

3D Digital Interactive Model of IIT Hyderabad Campus

Veena Thakre
MD17MDES11012

Under the Guidance of
Dr. Prasad S. Onkar

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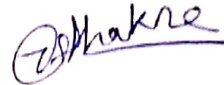


Department of Design

May 2019

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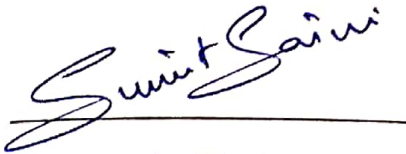
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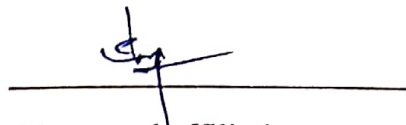
Approval Sheet

This thesis entitled – 3D Digital Interactive model of IIT Hyderabad Campus – by Veena S Thakre– is approved for the degree of Master of Design.



-Name and affiliation-

Examiner SUMIT SAINI



-Name and affiliation-

Examiner SHIVA JI



-Name and affiliation-

Adviser DR . PRASAD ONKAR

-Name and affiliation-

Co-Adviser

-Name and affiliation-

Chairman

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Abstract

This project aims to provide campus visitors an interactive tour of the beautiful IIT Hyderabad campus, using a user-friendly interface. In this project, different navigation technology is used to bring up relevant information queried by a user using visual analysis. The concept is a 3-Dimensional interactive campus model. Any visitor can browse, view, and interact with the immersive campus environment by different user actions. User can click on a building, zoom in or out which can help the user to find required information with 360-degree images, and videos. The proposed model can provide the real feel of campus from anywhere. In this project, different design tools and interaction methods were learned and used. Tools like Sketchup, Photoshop, Unity, Adobe XD, helped in designing the model.

Keywords: Campus Maps, Virtual Tour, Interactive Maps, Interaction Design, Navigation, Campus Model, IIT-Hyderabad

Chapter 1: Introduction

1.1 Background

Interactive design is not only a fantastic way to draw attention, but also it creates an engaging experience. This project aims to provide users a virtual tour of the beautiful IIT Hyderabad campus, using a user-friendly interactive interface. In this project, location sensing technology is used to bring up relevant information related to navigation using visual analysis. The concept is a 3D interactive model by which a person can view and interact with the environment by clicking on a building, which helps the user with detailed information, 360-degree images, and videos. The 3D model provides the real feel of campus from anywhere. Online users can go for a virtual tour by using a virtual platform, and on-campus visitors can use augmented reality to navigate and explore places on the campus. If anyone wants information about the campus, it will be beneficial. People can understand about the campus better with such application and can benefit new joiners to visitors.

1.2 Who will be users?

New admission student, Campus monitors, parents, guardians, administrative services, researchers, conference event attendees, workshops, people who want to know about college, the temporary users such as auto drivers, cab drivers, deliverable boys, etc.

1.3 IIT Hyderabad Campus

The IIT campus is spread across the land area of 576 acres. Pune-based American architect, Prof. Christopher C. Benninger had designed the campus. The campus construction is done in phases and is getting completed as a group of buildings.

The campus is designed to be energy efficient, neutral, and sustainable. Local climate conditions and required learning environment were considered while designing the campus.





Figure 1: Existing 3D model of the IITH campus

1.4 Existing Facilities

There are basic signages and maps to help visitors navigating smoothly through the campus. But these are not user-friendly, visually appealing, and very few facilities are mentioned such as canteen, hostel area, staff quarters, ATM and entrance. 0 (Zero) app is a community app of IIT Hyderabad. This application is useful to channelize the facilities available like bus services and mess related information for the student and other stakeholders of the IIT Hyderabad campus.

1.5 Why we need a 3D campus model?

Traditional maps are hard to decode, in terms of comprehension. The reader needs to create a mental model of the shown area, translate symbols, and equate the features with the observed world. This is time consuming, tedious, and confusing. It explains why people have trouble understanding maps and face difficulties in navigation. The potential of the 3D maps uses on their most advent facility of representation in comparison with traditional maps, the inherent power of their understanding and relatively greater intuitiveness. It is a significance

of the way we see the 3D interactive maps and the world. But the asset of the 3D maps lies not only in representational value that replicates the way humans perceive the world. Another advantage is the use of the 3D symbols, which are easier and quicker to understand than the traditional 2D versions of the same. The use of the 3D symbols adds to the increased use of 3D maps also for large areas, where otherwise the imagining of terrain topography loses the effect of 3D world and becomes visually flat, almost like the 2D world. For understanding the 2D maps, the required time factor and mental effort have severe consequences in zones where temporal analysis of the situation is central.

This project will give the real experience of campus from anywhere. It will help the campus authorities to represent the college campus effectively in different conferences. We can get motion sensor information, and we can control it in one place. If it is with real-time, then we can control many things. It can be helpful for campus monitoring, i.e. campus light, classroom lock, AC, etc. This whole campus view will also be available on the official website. 3D campus model is not only a model but also can work as a smart campus system. The mentioned model will be an intelligence location-based system which uses different indoor and outdoor sensors. The proposed navigation system can use mobile sensors such as a compass, light sensor, gyroscope, accelerometer, orientation sensor, etc. to enhance the experiences and provide a context-aware adaptable system.

Chapter 2: Literature review

2.1 Introduction

The purpose of this literature review is to understand existing work in this field, which includes the creation of interactive maps, underlying the design process, conventions, and the evaluation of the resulting maps. In each section, existing literature was reviewed to cover the full breadth of areas that influence the interactive 3D model. These influences include web design, user experience design, interaction design, and graphical user interfaces.

2.2 Existing literature

Literature and technologies were studied from different sources to understand, describe the location services and existing applications. Some applied examples were studied. Different websites such as WRLD, mapbox, unique mapping, google scholar, google earth were referred. In this chapter, existing map providers and their service offerings related to navigation are discussed.

Below are some of the existing technologies used in different applications:

2.2.1 WRLD

WRLD helps in creating immersive 3D maps of the world, including buildings, smart cities, and campuses. WRLD App is a showcase of their immersive mapping platform which is used in location-based games, mixed reality experiences, smart cities, buildings, and campuses. The platform makes it easier to take better decisions to address specific problems by providing a human layer of understanding to them. WrlD provides tools to quickly develop an engaging, custom mapping experience with their cross-platform SDK and APIs.



Figure 2: 3D Indoor map design



Figure 3: IITH 3D Campus map

WRLD can render 2D indoor floor plans into a 3D model in a user-friendly interface with geospatial intelligence. WRLD's vector-based 3D maps provide real-time, high-performance rendering and deliver new content smoothly without any glitches. Their map design tool helps in creating custom maps that users can interact in real-time with the point of interest management. It helps to make sense of the geospatial information. WRLD is a new visualization type works equally well in both indoor as well as outdoor environments so that one can visualize everything from property prices of a city to footfall levels inside closed space like a shopping mall. It helped in understanding how 3D visualization uses data beyond a top-down overlay, allowing the user to view map data from different perspectives.

2.2.2 Mapbox

Mapbox is an open source mapping platform to design customized maps. Their APIs and SDKs help in integrating the location services into any mobile or web app. It helps in solving problems related to navigation and build a full-featured geoprocessing application. Mapbox provides custom online maps for different websites and applications such as Facebook, Lonely Planet, Foursquare, and Financial Times.

2.2.3 Spatial mapping

Spatial mapping provides a detailed symbol of actual surfaces in the atmosphere around the HoloLens, allowing developers to create a convincing mixed reality experience. By integration of the real world with the virtual world, an application can make holograms seem real. Applications can also more obviously align with user opportunities by providing aware of real-world behaviours and interactions.

2.2.4 Google earth

Google Earth renders based-on satellite imagery. It maps the Earth by superimposing satellite images, aerial photography, and GIS data onto a 3D globe allowing Explore worldwide satellite imagery and 3D terrain for hundreds of cities. It allows zooming anywhere in the world. Users can also get a 360-degree perspective with street view.

2.3 Summary

There are several academic universities already having campus maps such as MIT university, Carnegie Mellon University, The University of Sheffield, Emory University, etc.

They use google maps as a backend technology along with the GPS coordinates from the device. However, these technologies are not helpful inside big multi-storey buildings. Hence there is a need for a way to assist people in find places in a user-friendly manner. After having a campus survey and discussing with people, a mind map was created. Then using the design thinking process, multiple solutions were conceptualized. Since almost everyone has a smartphone, the decision was in favor of developing an interactive map with augmented reality. The idea was inspired by the Nokia city lens and Google Lens. Having such a campus map can be unique.

Chapter 3: Campus Map Survey

3.1 Introduction

The primary challenge for decision-making is not having enough information but to ensure having the right information at the right time. To understand the pain points of campus visitors and residents, an exploratory survey was conducted among 30 students and staffs, and their opinion was taken. The participating group included campus visitors, staffs, and students. Opinions of Research Associates, fellows, and visiting students from other universities were considered. The survey had 15 questions, and the questionnaires were distributed by online and offline forms.

3.2 Objectives

The survey was an experimental survey. This survey aimed to collect data from visitors and residents about difficulties with existing campus navigation and understand their pain points. The survey question consisted of campus familiarity and navigation requirements. The objective was to collect information about navigational challenges in the existing campus map.

3.3 Results

The survey form circulated in online format between 15 students and visitors. Many of them are from various disciplines of the campus those are already familiar with maps. The students and also some staffs did the survey. Most of them prefer functionality over the design and style. For instance, the fast and quick response in application launch time plays an essential role in the map/App.

Primary outcomes that can be concluded from this survey are as follows:

- Finding location is the most imperative aim in campus map like a mess area, staff's rooms, library location, and café.
- Students ask queries about navigation to the guards for getting information,
- Using available maps (e.g., Google map) and other pictorial views have less impact on students,
- No. proper campus map for interview students,
- Need More bus and cab shuttles for outdoor navigation. For indoor navigation inside buildings, signages and Lobby displays showing room numbers of faculty, offices.
- No Signage
- No transport service for newcomers.
- No bus timings, no app for iOS
- Proper maps of each building with details including washroom, drinking water, charging points, etc.
- There is a need for a display of interactive model inside the campus
- Alumni can know about the latest improvements in infrastructure happening in the campus, by looking and navigating at the model

Chapter 4: Modelling of IIT Hyderabad Campus

4.1 Introduction

Demands for 3D modeling are increasing rapidly with the newly developing and advanced technologies emerging into various applications. 3D modeling is the real replica of Real World, especially if it is precise. Also, using such a concept in the geographic information system (GIS) environment proposes a flexible, interactive structure for providing the best possible visual version, arrangement, and decision-making process. The built model becomes one of the most resourceful technologies for exploration. Nowadays, with the new expansion of technology, smart processors, and digital tools, and software is becoming more doable and needs much less time and, energy using proper procedures. The 3D model delivers a more realistic vision and convincing virtual reality environment by adding texture mapping to the 3D objects. At very first, Sketch-up software is used to produce an exact 3D model with real texture. The other discussed application is stretching the taken images of the building sides directly to its 3D model using the sketch-up software to build a 3D model. The results were admirable, but comprising little distortions and deliver satisfactorily clear results for many presentations in campus modeling.

4.2 Project Planning

To conduct a successful campus project to build a 3D campus model, different steps were taken into consideration in implementing this project.

4.3 Data Collection and Preparation

To make the model, proper drawings and master plans were required, which were obtained from the Estate Office of the institute. They gave cad files, Site map, jpeg images of the building. Some photo I took from the phone for the campus as reference for making a real model of campus. I began to learn a few software which doesn't know before, like SketchUp, blender, and unity.

4.4 Data Modelling:

- Data collection of all available quality data whether it is AutoCAD files, CAD File available from the blueprints and building drawings for the area of interest Paper- and scanned- campus maps of the city.

Data measurements:

In this project, the following are my essential data measurements:

- Photographs of objects to build 3D models,
- Photographs of textures required to be used as a database, to produce textures later to 3D models

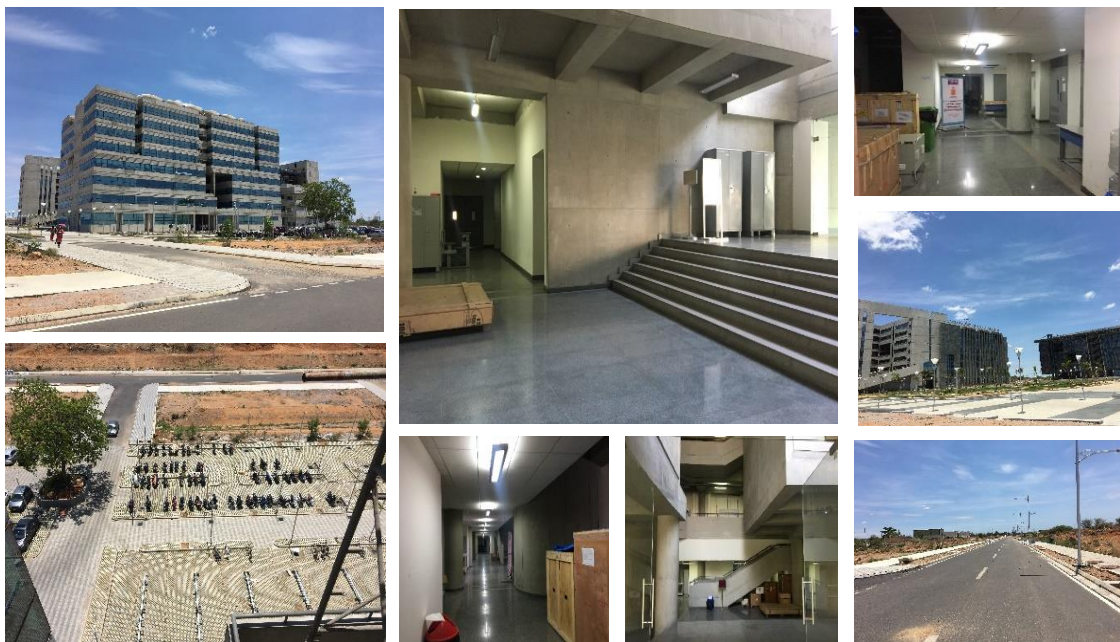


Figure 4: Images of campus to build 3D models

Data Processing and Planning: In this process, the following steps are undertaken:

- A Build terrain to build a 3D view (SketchUp is used),
- Digitizing the photo to create all mandatory 2D vector layers.
- The detailed layout on CAD files to these digitized layers to design and measure it to appropriate dimensions (SketchUp is used),

Editing of the photographs to exclude any redundant feature in the photograph before using it in a database as a filter to add texture (Adobe Photoshop 2017CC).

- **3D shape geometry:** 2D layer is designed by taking layouts from CAD drawings. The shape seems like 3D blocks shapes (SketchUp software is used).

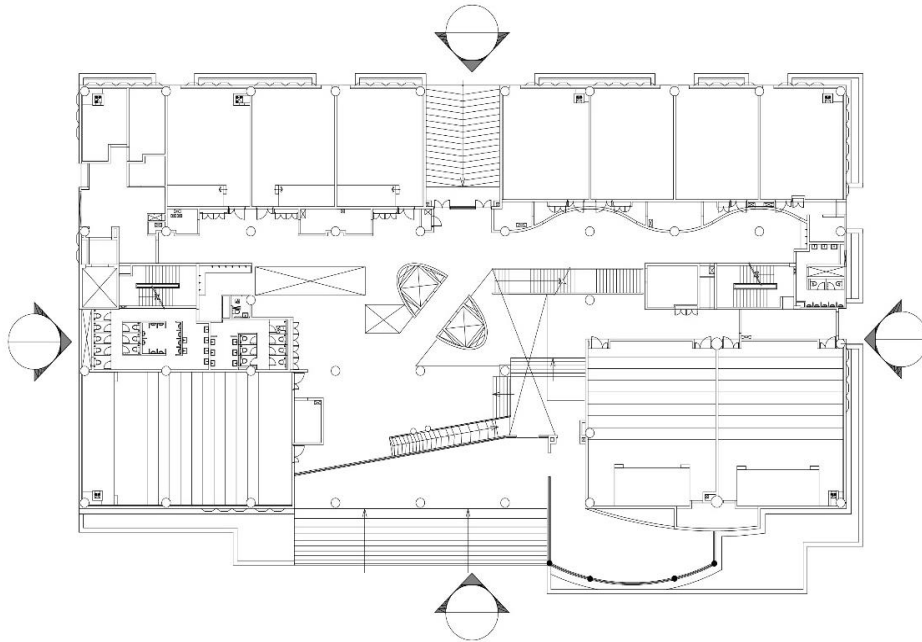


Figure 5: CAD drawing of C block Ground floor

Source: Designed by Estate office of IIT Hyderabad

- **3D CAD Model is available:** The CAD software is used to export the 3D model files into 3D shapefile, then it is imported into Sketch-up software files. My exercise found that the use of Sketch-up software is more promising for the results.

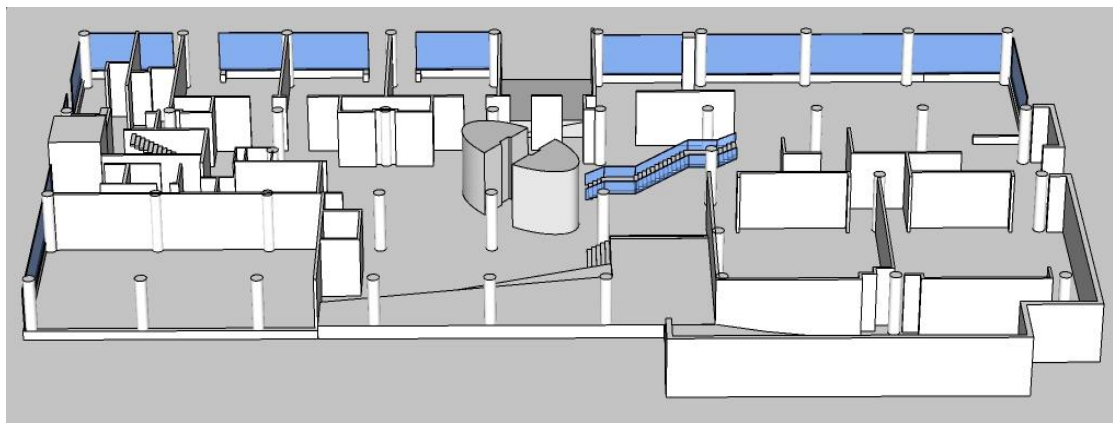


Figure 6: final 3D C block Ground floor model

- **Texture Mapping:** For all exteriors of the 3D models, the presence of the texture is important to pretend the virtual reality to be real and thus offer the user with a real prospect that can help in making credible results. The best way to achieve this is by exporting the 3D model with texture through Sketch-up files.



Figure 7: a 3D model with the texture

- **Use of Color/textured files for 3D similar models**

Objects can be executed for the sorting and arranging structure as texture mapping applications to provide helpful results.

- **Tool Used**

In this project, the following are some software I used.

Adobe Photoshop software, SketchUp software, blender software, adobe xd, Unity software, CAD software.

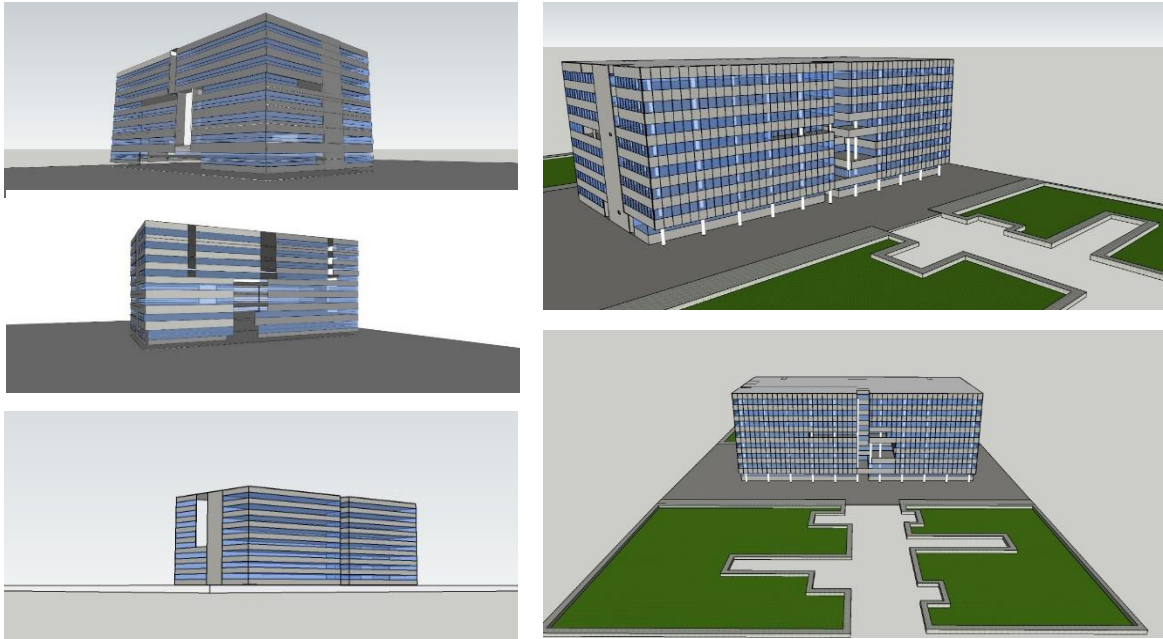


Figure 8: Rendering C block model





Figure 9: 3D model of C block in a different view

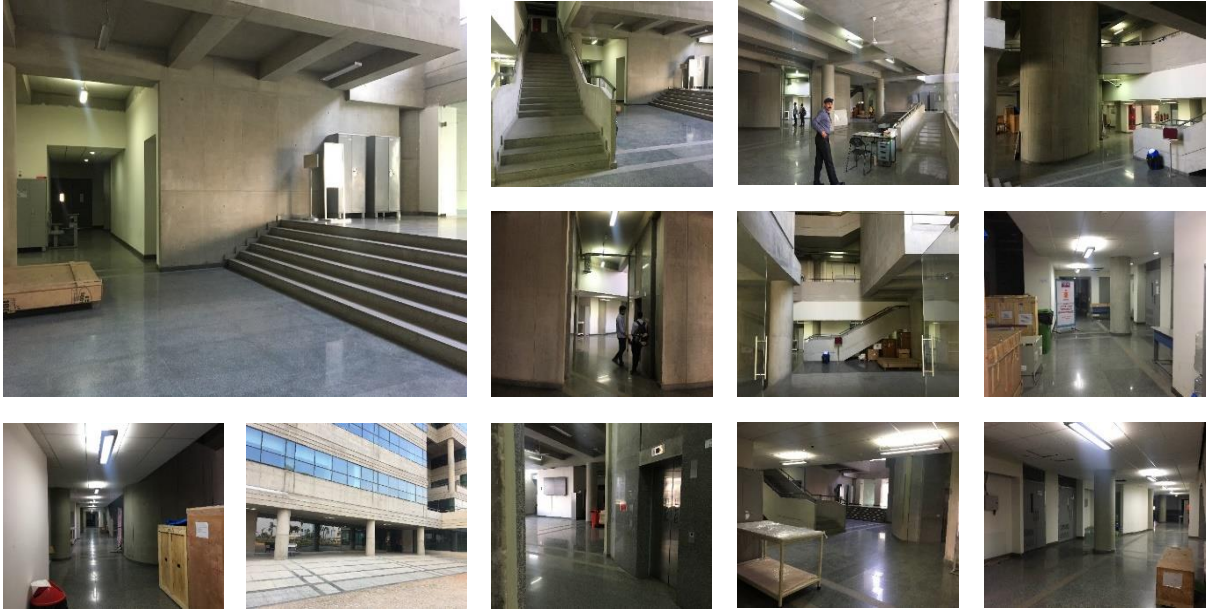


Figure 10: Reference image of C block the Ground floor

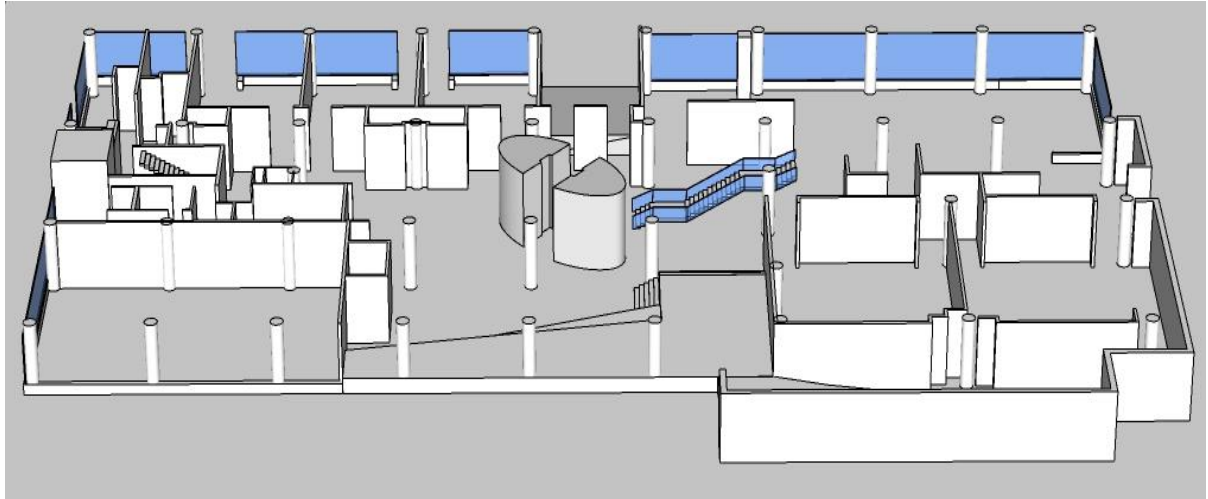


Figure 11: 3D model of C block Ground Floor



Figure 12: 3D model of the main Road of IIT Hyderabad



Figure 13: 3D Rendering of the main Road of IIT Hyderabad



Figure 14: graphic layout map

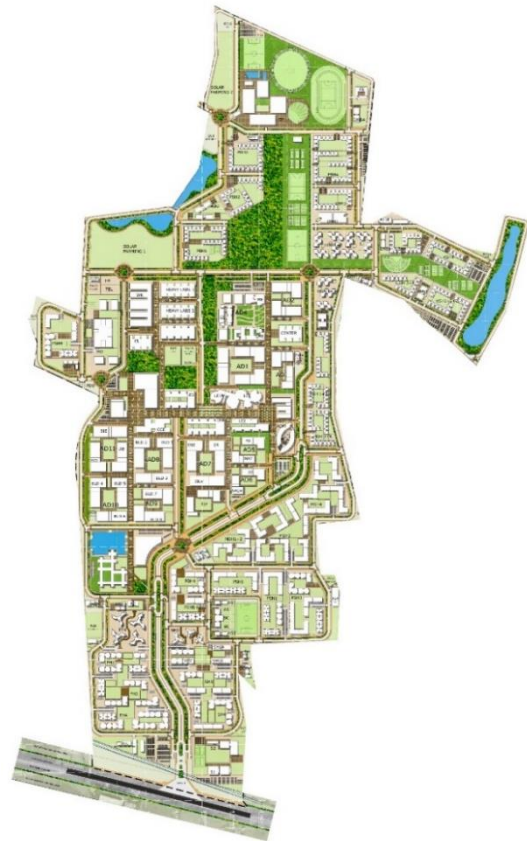


Figure 15: site map



Figure 16: site map with information

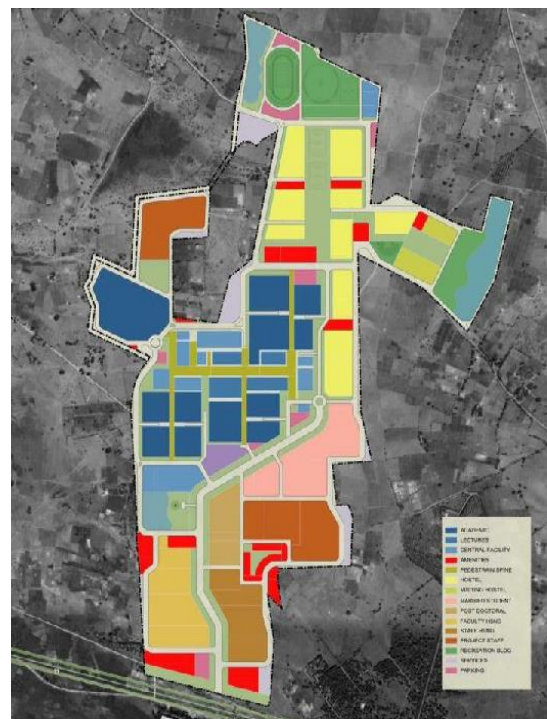


Figure 17: zoning map

Source: Figure 15,16 and 17 Estate office of IIT Hyderabad



Figure 18: Final site map 3D model

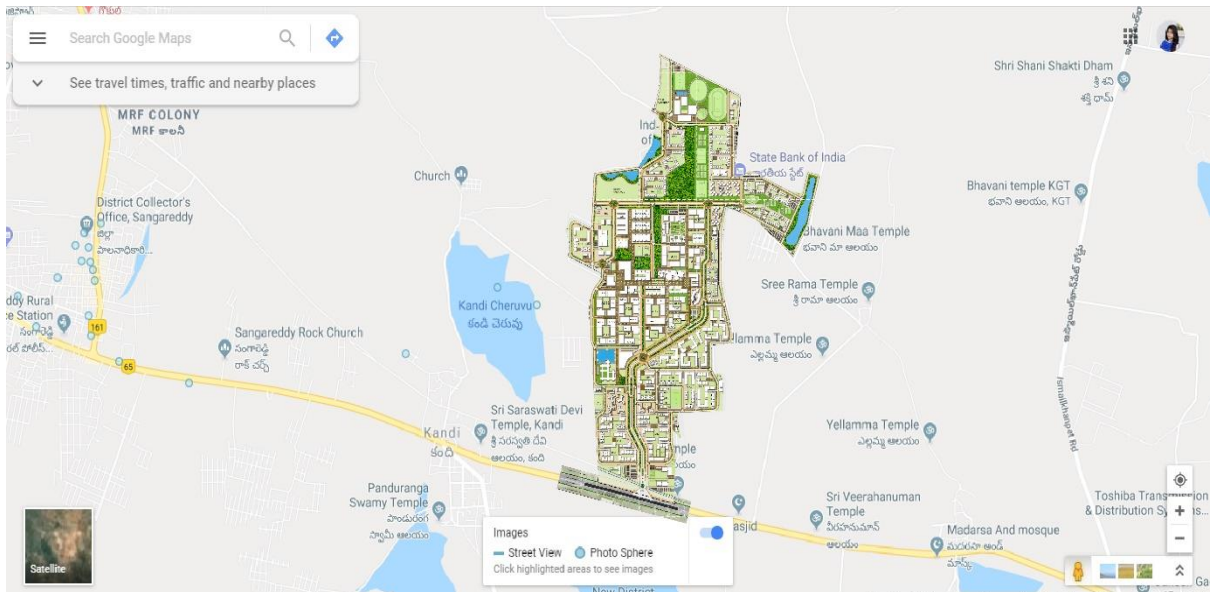


Figure 19: Google map integrated with the updated campus map of IIT Hyderabad



Figure 20: Google map aerial view of IIT Hyderabad

Chapter 5: Interaction Design

5.1 Introduction

Interaction design is a process in which designers focus on creating appealing interfaces with logic and creativity. The successful interactive design uses technology and principles of excellent communication to create desired user experiences. The goal of providing a 3D interactive model of IIT Hyderabad is to provide an interactive virtual tour or interactive campus map dynamically. It should be simple to use, compelling, and impressive. Interactive maps are more advanced than view-only maps. The interactive maps let the users explore the map, navigate, add and remove additional information, change map parameters, maintenance issues, find people, book meeting rooms, and are ultimately set up for success with one connected campus solution and much more. Previously most maps integrated into web sites were view-only single image maps without possibility to interact, but due to enhancements of web technologies maps are getting more interactive and map service providers today offer web-based map application program interface (API) for easy integration of dynamic and interactive maps. This thesis will, therefore, focus on the modern dynamic and interactive map. By integrating realistic campus images and customized illustrations with the latest interactive technology, our interactive campus maps will make it easy to find academic buildings, common areas, hostel area, playground, cafeteria, etc.

5.2 Inspiration

Behind Concept, 3D maps are a powerful yet intuitive content management system ready to serve admissions, marketing, facilities, and other departments. Concept 3D's platform offers the skill to easily create interactive campus tours, adding unlimited amounts of interactive media to involve prospects and serve students, parents, staff, and alumni. Few campus 3D maps were studied, where a different style of model, interaction, graphical representations are used. How they make a map to peoples often like to get familiar with the site, so they know their way around and can figure out where they want to spend their time. If students already have a major in mind, they may want to find that particular department's location, get a feel for the classrooms and available resources.

Below campus maps were studied, and inspiration was taken for designing the IIT Hyderabad campus map:

- The University of Texas at Paso.
- MIT campus map
- Emory University
- Carnegie Mellon University
- The University of Sheffield.

5.3 Interactive Mapping

Interactive mapping comprises of maps those allow zooming in and out the view, features of panning, identification of specific functions, query about data using filters such as by the name of the topic or a particular indicator, creating reports and other channels of using or visualizing selected data in the map.

Interactive mapping processes the GIS (Global Information System) to track the exact information on a map. Working in layers, the various levels of geographical information are positioned as layers. Unlike the strategy of static maps, interactive maps have the advantage of several features designed to expand the display of a large extent of complex data.

5.4 Why Use Interactive Maps?

There are different types of interactive maps such as a geographic map operated on the click events, a locator map with the facility to list out points of interest, or advanced maps as Google map. These maps allow their users to click, select, or mouse over to display a pictorial view or text related data about the location on the map.

But there are many different approaches to deploy interactive maps for a campus that are yet to be built. When visitors visit the campus physically or virtually, they expect to find the information as quickly as possible without waiting for the data to load or ask anyone. They need not search the whole campus map and then decide to use the home or back button to travel back to their previous starting point. Interactive maps allow the user to see a lot of information on a single layout and to choose what they want to find.

Few common practices that interactive maps are essential for the campus are location mapping that guides where a building is exactly located on the campus and interactive floor plan guidelines. Another concept is to present an aerial photograph of surroundings or region

in a top view fashion. One can drop pins to show amenities by utilizing the pictures on the map to offer viewers an exclusive perspective of the region.

5.5 Features of an interactive map

To make interactive map navigation informative and engaging, below features are considered:

- A high visual complete street view walkthrough,
- Visualize the whole campus from anywhere,
- Interactive information,
- Quickly find faculty information and navigate,
- Graphical icon to make it simple for users to see what they need quickly,
- 360-degree photo, video, text format brief information,
- Availability on google map,
- Bus and cab timing and tracking system,
- Weather and season information map,
- Audio guides,
- Motion sensor information (campus monitors),
- Improve workplace productivity,
- Consistency and reckless loading are crucial factors in designing map.

5.6 Cartographic interaction

Cartographic interaction is defined as the exchange of ideas between a human and a map facilitated through a smart device. The survey revealed parameters from the following questions that the concept of cartographic interaction must report: (1) why? (2) what?, (3) where?, (4) who?, (5) when?, and (6) how?

Question	Definition
What?	the definition of cartographic interaction in the context of cartographic research
Why?	the purpose of cartographic interaction and the value it provides
When?	the times that cartographic interaction positively supports work, and should therefore be provided
Who?	the types of users provided cartographic interaction and the way in which differences across users impacts interface designs and interaction strategies
Where?	the computing device through which cartographic interaction is provided and the limitations or constraints on cartographic interaction imposed by the device
How?	the fundamental cartographic interaction primitives and the design of cartographic interfaces that implement them

Table 1: The six fundamental questions of the science of cartographic interaction [Roth, 2011]

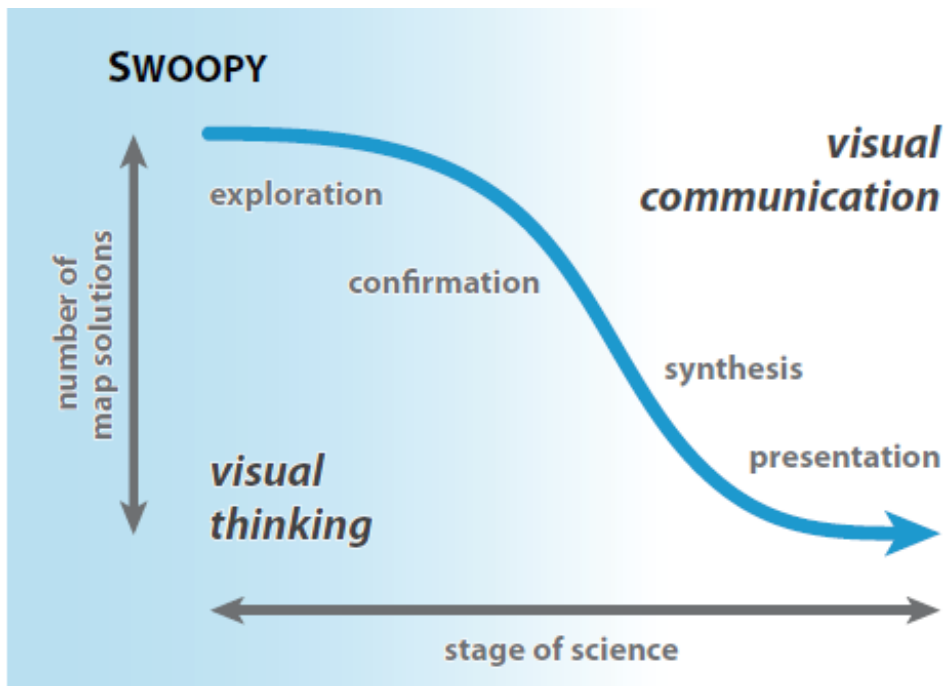


Figure 21: The swoopy diagram. In the early, exploratory stage of science, scientists require numerous different map solutions to promote visual thinking and prompt new research hypotheses.

Chapter 6: Implementation

6.1 Introduction

The 3d interactive map is an asset for the campus. We have a beautiful campus, and I want to highlight it in as many ways as potential. The 3D interactive map is a great tool to help prospective students tell themselves with the campus. This map is appreciated because it gives users a sense of place, which is something that doesn't translate through the 2D map.

6.2 Methodologies

6.2.1 Explore all view

The main purpose of our site plans is to offer local orientation in the most user-friendly way. People first journey to our campus is their first impression. People can visualize the campus from anywhere. We can show three-dimensional views for buildings.

6.2.2 Examine building floor by floor

Text and images can complement each other and thus can benefit comprehension; their combination also forces the readers to split their attention between the two. To reduce this split attention effect, it is mandatory that text and image are optimally integrated.

This can be achieved using the design (for example by placing related textual and graphical elements close together, or linking them with lines or arrows) or by creating linguistic relations, like a textual reference to an image or its content

6.2.3 Focus on detail from the ground floor

The primary purpose of our site plans is to offer local orientation in the most user-friendly way. The amount of time gone trying to find our bearings in on campus is entirely stoppable. Present plans are often technical architect drawings designed for different purposes, where 3d Maps of campus plans are designed to help our visitors get where they need trouble free and on-time. Easy to follow, user-friendly plans for all your visitors

6.2.4 1st person perspective walkthrough

Walkthroughs are several user-friendly and engaging. They offer a different viewpoint with an authentic mini-movie that involves users from the get-go. What's more, 3D walkthroughs immerse users in the design before it's built to create a realistic representation. Not only does creating walkthroughs save you countless hours of design time, but it also makes it easier to share them with the user. Simply generate a unique embed walkthrough on the campus website for an immersive and informative experience.

6.2.5 Detailed descriptions of locations map

Location maps are expert maps dedicated to navigating a specific location, showing how to travel from one place to another in the most reliable possible way, with the most particular journey details such as distinguishable landmarks, academic buildings, mess, cafes and any other clue useful on the way.

In another notion, a location map is a visible down style of a normal map because it is redundant to show every minute details about the road, rather the important ones are needed to the intended purpose. In a decent location map, all the streets prime to the user are only visible. It is also more detailed than a standard map as it is beneficial to have as much additional information as possible to channelize the visitors, sometimes down to exact road signs at crucial junctions.

This discussion is crucial to designing a successful location map, and clients often supply us with an existing diagram or travel directions as a guide to what they want to achieve with their new map. Similarly, the response from visitors who were not familiar with the area before they used the location map is essential.

Location maps are commonly a mixture of several maps at different scales to show how to reroute from the highway network to the local streets. This combined approach offers the visitors all the necessary information they requisite in a well-designed piece of a document. A committed location map is a custom-designed with a prime goal in mind, to address the first-time visitors to help them to find their destination at ease.

The benefits of location maps:

- By making it easy to find, both our visitors and our organization a big favor. Will put our visitors in a better frame of mind by cutting out the frustration of finding their way to you.
- All maps and travel directions are prepared in session with us, so we can be sure that all the details that matter are involved
- our visitors receive the whole story - from motorway access routes through main roads.

Chapter 7: Conclusion and Future work

In this Project, different campus navigation designs and technologies were studied. Necessary improvements were added to suit specifically to IIT-Hyderabad campus needs. In this project, different design tools and interaction methods were learned and used. Tools like Sketchup, Photoshop, Unity, Adobe XD, helped in designing the model.

Hope this project sparks new hopefulness among students and administration alike, to take up more such projects, which are beneficial for students, faculty, campus monitors, administration, and visitors, as well.

The Campus Model project offers the users exciting features, which were incorporated to provide a clean, user-friendly interface, which combines to give a great experience. The following are the list of features:

- Making 3D objects lighter because the process of building rendering in large quantities will require high-capacitated memory.
- A high visual complete street view walkthrough
- Visualize the whole campus from anywhere.
- Interactive information
- Quickly find Faculty information and navigate to each other.
- Graphical icon to make it simple for users to find what they need quickly
- 360-degree photo, video, text format brief information
- Availability on google map.
- Live campus shuttle information
- Detailed descriptions of locations and services
- Bus and cab timing and tracking system
- Weather and season information map
- Motion sensor information (campus monitors)
- Improve workplace productivity.
- Parking space availability
- Printing, sharing and embedding customized maps and directions

Bibliography

- [1] Campus Map. (2019). Retrieved from <https://www.utep.edu/map/>
- [2] MIT Campus Map. (2019). Retrieved from <https://whereis.mit.edu/>
- [3] Carnegie Mellon University (2019). Retrieved from <https://admission.enrollment.cmu.edu/pages/online-campus-map>
- [4] Emory University (2019). Retrieved from <http://emap.fmd.emory.edu/website/campus/index.htm>
- [5] University of Minnesota (2019). Retrieved from <https://campusmaps.umn.edu/>
- [6] The University of Sheffield. (2019). Retrieved from <http://ssid.sheffield.ac.uk/campus-map/?location=38-mappin-street>
- [7] 3D Maps and Indoor Mapping Platform. (2019). Retrieved from <https://www.wrld3d.com/>
- [8] 3D Models — Project Subway, NYC. (2019). Retrieved from <http://www.projectsubwaynyc.com/3d-models>
- [9] Smart city thinking | GIS technology | Esri Singapore. (2019). Retrieved from <http://esrisingapore.com.sg/smart-city-thinking>
- [10] Pokemon Go Map - Campus Map | Emporia State University. (2019). Retrieved from <https://www.emporia.edu/campus-map/pokemon-go-map.html>
- [11] Safari Interactive Experience - AVC IMMEDIA. (2019). Retrieved from <http://avcimmedia.com/portfolio/rowett-institute-app/>
- [12] Google Earth and SketchUp animation. (2019). Retrieved from <https://www.youtube.com/watch?v=EosjyUmCea0>
- [13] Lumion, Sketchup, Google Earth - Animation. (2019). Retrieved from <https://www.youtube.com/watch?v=yjc50iAf6jc>
- [14] Free Map APIs for Developers | Maps API Integration | Web Rest API Documentation & Mobile Maps SDK for IOS and Android. (2019). Retrieved from <https://www.mapmyindia.com/api/>
- [15] Walkthrough | Facilities at Woxsen Campus. (2019). Retrieved from <https://www.woxsen.edu.in/site/Campus-Walkthrough>
- [16] Interactive Mapping | Better Evaluation. (2019). Retrieved from https://www.betterevaluation.org/en/evaluation-options/interactive_mapping
- [17] Roth, R. (2013). Interactive maps: What we know and what we need to know. *Journal of Spatial Information Science*, (6). doi: 10.5311/josis.2013.6.105

Appendix I: Reference of Different style of model



Appendix II: Survey Questionnaire

- 1) Are you a visitor or a campus resident?
- 2) How long have you been on this campus?
- 3) Did you feel getting lost inside the campus during your first visit?
- 4) What is the problem you faced during your 1st visit to campus?
- 5) Did you face any problem in finding the academic block or interview room?
- 6) How did you find the destination?
- 7) Did you use Google maps to find the destination?
- 8) Did you search for campus map in the official website?
- 9) What kind of problem did you face in finding amenities?
- 10) Do you find it easier to navigate through the campus after your first visit?
- 11) What action can be taken to make navigation easier on the campus?
- 12) Do you use a smart phone?
- 13) Will you download an app to navigate easily inside the campus?
- 14) Did you use a personal vehicle or used campus transport?
- 15) Did you face difficulties in traveling inside the campus?