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Storyboard Development for Geospatial e-Tourism Based Augmented Reality

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ABSTRACT

One of the important factors in designing an e-tourism based on the mobile application is the ease of use. Some of the problems often encountered by e-tourism users include the complex nature of the application, making it difficult for users to navigate. To answer user needs related to the ease of display on the application, it is necessary to design a good interface using tools and methods that are fast but effective and efficient. In the initial cycle of user interface design, a storyboard is needed as an initial description of the display that will be made. The storyboard is used as a visualization of ideas so that it can provide an overview of the appearance of the application that will be made. The storyboard makes production performance easier and eliminates trial and error. In developing this geospatial augmented reality, mobile application storyboard, we use the design sprint method. This method is widely used in start-up environments to develop software interfaces and product innovation in the consumer area. This method consists of the stages of understand, define, sketch, decide, prototype and evaluate. The use of the design method has a fast process but still provides optimal results. The results of this study indicate that the development of mobile applications using the design sprint method is able to reduce the time and energy which is relatively longer when using other methods. We conclude that storyboards can make it easier for developers to realize initial sketches into application prototypes that are high fidelity or close to the final appearance.

***Keywords**: storyboard development, geospatial, e-tourism, augmented reality, design sprint*

INTRODUCTION

The tourism sector has become a mainstay and development priority for a number of countries. This is because tourism plays a role in contributing through foreign exchange earnings, regional income, regional development, employment, and increasing creative industries. On the other hand, tourism has also become part of basic human needs which are manifested in various kinds of activities carried out by tourists, supported by various facilities and services provided (Tavitiyaman et al. 2021). Over time, the influence of information technology has brought the tourism sector to the realm of digitalization called e-tourism. E-tourism can be said as a form of digitalization of conventional tourism, which previously did not utilize information technology and the internet (Hamid et al. 2021).

Currently, there are many areas that have tourism potential but have not been explored properly. This is caused by several problems such as lack of socialization, promotions that are less attractive are only limited to brochures, pictures on the internet, and social media. We need a technology that is able to realize the even distribution of tourist attraction recognition. One technology that can be used is augmented reality. Now augmented reality can be used easily via smartphone (Zimmer et al. 2021). The use of Android-based smartphones is now widely used in the community so that it really supports the application of this technology. Currently, many mobile applications based on augmented reality have been developed for tourism. The use of augmented reality is considered effective to improve the travel experience of tourists with interactive maps (Hincapié et al. 2021). Many research developments regarding augmented reality have been carried out such as walkable mixed reality map as interaction interface for virtual heritage (Bekele 2019), development ARtention: a design space for gaze-adaptive user interfaces in augmented reality (Pfeuffer et al. 2021), dan mobile based augmented reality application prototype for remote collaboration scenario using arcore cloud anchor (Kerthyayana Manuaba 2021).

One of the important factors in designing a mobile application is the ease of use (Llema and Vilela-Malabanan 2019). This relates to the user interface design of the application. Some of the problems that users often encounter include the complex nature of the application, making it difficult for users to navigate. In this application, the main feature will be designed, namely AR Camera. In this menu, we use augmented reality technology, where users can obtain information on the nearest tourist location in the form of an interactive map using the camera on a smartphone. In its design, it is important to make the attractive navigation and easy to use (Pryss et al. 2017). This can help users during their travels.

To answer user needs related to the ease of display on the application, it is necessary to design a good interface using tools and methods that are fast but effective and efficient (Grygiel et al. 2021). In designing an application, many developers encounter difficulties, especially in the early stages of interface design. In the initial cycle of interface design, a storyboard is needed as an initial description of the display that will be made. The storyboard is used as a visualization of ideas so that it can provide an overview of the appearance of the application that will be generated (Fujino et al. 2019) . Storyboards offer an alternative approach to sketching interface schematics and allow design ideas to be refined for prototyping and testing (Jones 2008). With storyboards, makes production performance easier and eliminate trial and error.

In developing this geospatial augmented reality based on a mobile application storyboard, we use the design sprint method. This method is widely used in start-up environments to develop software interfaces and product innovation in the consumer area. (Pokorni, Zwerina, and

Hämmerle 2020). This method consists of the stages of understand, define, sketch, decide, prototype and evaluate. The use of the design sprint method was chosen because it is effective and efficient in developing an application interface (Kokotsaki, Menzies, and Wiggins 2014). However, the implementation of storyboard development is still difficult to implement in geospatial applications used in e-tourism. This is because the integration between application programming interfaces for various applications on different platforms is often not in line with the technically built business processes. A more detailed design is needed to ensure that the planned business processes can run properly without causing errors. On the other hand, it takes a description that is easily understood by programmers to build applications in detail to achieve the desired goals for the application. Storyboard development is an important solution in developing applications in detail and easily understood by programmers. In addition, the storyboard contains a detailed description of the business processes that will be executed in the application. This research is important to ensure storyboards can be built with measurable and precise steps so that they can be used in building an application. The purpose of this research is to build a detailed storyboard with measurable steps that can be implemented in the Geospatial e-Tourism Based Augmented Reality application.

METHOD

In designing the application storyboard, we use the design sprint method. The design sprint method is a method or framework approach in testing or validating ideas, based on user needs or problems through prototyping, design testing, especially User Interface (UI) and idea testing to prospective users (Pokorni, Zwerina, and Hämmerle 2020). Some research and development discuss the use of the design sprint method, including the Human-centered design approach for manufacturing assistance systems based on the design sprint (Pokorni, Zwerina, and Hämmerle 2020), peneliti lain melakukan mengimplementasikan Agile Design Sprint Methods pada Prototyping a Health and Wellbeing Platform (Keijzer-Broers and de Reuver 2016) dan Designing prototypes for crowdsourcing platforms using Google Venture Design (Ferreira et al. 2019).

The conceptual design sprint method can be done in a short time with 6 stages, namely understand, define, sketch, decide, prototyping, and validate. This method starts from the stage of understanding application needs and user needs to validate mock ups or wireframes of the application design that will be used (Keijzer-Broers and de Reuver 2016). See figure 1.

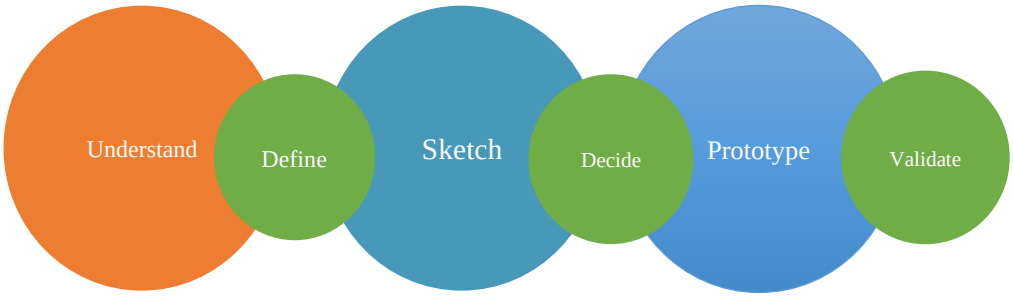


Figure 1. Design Sprint Process

The stages in figure 1 can be explained as follows,

The understanding stage: the process of gathering information regarding user problems and needs, determining business goals, and reviewing technological support that can be used to address

user needs. At this stage, it is very important to identify the problems faced by the user in order to get new insights or those that did not exist before. Furthermore, it is very important to know what experience the user is having, this will also help to get an experience based on the user experience point of view (Liu et al. 2021). The define stage is the stage to find out what the potential strategy is based on insight and user needs. At this stage, the process of evaluating user needs has also passed through the understand stage. This stage will create a potential solution according to the user's needs. Sketch stage: is a stage to explore and develop ideas based on the defined stages that have been passed. At this stage, a review process is also carried out on the new views obtained, collecting thoughts or solutions and preparing the description of the ideas that have been passed from the understand stage. The next stage is decide: determining the best idea that will be used according to the sketch process that has been done previously. This process will be carried out by way of voting, selecting new views through the majority of votes to be continued to the next stage, namely the prototype. The prototype stage is the stage of creating a prototype according to the concept and selecting the best idea in the previous stage. Applying the concept that has been selected by utilizing prototype tools which can then be tested on the user. The last stage is validate: is the stage of testing a prototype that has been designed for users, or experts in the technical field of mobile application development. This stage will also provide improvisation to the storyboard solution that has been produced.

RESULT AND DISCUSSION

Understand

At this stage, several problems faced by tourists were found, namely the search for information about tourist attractions still using methods such as browsing via the internet or through social media. Other problems were also encountered during the application design process, many developers encountered difficulties, especially in the early stages of interface design. Meanwhile, users expect mobile applications that are easy, to use. Several methods offer systematic application interface design but have a long process, so they are considered less effective and efficient to use (Pokorni, Zwerina, and Hämmerle 2020). For this reason, in the storyboard development process, we chose a method that has a fast, effective and efficient work process as well as supporting tools to maximize the application storyboard design that will be created.

Define

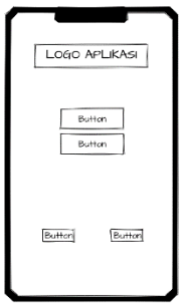
At this define stage, it is the stage to find out what potential strategies are based on insights, interview results, and user needs. Based on interviews with users, insights and problems that are often encountered by users are found, namely the complex nature of the application, making it difficult for users to navigate the application. In addition, many developers encounter difficulties, especially in the early stages of interface design. So it is difficult to define the initial appearance according to user needs. At this stage, the evaluation process is also passed based on the results of insight and user needs that have been passed on the understand stage. This stage will produce a potential product or application process that is designed based on the user's needs.

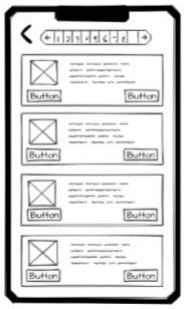
Sketch

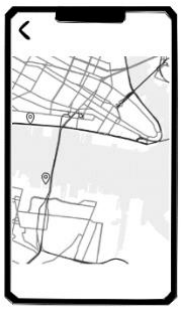
In this sketch stage, we visualize the user's ideas and needs with a storyboard. The storyboard is a series of manual drawings that are made so that they describe a story or preview the final appearance and functions of the application (Madden, Chung, and Dawson 2009). In the process of making this storyboard, the level of interaction is still simple or low-fidelity where the design results have not presented the final product (Kaya et al. 2018).

The development of this storyboard uses the format developed by Farra (Farra et al. 2016) which is an adaptation of the Jeffries simulation framework (Cowperthwait 2020). This format consists of objectives, scene, action, challenge, and redirection. See table 1.

Table 1. Storyboard development

Objective	Scene	Action	Challenge	Redirect
The initial appearance of the application, a logo will appear as a visual identity to introduce the application to users.		When the application logo display appears, users only need to wait a few moments before being redirected to the next screen.	When opening the application, some obstacles can be encountered such as the application logo does not appear perfect, which is caused by internet speed. Another obstacle that may also be encountered is the application is stopped and cannot be used, this can be caused by the application experiencing a bug.	*Restart the app*
The loading screen display will display the application logo and progress bar which serves to load or initiate data that will appear on the next screen.		When the progress bar display appears, the user only needs to wait a while before being switched to the next view.	When switched to the progress bar display, some obstacles can be encountered such as the60pplicats bar running too long, it can be caused by internet speed or a bug in the application so that it cannot initiate data that will be displayed to the next display.	*Restart the app*
The main menu display will display the application logo, AR camera menu buttons, tourist		When entering the main menu view, the user can select the existing menu options. AR camera menu to view nearby location	When switched to the main menu view, users may encounter problems such as unable to access the selected menu or the application is stopped.	*Restart the app*

attractions, guides and assistance.		recommendations and route information for that location. To view information on existing tourist attractions, users can select the tourist attraction menu. If there are problems in using the application, users can access the guide menu. If there is a bug in the use of the application, the user can inform the developer through the help menu.	This can be caused by internet speed or bugs in the application so that it cannot display the menu that will be accessed by the user.	
The tourist attraction view, it will display a list of existing tourist attractions. Menu button for location info and maps button to display 2D maps.		When entering the tourist attraction view, users can access the available menus such as tourist attractions, information, and the maps menu to find the location or route to be taken. In the tourist attraction menu, there are several tourist information pages that can be viewed with the page navigation button at the top of the application display.	When switched to the tourist attraction view, users may encounter problems such as not being able to access the selected menu, or the application is stopped. This can be caused by internet speed or bugs in the application so that it cannot display the menu that will be accessed by the user.	*Restart the app*
The AR Camera view, a notification will display that shows the location scanning process.		When entering the AR camera view, users can scan by pointing the camera at the surrounding environment, to find out recommendations for nearby tourist attractions.	When switched to the AR camera view, users may encounter obstacles such as the location is not detected, the application does not respond, location information does not appear. Some of these problems can be	Scan again by paying attention to the position where the user points the camera, it may not be within the range specified by

			caused by problems with network speed and the ability of application initiation to load data to be displayed.	the62pplication. Go back to the previous menu, and try to access it again. Restart the app
The AR camera display, it will display a recommendation for the nearest location if the coordinates of the location have been detected. There is a menu to see the route to the nearest location.		When entering the AR camera view, users can scan by pointing the camera at the surrounding environment, to find recommendations for nearby tourist attractions. When the camera detects a nearby tourist attraction, the user can see the recommended route. If you need to navigate to a location, users can take advantage of the maps feature.	When switched to the AR camera view, users may encounter obstacles such as the location is not detected, the application does not respond, location information does not appear. This problem can be caused by problems with the network and the ability of the application initiation to load the data to be displayed.	Scanning again by paying attention to the position where the user points the camera, may not be within the range specified by the application. Go back to the previous menu, and try to access it again Restart the app
The map view will display the route of the closest location and the distance between the user and that location.		When entering the map's view, users can take advantage of this feature as a navigation to the destination location. Make sure the user has enabled location.	When you enter the map's view, you may encounter obstacles, such as the navigation doesn't work and the map doesn't appear perfect. This can be caused by problems with the network, locations that are not turned on, or bugs that occur in the application.	Waiting for the network to stabilize Checking whether the location on the smartphone is activated Restart the app

The AR camera display will display location information via a pop up if the user has arrived at the destination location.		When entering the AR camera view, users can scan by pointing the camera at the surrounding environment, to find recommendations for nearby tourist attractions. When the user has arrived at the destination location, pop-up information will appear about that location.	When switched to the AR camera view, users may encounter obstacles such as the location is not detected, the application does not respond, location information does not appear. This problem can be caused by problems with the network and the ability of the application initiation to load the data to be displayed.	Scanning again by paying attention to the position where the user points the camera, may not be within the range specified by the application. Go back to the previous menu, and try to access it again Restart the app
The map's view will display a 2D map that can be used to perform a location search.		When entering the map's view, users can take advantage of this feature as a navigation to the destination location. Make sure the user has enabled location.	When you enter the map's view, you may encounter obstacles, such as the navigation doesn't work and the map doesn't appear perfect. This can be caused by problems with the network, locations that are not turned on, or bugs that occur in the application.	Waiting for the network to stabilize Checking whether the location on the smartphone is activated Restart the app
The tourist information display will display photos and a description of the place.		When entering the tourist information display, users can take advantage of this feature to get information about the location.	When entering the tourist information display, problems can be encountered such as descriptions and pictures that do not appear perfect. This could be caused by a problem with the network.	Waiting for the network to stabilize Go back to the previous menu, and try to access it again.
The guide display, will display instructions on how to use the application.		When entering the guide view, users can take advantage of this feature if they have difficulty using the application.	When you enter the guide view, you may encounter obstacles, such as descriptions and pictures that don't appear perfect. This could be caused by a problem with the network.	Waiting for the network to stabilize Go back to the previous menu, and try to access it again.

The help display, a menu will display to send feedback or complaints related to problems found in the application via email.		When entering the help view, users can take advantage of this feature if they find problems with the application, or give feedback to developers.	When you enter the guide view, you may encounter obstacles, such as descriptions and pictures that don't appear perfect. This could be caused by a problem with the network.	Waiting for the network to stabilize Go back to the previous menu, and try to access it again.

Based on the initial sketch that has been made, we get an idea of how the user interface of the application that will be designed will look. On this sketch stage, several design sketches are produced which will be selected later in the decision process using a voting system.

In the initial design, we defined each display to be included in the application, namely the splash screen display, progress bar display/loading screen, main menu display, AR Camera display, tourist attraction display, tourist attraction information display, maps display, guide and assistance display. . Scenes are described with words or pictures embedded in the storyboard so that the designer recognizes the area and objects created.

Flowchart Aplikasi

Applications that are built can be used immediately after being installed on a smartphone. Using the application is quite easy, when you first open the application, the user will be directed to the splash screen menu as the initial display. After that, a selection of tourist attraction menus, AR cameras, and application guides will appear. In the AR camera menu, users can scan using the camera, if the coordinates of the location are detected properly, then nearby location information will appear or the closest location that can be reached by the application and route guidance available via the map. In the tourist attraction menu, users can see what tourist objects are available. This menu also contains information or descriptions related to these attractions. To find the user's location, you can use the existing map feature, so you can see route information to the destination. For application usage information, users can access the guide feature. If the user encounters a problem such as a bug in the application, the user can inform the development by accessing the application's help menu. See figure 2.

Through the storyboard, application flow is also generated which is presented through the following flowchart:

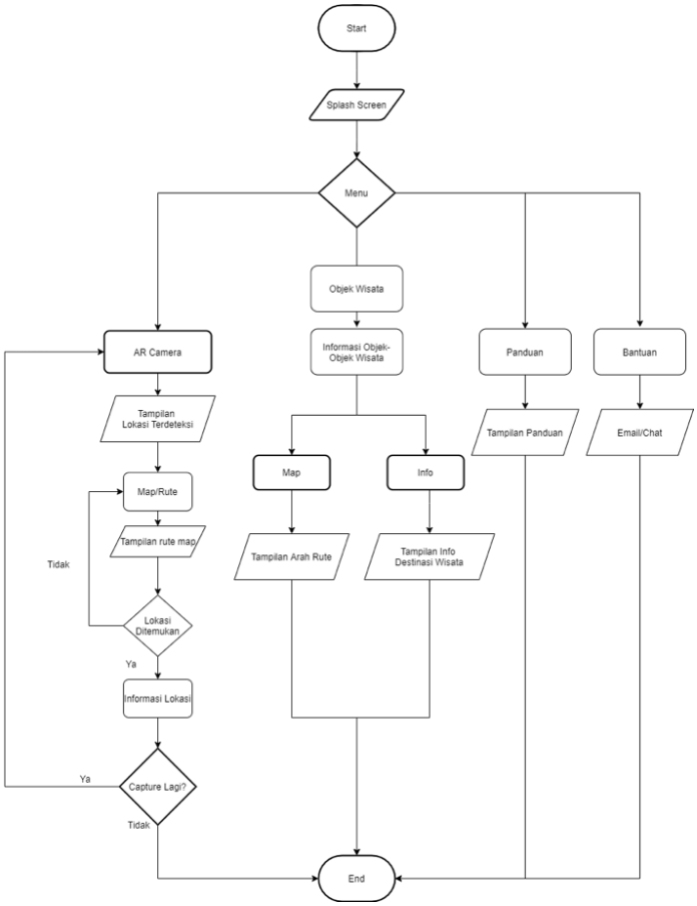


Figure 2. Flowchart Aplikasi

Decide

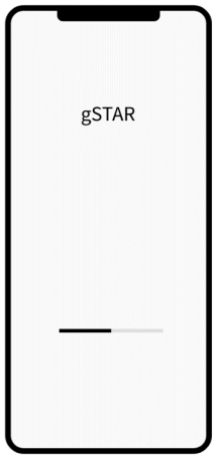
The fourth stage is the decide stage, namely determining the best idea contained in the storyboard sketch that has been carried out in the previous stage. This determination stage is usually done quickly and utilizes a voting system. Voting is done by inviting potential users as well as the user research team and letting them decide which sketch they choose. After the voting process is complete, a review process is carried out on the voting results that have been obtained which will be used as a reference in designing this application.

Prototype

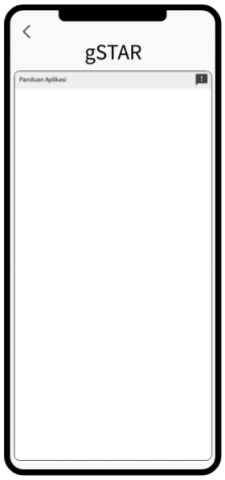
The prototype stage is the stage of realizing a simple sketch that has been selected on the previous decision stage. Making design prototypes using the mockflow application so that mockups and wireframing can be generated from this application.

Based on the storyboard that has been made, a blueprint is obtained as an overview of the application interface to be developed. See table 2.

Table 2. Prototype Aplikasi

Splash Screen	Loading Screen	Menu
		
Scene 1. Initial view when opening the app	**Scene 2.** A display containing a progress bar before entering the main menu.	**Scene 3.** App menu display with AR buttons, attractions and guides.

Tourist attraction	AR Camera	Map
		
Scene 4. Displays list of tourist attractions (in this menu, the number of sections will be adjusted to the number of tourist attractions information contained in the application)	**Scene 5.** Displays information on nearby attractions and directions with the help of augmented reality.	**Scene 6**. Displays travel route information connected to google maps.

Guide	Information	Help
		
Scene 7. Displays information on how to use the application.	**Scene 8.** Displays information about tourist attractions such as photos, operating hours information, entrance fees and other information about tourist attractions.	**Scene 9.** Displaying a help page or feedback from users to application developers.

Nearby Location AR	Rute/Maps	Location Information
		
Scene 10. Shows nearby location recommendations with AR location pins.	**Scene 11.** Displays the route for the nearest reachable location.	**Scene 12.** Displays location information when tourists arrive at the destination point.

The menu function in the application that was built is as follows:

1. Main Menu Function, Is a menu used by tourists to access the main page which contains a tourist attractions menu and an AR menu.
2. The function of the AR Camera feature is a menu that is used to display a pinpoint object that contains information on the location and direction of tourist attractions using augmented reality.
3. The function of the tourist attraction menu, is a menu that is used to get information on a list of existing tourist attractions.
4. Map menu function, Is a menu that is used to display route information to the location of the destination.
5. Guide menu function, Is a menu that is used to display information on how to use this application.
6. Information feature function, This is a menu that is used to display detailed descriptions of tourist attractions, so that users can obtain information related to the destination tourist attractions.
7. Help feature function, This is the menu used by the user to be able to complain about the problems encountered when using the application.

User Characteristics

The characteristics of the users of this application are as follows:

1. Developer: Understand the operation of smartphones, servers, and the operation of smartphone-based applications.
2. Travelers: Understand the operation of smartphones and the operation of android smartphone-based applications.

The limitations in the development

The limitations in the development of this software are:

1. General Policy, Guided by the purpose of developing this software.
2. Hardware limitations, can be known later after the system is running (according to needs).

Assumptions and Dependencies

This system can be run on hardware (smartphones) that use the Android operating system. This software can be accessed by all users who have installed this application. Users include developer administrators who are tasked with monitoring whether the application can be used, and if you find a bug or error, repair or maintenance can be done on the application. Users, in this case, tourists, are tasked with getting information on tourist attractions, looking for nearby tourist destinations by utilizing an AR camera, accessing route information through the map menu on the application.

Validate

At this stage, the validation process will be carried out by testing the storyboard results that have been made in the previous stage. Testing can be done by providing opportunities for potential users or users to operate the blueprint prototype simulation form that has been made.

Disscusion

There are some interesting things to discuss in the development of this storyboard. The first is that it is important to understand the problems encountered by users in order to be able to define what kind of application design should be made. Designs that are tailored to user preferences will be easier to use. The addition of the augmented reality feature as an interactive map must be balanced with the design of the navigation display that can maximize this feature but must be easy to use. In developing this application storyboard, a method is needed that can make the design process faster but still effective and efficient. The use of the design sprint method is able to answer this challenge because the process is fast but still provides optimal results. With this method, the initial stage of any mobile application development is able to reduce time and energy which is relatively longer if not using this method. Through this storyboard, it can make it easier for developers to realize the initial sketch into an application prototype that is high fidelity or close to the final appearance of the application.

CONCLUSION

This study concludes that by using the design sprint method, a storyboard has been successfully developed which can be used as the basis for building an application prototype. The use of this method can facilitate the design of storyboards and can be adapted to the problems and needs of the user. This research is a work in progress. In the future, the storyboard design that has been made can simplify the process of developing this application to the final stage.

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