aid in speeding up the process of identifying the skeletal bones.
- It reduces the search space for an Anthropologist by eliminating the manual efforts.
- The ability of human cognition and perception can be leveraged to support these three activities,
  - Exploratory Analysis-discover new knowledge
  - Confirmatory Analysis –evidence for acceptance or rejection
  - Presentation-represent relationships.

Discussion

The force directed graph can give a greater level of control to the user by providing an ability to add or delete the links between the nodes. This can be achieved by building a D3.JS enabled framework.

There is a greater possibility of making accurate inferences on identification of skeletal bones by using machine learning algorithms such as bipartite maximum matching to match pair of skeletal bones belonging to a single instance.

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