

GeoCamera: Telling Stories in Geographic Visualizations with Camera Movements

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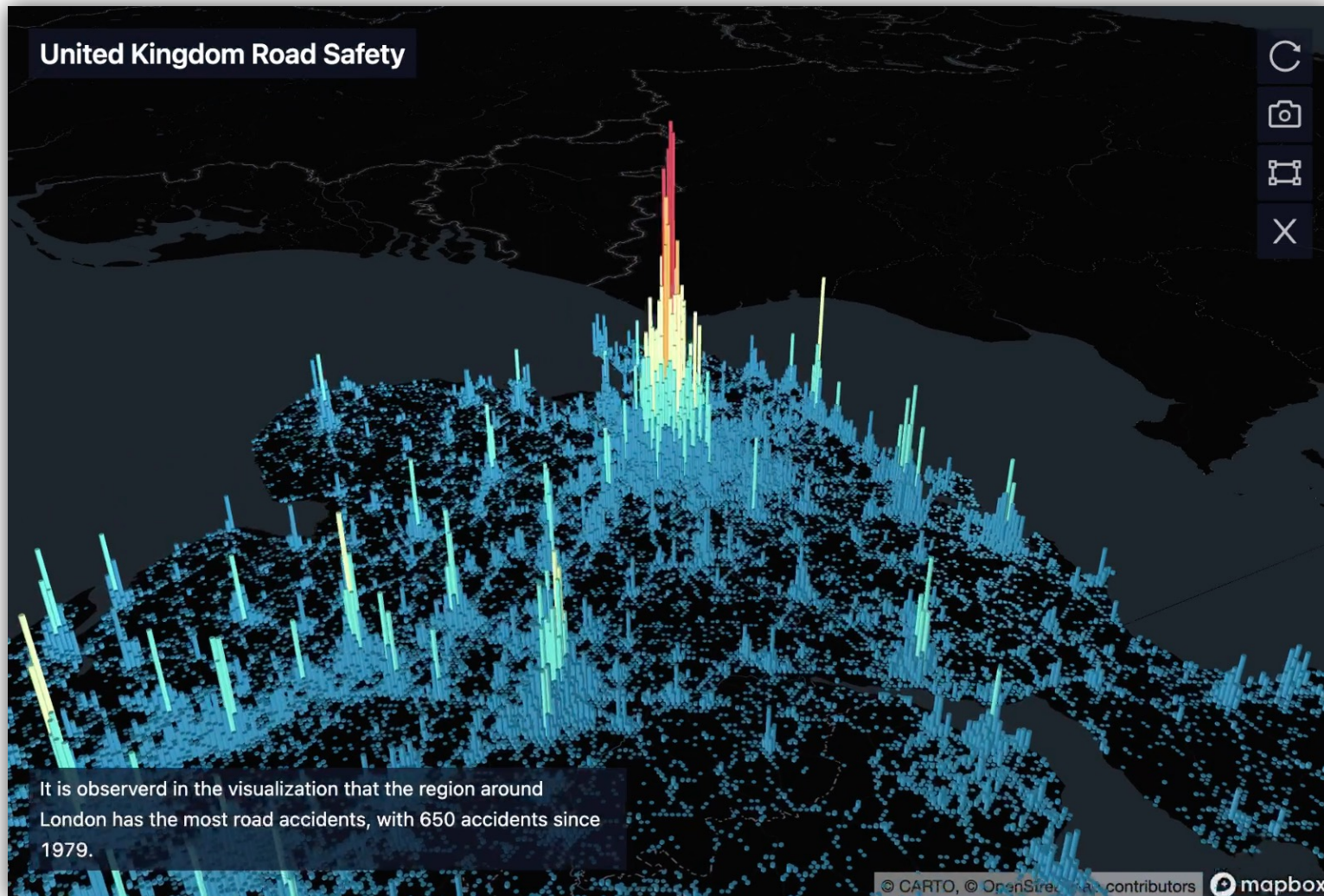


CHI23

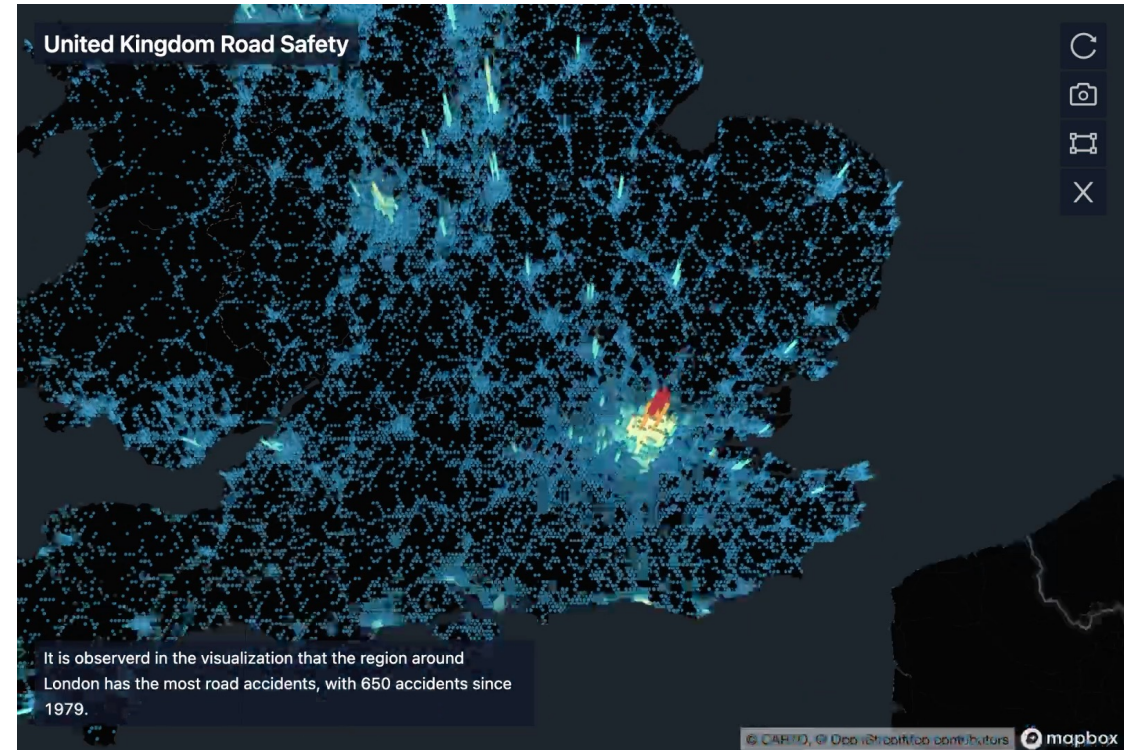
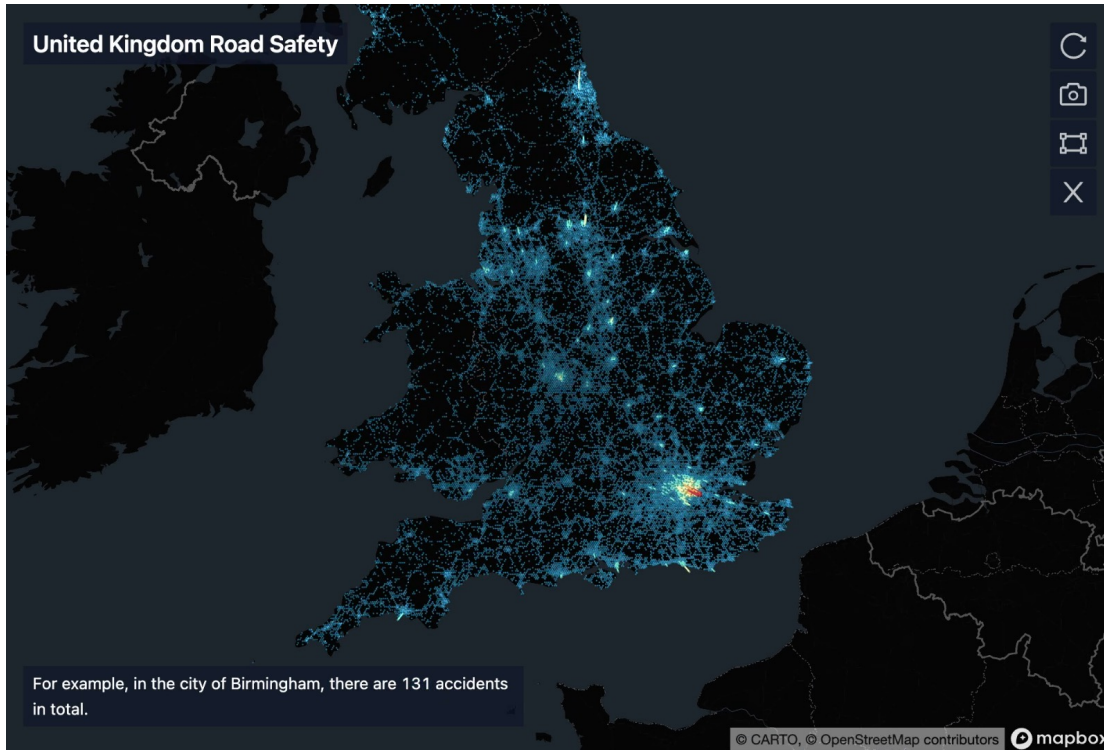
Hamburg, Germany | Hybrid
April 23-28, 2023
reCHInnecting



Geographic Videos



Camera Movements in Geographic Data Videos



Designing Camera Movements

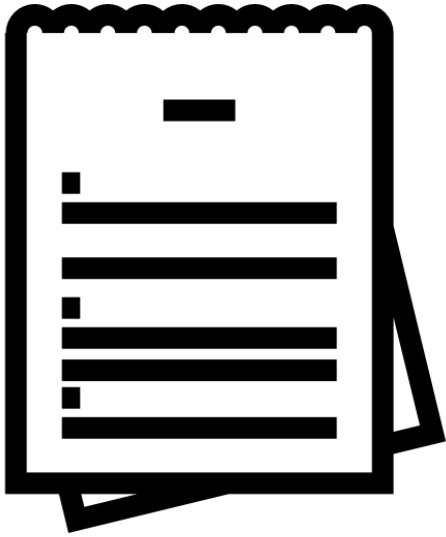


Challenging



Lack of expertise

Challenges

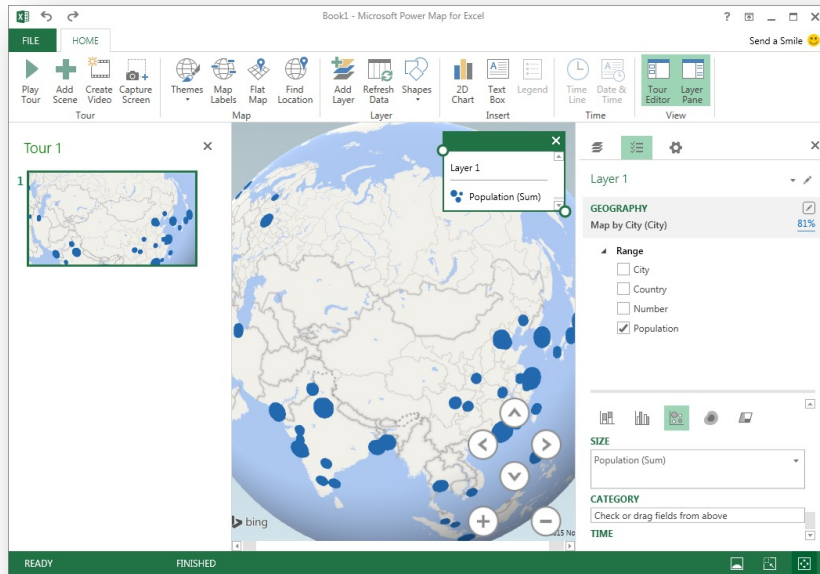


Story

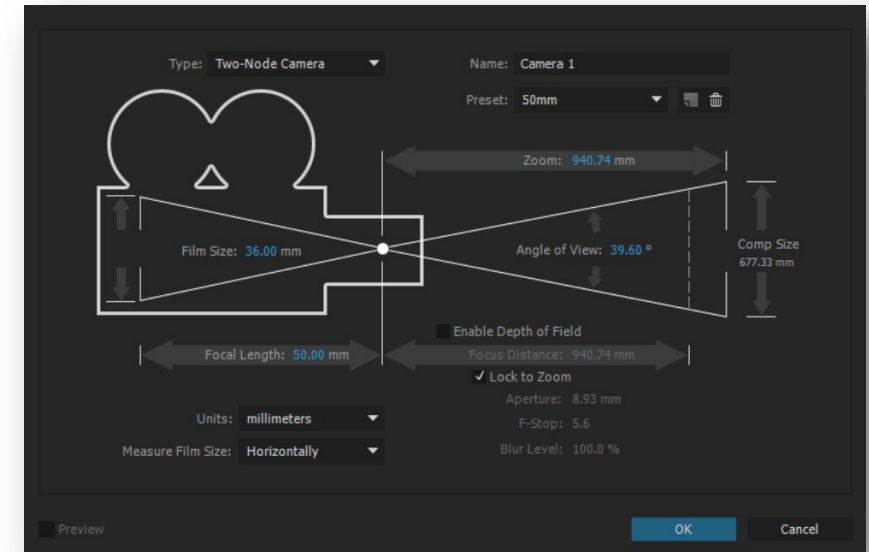


Camera movements

Challenges



Microsoft Power Map



Adobe After Effect

GeoCamera

GeoCamera

Tutorial

Camera Library

Default

Manual

Narrative Purpose

None

Emphasizing a Target

Overviewing Multiple Targets

Making a Comparison

Supplementing Information

Increasing the Dynamic

Camera Types

Static shot

Static shot for showing changes.

Push in shot

Push in for showing details.

Pull out shot

Push out for emphasizing a target.

Pan shot

Pan for showing details.

Camera roll

Camera roll for showing the elemen...

Arc shot

Arc for drawing attention.

Tilt shot

Tilt for highlighting.

Push in & Tilt shot

For emphasizing the center object.

Arc & Tilt shot

For emphasizing the center object.

Pan & Tilt shot

Pan with fixed tilt for emphasizing t...

United Kingdom Road Safety

mapbox

Timeline

Camera Movement 0: emphasis-arc

00:00.00/00:18.00

POINT

London

start

end

Delete

1: EMPHASIS

Arc shot

camera end

stay end

Delete

2: SUPPLEMENT

Pull out shot

camera end

stay end

Delete

Camera

Annotation

Visualization

Current Camera

All Cameras

Import Cameras

Export Cameras

C1: [Arc shot]

[emphasis-arc]

Timing

Duration: 12000ms

Stay: 2000ms

Interpolation

Transition: None

View State

Edit View State

Initial State

Final State

Longitude: -0.12

Latitude: 51.51

Zoom: 5.30

Pitch: 0.00

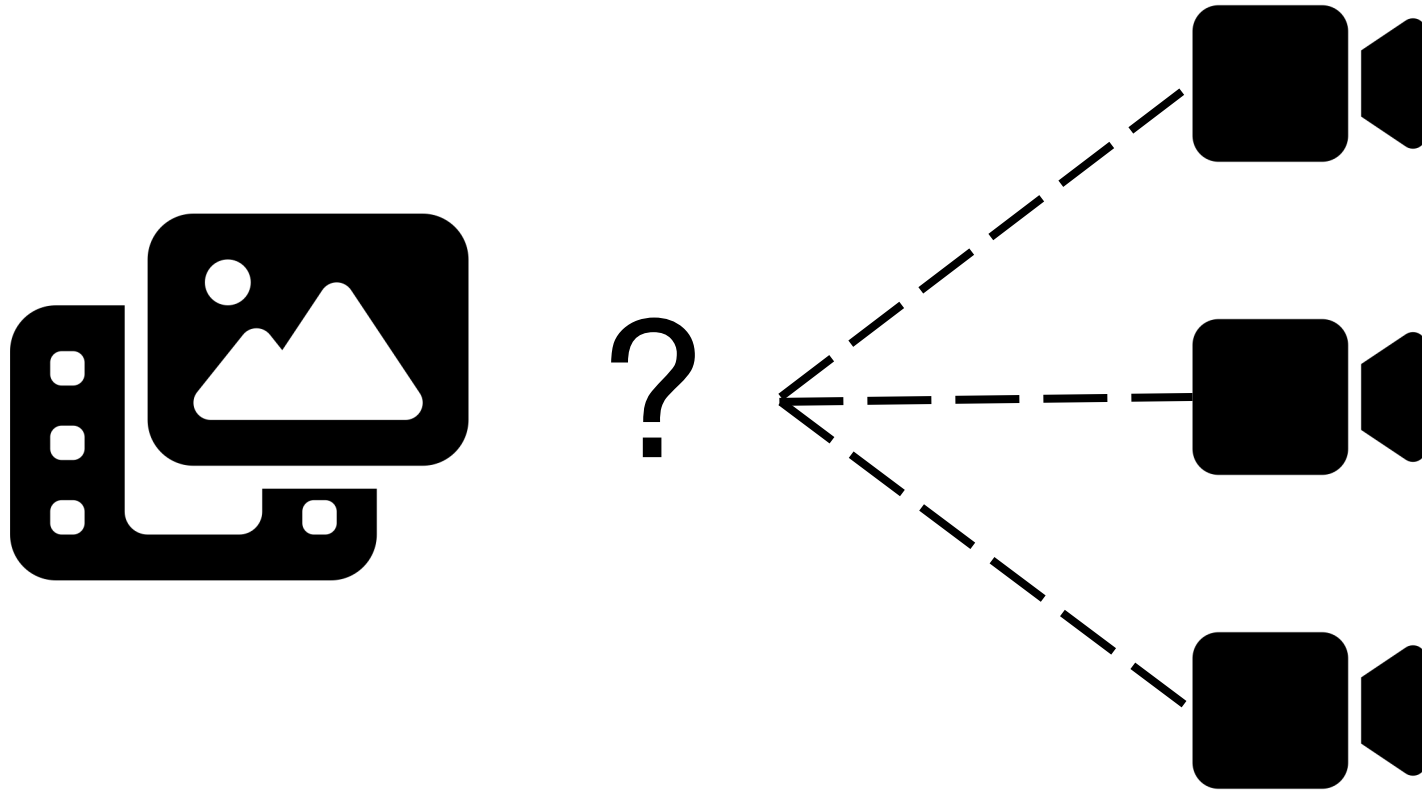
Bearing:

7

Design Goals

- **G1**: To produce compelling camera movements for storytelling
- **G2**: To lessen the barriers in authoring geographic data videos

Preliminary Study



Preliminary Study

- A corpus that includes **66** geographic data videos and **805** camera movements
- **Why** camera movements are employed (**Narrative purposes**)
- **What** objects are the focus of narration (**Geospatial targets**)
- **How** camera movements are designed (**Camera shots**)

Design Space

- Narrative purposes identification based on literature review from narrative visualization, data graphics design, and cinematic storytelling

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- **Three authors** coded each camera movement and **iterated** until all camera movements could be coded consistently

Design Space

- Narrative purposes identification based on literature review from narrative visualization, data graphics design, and cinematic storytelling
- Three authors coded each camera movement and iterated until all camera movements could be coded consistently
- Design space **refinement** with two **professional drone photographers**

Design Space

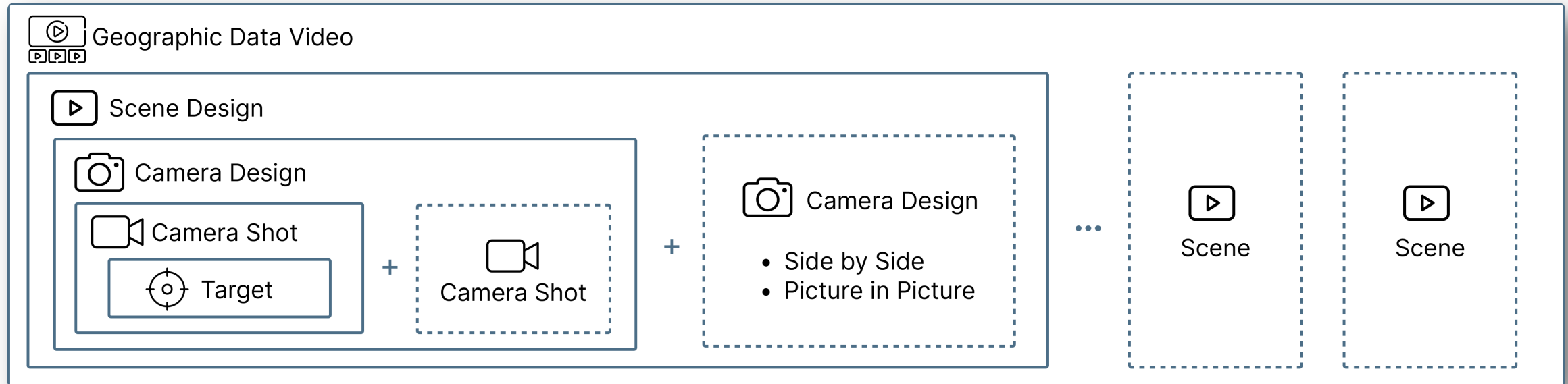
- **Geospatial Targets:** (1)Location, (2)Region, (3)Path, (4)Multiple Targets
- **Narrative Purposes:** (1)Emphasizing a Target, (2)Overviewing Multiple Targets, (3)Making a Comparison, (4)Supplementing Information, (5)Increasing Dynamics
- **Camera Shots:** (1)Static, (2)Push in, (3)Pull Out, (4)Pan, (5)Tilt, (6)Camera Roll, (7)Arc, (8)Tracking

Design Space

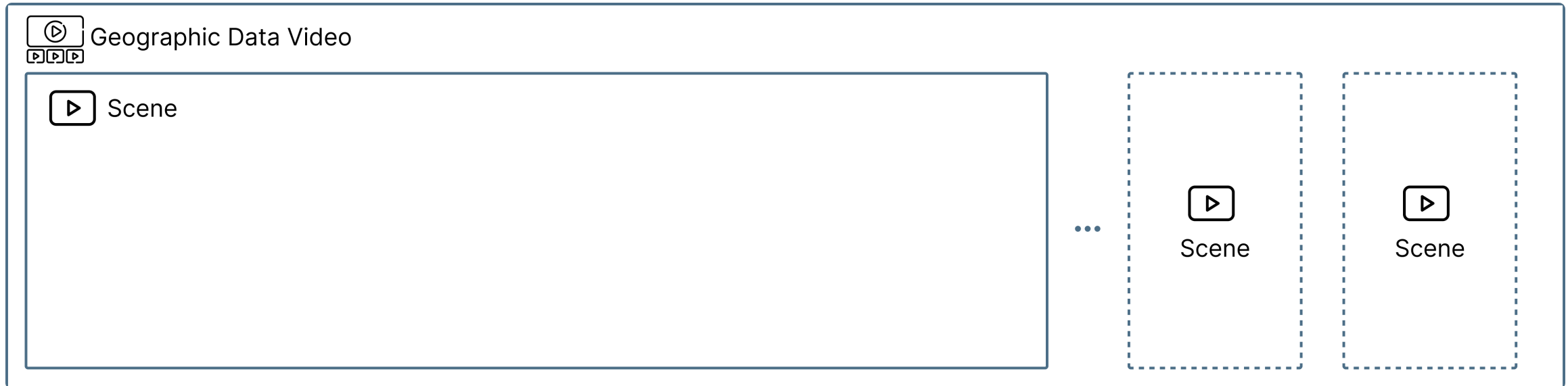
	Video Title	Link	Clip	Camera Shot	Narrative Purpose	Geospatial Target
1	Why Israel is a Tech Capital of the World	https://youtu.be/RuPx61911Oo	1:07-1:09	pan	Emphasizing a target	region
			1:09-1:11	zoom out	Supplementing information	region
			2:31-2:33	zoom out	Making a comparison	regions
			7:59-8:01	pan, zoom out	Overviewing multiple targets	regions
2	Milk. White Poison or Healthy Drink?	https://youtu.be/oakWgLqCwUc	2:10-2:12	pan, zoom in	Emphasizing a target	region
			2:14-2:16	pan, zoom out	Overviewing multiple targets	regions
3	The Economics of K-Pop	https://youtu.be/-bbfFf07WNw	2:39-2:42	pan	Overviewing multiple targets	regions
			2:44-2:46	pan, zoom out	Supplementing information	regions

Narrative Purposes	Geospatial Targets	Camera Shots (ranked by frequency)		
Emphasizing a Target	Location	Push In(8), Pan(8), Arc(4), Camera Roll(2), Pull Out(1)		Emphasizing a target
	Path	Push In(19), Pull Out(17), Pan(12), Camera Roll(6), Tracking(4), Tilt(3), Arc(2)	in	Emphasizing a target
	Region	Push In(182), Pan(112), Pull Out(29), Tilt(20), Arc(16), Camera Roll(14)	in	Emphasizing a target
Overviewing Multiple Targets	Multiple Targets	Pull Out(39), Push In(33), Pan(31), Tilt(7), Arc(5), Camera Roll(1)	in	Making a comparison
Making a Comparison	Multiple Targets	Pull Out(15), Pan (13), Push In (6), Tilt(1)	in	Emphasizing a target
Supplementing Information	Location	Pull Out(2)	out	Emphasizing a target
	Path	Pull Out(2), Tilt(2)	in	Emphasizing a target
	Region	Pan(45), Pull Out(33), Tilt(11), Push In(4), Arc(1), Camera Roll(1)	in	Supplementing information
	Multiple Targets	Pull Out(12), Tilt(3), Push In(1)	in	Emphasizing a target
Increasing Dynamics	None	Push In(54), Pull Out(16), Tilt(4), Pan(3), Camera Roll(1)	out	Emphasizing a target
				Supplementing information
				Overviewing multiple targets
				Overviewing multiple targets

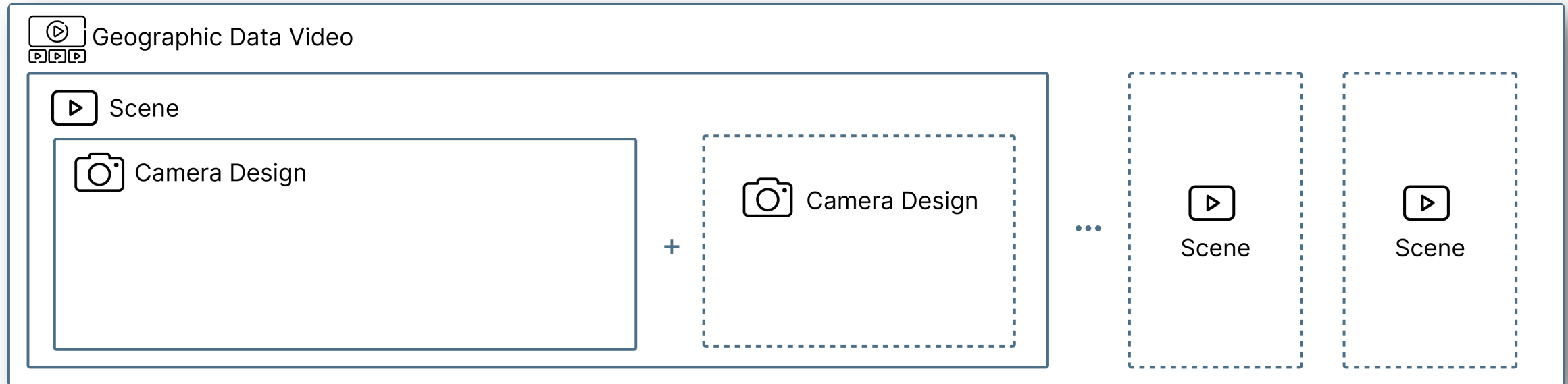
Video Model for GeoCamera



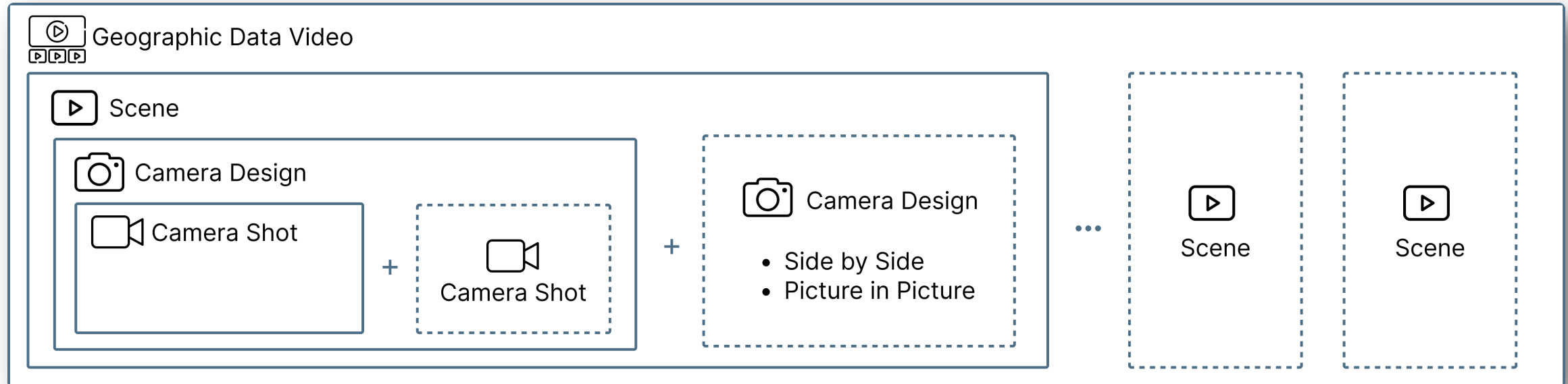
Video Model for GeoCamera



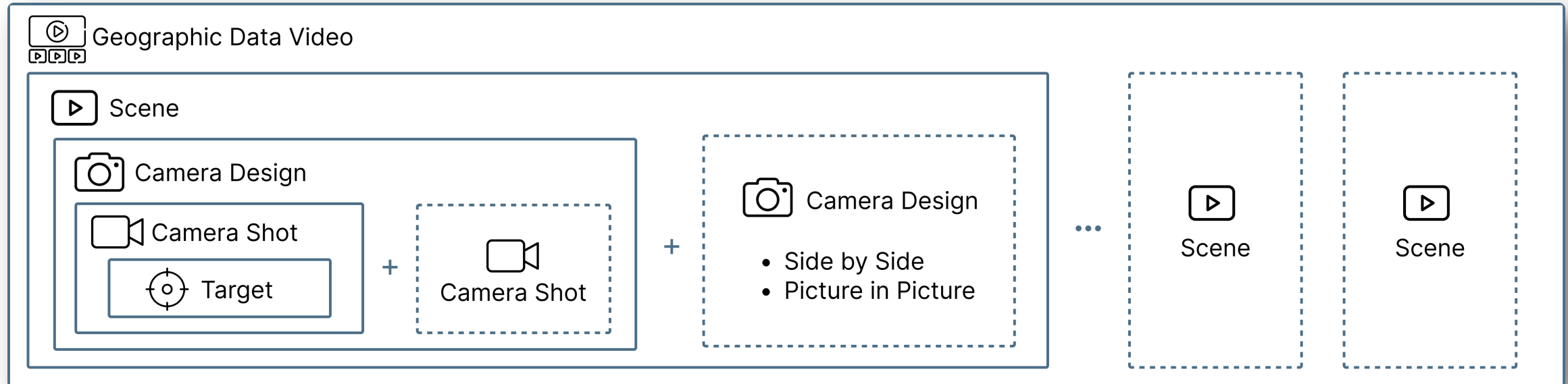
Video Model for GeoCamera



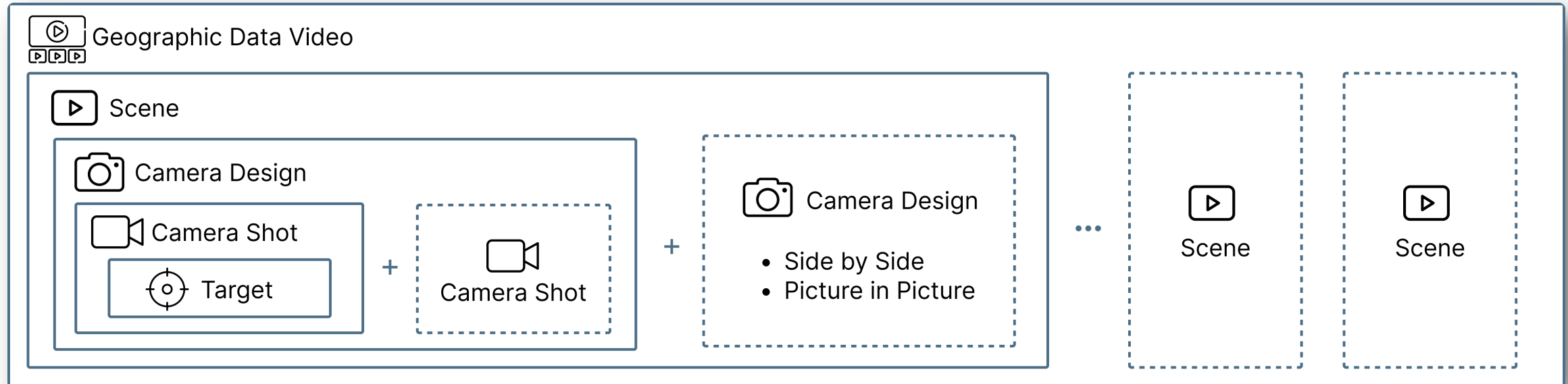
Video Model for GeoCamera



Video Model for GeoCamera



Video Model for GeoCamera



GeoCamera



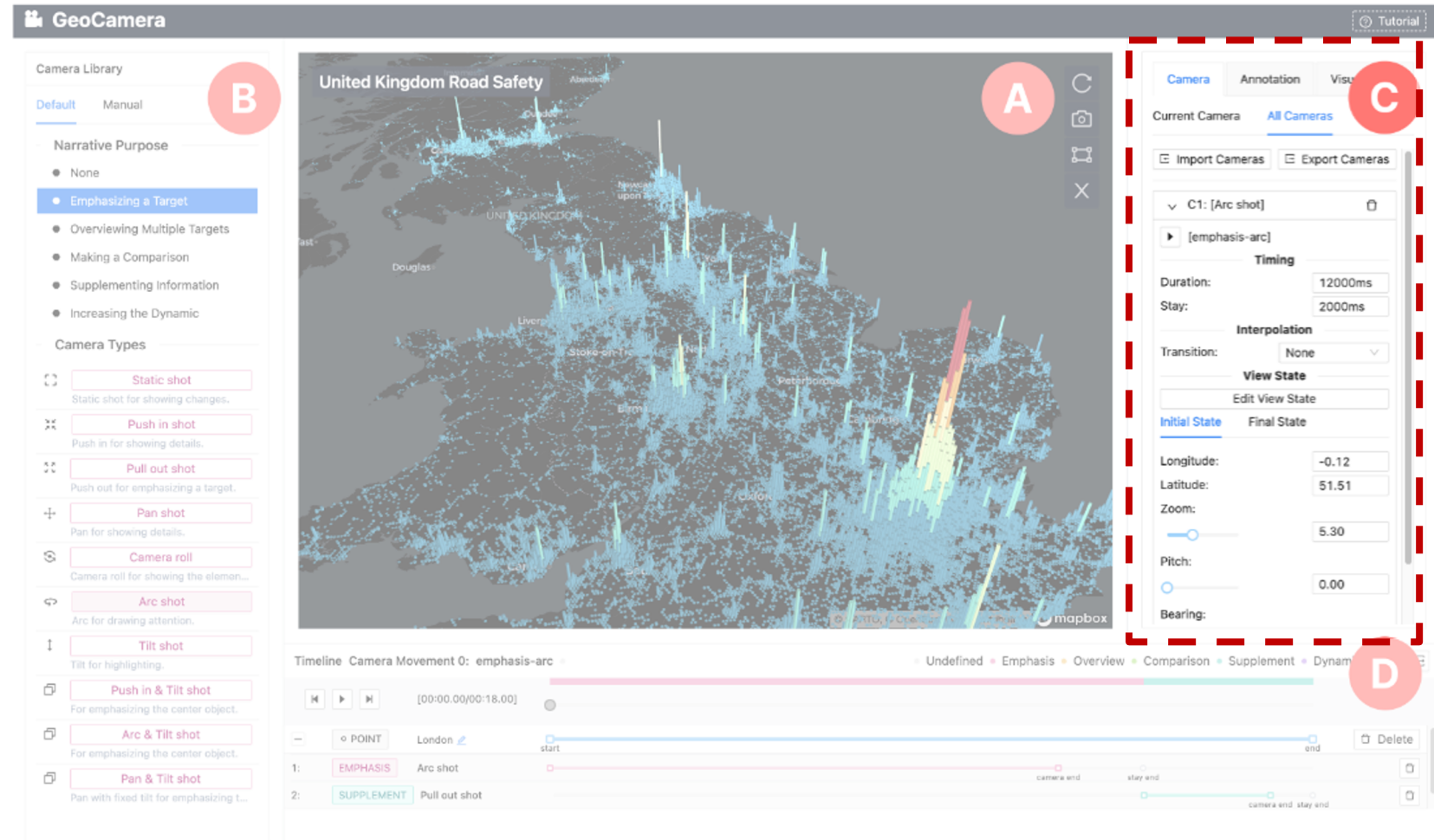
An interactive canvas for geospatial **target selection**

GeoCamera



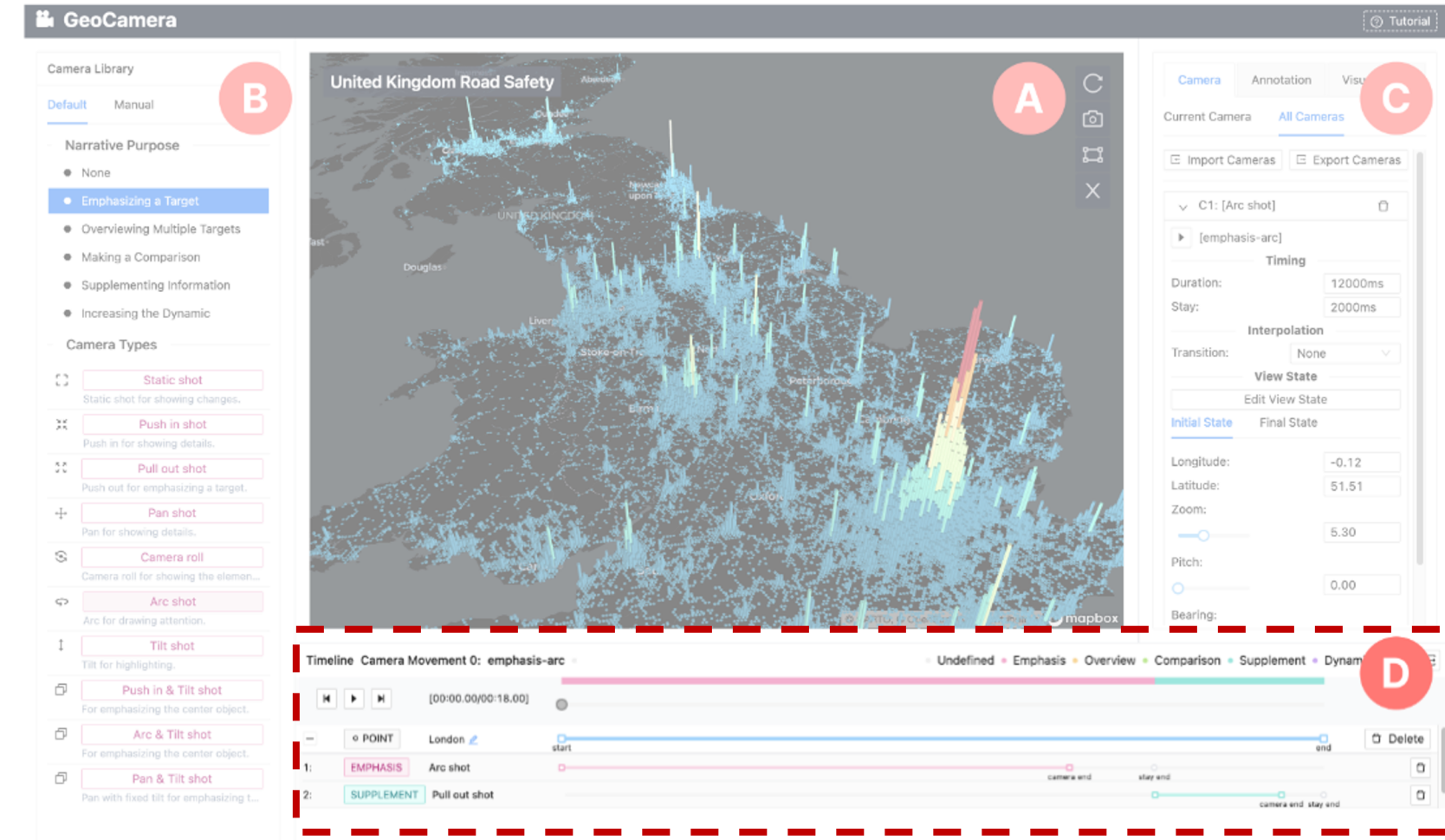
A library of camera movements

GeoCamera



A panel for configurations

GeoCamera



A location-camera hierarchical timeline

Target Selection

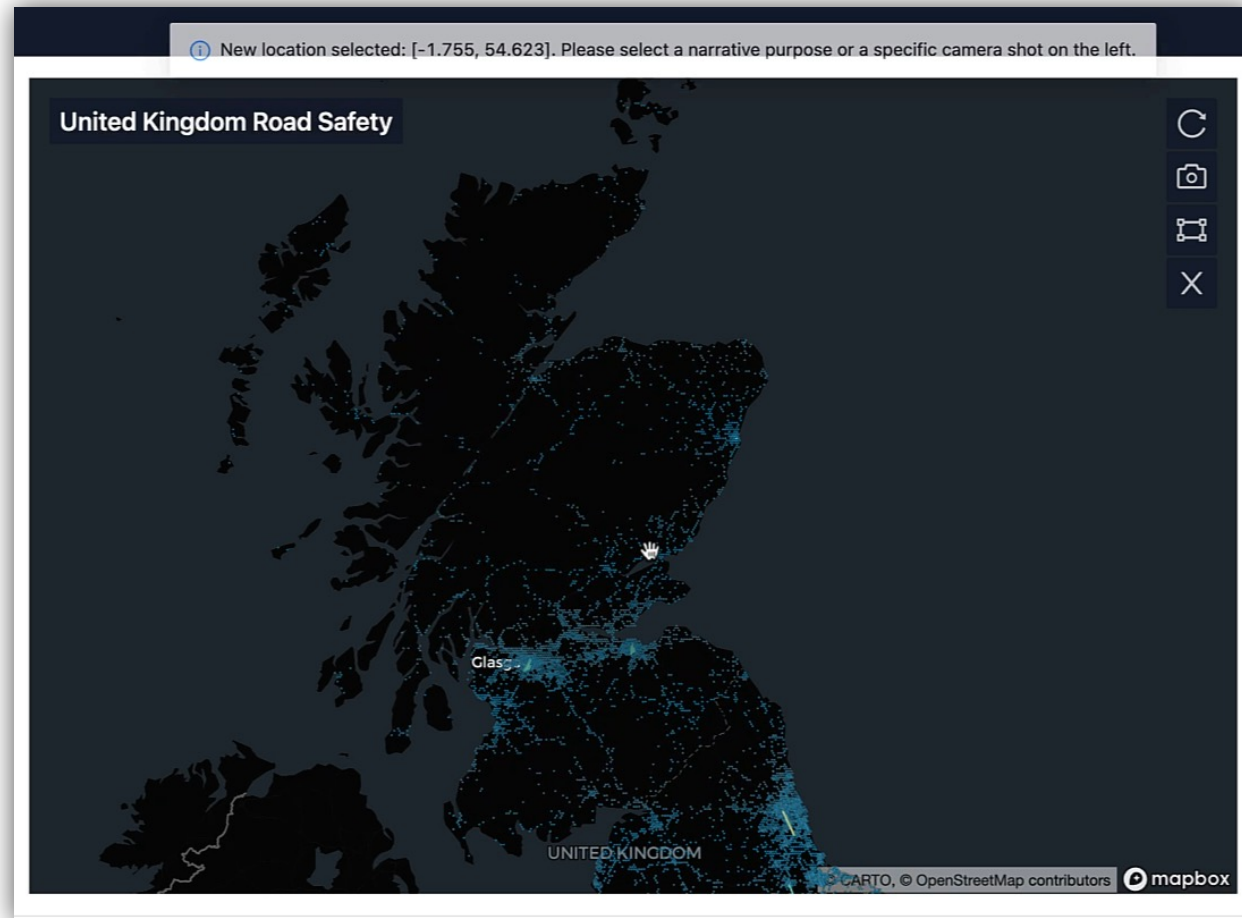
Point



Path



Region



Narrative Purpose Selection

The screenshot displays the GeoCamera application interface. At the top, a status bar indicates the selected region center: [-4.126, 57.336] and prompts the user to select a narrative purpose. The main map area shows a dark-themed map of the United Kingdom with road networks highlighted in blue. Labels for 'Glasgow', 'UNITED KINGDOM', and 'ISLE OF MAN' are visible. A sidebar on the left contains a 'Camera Library' with tabs for 'Default' and 'Manual'. Under 'Narrative Purpose', the 'None' option is selected, with other options including 'Emphasizing a Target', 'Overviewing Multiple Targets', 'Making a Comparison', 'Supplementing Information', and 'Increasing the Dynamic'. Below this, 'Camera Types' are listed, and a 'No Data' icon is shown. On the right, the 'Annotation' tab is active, showing 'Current Annotation' and 'All Annotations'. The 'Timing' section includes 'Delay' (0ms) and 'Duration' (5000ms). The 'Text' section contains the text: 'Compared with the cities like Edinburgh in Scotland, however, the number of road accidents is less than 180.' The 'Shape' section has a 'Draw shapes' button. At the bottom, a 'Timeline' section shows 'Camera Movement 3: comparison-pan' with a color-coded bar for 'Undefined', 'Emphasis', 'Overview', 'Comparison', 'Supplement', and 'Dynamic'. Below the timeline, a list of camera movements is shown, including 'POINT' at [-0.117, 51.511] and [-1.62, 54.974], and 'COMPARISON' Pan shot.

GeoCamera

Selected region center: [-4.126, 57.336]. Please select a [Narrative Purpose] on the left.

Camera Library

Default Manual

Narrative Purpose

- None
- Emphasizing a Target
- Overviewing Multiple Targets
- Making a Comparison
- Supplementing Information
- Increasing the Dynamic

Camera Types

No Data

United Kingdom Road Safety

Bergen

Glasgow

UNITED KINGDOM

ISLE OF MAN

CARTO, OpenStreetMap contributors, mapbox

Camera Annotation Visualization

Current Annotation All Annotations

Annotation-4: [Pan shot]

Timing

Delay: 0ms

Duration: 5000ms

Text

Compared with the cities like Edinburgh in Scotland, however, the number of road accidents is less than 180.

Shape

Draw shapes

Timeline Camera Movement 3: comparison-pan

Undefined Emphasis Overview Comparison Supplement Dynamic

[00:00.00/00:33.00]

start end

POINT [-0.117, 51.511]

1: EMPHASIS Arc & Tilt shot

POINT [-1.62, 54.974]

1: COMPARISON Pan shot

Delete Delete

Editing A Camera Movement

The screenshot displays a software interface for editing camera movements. The main view is a map of the United Kingdom, showing road safety data. The right panel shows the settings for the current camera movement, which is a 'Push in & Tilt shot'. The settings include Duration (3000ms), Stay (2000ms), Interpolation (None), and View State (Edit View State). The bottom panel shows a timeline with multiple camera movements, including 'Overview', 'Static shot', and 'Push in & Tilt shot'.

United Kingdom Road Safety

Camera Annotation Visualization

Current Camera All Cameras

2: [Push in & Tilt shot]

Timing

Duration: 3000ms

Stay: 2000ms

Interpolation

Transition: None

Duration: 0ms

View State

Edit View State

Initial State Final State

Longitude: -1.89

Latitude: 52.48

Zoom: 5.30

Pitch: 0.00

Bearing: 0.00

Timeline Camera Movement 1: emphasis-combination-push-in-tilt

Undefined Emphasis Overview Comparison Supplement Dynamic

00:00.00/00:09.00

REGION overview start end Delete

1: OVERVIEW Static shot camera end Delete

POINT [-1.89, 52.479] start end 00:07.00 Delete

1: EMPHASIS Push in & Tilt shot camera end stay end Delete

Editing A Camera Movement

The screenshot displays the Mapbox Studio interface. On the left, a map of the United Kingdom is shown with a dark background and blue road network. A title 'United Kingdom Road Safety' is visible in the top left of the map area. On the right, a panel for editing camera movements is open. The panel has three tabs: 'Camera', 'Annotation', and 'Visualization'. The 'Camera' tab is selected. Below the tabs, there are two sub-tabs: 'Current Camera' and 'All Cameras'. The 'Current Camera' sub-tab is selected, showing a camera movement named '4: [Pan shot]'. The panel is divided into several sections: 'Timing', 'Interpolation', 'View State', and 'Initial State'. The 'Timing' section has 'Duration' set to 2000ms and 'Stay' set to 3000ms. The 'Interpolation' section has 'Transition' set to 'None' and 'Duration' set to 0ms. The 'View State' section has a button 'Edit View State'. The 'Initial State' section has fields for 'Longitude' (-2.00), 'Latitude' (53.70), 'Zoom' (5.30), 'Pitch' (0.00), and 'Bearing' (0.00). At the bottom of the interface, there is a timeline and a legend. The timeline shows 'Camera Movement 3: comparison-pan'. The legend includes 'Undefined', 'Emphasis', 'Overview', 'Comparison', 'Supplement', and 'Dynamic'.

United Kingdom Road Safety

Camera Annotation Visualization

Current Camera All Cameras

4: [Pan shot]

Timing

Duration: 2000ms

Stay: 3000ms

Interpolation

Transition: None

Duration: 0ms

View State

Edit View State

Initial State Final State

Longitude: -2.00

Latitude: 53.70

Zoom: 5.30

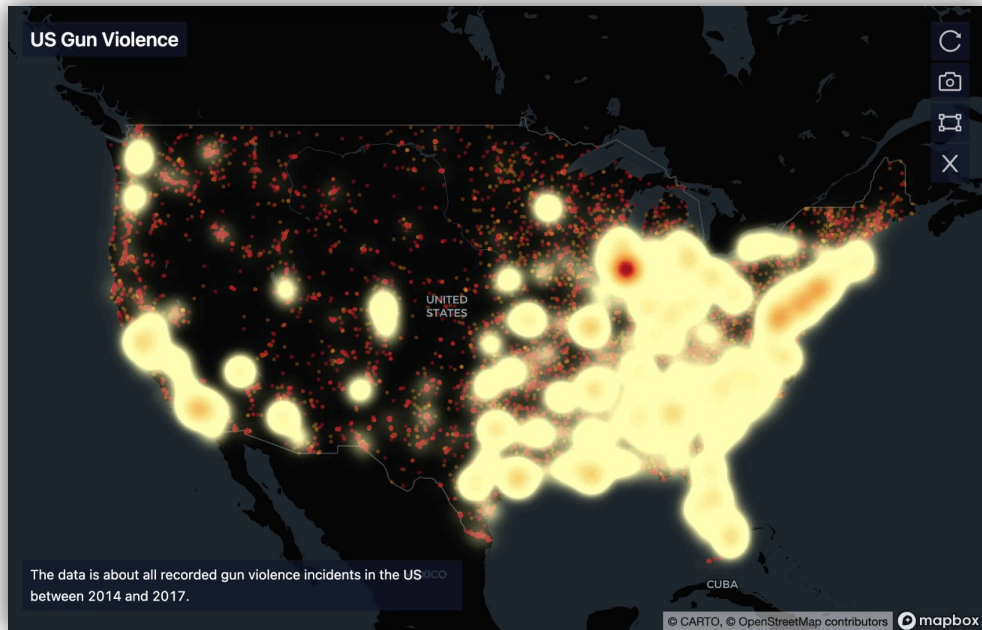
Pitch: 0.00

Bearing: 0.00

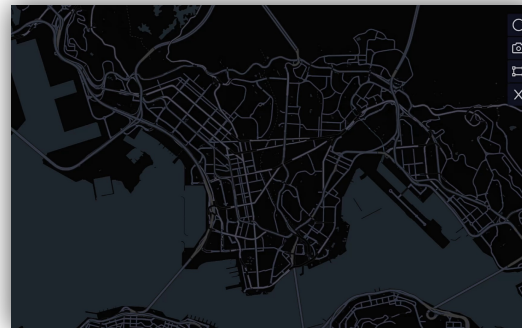
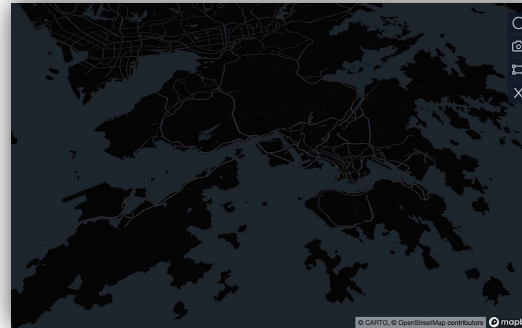
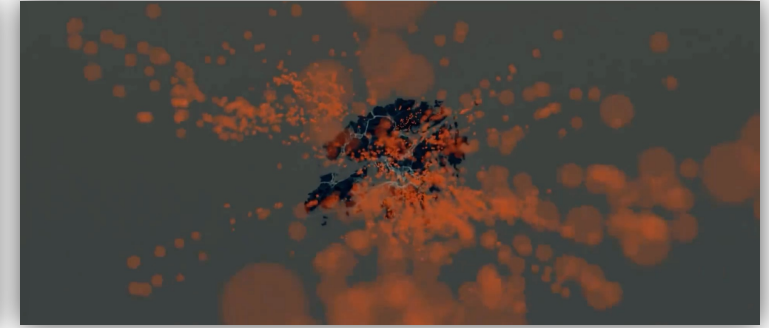
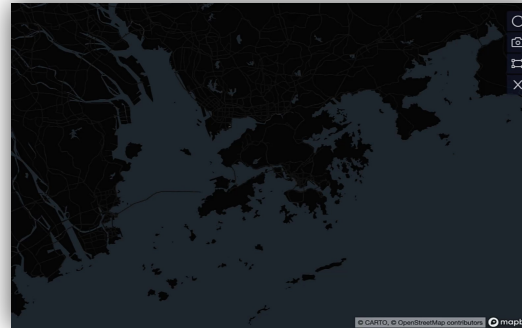
Timeline Camera Movement 3: comparison-pan

Undefined Emphasis Overview Comparison Supplement Dynamic

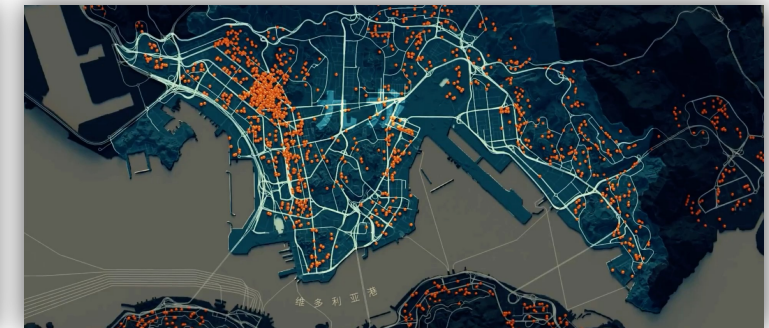
Case Study



(Data video clip)



(Ours)



(Example video)

User Evaluation

- 8 participants
- Slides that introduced each category of our design space with examples as **teaching material**
- **Tutorial**: 15-min **introduction** + 20-min **demonstration**
- **Creation**: 15 - 30 mins
- Post-study **Survey** and **Interview**: usefulness, ease of use, and satisfaction of GeoCamera
- Compensation with a gift card worth \$15

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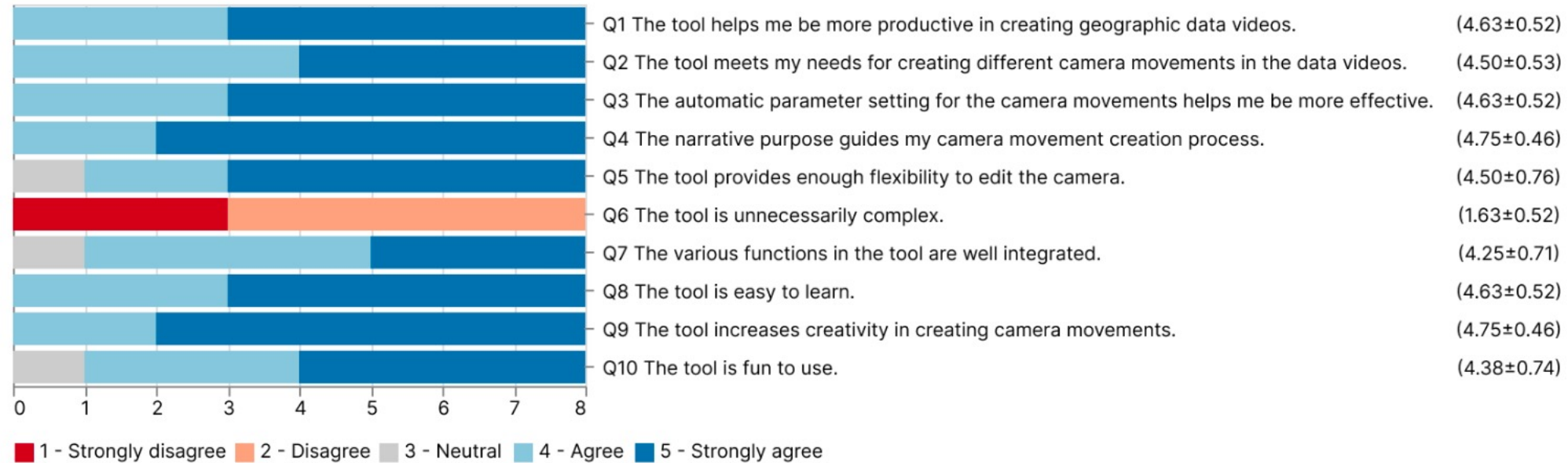
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User Evaluation Results



Ratings for system usability on a 5-point Likert scale

Discussion

1. Understanding the best practices in authoring geographic data video

Discussion

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 - We treat our design space as a **probe** for camera movements

Discussion

1. Understanding the best practices in authoring geographic data video
 - We treat our design space as a **probe** for camera movements
 - The camera movement recommendations in GeoCamera are based on the **statistical frequencies** of the combinations from the corpus

Discussion

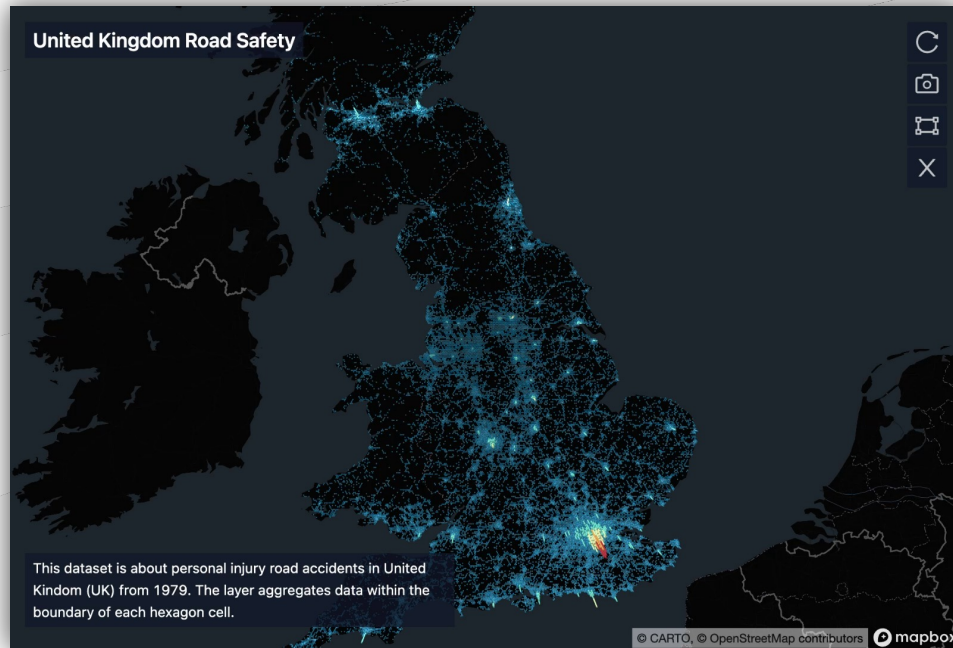
2. Data insights and story structures recommendation

Discussion

3. Enriching editorial layers for storytelling

- Visual embellishments
- More animation
- More cinematic effects

GeoCamera: Telling Stories in Geographic Visualizations with Camera Movements



CHI23

Hamburg, Germany | Hybrid
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reCHInnecting



✉ wenchao.li@connect.ust.hk

🏠 <https://wenchao.li>

