The Implementation of User Centered Design Methods on Public Service Mapping Websites

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Abstract. Public services are basically held to increase the level of community satisfaction. To achieve the satisfaction, a city / country will be demanded the quality of professional public services. One of them is the city of Tegal. Tegal is one of the cities in Indonesia. In order to implement a smart city, the city government of Tegal strives to provide services to the public quickly, effectively and efficiently. The public services of Tegal City Government have been running quite well, but information on services has not been integrated between Regional-Owned Enterprises (BUMD) and the private sector. Therefore a website-based mapping media was created in the form of clustering of Tegal city public services, both organized by the government, BUMD and the private sector are integrated each other and can be accessed and used easily by the people of Tegal city. This website can provide the closest route and is equipped with a comparison chart of public service categories in the city of Tegal. This application was built with the User Centered Design method so that it can be adjusted to the needs of the user and speed up the completion time, which only takes 105 days or 15 weeks. The results of this mapping website test were carried out by using Black Box Testing with the equivalence partitions method, which is the effectiveness value for all ID Test results is 83%, and the user test results are carried out by using the Usability Testing method that applied the SUS scale, with a value of 89% or excellent.

1. Introduction

Cities are large human settlements[1], cities generally have housing, sanitation, utilities, land use and communications systems. The urban population originally constituted only a small part of the total human population, however after two centuries of urbanization, nowadays the world's population lives in urban areas which have major consequences for globalization [2]. The growth of a city is always directly proportional to population growth, technological developments, and the demands of a modern lifestyle. It makes the city is being unfriendly to the people, there are always various inequalities, both economic and social in every part of the city, congestion and various pollution also cannot be avoided.

Public service is defined as any form of services, either in the form of goods or public services [3] which should be implemented by the Central Government, Regions government, as well as State-Owned Enterprises (BUMN) and Regional-Owned Enterprises (BUMD) in order to fulfill the needs of the community and in terms of implementation of statutory provisions. Public services that are transparent, accountable and have high responsibility will generate high public trust as well. It takes public service ethics as a pillar and public trust to be substantial and fundamental in order to create good government [4]. The purpose of public service is basically for community satisfaction and to achieve the satisfaction,
professional public service quality is necessary. These principles are reflected in: transparency, accountability, participation, security of rights, balance of rights and obligations. This is what every community wants, one of which is the city of Tegal community.

Tegal is a city in Central Java - Indonesia with an area of $+39.68 \text{km}^2$ [5], in order to implement a smart city which is an integration concept between information and communication technology with various physical devices connected to the Internet of Things (IoT) network to optimize the efficiency of city operations and services that are directly connected to its citizens [6], so the city government of Tegal makes every effort to provide services to the community quickly, effectively and efficiently.

Public services in the city of Tegal have been running quite well, but service information has not been integrated between those organized by BUMD and private. Besides that, not a few people in the city of Tegal do not know the right place to get public services in accordance with the problems they are experiencing and also not a few people who do not know the location of several public services in the city of Tegal, so people often experience difficulties and confusion in getting service for the problems they are experiencing.

These things can certainly hinder the progress of the city of Tegal to implement a smart city. Therefore a publication media with attractive visualization is needed, such as a website-based mapping application which is integrated between the government, BUMD and the private sector in the form of cluster and can be accessed or used easily by society of Tegal city.

This application is developed using the User Centered Design method, which is one of the methods of developing application software in which the user is the center of the system development process, objectives / characteristics, context, and system environment that are all based on user experience [7]. This method is one of the applicable methods used in Human-Computer Interaction, its relationship with user needs and satisfaction [8].

2. Related Research

Zheng, et al developed a local climate zone classification map and established an urban climate database as an information platform and planning decision-making in Hong Kong. The Geographical Information System is applied to synergize various types of data and classify the land surface in Hong Kong based on the local climatic zone classification [9].

Sasmito and Nishom developed a land use mapping system in the city of Tegal. The mapping system is a website platform application with mapping content for housing, government facility land, educational facility land, health facility land, trade facility land, industrial facility land, mixed service facility land, tourism facility land, and agricultural facility land which can be easily accessed [10].

The User Centered Design (UCD) method is applied for modeling the user interface in producing a “Panic Button” application that can be used by Deaf people. This application is designed to make the user interface can match the characteristics and limitations of the user. The USE questionnaire was used to test the prototype product and resulted a usability value of 87% with a very good category after the third iteration. These results indicate that the redesign product met the needs of the deaf, by using appropriate [11].

Ulya et al applies the User Centered Design (UCD) method to design a smartphone application to introduce culture that can be used by deaf people. The usefulness of the prototype was measured by the USE Questionnaire method. the result of usability test showed a value of 82.75%. This score indicates that the user interface design has a usability value with a very good category, and it can be said that the user interface has met user needs [12].

User Centered Design (UCD) is used as a method to develop e learning applications: Android-based reproductive learning which allows blind adolescents to easily operate it. The designed applications can involve several human senses in their utilization, which offers flexibility, efficiency and user friendly. The application allows users to interact through several inputs such as touch or gestures and get output in the form of sound. In this research, the design is focused on the user. The user interface model has been tested with the USE questionnaire parameter which reaches an average usability percentage of 87.4%, this shows that usability is obtained in the very good category [13].
User Centered Design (UCD) was utilized in the research of Luna, Daniel R et all, the study was used to redesign a Warning System at the Italiano de Buenos Aires Hospital in Argentina which focuses on electronic health records with a warning system for drug interactions which is given to patients. His research found that the UCD warning system was more efficient (faster warning resolution), more effective (tasks completed with fewer errors), and more satisfying. These results suggest that UCD techniques adhering to ISO 9241-210 can produce more useful warnings than traditional designs [14].

Korpershoek, et all in their research have applied the User Centered Design (UCD) method to develop Mobile Health (mHealth) application for the management of chronic obstructive pulmonary disease (COPD) which involves patients in managing their own health. The UCD method used consists of four iterative phases: (1) background analysis and design conceptualization, (2) reusability alpha testing, (3) iterative software development, and (4) field usability testing. His research shown that by following the UCD method, the mHealth intervention developed meets the needs and preferences of COPD patients, and has high potential to be effective in reducing the impact of exacerbations [15].

3. Methodology

3.1. Thinking Framework

The thinking framework for this study is shown in the figure 1.

Based on Figure 1, the frame of thinking in this study begins with identifying problems regarding information on mapping public services in the city of Tegal. After the identification of the problem has been completed, it is followed by data collection, where the data sources come from Public Relations, the Head of the Organizational Section of the regional Secretariat (SETDA) and the Central Bureau of Statistics (BPS) of Tegal city. In addition, information on the needs of the community / users is also collected regarding the ease of access to public service information.

After the data and information sources have been collected and validated, the analysis is conducted to determine the right solution of existing problems, and determine the needs to produce a solution to these problems. The results of the analysis are submitted to the system designer as the main / reference material in producing the design, interface, application flow and prototype of an application. At the design stage, the user is used as the main source of knowledge, since the solution of the problems must be based on a perspective and oriented towards user needs. The design that has been completed produced and approved by the user, then submit to the software engineer to create a product as a solution of the
existing problems; a public service mapping website, so the website is expected can make the society easily to get information about public services in the city of Tegal and can be easily updated and integrated with Regional owned enterprises (BUMD) and the private sector.

3.2. Software Development Method

The method applied in designing this mapping application is the User Centered Design (UCD) method, with the scheme [16] in figure 2.

Figure 2. User Centered Design Model

Figure 2 can be explained in full as follows:

1. Plan the human centered process
   At this stage the researcher determines that the process of making this mapping website is user-centered, therefore to find out the substance and detail of the problem, and produce the user need applications, the user is involved the production of the application from the beginning to the end of the production process by providing data, information as well as arguments.

2. Specify the context of use
   This stage determines the user of the mapping website is generated. Public service mapping website of Tegal consists of 3 users:
   a. The community is the user who can access information on the mapping of public services in the city of Tegal in general.
   b. Admin is a user who manages data on every public service in the city of Tegal, whether organized by the government, BUMD, or the private sector.
   c. Super Admin, is a user who manages admin data

3. Specify User and Organisational requirement
   At this stage, identification of every user need is carried out through a questionnaire technique. Based on the results of the distributed questionnaires, the following results are:
   a. Information Needs
      • Public service agency data
      • Public service agency profile data
      • Public service information data that is owned by each agency
      • Location data and address of public services
      • Public service route data
   b. Functional Requirements
      • Connect with Google Maps servers
      • Administrators have public service data management facilities for each agency
      • Able to display every existing public service profile
      • People easily choose public services based on predefined keywords
      • Able to route to the location the intended public service
- Super admin has admin data management facility
- Able to display static data of the number public services according to the classification

c. Non-Functional Requirements
- The application has an authentication system to sign into the Admin and Super admin pages
- Able to display information in the form of area maps and statistical charts
- Applications can be accessed anywhere and anytime, while connected to the internet
- Applications can be accessed using a variety of browsers
- Applications can be accessed using various platforms, such as: Tablets, Laptops, Personal Computers, and Smart phones.

4. Product design solution

This stage is the solution design stage, which consists of:

a. Website design

The website design used in making this application is the Unified Modeling Language (UML) which is a design for object-oriented systems [17]. At this stage the user is really involved to provide advice and information about the needs of making user interface designs, user experience designs, system flows, and prototypes according to user needs. so that it is expected that the resulting website is really in accordance with the user's perspective and needs.

b. Website development

This stage is the coding stage / system design which refers to the system design, built by using the PHP programming language, My SQL database. PHP is a programming language which is widely used to create and develop a website and can be used together with HTML [18]. Meanwhile, MySQL is a database management system that uses SQL (Structure Query Language) basic commands [19].

5. Evaluate design against user requirement

In this study, evaluation was carried out in two ways, they are:

a. Website evaluation

Website evaluation is carried out by using black box testing that focuses on existing functions in the application [20]. Black box testing tends to find several things such as: incorrect or absent functionality, database access errors, interface errors, performance errors, and initialization and termination errors [21].

b. User evaluation

In this study, user evaluation is carried out by using usability testing, this is conducted to determine the ease of using the application, the efficiency and effectiveness of the application, and user satisfaction to the result of website application [22].

4. Result and Discussion

4.1. User Interface

Design and build a website for mapping public services in the city of Tegal has been successfully created. The display of the design results page is in accordance with the design. It is shown in figures 3 and 4.

The application of the UCD method to develop this Public Service Mapping Website has been completed successfully in 15 weeks or 105 days according to the explanation in table 1. This is due to the vital role of users who are directly involved in providing the information needed from the initial process to the completion of this mapping website, both users in public service agencies as admin and community users. So this accelerates the completion of software development and ultimately has an impact to more optimal cost efficiency and resource productivity.
This result is a fact that the UCD method can accelerate the duration of system development with better software quality, since all the processes conducted have been adjusted to user needs [23]. This method is very appropriate for small to medium scale software development. However, smooth, effective and efficient communication between the team and users is one of the determinants of successful software development using the UCD method.

4.2. Application Test
The website application that has been produced is tested using Black Box Testing, by determining the input range and output range using the equivalent partitions method. Several fields on the application interface display are also in the database table structure. The application of Black Box Testing is used to test the input data sample. The guideline used is the input condition specifies the range, so a value of 1 is defined as a valid state, and a value of 2 is defined as an invalid state for its equivalence.

Based on the results of the tests that have been carried out in accordance with table 2, it can be seen whether the test results were successful or failed, to all fields on the menus of the website application. Test ID 1,2,4,5,6 all are True, so, the effectiveness value is 100%, while in Test ID 3, the field testing
conducted is 1 false, and resulted in a 2:3 effectiveness value, namely 66%. So that the effectiveness value for all Test ID results obtained: 83%.

Table 2. Black Box Testing

| Test ID | Description                  | Test data field                      | Test Result   | Conclusion |
|---------|------------------------------|--------------------------------------|---------------|------------|
| 1       | Sign In Menu                 | Username, Password                   | True, True;   | Success    |
| 2       | Service Type Category Menu   | Category Type Id, Category Name      | True, True;   | Success    |
| 3       | Service Management           | Service Id, Service Name, Number of Services | True, True, False; | Failed     |
| 4       | Service Profile              | Profile Id, Address, Point of Coordinates | True, True; True; | Success    |
| 5       | Report Management            | Report Id, Report Type, Report Name  | True, True, True; | Success    |
| 6       | User Management              | User type, user account, user profile | True, True, True; | Success    |

Figure 5. Graph of Black Box Testing Result

4.3. User Testing

After the website application has been successfully tested by using the Black Box Testing method, then testing is carried out to the user by using the Usability Testing method. This test was carried out by distributing questionnaire sheets randomly to 10 Mapping Website Admin, Society, Academics, and Software Developers with 10 questions, regarding: the ease of application, efficiency and effectiveness, and user satisfaction. With a list of questions according to table 3.

Table 3. List of Questions

| No. | List of Questions                                      |
|-----|--------------------------------------------------------|
| 1   | I think this application is easy to use                 |
| 2   | I found this system is not very complicated             |
| 3   | I think I will use this application                     |
| 4   | I think I don’t need assistant to use this application  |
| 5   | I find the integrated various functions in this application |
| 6   | I think the contents of this application are quite consistent |
| 7   | I have no difficulty using this application             |
| 8   | I feel comfortable using this application               |
| 9   | I think the quality of the information in the application is very good |
| 10  | I think users will quickly understand using this application |
Before filling out the questionnaire, respondents were asked to operate the Mapping Website in accordance with their respective levels, except for academics and software developers who were asked to use it at all user levels. Then each respondent provides an assessment of the questions that have been given through a questionnaire sheet, with a description of the score according to Table 4.

### Table 4. Description of score value

| No | Score | Description |
|----|-------|-------------|
| 1  | 5     | Excellent   |
| 2  | 4     | Good        |
| 3  | 3     | Okay        |
| 4  | 2     | Poor        |
| 5  | 1     | Awful       |

The results of the respondent's score are in accordance with those in Figure 6.

![Figure 6. Results of Respondents' Score](image)

The result of the respondents' score is calculated using the SUS (System Usability Scale). The calculation used the formula [22]:

\[
Y = \frac{Q}{S} \times 100\%
\]

where
- \( Q \) = Number of respondents' scores for each question
- \( S \) = Maximum total respondent score
- \( Y \) = Percentage value

So the results of Usability Testing using SUS are:

\[
Y = \frac{445}{500} \times 100\% = 89\%
\]

The Adjective Rating based on the SUS scale is according to Table 5.

#### 4.4. Security Information

Information security is an the protection of information from various threats in order to ensure the continuity of business processes, reduce risks, open opportunities and optimize return on investment (ROI) [24]. In designing the security system on this mapping website, there are aspects that have been conducted, they are:

1. Confidentiality: A concept to protect the confidentiality and privacy of information
2. Integrity: The concept of protecting the accuracy of processing information and data from improper modification
3. Availability: The concept of ensuring systems and data can be accessed
4. Control Access: The concept to ensure a person has full authorization in accessing information
5. Non Repudiation: The concept to ensure someone cannot deny for having done a transaction
6. Privacy: The concept to ensure that the privacy of a person's account or data on a is protected
7. Authentication: The concept to ensure that the authenticity of the message comes from the requested information
8. Authority: The concept to guarantee that existing information cannot be manipulated by unauthorized persons.

The series of these aspects have user id and password authorization when accessing the administrator menu.

| Score    | Grade | Adjective Rating |
|----------|-------|------------------|
| >80.3    | A     | Excellent        |
| 68-80.2  | B     | Good             |
| 67       | C     | Okay             |
| 51-66    | D     | Poor             |
| <51      | E     | Awful            |

Table 5. Adjective Rating

5. Conclusion

Based on the results and discussion, it can be concluded that the Mapping Website can provide the information of location, route, profile, facilities, graphics and categories of public services of Tegal city, whether organized by the government, Regional-Owned Enterprises (BUMD), or the private sector. The mapping website is quickly completed, which is only 105 days or 15 weeks, since it is developed by using the User Centered Design (UCD) method where from the beginning to the end it always involves users in completing data for this mapping website to suit user needs. The test results of this website application are carried out by Black Box Testing with the equivalent partitions method in which the effectiveness value for all Test ID results is: 83%, and the user test results are carried out by using the Usability Testing method that applied the SUS scale, with a value of 89% or excellent.

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