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Mall Map Application with Indoor Positioning and Navigation
(An android Based Mobile Application)

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ABSTRACT

The purpose of this paper is to describe the study of literature survey done on shopping related campus navigation applications. The Mall Map is an android based mobile application which helps the user to position and navigate inside the shopping malls. This application proposed to enhance the shopping experience of customer by providing floor map layouts, user's current location in the mall, store's location on map, path from user location to shop, navigating by showing graphical shortest path on map. Shop information such as shop name, location, categories, products availability and description will be provided in the application. Users can use this application inside the mall campus for navigating themselves to the desired locations. User can also use this outside the shopping mall campus for searching products availability in particular mall by using search option. It will be developed by using android and sever side module which will act as main database to connect with the customers and shop owners. This project is based on concept of indoor maps, In this project wireless communication technique –Wi-Fi is used to identify the location of the user inside the building.

Keywords: Indoor positioning, Indoor navigator, mall directory, indoor maps, android shopping application.

I. INTRODUCTION

The requirements of shopper's are increasing day by day for various products, brands and goods, the best place to shop all those things are in shopping malls, where they get everything under one roof. The building infrastructures of these Shopping malls are such huge that they may consist of various floors, numbers of shops and variety of products to buy, which causes difficulties to customer for finding desired shop or product in these buildings.

The maps in the current market are static paper maps attached on board in one corner which are difficult to understand and read all the times. One need to look all over the map for finding needed shop in the mall. These maps are difficult to maintain over a period of time also the updating of map will result into recreation of whole paper map. Mall Map application is intended to fill this void. It is designed to be run on smart phones making it easily accessible to users. This application will assist the user in finding the desired shop, check the availability of the products. The locations of the shops will be fixed on map as per the shops are situated in mall. The map will include a feature which provides details of the stores in the mall if a customer wants to search about a specific product or offers in the mall.

This application will be able to identify the location of the user in map. User can find the shortest path to the destination by using navigation feature of application. This application uses Wifi (wireless communication technique) for identifying user's location. User's location will be identified by the received signal strength indicator (RSSI) from mobile device.[1][2][6][7][8][10]. Mall Map application aims to provide a user-friendly Graphical User Interface (GUI) that can be used on smartphones that run on the Android OS. The Mall Map Application will provide the user real time information on where the shop is located and the product information from the shops. It interacts with a Server to obtain the shop's information. Once this information is received by the application it will display this information in an easy-to-understand way to the user. Mall Map is a simple shopping mall

application. The mall map will provide a great shopping experience to a customer.

II. METHODS AND MATERIAL

1. Positioning Techniques

This section presents the various indoor positioning techniques that are appropriate for WiFi devices. The majority of the available research is focused on trilateration using the RSSI signal for calculating distances although several fairly recent articles have explored a cell based approach. Research is also being done on fingerprinting techniques.[6][12]

A. Fingerprinting

Fingerprinting uses the RSSI values of a group of devices to create a signature (Fingerprint) of a specific location. This is done by storing these values, along with the addresses of their corresponding devices, in a database. Once several Fingerprints of different locations are created, continuous scans are performed and a runtime Fingerprint is generated every time. This last one is then compared to each one of the saved Fingerprints in order to obtain the closest match which represents the location where the user is.

Fingerprinting offers reasonable accuracy and is easy to implement. In the case of Wi-Fi [4], existing APs in a building are used. One disadvantage, however, is that the availability of the APs used to create the Fingerprint cannot be assured. Even though this issue can be easily addressed by replacing missing RSSI values with arbitrary measurements, this could decrease the accuracy significantly, especially if more than one of these values is missing.

BLE Beacons are also used for Fingerprinting [2]. They can be positioned strategically in order to obtain as many necessary readings as possible and offer lower power consumption. Having dedicated devices for this purpose is definitely favourable; however, a large quantity of them must be purchased in order to cover a large area.

Regardless of the type of signal being used, Fingerprinting has some drawbacks. First of all, the collection of Fingerprints around a building is time-consuming. While using Beacons, a survey of the building is needed to be done to evaluate the best locations to place. Changes in the building can also affect the signal readings and many times the Fingerprints need to be re-calibrated.

2. Algorithms:

A. Dijkstra's algorithm

Dijkstra's algorithm is an algorithm used for finding the shortest paths between nodes in a graph, which may represent, for example, road networks. It was conceived by computer scientist Edsger W. Dijkstra in 1956 and published three years later

The algorithm exists in many variants; Dijkstra's original variant found the shortest path between two nodes, but a more common variant fixes a single node as the "source" node and finds shortest paths from the source to all other nodes in the graph, producing a shortest-path tree.

For a given source node in the graph, the algorithm finds the shortest path between that node and every other. It can also be used for finding the shortest paths from a single node to a single destination node by stopping the algorithm once the shortest path to the destination node has been determined.

Pseudo code

The code u ← vertex in Q with min dist[u], searches for the vertex u in the vertex set Q that has the least dist[u] value. length(u, v) returns the length of the edge joining (i.e. the distance between) the two neighbour-nodes u and v. The variable alt on line 17 is the length of the path from the root node to the neighbour node v if it were to go through u. If this path is shorter than the current shortest path recorded for v, that current path is replaced with this alt path. The prev array is populated with a pointer to the "next-hop" node on the source graph to get the shortest route to the source.[13][14][15]

function Dijkstra(Graph, source)
create vertex set Q
for each vertex v in Graph
dist[v] ← INFINITY
prev[v] ← UNDEFINED// Previous node in optimal path from source 8 add

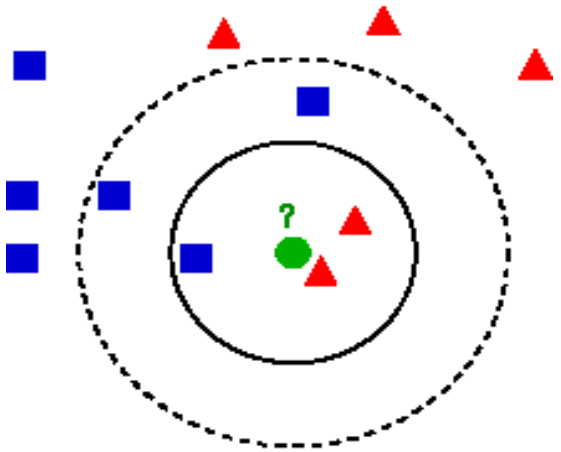
v to Q
dist[source] ← 0 // Distance from source to source
while Q is not empty:
u ← vertex in Q with min dist[u] // Node with the least distance will be selected first
remove u from Q
for each neighbor v of u: // where v is still in Q.
alt ← dist[u] + length(u, v)
if alt < dist[v]: // A shorter path to v has been found
dist[v] ← alt
prev[v] ← u
return dist[], prev[]

B. k- Nearest Neighbours Algorithm

The k-nearest neighbour's algorithm (k-NN) is a non-parametric method used for classification and regression. In both cases, the input consists of the k closest training examples in the feature space. The output depends on whether k-NN is used for classification or regression:

In k-NN classification, the output is a class membership. An object is classified by a majority vote of its neighbours, with the object being assigned to the class most common among its k nearest neighbours If k = 1, then the object is simply assigned to the class of that single nearest neighbour.

n k-NN regression, the output is the property value for the object. This value is the average of the values of its k nearest neighbours.



Pseudo code

Classify (X,Y,x) // X training data, Y class labels of X,
x: unknown Sample.
For i=1 to m do
Compute distance d(Xi, x)
End for
Compute set I containing indices for the k smallest distance d(Xi, x).
return majority label for {Yi where i ε I}

Example of k-NN classification: The test sample (green circle) should be classified either to the first class of blue squares or to the second class of red triangles. If k = 3 (solid line circle) it is assigned to the second class because there are 2 triangles and only 1 square inside the inner circle. If k = 5 (dashed line circle) it is assigned to the first class (3 squares vs. 2 triangles inside the outer circle).

3. Softwares:

Andriod Studio:-

Android Studio is the official integrated development environment (IDE) for the Android platform. Applications are usually developed in Java programming language using the Android software development kit (SDK), but other development environments are also available.

Node.JS:-

Node.js is an open-source, cross platform JavaScript runtime environment for executing JavaScript code server-side, and uses the Chrome V8 JavaScript engine. The version 6.5.0 is being used for server scripting in the system.

PostgreSQL

PostgreSQL, often simply Postgres, is an object-relational database (ORDBMS) – i.e. an RDBMS, with additional (optional use) "object" features – with an emphasis on extensibility and standards compliance. As a database server, its primary functions are to store data securely and return that data in response to requests from other software applications. It can handle workloads ranging from small single-machine applications to large Internet-facing applications with many concurrent users; on macOS Server, PostgreSQL is the default database; and it is also available for Microsoft Windows and Linux.

Postman

The Postman Rest Client is a very popular and easy to use HTTP Request composer that makes it easy to call web services, similar to Fiddler's Composer. It also provides as an alternative for auto generating API documentation to Service Stack's Swagger support that makes it easier to call existing services but does require users to install the Postman Rest Client. Postman is a tool chain for API developers to share, test, document and monitor APIs.

III. RESULTS AND DISCUSSION

The propose system consists of two panels viz., the admin panel and the user panel. The admin panel has the authority to make desired changes in the data that is fed in the application where as the user can access the data provided. The user can locate their current position, navigate them from one position to another as well as search for desired products. The above functionalities are shown in the figures that follow.

As after the necessary work is done by the admin such as placing shops on map, including products, training the system for locating and navigating user, while deploying the application, now the user can use the application by their side.

Fig (a) shows the User Interface at the customer's side. It displays the list of malls that are located in particular vicinity. The user can select the mall by tapping on the name. Once the user selects the mall, the application takes the user to the floor list.

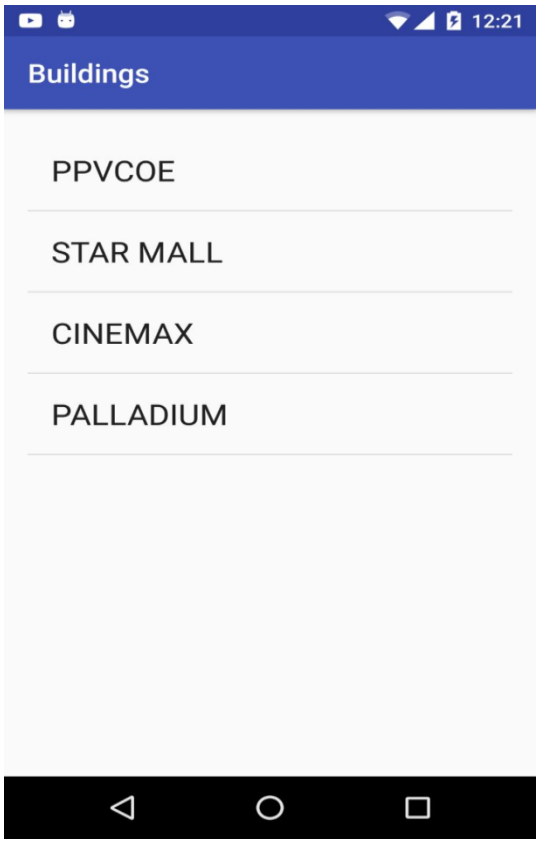


Fig (a):- Building Selection

The figure (b) displays the list of floor that the mall has. If the user wants to locate him/her based on the current location the application provides a feature including the same.

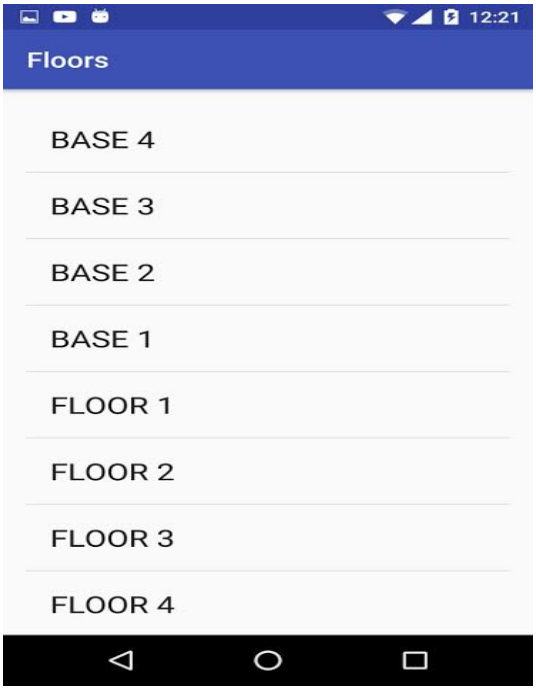


Fig (b):- Floor Selection

Fig (c) shows the current location of the user. The blue circle at the right bottom of the screen helps the user to locate them.

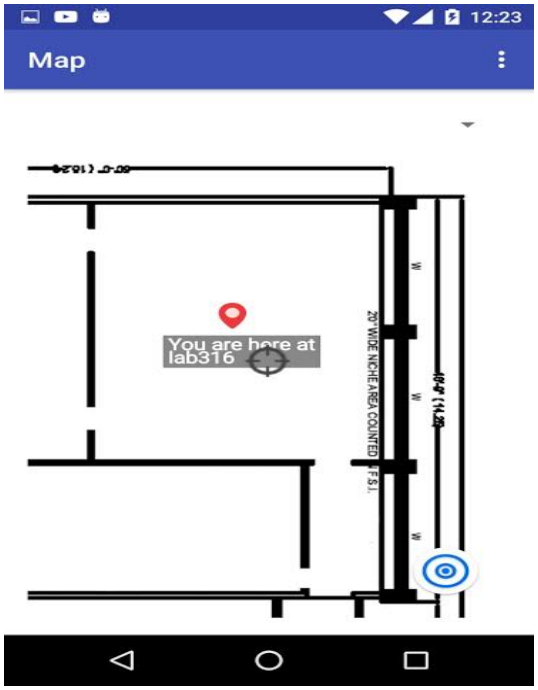


Fig (c):- Current Location

Fig (d) shows the path from user's source to their destination. The user has to select the destination from the drop down menu. After selecting, the application will display the path and navigate the user to the destination.

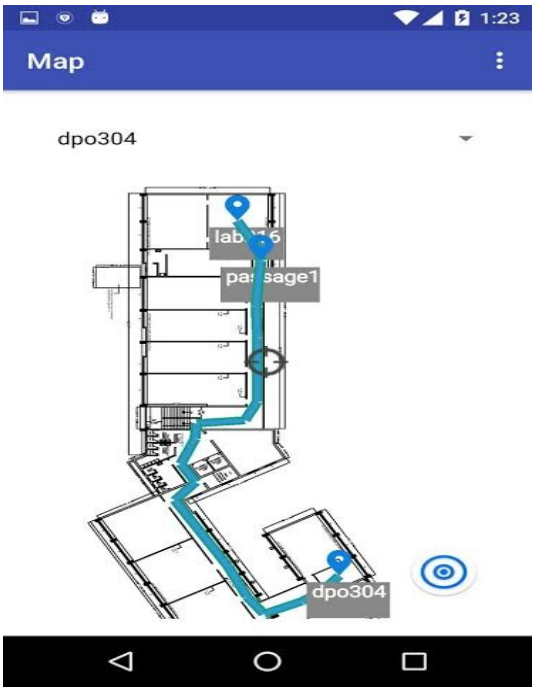


Fig (d):- Navigation

Fig (e) displays the product list that a shop consists of. It displays the list of products with their price and the offers that are on going on the products and in the shop.

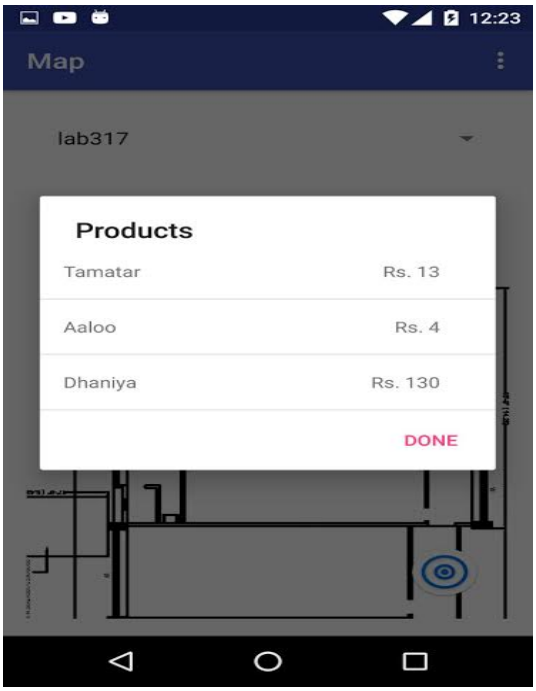


Fig (e):- Product List

IV.CONCLUSION

The conclusion that can be drawn from the above is that using indoor maps with position and navigation in the shopping malls will help the customer to locate the shops easily and enhance their shopping experience with various features of the application.

The creation of digital maps instead of static paper maps will be less efforts consuming, with low maintenance it will be cost efficient for the developers of the map.

This application will assist the user in finding the desired shop, also see the products whether available or not with offers available in it. The locations of the shops will be static as per the shops are situated in mall. The map will include a feature which provides details of the stores in the mall if a customer wants to search about a specific product or service in the mall.

Mall Map application aims to provide a user-friendly Graphical User Interface (GUI) that can be used on smartphones that run on the Android OS. The Mall Map Application will provide the user real time information on where the shop is located and the product information from the shops. It interacts with a

Remote Server to obtain the shop's information. Once this information is received by the application it will display this information in an easy-to-understand way to the user.

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