Chapter

Smart City Serious Game Based on Features Selection

Fachrul Kurniawan, Supeno Mardi Susiki Nugroho, Mochamad Hariadi, Isdaryanto Iskandar and Prita Dewi Basoeki

Abstract

In general, the smart city concept integrates ICT devices to collect various types of data related to urban life. The data will be used to manage and improve assets and operations in the city. In determining a smart city, there are eight key aspects (features) as a consideration. However, implementing eight smart city features will require many resources, including time, cost, and human resources. Therefore, this paper aims to develop a scenario and method of features and smart city parameters establishment in a serious game. This game consists of visualization, storyline, and gameplay as a learning platform to increase players' understanding of the smart city concepts. The development was started by collecting feature data of each city. The collected data will be discovered for the relationship between its features using differential equations. Then, data processing results will be classified and used as a basis for serious games. This study's product is an easy-to-use game that can simulate planning and constructing a smart city. This game is intended for the city government or the mayor as a critical role in city development. It will ease the user to understand the concept of the smart city based on the city characteristics. Furthermore, this serious game will provide feedback and recommendations on aspects that need to be improved in the city. It can be basic knowledge to make an actual decision and policies in smart city development.

Keywords: city development, serious games, smart city

1. Introduction

The challenges to implementing a smart city concept in developing countries are technology adaptation, government operational management, and lack of clear strategy [1]. As one of the developing countries in South East Asia, Indonesia has potential for smart city development [2, 3]. However, this archipelago state implements smart city is difficult. Each city has its characteristics, so that implementation cannot be equated. In general, these cities are classified based on the number of population, which are small city (<100,000 population), medium city (100,000–500,000 population), big city (500,000–1,000,000 population), and metropolis (>1,000,000 population).

There are several considerations to determine a smart city, such as a feature of the smart city. In its application, there are eight main features that each feature has several parameters. The factor will decide the level of a city, whether it is categorized as a smart city or not [4, 5]. It is tough to implement all the eight smart city features because it requires a lot of resources. Therefore, it needs a platform that can simulate planning and constructing an ideal smart city. One simulation model is in the form of a serious game [6, 7].

In this case, the use of serious games has several advantages. This kind of game emphasized a specific purpose such as education, scientific exploration, city management, etc. [8–10]. The smart city serious game aims to simulate the implementation of the smart city based on features. Based on the simulation through the game, it can be a consideration as a problem solving related to the smart city issues. Furthermore, using these serious games helps to save costs, human resources, and time.

According to the researcher's project, a smart city-based development project provides many data from the smart operation room. It records issues around the city, such as delay in the development projects and the determination of bandwidth network technology needed to integrate CCTV cameras and operation rooms. This phenomenon encourages researchers to use a game-based method as part of problem-solving to find the most effective development system [11, 12]. One of the expected outputs from the serious game is the clarification optimization process that can be implemented in city development [13].

The game will provide feedback, knowledge, and specific result related to the city's problem. It will make a player focus on the issues and create a solution in starting the development using the smart city system [6, 14]. The scenario of these games is adjusted to the city's problems covered in eight features smart city [4, 15]. In the next section, it will describe the formulation of smart city features and parameters.

2. Smart city features and parameters

The formulation of smart city features is based on current development in a developed country [16–18]. Those features are smart health, smart education, smart mobility, smart energy, smart government, and smart technology. However, there are

Smart city features	Parameters
Smart health (HE)	Medical team, disease sufferer, blood donors
Smart education (ED)	School, university, college graduate
Smart mobility (MO)	Vehicle, mobility, traffic accident
Smart energy (EN)	Electricity, water
Smart government (GO)	Demography, state civil apparatus, regional income
Smart technology (TE)	Social media, internet, smartphone user
Smart infrastructure (IN)	Industry, agriculture, farm, fishery, school, hotel, hospital, worship place, government offices, fiber optic
Smart people (PE)	Population density, urbanization, birth rate, death rate

Table 1.
Smart city features and each parameter.

two additional features based on characteristics and differences between developed and developing countries: smart infrastructure and smart people. Furthermore, there are some parameters to measure each feature value. **Table 1** presents the smart city features and each parameter. Based on **Table 1**, those parameters are collected from the Indonesian central bureau of statistics. The data of parameters will be processed and resulting in a main value of features. In general, the feature data will be compared end evaluated with the standard of a smart city. The information of current city condition becomes a fundamental consideration to improve the low sector.

This feature formulation is essential as preparation of scenario development in the smart city serious game. The formulation process of feature value is based on differential equations. The final score for each feature is 0.125, so that the overall value is 1 or 100%. The results will be used to give weight to the serious game scenario, and then it will be classified into three categories (not ready, standard, smart city). This classification will determine the game's feedback on a smart city serious game scenario.

3. Proposed method of the smart city serious game

The research process begins with identifying data based on several previous studies related to the smart city. This identification produced the required features and parameters that are used for smart city determination. In the previous section, it is known that eight features were identified in this study. After that, the collected data will be processed using a differential equation and classification algorithm to develop a whole smart city serious game (visualization, storyline, and gameplay). **Figure 1** presents the research flow of smart city serious game development.

Data resources become an essential thing in this study. It was collected from the Indonesian central bureau of statistics within the last 3 years. It is crucial to use credible data as a basis for future experiments. For example, **Table 2** presents the energy feature data that consists of two parameters: electricity and water. Researchers are also participating in smart city planning projects to enrich data identification and explore related problems.

After the data identification and collection, it continues with the data modeling using a differential equation. This step aims to find out the difference of smart city feature data and determine each feature's urgency level. The use of differential equations also aims to determine the weights in the game process. Also, the slope one algorithm is used to discover data comparisons in each city. It can provide a recommended formula for smart city development. Next, the data classification is calculated by the learning algorithm. This algorithm will classify the data into three categories (not smart, standard, and smart). This classification process is important because it is the feedback that the serious game gives to the players.

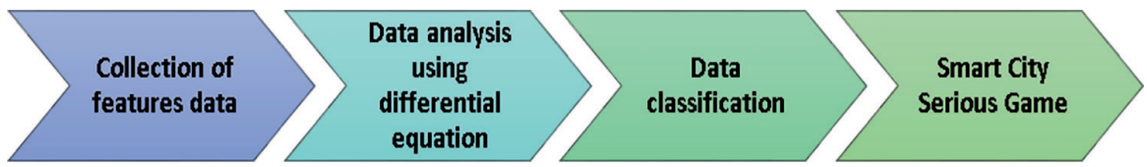

Figure 1.
Research flow.

City	Parameter of energy features						
	Electricity			Water			Smart energy
	Customer	Population	ax	Customer	Population	ax	
Jakarta	4,819,168	10,075,310	0.478	813,356	10,075,310	0.081	0.559
Cirebon	132,686	305,899	0.433	51,516	305,899	0.168	0.602
Pasuruan	76,169	193,329	0.393	224,210	193,329	1.159	1.554
Surabaya	1,043,501	2,765,487	0.377	526,688	2,765,487	0.191	0.568
Kediri	78,321	293,282	0.267	13,900	293,282	0.047	0.314

Table 2.
Data of energy features and its parameter.

4. Result and discussion

4.1 Scenario design of smart city serious game

The purpose of scenario design development is to identify a required process. In this study, the fidelity aspect means that simulation cases are based on the actual data. Furthermore, this game trains the process of identifying cities and their problems, especially for the local city government. **Figure 2** presents the scenario of a serious game. **Figure 1** started with the type of city based on the population number (small city, medium city, big city, and metropolis). From the city classification, players are directed to understand the differences from each city in Indonesia.

After understanding the type of a city, players are required to know about the concept of a smart city through its features and parameters. Players will be invited to study the smart city components, which consist of features and parameters data. By introducing the smart city components, players can imagine the concept of the game. Further understanding of the smart city concept can be reached after players completed the parameters of each feature. After that, it will be processed, and the results will be given in the form of a graph. It describes and concludes the gameplay, also provides a detailed description of each feature visualized in the graphic.

4.2 Main principles of smart city serious game

There are three essentials principles in developing smart city serious games: learn, rule, and play. It aims to make the players reach as much benefit as possible, and they would completely understand the concept of smart city development.

The learning principle is related to the type of city. By learning the city type, the player will understand the characteristics and issues of each city. Then, it would give feedback on development projects that were supposed to be prioritized [14, 19]. With an entertaining concept, a different learning experience would be gained when the players understand the issues [12, 14, 20]. **Figure 3** shows the learning process of city data identification.

Furthermore, **Figure 4** shows that the population of a city affects the city's type and the problems faced by the city. Thus, the score and development treatment would be different, depending on the type and level of the city's problems. This learning experience through the game will affect knowledge improvement. **Figure 5** shows that the level of understanding was started with level 1 with

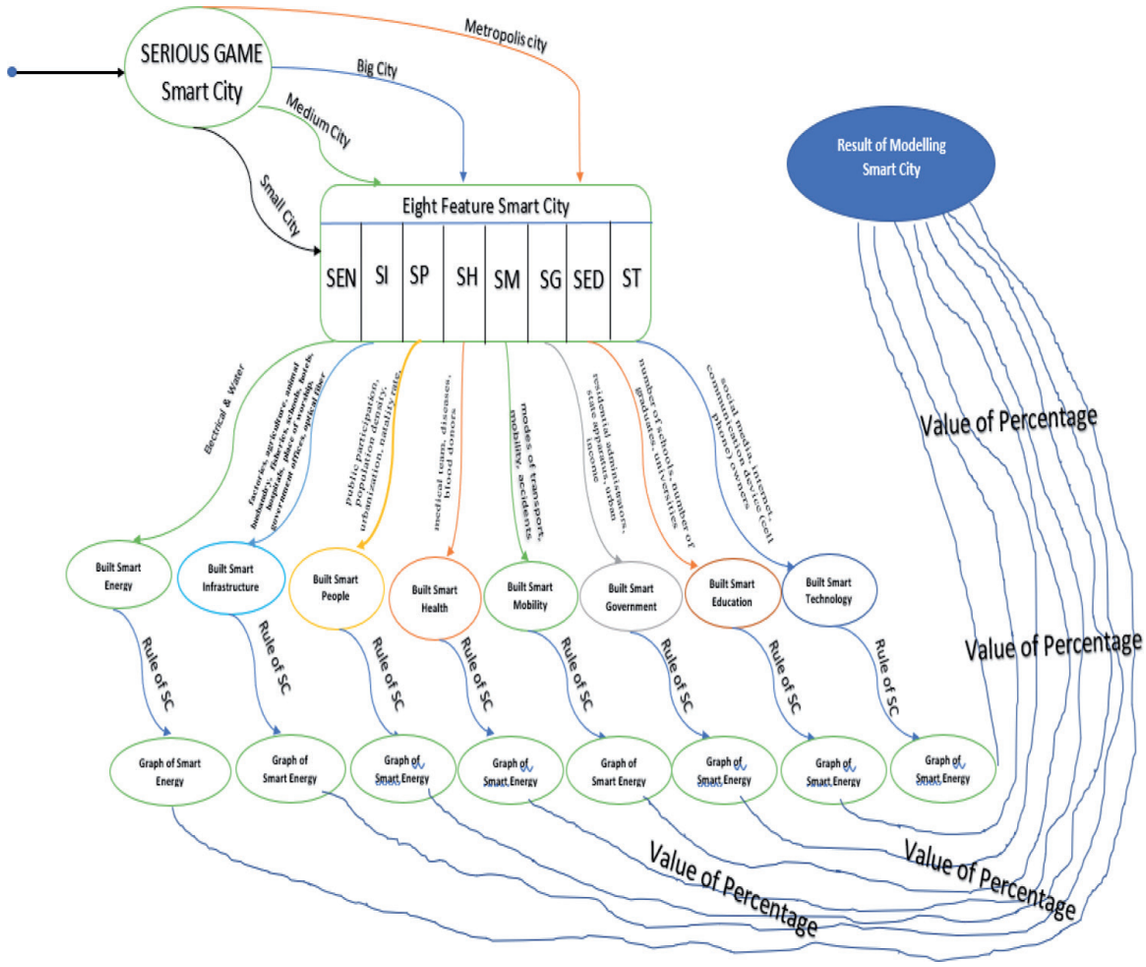

Figure 2.
The scenario of smart city serious game.

limited data, 10%. As the level increases to level 2 or 3, the cities were getting bigger and more complex problems. It allowed the players to get more experience and improve their understanding.

In a serious game, rules are necessary as a basic guideline related to the actual case. The serious game rule must be in accordance with the real facts, and this interaction would be relevant to the real case. Each feature has been given a weight based on its priority level that becomes a rule for the smart city serious game. **Figure 6** shows the rule function control in serious game development.

According to **Figure 6**, the rule function that formed a set of data relevant to the standard and actual conditions. Then, it was used to set training data to provide scores for the smart city system's eight features. Each rule had an objective in training: to get the general description of the training to collect relevant conditions and result in actions that followed the training guidelines. This rule was highly important and affected the users' knowledge of the cities' problems, which were seen from the scores of the parameters.

The last principle of smart city serious game is play. Raw data collected from the survey were input to be processed using a clustering system and classified before the training process. The game did not use levels to show acceleration. Instead, it required the players to prove input based on the types of cities, and thus an optimal score would be gained at the end of the game. The game would provide recommendations to players on required actions to solve a similar problem.

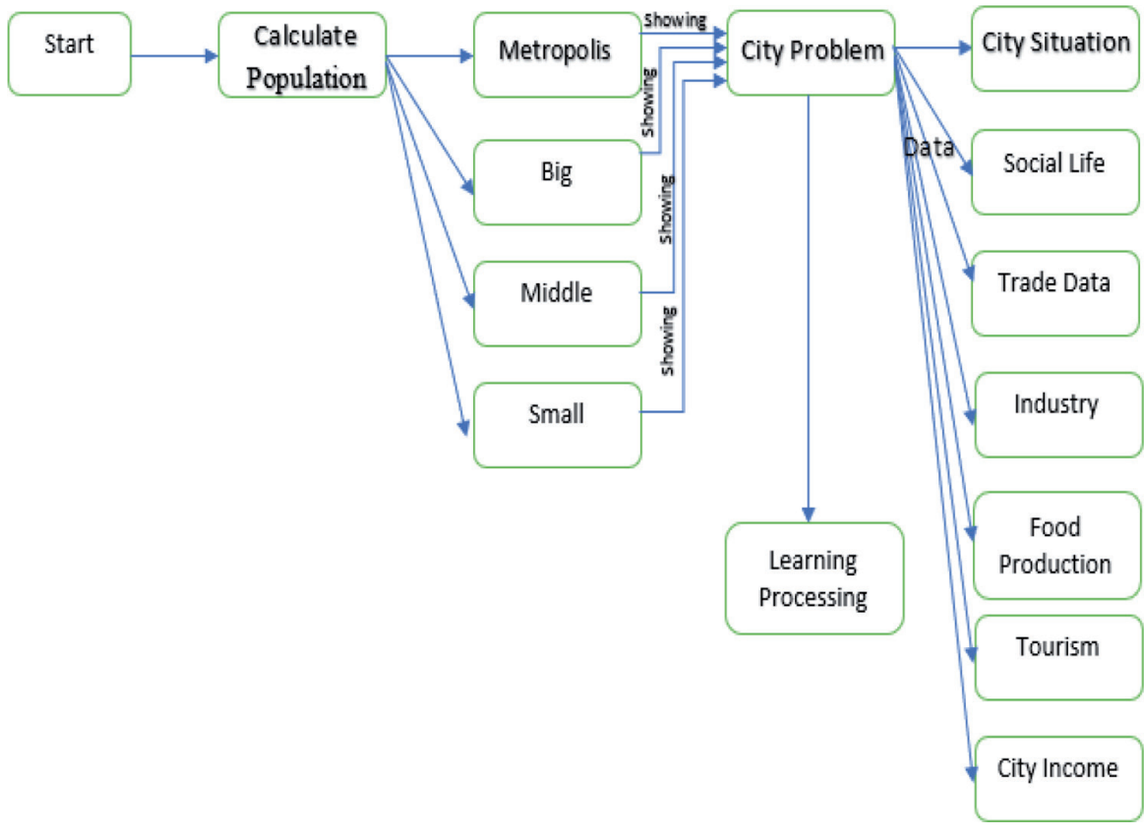

Figure 3.
The learning process for city identification.

Figure 7 shows the indicator input in accordance with the game level. It started with the small city category and increasing along with the higher level. The level of the game is increasing while the player completes and understands the current level. After that, the player can play at a higher level with the higher type of city and face more complex problems.

4.3 Implementation smart city features in the serious game

As we mentioned before, the game begins by selecting the city's type based on the population number. It is important to understand the players who act as city mayors to consider the characteristics and limitations. **Figure 8** previews the city selection page in the game.

After the city type selection, the game will preview the features and parameters of the city. The player has to input the number according to the actual data. The input of real data is vital so that the system will provide a calculation and feedback as accurately as possible. It can be basic knowledge to develop the current city condition. For example, **Figure 9** previews the input page of the smart energy feature in the small city. Based on the preview, it can be seen that the smart energy feature consists of two parameters (electrical and water).

The category of the city could be seen from the number of populations shown and from the eight features of the smart city as well as their parameters. **Figure 10** presents another feature (smart infrastructure) with its parameters.

After the player completes all the features and parameters, the data will be processed using the impact factor score determined in the system. The game's result

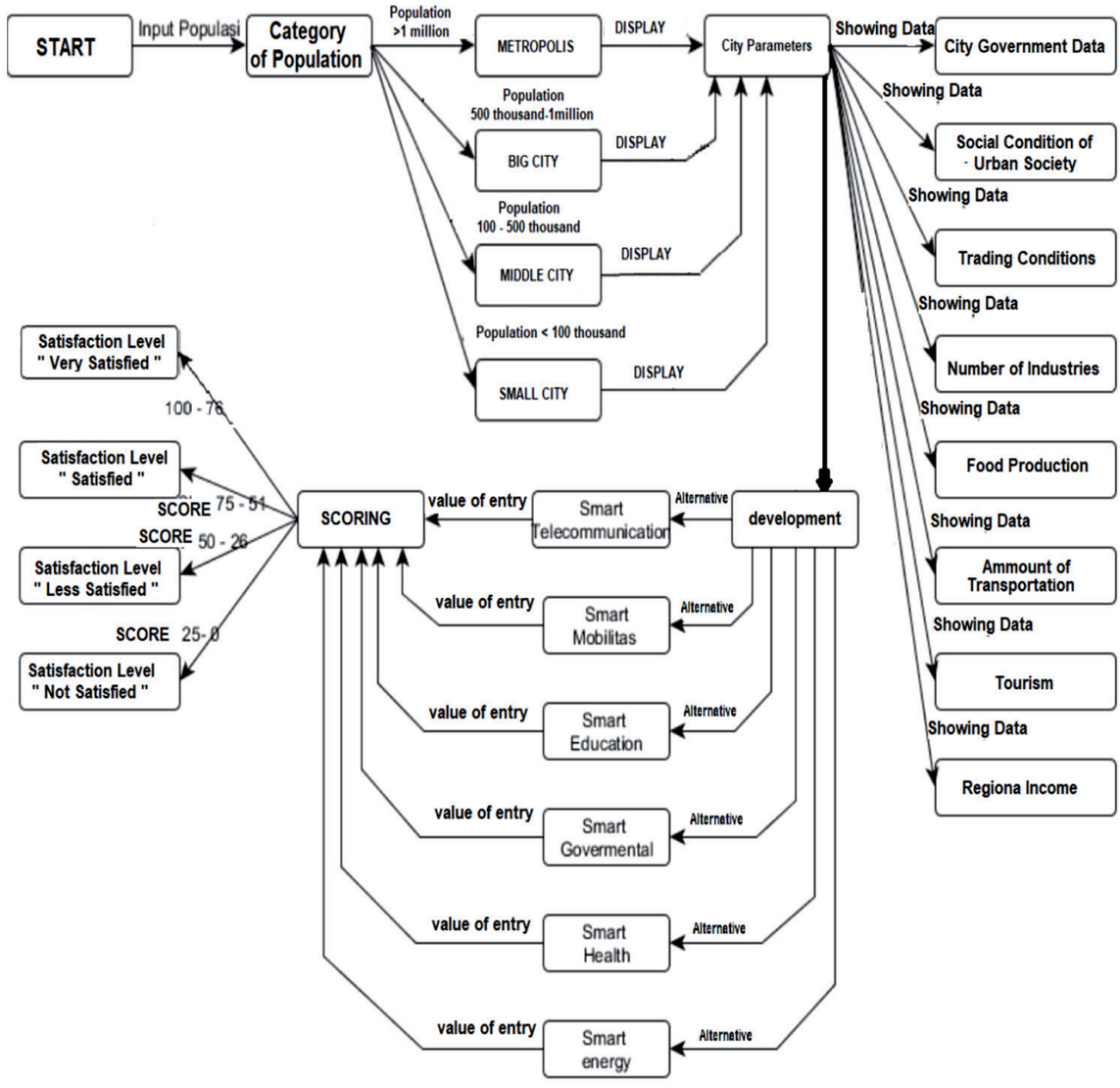

Figure 4.
Diagram of learning data.

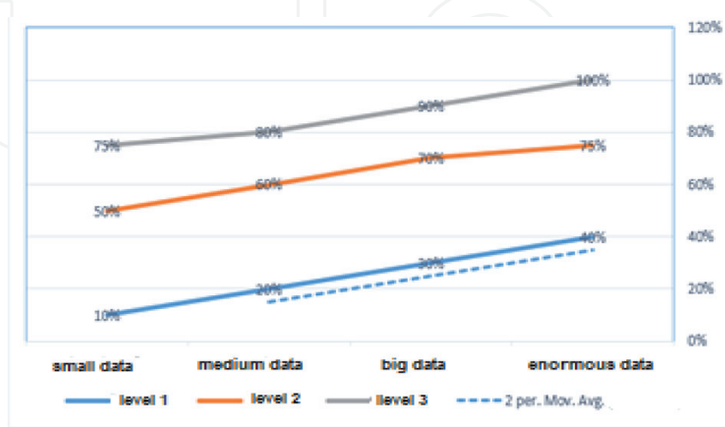

Figure 5.
Level of game understanding.

concludes that the mayor's policies are around 34% of development. It means that the development of the smart city is relatively low. **Figure 11** presents the result and recommendation page of the game.

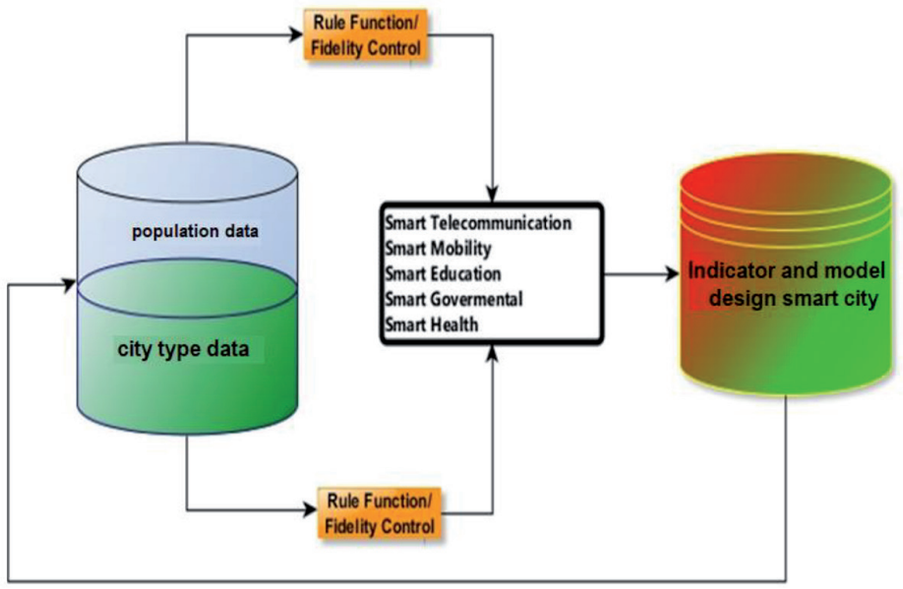

Figure 6.
Rule function (fidelity) in smart city serious game.

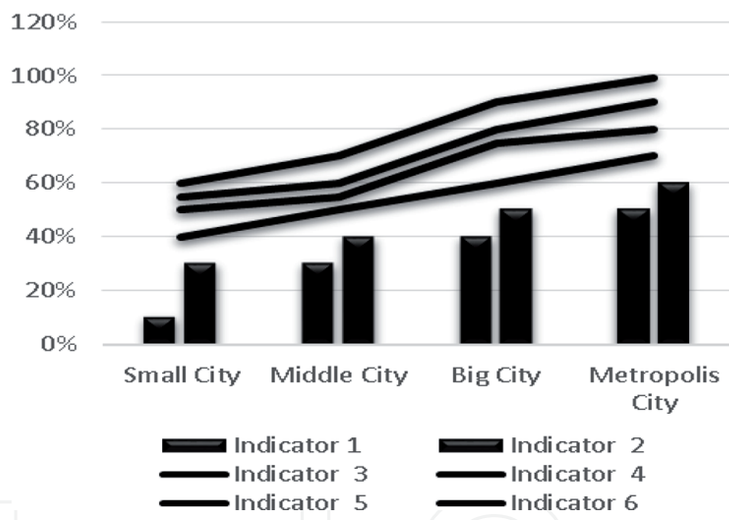

Figure 7.
The indicator of data input based on the game level.

Furthermore, detailed info will be provided in the graph that shows the city conditions. It shows the value of each smart city feature. It is used to evaluate policies and optimize values lacking in smart city features to make improvements in the next game. This feedback and recommendations make a player more focus on areas that need improvement to meet the smart city's standard.

The score of the game estimates the mayor's level of understanding of the city's problems. It could help to improve the level of understanding of smart city-based development programs. The smart city game could be useful if used continuously until it achieved a standardized score as intended by the player (city mayor). It could eventually improve the smart city system's knowledge and provide many considerations in determining developing cities' policies.

Moreover, the use of smart city serious games has many advantages [21, 22]. It helps the player to simulate that appropriate with the actual city cases. It can save time, costs, and resources before implementing the real improvement. It is also used

Figure 8.
Selection of the type of the city.

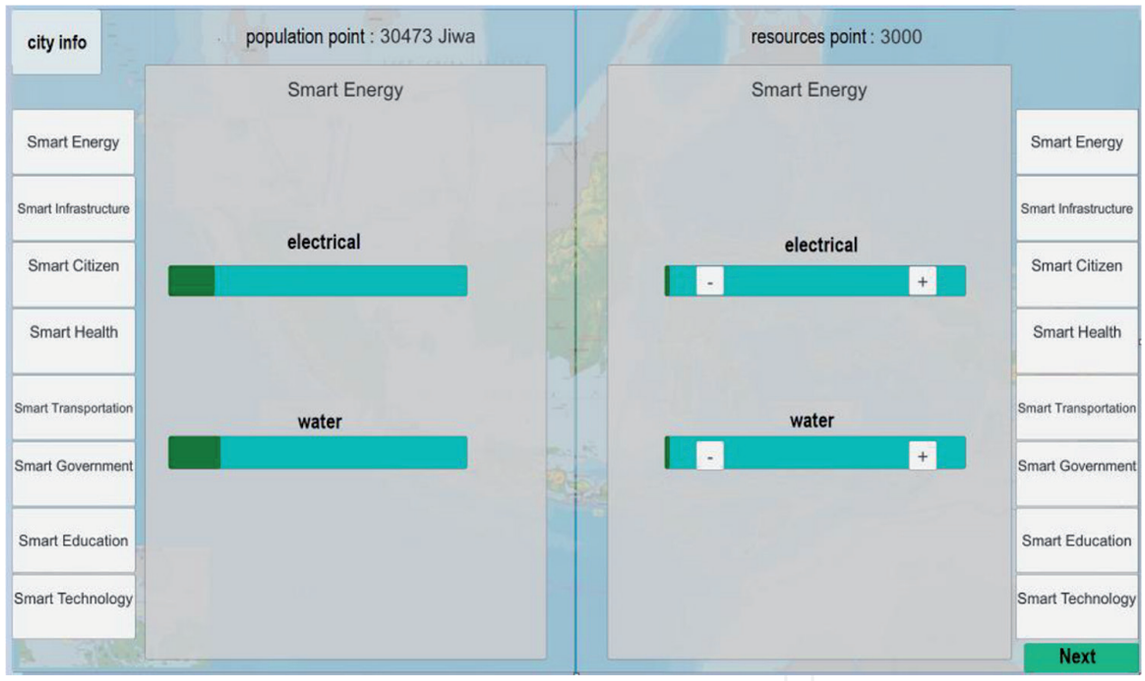

Figure 9.
Input page of smart energy feature in the small city.

to minimize a potential failure due to the lack of understanding by the city mayor [23]. Furthermore, the smart city serious game is expected to help an equitable city development, especially in developing countries.

5. Conclusion

The differences between developing and the developed country become a factor in the development of the city. Infrastructure and human resources are the two essential differences of it. Therefore, more considerations are used so the development

can be implemented properly. The serious game could be considered a training and learning platform to decide and policies in actual city development. In smart cities, the game could help minimize failure for the city mayors in implementing development programs. Also, it would save the required time, costs, and resources

Figure 10.
The input of smart energy and smart infrastructure parameters.

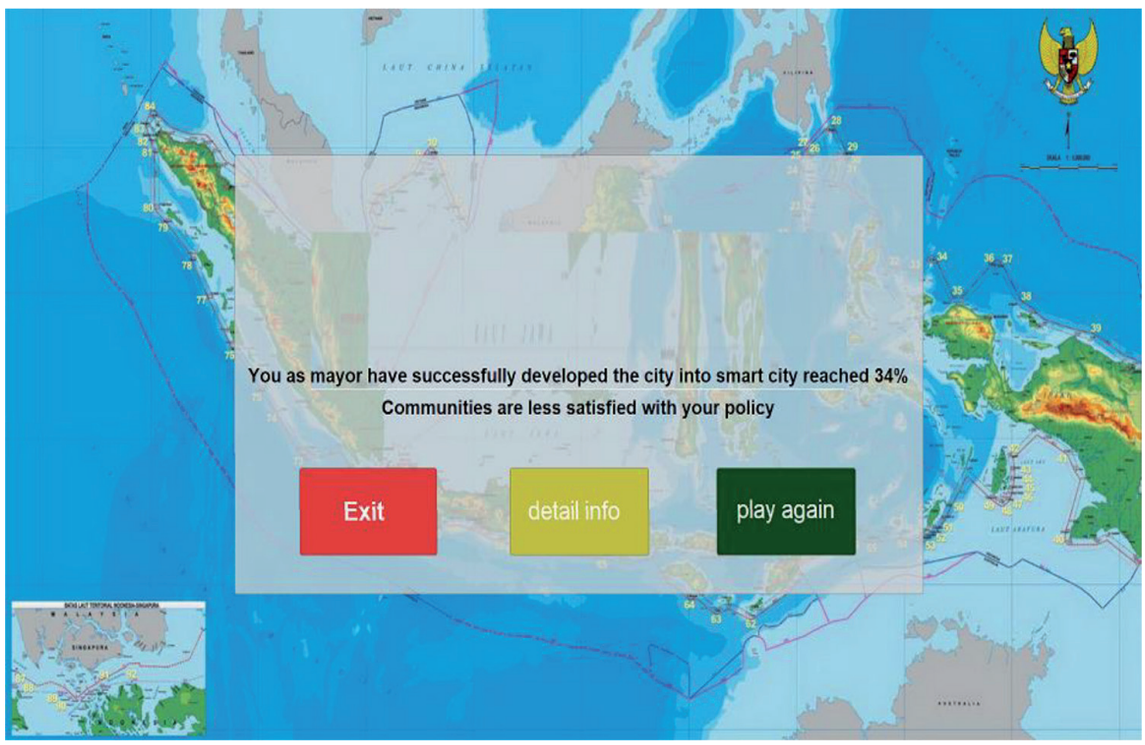

Figure 11.
The result and recommendation page.

before implementing the city development. Features and parameters of the city are an indicator to determine the smart city level. Thus, it must be customized with the characteristics of the country or the city. The formulation of features and parameters is important to help each city to reach the potential improvement. The three essentials principles: learning, rule, and play, allow the player to understand the characteristics and complexity problem in the city. It makes a player, especially a city mayor, increases their understanding of the smart city concept.

A serious game scenario design methodology is still highly challenging for further study since it is often not relevant to the actual conditions. It is needed and optimization to produce an adequate configuration. The development related to big data and business intelligence is also considered in the next study. It will help the government to make a policy and solution based on the actual condition. The collected data can be analyzed comprehensively with several artificial intelligence algorithms and make data becomes useful information.

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