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Indoor Navigation System

R.Abhilash[1], P.Asha[2]
[1] *M.E Student, Department of Computer Science, Sathyabama University.*
[2]*Asst.Professor, Department of Computer Science, Sathyabama University.*
[1]*abhicse46@gmail.com*, [2]*ashapandian225@gmail.com*

Abstract

The indoor navigation is a system which is used to locate the exact locations inside a campus. This paper discusses about the navigation technology which uses the data stored in the active database of a University to locate the places which are requested, this system does not use the GPS (Global Positioning System) and any other Internettechnologies. Both the 2-D (2-dimensional) and the 3-D (3-dimensional) navigations are possible in this system. The 2-dimensional navigation system uses the floor map of the campus and it directs the user with help of a route and in addition, the system guides with a path assistance mechanism. The graphical representations of the University buildings are used for 3-dimensional navigation which offers street view of the campus for the user to locate places.

Keywords: Indoor Navigation system, 2-D, 3-D, Street view.

Introduction

In most of the Universities, there are many buildings with various departments, if someone are new to the university there is a possibility that they may be lost easily inside the vast campus. Not only in universities but people in most of the shopping malls face the same problem, they are unaware about the locations of the shops. In Universities, the people who come for cultural, functions or any other purpose for the first time and the students in the beginning of each scholar year. To avoid this situation, the indoor navigation system can be developed and can be placed in the campus. This will help the students to locate their classes and the people who are new to the campus can use this to find the places where they have to reach.

Review of Existng Work

The indoor navigation system is a (usually electronic) system that aids in navigation. Navigation systems may be on dash-board of a vehicle or these can be fixed to communicate with the use of radio signals with a vehicle.

The Navigation systems use maps and the specified locations, displayed in an understandable format using text or in a graphical format. It providing suggested directions to a human in charge of a vehicle via text or speech. This provides information of nearby buses, cars, or other hazards or obstacles. This also provides the informationof traffic conditions and this suggests other alternate directions.

Anne-Laure Chauve, Patrick Labatut and Jean-Philippe Pons have presented a paper with a novel method in which the 3-D models can be reconstructed [1]. The automatic 3-D modelling algorithms are very complex in their method of storing data (indexing and rendering). This problem can be simplified by a posteriori mechanisms. These lag in their geometric features and this has a worst reconstruction distinctive attribute. The mechanisms such as the Order of approximation, Degree of geometric primitives, Scale of analysis, Topological guarantees, Visibility-consistency, Prior-based completion are used.

The blocks in the models are designed using a typical mechanical CAD models. A concise mesh is obtained as the result and in addition cylindrical parts [1] by the planes are also obtained with better approximation.The main conditions are met in designing these models they are visibility, position and tangency. Where the visibility is the positive side of the axis, position is the distance between the plane and the angle of inference and the tangency is the angle between the neighbouring planes. The planar primitives are used to design the 3-D models these planar primitives are also called as the ghost primitives.

DzmitryAliakseyeu, Sriram Subramanian, Jean-Bernard Martens and Matthias Rauterburg have proposed a working prototype for navigation by using some interaction techniques through which the manipulation of 2-D and 3-D data can be performed [2]. The usability of the interaction demonstrates the concept of two disciplines they are architectural design and surgical planning. Five main design [2] guidelines are used by this author to interact with the devices, dual handed interactions must be performed instead of single handed interaction. The sight feedback is very much important in this for the user to feel being present in the 2-D or 3-D space. The process of doing something and the ability to see, hear, or become aware of something through the senses must be same. The usage of Head mounted devices should be reduced.

The user interface requirements are forced by various applications and domains. For this the author has addressed some user interaction and interface requirements by four possible combinations. The combinations are 2-D navigation, 3-D navigation, 2-D manipulation and 3-D manipulation with their tasks and data dimensionality [2]. Where the navigation mechanisms deals with establishing the locations and identifying the 2-D and 3-D structures, the manipulation deals with creating the models, modifying the paths and positioning the planes.

Branislav Micusik and Jana Kosecka proposed a model of unified framework by which the 3-D models can be created for a city. The author has demonstrated how the camera poses and multi viewed stereo to operate directly on the panorama techniques [3]. The buildings of the ancient period are now demolished the proposed mechanism of this author makes the demolished buildings to be reconstructed in the specific

applications which makes the users to know how exactly the demolished buildings were in reality.

The street view maps are fused with the depth of the 3-D model which can be represented by triangular surfaced mesh [3]. The fusion mechanism strategy follows various steps such as indexing the consecutive images with their depth and it maps to a specific plane in the model. The reconstruction of the 3-D points are done. For all the 3-D points a pre-defined radius sphere is centred. There 3-D points are made to merge with the projections falling to the same pixels of the image.

StepanKment [4] proposed a model for Building the Local Navigation System, which discusses about the problematic design of the Local Navigation System (LNS), de facto the interactive map useful for the 3D objects like houses with multiple floors. The 3D scene is designed using the VRML (Virtual Reality Modelling Language, before 1995 this was known as the Virtual Reality Mark-up Language) is a standard file format for representing 3-dimensional (3D) interactive objects, in particular designed with the World Wide Web in mind. It has been outdated by X3D.

The advantages of the system was the development of the 3D models. 3D Max modelling was used to design and those designs are automatically exported to VRML format and GPS for locating the user's position. The VRML nodes were used to find the locations of the user in the 3D models which helps the users to know in which path he/she is moving.The disadvantages of the system is that designing the 3D models using 3D Max was difficult. In 3D Max the Field ofVisibility (FOV) should be in the angle of 45 to 60 degrees. If the angle is slightly deviated the navigation system doesn't show the location of the user.

Manh Hung V.Le, Dimitris Saragas and Nathan Webb [2] proposed a model which explains the Indoor Navigation for Handheld devices. To determine user position the system uses the data from the wireless adapter, compass and the accelerometer. The optimal path from user position to destination is calculated using the routing algorithm. This technique promises handheld indoor navigation systems that can be used in college campuses, malls, and other places which has a larger landscape.

The advantages of the system is Positioning techniques, Indoor Propagation models, Inertial Navigation techniques and Mapping techniques. The positioning techniques used were Cell of origin, Angle of arrival, Angle difference of arrival, Time of arrival. Free space model, One slope model, Multi-wall mode are the Indoor propagation models used. The mapping techniques used were Map information formats and Map creation tools.

The disadvantages of the system is the web interface could be created that will allow a user to download the mapping information from a remote site. By adding a feature like this the application can reach a new level of availability to users. Another useful subsystem that can be developed is an application convert a building map into a format useful for routing. This map creation system also helps the user through a procedure to input any necessary information not found on the map including database information, WAP location, and WAP signal strength.

Sabine Volbracht and GittaDomik [3] proposed a system for developing the Effective 3D environments which uses the GPS to locate the position of the user. They developed a rigorous model of navigation which contains the relevant factors of

influence and determines the quality criteria for an effective navigation.The advantages of the system was the system was aware of the environmental factors such as display mode, degree of abstraction, size, and density. The user factors defines the characteristics of the user such as gender, abilities and weakness. Navigation strategies used were searching, vectorial navigation and positional navigation. The quality of criteria determines and differentiates the factors and the characteristics. These techniques were used and an application called as “City Game" was developed.

The interactive maps are used in most of the universities worldwide, the interactive maps uses the google maps for locating the places inside the campus. The system had a search box in which the user can type the required location, as a result of the user request the system searches for the place in the database and it specifies the requested location in the map using a marker. These interactive maps also contains the labels of all the places inside the campus. Later the interactive maps had the source and the destination search boxes were the user can type the required location and the request in turn user the internet and directs the way for the user to the requested location.

Proposed System

The implementation of this Indoor navigation system can be done in web browsers. Both 2D and the 3D indoor navigation is possible. In 2D the floor map of the campus is used, where in 3D the graphical representation of the buildings of the campus are used.

The 2D navigation shows the bird sight view of the campus, the user interface contains the search fields for source and destination areas. The user is requested to type the location where he/she wants to know, the system searches the floor map for the user request in the database and it directs the user to the requested location it assists the user with a route map and path assistance.

The route map shows all the possible paths to reach the destination from the source. The shortest path among all the possible routes is highlighted and thus the user can know which the shortest route to reach the destination is. The route highlights the important landmarks along the route, which will be helpful for the user to know the additional locations along the path. This system is fully automated, the map creation of the campus and the user location are identified using the source and destination areas requested by the user. This searches the source and destination regions in the database and creates the floor map for the region and it creates the route by which the user can reach the destination form the source, in addition it generates the path assistance along the route. Thus there is no use of internet technologies to create the map and there is no use of the Global Positioning System (GPS) to locate the user's location.

In 3D indoor navigation the street view is offered to the user, the user can travel along all the locations in the campus and the 3D representation helps the user to know the paths in detail. Since all the buildings and the blocks of the university are clearly represented in the street view the user can know the exact picture of the buildings. The 3D models can be developed in software's like Anim8or, Autodesk123D, Flux, etc. These are the freeware to develop the 3D models. In addition to these software

like Art of illusion, AutoQ3D Community, Blender, BRL CAD, Open CASCADE, Open SCAD are the free and open source software to develop 3D models, these software not only helps to develop the 3D models it provides 3D rendering of the 3D models.

The 3D models of the campus are imported to web browsers and thus these can be implemented in handheld or stable devices in the campus. The system contains both the 2D and 3D Navigation then the user can prefer which system to use.

Architecture Diagram

The architecture diagram explains the flow of the process by which the user requests the location and the mechanisms used to find the path between the source and the destination areas and the path assistance along the path. When the user requests for the 2-D navigation the user needs to set the source and the destination locations, then the system checks for the locations in the database. The database in return generates the Floor map and it creates the route map with the use of the coordinates. The floor map and the route created are matched with the site map of the campus, then the routing directions are created and it assists the user (Fig 1). When the user requests for 3-D navigation, the database responds with the 3-D graphical representation of the campus then the user can navigate all over the campus, like it is done in google street view.

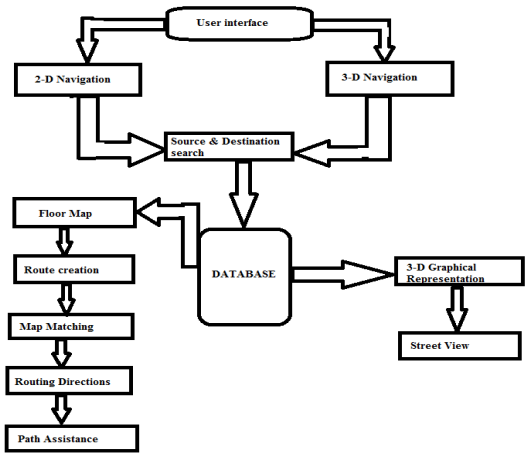

Figure 1: Architecture Diagram.

2-D Navigation:

This system is fully automated, the map creation of the campus and the user location are identified using the source and destination areas requested by the user. This searches the source and destination regions in the database and creates the floor map of the region and it creates the route by which the user can reach the destination form the source, in addition it generates the path assistance along the route. Thus, there is

no use of internet technologies to create the map and there is no use of the Global Positioning System (GPS) to locate the user's location. When the user enters the source and the destination locations the system in turn searches for these locations in the database and this retrieves the floor map of the campus which has the locations of all specified landmarks. Then the system creates the route map for the requested source and destination areas using the routing mechanism in the database directory. In addition to this the database directory matches the floor map with the route map created by the system and this assists the user with the path assistance along the route.

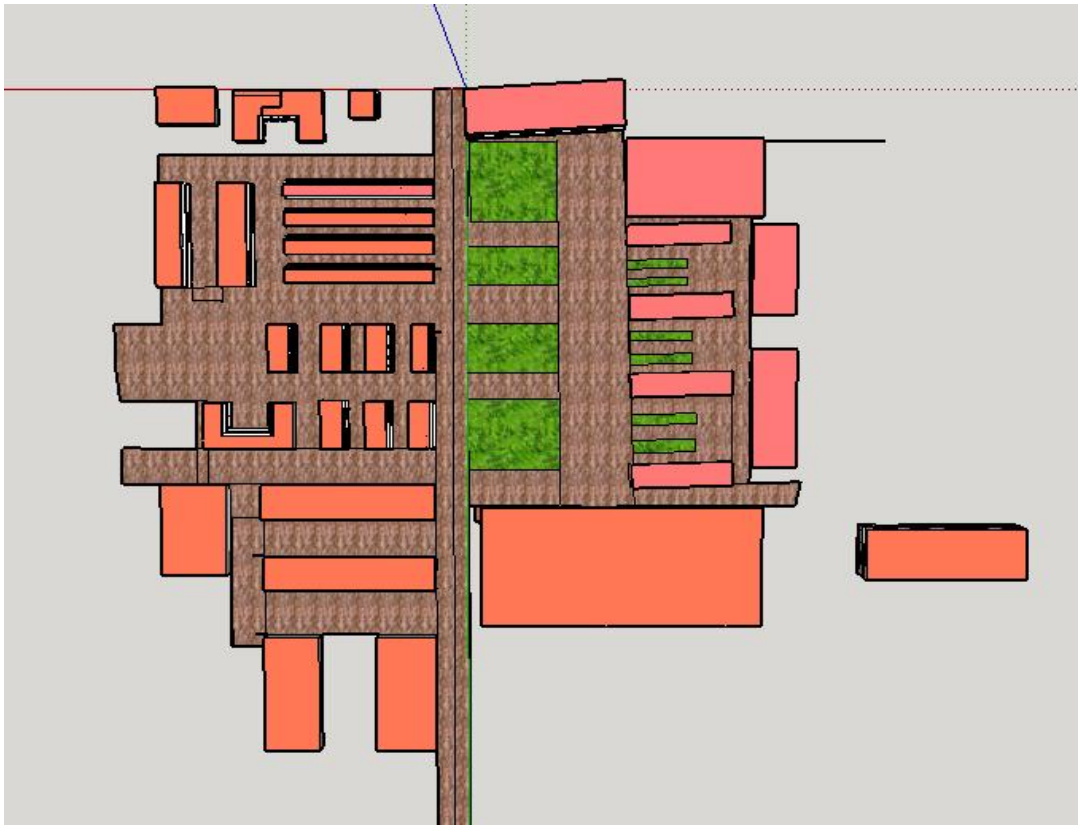

Figure 2: 2-D map of Campus.

3-D Navigation:

The 3-D navigation offers the campus buildings and other areas as virtually real buildings, thus it helps the user to know the exact buildings and it makes the user to navigate throughout the campus. The user can navigate using the arrow keys and apart from these four default directions, the user can view the buildings by rotating to any angle as the user needs. This can be clicked and dragged on the graphical representation area. If the user starts in the middle of the window he can move up and down or left and right, then the view can be rotated around the middle of the window. The user can navigate in the 3-D space by clicking the left mouse button and dragging the mouse pointer. The rotations are performed at a point in space for rotating all the three axes are considered, they are up-down, right-left and in-out axis. The new centre

of location can be set by double clicking the mouse at the 3-D space provided. Thus 3-D navigation becomes simple for the users and this makes the user to navigate easily.

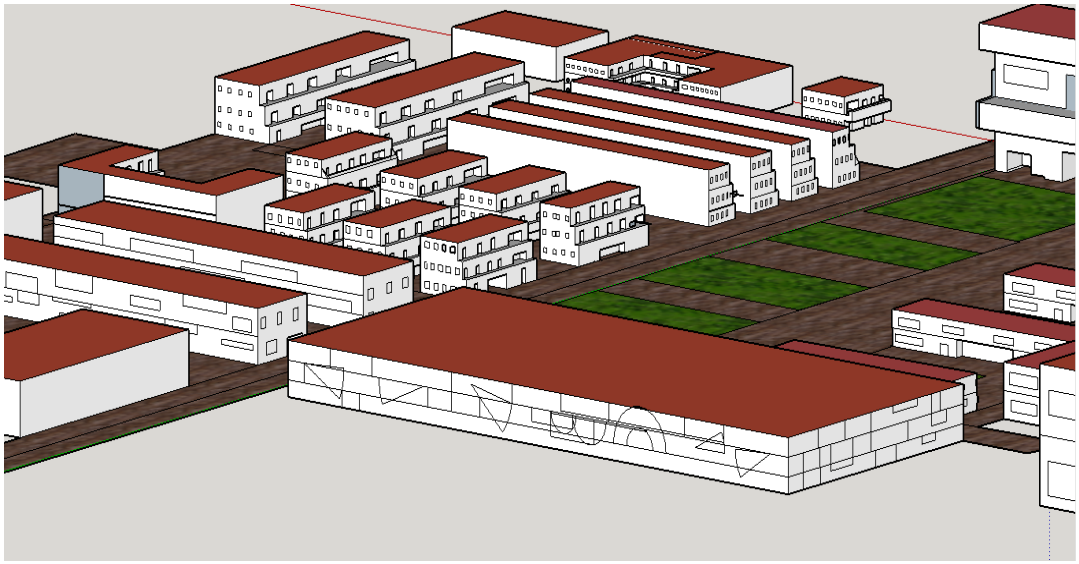

Figure 3: 3-D Graphical Representation.

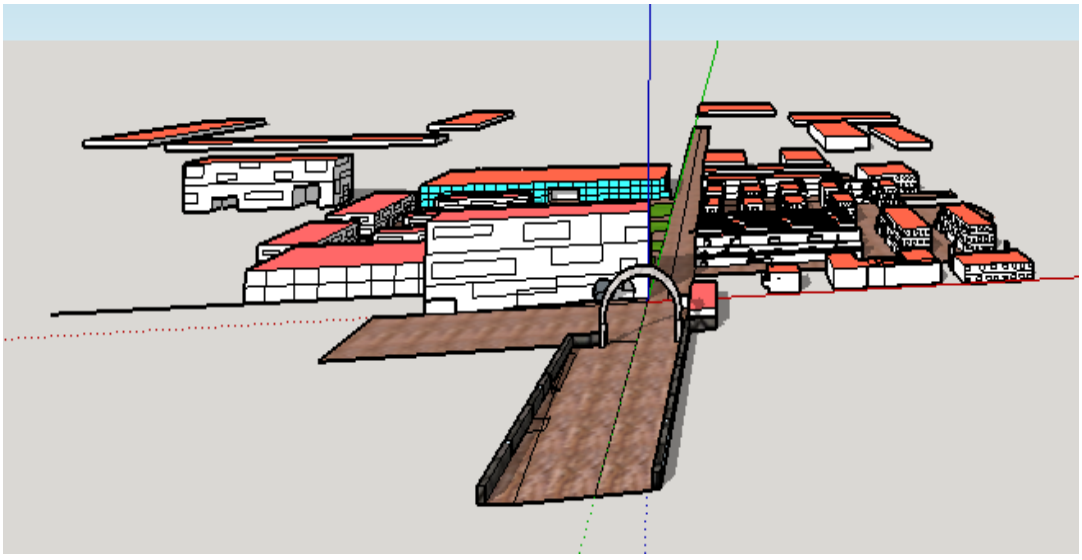

Figure 4: 3-D Graphical Representation in Two Point Perspective.

Results and Future Work:

The system makes navigation simple by designing it to work in offline mode and street view makes the user to know the buildings inside the campus as it is in reality. In future the 3-D navigation can be provided with the route map as it is provided in

the 2-D navigation system, thus it provides the user a clear understanding of the routes all around the campus with shortest routes and the landmarks of important buildings.

Figure 5: Street View-From first floor.

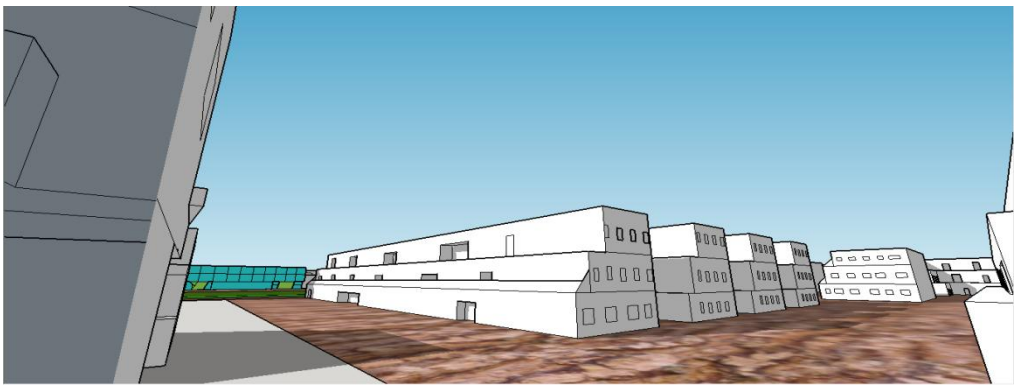

Figure 6: Street View-From Ground floor.

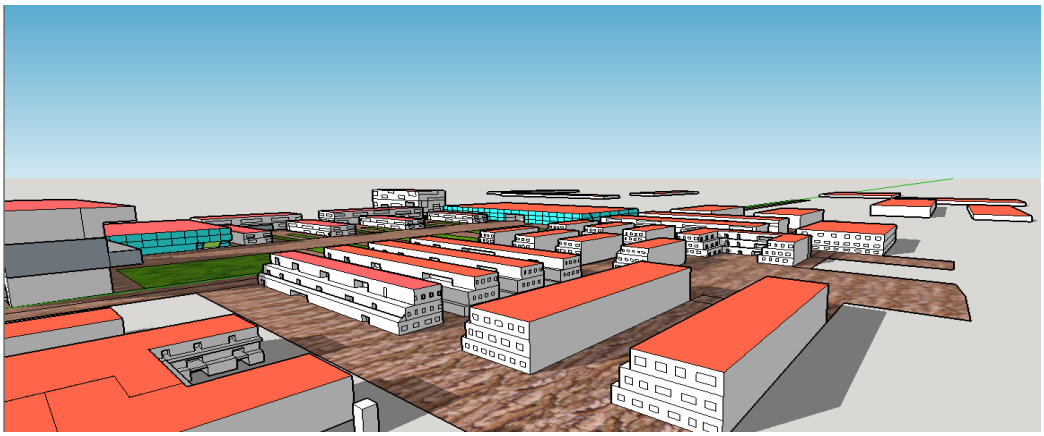

Figure 7: Bird sight view

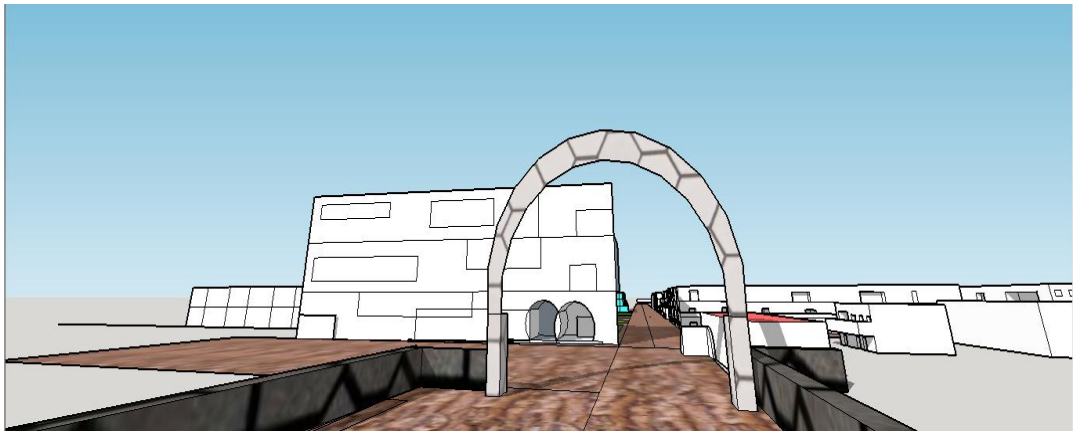

Figure 8: Street view- From Entrance

Conclusion

The system offers both the 2-D and the 3-D navigation mechanism for the user. Since the navigation is offline the system does not use any internet facilities and applications for navigation. The 2-D navigation system offers the floor map and the route map with the path assistance, the user needs to select the source and the destination locations in the dropdown box provided in the system. This makes the navigation much simple since it provides path assistance. The 3-D navigation provides street view thus the user can view the whole campus and can navigate and can view at any angle and this makes the system a better one for providing indoor navigation.

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Internet Links:

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[2] Interactive maps- Oregon State [Online]- http://oregonstate.edu/campusmap/
[3] Interactive maps- University of Alabama [Online]- http://tour.ua.edu/map/
[4] Interactive maps of India [Online]- http://www.mapsofindia.com/maps