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NAVIGATION IN RURAL AREAS USING MOVE BY DIRECTION

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ABSTRACT

In navigation system a major issue is to find out the best path from several paths available but what about the path when no road maps are available. Then it is required to design the application which works in rural areas where no road maps are available. DN navigation application is developed with the solution of navigation in rural areas with the movement of user by direction. This features helps to move by providing the direction as input with kilometers that user want to cover, when user covered the predefined distance then automatic alarm is generated to intimate the user about the covered distance in given direction. With this move by direction feature user can tag a location for the future reference so that whenever user again navigate then that tagged location will help the user to navigate using given landmark. This feature is beneficial for user who lives in rural area and can use efficiently this application their mobile phones.

Key words: Android, GPS, Latitude, Longitude, Maps, Navigation, Routes, Geospatial data

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1. INTRODUCTION

Travelling from one place to another station plays is an important role and found challenging due to several misguiding applications are available. Generally people uses the android application for navigation from one place to another but hardly few application is efficient with certain number of limitation. When the navigation using road map is used by user then various application provides the route for the intended destination, but when navigation in rural areas is the challenge then no application provide the accurate information of location as well as final destination due to unavailability of road maps. With the help of Geographical

Information System, the spatially referenced set of data will help to locate the position on the map. Global Positioning System helps to locate the position of the user with latitude, longitude coordinates. GPS uses three components to work in positioning aspect that is user segment, control segment and space segment. Through this component GPS position can be found for an object. DN navigation is developed to solve the problem to travel with navigation system in rural area where no road map is available. In this work, the navigation is provided with the help of direction that is user has to move by direction. In move by direction north, east, south, west or the combination of two directions is used to travel on the way. The navigation application system has set of programs through which the decision has taken to guide the way and noted down the latitude and longitude position of travelled path. The move by direction is equipped with alarm facility, the alarm generation facility to intimate the user that pre-specified distance has been covered. If user is moving in wrong direction the application automatically shows a message to the user that moving in wrong direction as figure shows. This feature of DN navigation is unique and very useful feature through this user can travel in any direction without worry how much he has travelled, once specified it will automatically generates alarm to intimate on covering that distance. Vehicle navigation applications, especially in urban centers where there is poor or no GPS signal, struggle to maintain a reliable and continuous navigation solution. GPS integrated navigation systems have an advantage in bridging this unavailability. However, they still require some help to avoid drifts in the solution due to long outage periods.

2. LITERATURE SURVEY

J.Parthasarathy researched about the positioning and navigation that incurred in designing a positioning and navigation system. In this work and experiments he provides the usage of a GPS device receiver in the region of precise positioning, location mapping, navigating across the mapped locations. According to his research the location and position of the object is defined in the digital map which provides the route determination and help in navigation. This research emphasized on accurate positioning and navigation [5].

The vehicle Positioning monitoring system was designed by Zechun Huang, Dingfa Huang, Zhu Xu and Zhigen Xu using CORS and Mobile GIS [8]. The accuracy and precision is provided by CORS service network and Mobile which has also verified the feasibility to integrate CORS and Mobile GIS for mobile location services.GPS helps in to get accuracy and high speed for performing in faster way. It is best suited for taxi monitoring and navigation, vehicle anti-theft and other fields.

To help individuals in finding addresses and locate their services of interest using their mobile devices Hassan I. Mathkour [3] has propose and develop a GPS-based Mobile Service Locator System. To determine the approximate distances between the user and the locations of the desired place this system was developed. This system is flexible and extendible to easily get the location of the users interest places. A main purpose of departure from existing similar systems is that it is the GPS-based rather than the mobile-based service provider to allow for a more accurate.

Bagrecha Komal S. Bramhecha Amit R. Chhajed Sneha S. Chhajed Sneha S. Khivsara B.A designed a set of multiple applications like Place Marking, Shortest Path Strategy & Weather Predictions for Next 4 days. These applications work with co-ordination with Google Maps in live environment to keep track of the Places and points of interest as per user for future use. Also these applications find the shortest path and weather prediction for next four days in degree centigrade as well as Fahrenheit. Another application of proposed system is shortest path is going to provide the service to user by mining the shortest distance between

source and destination. The last application named GPS Alarm of proposed system will provide the notification to the user of arrival of its specified destination while travelling in the form of alarm.

Mohamed Ali Attia [1] proposed map aided indoor and outdoor navigation applications In this work, a navigation system with map aided solution is developed for GNSS-denied environments. The various techniques and algorithms are developed to integrate several navigation sensors for different navigation application. Several information of location, geospatial models for both indoor and outdoor environments (e.g. urban canyons) in addition to various map matching techniques were used to compare and project navigation system position estimates on the geospatial map and used as an additional feedback for the navigation filter in terms of performance.

The developed algorithms and designed techniques were thoroughly tested in field with several indoor and outdoor environments and yielded accurate matching results through which user can navigate easily in efficient manner as well as a significant enhancement to positional accuracy. The achieved output demonstrates that the efforts to developed map aided system enhance the reliability, usability, availability and accuracy of navigation system trajectories in GNSS-denied environments.

3. METHODOLOGY

3.1. The Geospatial Data Model

The data models comprise of data structure, data semantics and data constraints of GIS maps with specific properties which are required to implement in navigation application. In navigation applications, the digital maps and their properties have several roles in the different stages and procedure of a navigation process. The display of digital map in different manner is the main role and most commonly used in travelling from one place to other using navigation process. The map basically used to refer the user location by latitude, longitude and direction, as well as several navigation states such as velocity, time and orientation. In addition, the map can include many relevant attributes for roads and passage way; it can be used for aiding the navigation solution by implementing a logical level based on the geospatial model. Other attributes for other features, such as buildings, rooms, stores, and utilities are essential for many other location-based service applications. The digital map used for navigation application requires various layers based on the area and the right application. To choose a particular required layer and its associated characteristics which are a critical issue in designing the geospatial data model

3.2. Requirements for Maps in Navigation Applications

In navigation application there are many specifications and characteristics requirements involved in using a digital map for navigation in urban and rural areas. Many factors in navigation application affect the selection of the conceptual or geometric model [12]. In that the map which required by application and database contents need to display on layout. In navigation accuracy of digital map is more important aspect which plays an important role. The positions of an object, latitude, longitude and directions are dependent on map accuracy. If the positional accuracy is higher of the spatial data than that of the navigation solution, specifically in GPS-denied environments, then the collection of spatial data itself can help in improving the performance and accuracy of the navigation system. Several parameters are taken into consideration when expressing the digital map performance and accuracy. The research has been done to complete the comparative studies; these studies have been developed to evaluate the performance and accuracy of the main digital map provider for

location-based services. However, the extract was concluded that both the accuracy and quality of a provider are significantly dependent on the coverage area. For example, major city areas, which cover a large coverage area, are more correct than smaller, urban and rural area [6]. The spatial feature of objects information retrieved from spatial database. For any given feature there could be various types and enormous amount of information in addition to the several digital map forms and structural forms it took to build navigation application. When compiling these databases, the major task is to collect only the necessary information and make a data set with the most appropriate structure to fit the required application. For example, there are five main operations in digital road databases required for navigation application: map matching, address matching, path finding, and route guidance.

3.3. Map Display

The main focus of digital map display is to be as informative as possible. The excessive information can significantly disturb or distract a user's attention, particularly as it relates to safe driving while using an in-vehicle navigation system. In this case, the map should show the 12 positions of the user depicted on the digital map while covering it to the most appropriate feature (e.g. road centerline) this - is known as map matching technique [4]. For most vehicle navigation applications with its navigating area, the digitized vector maps are appropriate which is in use. However, navigation devices and hardware are having the raster satellite/aerial images to capture which is in recent technologies. Basically vector maps and the coordinates of vector map model the intersections (nodes) as points with known coordinates, and the road map segments joining them (links) as polylines. This dataset should be taken in research while considering factors such as the performance and accuracy of coordinates, geometrical errors and storage units. This will help the user in such a way that the technology implementation can assist the driver with their handheld navigation application [2]. A sample digital map in different view display is shown in with some of the abstract information displayed for the user to efficiently use navigation application.

3.4. Map Matching

Map matching is the process of locating a user's position a specific feature of a map. It has two objectives in navigation systems: to visualize the user's position on the map and improve the positioning accuracy. In cases of land vehicle navigation, map matching occurs by forcing the position to be related to the road path. Since the map matching process seeks to improve the positioning accuracy of the user, maps must be of better positioning quality than the positioning system [7]. The database features required for map matching are similar to the above functions; however complete road topology must be included. Road topology includes medians, centrelines, number of lanes, two-way or one-way, roundabouts etc.

4. NAVIGATION IN RURAL AREAS

When user travels from one place to another it is require guiding the pathway with the help of technology driven navigation system. In urban areas the navigation system uses road maps to easily identify the routes to reach final destination with the help of landmark. But in rural area there are no road maps are available, in maps only water area like pond or river and mountainous area, green belt means agricultural fields are shown. In rural areas roads are rarely seen and it is difficult to navigate without road map. Through this object user can navigate with the help of directions. DN navigation had invented a new concept to navigate in rural areas using directions. In this system, user can navigate as well as tag allocation for the further use. For navigating in rural areas user has to provide direction in which he wants to

move North, South, East or West with distance to be travelled in kilometers. When user starts moving in a given direction and keeps moving until it covers the given distance.

Once it the distance is covered DN navigation generates message intimation with alarm that you have covered the distance. This alarm generation facility to intimate the user that pre-specified distance has been covered. If user is moving in wrong direction the application automatically shows a message to the user that moving in wrong direction as figure shows. This feature of DN navigation helps user to move efficiently in that area where no road maps are available which is unique and very useful feature in navigation system application. Through this user can travel in any direction with tagging of location for the further track the route. Additional feature of navigation is alarm generating facility which makes user to use the application in efficient manner.

Navigation by direction is a new concept, but the common need to visit unknown area to and one's way increased the request of autonomous android systems that can support human way finding, both in rural and urban areas. In navigation yet exists, the challenged of navigation system for human guidance will be taking into account in this work with these requirements:

4.1. Open Source Spaces Modelling

Closed spaces such as narrow and long pathways, valley, mountain and other linear features represent a location with an implicit direction to move in, having less difficult to deal with; instead open spaces. It have a vast number of different ways for crossing it. We want an intelligent solution that can split and manage big open space through a network model that reflects the real human free movement with the minimum deviation to the given direction.

4.2. Route Planner Feature

It is required to plan a route that computes paths between any starting and ending point inside the environment and estimates distances as close as possible to the real paths.

4.3. Positioning System Aspect

The navigation system that hasn't additional infrastructural costs to calculate position and that can also work in emergency cases without power throughout the area, only with an external network data Connection (e.g. GPRS, UMTS, EDGE, etc).

4.4. Humans Orientation

It is required to find the centric orientation system that can conclude users direction while moving and capable to provide instruction based on individual current orientation. This orientation conclude the user direction.

4.5. Landmarks or Tagged Location Usage

Tagging a location makes the position landmark to refer in future, usage of landmark is widely performed in common human route directions; we want to integrate guidance with landmarks.

4.6. Real time or Run time Directions

It is required to use directions as close as possible to the real-world spoken guidance often used by people.

4.7. Hierarchical data Instruction

It is required to have a multiple level of details in route instructions that exploit the advantage of splitting long path into smallest sequence giving higher level instruction and, if requested, other levels of details.

4.8. Directions Generation Adaptability

It is required a dynamic route directions generation that reflects the changes of an editable data model. This requirement can answer to the request of emergency situations and work in progress cases, where the data model must be changed and adapted to the current needs and availability [9] and route directions must take into account this real time changes (e.g. a corridor is unavailable due to fire, a room is closed due to work in progress for the next 3 days, an emergency exit is unavailable for common use but in emergency case could be take into account). We don't want a static route direction system, using recorded videos, or stored directions that aren't flexible to daily scenarios.

4.9. Personal Digital Assistance

We want a common platform for guidance with low costs for users and system management, widely spread and easy to use [10].

Pseudo code is shown below

```
if (mybearing > 0) {
    if (mybearing < 23) {
        finalDirection = "North";
    } else if (mybearing > 23 && mybearing < 68) {
        finalDirection = "North East";
    } else if (mybearing > 69 && mybearing < 112) {
        finalDirection = "East";
    } else if (mybearing > 113 && mybearing < 156) {
        finalDirection = "South East";
    } else
        finalDirection = "South";
} else if (mybearing > -23) {
    finalDirection = "North";
} else if (mybearing < -23 && mybearing > -68) {
    finalDirection = "North West";
} else if (mybearing < -69 && mybearing > -112) {
    finalDirection = "West";
} else if (mybearing < -113 && mybearing > -156) {
    finalDirection = "South West";
} else
    finalDirection = "South";
```

Figure 1 Pseudo codes for personal digital assistance

Through this we use to decide the direction, the numbers are shown is dependent on latitude of source coordinate.

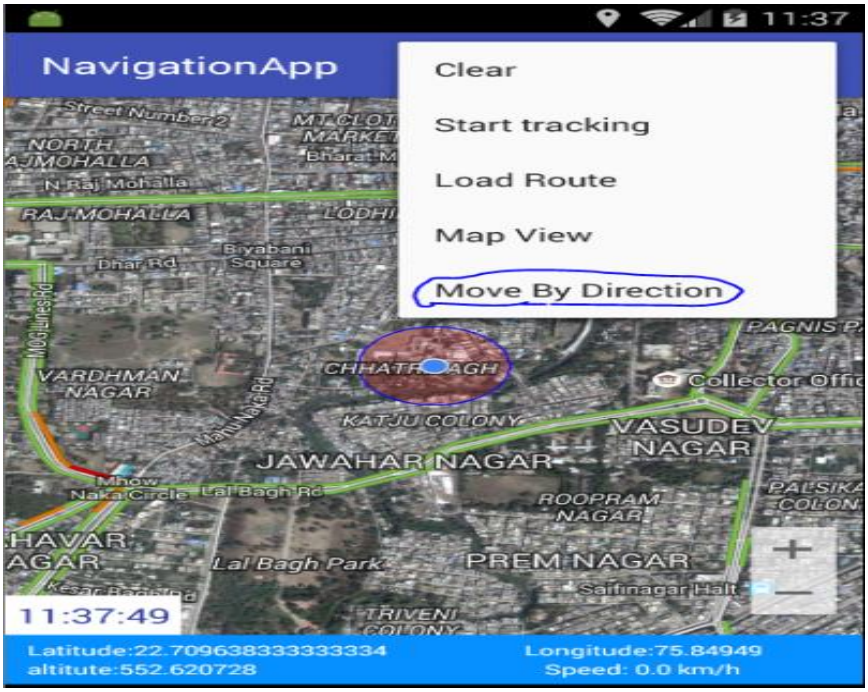

Figure 2 Move by direction option

5. NAVIGATION FROM SOURCE TO DESTINATION

In this feature application has given facility to the user to navigate the route by input the direction, distance in kilometers and source. While entering the source to the application interface it will automatically takes the latitude and longitude positions of that source, it means it automatically select the coordinate of source on map. The DN Navigation application also provides flags representation on map to identify the source and then after the final point reached.. Figure shows how interface takes input in form of source, distance and also takes the current position by latitude longitude. When user travels in one of the chosen direction and covered the distance which is predefined are considered to be as source to destination navigation.

Through the above we use to track the direction from marker option class and we distance covered is divide by 1000 to calculate distance in meters, this code will also display the messages also.

6. LOCATION USING LATITUDE AND LONGITUDE

Locations on the surface of the earth can be specified by geographical coordinates. There are different kinds of geographical coordinates in use. The most common way to locate a point on the earth is by using latitude and longitude. The latitude value represents the angular distance measured in degrees between a point on the surface of the earth and the equator. Locations on the northern hemisphere are given positive latitude values and those on the southern hemisphere are given negative ones. Points on the equator are at 0 degree in latitude, the north pole of the earth is at positive 90 degrees in latitude and the South Pole is at minus 90 degrees in latitude. This positional coordinate helps in guiding the path in rural areas where no road maps are available.

Pseudo code is shown below

```
MarkerOptions markerOptions = new MarkerOptions();
    markerOptions.position(latLng);
    markerOptions.title("Moving towards " + finalDirection + "
" + message);
currLocationMarker =
mGoogleMap.addMarker(markerOptions);

Toast.makeText(this, "Location Changed" + latLng,
Toast.LENGTH_SHORT).show();
CameraPosition cameraPosition = new
CameraPosition.Builder().target(latLng).zoom(12).build();
 mGoogleMap.animateCamera(CameraUpdateFactory
 .newCameraPosition(cameraPosition));
showNotification("Moving towards " + finalDirection + " " +
message, message);
 if (this.distance <= ((distance) / 1000)) {
 showNotification("You have reached the destination",
message);    }} else {
Toast.makeText(MoveByDirectionMapActivity.this, "You are
going in wrong direction", Toast.LENGTH_SHORT).show();}
```

Figure 3 Pseudo code for Location using Latitude and Longitude

Longitude represents the angular distance measured in degrees from a point on the surface of the earth to the prime meridian (the longitude line that runs through Greenwich, England, internationally accepted as the 0 degree longitude line). The whole globe is divided equally into 360 degrees of longitude, points that located east of the prime meridian have positive longitude values and those on the west of the prime meridian have negative longitude values.

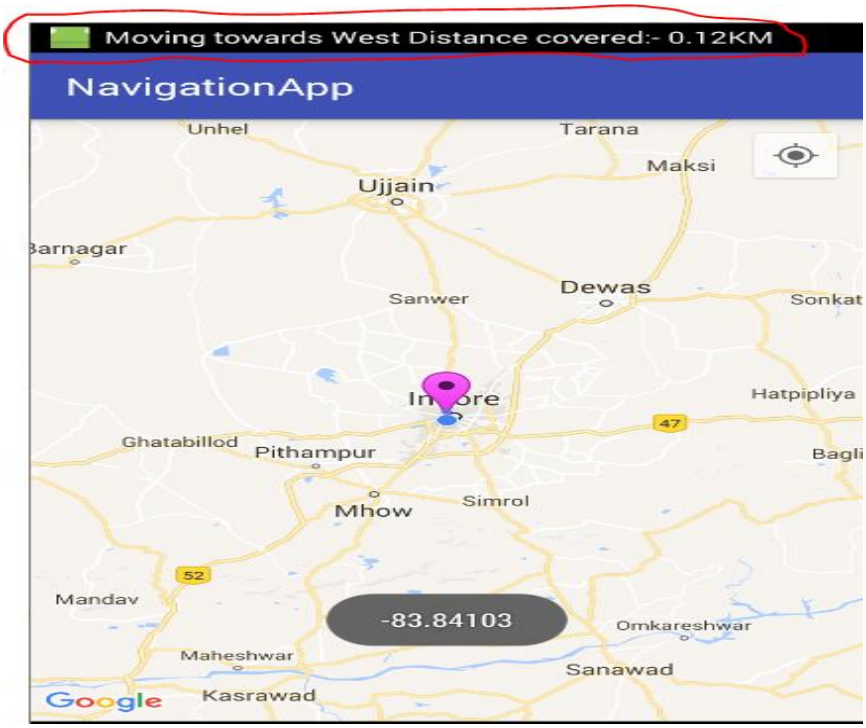

Figure 4 Navigation using move by direction in west

Combining the values of the latitude and longitude, any point on the globe can be located. Locations on DN Navigation are specified in latitude and longitude. For example, when creating a map object, the location that the view of the map is to be centred on is specified in latitude and longitude [11]. Also, when adding overlays onto a map (e.g. polylines, markers), locations at which those overlays are to be drawn are specified in latitude and longitude as well. However, the view of map is presented in a space of pixels on the computer monitor.

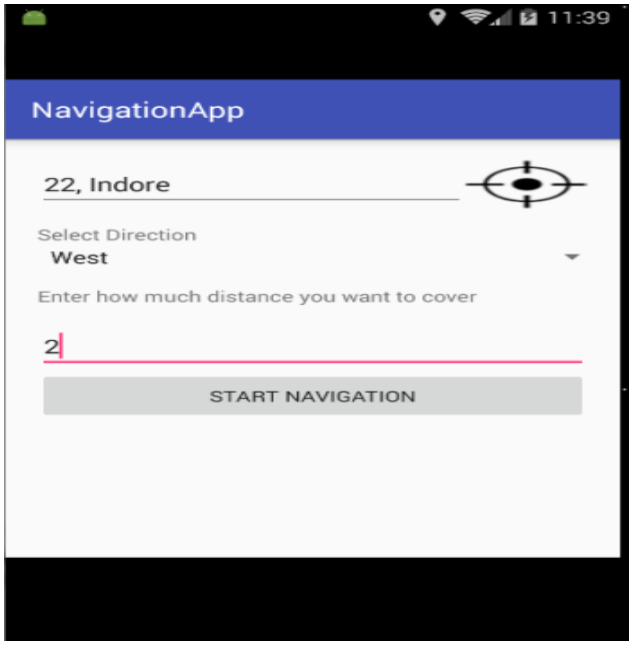

Figure 5 Navigation using move by direction

In this feature, the concept is implemented for rural areas where road maps or predefined locations or landmarks are not available. To implement this feature move by direction step by step procedure is applied with all prescribed libraries and methods. In this research contribution, the directions are defined category wise through which user navigates in given direction with certain limitations of area in which he is moving. If user moves out of area navigation application track the position with the help of latitude and longitude to show the message that user moves in wrong direction. With the help of this feature now people in rural areas can navigate easily and also tag the location.

In implementation of this feature the required libraries and methods need to import with digital map equipped with latitude and longitude positions. The algorithm to implement this feature is described below with the help of suitable flow chart.

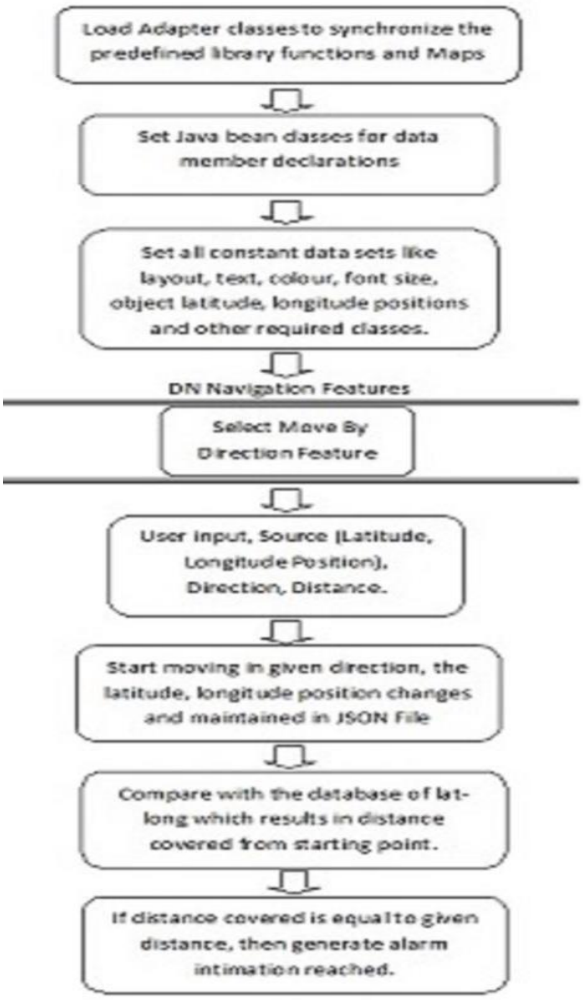

Figure 6 Flow chart of Move by Direction

Any one of the above providers is enough to get current location of the user or user's device. But, it is recommended to use both providers as they both have different advantages. Because, GPS provider will take time to get location at indoor area. And, the Network Location Provider will not get location when the network connectivity is poor. The GPS is a space-based satellite navigation system that provides longitude and latitude of location in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.

Network Location provider is comparatively faster than the GPS provider in providing the location co-ordinates.

- GPS provider may be very slow in in-door locations and will drain the mobile battery.
- Network location provider depends on the cell tower and will return our nearest tower location.
- GPS location provider will give our location accurately.

7. ALARM GENERATION

One more important feature is alarm generation. The mobile device is hardware equipment which enables the usage of the distance based alarm system. The GPS is a space-based satellite navigation system that provides longitude and latitude of location in all weather

conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. It will also enable the user to view the nearby places and generate the alarm after regular interval of distance of the desire location which be tracked by the GPS. This is useful when user is driving a car and searching for a destination through navigation system. It generates an alarm after every given distance specified by user. The alarm will rise when the user is travelling. (The default distance is 1000 meters, user can also change the distance according to his desire).Whenever user reach at destination the alarm generates and display the message destination reached. The aim of this system is to provide an alarm facility in the mobile devices based purely upon the given interval of distance.

8. CONCLUSIONS

The target of this research was to develop a navigation technique for travelling from one place to another in rural areas where no road maps are available. This navigation application helps user to navigate efficiently in GPS-denied environments. This type of navigation applications are useful for both vehicle and pedestrians users in rural areas where no references and user can create his own reference by tagging a location for the future use. The developed navigation application is properly tested and the working condition of the application is better to use. The techniques applied have several different architectures which is based on the navigation application and environment. On the basis of the three main components of the developed techniques are: geo informatics that is a geospatial data model with navigation related properties and remote sensing which is a virtual boundary that forces the estimated navigation trajectory on a certain logical positional coordinates, a map matching algorithm based on the geometrical and topological properties for the navigated regions networks in order to match the estimated position fixes on the geospatial model, and an integrated navigation model based on multi-sensors integration to estimate the position fixes with the better performances. The developed application has some unique features and compared with the existing model.

In this research work, each component was introduced with a short description and followed up with presentation of the state of the art technology and work this research would develop. The integration of these components was also introduced in addition to a discussion on the way in which they were implemented according to each application and environment. The evaluation of these techniques in real life navigation applications (with the use of several sensors and at differing accuracies) was investigated and the results were presented. Based on the achieved results, it is fair to state that the developed DN Navigation systems have succeeded in enhancing the navigation solutions for GPS environments such as rural areas. Furthermore, these navigation systems have improved the data reliability.

The navigation applications are considered essential and vital for many areas of use: daily activities, industrial, commercial, law enforcement, and emergency. Navigating in open space has been well researched, and despite some of the challenges it might face it can be considered in many cases a stable and consistent application. Navigation challenges in GPS-denied environments are currently one of the most relevant areas of research and as such, can produce significantly beneficial navigational aid solutions.

In this research work, record routing solutions were developed using several constraints and mapping information. Map aiding systems were developed based on geospatial models and map matching algorithms. The geospatial data models were built according to navigation applications requirements and characteristics. Several models were created for environments to be used in implementing the map aided algorithms, and for evaluating the performance and testing of the systems in real-life trajectories. Both geometrical and topological map matching

algorithms based on automatic turn detection techniques were developed to project the obtained navigation solution position fix into the created geospatial data model.

In future navigation can be taken up to dynamic routing. It means if a user is travelling with the navigation application and sharing the runtime travelling path with their trusted members then the trusted members of a user can track the runtime route which is travelling by user. This feature helps in major aspect like if accident occurs then trusted member can see the runtime or dynamic navigation of user is stopped which may help to intimate the trusted member on application that vehicle has been stopped. This feature helps to user in future.

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