2013 International Conference on Advances in ICT for Emerging Regions (ICTer): 068 - 074

Location Based Advertising Framework for Mobile and Web Application Developers in Sri Lanka

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Abstract*— *The development of multimedia and technology has introduced various methodologies for business advertising where the target audience for an advertisement can be converted into potential customers for the business. With the rapid growth of smartphone users and internet users in Sri Lanka, an opportunity is there to create a link between them and businesses making advertising more effective. This research is carried out to develop a framework where mobile and web application developers can develop their applications on top of the framework enabling location based advertisement streaming in their applications. Businesses can publish advertisements tagged to specific geo locations and the smartphone and internet users in the nearby area of the tagged locations can view the advertisements in their smartphone applications or in the websites they visit. The primary goal of this project is to encourage the mobile and web application developers in Sri Lanka by providing a framework to monetize their applications. The secondary goal of the project is helping smartphone users and internet users to find business promotions in nearby area and guide them to reach the business locations associated with the advertisements, by providing directions.

Keywords— **Location Based Advertising, Location Based Services, LBS, Advertising, Advertising Framework, Mobile Advertising, Web Advertising, Application Monetization, Software Development, Sri Lanka**

I. Introduction

Advertising is one of the most revenue generating businesses in today's software and IT services industry where companies such as Google Inc. derives more than 95% [1] of its total revenue from the advertising programs. With the modern life style of people and the growth of technology, traditional newspaper advertising has been replaced by online advertising where advertisements are published on internet. Businesses can publish their advertisements in online advertising services such as Google AdSense [2] and those advertisements will be visible in websites and smart phone applications that are embedded with advertisement streaming.

In order to make a website or smart phone application stream advertisements, the application developers have to use the Application Programming Interfaces [3], [4] provided by the advertising service provider in their applications. Based on the views and clicks of the displayed advertisements on websites and smart phone applications, the application developers can earn revenue which is a boost and an encouragement for their work.

The major advertising services use content based advertisement streaming [5] where the displayed advertisements on a website or a smart phone application are related to the content that the users are looking for. In order to increase the effectiveness of the advertisements, country level filtering is applied mostly where the users view advertisements published by the businesses in their country.

With the rapid growth of smart phone usage in Sri Lanka [6], the market niche is there for mobile advertising where local advertising services can provide a better service for businesses to publish their advertisements such that they reach a wider audience and for smart phone users to get information of business promotions of local businesses. With the location tracking capabilities of the smart phones, advertisements can be filtered based on the distance between the businesses and the smart phone users. The smart phone user can view advertisements published by the businesses in nearby locations which encourages the user to visit the business places and to make purchases, increasing the potential customer base for businesses. With the improved capability of geo location tracking of internet users [7], the same advertising service can be extended for websites where website visitors can view advertisements that are related to the businesses located nearby.

In order to make that possible, this research has been carried out by the authors where a location based advertising framework is developed for Sri Lanka to be used by mobile and web application developers of the country to develop their applications consuming the services provided by the framework while earning revenue, and for businesses to publish advertisements based on geo-locations. The value addition for advertisements in the developed system is that the viewers of the advertisements can find directions to the relevant business location from their current position [8]. The developed framework by the authors builds a network among the businesses, mobile application developers, web developers, smart phone users and website visitors benefiting all the parties.

II. Related Work

Online advertising and mobile advertising are not very new topics for research where there are so many international level advertising service providers are available. Several major advertising service providers and the services provided are taken into consideration during the research where the

978-1-4799-1276-6/13/$31.00 ©2013 IEEE

focus of the research is based on application monetization and location based advertising for Sri Lanka.

A. Google Adsense

Google provides advertising services [2] in mobile applications and web applications allowing developers monetizing their applications. Content based advertisements are mostly displayed to users where the advertisements are related to the content the users search. Filtering is done at country level based on the IP address of the user where local advertisements are displayed mostly. Location based advertising is an emerging research area with Google Adsense but still it is limited to few countries and not supported in Sri Lanka.

B. Facebook Advertising

Both content based advertising and country based filtering are available for advertising in facebook [9], but location based advertising is still not available. Monetizing apps on facebook is available providing benefits to software developers.

C. Foursquare for Business

Location based advertising is available where the users can find out nearby places and business promotions [10]. Application monetization is not available for developers.

D. Dialog Ideamart

Location based advertising services are provided where mobile phone users can subscribe to such service by paying a rental and obtain nearby business promotions via SMS [11]. The location tracking is done using the tower location and therefore the accuracy of the area tracking is limited. A disadvantage with this is that the users have to make payments for obtaining information. Application monetization is also not available for advertising.

E. Ikman.lk

A local business in Sri Lanka that provides facility of advertising where location based advertising is used at district level [12]. Since a large geographical area belongs to a district, finding advertisements only in nearby locations is impossible. There is no framework for application development or monetization.

Apart from the above services, there are several other major service providers such as Microsoft Advertising [13] and iAds by Apple [14] where both location based advertising and application monetization are used but still those services are not supported for Sri Lanka. Thus the software developers in Sri Lanka cannot benefit from such services where they can earn revenue from their work. In order to address this problem and to provide an effective way of advertising, the location based advertising framework is developed by the authors. With the existing services that offer location based advertising, the concept of guiding the customers to reach the business is not popular. In the developed system by the authors, this concept is used where advertisements are displayed to smartphone and internet users in nearby areas [15] from the business location and they can view how to reach the business in a map. In addition to that, advertising browsing is also considered where a search engine is provided with the framework for users to search nearby advertisements based on their interests. Software developers in Sri Lanka can develop their applications on top of the developed framework for monetizing their applications.

F. Researches

Location Based Advertising has been evolving since the invention of m-commerce where many researches have been conducted in this area. In early stages the concentration was more on the implementation of basic mobile advertising [16] such as sending a pull request to a remote server where advertisements are stored and then displaying them in a mobile phone. With the development of technology, using multimedia in mobile advertising [17] was identified more effective than text based advertising. Using the location as a dimension for marketing was tested in researches where the results suggest that this location dimension and what the recipients are doing (context) affect their perceptions of usefulness of the advertisement, store evaluations, and willingness to respond to the offer [18] which is encouraging further development of location based advertising methodologies. Consumers' attitudes towards location based advertising [19] are also important in this research area where some users may not prefer tracking their location with the mobile devices for advertising. The distinct factor of this project compared to the researches conducted in the same domain is that the authors more concentrate on application monetization through smartphones supporting location based advertising.

III. Methodology

The Location Based Advertising Framework is developed by the authors, following the Client-Server software architecture.

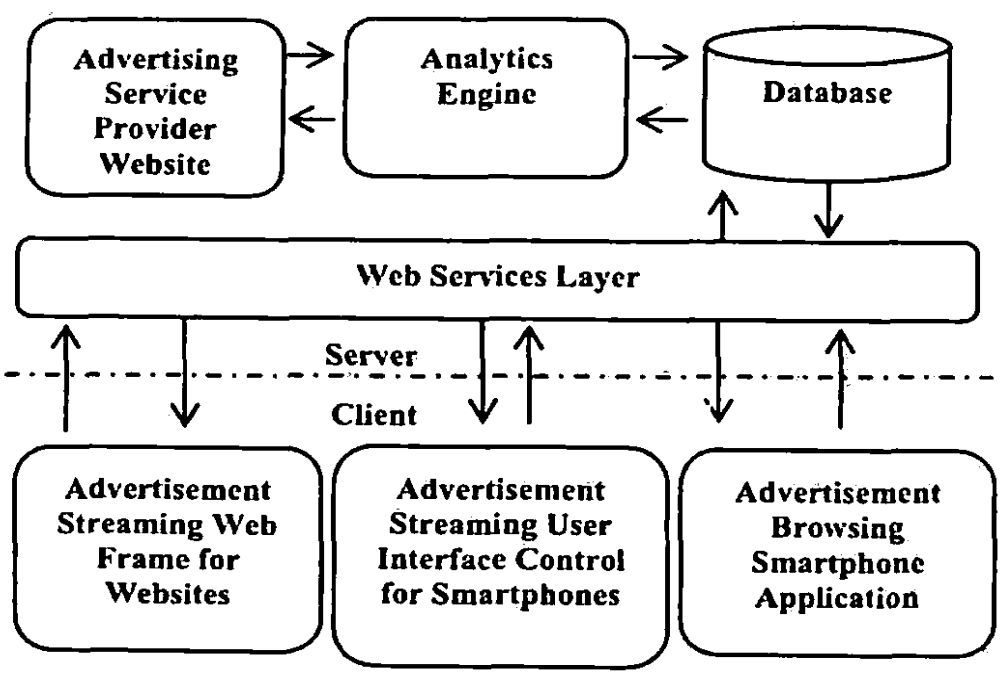

Figure 1: High Level Architecture of the Location Based Advertising Framework

1. Advertising Service Provider Website

The operations performed by the website changes according to the type of the user.

i. Business Organizations

A business organization can create an account in the website for publishing advertisements. When publishing an advertisement, the categories that the advertisement falls into, have to be selected. Some examples for the categories are Food, Banking, Automobile and Property. Before publishing the advertisement, it has to be tagged to a geo-location where the business promotion is available. A map view is provided in the website where the user can navigate to the relevant geo-location and attach the advertisement to the selected coordinates. After making the required payment, the advertisement is stored in the database of the system.

ii. Web Developers / Bloggers

Web developers or bloggers who own websites can create an account in the advertising service provider website and download a web script which can be embedded in the websites they own. The generated web script will include a unique identity number in order to uniquely identify the website that the web script is embedded. When downloading the web script, they have to subscribe for one or more advertisement categories. Then the web script will be generated where it can stream advertisements from the subscribed categories. The benefit of subscribing to different categories of advertisements is that when streaming advertisements in their websites, only the advertisements relevant to the type of blog or website will be displayed. An example would be a blogger who writes about food recipes in his blog subscribes to the advertisements in the category of food and the advertisements displayed in his website will be related to food and be useful to the readers of the blog.

iii. Smartphone Application Developers

The developers who develop mobile applications for smartphones can create an account in the advertising service provider website where they can register each smartphone application they develop in the system and obtain a unique identity number for the application. When registering an application, the developer has to subscribe for the relevant advertisement categories. The subscription is important in order to provide only the related advertisements to the interests of the users of the smartphone application. An example would be a smartphone application developed for kids can subscribe for a category such as Toys where the advertisements displayed in the application will be related to toys. The users of the application will be kids and they will find it interesting to find out the information of latest toys in the nearby shops. Marketing benefit can be obtained by the businesses by targeting the right audience for the right advertisement.

iv. Advertisement Information Seekers

The people who are interested in finding out business promotions or events in different places in Sri Lanka can visit the advertising service provider's website and select a specific location on the map provided in the web page. Then the user can search advertisements that are tagged to nearby locations from the selected position. Results can be filtered based on the category of advertisements or by providing a specific text to search the related advertisements. The website acts as a search engine for browsing location based advertisements. The users can also get the directions to visit the business location from their current location, which adds more value to the published advertisements.

2. Web Services Layer

The web service layer provides several services [20] to the clients of the system. It contains a separate service for each type of client where the client can send the geo-location of the application user along with the unique identity number which is obtained by registering the website or smartphone application in the advertising service provider website. Based on the geo-location of the client, it filters the published advertisements and selects only the advertisements tagged to nearby locations. The radius from the client for finding nearby advertisements is set to 5Km by default where it can be easily changed by modifying a configuration file. For calculating the distance between the client's location and the location of the advertisement tagged to, Haversine formula [21] is used.

$$a = \sin^2(\Delta\varphi/2) + \cos(\varphi_1).\cos(\varphi_2).\sin^2(\Delta\lambda/2)$$
$$c = 2.\text{atan2}(\sqrt{a}, \sqrt{(1-a)})$$
$$D = R.c$$

D is the distance where φ is latitude, λ is longitude, R is Earth's radius (mean radius = 6,371km). All angles are given in radians.

From the unique application identity number provided by the client, the service can obtain the list of subscribed advertisement categories. Then the nearby advertisements are filtered again and only the advertisements from the subscribed categories will be set to the client.

The clients can also send click stream information of each advertisement to the service where they are recorded in the database. Here the click stream means a client application user has either viewed an advertisement or has clicked/tapped on the advertisement that would redirect the user to the associated website of the advertisement. By this, the actual audience for each advertisement is recorded for the purpose of statistics calculation.

3. Advertisement Streaming Web Frame for Websites

This is a web script that is compatible with HTML which can be embedded in any website. The script can be obtained by the web developers by registering their website in the advertising service provider website. The knowledge required for embedding the web script in a website is very less where a

person with basic knowledge in writing a web page or maintaining a blog can use this in his website or blog. The script contains the unique identity number generated by the service provider website and the link to the particular service in the web services layer. The web developer can place this web script anywhere in his website and it will be displayed as a banner image on the website. When a website that has been embedded with this web script is viewed by a user, the user's geo-location is sent to the service layer along with the unique identity number that the script contains and advertisements are requested. Due to privacy concerns of tracking the user's location, the user is prompted to allow location tracking for the website. From the web services layer, nearby advertisements are obtained which belong to the subscribed categories of the web developer. If the location tracking is not allowed by the user, a default location in Sri Lanka will be sent to the services layer and nearby advertisements will be requested. Advertisements are displayed on a website in a timely manner where after a predefined time; a new advertisement will be visible.

Once an advertisement is displayed on the website and the user clicks on the advertisement, it redirects the user to a web page in the advertising service provider's website. In that web page, the user can view more information related to the advertisement. This increases the web traffic [22] and site ranking of the advertising service provider's website which is a benefit for the service provider. This also secures the user from getting redirected to harmful websites which can damage the user's computer or the internet device. From that web page, user can get directions to the business location where the advertisement is tagged from the user's location. This ensures that if a user is really interested in the advertisement, he can easily find the business place to get the business promotion or to make a purchase which benefits both the customer and the business.

Each advertisement displayed on websites has a unique identity number where each click on the advertisements is tracked in the system. Upon clicking on an advertisement by website users, the advertisement identity number, date, time and IP address are sent to the services layer as a click stream. These click stream information are recorded in the database of the system.

4. Advertisement Streaming User Interface Control for Smartphones

Smartphone application developers use different user interface controls such as text boxes, buttons and labels in their applications. The authors have developed a user interface control for smartphone applications which is similar to an image or a banner that can be used for displaying advertisements on top of smartphone applications. The user interface control can be imported into smartphone application projects by the smartphone application developers and can be placed anywhere on the display of the application. Then the developers have to set the application identity number property of the user interface control. This identity number can be obtained by the developers by registering the smartphone application they develop, in the advertising service provider's website. During the registration, the developers have to subscribe the application for related categories of advertisements. For example if the developer is developing an application related to employment opportunities, he can subscribe the application for an advertisement category such as jobs where only the advertisements from that category will be visible in the user interface control. The developer can control when to display the user interface control in order to avoid any inconveniences faced by the smartphone application user. For example, if the smartphone application is a game, the user would not like to see advertisements within the limited space of the screen of the game while playing the game. In such cases, the developer can program the user interface control to be visible at times such as after completing a level in the game or when the game is over.

When a smartphone application that contains the user interface control developed by the authors is run by a smartphone user, the location of the smartphone and the application identity number of the smartphone application are sent to the web services layer. For this, internet connectivity in the smartphone should be available. Same as in "C. Advertisement Streaming Web Frame for Websites" above, the nearby advertisements are filtered and displayed as images one after the other in a timely manner on the user interface control. Here, only the advertisements related to the smartphone application will be downloaded from the web services layer. The relevance of the advertisements to the smartphone application is identified by the application identity number property of the user interface control that is set by the application developer. Only the advertisements fall into the categories subscribed and associated with that identity number will be sent to the user interface control in the smartphone application by the web services layer.

While viewing advertisements displayed on top of the application, interested users can tap on the advertisements in order to find more information of the advertisement. This will redirect user to the advertising service provider's website where the directions to the business that published to advertisement can be viewed on a map in addition to the provided details of the advertisement. Each time an advertisement is viewed or tapped by a user; that action is sent to the web services layer as click stream information for keeping track of the actual audience for the advertisement. Along with the click stream information, application identity number and the IMEI number of the smartphone is also sent to the web services layer for correctly identifying which advertisement is viewed or tapped on which developer's application.

5. Advertisement Browsing Smartphone Application

In order to display a published advertisement in the system to a user, either the web developers have to embed the advertisement streaming web frame in their websites or the smartphone application developers have to use the provided user interface control in their applications. This adds a dependency to the system where without using the provided advertisement clients by developers, advertisements cannot be taken to a larger audience of the general public. For that, advertisements can be searched and viewed in the advertising

service provider's website; but for smartphone users it does not help much. In order to remove this dependency, a separate smartphone application has been developed by the authors. Once this application is installed in the smartphones by the smartphone users, they can easily view all the advertisements that are tagged to nearby locations. They can also search what they are looking for or filter results by category. They can also get directions to the business location from the smartphone application itself. This helps travellers to find what they are looking for while they are travelling and also for businesses to attract a wider audience of potential customers. Each view of advertisements is tracked and recorded in the system for generating statics of the audience for advertisements which are provided to businesses for their decision making processes.

IV. Analysis & Results

The important fact of the location based advertising framework developed by the authors is that it provides a way to monetize the applications [23] developed by the web and smartphone application developers in Sri Lanka. The motivation for the local developers is that they get paid for using the provided advertisement streaming clients in their applications. Their contribution to display advertisements to the end users is tracked by the analytics engine where each developer gets paid based on the number of advertisements viewed or clicked/tapped from their applications. Developers can login to their accounts in the advertising service provider's website and view the estimated earnings for a period. Once a pre-defined boundary level for the total earnings is reached, the developers can withdraw money. Thus it encourages the local developers to develop more creative applications and embed the provided advertisement streaming clients in them that will be continuously generating revenue which is a boost for their work.

For businesses that publish advertisements, it is crucial to know the size of the audience that their advertisement is reached. Based on the size of the audience and the improvements of sales for their products or services, businesses can decide up to which level advertising affects their business. The strength of advertising should be measured and necessary improvements should be done in order to gain attraction of more customers. The analytics engine in the location based advertising framework provides businesses the facility to view the audience for their advertisements. Graphs and charts can be viewed from the advertising service provider's website where businesses can obtain statistics of time series based advertisement view counts' graphically to identify patterns in the views for the advertisements. This helps businesses to identify how effective their advertising is and helps them in developing marketing strategies for their products and services. Two examples of the graphs that can be viewed by a business for an advertisement they have published are shown in Figure 1 and Figure 2.

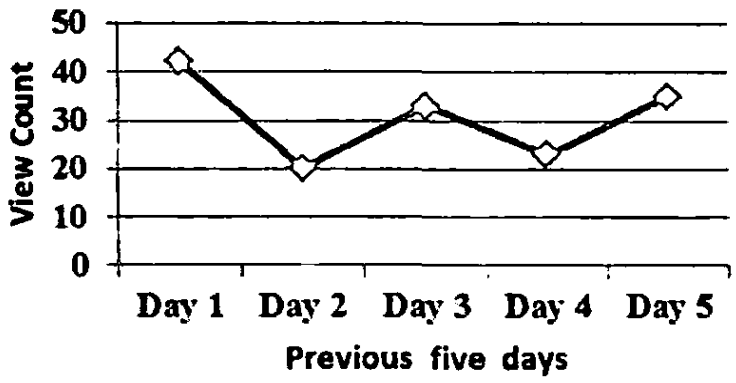

Figure 2: A sample line graph displaying the view count of an advertisement for previous five days.

The analytics engine is developed by the authors uses prediction algorithms [24] where based on historic data, it can simulate and predict the flow of the variable for a future period. For developers, earnings for displaying advertisements in their applications in near future are predicted based on the actual number of views and clicks of currently displayed advertisements. For businesses, the audience for their advertisements in near future is predicted based on the current audience. These predictions help the developers and businesses to make decisions to improve their earnings and audience respectively.

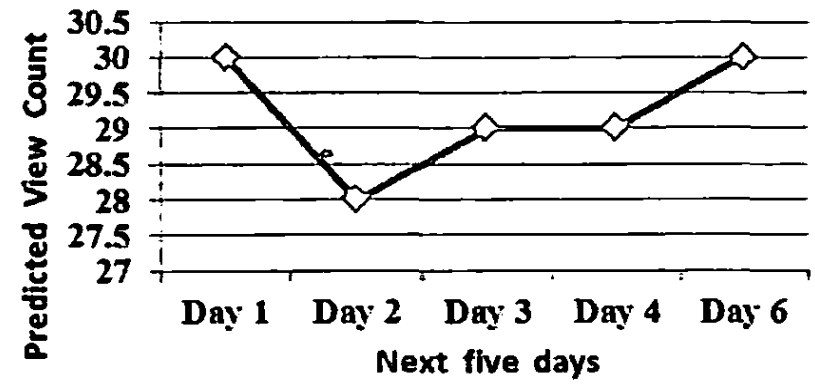

Figure 3: A sample line graph displaying the predicted view count of an advertisement for next five days.

As developers are getting paid for the number of advertisements displayed and clicked from their websites or smartphone applications; with the intention of earning more, the developers may try to fabricate the views and clicks of advertisements visible in their applications. This will cause the calculation of the audience inaccurate where the actual audience would have a lesser size. In order to reduce the effect of this problem, the analytics engine is developed with pattern identifying capability. The analysis is based on the timestamp where for a specific time period, the number of advertisement views or clicks cannot exceed a pre-defined count. The click stream data is processed for each application where the analytics engine can ignore abnormal click streams. This ensures that the accuracy level of the size calculation of the audience is kept at a higher level and also reduces the unnecessary payments made to the developers.

V. Discussion

The Location Based Advertising Framework is a echnological solution to a business problem where its focus is co provide an effective advertising system for Sri Lanka with ofhe help of the software developers providing benefits to both soarties. For businesses, it is not sufficient displaying large soanners in front of business locations to attract customers. n'From the developed framework, the authors provide a cost ffeffective solution for advertising, targeting more potential :customers rather than reaching a wider audience. The concept e.ised here is attracting people in the nearby area to business oocations by providing them with information about business nioromotions and guiding them to visit the business by nioroviding directions. Smartphones and websites are used as sdhe main sources of streaming advertisements where mobile :mand web application developers can integrate the bidvertisement streaming clients with their applications. The :motivation for the developers to take part in the system is that, :sfor their contribution to take advertisements to the customers; sdhey are rewarded.

Smartphone users use various applications in their phones :varying from games to complex real-time stock exchange :malysis applications while they are travelling. They can be :nousy with their phones where no attention is paid to the :nousinesses nearby and thus valuable business promotions can soe missed. Using this as an opportunity, the developers can sr:reate applications using the provided advertisement clients by sdhe framework where advertisements are popped up while the msmartphone users are using those applications in their phones. 1'1f the business promotion is really useful and interesting to the se iser, he can obtain more information of that by tapping on the vEidvertisement. If the advertisement is displayed on a webpage, sdhe user can click on the advertisement to find more details of sdhe advertisement. Here, more information contains directions :co the business location from the location of the user where si/vithout any assistance of others, they can visit the business to :sget the benefit of the business promotion. These views and :clicks of advertisements in websites and smartphone qqpplications are used to track the real audience for each vbidvertisement and for that, the developers are paid as they :contributed to take the advertisements to the customers.

The importance of the framework to the developers in Sri :anka is that this does not need credit cards to monetize their qqpplications where most of the young developers in Sri Lanka :dlo not have credit cards, due to the limitations and restrictions qqpplied by local banks. Therefore all the mobile and web qqpplication developers in Sri Lanka can take part in the system bsand get benefitted by earning a continuous revenue with their qqpplications.

In addition to this, the advertising service provider's dswebsite and the advertisement browsing smartphone qqpplication can be used as a search engine for finding business iooromotions in nearby locations based on the interest of users. smSmartphone users and website visitors can develop a habit for iooorowsing advertisements and find best offers in the town.

VI. Conclusion

The Location Based Advertising Framework is a network that brings businesses, web application developers, smartphone application developers, smartphone users and internet users in Sri Lanka together. The system provides an effective way of advertising, bridging the gap between technology and business. The software development community in Sri Lanka is rapidly growing at present, where this system can boost their work allowing them to monetize their applications and adding value to them. Due to the current unavailability of such a system in Sri Lanka, target audience can be easily reached. More than the developers, the smartphone users and internet users can be attracted quickly as the information about business promotions in their nearby locations can be obtained and the directions will be provided to reach the business location.

The developed framework by the authors will be made public to be used by the software developers in Sri Lanka. Documentation and guidelines will be made available to the developers such that with less effort, they can use the framework and build their applications on top of that. With the growth of the user base for the framework, more features can be implemented such as sharing the advertisements in social networks which enlarges the potential customer base for businesses.

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