

# Model into Playable Simulation in Games Cities: Skyline

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## ABSTRACT

Urban modeling is a way to visualize and simulate urban areas to make it easier to analyze complex urban systems. Games Cities: Skyline as a CBG (City Building Game), can be used for the non-game purpose to simulate urban-related processes in a visually appealing 3D city environment in the field of urban planning and design. CBG offers an interactive way to visualize and simulate the city in playable ways. Using Denpasar City as a field study, the process of making the real 3D city model accurately into playable simulation requires geodata information. By using automatic geodata processing methods, the model is created by translating geographic information of city elements such as DEM (Data Elevation Model), road networks, vegetation, water sources, land use, etc. are forming into Geographic Information System (GIS) data format. By using a game modification system (commonly called mod), the city geodata information is imported into the Cities: Skyline. There are two steps to create a playable city model that can be running in the game: firstly, importing the entire Denpasar City Geodata which will be generated automatically into the game, and the second is the post-production by manually modifying the model to make city model can be running in the game properly. The result is the Denpasar City model is accurately created based on geographic data and offer valuable simulation such as traffic simulation, population density, pollution, etc. And also, through the playable simulation, we could interactively design the ideal city based on real city simulation.

**Keywords:** Urban, City Building Game (CBG), Geodata, Simulation.

## 1. INTRODUCTION

This paper presents a new modeling visualization technique for developing urban models with an interactive approach by using playable city simulation. The interactive way of visualization method uses video game-based methods as one of its approaches. Recognizing video-game in academic field, Cities: Skylines can be used most notably as an experimental learning tool in the spatial planning field study [1].

Cities: Skylines is a genre game based on building and developing cities or CBG (City Build Game). Cities: Skylines is an open-ended city-building simulation game in which every player engages in urban planning by establishing the traffic road network, building zoning controlling, providing the proper in-game public services, and city mobility. The various city conditions are monitored by "info views" that provide visually attractive outputs such as budget, education, employment, pollution levels, traffic, etc.

Using CBG (City Build Game) as playable simulation tools for urban simulation, this 3D city simulation should create an attractive approach to analyze how the city works. CBG represents an effective and unique medium for learning and cognitive development to understand system dynamics to solve problems critically and creatively on city spatial dimensions to fulfill the city needs in-game condition [2]. This approach leads to the new paradigm to visualize city design and planning methods to simulate the integration of any city elements which turn into a playable city model.

Moreover, it also presents Denpasar City as a case study of an urban area in size of 17.28 km x 17.28 km or with a total area of 298.5984 sq km. Using the automatic geodata processing method, any urban facilities such as roads, houses, trees, and green areas, can be visually generated into 3d in-game objects by processing the UI (user interface) in the form of an OSM map type into the game.

The Mod feature or "Modification" purpose is to provide the flexibility to modify the game whatever every player wants [3]. The mod contained in the game Cities: Skylines is an OSM Map to export city maps into OSM format. With this mode, we can simulate any city map in real-time in the game. This mod could identify specific city elements to visualize the most relevant city in-game issues [4]. This playable modeling should be very efficient even though it does not present the whole process realistically. However, city game design is very well modeled and can be applied for educational purposes [5].

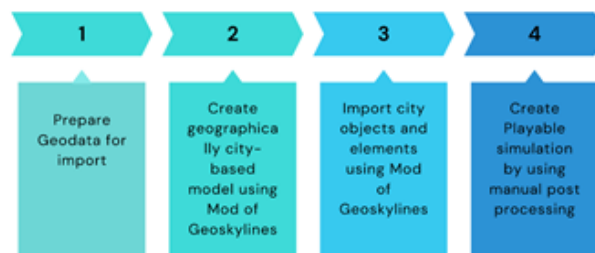
The main contribution of this study is the development of a new workflow for generating an interactive city model into a playable simulation. As a result, this tool can be used in both urban planning and design method. Moreover, this workflow is the first step for the integration of parameterizable city simulation models using geodata [6]. This would allow the proposed workflow to produce more accurate environments by simulating the selected city element. Thus, this work presents a new paradigm, using playable simulation as an experimental learning tool in the spatial planning field study, that integrates known urban structures and facilities imported from other cities into a given city model, following specific in-game rules. As a result, Playable simulations can provide insight and make it easier for someone to understand the development of geographic knowledge, creativity, and spatial awareness of the city itself because this is done interactively [7]. The game presents graphics that are more playful and interesting to understand, so for educational purposes, this is an opportunity for researchers, students, and everyone in the future to better understand how cities work.

## 2. DATA AND METHODS

### 2.1. Data

Using the city of Denpasar as a case study, the first step for conversion is to recognize the coordinate system or more commonly referred to as CRS (Coordinate Reference System) or in its translation is the Coordinate Reference System. In this study, two types of CRS, namely the 1984 World Geodetic System (WGS 84) and the Universal Transverse Mercator (UTM). Simply put, WGS 84 is 3D (three-dimensional) with the origin at the center of the earth and measured in degrees. UTM is 2D (two-dimensional) measured in meters. This is useful for placing a 3D globe onto a 2D plane accompanied by large map deformations at the edges. Therefore, UTM is divided into 60 zones that have CRS in each zone. The geographical coordinate of Denpasar City in World Geodetic System is WGS 84 EPSG and get code of WGS: 4326. The UTM for the city of Denpasar is 32750. Bounding Box function to

capture geographic information on the map location of bounded areas by a rectangular borderline. This is the basic process before converting other geographic objects. The area of the Bounding Box used to make it compatible with the Cities Skylines game is 17.28 x 17.28 Km or 298.5984 sq. km. The bounding box is created using the QGIS application with metric coordinate "x,y" Denpasar City is 303339.582.9041088.390 and zone code is EPSG for the Bali area is "EPSG 50s". The result of applying the bounding box in the city of Denpasar is shown in figure 1 below.



**Figure 1** Applying the bounding box in the city map of Denpasar.

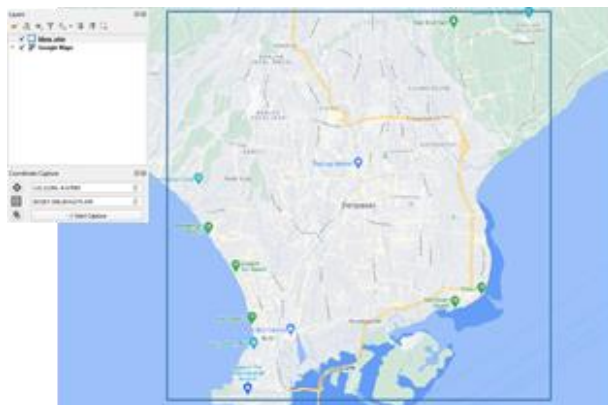
### 2.2. Methods

Processing geodata is an important procedure for creating a real-time city map on Cities: Skylines. Geodata needs to process efficiently for the game by using GIS (geographic information system) software. These tools provide an efficient method to convert any geodata from the GIS domain through the game engine or vice versa. GIS should offer the integration of geographic data simply and effectively. This tool is designed to capture, store, manipulate, analyze, and geographically accurate information of the real-world city. Using Mod would help to generate any geodata in a few minutes, by pressing the keyword. The presented GeoSkylines game mod is designed to cover the following aspects [8]:

- Allows the use of any geodata dataset and not tied to OSM directly.
- Enable to capture, store, manipulate, analyze any source of geodata.
- Provide a simple graphical user interface (GUI), so the Mod will not be breakable within the game changes and updates
- Provide the data accuracy of the import and export method between geodata and game objects.

The geodata assets in the first two aspects were formatted separately. First, we have to use geodata format in Comma Separated Value (CSV) with geometry data recorded in Well-Known to store the selected geodata. According to the third aspect, the mod

of GeoSkylines are activated via specified hot-key combinations. The research design process to create a playable real-time city model in Cities: Skylines consists of four stages, as shown in Figure 2.



**Figure 2** Stages of creating the playable real-world cities using GeoSkylines methods.

### 3. RESULTS

There are two results as the steps of visualizing real 3D city model into the playable simulation in games Cities: Skyline:

#### 3.1. Creating a Real City Geographic Map as Base Model

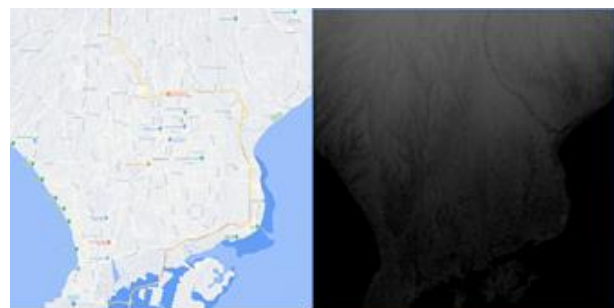
The purpose of creating a geographical city map is to represent the actual city geographical shape and contours based on real-world geodata. Geographical city maps are primarily used as a base city model. To create a geographical map of the city Denpasar needs a few steps to analyze the geodata city of Denpasar into CSV format. Due to its reasonable size, all coordinate data is needed for testing the import and export methods. As mentioned above, the city of Denpasar has a geographical information bounding box that represents an area of 17.28 x 17.28 km for the selected location with the specific coordinate which is shown in Table 1.

**Table 1.** Geographical information bounding box for the city of Denpasar Area

No.	Name	Geographical Information
1	CenterLongitude	115.21264476535902
2	CenterLatitude	-8.670727643171674
3	gdal_translate	-projwin 294699.582 9049728.39 311979.582 9032448.39
4	x, y	303339.582, 9041088.39
5	EPSG code	32750

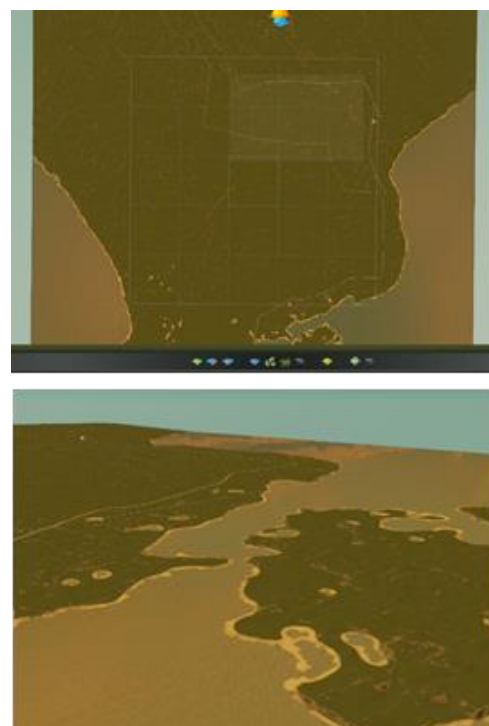
The next two step of getting a geographical map is to create an image overlay and create topographic geographical-based model of Denpasar city. This method could display PNG images in-game simulations

for calibration purposes. The heightmap is a map that provides information on the height of an area. The specific heightmap of Denpasar city can be obtained through DEM (Digital Elevation Model) in TIF format on the Indonesia DEMNAS website. The following is the image of a topographic geographical-based model of Denpasar city in Figure 3 below.



**Figure 3** Image Overlay Area (Left) and Heightmap (Right) calibrated with Denpasar City Bounding Box.

The final step is to create base map of Denpasar city on game Cities: Skyline is by importing terrain data using the inbuilt heightmaps loader in Cities: Skylines. The following are the results of the geographical simulation of the City of Denpasar in figure 4 below.



**Figure 4** DEM Simulation results and geographical shapes of Denpasar City and surroundings through the game Cities: Skylines.

#### 3.2. Create Real City into 3D Playable Simulation

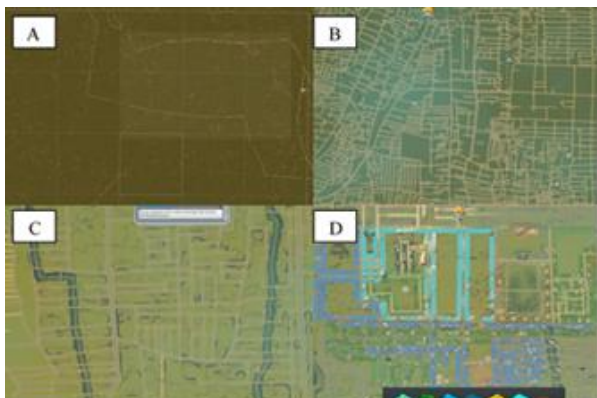
The main data source for preparing the geographic object of Denpasar City is using OSM (Open Street



Map). Therefore, the documentation will focus on working with OSM data. There are various ways to get OSM data (directly from [openstreetmap.org](https://openstreetmap.org), OverPass API). But since it's not just about getting the data but also about processing it, the options used are the QGIS application and the QuickOSM plugin, and the HCMGIS plugin which gives access to various base maps. The processing of geographic objects data information involving CSV (Comma Separated Values) as the main source data format. CSV contains geographic information of an area and functions presented in the form of tables and columns in Microsoft Excel format. In the next stage, a base model is created by the game's map editor by running import methods of the GeoSkylines game mod. The mod purpose is to convert CSV files into in game-model of geographic objects. The method is by importing geographic objects using Mod. To generate the geodata city objects in games, we need to prepare the geodata in the following methods:

- Create whole geographic object such as game road network, waterbody, waterway, building zone based on geographical road segment data in CSV format
- Create game landscape coverage based on geographical tree coverage data (rasterized) in PNG data format; and create city amenities based on geographical data of services.

The final step of creating a playable simulation real city model in Cities: Skylines involves post manual processing to fixing inaccurate or distorted imported objects generated in the base model. The early steps to running the city in-game requirement are to connect the city model to the highway game objects and also place water resources or electricity. The amount of time spent on manual post-processing of the base model exactly took a few hours to adjust in-game city conditions. The steps of creating a playable model of Denpasar city are described in figure 5 below.



**Figure 5** Creation of a playable model of Denpasar city using the GeoSkylines methods. (A) Geographical map of Denpasar city as the base model (B) the map after generating roads network, (C) the map after generating waterway with water sources. (D) the maps after generating building zone and tree coverage.

As part of the manual post-processing of the base model, the following methods were completed:

- Fixing issues of the road networking model, building zone (e.g., due to incorrect geographical and distortion data); and Adding the water resources manually using overlay images due to incorrect geographical data;
- Adding water resources and Connecting the city to the outside highway connection is the basic condition in the game;

The manual editing processes are needed to match the geographical object and the required conditions in the game so that the Denpasar city simulation can run into a playable model. Here are the results of the Denpasar City simulation in the Cities: Skylines game which shown in Figure 6.



**Figure 6** Overview of the final playable model of Denpasar city after manual post-processing of the base model.

## 4. DISCUSSION

This game offers every player to create any open-source game modification. The mod becoming an important feature so the players can develop anything they want to fulfill their needs while the basic game features do not provide it. In this case, Geoskylines Mod became the bridge to convert any geodata in the real world through the game such as geographical terrain and object data. With these Mods, we can simulate any city map in real-time in the game. These mods could identify specific city elements to visualize. The lack of Geoskylines mods is unable to load a complex and unorganized roads network. An error will appear on the system, so that cannot attach more geodata objects in the game. This can be solved by, manually processing any geodata by creating manually using the tools provided in the game. Using the game's approach to creating playable simulation sound interesting yet interactive in the results. But the process itself takes a lot of effort to achieve playable models. In the end, the final result of playable modeling takes a new paradigm and perspective to understand the city interactively.

## 5. CONCLUSION

Talking about the real city model, the Cities: Skyline has its limits to visualize the detail for contextual uses in a specific city. The game is designed by a developer based on a European city, which means all the building facade or other city in-game objects are more often uses European or western type of architecture. By the limitation of the game, defining a real city model is limited by the city representation as an accurate actual city object based on geographical information. It is possible to create more level detail like local building facades by designing them one by one and it takes a lot of time. The conclusion from this research results of Visualizing Real 3D City Model into Playable Simulation in Games Cities: Skyline is described as follows:

- There are two steps, first step is creating a real city geographic base model and the final result is to Create Denpasar city into 3D Playable Simulation.
- The geodata assets in the first two aspects were formatted in Comma Separated Value (CSV) with geometry data recorded and loaded on the game using game modification GeoSkylines that activated via specified hot-key combinations.

- The results of the Denpasar City simulation require a manual process to edit and adjust so that the simulation model can run according to the conditions and prerequisites in the game.
- Using the game's approach to creating playable simulation sound interesting yet interactive in the results. The final result of playable modeling takes a new paradigm and perspective to understand the city interactively.

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