Automated Procedures for Visual Scenes of Scenario-based Models

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Motivation

This research advances the understanding of couple human-environment systems by visualizing results from existing growth models. A statewide, NSF-funded initiative is generating alternate futures using computational analysis of human decision making, its effect on the environment, and the influence back on human actions. This research visualizes results in stakeholder-accessible, immersive 3D renderings to complement existing GIS and statistical output of these models.

Balancing the need for economic growth with myriad environmental concerns is a challenge faced by governments at all levels. Effective forecasting, strategic planning, and regulatory implementation all benefit from timely communication and stakeholder engagement[1]. This project seeks to develop simple and accessible illustrative tools that will allow users to directly observe and intuitively interact with simulations, computations, and data flows; a common definition of visualization. Automation is a key performance parameter to retain the scientific validity, testability, and repeatability of the underlying growth models.

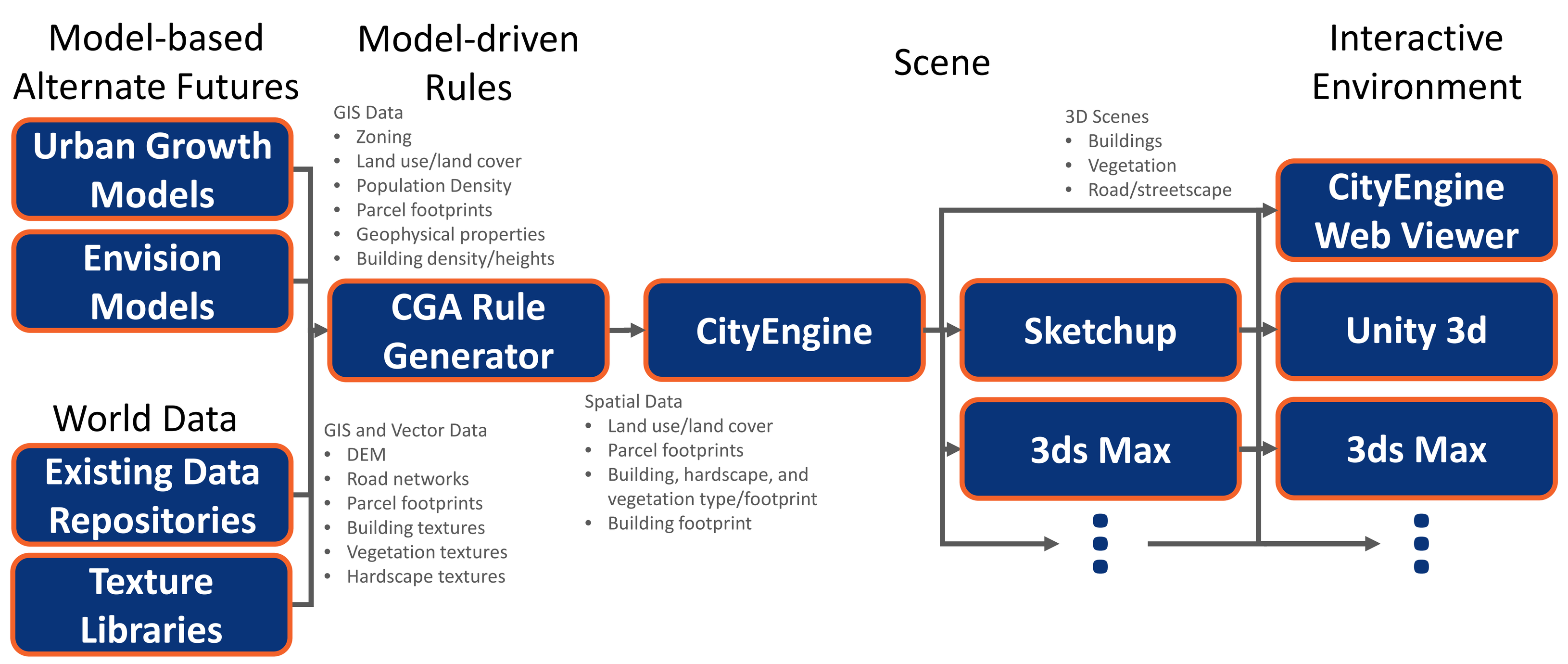

Figure 1: Block diagram of visualization process. Data extracted from alternate futures and the current state are converted to interactive visual models.

Research Goals

The goal is to automate procedures to produce scenario-based visualization of both environmental[2][3][4] and urban-growth model-driven scenarios.

- Produce interactive visualizations of Treasure Valley alternate futures using CityEngine[5] and procedural modeling to generate buildings and landscapes
- Convert GIS data, structure and road configurations, and Envision and urban growth model output into prescriptive rules as required by CityEngine
- Export results from CityEngine modeling to an interactive framework for exploration and contribution by stakeholders

An additional outcome is developing and documenting policies, processes, and tools that promote software quality in a research environment. Applicable tenets of the CMMI (Capability Maturity Model Integration) project management approach and Extreme Programming are synthesized into a process that promotes increased client satisfaction, superior product quality, more accurate scheduling, lower development costs, and improved researcher morale.

Acknowledgements

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CityEngine

CityEngine improves urban planning, architecture, and design by utilizing 3D visualization power to see the relationships of projects, assess their feasibility, and plan their implementation[5]. CityEngine was selected for this project because its procedural rules can automatically enforce consistency with model-generated alternate futures without introducing bias in the artistic interpretation integral to traditional CAD software like 3ds Max and Sketchup.

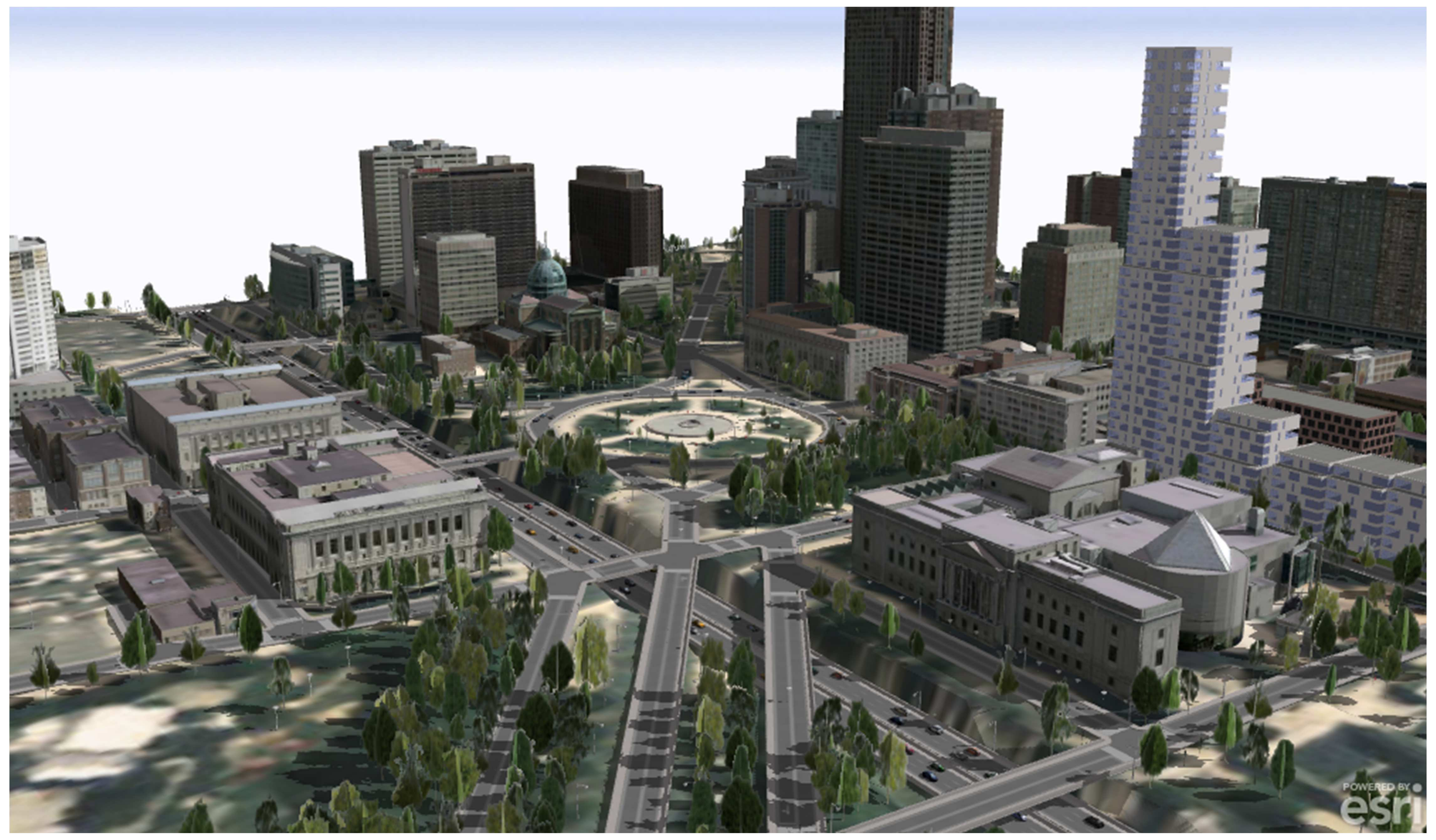


Figure 2: A example scene from CityEngine with downtown Philadelphia

Faithful Representation of Scenarios

A novel innovation is the degree to which this project automates adherence of the visualization to scenarios generated by alternate futuring models. Faithful and accurate representation of modeled scenarios will expose the validity and/or desirability of these scenarios. The goal of the visualization is to be consistent with the model, rather than elicit a particular stakeholder outcome.

Model output includes a wide variety of sources and data types, including geological, hydrological, topological, environmental, and demographic elements. The research visualizes outcomes from models of different future scenarios, spanning a range of assumptions about possible climate, policy, and demographic forcings and play out using rules to model human and physical behavior. Specifically, the visualization incorporates results from Envision [ref] and urban growth models.

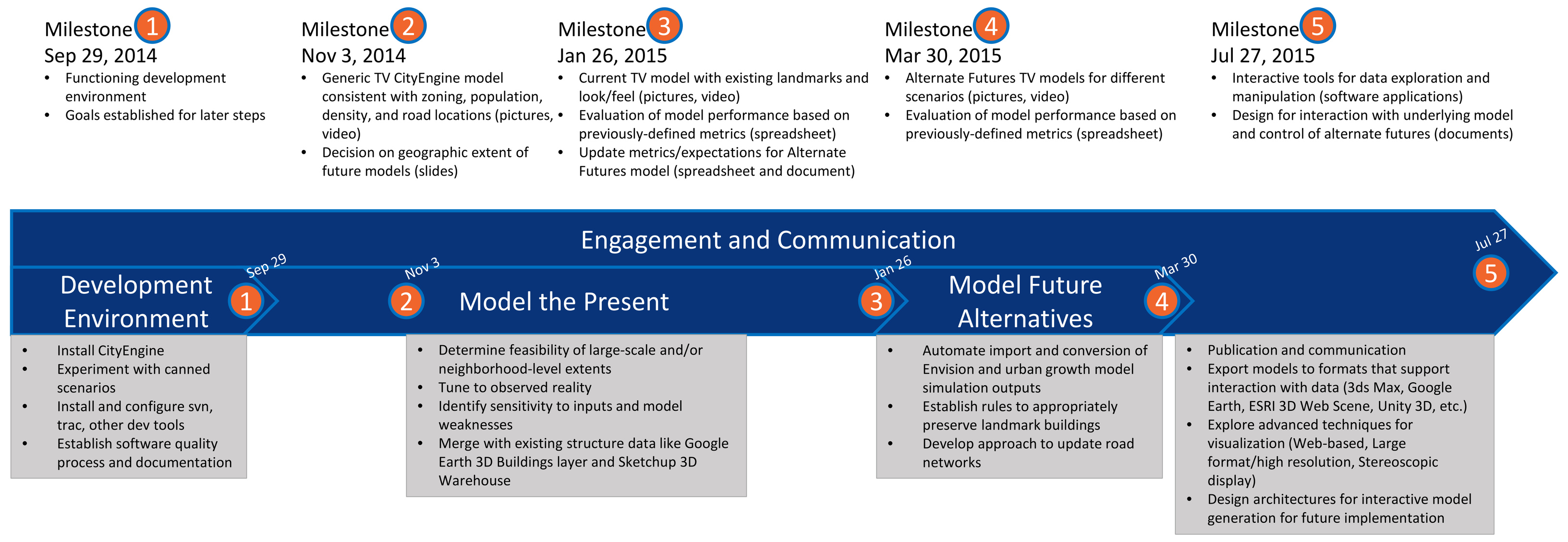
Figure 3: Data from future scenarios: aridity (left), land use/land cover (center), and population density (right)

Treasure Valley Pilot Site

This research is initially focused on Idaho's Treasure Valley pilot site and identifies sensitive areas that best represent differences between modeled outcomes. This pilot site has data coverage for important inputs like road networks, government boundaries, elevation, hydrology, census data, and land use. It is already being modeled by other EPSCoR participants so future scenarios are available and ready for application.

Figure 4: The OpenStreetMap road network for downtown Boise imported into CityEngine

Schedule



References

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