Geographic Simulation of Denpasar City in Game Cities : Skylines

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Abstract. Cities: Skylines is a video game based on building and developing cities or CBG (City Build Game). This game is a representation of the planning system in this game is very efficient even though it does not present the whole process realistically. However, city design games are very well modeled and have real potential for educational purposes. In the development of the game, Cities: Skylines has an extensive application programming interface (API) that allows the game to be modified from the appearance and behavior of the game. With this mode, we can enter the city map in real time into the game to be simulated. This mod can map various land uses, buildings including infrastructure found in specific cities, to map relevant urban issues. Denpasar City will be the object of study to be simulated in real time in the Cities game, Skyline. Apart from being the capital city of Bali Province, Denpasar city has the heterogeneity and complexity of urban activities on a downtown scale in the Bali region. The perspective of infrastructure completeness, density and complexity are the reasons why Denpasar City deserves a simulation test in this study as the first pilot area to be simulated. By using an automatic geodata processing method, the simulation of urban areas in the Denpasar city area can be translated not only visually but also in terms of city-specific behavior. The use of game-based simulations is able to provide views and make it easier for someone to understand the development of geographic knowledge, creativity, and spatial awareness of the city of Denpasar so that for educational purposes this is an opportunity for researchers, students and everyone in the future to better understand the city of Denpasar with more interactive media.

Keywords: Mobilitas; Cities, Skyline; Geodata

1 Introduction

The city is a system that supports human life that has complexity. The complexity in question is the result of the concentration of the population with its activities and is a place. Due to the level of urban complexity, in the study a modeling method is needed to see specifically how the city is active on a massive scale. In today's technological developments, various methods and technologies for city modeling have been developed. So that the analysis of urban areas is easier to do both quantitatively and qualitatively just by predicting it through modeling. One of the urban modeling methods that is currently developing is through gamification. Gamification is a learning approach using elements in games or video games with the aim of

motivating students in the learning process and maximizing pleasant feelings towards the learning process, besides that this media can be used to capture things that interest students and inspire them to continue doing learning (Jusuf, 2016)

On the educational side, gamification is an effective medium to improve logical skills and speed in understanding a problem according to the game being played. Games provide an educational side that is superior in several aspects when compared to conventional learning methods. This advantage is in the form of an educational technique that tends to display animation so that it is easy to understand.

The simulation-based educational game genre is designed to be an alternative educational game. This simulation genre game tends to have a learning by doing pattern of learning. By simulating certain objects or conditions, we are trained to solve problems that occur during the game. Game status, instructions, interfaces and tools contained in the game will guide players actively to explore information so that they can enrich knowledge and strategies while playing (Vitianingsih, 2017). In its development, the simulation genre was expanded into a Life simulation game, which offers players more freedom to do things like in everyday life, with the aim of simulating life in real and in detail. Haahtela, P. (2015).

Cities: Skylines is a video game based on building and developing a city or CBG (City Build Game) created by the Finnish game developer, Colossal Order and published by Paradox Interactive in March 2015. Since the five years this game was launched, many fans have emerged from both pro-gamers and practitioners in the field of urban planning and design to play this game. With a review rate that reaches a percentage of 96%, with very positive reviews of 102,744 from people who play this game.

This game learns to build a city comprehensively. Seeing everything from a multi-sectoral perspective, to build certain infrastructure, the government must think about funding, its functions, and its impact on people's lives (Rismawati in Kompas, 2015). The realistic and complex simulation is the main reason why a good city design is needed in this simulation game. Despite their limitations as formal pedagogical tools, CBGs still represent an effective and unique medium for learning and cognitive development to understand system dynamics in order to solve problems critically and creatively with respect to spatial dimensions (Brysch, Huynh, and Scholz 2012).

In the development of the game, Cities: Skylines has an extensive application programming interface (API) that allows the game to be modified from the appearance and behavior of the game. The Mod feature was added to give players the flexibility to modify the game for a specific purpose. Mod is short for Modification as a development innovation carried out by the player himself to expand the game design and experience in playing it (Scacchi, 2010). The mod contained in the game Cities: Skylines is an OSM Map to export city maps into OSM format.

With this mode, we can enter the city map in real time into the game to be simulated. This mod can map various land uses, buildings including infrastructure found in specific cities, to map the most relevant issues that need to be considered (Pinos et al, 2019). Cities: Skylines is a representation of the planning system in this game which is very efficient even though it does not present the whole process realistically. However, city design games are very well modeled and have real potential for educational purposes and can be applied (Haahtela, P. 2015).

Based on these developments, in this study Denpasar City will be used as the object of study to be simulated in real time in the Cities game, Skyline. Apart from being the capital city of Bali Province, Denpasar city has the heterogeneity and complexity of urban activities on a downtown scale in the Bali region. The perspective of infrastructure completeness, density and complexity are the reasons why Denpasar City deserves a simulation test in this study as the first pilot area to be simulated into the Cities: Skyline game media. By using an automatic

geodata processing method, the simulation of urban areas in the Denpasar city area can be translated not only visually but also in specific behavior of the city area, so that we can study Denpasar city interactively and be able to predict various future possibilities. The aspect considered in this simulation is to focus first on processing the API in the form of an OSM map type into the game, and then translating land use in relation to seeing the mobility simulation in the Denpasar city.

City building games represent a specific example of the use of games in the field of urban planning. Indeed, in reality, the process of planning and designing the City has many elements that are quite complicated and complex. But by looking at the approach through the in-game Cities API; Skyline we can expand the simulation to see some important aspects in urban planning and design, especially Denpasar City. The use of game-based simulations is able to provide insight and make it easier for someone to understand the development of geographic knowledge, creativity, and spatial awareness of the city of Denpasar itself, because this is done interactively (Bereitschaft, 2016). 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 the city of Denpasar.

Research Problem

Based on the above background, the formulation of the research problem is:

What are the elements involved in making the Denpasar City mobility simulation in Cities; Skyline ?

Bagaimana proses dan hasil pengolahan Geodata Kota Denpasar pada Cities ; Skyline sebagai hasil visualisasi mobilitas Kota Denpasar?

Research Purpose

The purpose of this study is to provide a real time mobility simulation in Denpasar City through Geospatial data processing which is carried out through the Cities game; Skyline, which in the future can be used to provide views and make it easier for someone to understand the development of geographic knowledge, creativity, and spatial awareness of the city of Denpasar. Analyzing the Denpasar City Map through the process of modifying the Denpasar city map in real time which is imported into the Cities game; Skyline to obtain overall geodata regarding the infrastructure network and land use in Denpasar City.

2   Research Methods

Importing the entire geodata, the data analysis process is carried out by modifying the geodata into a playable model in Cities: Skylines involving manually post-processing the base model and converting the geodata into playable models and running simulation games. The model creation process is carried out by modifying the game based on the availability of geodata that has been imported into the game, which consists of:

Table 1. Types of Methods in Geoskyline Modification

Methods	Description	Shortcut	Requirement
ImportRoads()	Uploads roads_rwo.csv, matches road types according to rwo_cs_road_match.csv and creates a road network.	Ctrl + R	roads_rwo.csv, rwo_cs_road_match.csv, import_export.conf
ImportRails()	Uploads rails_rwo.csv,	Ctrl + L	rails_rwo.csv,

	matches rail types according to rwo_cs_rail_match.csv and creates a rail network.		rwo_cs_rail_match.csv, import_export.conf
ImportWaterBody()	Uploads water_rwo.csv and lowers the terrain for each polygon using the Ray casting algorithm.	Ctrl + W	water_rwo.csv, import_export.conf
ImportWaterWay()	Uploads waterway_rwo.csv and lowers terrain for each waterway segment.	Ctrl + Q	waterway_rwo.csv, import_export.conf
ImportTreesRaster()	Uploads trees.png and for every non-white pixel creates a tree	Ctrl + T	trees.png (1081×1081 resolution), import_export.conf
ImportTreesVector()	Uploads trees_rwo.csv and creates a tree for each record	Ctrl + V	trees_rwo.csv, import_export.conf
ImportZones()	Uploads zones_rwo.csv, matches locations of each zone with the locations of game's zone blocks and sets the zone	Ctrl + Z	zones_rwo.csv, rwo_cs_zone_match.csv, import_export.conf
ImportServices()	Uploads amenity_rwo.csv, matches service types according to rwo_cs_service_match.csv and creates services.	Ctrl + S	amenity_rwo.csv, rwo_cs_service_match.csv, import_export.conf
ExportSegments()	Exports all road segments created in the game into a CSV file.	Ctrl + G	import_export.conf
ExportBuildings()	Export all buildings created in the game into a CSV file.	Ctrl + H	import_export.conf
ExportZones()	Exports all zones created in the game into a CSV file.	Ctrl + J	import_export.conf
ExportTrees()	Exports all trees created in the game into a CSV file	Ctrl + K	import_export.conf
DisplayLLOnMouseClick()	Displays screen, game and WGS 84 coordinates of the place of the click.	Ctrl + left mouse click	import_export.conf
OutputPrefabInfo()	Outputs all road, building and tree types that are currently loaded in the game	Ctrl + P	Nothing

Manual post-processing covers the fixed problems of the generated base model, but also adds other requirements such as linking the city model to existing infrastructure (making the amount of time spent on manual post-processing of the base model longer). The following is the sequence of the geodata analysis process into a model that can be simulated or played.
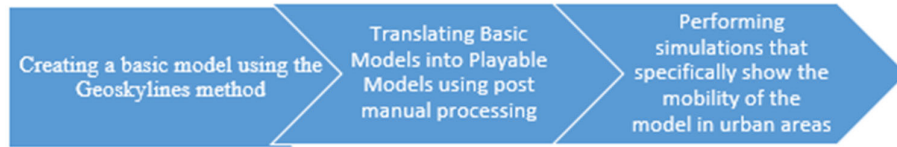
Fig.1. Stages of Geodata Analysis and Simulation into a Playable Model

3   Results and Discussion

Geographical Simulation of Denpasar City and its surroundings

The basic thing that needs to be done in making geodata for Denpasar City is to convert geographic coordinates in real time according to the desired target location into game coordinates. For information, in the game Cities: Skylines uses cells with a size of 8 x 8 m in the game which is equivalent to 1920 m x 1920 m or can be called 9 x 9 cells, in real dimensions. On a metric scale this area is equal to 17.28 km x 17.28 km or with a total area of 298.5984 sq km. However, the basic version only consists of 5 x 5 cells that can be played, the illustration is as shown below.
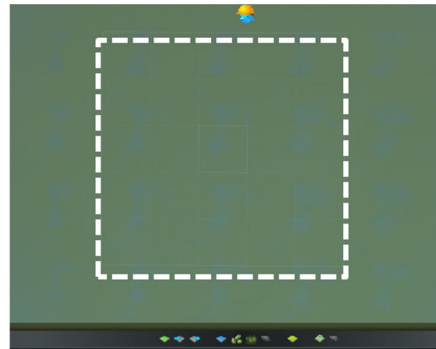

Fig.2. Tile Area in Cities : Skylines

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 are considered relevant, 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 which have CRS in each zone.

Bounding Box serves to capture geographic information on the map of the location of objects that are bounded by a rectangular border line. This process is basic 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.

By using google maps as a base map, here is the geographic information of Denpasar City:

a. Metrics Coordinate "x,y" Kota Denpasar is 303339.582,9041088.390
b. EPSG code for Bali Region epsg: 32750"
c. Zone Code for Bali region"epsg 50s"

Navigating through CRS may be confusing at first, but using the EPSG code (EPSG is the authority that manages CRS) and Google makes it easier. Use the code found in QGIS to select the appropriate CRS.
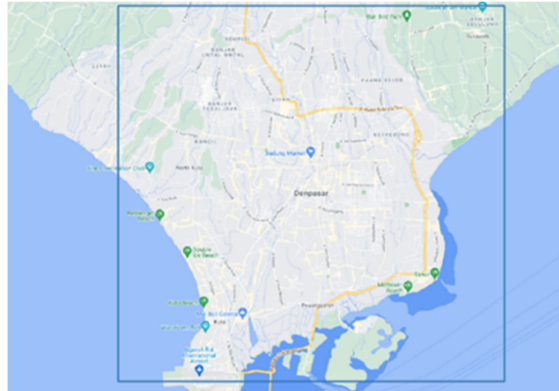

Fig.3. Denpasar City Area Bounding Box

Height Map is a map that provides information on the height of an area. To get a special heightmap map in the territory of Indonesia, it can be obtained through DEM (Digital Elevation Model) data which can be downloaded in TIF format on the https://tanahair.indonesia.go.id/demnas/#/demnas website. By selecting the desired area, topographic elevation data will be obtained in Denpasar City and its surroundings. Especially for the elevation of the city of Denpasar, it takes 3 different cells to get the entire DEM data. The following is an illustration of the DEM on the National DEM website.
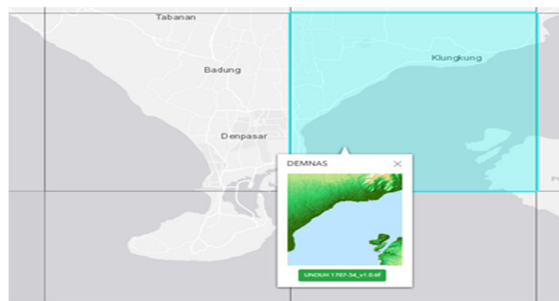

Fig 4. Denpasar City DEM map on the National DEM website
Sumber : Hasil Penelitian, 2021

After getting the complete file, the final step is to provide the desired DEM limit using the bounding box that has been prepared previously. The following is an illustration depicted in Figure below.
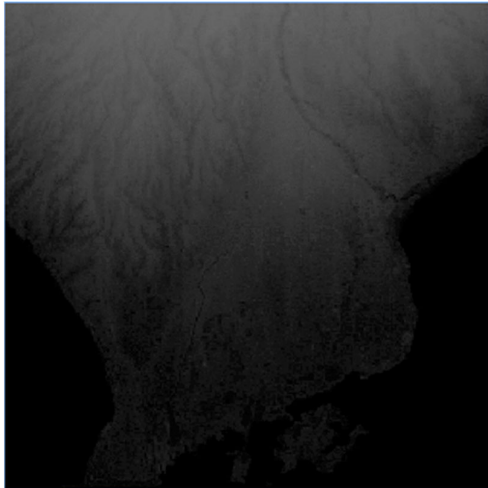
Fig 5. Height Map calibration results with Denpasar City Bounding Box

Simulation of Geographical Results for the City of Denpasar and the elevation of geographic contours in Cities: Skylines. After going through the whole process to get the geographic data of Denpasar City, the next step is to import the following data into the simulation game Cities: Skyline by doing a cross platform from the mapping application into a game application. The following are the results of the geographical simulation of the City of Denpasar.
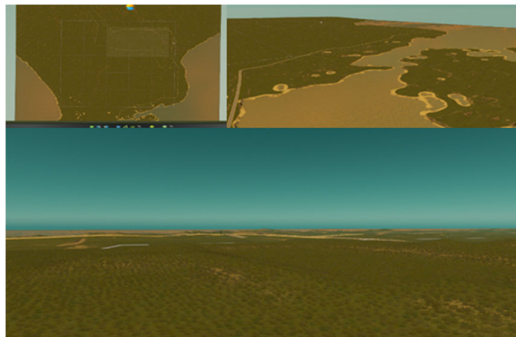

Fig 6. DEM Simulation Results and Geographical Shapes of Denpasar City and Surroundings through the game Cities: Skylines

4 Conclusion

The process of preparing geodata for the city of Denpasar is described in two major processes, namely the preparation of a map of the city of Denpasar in terms of elevation and geographical area and the preparation of geographic objects in the city of Denpasar as a whole

Making a Denpasar City Simulation so that it can be simulated into a game can actually use various methods, but in this study the simulation process is carried out by creating a file in CSV format. So it is necessary to prepare all geographic objects in this type format.

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