

Tour Guide with Augmented Reality

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Abstract

Kyoto city in Japan has a large number of historic temples and shrines, so the number of tourists is increasing. In particular, the number of tourists from overseas is increasing. However, due to consideration that many landmark buildings are not damaged and the landscape surrounded by the mountains is not damaged, it is strictly restricted by the ordinance of Kyoto City to post a signboard outdoors. Therefore, it is not easy to add a signboard for tourist information.

Therefore, we developed a tour guide using augmented reality (AR). Along with the guidance for the first visitor on easy navigation throughout the digital map, it was possible to expand the opportunity to actually expand the user's augmented reality experience while improving the level of entertainment.

In this paper we discussed the development thought of the system we developed and the implementation result.

1. Introduction

1-1 "Augmented Reality Tour Guide"

Kyoto city is a major Japanese city known as the ninth largest city in Japan and has a population of approximately 1.4 million people. Although it is such a large city, Kyoto city has many historic buildings and has a landscape surrounded by mountainous areas, so the number of visitors from foreign countries is increasing. However, in order to not destroy the beautiful landscape, it is strictly restricted by the ordinance of Kyoto City to post a signboard outdoors. In this way, it is not easy to add a signboard for tourist information.

So we developed a tour guide using Augmented Reality (AR) [3]. Along with the guidance for the first visitor on simple navigation throughout the digital map, it also allowed us to broaden the opportunity to actually extend the user's augmented reality experience while improving the level of entertainment. It can also be applied especially to different industries [4] - [7].

Also regarding safety hints, follow sudden

disasters should follow and introduce them with some rules that must be followed. Basically, our "Augmented Reality Tour Guide" has the main function of easy navigation throughout the digital map, enhancing the visitor's experience in the temple of historical artifacts. We aim to provide an attractive educational environment to cope with the increased reality.

This paper is a detailed report which will enhance what the problem that was addressed with this application and how the project was initiated and documented and how the challenges were met. Also, the key concern had been put upon the phase of feasibility study and requirement gathering in order to conduct them and show the results gained as a proof of project selected is a real-time project. Furthermore, the design overview will include of WBS, Gantt chart whereas resource allocation and a possible milestone plan so that work will be prepared accordingly. Appropriate designs of UML diagrams and specific system designs will be prepared and included throughout this report to give a diagrammatic view of the flow of this project.

Moreover, further enhancements will also be discussed thoroughly in which that can be addressed moving forward to get the maximum benefit out of it to the target audience. Finally, we have created a prototype of application software as a graduate master's course project of Anton Nilupul Sadesh Warnakulasooriya,.

1-2 Problem Statement

With the increase in travelling of individuals, the tourism industry has become more competitive. With that advantage people attempt in various methods targeting the tourists that travel within their countries for example travel guides, different applications that gives information regarding the destinations, yet the users aren't fully satisfied as they aren't accurate enough and such applications are just information based ones in which the users aren't interested in gathering the destinations.

Kyoto, Japan has become one of the mostly visited city by foreigners, yet the languages currently used by the people living in the city as well as the tour guides are poor as they are only capable of Japanese language while the tourism language, English is rarely used where the foreigners to come to Kyoto to visit temples face is quite difficult in dealing with it. Even the road signs and destination boards happen to be from Japanese where it's quite confusing to the foreigners.

Therefore, in order to address the above-mentioned problem within the tourism industry, developing of an AR mobile applications for the field of tourism, aiming to release AR's full potential within the field will be the main purpose of proposing this project to address the implications addressed above

1-3 Project Scope

A project should have a proper project scope at the beginning of the project initiation in order to proceed without any issue. Project scope is a part of the project planning within involves of determining and listing out the specific project goals and deadlines that have to be achieved

throughout and at the end of the project to be successful. Following discussed is the project scope where the specific project goals in order to be met had been identified and discussed thoroughly.

As the selected project of Tour guide with Augmented Reality application involves of an advance concept, its project scope includes of core areas to be met in order to successfully achieve this project successful. When looking at the project scope of the application the main scope involves the Point of Interests (POI) that nearby the user's GPS location in order to display the AR tags in the Camera view. Based on the given categorizations of tourists most searched tags in Google Maps. In order to give the information of the user's selected AR tag, that feature has to get the place information thorough out from the Google Maps API service in order to preview the location's current address and more information.

Other than the core part of the project the rest involves of providing the basic functionality of a normal tourist information application as providing a map of the current location and tourist information which would be help to know about Kyoto City.

1-4 SWOT Analysis

Basically, a SWOT analysis is conducted with the sole intention of identifying what the market position is there for the relevant project you do. When undertaking a project in order to be successful and meet the project goals successfully it is mostly guided that as the best option it is better to follow the project management tools and techniques when making of decisions as where appropriate. Therefore, SWOT analysis is one of the analysis which is being conducted in project management. It can be identified as a tool which concerns about strengths, weaknesses as well as opportunities and threats of this project idea. Following is the SWOT analysis which was conducted for identifying the Strengths, Weaknesses, Opportunities and Threats of the proposed AR Tour Guide (See Figure 1).

Strengths <ul style="list-style-type: none"> • Rapid increase in tourism • Adaptiveness with new technology • Best entertainment exposure 	S	W	Weaknesses <ul style="list-style-type: none"> • Competitors can offer similar products • Less entry barriers • Navigation content/inaccuracy
Opportunities <ul style="list-style-type: none"> • Innovation • Continuous expansion on the app • Selling in internationally 	O	T	Threats <ul style="list-style-type: none"> • High competition • Limited awareness

Figure 1. SWOT Analysis

2. Background of the Study

2-1 What if tourists could easily get guidance from the tourist information center?

Providing augmented reality tour guide from a tourist information center will be very meaningful. Essentially, this AR application needs to consider the specific needs tourists and the tourist information center. Within the aim of analyzing the design process it includes four steps which is the design of mental model, the laying out of the use case and class diagram which can be seen in the later chapters. During the design process, the first step is to represent the current situation that depicts both type of users. Ex: The tourist and the system (mobile application) provider, who in this case can be a new city or a heritage site etc. following figure presents an illustration of both sides needs and their relationships (see Figure 2).

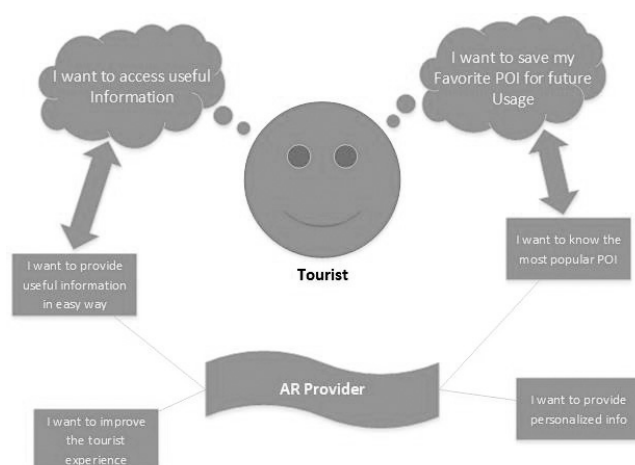


Figure 2. Our concept of AR

2-2 User Requirements

As this system involves with an important role in

natural human computer interaction, beforehand of the project it is a key point that user requirements have to be identified clearly in order to meet all the user requirements successfully make this android app a success. Therefore following are the set of major user requirements that was identified beforehand in order to make correct decisions related to application functionalities and the success of this Tour guide with Augmented Reality android application.

2-2-1 Accuracy

As in general the common requirement which the user expect from system projects is the accuracy which they mostly expect as in order to work successfully accuracy is the key aspect which mainly depends upon. As this app will deal with user expressions they would highly request in getting accurate feedback from the application which is why accuracy can be listed as a key user requirement.

2-2-2 User Friendliness

Not only the accuracy is being required when it comes to an android application as of all mostly the user friendliness is being highly considered. As this Tour guide with Augmented Reality will be an android application with a combination of a normal tour guide app functionalities more the user friendliness in the application more number of users will be attracted to this application as they highly expect of user friendliness in android apps.

2-2-3 Higher Interactivity

As well as the higher the interactivity with the user more the satisfaction will be gained. Nowadays interactivity is also being checked by users when applications or systems are being implemented. As this is an android application unlike desktop applications higher interactivity is being expected by the users.

2-3 Explanation of our System

As it was clearly specified in the problem

statement that Kyoto, Japan has become one of the mostly visited city by foreigners, yet the languages in use by the people living in the city as well as the tour guides are poor as they are only capable of Japanese language while the tourism language, English is rarely used where the foreigners to come to Kyoto to visit temples face is quite difficult in dealing with it.

Therefore, with the main intention of addressing the following issue mentioned in the problem statement, an AR Tour Guide has been proposed. The ultimate goal of the proposed system is to expand the chances of expanding the augmented reality experience for the users for real and at the same time to give the users to experience in the virtual world with all the guidance they need in terms to travelling around the city. The proposed AR Tour Guide includes of the following features in order to enhance the experience in the virtual world.

- ☐ Easy Navigation throughout a digital map
- ☐ Increasing visitor's experience in temples of historical artifacts
- ☐ Making the planning journey much more interactive and simple
- ☐ Guidance with regards to safety and regulations so they are guided from start to end
- ☐ Providing a compelling educational environment on how to deal with augmented reality

Moving forward, the report will have a detailed breakdown of how the challenges will be addressed in the process of achieving the project proposed to succeed.

2-4 Feasibility Study

This phase of feasibility study and requirement gathering is one of the core important study which comes under the initiation phase of the project cycle. Therefore this is done beforehand of the project mainly in order to check whether this project is feasible enough to engage with on all the aspects of cost, time as well as scope and technical. Along with the feasibility study under this section requirement gathering is being undertaken where possible methodologies are being used as

techniques of gathering data related to the project so that before starting of project planning can have a clear idea of how the data can be amended with this project and have a clear picture of how are the exact users of this system and what are their thoughts related to this project idea.

2-5 Requirement Gathering

Requirement gathering is the core main section where data related to the project is being gathered using the help of various requirement gathering techniques and methodologies. Without maintaining of a successful requirement gathering it is quite challenging to continue effectively with the particular project. Therefore under this section of requirement gathering mainly will focus on what are the fact gathering techniques that had been applied in order to collect the data related to this project and what was the final results of the collected feedbacks at the end.

2-5-1 Requirements Determination

The best ideal method in order to gather relevant data is to analyze the data once after the requirement gathering is undertaken. Once after the requirement gathering is being undertaken successfully here is the section where the major else core requirements that had to be met with the system has to be identified clearly and the secondary requirements that are involved with this Tour Guide AR app other than to the core requirements. Therefore following are the core requirements and secondary requirements which were analyzed from the data gathering by undertaking requirement gathering techniques.

2-5-2 Core Requirements

Core requirements are the major areas which has to be considered when implementing of the core part of this project which involves of the viewing the AR tag's from the Google API JSON part. Therefore following are the identified core requirements that was gathered after the requirement gathering was undertaken.

What are the categories in which people

(foreigners) would search in the Google maps? (Ex. Restaurant, Bar, Parks, Shrine, Temples)

In order to detect the location and display the POI accurately major areas which will consider the from the getting right data from the Google API JSON service

2-5-3 Secondary Requirements

However secondary requirements are the areas which has to be considered along with the core part of this project in order to succeed as a whole. Therefore following are the identified secondary requirements other than the major requirements in which the system should be functioned with.

Design the tour guide app with normal guide application features (Ex. Navigation system, Kyoto useful information's for Foreigners Etc.)

Train the data set to maintain the highest accuracy of the results which is being generated.

Who are the users who be involved once this app is being implemented

2-5-4 Resource Identification

Resource identification process allows the developers to have a better understanding of the current resources they process and the resources that will be required for the development process. The development process consist of both hardware and software requirements in which both areas needed to be covered in order to have a successful development.

Hardware

- ☐CPU - Dual Core 1.5GHz or higher
- ☐GPU – Mail 800 or higher
- ☐Memory (RAM) – 1GB or higher
- ☐Storage Space – 40MB
- ☐Camera(Front) – 5 Megapixel or higher
- ☐Camera (Rear) – 8 Megapixel or higher
- ☐GPS Required
- ☐Gyroscope Required

Software

To create the system there are a couple of core software programs in the development process, starting with the operating system due to the compatibility it is required to do the development

in devices running low version of android (ice cream sandwich) or higher. The development will be done using:

- ☐Android Studio
- ☐Eclipse (ADT Plugin, CDT plugin, Sonar cube Plugin)
- ☐Wikitude SDK
- ☐Adobe Photoshop
- ☐Adobe Illustrator
- ☐GIMP Tool
- ☐JuntInMind Prototyper
- ☐Android SDK Managers
- ☐Microsoft Office Package(Including Visio and Project)

3. Design

3-1 Design Overview

Design overview will be focused on a documented analysis discussing of a detailed design methodologies which has to be applied in order to determine its capabilities and adequacy to meet its requirements. Designing phase plays a major role when developing of a project where correct and effective design patterns and necessary methodologies have to be applied in order to meet the project scope. Therefore due to the complexity of the systems which requires of plenty of coding the design technique which will be used is the object oriented designing technique so that within the implementation stage it would reduce the lines of code written by approximately 4 times compared to the functional designing method which would also help in way to speed up and efficiency of the coding standards and the system.

Another area which has to be concerned and select before implementation is the software architecture that has to be used. Software architecture mainly focuses on how the system coding should be structured in order to be more efficient. The software architecture that will be used within this project is the MVC architecture where it will be categorization into major three parts of Database layer, business player and presentation layer, so by diving the logic, user

interfaces and the database related codes separately will maintain higher efficiency and convenience in the coding. Therefore when an object oriented method is applied necessary designing of diagrams have to be prepared as it gives out clear view of the project system plan in a view of a diagram beforehand will help in making proper designs after it and the diagrams which will be prepared under the designing phase includes of UML use case diagram, UML class diagram and UML sequence diagram [8], [9].

3-2 Design of the System

3-2-1 Use Case Diagram

Use case diagram refer to diagrammatic view of showing out what the actions that external actors and internal actors (users involve with the system) who take part in performing the system. The opportunities that can be gained by designing of this use case diagram is that it will help in identifying who the users of the system which is being implemented.

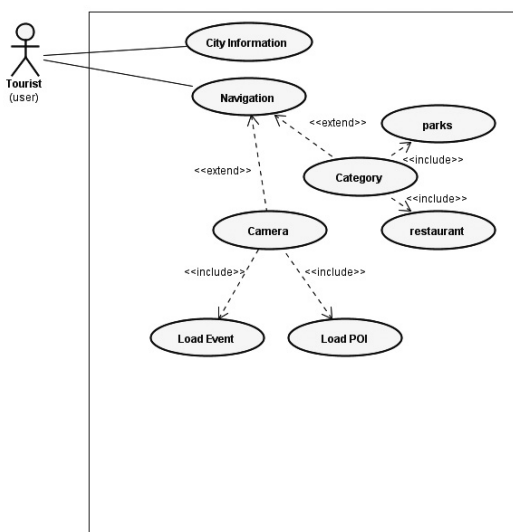


Figure 3. Usecase Diagram

Furthermore, by preparing this use case it will help in identifying the goals associated with each actor involved with the system as well.

Following provided is the user case diagram that was prepared based upon the requirements and system functionalities that will be included within the AR Tour Guide.

3-2-2 UML Class Diagram

UML class diagram refers to diagrammatic view of the structure on how the system coding should be organized into set of classes which will map to the object oriented language which had been applied to this system code. Therefore using this diagram it will show what are classes which will included within the system coding and on how the methods are had been categorization under each class so by structuring them beforehand would help in implementing of the system in a much organized[9]. Therefore the opportunities that can be gained by preparing of this UML diagram class is that it would be help in organizing the system code into several classes under name package and assign particular methods under each appropriate class. Moreover by creating this UML class diagram beforehand would help in describing what the functionalities that has to be performed by the system.

3-2-3 Sequence Diagram

Another diagrammatic scheme which is important in UML designing. It also represents a major part of the system coding. Sequence Diagram (Figure 4) represents an object collaboration and is used to define event sequences between objects for a certain outcome[10]. Using UML sequence diagrams, it represents the flow of messages as well as events and actions between objects of the system. Therefore the opportunities that can be gained by creating the sequence diagram is that it will help in identifying the architecture as well as the interface and logical problems beforehand.

The Figure 4 is “the Search a place” sequence diagram where the user involved with this activity is the looking for a park in the AR Camera Display. As this shows the process of user clicks the park icon in the search activity, once go back to display camera display and shows the all nearby places near to the current users’ GPS location in AR tags, In the each of AR tags it displays the distance back from the place to the user’s location.

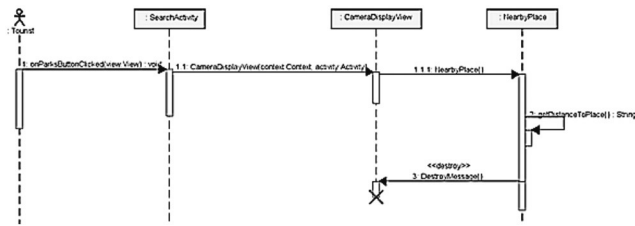


Figure 4. Sequence Diagram.

4. User Interface of the Application

Welcome Splash Interface

The Figure 5 is a screenshot of the “First Welcome Splash Screen of the Tour guide with Augmented Reality”. In this interface, a user gets a nice view of Kyoto city and attraction with the bright, colorful imaginary view of the application from firsthand. Once the user clicks the next button it the second welcome splash screen will appear.

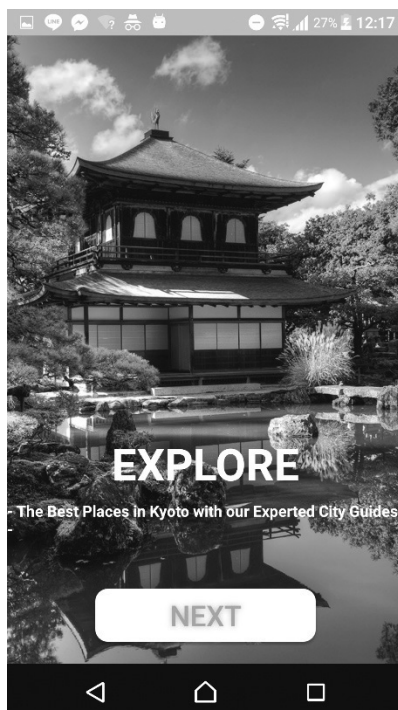


Figure 5. Welcome Splash Interface

Home Menu Interface

The Figure 6 shows us the home menu of the application. In the first button icon which the AR guide and will be the main core part of this project. Map, places and City info are the additional feature which was designed in order to cover the basic tour guide application features.

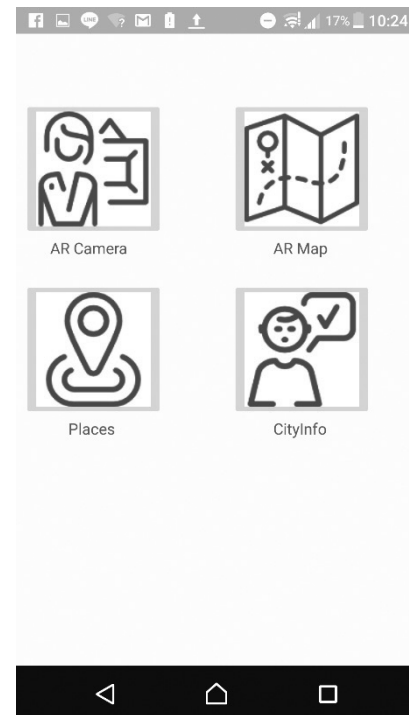


Figure 6. Home Page Interface

Categorization Interface

The Figure 7 shows us the Categorization Interface of the application, circle is the context categorization within the selected ALL ICONS and had been clicked then and going back to camera view will be displayed all the all the AR tags nearby the user’s current location based on the Google API JSON. Each circle represents keyword, from the left top to right, Café, Restaurant, Temple, Park, Shrines, Art Gallery, Movie Theater, Lodging, Supermarket, ATM, Pharmacy and Bus Transits.



Figure 7. Categorization Interface

Camera View Interface

The Figure 8 show us the “Main Camera View” from the home menu interface, which was displayed once after the “AR Camera” button top left corner was clicked which will display the augmented reality screen interface of the tour guide application which the main core part of the application. Each AR tag represents a different icon and the distance from the place to the user’s current location.

Place Information Interface

We can get a place information interface once the user clicks the AR tag of the current user’s location and one of is selected, all the information will appear in new display place information interface. In this interface will include place of name, address, contact number, ratings from the visited user’s as well as previous user’s feedback comment.

Above sequence diagram where the user gets the information about place details when looking for a place in the AR Camera Display. As this

shows the information of place details and customer review (as feedback) of the selected place.



Figure 8. Camera View Interface with AR

5. Critical Evaluation and Conclusion

5-1 Evaluation of the Solution

When going through the report in detail it’s quite clear that the mentioned requirements and scope have been met successfully. As the requirements stated in the proposal was met it is quite clear that the implemented AR Tour Guide was a success with fulfilling the functionalities of interacting the user behavior in a virtual environment while giving away the entertainment and information when require from a tour guide.

The challenges of the proposed mobile application were the ability to get users exact location from the specified favorites from the Google Maps API, current location, map and distance between user’s location and the selected place distance. Pointing out from the research many applications has been developed, but some of the tourist information is mainly guided

throughout newspapers, magazines, guide books and web sites, these methods do not provide the exact information while users on the move.

When terms of evaluating at the core functionalities which the system has, the ultimate goal of the proposed system was to expand the chances of expanding the augmented reality experience for the users for real and at the same time to give the users to experience in the virtual world with all the guidance they need in terms to travelling around the city.

Once after the AR Tour guide was implemented the necessary user testings [11] were undertaken in order to maintain the visibility of errors within the system and to submit an error free application to the music users.

Concluding the evaluation of the project it's clear that the project objectives were met as planned with the availability of limited resources and skills, yet attempted it to introduce the Augmented reality experience to the users who engage in tourism and who specifically visit Kyoto to historical temple visits and city rides with giving them the best city tour guide exposure in an innovative new technology applied manner.

5-2 Discussions

When undertaking of IT related projects, the lessons learnt report is one of the mainly considered topic which is being done at the latter part of the project documentation in terms of specifying what are the areas newly gathered and learnt throughout the project initiation to close-off. Basically, within this lesson learned report it discusses about what are the gained experiences and knowledge throughout this project time period.

Moreover the reason why the lesson learned report is important is that it is a matter of improving the productivity and the efficiency of the process. Individually by engaging in these types of projects and getting have the ability of gaining valuable experience will long term vise be more beneficial. Not only that but this lesson learned report would also help in producing project

teams which operate with the less risk of failure as well as increased efficiency and more aware of their related surroundings. Following discussed are the areas highly addressed under lessons learnt report based on this AR Tour Guide.

★Out of all the main reason why this project helped me out with is that by undertaking this project all alone which involves of a huge concept which has to be undertaken by a team of members, I was able to experience the ups and downs I came up throughout the project and how was able to complete all the tasks by finish off the project activities within the project deadline. Therefore, on one side I was able to learn valuable lessons on how exactly the project should be handled properly in order to succeed no matter what number of members are engaged with the project activities.

★Unlike other projects that I had undertaken throughout my academic carrier this project was guided to be a real-time project I had to interview various people related to the project and even to undertake surveys and collect their feedbacks, which in way gave me the opportunity of engaging in real time projects beforehand of entering into my job carrier which would be beneficial.

★Virtual reality and augmented reality is quite new to my IT carrier throughout the academic life of mine, where I was able to gather a lot of information and skills on how augmented reality projects are based on.

★Applying the Augmented reality with android was even more challenging and I was able to gather and research more into this, which gave me the opportunity to study more onto new areas related to the areas concerned.

Therefore, when looking at the above discussed points under the lesson learned report that by developing the AR Tour Guide it helped in many ways to gathering the knowledge I lacked in and even the experience of dealing with real time projects.

6. Conclusion

Kyoto city has a historical building, and has a beautiful landscape surrounded by mountains. To prevent this beautiful landscape from being impaired, placing signboards outdoors is severely restricted by the ordinance. Despite the fact that tourists from foreign countries are increasing, it is not easy to add signs for sightseeing information.

Therefore, we have developed "Augmented Reality Tour Guide" is at the same time as the guidance for the first time visitors about the easy navigation of the entire digital map, while improving the level of entertainment, actually expanding the user's augmented reality experience. It has made it possible to expand the opportunity to do.

It has made it possible to widen the opportunity to actually expand the user's augmented reality experience. In particular, it was also possible to apply it to different industries. It also made it possible to give safety guidance in case of a sudden disaster.

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