E-Luu : A Smart Dumpsters Location Planning System For Urban Management

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Abstract. The increase of population in an area will increase the flow of urbanization occurred in that area. This then brings an impact on the urban infrastructure needs and land use that will rapidly and drastically change. For this, urban planning should be rearranged primarily in relation to the waste issue. Spatial planning of public facilities associated with Temporary Waste Disposal Site (locally abbreviated as TPS) is no longer appropriate to be structured in a traditional way. A simulation system capable of evaluating the feasibility of the location of various public facilities, as a consequence, is required intentionally to minimize the negative impacts of TPS placement. The issue in spatial also occurs in Jembrana District, Bali. In this area the population in the end of December 2016 increased by 19.42%. We developed a Geographic Information System (GIS) based simulation system named E-Luu. This system evaluates the feasibility of the location of public facilities based on the direction and strength of wind and distance from TPS. There are 3 public facilities that can be evaluated by E-Luu, including parks, green areas and residential areas. In addition, an evaluation index has been proposed to evaluate the planned site planning scheme by providing a different staining on each of its markers in which red symbolized the location considered vulnerable and green was for the suggested location. Finally, the E-Luu system used in the location analysis for this urban public service facility was successfully implemented and demonstrated its effectiveness.

1. Introduction

Based on Jembrana District Government’ data, in 2009 the population number in Jembrana-Bali reached 269,859 people. This figure increased by 19.42% in the end of December 2016 into 322,256 people. This increase in population has led to an increase in the level of urbanization. The demand for urban infrastructure particularly related to waste will increase, and therefore there will be a rapid and drastic change. Prior to the changes, an appropriate planning is required¹. The facility of TPS (Waste Disposal Site) in urban areas is closely related to the daily life of the inhabitants, so that the location planning should have a more serious attention.

More issues in urbanization occur in many big cities in other countries. To cope with these problems, a solution using GIS (Geographic Information System) has been successfully and widely
used. Since the 1960s GIS has been used in urban planning and became more popular in the 1970s when a number of researchers and planners conducted a series of studies. Based on the research, a GIS-based system called e-luu was developed as a solution for public facility planning consisting of model of temporary waste disposal (TPS), trees, parks, and residential areas. Spatial planning was mapped using an algorithm utilizing the data of strength and direction of wind and distance among TPS, trees, parks and residential area.

The result of the evaluation on the location feasibility was marked by the marker staining in the map in the E-Luu system. Red indicated an unfavorable location and green referred to the suggested location.

2. Experimental

Figure 1 shows the flow of analysis model and evaluation of TPS location towards residential area and wind direction. The results of the evaluation would give the red marker if the TPS location was close to the residential area and, the smell of the waste, by the wind direction, could reach the residential area. Likewise, for green marker, if the location of TPS is far from the residential area and based on the wind direction, the waste smell did not reach the residential area.

![Figure 1. Dumpsters Analysis and Evaluation Model](image)

Figure 2 shows a flow of analysis model and evaluation of the location of trees towards the residential area and wind direction. The results of the evaluation provided a red marker if the location of trees blocked the wind blowing to the residential area. Likewise, for green marker, it was if the location of the trees did not block the wind blowing to the residential area.

![Figure 2. Trees Analysis and Evaluation Model](image)

Figure 3 presents the model of the analysis and evaluation on the park location towards the residential area and bins. The evaluation results showed a red marker if the park was close to the waste
and was not inside the residential polygon, while the green marker was given if the park was not close the waste and not present in residential location polygon.

**Figure 3. Parks Analysis and Evaluation Model**

The data of wind direction used in this study came from Meteorology, Climatology and Geophysics Council (Sanglah-Denpasar-Bali). The data was obtained from a sensor placed in Jembrana district and was recalled from January 2016 to December 2016.

3. Result and Discussion

As seen in Figure 4, the first stage in using this system was by managing the data of TPS (Waste Disposal Site), trees, Resistant, Residential area and Wind Data. Data processing (adding, modifying and deleting) can be done by admin through a specific web page accessed using a web browser. Data sent by the admin from the browser would be sent through internet, and it would then be accepted and filtered by the webserver, which would then be stored in the database. The system is built using Apache web server, PHP programming language and Javascript, MySQL as data storage, Linux operating system.

**Figure 4. Software Architecture**

Figure 5 below shows one of the page displays to manage the data that can be accessed by the admin. On this page admin can import the data obtained from BMKG Sanglah-Denpasar-Bali.

**Figure 5. Admin Page**
Figure 6 below shows the main page showing the map and location information of Waste Disposal Site, Trees, Park, Residential area and Wind Data in Jembrana District (e-luu.com). The average wind direction (according to the start-end range of the selected month) is displayed with arrows. The residential area was displayed with a box polygon (rectangle). Waste Disposal Site, Trees and Parks are displayed with the markers of trash cans, trees and parks.

The coloring identity of the graphic symbol was adjusted based on the data of Waste Disposal Site, Trees, Park, residential and wind direction. Table 1, 2 and 3 present the results of system testing:

| No | Testing Scenario                                                                 | Target                                                                 | Output |
|----|----------------------------------------------------------------------------------|------------------------------------------------------------------------|--------|
| 1  | Selecting the button See the Map on the First Page                               | Displaying the Main Page                                               | On Target |
| 2  | Giving a tick on checkbox of Waste Disposal Site                                | Displaying the location of the Waste Disposal Site                     | On Target |
| 3  | Giving a tick in the checkbox of Trees                                           | Displaying the location of Trees                                        | On Target |
| 4  | Giving a tick on the checkbox Park                                               | Displaying the location of Park                                         | On Target |
| 5  | Giving a tick on the checkbox Residential Area                                  | Displaying the Residential Location                                     | On Target |
| 6  | Selecting the menu the Wind Data, the Range of Date and then the button of See   | Displaying the list of Wind Data (rate of wind and the wind direction per month) and the average of wind direction | On Target |
| 7  | Giving a tick on TPS (Waste Disposal Site) and Trees                             | Displaying the status of TPS and status of Trees with the Red or Green symbol | On Target |
| 8  | Typing the searching word on the form of Search or selecting one of items of the searching result | Displaying the list of names of Location of the searching results based on the searching word, and displaying the Popup based on the items selected | On Target |
| No | Testing Scenario | Target                                                                 | Output               |
|----|------------------|------------------------------------------------------------------------|----------------------|
| 1  | ID and Password  | Admin successfully sign-in, then transferred to the Admin page          | On Target            |
| 2  | Selecting the menu Data of TPS Location | Displaying the list of TPS locations | On Target            |
| 3  | Typing the searching word in the form of Search and then selecting the button of Search (Magnifier) | Displaying the list of TPS location based on the searching word | On Target            |
| 4  | Selecting the button Add (+), filling the name of location, determining the way to move the marker, and selecting the button Save | Saving the location of TPS, displaying the message success, and reloading the page (refresh) | On Target            |
| 5  | Selecting the button Map | Displaying the detail of TPS Location | On Target            |
| 6  | Changing the data of Name, moving the marker, and selecting the button Save | Saving the change of data, and displaying the message success | On Target            |
| 7  | Selecting the button Delete and selecting the button Yes (Confirmation) | Deleting the Location of TPS, displaying the message Delete the Data Success, and then reloading the page (refresh) | On Target            |
| 8  | Selecting the menu the Data of Location of Trees | Displaying the list of Location of Trees | On Target            |
| 9  | Typing the searching words on the form Search and selecting the button search (magnifier) | Displaying the list of Location of Trees based in the searching word | On Target            |
| 10 | Selecting the button Add (+), filling the Name of Location and Determining the way to move the marker and then selecting the button Save | Saving the Location of Trees, Displaying the message of success, and reloading the page (refresh) | On Target            |
| 11 | Selecting the button Map | Displaying the detail of the Location of Trees | On Target            |
| 12 | Changing the data of Name, Moving the marker, and selecting the button Save | Saving the data change and displaying the message success | On Target            |
| 13 | Selecting the button Delete, and selecting the button Yes (Confirmation) | Deleting the Location of Trees, displaying the message Delete the Data Success and then reloading the page (refresh) | On Target            |
| 14 | Selecting the menu Data of Park Location | Displaying the list of Park Location | On Target            |
| 15 | Typing the searching words on the form of Search and then selecting the button search (magnifier) | Displaying the list of Park Location based in the searching word | On Target            |
| 16 | Selecting the button Add (+), | Saving the Park Location, displaying | On Target            |
filling the Name of Location and determining the location by moving the marker, and selecting the button Save

Selecting the button Map
Displaying the detail of Park Location

Selecting the button Delete, and then selecting the button Yes (Confirmation)
Deleting the Location of Park, displaying the message Delete the Data success, and reloading the page (refresh)

Selecting the menu of Data of Residential Location
Displaying the list of Residential location

Typing the searching word on the form of Search and selecting the button search (magnifier)
Displaying the list of Residential Location based on the searching word

Selecting the button Add (+), filling the Name of Location and Replacing and adjusting the box (rectangle), and then selecting the button Save
Saving the Residential Location, displaying the message success, and reloading the page (refresh)

Selecting the button Map
Displaying the detail of Residential Location in the form of map

Changing the data of Name and replacing the box of Residential Location and selecting the button Save
Saving the change of data, and displaying the message of success,

Selecting the button Delete, and selecting the button Yes (confirmation)
Deleting the Residential Location, displaying the message Delete the Data success, and reloading the page (refresh)

Selecting the menu of Wind Data
Displaying the list of Wind Data

Selecting the button Add (+), filling the form, and selecting the button Save
Saving the Wind Data, displaying the message success, and reloading the page (refresh)

Selecting the button File, Browse, and file Excel (extension file “.xls” or “.xlsx”) saved on the computer and selecting the button Save
Displaying the form to select file, system checks the content format of file Excel, and saving the data of wind.

Selecting the button Info
Displaying the info of Wind Data

Changing the data of period wave and the wind direction and selecting the button Save
Saving the data change and displaying the message success

Selecting the button Delete and selecting the button Yes (confirmation)
Deleting the Wind Data, displaying the message Delete the Data of success, and reloading the page (refresh)
32 Selecting the menu Operator 
33 Selecting the button Add (+), Displaying the list Operator 
Filling the form, and Selecting the button Save Saving the Account data of Admin, and Reloading the page (refresh)  
34 Inputting the ID and new name On Target  
35 Inputting the old password, new ID and the name in the database password and confirms the message of success were changed, and displaying the 36 Admin clicks the photos and Changing the password in the selecting one of the photos database and displaying the message of success 
37 Selecting the button Delete, and Data operator is deleted from (confirmation) selecting the button Yes database, and displaying the message of delete the data success  
38 Admin selects the menu Out Admin is transferred to the page of On Target 
Sign-in

4. Conclusion and Future Work
This research is designed to build a simulation system and evaluation of spatial feasibility in terms of the TPS (Waste Disposal Site) placement in Jembrana, Bali. There are four public areas that can be evaluated: TPS, trees, parks and Residential Area. Simulation and evaluation were calculated based on wind direction, wind strength and the distance of TPS and trees, parks and residential areas. The established system is called E-Luu based on GIS and Web. Based on the testing results, the models and new method used in the location analysis for these urban public service facilities have been successfully implemented and demonstrated for their effectiveness.

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