Customizable Indoor Navigation and Location System

Tejas Patil[1], Amit Mishra[2], Himani Rana[3], Sayali Choudhari[4]
Computer Department
P.D.E.A's COEM
Pune, India
[1]tejaspatil52@gmail.com ,[2] amitkm492@gmail.com,[3] himanirana05@gmail.com,[4] sayali.choudhari10493@gmail.com

Abstract— **Over last years, Indoor Positioning and Navigation Systems (IPNS) has been subject of intense study and research ought to it have become a blind spot with regard to Positioning and Navigation Software. None of proposed indoor solutions has been as successful as outdoor systems like Global Position System (GPS). Our proposal presents the design and implementation on mobile device(android phones), of a customizable indoor location and navigation system for indoor based on the use of Bluetooth (BT) radio technology and implemented using Java and J2ME, this implementation is adaptable to whatever indoor environment (commercial centers, offices, museums, etc.) previously modeled and loaded. Location is implemented on BT with distributed estimation (the mobile device performs it).We will be making a customizable indoor location and navigation system. This model will be generic so that the end user won't have to get a new mobile application designed every time for a new premise.**

Keywords—Bluetooth, Dijkstra's, Triangulation

I. INTRODUCTION

Many applications require Knowledge about the environment to locate and identify the position of an entity (user, device, and so on), some areas where these needs can be found from industry [1], e-marketing [1], health and emergency services [1] to automatic activation services. An important part of these environments is the use of location systems, identification and navigation targeted to mobile devices with wireless capability, which enable to use applications automatically based on an authorization given by the user previously located in a certain position within the system coverage area. Positioning and Navigation Systems (IPNS) has been subject of intense study and research ought to it have become a blind spot with regard to Positioning and Navigation Software. None of proposed indoor solutions has been as successful as outdoor systems like Global Position System (GPS).Location is implemented on BT with distributed estimation (the mobile device performs it). A routing algorithm calculates the optimal path from user position to destination. This has been implemented in a Bluetooth-capable handheld device. We will be developing a customizable indoor location and navigation system based on Bluetooth. We will be developing an Android application which will be used by the user to find his position in an indoor environment such as colleges, malls, museums, or any companies. The range estimation of the positioning system is based on an approximation of the relation between the RSSI (Radio Signal Strength Indicator) and the associated distance between sender and receiver. The actual location estimation is carried out by using the triangulation method.

II. EXISTING SYSTEM

The existing system presents the design and implementation of the indoor navigation on mobile phones. This system uses Bluetooth (BT) radio technology and is implemented using Java and J2ME.This system also uses 3D modeling techniques to present very interactive results to the user on the end user side of this system and can be built using the most common 3D design tools with M3G formats support.
KNN method was used to calculate locations, keeping in mind that the system is running on mobile devices. This method requires few computational resources and provides good results in terms of estimation of the location and approach. Other feature required is portability, that's why several languages and development tools were analyzed (C, C++, C, J2ME and Android) and their support to BT and 3D modeling.
The existing system uses Blender (3D modeling technique) although the user interface is less friendly and there are few clear references about the generation of models compatible with the JSR-184. It is free, robust, multi-platform, widely used and whose export plug-in M3G model is more complete.

Even though this existing system has some positive sides it also has some drawbacks. The major drawbacks of this system are Adaptability, this system cannot adapt to the indoor environments, Usability; any novice user cannot use it, and moreover this system does not meet the technological needs. Hence to overcome these drawbacks, we are implementing a solution that meets the above factors which are missing in the existing system. Moreover we have also thought of another factor that may add a plus point to our system is scalability. In the near future our system will play a very crucial role in advancement of the technology as our system meets the required technological needs. It can also be deployed in any indoor environment.

III. PROBLEM DEFINITION

The previous system gave the user's current location in an indoor environment and it used 3D techniques for better results which was not needed and moreover the system was not customizable means if the user goes from one floor to other the system failed because the system was developed only for one floor and the researchers also failed to check the aspect of the scalability. So to overcome we thought of implementing

a customizable indoor navigation and location system which will be not for one particular floor but for an entire building. If the user goes from one floor to another then the user just needs to select the map of the respective floor and the system will work without any constraints. If we want to develop the same system for another indoor environment then we just need to load the Blueprint of that building.

IV. PROPOSED SYSTEM

A. Android System

Strongly inspired by the above implemented system we designed our system to overcome the drawbacks of the already implemented IPN's. We developed our system using Bluetooth[5][9] and it is not restricted to be used for one particular room. This system can be used for an entire building .For that purpose we have to load the images or the blue prints of various areas or floors so that we can generate a map of the same on the user side. The key reason for using the Bluetooth is that it has low packet loss than compared to Wi-Fi and moreover Bluetooth is used for a private network. It is also available at a cheaper rate .The system consists of three modules namely Desktop module, Bluetooth module and the mobile module.

The Desktop module is managed by the administrator of the system. All the work that is to be performed by the administrator such as setting up of BT devices or modems, managing links between them and the computation of the shortest path is accomplished by using the Desktop module. And finally all these mappings are then stored in a file named map.dat which is made available to the user of this system along with the .apk file (Extension for the android application). The application is then broadcasted via Bluetooth/Wi-Fi/FTP/Internet. The user can download the application accordingly and then install and run the application. When the user wants to use the application the user needs to select a proper source and destination and then can see the map highlighting the shortest path to reach destination from the selected source. For this the user must keep his mobile's Bluetooth in the discoverable mode so that the BT devices around the user will be able to discover the user. The most important thing is that there will not be Two-way communication taking place between the user and the BT devices, there will be only one –way communication between the BT devices and the user. Also the user's current location will be given depending on his presence in the range of the BT devices.

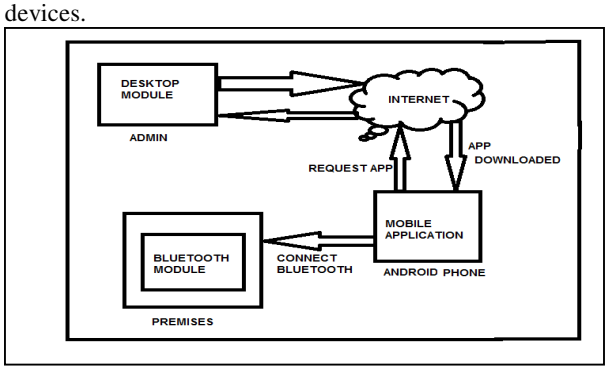

Fig. 1. System Modules

B. Algorithm's

1) Dijkstra's Algorithm:

The Dijkstra's algorithm is mathematically proven to find the shortest path.

This algorithm will be used to calculate shortest path from user current position to destination.

Solution to the single-source shortest path problem in graph theory

Both directed and undirected graphs

All edges must have nonnegative weights

Graph must be connected

2) Triangluation:

Uses the geometric properties of triangles to compute object locations.

This method will be used to find the user location more accurately

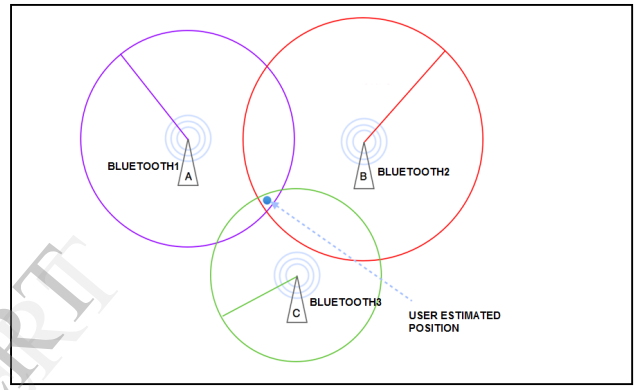

Fig. 2. Triangulation.

C. System Features

1) Customizable:

Means the user has to just select the map according to his field. For e.g., the entry and exit points for the vehicles may be different for the staff and the customers. Therefore depending upon the user selection different maps would be shown to the user.

2) Generic:

This system is generic means it can be used anywhere irrespective of the indoor environment. For e.g., this system can be deployed in the malls, hospitals arena, museums, colleges etc.

3) Easy To Use:

Any novice user can use this system.

V. MATHEMATICAL MODULE

Let B be the set of the Bluetooth devices that are set up in the premises. There is a vector of the Bluetooth devices which are linked with each other and moreover the links are again connected to other links.

B={b1,b2,b3,b4,...,bn}

Every Bluetooth that is set up in the premise has a range of its own and each and every point within the range of that Bluetooth is denoted by a single point so that we can go easy on the calculation i.e. every point within the range of BT b1

will be denoted by $L_{a,}$ those in the range of b2 will be denoted by L_b and on similar basis $L_{N,}$ for BT bn.
For calculating the user's location we will use the following formulae accordingly:

A. *Triangulation*

Lets say the user is in the range of 3 BT's then user's location will be calculated by using the above discussed Triangulation algorithm. Consider the user is in the range of BT1, BT2, BT3 then all the points within the range of these BT's are represented by $L_{A,}$ L_B, L_C whose co-ordinates are given by $L_A=(x_1,y_1)$, $L_B=(x_2,y_2)$, $L_C=(x_3,y_3)$. The user's location is given by the centroid of the triangle as
$L_P=[(x_1+x_2+x_3)/3 , (y_1+y_2+y_3)/3]$.

B. *Mid-Point*

If the user is in the range of the 2 BT's then the users location can be found by computing the midpoint of the line joining the 2 BT's . It is given as
$L_P=[(x_1+x_2)/2 , (y1+y_2)/2]$.

C. *Single Bluetooth*

If the user is in the range of only one Bluetooth device then the co-ordinates of user's location is same as the co-ordinates of the location representing all the points in the vicinity of that BT device i.e. $L_P=L_A$.

VI. CONCLUSION

None of proposed indoor solutions has been as successful as outdoor systems like Global Position System (GPS). GPS cannot be used at indoors and thus we have used Bluetooth. Bluetooth are low cost and packet loss is very less. In our project Customizable Indoor Location and Navigation System using Bluetooth we have used Dijkstra's Algorithm is capable of determining the optimal route to a destination. We have developed an Android application which will be downloaded and installed by the user on his android phone. The android application is easy to use and hotspot in today's world. The user has to access this application and provide the source and destination. The mobile application will show the user shortest path from source to destination. The administrator will perform all the operation related to creating, managing and scaling maps. Database management is done by the administrator.

ACKNOWLEDGMENT

It is our pleasure to be indebted to various people, who directly or indirectly contributed in the development of this work and who influenced our thinking, behavior, and acts during this paper. We have taken efforts in this paper. However, it would not have been possible without the kind support and help of our Guide. We would like to extend our sincere thanks to all of them. On the way of accomplishing various tasks we express our heartfelt gratitude to our group members who have equally contributed in the development of this system.

REFERENCES

[1] A Survey of Indoor Positioning Systems and Algorithms by Klaithem Al Nuaimi, Hesham Kamel.Ding, W. and Marchionini, G. 1997

[2] A Study on Video Browsing Strategies. Technical Report. University of Maryland at College Park.

[3] Development of Geographical Location Estimation System for Wi-Fi users in campus by Kenzi Watanabe, Hisaharu Tanaka, Makoto Otani.

[4] A Survey of Indoor Positioning Systems for Wireless Personal Networks by Yanying Gu, Anthony Lo, Ignas Niemegeers

[5] An indoor Bluetooth-based positioning system: concept, Implementation and experimental evaluation by Silke Feldmann, Kyandoghere Kyamakya, Ana Zapater, Zighuo Lue.

[6] Indoor Navigation System for Handheld Devices by Manh Hung V. Le, Dimitris Saragas, Nathan Webb.Brown, L. D., Hua, H., and Gao, C. 2003. A widget framework for augmented interaction in SCAPE.

[7] Indoor Navigation Using Smartphones by Nagesh Potdar, Dipak Pawar, Sachin Jain, Bhumil Haria, Seema Shrawne Spector, A. Z. 1989.

[8] A study of frequency interference and indoor location sensing with 802.11b and Bluetooth technologies by International Journal of Mobile Communications

[9] The GET A Sandals: A Footprint Location Tracking System by K. Okuda, S. Yeh, C.Wu, K. Chang, and Chu

[10] The GET A Sandals: A Footprint Location Tracking System by K. Okuda, S. Yeh, C.Wu, K. Chang, and Chu