

Ads-In Site: Location based Advertising Framework with Social Network Analyzer

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Abstract— Social networks contain a vast amount of data that holds very valuable information and is nowadays identified as a very effective source in marketing. The content of social networks can be used to identify the business needs and preferences of people. This research is carried out with the aim of providing suitable advertisements for people based on their preferences by analysing their social network content. Users' demographic details are also considered in providing suitable advertisements of the shops that are most conveniently located for a particular user. The primary goal of this research is to build an advertisement framework that supports targeted advertising by analysing social network content. The information extracted by analysing the content of social networks is used to predict the advertisement categories that interest a particular user. The framework applies location based services to filter advertisements based on the location of the shop.

Keywords— Social Networks, Support Vector Machines, Target Advertising, Location based Services.

I. INTRODUCTION

One of the major concerns in marketing a product or a service is identifying the potential customers who are most likely to purchase it. But this intention is not achieved most of the time as it is not easy to identify who are really interested in purchasing a particular product. Therefore, businesses spent a huge amount of money in vain for advertising their products and services to people who have no intention in buying them. On the other hand, people receive advertisements of products and services of which they have no interest in buying at all. With the rapid changes in the commercialized world, there are many places available for the customers to buy everything they need under one roof. But as such shopping malls consist of a huge amount of shops, customers often find it difficult to locate the shops that are really useful for them, so that they do not have to go from shop to shop in search of the product they want to buy. Another concern is the location where the product or service is available, as it is not convenient for customers to travel halfway around the country to buy a product. Nowadays location based advertising is used by many businesses, but most of them are limited to country filtering and even the rich location based systems work only when GPS (Global Positioning System) connection is available.

There are many concerns regarding the sources that can be used to identify the business needs of people more accurately. Social networks has gained a very powerful foothold on today's society and the pool of data that is been

shared through these networks contain valuable and accurate information about the users and most importantly about the necessities and preferences of people based on their opinions, experience and other demographic factors.

This research is been carried out with the goal of identifying the business value of such data and using them in a marketing aspect that will benefit both the supplier and the consumer. 'Ads-InSite' is been implemented with the objective of supplying a user with a well customized and filtered list of advertisements by analyzing the social network content of that particular user. The framework has been integrated with the API of Watapita Ads[1], which is a location-based advertising framework for mobile and web application developers in Sri Lanka. One of the APIs of the framework is been developed based on the weighing methods used in Intellemo [2][3], a mobile instant messaging application with intelligent emotion identification. The intended outcome is a rich advertising framework that supports both targeted and location based advertising. The framework is being applied in creating a mobile application that supports indoor navigation inside a shopping mall.

The organization of this paper is as follows; Section 2 explains the background and a review of work related to this research. Section 3 describes the overview of the prototype system and the main modules of the framework. Section 4 contains the discussion and evaluation of the built framework. Section 5 concludes the research along with planned future work.

II. BACKGROUND AND RELATED WORK

A. Social Networks and Location based Advertising

As social networks contain a vast amount of data about people, their opinions and preferences, much research has been conducted in identifying different aspects of the effective usage of social network data.

Some of this research and findings are based on identifying the market value of data available in social networks. According to [4], many organizations and companies are looking for ways to use the content posted in social networks for business purposes. Main issue faced by such companies is identifying the relevancy of posted content [5]. It is important to get behavioral data on personal preferences and interests for more appropriate targeting of advertisements, as well as the use of demographic and historical customer data [5]. In [6], it is stated that Facebook is currently working with a data mining company to track purchases of users. They have intentions to identify whether

consumers purchase a particular product or a service after searching for it online.

ForSight [7] is a tool that facilitates marketers and market researchers to listen to online conversations and understand the opinions of consumers, shoppers, and audiences expressed on social networks. ForSight uses an opinion analysis algorithm called BrightView[8].

In addition to these, there are many advertising services available and all of the major advertising services are considered in carrying out this research.

Admob[9], Millennial Media[10] and iAds[11] find their targeted consumers by analyzing past buying patterns of the user. Facebook[12] find targeted users by analyzing the behavior of the user on their Facebook profiles.

Location based advertising has been achieved by Admob[9], iAds[11] and Millennial Media[13] by using GPS. But if the GPS connection is not available, these systems are unable to find the user's current locations. Facebook locates users by the available location details of the user's profile[12]. Therefore Facebook does not contain street level location filtering mechanism.

This research is carried out as an extension to Watapita Ads [1] which is a location based advertising framework aimed at developers of Sri Lanka. The framework provides an API for developers to build their web and mobile applications on top of it, which enables them to provide advertisements for users who are using the developer's application. The category of the advertisements received through a particular application is chosen by its developer. The application will prompt users with advertisements of the developer preferred category by tracking down their current location.

This research aims to build an advertising system combining both location based advertising and targeted advertising together, with extending the researches done in Watapita Ads[1]. Authors of this research expect that, this research will exceed the limitations of the similar systems that are currently available.

B. Indoor navigation

One of the major components of this research is to build a navigation system for shopping malls, which will direct the users to shops based on their preference. It provides access to get closer to shops and the working community who require quick and easy solutions in a hectic daily schedule. There are many indoor navigation technologies[14] that are been used by the currently available shopping mall navigation applications.

WiseBy [15], Mally, GeniusMatcher and Wi-FiSLAM [16] use technologies such as indoor GPS, computer vision, 3D technology and Wi-Fi signals to navigate. None of these applications apply targeted advertising. Some of these applications do provide a social networking experience within the shopping mall [17]. However, none of these available applications has the ability to track shopping patterns through the user's social network and provide advertisements that are relevant to the user.

Indoor navigation in mobile benefits from decade old technologies such as Bluetooth Low Energy [18]. Image Edge Detection [19] which is an image processing technique is used to detect navigation paths in maps. However when using such technology in a mobile indoor navigation app, performance issues arise. It will take a

considerable amount of time for scanning the image and will decrease the performance as this should be done iteratively.

III. ADS-INSITE: PROTOTYPE SYSTEM OVERVIEW

The research is focused at developing an 'Advertising Framework' that will consist of four vital components mentioned below. 'Social Network Connector API' that will provide the complete functionality required to access the major social network accounts of a particular user and retrieve information, 'Social Network Content Analyser' to analyse the data retrieved from one's social network account and provide a list of advertisement categories which interests the him the most, 'Advertising Web Portal' that facilitates anyone to search and retrieve advertisements of products that will hold his interest and 'Shopping Mall Mobile Application' that assists the user in finding shops of interest inside a shopping mall, along with the advertisements and the path directions to the exact location. Fig. 1 shows the high level architecture diagram of the Advertising Framework

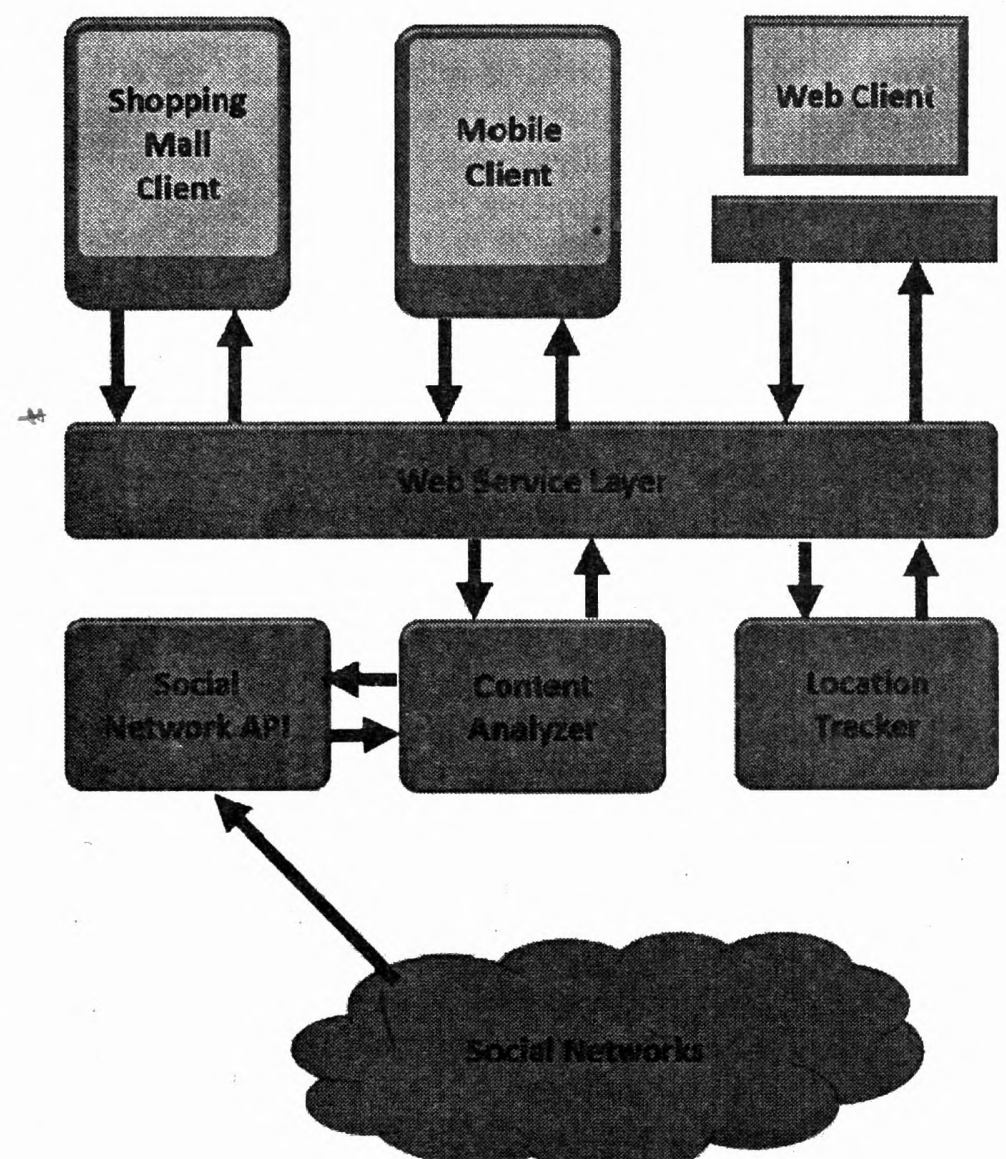


Fig. 1 System Overview

A. Social Network Connector API

One of the major outcomes of this research is an API with the combination of all major social network APIs to access any social network account that belongs to a particular user. Social Network Connector API gathers all the data that is required for extracting the relevant information for the prediction done by the Content Analyser API. The API connects with the users' profiles online or offline and gets information to the system. To interact with social network users and access user information, almost all the major social networks require creating a public application. These public applications are

created inside each social network and also combined with the implemented API. Developers simply have to create their own applications in the relevant social network, get credentials and configure the developed API. The implemented API has used all social network software development kits (sdk)[20] to communicate with public application. The API has to interact with the developer's application and register users to developer specified social network. The implemented services of the API can be accessed by calling a restful link and it will return a JSON result. The API will have a smooth interaction with mobile and web applications due to the techniques used in development. With the user's permission, the API gets all latest user details of his social network account such as the latest user profile status, home page details, likes, share details and these will be used for extracting useful information.

B. Social Network Content Analyser API

The Social Network Content Analyser API is responsible for extracting and analysing relevant information by using the data provided via Social Network Connector API. The main objective is to provide the user with a customised list of advertisements based on their preferences, which is known as targeted advertising or personalized advertising. The API consists of two components, namely the Tokenizer module and the Text analysis and Prediction module.

I) Tokenizer Module:

Information extraction techniques are used by the Tokenizer module to extract information from users' posted statuses in social networks. For each posting of the user, the API splits the posting into very simple tokens such as numbers, punctuation and other parts of speech tags and these are used for identifying patterns and making predictions about the advertisements that will interest the user. This module is responsible for providing a vector of extracted information to the Text Analysis and Prediction module. All user-related social network data is obtained based on the date and the following steps are used for creating the vector.

The first step is creating the Social Feed Term Map and the following list clarifies the procedural steps.

- Preprocess the social network feeds of the user gathered by the Social Network Connector API and identify important text for vector on the feeds.
- Tokenize and remove stop words [21] by using a Java-based tokenizer and Part-Of-Speech Tagger (POSTagger). Each social feed is separated into individual words using spaces and other special characters. Insignificant words that have no value in creating the vector are identified and removed.
- Instantiate the POS Tagger using Viterbi decoder[22] and by using parts of speech tags [23] such as adjectives, adverbs, nouns, hash tags and proper nouns.
- Perform a synonym check to improve the accuracy of the weights assigned for each and every token extracted. Java API for WordNet Searching (JAWS)[24], a widely used API with the ability to retrieve data from WordNet database is used for achieving this purpose.

- Use a business model to apply a significant weight for terms related to businesses and marketing. This is achieved by comparing the extracted terms against a set of keywords related to businesses.
- Perform stemming for social feeds [25], the process of identifying words that have same stem but some variance in order to reduce the size of the vector and improve performance.

At the end of each pre-processing task, one vector related to user and particular date will be provided as the output of the module. The third step is creating the Term-Weight Map Weighing Method, to determine the importance and relevance of each item in the vector. Each entry in the map contains terms related to a single social feed along with the weighing of that term. The weighing is performed by Term Frequency – Inverse Document Frequency [26](TF-IDF). However, the formula will output the weight as zero, if the total number of documents is equal to the number of documents that the term appears in and this will occur frequently in a small data set. Therefore, in order to prevent it, a smoothing techniques[27] is applied to the weighting

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[{Nouns & Proper Nouns: [{window: 0, air: 0}]},
{Verbs: [{look: 1, use: 2, email: 3}]},
{Adjectives and Adverbs: [{expensive: 2, perfect: 3}]},
{Numbers: [{908: 2, 2500.00: 1, 340: 1}]}
```

Fig. 2 Token Vector

method. A sample output of the Tokenizer module is shown below in Fig. 2.

II) Text Analysis and Prediction Module:

The main goal of this module is to predict a list of advertisement categories relevant to a user, based on the information extracted through the Tokenizer module. This module contains the implementation of a classification model, and it is achieved via Support Vector machines(SVM)[28]. SMO (Sequential Minimal Optimization) [29] algorithm by J. C Platt is used to implement the SVM and to classify[30] advertisement categories. Weka framework [31], which is a collection of machine learning algorithms designed for data mining tasks by the University of Waikato is been used for the implementation of the classification model for predicting the advertisement categories that the user will find interesting.

The prediction model is built with the aim of accurately classifying the advertisement categories out of the data extracted through social networks. This is achieved by modifying one of the algorithms provided in the Weka jar for training the Support Vector Machines. SVMs find an optimal solution out of all the possible solutions to identify the hyper plane that separates the different advertisement category classes available in the data and maximize the margin around the separating hyper plane [32]. The problem of finding the optimal hyper plane requires solving a very large quadratic programming (QP) optimization problem, which consumes a huge amount of time and resources. SMO breaks this large QP problem into a series of smallest possible QP problems to solve them analytically [29]. Weka provides the implementation of SMO algorithm

in the jar they provide and it is been used to achieve the purpose of this research. Developers can use the Social Network Content Analyzer API to get user related advertisement category list as a JSON result (When the developer app is integrated with other APIs). Both APIs are provided as restful web services, so any developer who is interested in getting a list of user related advertisement categories for their application, can use the implemented APIs for both mobile and web applications.

Fig. 3 describes the composition of Social Network Connector API and Social Network Analyzer API.

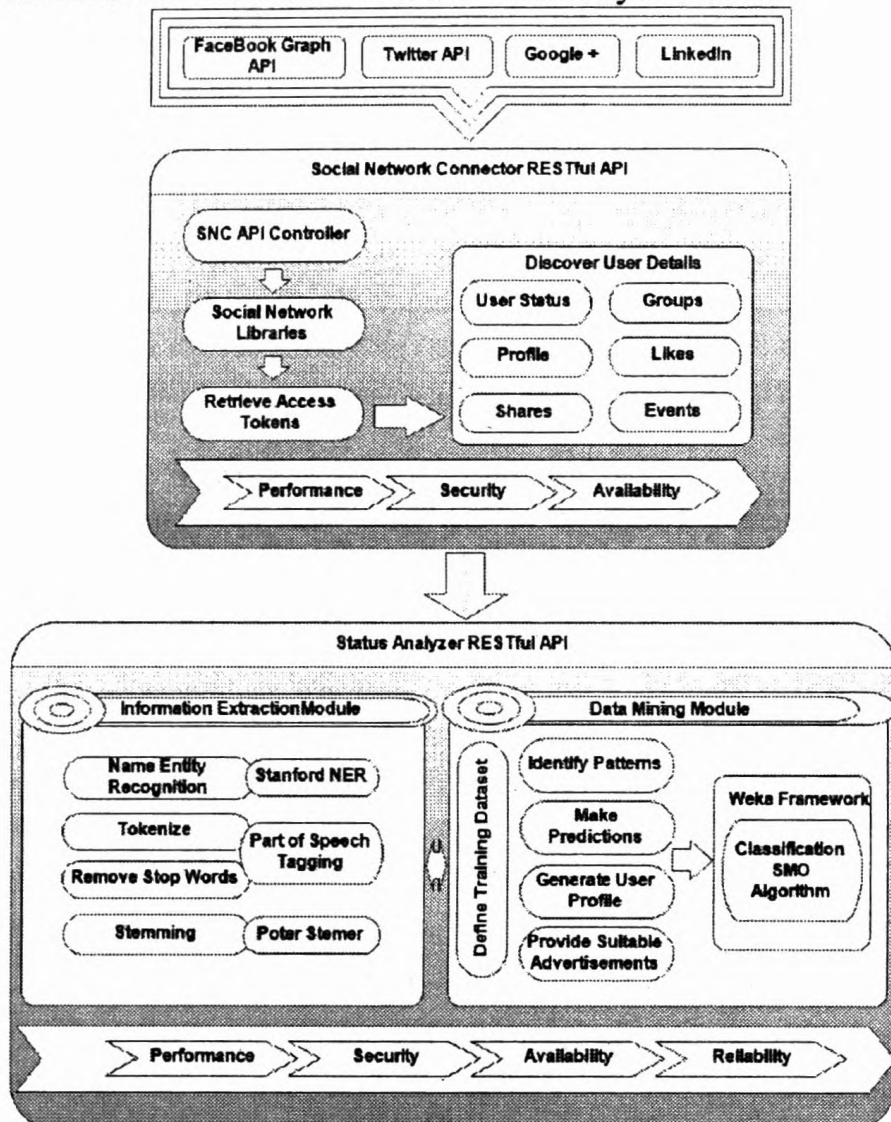


Fig. 3 Social Network Connector API and Content Analyzer API

C. Shopping Mall Mobile Application (SMAPP)

The SMAPP mobile application is unique. It will contain features where the user can navigate within the shopping mall while searching for advertisements. The search results will be filtered to match the user’s shopping perspective and taste while it is focused on retrieving the closest shops to the user.

For finding distance from the user within a shopping mall to a router configured inside the mall, the Free Space Path Loss [20] equation is used with an algorithm to overcome reductions in strength. The calculated distances from three such routers will be used to calculate the intersection point. This algorithm uses equations such as Pythagoras theorem [21] and Trigonometric functions [22]. The intersection point will signify the user location.

The process of indoor navigation requires that the shopping mall navigation path be saved within the database in the form of a set of data entries. The navigation paths per floor are required, as they differ from floor to floor. Technically Path Detection mishaps can occur. In an instance where the user is within a stall and wants to go to a nearby stall but using Dijkstra’s algorithm [23] the shortest path may not identify the situation the user is in. Therefore the resulting path may cross the stall boundary which is

incorrect. In addition to the floor navigation path, the boundary paths per stall are also saved. The logic in Dijkstra’s algorithm [23] will provide an improved procedure to deliver the accurate navigation path.

When a customer enters a shopping mall, the advertisements provided through the Social Network Content Analyzer API will be filtered by the shops registered within the shopping mall and provided to the customer. The technology of Wi-Fi has been used for the indoor location based purposes [33], [34]. For example: the prediction of the distance between the user and a router is computed based on the signal strength loss and frequency of the Wi-Fi signal. The received signal may be reduced by many environmental effects and mainly by the walls of the shopping mall. Therefore to overcome this effect an algorithm to add any reductions of ‘decibels’ will be defined, assuming that shopping malls have standard shop sizes. The final computed signal strength will be equal to the value that is encountered in a free space. This computed signal strength and the frequency of the Wi-Fi router are inputs for calculating the distance of the user from each router by means of the ‘Free Space Path Loss’ equation [35].

When determining the location of the user within the shopping mall, a minimum of 3 routers is required. Wi-Fi triangulation algorithm [36] is used for determining the user position. Once the network is set up, initially one triangle is drawn with the 3 routers. When the user position is connected to Router 2 and Router 3, another triangle can be created as shown in Fig. 4. Two right angled triangles are created by splitting the line that adjoins Router 2 and Router 3 in line with the user position.

$a_1 = \theta$ is the angle between line from Router 2 to user position and line between 2 routers

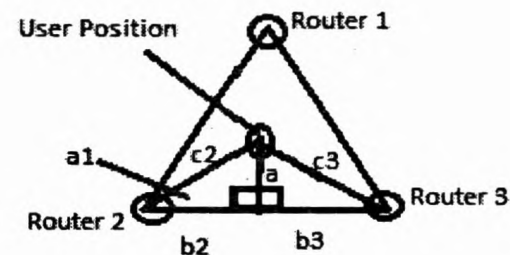


Fig. 4 Router Diagram

The distances of the lines of each triangle will be defined by variables as shown below in Table 1. The distance between 2 routers (Router 2 and 3) is taken as variable “fd”. This value gets split between the 2 right angled triangles in Fig. 4 by the equations shown below. The “z” variable is a decimal value and less than 1. Therefore one triangle will have a “z” part of the line and the other triangle will have rest. The rest sums up to be “1-z”.

Distance between Router 2 and Center = $z * fd$

Distance between Router 3 and Center = $(1 - z) * fd$

Pythagoras theorem [37] will be applied to each triangle to form a new set of equations to get value “z” as shown in Table I.

Table I Equations generated from Fig 4 triangles

Router 2 triangle $a^2 = c2^2 - (z * fd)^2$	Router 3 triangle $a^2 = c3^2 - ((1 - z) * fd)^2$
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Furthermore, these equations are simplified to form one equation as shown below. The simplification enables the computation of variable “z”.

$$c2^2 - (z * fd)^2 = c3^2 - ((1 - z) * fd)^2$$

Now the angle “a1” in Router 2 triangle in Fig.4 can be calculated as;

$$\cos a1 = b2/c2$$

$$a1 = \cos^{-1} \left(\frac{z * fd}{c2} \right)$$

From the triangles shown in Fig. 5, Triangle 1 can be used to find the height and width to the user position from Router 2. This can be found by using Triangle 2 in Fig. 5, as it creates a right angled triangle. The horizontal distance and vertical distance of Triangle 2 can be found using the x and y points of Router 2 and Router 3.

a2= Θ is the angle between distance from Router 2 to Router 3 and the horizontal line in Triangle 2 in Fig. 5.

The angle a2 can be found as the Tangent of the horizontal and vertical distances of Triangle 2. The value “c2” of Router 2 triangle in Fig. 4 which was calculated before is the same for Triangle 1 in Fig. 5. The angle of Router 1 (a1) and the angle of Triangle 2 (a2) sum up to the angle of Triangle 1 in Fig. 5 which is angle “a3”. Finally the width and height to the user position can be computed by Sin [38] of a3 and Cos [38] of a3 in Fig.5.

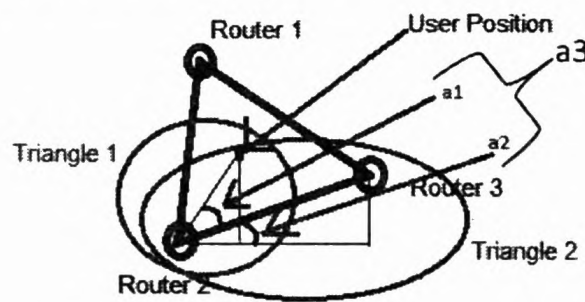


Fig. 5 Position of User

In order for this whole process to take place, the users have to be within range of the shopping mall routers and also all routers have to be up and running. For navigation within the shopping mall, the currently used concept is to allow the mall owner to save the path of each floor. SMAPP will then access the path to find shortest path to the shop by running Dijkstra’s algorithm [39]. Initially the shopping mall owner will be given a floor map template at shopping mall registration. After the floor map is created it can be edited to add the navigation path as shown below in Fig.6 as the rectangle around the shop and the pointers where shops within the shopping mall can register.

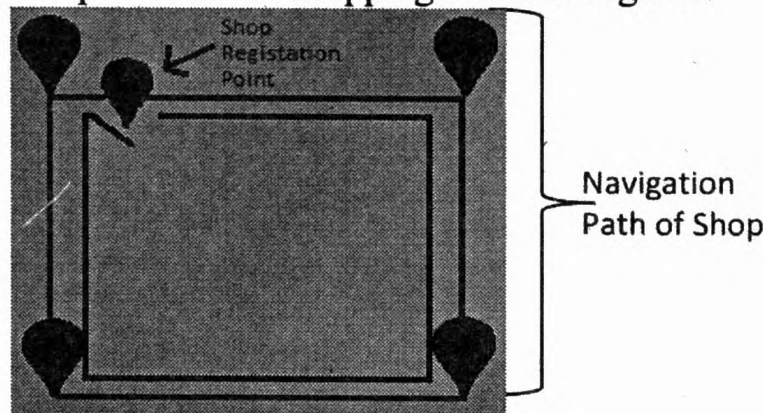


Fig. 6 Template Mall Image

The directions to the shop the user requests will be displayed on the shopping mall map. The user can follow the directions to the destination shop.

D. Advertising Portal and GPS Tracker (Location Tracker)

Out of the many location tracking systems available, GPS is the most popular and accurate location tracking technique for outdoor navigations [40][41]. User’s mobile device, where the mobile application is up and running, will be used to achieve location based advertising aspects. Once the geo-location is received, system will find a set of advertisements of closely located shops. In order to calculate the distance and find advertisements, an SQL query based on Haversine formula [42] will be used.

Even though smartphone usage nowadays has increased very rapidly, there is no guarantee that the user’s geo-location can be detected using his smartphone, whenever required. In order to achieve efficient results, this gap has to be filled. As a solution, this research proposes a new method to predict user’s geo-location by identifying a daily travel path of the user.

Identifying a path is done by the method mentioned below. The application will detect user’s geo-location using a mobile device, whenever the GPS connection is available. These details will be saved in a data warehouse for further analysis.

System will find the longitude and latitude values with the highest number of occurrences for each time interval. To find this value, all longitude and latitude values will be rounded to 0.000005. If this does not contain any value with 50% occurrences of total values, rounding value will be multiplied by two. This process will run until the rounding value reaches 0.01024. If not, the system will decide that there is no sufficient data to predict the user’s location on the particular time interval. Since this algorithm considers only on the highest number of occurrences, any deviation from the traditional travel path will not effect on the predicted travel path. These data will be saved in OLDB (Online Database), so that the system will be able to predict the user’s location using these details.

Retrieving the location is performed as described below. If user’s GPS connection is accessible when required, system can get the location using user’s mobile application. If not, still system will be able to predict it since the analyzed data will be there in the OLDB. But even though some locations of the user have been recorded, still there can be some empty time slots. This research proposes the following method to find the users geo-location using available amount of data.

In the following example shown in Table II, it is assumed that the system has to find a non-existing geo-location of a user at 9:30 AM.

Table II Example OLDB

time_interval	longitude	latitude
08:00 AM	79.984088	6.935855
08:30 AM	NULL	NULL
09:00 AM	NULL	NULL
09:30 AM	NULL	NULL
10:00 AM	79.929156	6.908078

It is assumed that the user will be moving through a straight line from A to B as shown in figure 7 and figure 8, the two locations that have been identified already, in same velocity. The location at 09:30 AM can be found using the technique described below.

Firstly, the current time is rounded to 5 minutes (In this example, 30 minutes time intervals are considered). If the value for the current timeslot is not available, then the system will look for the last non-empty time slot before the current time slot. In this example, longitude value will be 79.984088 at 08:00 AM. Then the system looks for the first non-empty time slot after current time slot. In this example, its longitude value will be 79.929156 at 10 AM. Now the system will calculate the user's geo-location for the current time slot using following formula.

$$longlat = (((G_n - G_p) / (T_{dp} + T_{dn})) \times T_{dp}) + G_p$$

G_n - GPS coordinate of next time slot

G_p - GPS coordinate of previous time slot

T_{dp} - time slot difference between previous time slot and current time slot

T_{dn} - time slot difference between next time slot and current time slot

In this formula, first the distance for a one time interval will be retrieved. Then, it will be multiplied by the number of time slots from the time slot of last known location, then will be added to the last known location to find the predicted location.

In this example, algorithm will give the users location as 6.915022, 79.942889, while the actual location of the user will be 6.905649, 79.948811 as shown in Fig. 7.

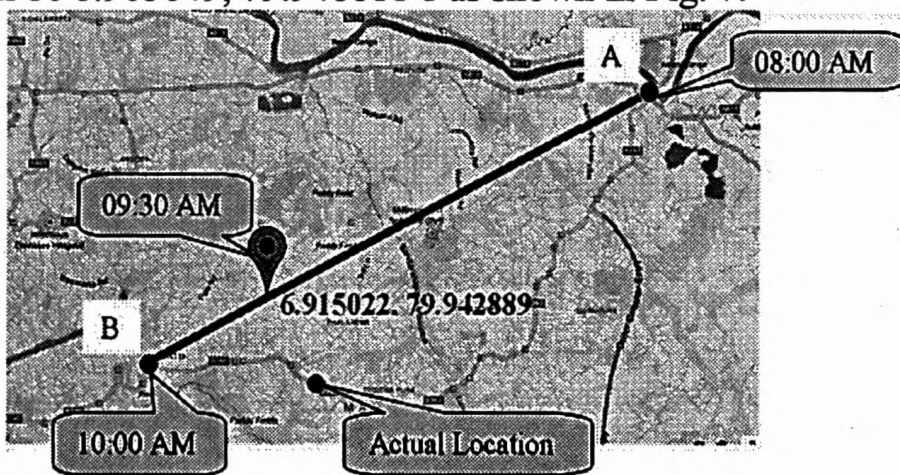


Fig. 7 Predicted geo-location 1

This method will become more and more accurate with the time, since the empty time slots will be filled with time. If the value for the user at 09:00 AM was found later, new 09:30 AM location will be predicted as illustrated in Fig. 8.

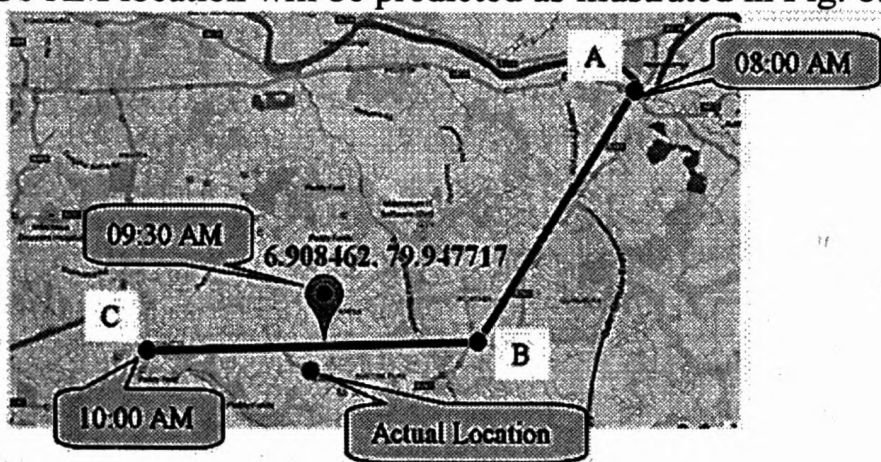


Fig. 8 Predicted geo-location 2

By using this method with 5 minutes time intervals, the system will be able to predict user's locations more accurately. Therefore the system can identify the location of the user, when GPS connection is not available and the raised research gap will be filled with the usage of this method.

IV. DISCUSSION AND EVALUATION

The developed Advertising Framework is currently in the stage of further improvement through evaluation. The four major outcomes of the research are evaluated separately.

Social Network Content Analyser API was trained initially with a training set of social network feeds along with their corresponding advertisement categories. Once the prediction model is built, the authors tested the API with a testing data set for evaluation. Testing the model was performed under stages, each stage aimed at identifying the effectiveness of the modifications done for the initial API. The modifications consist of the alterations in the weighing method done through smoothing techniques and introduction of the synonym checker. Table III demonstrates the calculated accuracy of each and every stage.

Table III Accuracy of Prediction

Features	Accuracy
Prototype Weighing Method + Prototype Vector	40% - 50%
Improved Weighing Method + Term Vector + Synonym check	65% - 70%

Daily movement identifier is tested using several users with their day-to-day movements, and module was resulted 67% of accuracy level, which is reasonably acceptable but needs to be improved.

In the Shopping Mall Navigation Application, the movement of the mobile device affects the positioning. As SMAPP is programmed to run in a shopping mall environment, its accuracy reduces when used in an environment with hard walls. The position shown is 75% accurate within a shopping mall with walls made of hard partitions, excluding materials such as brick or concrete. Routers that produce the same signal strength or with less deviation provide an efficient output. The web module that supports SMAPP indoor navigation is modelled to save the floor navigation paths and boundary paths of stalls.

V. CONCLUSION AND FUTURE WORK

This research is carried out with the aim of building a system that can reach the consumers with suitable advertisements on their preferences, based on social network contents. Since the mobile and the web application usage are rapidly been increasing, these technologies are used to fulfill the gap between the advertisers and consumers. In order to maximize the efficient usage of the system, useful APIs are implemented to reach consumers such as social network analyzer and the daily movement identifier.

The next phase of this research is to evaluate the accuracy of the framework as a whole. Once evaluated completely, the authors of this paper are expecting to pursue ways to improve the accuracy of the framework. The SMAPP module is to be developed further with the aim of automatic prediction of the shopping mall navigation, when the customer is on the move using Image Edge Detection [19]. The aim is to scan the image and identify the

edges in the image. Next from the user's current location predict the path such that no edges are intersected and it becomes the shortest path.

REFERENCES

- [1] E. A. T. D. Edirisinghe, G. Guruparan, R. A. S. M. Rupasinghe, N. J. A. H. S. Perera, P. S. Haddela and A. Kirupananda, "Location Based Advertising Framework for Mobile and Web Developers in Sri Lanka," in *International Conference on Advances in ICT for Emerging Regions*, Colombo, 2013.
- [2] S. R. Gunarathne, J. De Silva, E. M. C. P. Ekanayake, I. Samaradiwakara, P. S. Haddels and P. A. Fernando, "Intellemo: A mobile instant messaging application with intelligent emotion identification," in *8th IEEE International Conference on Industrial and Information Systems*, Peradeniya, 2013.
- [3] J. De Silva and P. S. Haddela, "A term weighting method for identifying emotions from text content," in *8th IEEE International Conference on Industrial and Information Systems*, Peradeniya, 2013.
- [4] L. Betancourt, "How Companies Are Using Your Social Media Data," 02 March 2010. [Online]. Available: <http://mashable.com/2010/03/02/data-mining-social-media/>. [Accessed 10 March 2014].
- [5] C. Boorman, "Why Data Mining Is the Next Frontier for Social Media Marketing," 25 February 2011. [Online]. Available: <http://mashable.com/2011/02/25/data-mining-social-marketing/>. [Accessed 02 March 2014].
- [6] T. Wasserman, "Facebook Now Tracks Consumers' Retail Purchases," 24 September 2012. [Online]. Available: <http://mashable.com/2012/09/24/facebook-tracking-retail-purchases/>. [Accessed 20 March 2014].
- [7] "Forsight Platform Overview," Crimson Hexagon, 2014. [Online]. Available: <http://www.crimsonhexagon.com/>. [Accessed 10 March 2014].
- [8] "Crimson Hexagon BrightView Algorithm," 2014. [Online]. Available: <http://www.crimsonhexagon.com/social-media-intelligence/brightview-algorithm>. [Accessed 02 April 2014].
- [9] K. Klein, "Google Updates: Brand in Analytics, Powerful Location Segmenting, and AdMob," 27 June 2014. [Online]. Available: <http://www.ppchero.com/google-updates-brand-in-analytics-powerful-location-segmenting-and-admob/>. [Accessed 02 July 2014].
- [10] "Focus: Pinpointed Audience Targeting," Millennial Media, 2014. [Online]. Available: <http://www.millennialmedia.com/advertise/targeting/>. [Accessed 03 July 2014].
- [11] "iOS 7: Understanding Location Services," 12 May 2014. [Online]. Available: <http://support.apple.com/kb/HT5594>. [Accessed 10 March 2014].
- [12] "About Facebook Ads," 2014. [Online]. Available: <https://www.facebook.com/about/ads/>. [Accessed 26 July 2014].
- [13] "The Power of Mapping," [Online]. Available: <http://www.esri.com/what-is-gis>. [Accessed 20 April 2014].
- [14] A. Caputo, "WiseSec Protects Users When Shopping On-the-Go," 09 January 2013. [Online]. Available: <http://www.mobilitytechzone.com/topics/4g-wirelessevolution/articles/2013/01/09/322228-wisec-protects-users-when-shopping-on-the-go.htm>. [Accessed 10 June 2014].
- [15] "FastMall - Shopping Malls, Community & Interactive Map," 14 November 2013. [Online]. Available: <https://itunes.apple.com/lk/app/fastmall-shopping-malls-community/id340656157?mt=8>. [Accessed 21 May 2014].
- [16] "WiFiSLAM," 16 April 2013. [Online]. Available: <https://angel.co/wifislam>. [Accessed 20 June 2014].
- [17] K. Kloosterman, "Find your way around the mall with Mally," 01 December 2013. [Online]. Available: <http://www.israel21c.org/headlines/find-your-way-around-the-mall-with-mally/>. [Accessed 10 February 2014].
- [18] J. Fleet, "Lost in the shopping mall? Israeli Innovators map future of indoor GPS," 17 September 2013. [Online]. Available: <http://www.jpost.com/Business/Business-Features/Lost-in-the-shopping-mall-Israeli-innovators-map-future-of-Indoor-GPS-326372>. [Accessed 5 July 2014].
- [19] B. L. Ecklbauer, "A Mobile Positioning System for Android based on Visual Markers," *Mobile Computing*, p. 91, June 2014.
- [20] "Facebook SDK for PHP," [Online]. Available: <https://developers.facebook.com/docs/reference/php/4.0.0>. [Accessed 02 February 2014].
- [21] K. Gimpel, N. Schneider, B. O'Connor, D. Das, D. Mills, J. Eisenstein, M. Heilman, D. Yogatama, J. Flanigan and N. A. Smith, "Twitter NLP and Part-of-Speech Tagging," 2011. [Online]. Available: <http://www.ark.cs.cmu.edu/TweetNLP/>. [Accessed 29 March 2014].
- [22] M. I. o. Technology, "Viterbi Decoding of Convolutional Codes," Massachusetts Institute of Technology, Cambridge, 2010.
- [23] K. Gimpel, N. Schneider, B. O'Connor, D. Das, D. Mills, J. Eisenstein, M. Heilman, D. Yogatama, J. Flanigan and N. A. Smith, "Part-of-Speech Tagging for Twitter: Annotation, Features, and Experiments," in *49th Annual Meeting of the Association for Computational Linguistics*, Oregon, 2011.
- [24] "Java API for WordNet Searching (JAWS)," 24 December 2009. [Online]. Available: <http://lyle.smu.edu/~tspell/jaws/>. [Accessed 20 August 2014].
- [25] M. F. Porter, "An algorithm for suffix stripping," *Program: electronic library and information systems*, vol. 14, no. 3, pp. 130-137, 1980.
- [26] S. Robertson, "Understanding inverse document frequency: on theoretical arguments for IDF," *Journal of Documentation*, vol. 60, no. 5, pp. 503-520, 2004.
- [27] S. F. Chen and J. Goodman, "An Empirical Study of Smoothing Techniques for Language Modeling," in *Center for Research in Computing Technology*, Massachusetts, 1998.
- [28] M. Hall, "Data Mining with Weka (4.5: Support vector machines)," University of Waikato, New Zealand, 2013.
- [29] J. C. Platt, "Sequential Minimal Optimization: A Fast Algorithm for Training Support Vector Machines," Microsoft Research, 1998.
- [30] M. Abernethy, "Classification," 11 May 2010. [Online]. Available: Data mining with WEKA, Part 2: Classification and clustering. [Accessed 16 February 2014].
- [31] "Use WEKA in your Java code," [Online]. Available: <http://weka.wikispaces.com/Use+WEKA+in+your+Java+code>. [Accessed 10 February 2014].
- [32] R. Berwick, "An Idiot's guide to Support vector".
- [33] "Wi-Fi Wireless Networks and Technology," [Online]. Available: <http://compnetworking.about.com/od/wireless/>. [Accessed 01 June 2014].
- [34] W. Gordon, "Top 10 Uses for Wi-Fi (That Aren't Just Connecting to the Internet)," 23 October 2010. [Online]. Available: <http://lifelacker.com/5671482/top-10-household-uses-for-wi-fi-that-arent-just-connecting-to-the-internet>. [Accessed 25 May 2014].
- [35] R. Miller, "Part 1: Wifi-based trilateration on Android," May 2013. [Online]. Available: <http://rvmillier.com/2013/05/part-1-wifi-based-trilateration-on-android/>. [Accessed 07 May 2014].
- [36] "Wifi position triangulation," 10 May 2013. [Online]. Available: <http://stackoverflow.com/questions/16485370/wifi-position-triangulation>. [Accessed 07 May 2014].
- [37] S. J. Morris, "The Pythagorean Theorem," [Online]. Available: http://jwilson.coe.uga.edu/emt669/student_folders/morris.stephanie/emt.669/essay.1/pythagorean.html. [Accessed 11 10 2014].
- [38] D. E. Joyce, "Summary of trigonometric identities," 1997. [Online]. Available: <http://www.clarku.edu/~djoyce/trig/identities.html>. [Accessed 11 10 2014].
- [39] M. Bhojasia, "Java Program to Implement Dijkstra's Algorithm using Set," 2014, [Online]. Available: <http://www.sanfoundry.com/java-program-implement-dijkstras-algorithm-using-set/>. [Accessed 11 10 2014].
- [40] S. P. Gupta, "Study of Variuos Location Tracking Techniques for Centralized Location, Monitoring and Control," in *IOSR Journal of Engineering (IOSRJEN)*, Mumbai, 2014.
- [41] R. S. S. R. Rasool, "24 Hours GPS Tracking in Android Operating System," in *International Journal of Scientific and Research Publications*, 2014.

- [42] "Creating a Store Locator with PHP, MySQL & Google Maps," August 2009. [Online]. Available: https://developers.google.com/maps/articles/phpsqlsearch_v3. [Accessed 26 July 2014].
- [43] O. Developers, Itseez, 2014. [Online]. Available: <http://opencv.org/>. [Accessed 11 10 2014].
- [44] "How to identify Name, Location and Organization in a text in java?," [Online]. Available: http://preciselyconcise.com/apis_and_installations/name_entity_recognition.php. [Accessed 03 June 2014].