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Sustainable Development for Smart City Education based on Features and Parameters Assessment Modelling Slope One Algorithm

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Abstract

Smart city concept has become an opportunity for sustainable development in developing countries, such as Indonesia. The successful implementation of smart city is related to several key factors. One of which is education. This study describes an educational concept, especially for the youth generation who learn computer science, to introduce and educate them on the smart city concept. The education is related to the urban big data based on several important sectors in a smart city such as energy, education, government, technology, mobility, and health. The concept is formed as data processing and analyzing related to the features and parameters in a smart city. The data processing uses slope one algorithm and differential popularity to find out the value of each feature in a smart city. Furthermore, by knowing the value of each feature, it can be used as a reference and recommendation to develop an unfavorable sector.

Keywords:smart city, education, feature and parameters, slope one algorithm.

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1 Framework of study

As an archipelagic country, Indonesia has 16,056 islands, five of which are the main islands. Because of this condition, each city in Indonesia faces different complex problems, such as education, transportation, and social economy. Therefore, development strategies and management are needed to overcome the problems in accordance with the characteristics of the cities [1]. One of the strategies to overcome the problems is to implement a smart city concept [2], [3]. The implementation of smart city is the first step undertaken by cities in Indonesia. This concept allows a city to maximize human resources, society, and modern infrastructures to realize sustainable development [4]–[6]. The development utilizes information communication technology (ICT) for the city management so that the city can be independent in developing existing resources and serve its needs independently. Through smart city, the sustainable development purposes can be achieved systematically and gradually with a long-term perspective [7]–[9].

To the measurement and analysis of the intelligence level of a city require urban data related to the city and the use of resources [10]. The data include various aspects, such as energy monitoring and distribution, transportation, and technology used [11]–[13]. Citizens as part of the city are required to have certain skills and abilities to realize the growing of urban data and use it for discover a local issues.[14]. However, not all citizens have these skills. Therefore, an effort to introduce and educate them is needed. One possible action is to integrate the concept into a learning subject [15]. The most possible learning subject is computer science, in which learners commonly process and analyze big data. With this educational concept, it is expected that students as future generations have an awareness and responsibilities as part of urban development. They can be active citizens giving suggestions and recommendations for the government based on their knowledge. Furthermore, they also as a next generations who will become candidate of a government official can use their skills, abilities, and knowledge as the basis for the decision to develop a city.

2 Smart City Education for Information Technology Students

Students have a significant role in the development of a country or a city sustainability [15], [16]. As future generation, they are expected to be able to make a better change in the future. In this case, smart city becomes the main concern in sustainable development at the urban level. Therefore, students have to be aware of and understand issues related to cities. Related to the problems in a city, data become an important resource. The data, called urban

data, is related to the city such as transportation, technology, and infrastructure. Based on the urban data, a solution or an innovation can be made for a change.

The skills to process and analyze urban data can be taught to students. In this study, the subjects are students who learn computer science at university level. The consideration is that they also learn about big data suitable for the context. They can also develop various techniques to produce innovation in urban big data contents. Moreover, through educational processes, they are expected to 1) have skills to process and analyses urban big data, (2) have smart city knowledge, (3) have an awareness of urban issues, and (4) give recommendations to the government for a better city change. Fig 1. illustrates the learning concept of smart city and urban data.

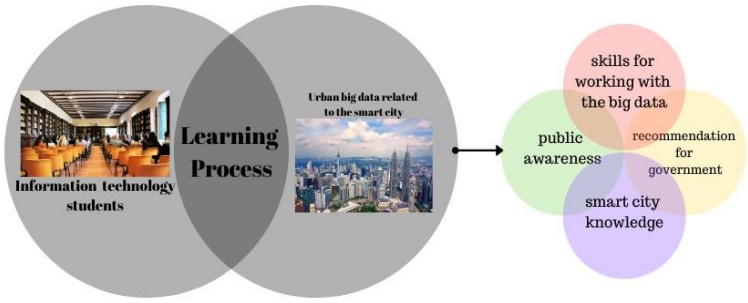

Figure 1 Learning concept of smart city

3 Smart City Feature and Parameter

The implementation of smart city requires features as indicators of city intelligence level. In Indonesia, there are six features which are influenced by several parameters. The development and implementation model of smart city features are influenced by the status of a country, whether the country is a developed or developing country [17]. The problems in a developing country certainly are more complex than those in a developed one. This is because the economic development is not balanced with the human resources development [18]. Urbanization flows also become a serious problem in a developing country, resulting in various risk, concerns, and problems.

In relation to these problems, currently the complex and big data is not well documented. So, the problem cannot be resolved properly. . Most urban data has limited access, so it is hard to access by public. The data may be obtained by mobile phones, sensors, and satellites. Also, it may collect from surveys and questionnaires. The data includes various aspects, such as population, electricity and water distribution, transportation, and technology used. Therefore, features and parameters are used as a reference for a smart city.

To find out the progress of smart city, the position of each main feature needs to be identified and understood so that the assessment of features will be known in accordance with the condition of the city. The purpose of measuring every feature and parameter in the smart city concept is to monitor the development so that it runs on the right track. In addition, it makes the city more focused on the development sector which is the main problem in the city based on the rating results obtained. Then, if carried out in accordance with the scenario, it will maximize the resolution of urban problems.Figure 2 illustrates Features on smart city concept in Indonesia.

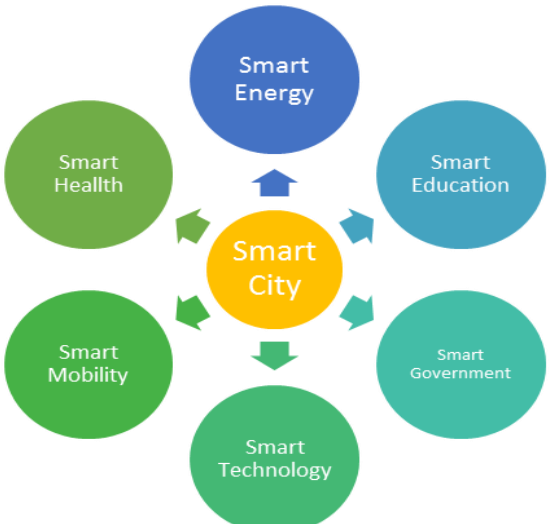

Figure 2 Features on smart city concept in Indonesia

There are several factors that influence features called parameters. The parameter formulation refers to research conducted in several European countries on the indicators of smart cities [19], [20]. Then, city feature data obtained from parameters is adjusted to the formation of the smart city concept. This is based on a reference to the city standards that exist in developed countries, where all development has been carried out both in terms of physical and human infrastructure. Table 1 shows the features and each influenced parameter. For example, in the energy feature, there are two parameters, electricity and water. After that, the value of the electricity parameter is obtained from the number of electricity customers divided by the population. Likewise, water parameters are obtained from the number of water customers divided by the population.

Based on the value of these parameters, the final value of each feature will be obtained. The value will be accumulated, which will be used as the final value of all features. The value of each feature is obtained from the formula $(\frac{p}{n})/6$ where p is the value of the parameter, and n is the number of parameters.

of each feature. From these calculations, the value generated from each feature has the same value of 0.166 for each feature so that the overall value of the feature is rounded to 1 or 100%.

Table 1 Feature and its influenced parameter

Feature	**Parameter**
Energy	• Electricity distribution • Water distribution
Education	• Total of basic education (Elementary to High school) • Total of higher education (Diploma and University) • Total of higher education graduation
Government	• Regional income • Government employees • Population
Technology	• Social media • Internet • Smartphone user
Mobility	• Transportation • Mobility • Traffic accident
Health	• Medical workers • Disease • Blood donors

4 The Model Slope One Algorithm

Slope one algorithm implements the regulation of differences in value between two unknown data [21]. This algorithm performs a process based on the linear relationship level of the preference value or weight of each item (feature) being compared by finding the difference between an item and other items by using a comparison [22]. This algorithm refers to differential equation in order to find out the data comparison of each city. Fig.3 shows the slope one algorithm flow diagram.

Equation (1) is used for the calculation, where i is a predictable features value, j is a feature compared to S_{ij}, S_{ij} is a set of cities that have values in both features, $r_{u,i}$ is a city value of u with feature i, and $r_{u,j}$ is a city value of u against feature j.

$$dev_{i,j} = \frac{\Sigma u \epsilon S_{i,j} \left(r_{u,i} - r_{u,j}\right)}{\left|S_{i,j}\right|} \quad (1)$$

If the difference is already obtained, the next step is obtaining recommendations by carrying out the process based on equation (2), where $P_{u,i}$ is the recommended value for feature j, and $\Sigma j \epsilon R_u$ is a smart city feature that already has value data.

$$P_{u,i} = \frac{\Sigma j \epsilon R_u \left(dev_{i,j} + r_{u,j}\right) x \left|S_{i,j}\right|}{\Sigma j \epsilon R_u \left|S_{i,j}\right|} \quad (2)$$

Furthermore, there are two steps performed using the slope one algorithm to do the calculation process from city data that has a zero-feature value. Using the differential popularity formula in the slope one algorithm, the features will be compared with five other features. It is used to predict the feature that has zero value using slope one algorithm as shown in Fig. 3.

In this section, the researcher used the differential popularity technique in a slope one algorithm to calculate the city feature data. In this case, energy feature data of Malang city, Indonesia is used as a trial. The feature value will be compared to the other features value. Following is the process of the calculation.

- The differential popularity value of smart energy to smart education:
  $\frac{0 + 1 + 1 + 0 + 2 + 2 + 2 + 2 + 2}{9} = 1.333$
- The differential popularity value of smart energy to smart government:
  $\frac{(-3) + (-2) + 1 + 0 + 2 + 2 + 2 + 2 + 2}{9} = -0.111$
- The differential popularity value of smart energy to smart technology:
  $\frac{(-3) + (-2) + 1 + 0 + 2 + 2 + 2 + 2 + 2}{9} = -0.111$
- The differential popularity value of smart energy to smart mobility:
  $\frac{(3 - 3) + (3 - 3) + (3 - 3) + (3 - 3) + (3 - 3)}{5} = 0$
- The differential popularity value of smart energy to smart health:
  $\frac{(-2) + 1 + (3 - 2) + (3 - 2) + (3 - 2)}{5} = 0{,}4$

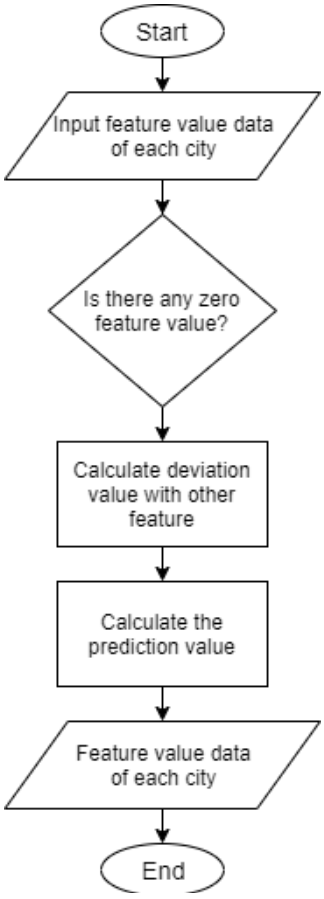

Figure 3 Slope one algorithm flow diagram

After getting the differential popularity value, then the calculation process is carried out to find the recommended value. The process of calculating is done by adding up the differential popularity value of each feature. The value is then multiplied by the number of cities that have a complete value. Then, it will be divided by the number of cities that have complete features. The result is as follows:

$$\frac{\big((3+0.4)x5\big)+\big((4+0)x5\big)+\big((4-0.111)x9\big)+\big((1+1.333)x9\big)+((1+1.333)x9)}{5+5+9+9+9}=3.083$$

Based on the result, the recommendation obtained for the value of smart energy in Malang is 3.083. It means the level of importance is in the second quartile or the level of importance to other features is sufficient. This output

value becomes a recommendation for importance level of each feature. For example, Fig. 4 shows the graph of feature value between Malang and Surabaya City in Indonesia. From the graph, it can be seen that value of energy feature in Malang City is at a sufficient level. Therefore, the development can focus on features that are still at a low level, such as government feature. So, in the end, all features can be at the same high level.

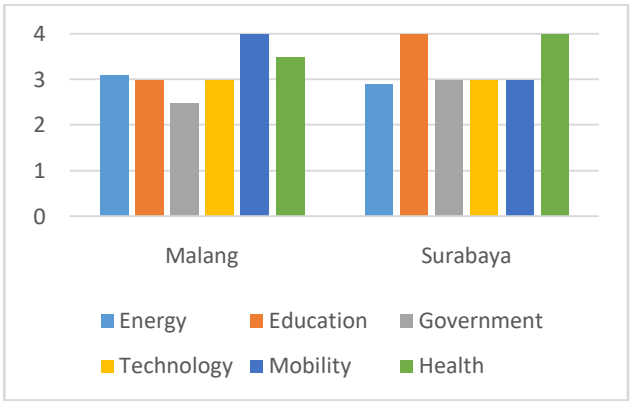

Figure 4 Feature value comparison between Malang and Surabaya City

From this result, it can be an opportunity for smart city education. Students can be more aware and understand the importance of smart city to the sustainable urban development. Furthermore, they can also develop an innovation related to the smart city concept and make it more promising in the future.

Several studies on the innovation and concept of smart city education have been conducted. For example, the development of urban data games to encourage and improve learning of working skills with enormous urban data sets using examples related to sustainability of real-life concerns [14]. Then, learning for human factors is needed to develop abilities, cultivate workers' knowledge, provide the social learning environment, and advance training in schools, organizations and institutions related to smart city [23].The development of smart city is influenced by higher education and its recent graduates staying in cities. Urban changes increase the demand for skilled people to manage different systems. Therefore, educating the youth is necessary to fulfill the demand in the future.

5 Conclusion

The need for skilled human resources in urban big data has increased in recent years. Therefore, education can be an effort to fulfill the demands. The concept of smart city learning through feature and parameter as an urban big data aims to educate, motivate, and support urban sustainable development. Slope one algorithm can be used as a tool for processing and analyzing the data. This can be a basis for further research related to the educational concept for smart city.

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References

[1] K. Vu and K. Hartley, "Promoting smart cities in developing countries: Policy insights from Vietnam," Telecomm. Policy, vol. 42, no. 10, pp. 845–859, 2018.
[2] A. Cocchia, "Smart and digital city: A systematic literature review," in Smart city,pp. 13–43, 2014,
[3] M. Lacinák and J. Ristvej, "Smart city, Safety and Security," in scientific conference on sustainable, modern and safe transport, pp. 522–527,2017.
[4] V. Fernandez-Anez, J. M. Fernández-Güell, and R. Giffinger, "Smart City implementation and discourses: An integrated conceptual model. The case of Vienna," Cities, vol. 78, pp. 4–16, 2018.
[5] A. Meijer and M. P. R. Bolívar, "Governing the smart city: a review of the literature on smart urban governance," Int. Rev. Adm. Sci., vol. 82, no. 2, pp. 392–408, 2016.
[6] V. Scuotto, A. Ferraris, and S. Bresciani, "Internet of Things: Applications and challenges in smart cities: a case study of IBM smart city projects," Bus. Process Manag. J., vol. 22, no. 2, pp. 357–367, 2016.
[7] T. Monfaredzadeh and R. Krueger, "Investigating Social Factors of Sustainability in a Smart City," Procedia Eng., vol. 118, pp. 1112–1118, 2015.
[8] Y. Wu, W. Zhang, J. Shen, Z. Mo, and Y. Peng, "Smart city with Chinese characteristics against the background of big data: Idea, action and risk," J. Clean. Prod., vol. 173, pp. 60–66, 2018.
[9] A. J. Meijer, J. R. Gil-Garcia, and M. P. R. Bolívar, "Smart city research: contextual conditions, governance models, and public value assessment," Soc. Sci. Comput. Rev., vol. 34, no. 6, pp. 647–656, 2016.

[10] I. A. T. Hashem et al., "The role of big data in smart city," Int. J. Inf. Manage., vol. 36, no. 5, pp. 748–758, 2016.
[11] F. Kurniawan, S. M. S. Nugroho, and M. Hariadi, "Promoting smart city research for engineering students," World Trans. Eng. Technol. Educ., vol. 17, no. 1, pp. 93–97, 2019.
[12] Á. Palomo-Navarro and J. Navío-Marco, "Smart city networks' governance: The Spanish smart city network case study," Telecomm. Policy, vol. 42, no. 10, pp. 872–880, 2017.
[13] J. Zhao and Y. Wang, "Toward domain knowledge model for smart city: The core conceptual model," 2015 IEEE First Int. Smart Cities Conf., pp. 1–5, 2015.
[14] A. Wolff, G. Kortuem, and J. Cavero, "Towards smart city education," in 2015 Sustainable Internet and ICT for Sustainability (SustainIT),pp. 1–3, 2015.
[15] R. Zhuang, H. Fang, Y. Zhang, A. Lu, and R. Huang, "Smart learning environments for a smart city: from the perspective of lifelong and lifewide learning," Smart Learn. Environ., vol. 4, no. 6, pp. 1–21, 2017.
[16] B. Williamson, "Educating the smart city: Schooling smart citizens through computational urbanism," Big Data Soc., vol. 2, no. 2, pp. 1–13, 2015.
[17] C. P. Liyanage and A. Marasinghe, "Planning smart meal in a smart city for a smart living," Proc. - 2013 Int. Conf. Biometrics Kansei Eng. ICBAKE 2013, pp. 166–171, 2013.
[18] I. A. Chub, M. V. Novozhylov, and M. N. Murin, "Optimization problem of allocating limited project resources with separable constraints," Cybern. Syst. Anal., vol. 49, no. 4, pp. 632–642, 2013.
[19] A. Caragliu, C. del Bo, and P. Nijkamp, "Smart cities in Europe," J. Urban Technol., vol. 18, no. 2, pp. 65–82, 2011.
[20] V. Javidroozi, H. Shah, A. Cole, and A. Amini, "Towards a City's Systems Integration Model for Smart City Development: A Conceptualization," in 2015 International Conference on Computational Science and Computational Intelligence (CSCI),pp. 312–317, 2015.
[21] J. Wang, K. Lin, and J. Li, "A collaborative filtering recommendation algorithm based on user clustering and Slope One scheme," in 8th International Conference on Computer Science & Education,pp. 1473–1476, 2013.
[22] T. Jiang, W. Lu, and H. Xiong, "Personalized collaborative filtering based on improved slope one alogarithm," in International Conference on Systems and Informatics (ICSAI2012), pp. 2312–2315,2012.
[23] T. Nam and T. A. Pardo, "Conceptualizing smart city with dimensions of technology, people, and institutions," in Proceedings of the 12th annual international digital government research conference: digital government innovation in challenging times, pp. 282–291,2011.

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