Problem and Users

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Project Overview

For our project we are going to design & create a web-based application for visualizing the probabilistic whereabouts of moving objects.

- Given a dataset of positions varied with time, use a set of tools to express the probability of the object existing at a given location in between any two samples (Generalize to chains of samples).

- Provide users with an interface that enables the user to enter queries and visualize results.

Problem Statement

The problem is that with our current sensor technologies is that we do not have infinite resolution temporal measurements.

- In the case of positional measurements (i.e. GPS) limited sampling resolutions leads to periods of time where the exact position is unknown.

- The more sparsely samples are taken in time; the lower the sampling frequency, the less certain you can be about an object's position.

List & Descriptions of Users

1. Zoologist
   - A biologist who specializes in the study of animals, their behavior, evolution, and habitats. They conduct research, observe animal populations, and analyze data to understand animal life and contribute to conservation efforts.

2. Chemist
   - A scientist who investigates the composition, properties, and behavior of substances at the atomic and molecular levels. They conduct experiments, analyze data, and develop theories to understand chemical processes and reactions.

3. Researcher
   - Someone who systematically investigates topics to discover new knowledge or solve existing problems, through rigorous methodologies and analysis. Their findings contribute to the advancement of understanding in various academic disciplines or practical applications in industry and society.

Graphic User Overview
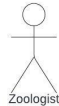
Zoologist

User Duties/Needs

Conduct experimental studies with animals in both controlled or natural surroundings.

Study animal characteristics such:
- Reproduction behaviors
- Interspecies interactions
- Species interactions with their environment
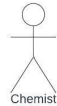- Movement patterns

Functional Requirements

- Create an account and store collected data.
- Query animal location datasets and visualize on a map.
- Draw query region on map and filter time instances where the animal has non-zero probability of residing within the region.
- Select two or more animals and filter time instances that have non-zero probability of residing in the same location.

Aesthetic Requirements

- The data will need to be overlayed on a map with different viewing options (i.e. Satelite, Map).
- Simple set of tools used to format plotted point styles and sizes.
- Use of color to establish probablistic wherabouts, and wherabout intersections with points of interest.
- Cleanly laid out user interface that aids in overall application utility(i.e. No distracting colors).

Experiential Requirements

- Satsifying aesthetic and functional requirements should provide a pleasant user experience.
- Inclusion of map navigation features such as panning, zooming, zoom window.
- Intuitive interface for querying data.

Chemist

User Duties/Needs

Conduct studies related to the interactions of particles whether for simulation and modeling, drug deliver systems, or better understanding reactions; this is a small set of possible applications.

Study Particle Reactions
- Observe the probablistic wherabouts of particles inbetween measurements.
- Find possible distances between a pair or set of particles at a given intermediate time.

Functional Requirements

- Create an account and store collected data.
- Query particle location datasets and visualize in a 3-dimensional space.
- Draw or configure query region and filter time instances based on the region.
- Configure a distance interval and filter by possible intermediate distances between particles.

Aesthetic Requirements

- The data will need to be visualized in a three dimensional space
- Simple set of tools used to format plotted point styles and sizes.
- Use of color to establish probablistic wherabouts, and wherabout intersections with points of interest.
- Cleanly laid out user interface that aids in overall application utility(i.e. No distracting colors).

Experiential Requirements

- Satsifying aesthetic and functional requirements should provide a pleasant user experience.
- Inclusion of multi-dimensional feature visualization such as panning, zooming, zoom window, rotation.
- Intuitive interface for querying data.

Researcher

User Duties/Needs

An individual whom wants to more generally observere the probablistic wherabouts of moving objects.

Compare and Contrast Algorithm Benefits & Drawbacks:
- Visualize a given methods approach to finding the probablistic wherabouts of a moving object.
- Customize visual representation and save to image format for later reference.

Functional Requirements

- Create an account and store collected data.
- Query stored dataset and find results matching the given criteria.
- Select from two algorithms and possible variants.
- Set contraints such as maximum speed and positional error.
- Specify the dimensionality of the data set and the columns of interest.

Aesthetic Requirements

- The display will need to be representative of the data selected. Either 2, 3, or 4 dimensional.
- Simple set of tools used to format plotted point styles and sizes.
- Use of color to establish probablistic wherabouts, and wherabout intersections with points of interest.
- Cleanly laid out user interface that aids in overall application utility(i.e. No distracting colors).

Experiential Requirements

- Satsifying aesthetic and functional requirements should provide a pleasant user experience.
- Inclusion of multi-dimensional feature visualization such as panning, zooming, zoom window, rotation.
- Intuitive interface for querying data, and making selections.

User Needs

1. Zoologist
   - Flat, map view with bridglet style positioning algorithm
   - Ability to input large data sets and share graphs with other Zoologists internationally

2. Chemist
   - 3D graph ability to visualize location of molecules with optional 2D ellipse "slice" view
   - Ability to change maximum velocity and start with unknown exact locations within a certain uncertainty

3. Researcher
   - Both 2D (Bridglet algorithm) and 3D (Cone algorithm) options to choose between for different applications
   - Ability to share large data sets and completed analysis with other researchers

User Requirements

1. Zoologist
   - Must be able to input data sets with over 4,000 data points
   - Must be able to login and view precious data sets
   - Able to change Bridglet "square" size and update map location

2. Chemist
   - Able to store and access up to 15 data sets from a single user account
   - Able to zoom in and out, pan, and rotate graph

3. Researcher
   - Able to store data sets with pre-set graph settings (e.g. Bridglet, Cone, Map, etc.)
   - Able to share data sets with other researchers by email invite

Conclusions

- Application will require graphical user interface that is customizable to user needs
- Must implement several algorithms and have the opportunity for growth in the future
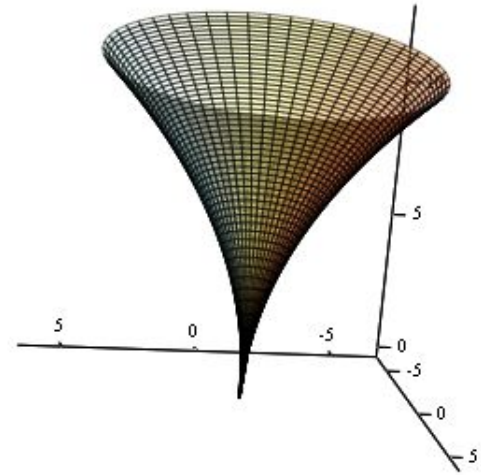- Needs specific and general graph settings

Figure: Example of what a simple, similar GUI looks like