Indoor Location and Navigation System in Mobile Services in cloud computing

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Abstract — **Indoor Positioning and Navigation Systems (IPNS) has been subject of intense study and research ought to it has become a blind spot with regard to Positioning and Navigation Software. An indoor solution has been as successful outdoor systems like Global Position System (GPS). This paper proposes the design and implementation on mobile device (the most common), of a 3D positioning and navigation system for indoor based on the use of Bluetooth (BT) radio technology. This paper details the development of an indoor navigation system on a web-enabled smart phone. A routing algorithm calculates the optimal path from user position to destination. Testing verified that two meter accuracy, sufficient for navigation, was achieved. This technique shows promise for future handheld indoor navigation systems. This 3D model can be build using the most common 3D Design tools with M3G formats support. Location is implemented on BT with distributed estimation (the mobile device performs it).**

Index Terms— **Indoor Environments, Radio Navigation, BT, Mobile Devices, 3D Models..**

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 , e-marketing ,health and emergency services 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.

To estimate the location we decided to use BT technology because it is widespread in typical mobile devices and has as main hardware features: low power consumption, low cost and low interference with devices that work on the same frequency range. In this project, an indoor navigation system that provides positioning and navigation capabilities is proposed and tested. The hardware installation requirement is alleviated through the use of existing Wi-Fi access points and through the integration of the final software application with a popular smart phone. While previous systems that make use of Wi-Fi access points require a lengthy period of data collection and calibration, this system does not. Data on the positions of walls and Wi-Fi access points in the building is used to simulate Wi-Fi fingerprint data without a time-consuming measurement requirement

The Wi-Fi positioning capability is augmented through the use of two other sensors common to smart phones: an inertial sensor typically used to characterize phone motion, and a magnetic sensor that acts as the phones compass in traditional navigation applications. Taken together, these sensors can be used to form a rudimentary inertial navigation system (INS) that estimates the nature and direction of a user's motion. Tracking a moving user's location in the building is better accomplished by combining this information with the output of the Wi-Fi positioning system. In addition to the positioning subsystem, a database and a navigation system are implemented to increase system usability. The database allows the user to search a directory of people and places within the building. The navigation subsystem informs the user of the optimal route to their destination. These system components form a software application that is accessible through an intuitive user interface.

Through completion of this project, contributions have been made to the indoor positioning knowledge base. An integrated propagation model was used to simulate wireless propagation and negate the need for data collection in a Wi-Fi-fingerprinting like system. Also, a statistical method was developed for estimating position based on successive, unreliable, measurements from Wi-Fi positioning and inertial navigation sensors. The development of these techniques made possible an innovative approach to the challenge of indoor navigation.

II. OVERVIEW

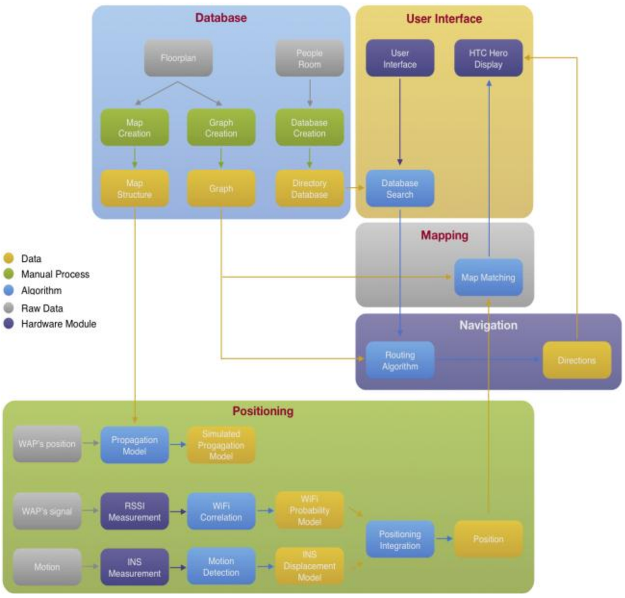

Fig.2 System Design Block Diagram

Overview contains goal and objectives.
The main goal is to facilitate for indoor navigation. The system will be easy to implement in building that have existing wireless connectivity.
The systems have three primary Objectives.
The devices must be able to accurately determine its location in a building.
The device must guide a user along optimal path to their destination.
The device must have an intuitive user interface.
These objectives will be accomplished through the design and integration of a number of subsystems. The first objective is to be able to locate the handheld device in a building. The device should be able to use signal strength measurements of the available wireless networks to accurately locate itself in a building. The device should be able to look up its exact location in relation to the map according to the wireless propagation model. The second objective is to use routing algorithms to be able to lead the user to their final destination by finding the shortest possible route and leading the user along it. Finding the optimal algorithm for determining the correct path with a minimum requirement for computing resources is necessary. The third and final objective is to create a user interface that is intuitive. The user should be able to look up a desired destination and the device should be able to show the user a route to it. A database of possible destinations should be provided. In the building that we will be testing this application in, the device should support searching of the database by multiple parameters.
The system consist of five subsystem as illustrated in figure of System Design Block Diagram .The system design include five subsystems. The design requirements include four subsystems and their descriptions as below.
Positioning – Locate the user in the building.
Navigation – Determine optimal route to destination.
Mapping – Mapping the estimated position to the map.
User interface – Allow user access to all provided functionality. It inform to user of their current location as well as destination. It allow user to select destination from database in the building.
Location Database – Directory of people and places in the Building.

III. PROPOSED SYSTEM

The Indoor navigation system that provides positioning and navigation capabilities is proposed and tested. Wi-Fi positioning capability increase through using through two sensors. Inertial sensor used to characterize phone motion. Magnetic sensor that acts as phone compass. In positioning subsystem, a database and navigation system are implemented to increase system usability .Database allow to user to search directory of people and places within the building. Navigation subsystem informs to user optimal route to their destination.

IV. METHODOLOGY

A. *Positioning*

The capability to determine a user's position within building is a necessary part of navigation system. The system described in this project uses measurement from Wi-Fi, magnet and inertial sensors.
The Wi-Fi positioning system consists of two primary subsystems, the propagation model and the location search algorithm.
The Propagation model is run on a computer and is used to pre-generate an estimate of wireless signal strengths at each location.

The Location search algorithm combines information from all detected wireless access points.
Inertial Navigation System:
The INS computes a new position .It uses data from the motion sensors to detect movement.

B . The INS involves four different phases

Calibration, Alignment, Initial Value, Evaluation.
Calibration: This stage provides coefficient for use in the interpretation of the raw motion sensor output.
Alignment: This stage provides axis and orientation.
State Initialization: This stage provides the initial position and velocity.
Current state Evaluation: This stage computes the position.

Combining output of Wi-Fi and inertial system:
The Wi-Fi positioning and inertial navigation system contributes different types of information regarding the user's position.

C. Navigation

Navigation system is responsible for determining an optimal route to a destination. It consists of graphing functionality and a routing algorithm.

a. Graphing

A graph can be a complex system of nodes and links that are connected in a tree like data structure.

A node represents a specific position in a building and tells the information about that position.

b. Routing Algorithm

The routing algorithm that we chose to find the shortest path between two nodes in a graph system is Dijkstra's algorithm. Dijkstra's algorithm has the characteristic that fit our requirement for a shortest path algorithm: it finds the shortest path from a single source to one or multiple destinations. The advantages of Dijkstra's algorithm are:

The algorithm always provides the shortest path (compared with A* which does not always yield the shortest path)

The complexity of Dijkstra when well implemented is O (N log N) which is suitable for campus like environments with a moderate number of nodes. With computing ability of mobile device nowadays, the algorithm could be performed for millions nodes.

The nature of the floor plan within the building is a sparse graph where most of the nodes are connected with two other nodes, which makes the number of edges are approximately equal to the number of nodes. The Dijkstra algorithm can be run very efficiently on sparse graph with much better performance.

D. Prototype Implementation

Android Platform Architecture:
The software application is implemented on the Google Android phone the HTC Hero. The HTC Hero is running the Google Android Operating System. The operating system is a Java virtual machine called Dalvik running on a Linux Kernel. The application is written in Java and its system files will be managed by the Dalvik Virtual Machine. Application thread is running under the framework activity and is called at the beginning of the software launch. The Activity is a thread responsible for processing information and communicating inside the software. It also manages View framework responsible for graphical representation of information to be displayed to user. The view is running its own thread to be refreshed periodically to display the information.
Application can be viewed as four major blocks of processing Positioning, Navigation, Database and Interfaces

Fig 3 Application Software General Functional Blocks

Software System Design:
The software application is implemented on the Google Android phone the HTC Hero. The HTC Hero

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V. Results

The results show that by using few computational resources and a location calculation acceptable considering that application is focused on mobile devices. It's possible to improve the calculation times for location if mobile devices manufacturers would change the BT implement in hardware/software by implementing multiple connections in parallel.. An additional feature, user can navigate and display 3D model at any time.

VI. Conclusion

This paper proposes three objectives were identified that First, the device must be capable of determining its location in the building. Second, it must be capable of determining the optimal route to a destination. Third, an intuitive user interface must provide the user with access to these features .Determine an optimal path to the user's destination, the rooms of building User interface provides user with the ability to determine their location. Development of these techniques made possible an innovative approach to the challenge of indoor positioning and navigation i.e. less difficult to implement and is compatible with existing handheld device.

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