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Model Architecture Software for Geospatial based Augmented Reality

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ABSTRACT

Software architecture is the basis of every software system and is very important used in software development. Augmented reality (AR) can make it easier for users to interact with virtual objects in a real environment through a camera display that displays 3D objects. In the tourism industry, augmented reality can be used to display the geographical location of tourist attractions, routes to locations, and 3D shapes of buildings that make it easier for users when looking for the nearest tourist destination. Designing an application in this case G-STAR requires several things, namely: Description of needs: Product perspective, product function, user characteristics, both developers and tourists. Specific needs: External interface requirements, namely user interfaces, hardware interfaces, software interfaces, communication interfaces. Software functionality requirements: Application flowchart. Functional requirements specification: Menu feature, function, camera AR function, tourist attraction function, Map function, info function, and guide function. Sequence diagrams. User interface/application prototyping.

Keywords : *Software architecture, augmented reality, tourism, application, G-STAR*

INTRODUCTION

A Software architecture plays an important role in the development of software systems (Garcés et al., 2021) which consists of software elements, the properties of which are interconnected elements (Banijamali et al., 2020), (Souza et al., 2019). Software architecture is the basis of every software system (Venters et al., 2018) is also a discipline that researchers rely on to understand and develop the elements of the system being built, as well as the patterns and compositions that are

integrated among these elements (Mizutani et al. ., 2021). The software architecture must take into account the interface as well as the hardware and software used (Boulanger, 2018). In designing software architecture, it is necessary to pay attention to architectural patterns, software design (Farshidi et al., 2020), and which architectural style to use, especially about how to design APIs (Razavian et al., 2019). Software architecture is often changed to ensure an adequate level of quality for various reasons, one of which is new innovation (Cortellessa et al., 2020), (Banijamali et al., 2020).

Technological assistance is needed in the process of making the application. One technology that has been widely used in Augmented Reality (AR). Augmented reality (AR) is the practice of augmenting a direct or indirect view of the physical world with virtual information in real-time (Scholz & Smith, 2016). With Augmented Reality technology, users can interact with virtual objects in a real environment (Davila Delgado et al., 2020) in this case is a camera view that displays 3D objects. The need for information is also an interesting experience for users who have a high level of mobility, requiring devices such as smartphones (Yavuz et al., 2021) which are currently not only used as communication tools but can also be used as marketing channels, and information in the tourism industry (Cranmer). et al., 2020) when looking for tourist destinations. Technological developments have had an impact on the tourism industry in recent decades (Buhalis, 2020), (Margaryan & Stensland, 2017) and "have forced the tourism industry to completely transform most organizations" (Navío-Marco et al., 2018). Through AR technology, tourists can view virtual objects (text, images, videos) through real-world scenarios (Peng et al., 2017) where real-world physical elements are combined with three-dimensional digital using their own smartphone or digital camera (Loureiro et al., 2017). ., 2020), (Do et al., 2020). With a digital map on a smartphone, users are given directions to the location they want to see anywhere. In addition to location, users will get object information, will also get distance information between the object and the user, as well as accurate estimation of compatible lanes. (Arman & Tampère, 2021), (Ivanochko et al., 2021).

In designing an application, it often does not follow a systematic process, so it is not ripe for use in software projects because the results obtained are not optimal. It does not also see the needs and goals of the application that you want to make. For that, we need planning in making an application. One of the applications developed by researchers is called G-STAR. G-STAR is a software developed to help tourists who come to visit a tourist destination. This application will provide information about the location of tourist destinations that are close to tourist locations, information on the direction of tourist destinations, and detailed information about tourist destinations when tourists are already at the location. The aim of this study is to be achieved in research are the stages or processes carried out in designing the G-STAR application.

METHOD

This research uses the Location Based Services (LBS) method. Location-based services (LBS) use mobile device geospatial data to provide information in real-time (Biswas & Sairam, 2018). In the development of modern smart devices, wireless communication, LBS has become the fastest growing service used by mobile device users regarding their activities (Peng et al., 2017). Location-based services are location-based services or a general term that is often used to describe the technology used to locate the device that the user is using. This service uses a global positioning service (GPS) and cell-based location technology from Google. With LBS services we can find out where we are, and destinations that are close to us. Location-Based Service consists of several

components including mobile devices, communication networks, position components, and service and content providers.

Mobile devices are a very important component. These mobile devices include smartphones, PDAs, and others that can function as navigation tools or as navigation tools based on the Global Positioning Service. The communication network is a mobile telecommunications network that transfers user data from the device to the service provider. Position component, what is meant by position component is the position of the user must be determined. This position can be obtained by telecommunications networks or from the Global Positioning Service. Service and the content provider are a service provider that provides different services to users such as route finding, position calculation, and others.

RESULT AND DISCUSSION

In general, the results of this research are divided into 5 main parts. The main part contains an introduction, Description of Requirements, special requirements, detailed requirements specification, and ERD regarding this SKPL document. The second part contains a general explanation of the G-STAR software that will be developed, including the perspective of the product to be developed, the functionality of the software product, user characteristics, limitations in the use of the software, and the assumptions used in the development of the software. The third section contains the specific requirements of the software which includes the external interface requirements and software functionality requirements. The fourth section contains a more detailed description of the requirements for the GSTAR software to be developed. The fifth section contains flow charts and application user interface.

Application architecture

G-STAR is a software developed to help tourists who come to visit a tourist destination. This application will provide information about the location of tourist destinations that are close to tourist locations, information on the direction of tourist destinations, and detailed information about tourist destinations when tourists are already at the location. This G-STAR software consists of a mobile application that runs on a smartphone with an android platform and is made using the C# programming language using the Unity 3D game engine which is connected to the Vuforia marker database. To display geospatial-based maps the system uses the API from Google Maps. In this application, users will interact through a GUI interface (Graphical User Interface). See figure 1.

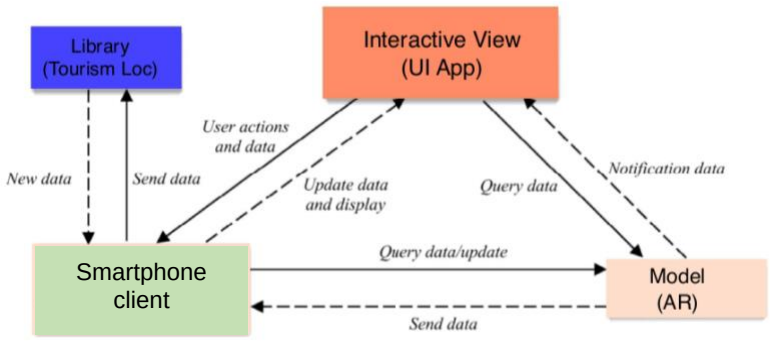


Figure 1. G-STAR Software Architecture

Product Function

The functions of the G-STAR software product are as follows:

1. Main Menu Function

   Is a function used by tourists to access the main page which contains a tourist attractions menu and AR menu.

2. AR Camera Function

   Is a function that is used to display a pin point object that contains information on the location and direction of tourist attractions using augmented reality.

3. Tourist attraction function

   Is a function that is used to get information on a list of existing tourist attractions.

4. Map function

   Is a function that is used to display route information to the location of the destination.

5. Guide function

   Is a function that is used to display information on how to use the gstar application.

6. Information function

   Is a function that is used to display detailed descriptions of tourist attractions, so that users can obtain information related to the intended tourist attractions.

7. Developer Function

   Is a function used to communicate with developer support services

User Characteristics

The characteristics of gstar application users are as follows:

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

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.

Hardware interface

The hardware interface used in the G-STAR software is:

1. Smartphone device (minimum specifications can be installed Android OS 4.4, 1GB RAM, 500MB empty internal storage).
2. Rear camera device at least 4 MPx

Software Interface

The software required to build and operate the GSTAR software is as follows:

1. Name : Unity,

   Source : Unity Technology

   As an engine to create and display objects.

2. Name : Vuforia

   Source : PTC

   As an engine to create Augmented Reality environments and markers.

3. Name : Mapbox

   Source : -

   As an API for calling and displaying maps.

4. Name : Android

   Source : google

   As the operating system for the smartphone used.

Flowchart Aplikasi

The G-STAR application can be used immediately after it is installed on the 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 are detected properly, then nearby location information will appear that can be reached by the application. On the tourist attraction menu, users can see what tourist objects are in the city of Tondano, on this menu, there is also information or description related to these attractions. To find the location of the user can use the existing map feature, so that information on the route to the destination can be seen. For application usage information, users can access the guide feature. See figure 2.

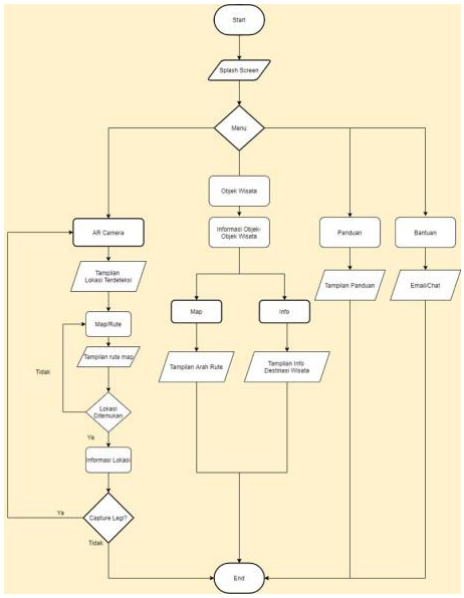


Figure 2. Application Flowchart

Functionality Requirements Specification

This application uses augmented reality technology that runs on smartphones with the android platform. Making applications using the C# programming language with the Unity 3D game engine connected to the Vuforia marker database. Functionality Requirements Specifications can be illustrated with use case diagrams in Figure 3, and sequence diagrams in Figures 4, 5, 6, and 7, as follows:

a. Menu function or feature
   This feature is used by users (tourists) to access several available menus, namely AR Camera and tourist attraction menus and application guides.
b. AR Camera Function
   This feature is accessed after the user selects the AR Camera menu. Through this menu, users get route information and nearby tourist attractions in real-time using augmented reality.
c. Attraction Function
   This feature is accessed after the user selects the tourist attraction menu. Through this menu, users will get information on what tourist attractions are in Tondano.
d. Map Function
   This feature is accessed after the user selects the Map menu. This menu is used to find the location and display location information to the destination.
e. Info Function
   This feature is accessed after the user selects the info menu on the tourist attraction. Through this feature, users can view descriptions of tourist attractions, so that they can obtain information related to tourist attractions to be visited.
f. Guide Function
   This feature is accessed after the user selects the guide menu. This feature is used to obtain information on how to use the gstar application.

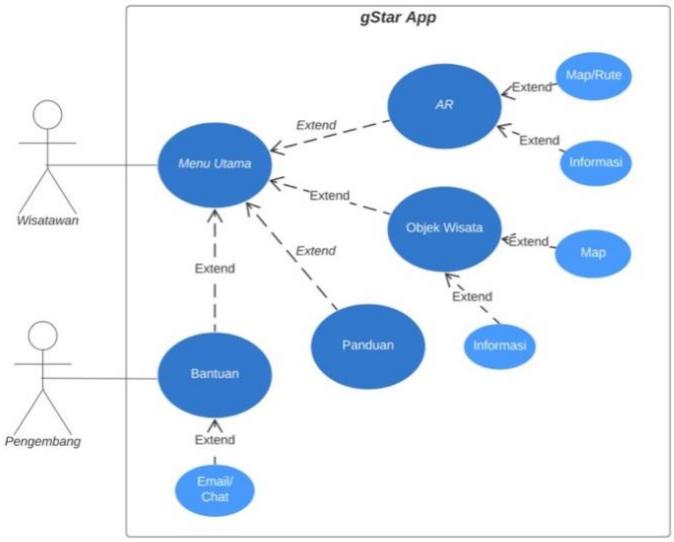


Figure 3. use-case diagram

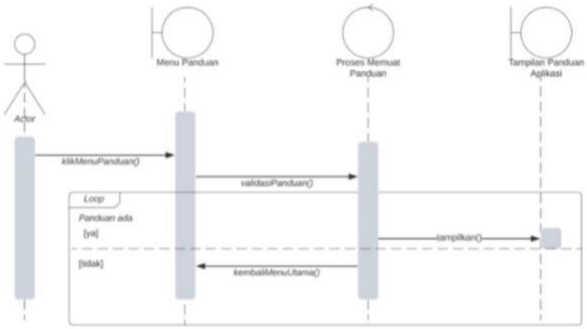


Figure 4. sequence diagram: help

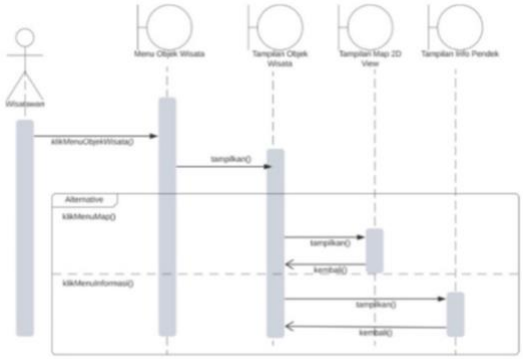


Figure 5. sequence diagram: tourist attraction

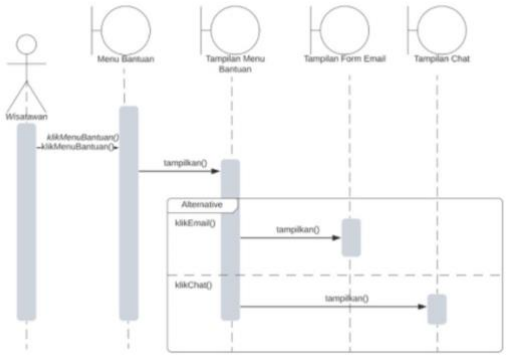


Figure 6. sequence diagrams: help

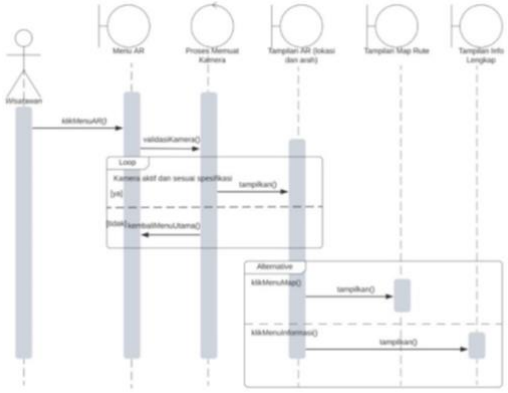


Figure 7. sequence diagram: AR camera

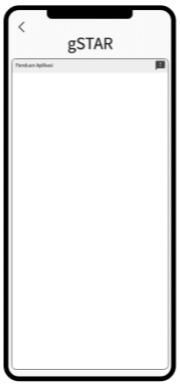
User Interface

The architectural design of this application is a model that is designed to be implemented easily. This design is the basis for building a user interface as shown in table 1.

Table 1. user interface design

Scene	Visual	Duration	Output

1	Splash Screen Page	Initial screen when entering the application	3 second	
2	Page Loading Screen	The page that contains the progress bar before entering the main menu	3 second	
3.	Main Menu Page	A page containing an application menu with an AR menu, Attractions Guide and Developer Information		
4	Attraction Menu Page	Displays a list of tourist attractions. The number of sections on this page will be adjusted to the amount of place information contained in the application.		

5.	AR camera page	Displaying location information and directions of tourist attractions in the form of augmented reality.	
6.	Map Page	Displays travel route information linked to g-maps.	
7.	Application Guide Page	Displaying information on how to use the app.	
8.	Information Page	Displays historical information about tourist attractions, such as photos, descriptions.	

Discussion

There are several things that can be discussed in the development of this application, namely, it is important for the developer to understand the problems of the user so that the designed application really fits the needs and goals of the developer. The addition of augmented reality

features as interactive maps must be balanced with the design of an easy-to-use navigation display. In terms of design, it needs to be adjusted to the ease that will be experienced by the user. Through this application planning, it can make it easier for developers to realize the designs that have been made to produce appropriate applications.

CONCLUSION

This study concludes that designing an application in this case G-STAR requires several important things such as Description of needs: Product perspective, product function, user characteristics, both developers and tourists. Specific needs: External interface requirements, namely user interfaces, hardware interfaces, software interfaces, communication interfaces. Software functionality requirements: Application flowchart. Functional requirements specification: Menu feature, function, camera AR function, tourist attraction function, Map function, info function, and guide function. Sequence diagrams. User interface/prototype Augmented reality application for e-tourism has been successfully built using a modified application architecture.

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