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Campus Compass: A Flutter-based Interactive Map for Campus Navigation

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***Abstract*—This work developed a Flutter-based interactive mobile application for effortless campus navigation called "Campus Compass." The app utilizes the Google Maps API to provide an interactive map display and routing functionality. The primary goal of the app is to assist students in navigating campus, finding their way to classes, and discovering new places on campus. The app includes features such as an interactive map display, search functionality, routing, real-time information about events and classes, and emergency contact information. The user interface of the appis designed to be user-friendly and intuitive, making it easy for students to use. The search feature allows users to search for specific buildings, services, or landmarks, and the routing feature provides turn-by-turn navigation to the user's destination. Real-time information about events and classes happening on campus is fetched from the university's website through web scraping. The Campus Compass app has been thoroughly tested on various devices and operating systems to ensure optimal performance. This app is expected to improve the overall campus experience for students, making it easierfor them to navigate and find their way around the campus. In conclusion, the Campus Compass app is a valuable tool forstudents to explore their campus and find the resources they need. It is an efficient and user-friendly mobile application that makes campus navigation more convenient and less stressful. The app is expected to be well-received by students and make a positive impact on their campus experience.**

***Index Terms*— Android app, Flutter, Navigation, Real-time updates, User-centric design.**

I. INTRODUCTION

The Campus Compass Android app, developed using the Flutter framework, is a powerful and user-friendly navigation tool designed to simplify campus exploration and navigation for students, faculty, and visitors. With its intuitive interface and comprehensive features, the app revolutionizes the way users interact with their college or university campuses. Navigating a large and complex campus can often be a challenging and time-consuming task. Traditional maps and signage may not provide the level of detail and real-time updates necessary to ensure efficient movement between buildings, facilities, and events. Recognizing this need, the Campus Compass app leverages the capabilities of Flutter to offer a seamless and personalized navigation experience. By combining the versatility of Flutter's cross-platform development with its rich set of UI components, the Campus Compass app provides an intuitive and visually appealing interface. Users can effortlessly explore the campus, search for specific locations, and receive real-time updates on events, schedules, and changes in campus resources. One of the standout features of the Campus Compass app is its indoor navigation capability. Flutter's flexibility allows

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for precise indoor mapping and navigation, enabling users to easily find their way within buildings, such as locating specific offices, classrooms, or departments. This feature not only saves time but also minimizes frustration, ensuring that users can navigate their campus environment with confidence. Additionally, the app offers personalized route planning based on individual preferences and needs. The app intelligently suggests the most efficient paths, taking into account the user's personalized settings and providing step-by-step guidance to their desired destinations. Users can effortlessly find information about academic departments, administrative offices, and libraries. One example where student is finding difficult to find his/her department. In conclusion, the Campus Compass Android app, built using Flutter, offers a comprehensive and user-centric solution for navigating college and university campuses.

II. Problem Definition

Users struggle with finding their way in unfamiliar locations and navigating to their desired destinations. Current navigation tools require internet connectivity or map downloads, which can be slow or unavailable in some areas. In addition, traditional navigation tools do not provide real-time updates or detours, causing frustration and wasted time. The Campus Compass application aims to solve these problems by providing a simple and reliable navigation tool that can be used offline, with real-time updates and detour options to ensure users reach their destination efficiently.

III. Objectives

- User-friendly interface: The application should have a clean, intuitive, and user-friendly interface that is easy to navigate and provides a seamless user experience.
- Real-time information: The application should provide real-time information about the campus, such as classroom location, department location.
- Campus maps and directions: The application should include a map of the campus, with directions and markers for important locations such as buildings, restrooms, and parking areas.

IV. RELATED WORK

[1] proposed an application enables users to obtain routes that are much more detailed than an existing commercial application can provide. They represented campus as a Graph structure, with locations (buildings, parking lots, etc.) on campus stored as vertices of the Graph and transitions between the locations (roads, sidewalks, etc.) stored as edges between the vertices. This application directs the user from his current location to the exact location he searches in the campus.author [2] proposed a Global positioning system based on map application will be most helpful to locate desired place and shortest path from current location and to get update of event on map with its location. Thus it will reduce frustration and confusion of anybody inside the campus. This paper present the architecture and design of a Google map based application on android platform. The application has been implement using android SDK and has been tested for K J campuses. Keywords: Identity-Based; Access Control; Rating System; Cipher Text-Policy Attribute-Based Encryption.
[3] proposed #GPS and Image based campus navigation app (UTRGV-Brownsville Campus). They propose a communitysystem where in users will create their custom maps and upload them to a central server.A user clicks photos of landmark buildings and surrounding scenes while going between location A and location B.We strip the GPS location from these pics and then create a map from them in a single form/view.While the app is in use - the user receives sound alerts / image alerts on his screen, as and when he/she is within (approaching) a certain distance from the landmark (20mtrs). Theauthors[4] This application is designed to provide better direction paths based on algorithms that would choose the best according to influencing factors like shortest distance, less time, more scenic, better snow path, etc. For the time being, only two factors are considered, distance and time. A Client-Server model is applied since route data is shared anonymously between different users. The client here is represented as smart phones interacting with a server. It can perform upload or retrieval of paths. Proposed [5]a map application whose primary goal of this research is to provide an optimal navigation solution through mobile applications that can exhibit a shortest-path calculation that benefits everyone. At first, the user's app requests Google API from a GPS satellite. The map is then loaded into the user's app. The current location of the user is monitored and shown on a map using a GPS activated system on the user's mobile phone. At first, the application in the user’s phone, requests for Google API from Google server. Then the map is loaded on user’s phone. By GPS of users mobile, current location of user is tracked and displayed on map. A HTTP GET request

is sent through the cellular data network services and internet to the Map Information Server (MIS). A cellular data network is used to send a User-app message.

V. Proposed Method

The complete application design is built using flutter framework based on Dart programming language. The core functionality revolves around a campus map integration, which utilizes services like Google Maps or Mapbox to display the campus map. Important locations such as buildings, libraries, dining areas, and parking lots are highlighted on themap for easy identification. To ensure inclusivity, the app incorporates accessibility features such as text-to-speech , multi-language and usage of different themes support. The solution is implemented by providing users with the capability to access the street view and obtain detailed directions to their preferred location. The solution includes presenting the normal view, satellite view, and terrain view.

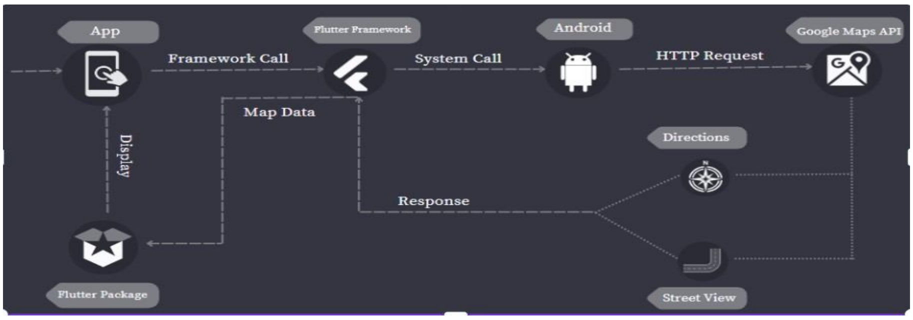


Fig. 1: low-level design

The low-level design in Fig 1 of the Campus Compass app combines the capabilities of the Flutter framework, Android platform, Google Maps API, and various system-level interactions to provide a seamless and user-friendly campus navigation experience.

In the Campus Compass app, the user begins by entering a search query for a specific location on the campus. This search query is then sent as an HTTP request from the app to the server. The request includes the user's search query, allowing the server to process it and search for matching locations within the map data. The server undertakes the task of searching for relevant results based on the query and generates an appropriate response.

Once the server completes its processing, it generates a response that contains the search results. This response is then sent back to the app as an HTTP response. The app receives this response, which includes the desired search results, and proceeds to handle the information accordingly.

To provide a seamless user experience, the app takes charge of displaying the search results to the user. It leverages the Flutter framework's UI capabilities to present the results in an intuitive and user-friendly manner. The user can then review and interact with the displayed search results, enabling them to find the desired location within the campus effectively.

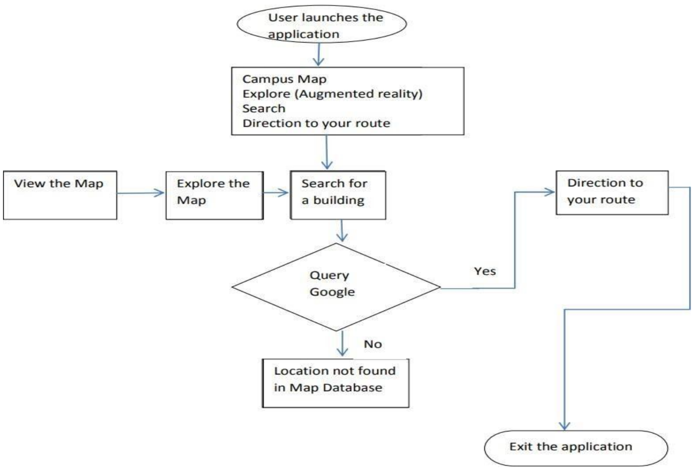


Fig 2: High level design

The system architecture depicted in Fig 2 showcases the fundamental components and their interactions within the system. It illustrates the overall structure and design of the system, highlighting the key modules, data flows, and interfaces. This architectural representation serves as a blueprint for understanding the system's functionality.

* user selects "Search for a Location," they are directed to the "Search Location" screen, where they can enter a query or keywords to search for a specific location on the campus.

* The application calculates the optimal route from the user's current location to the destination using the map data.

* The "Display Directions" screen shows the step-by-step directions to the user. Each step of the directions is presented to guide the user to their destination.

* If the user selects "Exit" from the main menu, the application ends, and the flow terminates.

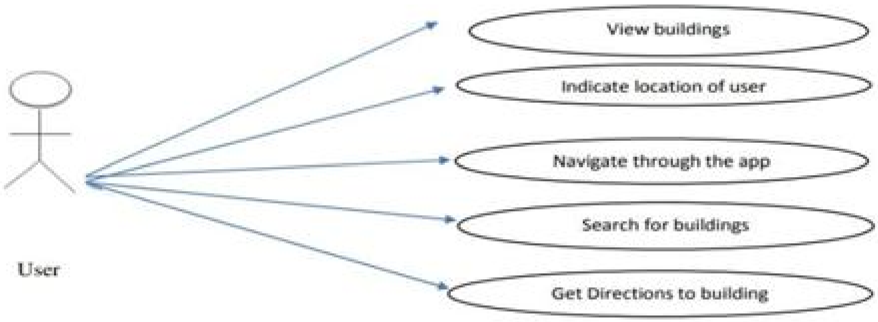


Fig 3: Use Case diagram for campus navigation system

As mentioned in Fig 3, it depicts the Use case diagram for Campus Compass App(proposed model) which assists the users in navigating and finding buildings. It shows an overview of how users interact with our app and the functionalities available to them.

* User: The "User" represents the person who interacts with the navigation app. They perform various actions and use the app's features to navigate and explore locations.

* View Buildings: This use case enables end users to view a list of available buildings or landmarks within the app. Users can access details about each building, such as its name, address, description and the 360 view.

* Indicate Location of User: This use case allows the app to determine and indicate the user's current location on the map. It utilises the device's GPS or other location services to pinpoint the user's position accurately.

* Navigate Through the App: This use case involves the basic navigation functionality of the app, allowing users to move between different screens, menus, change the theme and language and navigate through different sections within the app. It enables users to access various features and functionalities seamlessly.

* Search Buildings: This use case enables users to search for specific buildings or landmarks within the app. Users can enter the building's name or address or select from the list.

* Get Directions to Building: This use case allows users to obtain directions to a particular building from their current location or any specified starting point. The app calculates the optimal route and provides step-by-step instructions, including distance, estimated travel time, and any additional information like traffic conditions.

VI. Result and Comparison Study

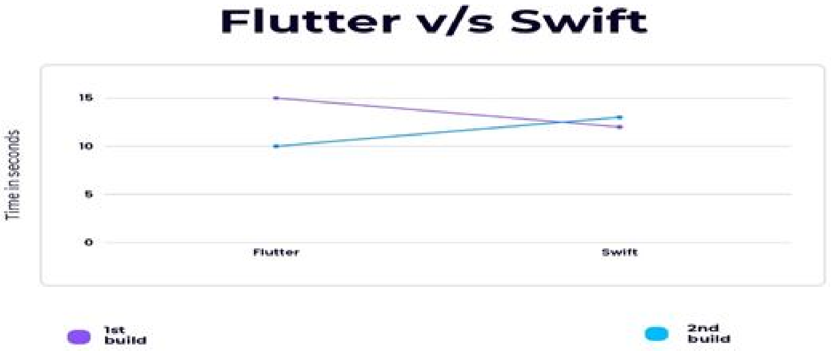


Fig 4: Build time performance

The graph in Fig 4 represents the build time performance of flutter With respect to mobile applications. Flutter takes at least 15 seconds to build for the first time while swift takes around 10 seconds to build. However, flutter builds incrementally faster after the first build, within 10 seconds. The graph in Fig 4 ,we represent two lines, One to represent the first build and other to represent the second build. Here we see that during the first build the flutter line increases and during second build it decreases. Meanwhile the swift line slightly increases or remains constant.

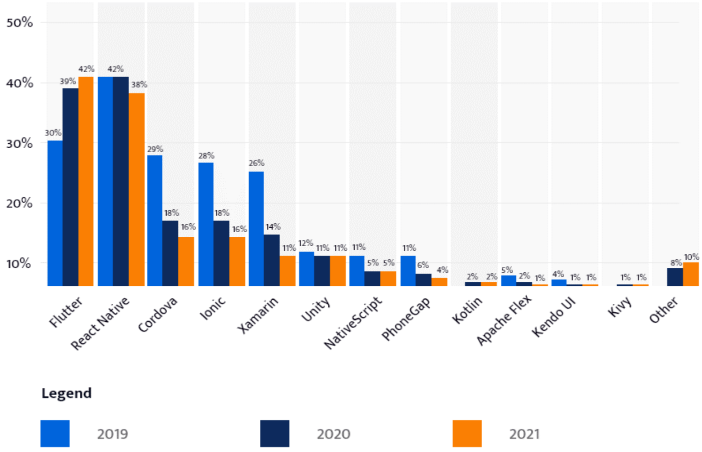


Fig 5: comparison of flutter with other programming languages.(Referred from Google trends)

The bar graph in Fig 5 says that Flutter is the most popular cross-platform mobile framework used by global developers, according to a 2022 developer survey. Based on the survey, 46 percent of software developers used Flutter. On the whole, roughly one third of mobile developers use cross-platform technologies or frameworks; the rest of mobile developers use native tools.

Lets us consider an example where a student/faculty wants to search SIT, Tumkuru.

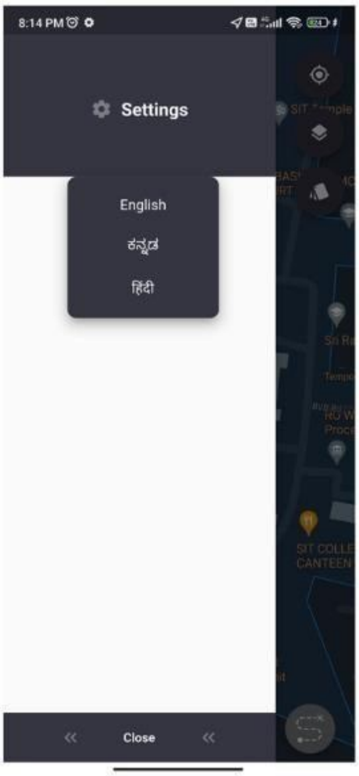


Fig 6: Multi-language support

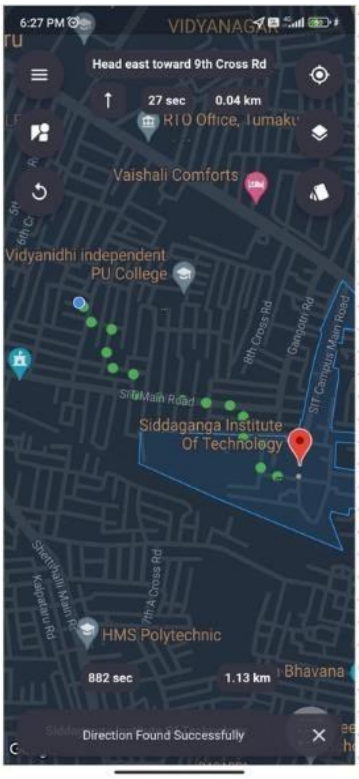

6:27 PM
Head east toward 9th Cross Rd
27 sec
0.04 km
RTO Office, Tumaku
Vaishali Comforts
Vidyanidhi independent PU College
SIT Main Road
Siddaganga Institute Of Technology
HMS Polytechnic
882 sec
1.13 km
Bhavana
Direction Found Successfully

Fig 7: selecting destination

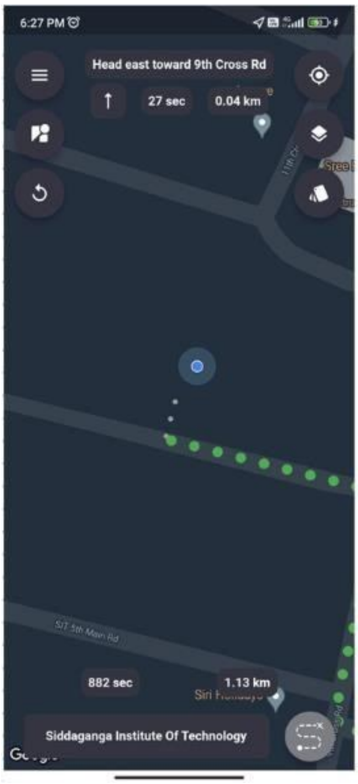

6:27 PM
Head east toward 9th Cross Rd
27 sec
0.04 km
882 sec
1.13 km
Siddaganga Institute Of Technology

Fig 8: Destination reached

In Fig 6, when the user enters the application, they are presented with a comprehensive set of features that include multi-language support and the ability to change the app's theme. These options cater to the user's preferences, allowing them to choose a language and visual style that aligns with their interests.

Moving to Fig 7, the user utilises the search bar within the application's interface to search for their desired destination address. They have the flexibility to input the building name directly or choose from a list of options provided. This intuitive search functionality streamlines the process of finding and selecting the desired destination.

In Fig 8, the app configures the current location of the end user. Based on this information, the app then generates a response that includes the shortest available route from the end user's current location to the desired destination, taking into account factors such as minimal traffic congestion. Additionally, the response includes the calculated distance for this recommended route. This ensures that the end user receives optimal navigation instructions that consider real-time traffic conditions and provide the most efficient route.

Together, the functionalities depicted in Fig 6, Fig 7 and Fig 8 provide an enhanced user experience by offering multi-language support, theme customization, intuitive destination search, and accurate route recommendations based on the end user's current location and prevailing traffic conditions.

Furthermore, our application offers users the option to switch between normal view, Satellite view and Terrain view. Fig 9 showcases the normal view, which presents the user with a standard representation of either the desired destination or the user's current location. This view provides a conventional and familiar perspective for users to visualise their surroundings and navigate effectively.

In Fig 10, the application showcases the satellite view, which provides users with a detailed and high-resolution imagery of either the desired destination or the user's current location. This view leverages satellite imagery data to offer a more immersive and visually rich experience, allowing users to observe their surroundings with enhanced clarity and precision. The satellite view enables users to explore their destination or current location from an aerial perspective, providing valuable context and aiding in navigation and orientation.

Fig 11 introduces the Terrain view, utilizing topographic data to present detailed landforms and elevation contours. It provides valuable insights into the natural landscape, helping users assess terrain complexity and plan routes effectively. Users can visualize mountains, valleys, and hills, making informed decisions based on potential obstacles and rugged areas. The Terrain view enhances navigation by allowing users to select suitable paths and interact with the environment more comprehensively. It offers a unique perspective beyond standard visual representations, enabling users to explore their location from a rich and insightful standpoint.

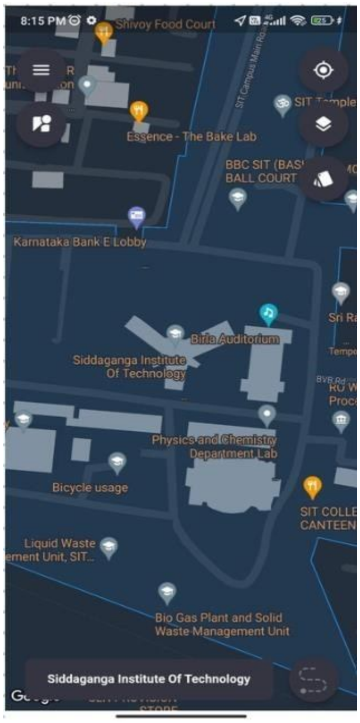

8:15 PM
Shivoy Food Court
SIT Temple
Essence - The Bake Lab
BBC SIT (BASKET BALL COURT
Karnataka Bank E Lobby
Birla Auditorium
Siddaganga Institute Of Technology
Physics and Chemistry Department Lab
Bicycle usage
SIT COLLEGE CANTEEN
Liquid Waste Management Unit, SIT...
Bio Gas Plant and Solid Waste Management Unit
Siddaganga Institute Of Technology

Fig 9: Normal view

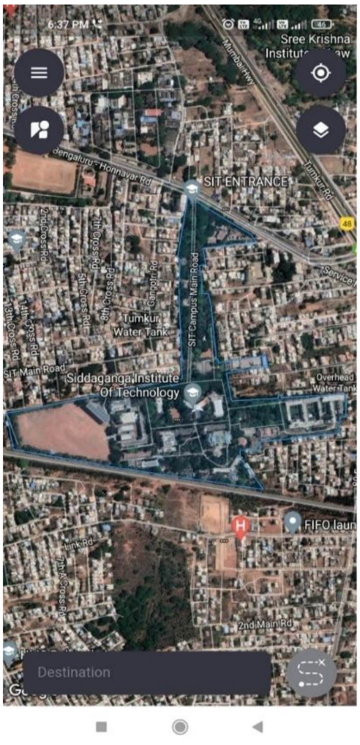


Fig 10: Satellite view

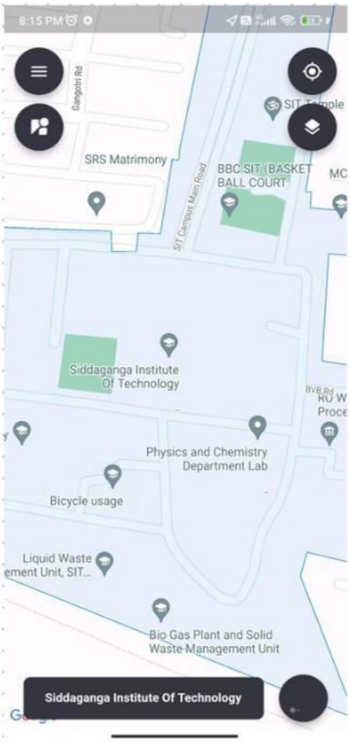
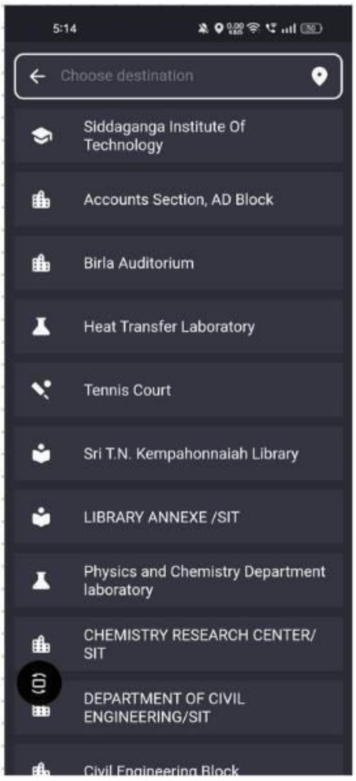

8:15 PM
Gangotri Rd
SIT Temple
SRS Matrimony
BBC SIT (BASKET BALL COURT
SIT Campus Main Road
Siddaganga Institute Of Technology
Physics and Chemistry Department Lab
Bicycle usage
Liquid Waste Management Unit, SIT...
Bio Gas Plant and Solid Waste Management Unit
Siddaganga Institute Of Technology

Fig 11: Terrain view



5:14

Choose destination

Siddaganga Institute Of Technology

Accounts Section, AD Block

Birla Auditorium

Heat Transfer Laboratory

Tennis Court

Sri T.N. Kempahonnaiah Library

LIBRARY ANNEXE /SIT

Physics and Chemistry Department laboratory

CHEMISTRY RESEARCH CENTER/ SIT

DEPARTMENT OF CIVIL ENGINEERING/SIT

Civil Engineering Block

Fig 12: Destinations

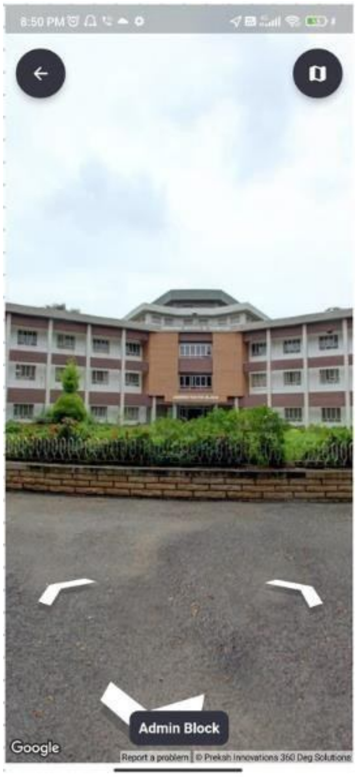


Fig 13: Admin block

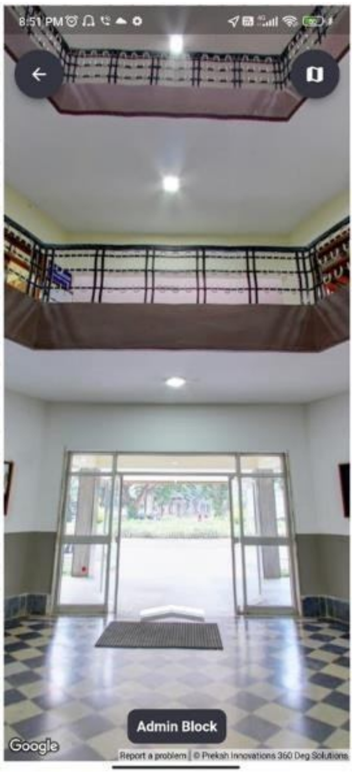


Fig 14: Result after clicking Left arrow in Fig 13

One of the standout features of our application is the ability to provide users with a 360-degree view of the desired location. This unique feature can be accessed through the menu, offering users a comprehensive and immersive visual representation of the chosen destination. By utilising advanced imaging technologies, the application allows users to virtually explore the surroundings, observing the location from different angles and perspectives. This 360-degree view enhances the user experience, providing a more interactive and engaging way to interact with and understand the desired location.

In Fig 14, the application showcases the 360-degree view of the admin block. This feature enables the end user to virtually navigate through the location, both inside and outside. The 360-degree view offers a highly immersive and interactive experience, allowing users to explore the administrative block from various vantage points. Users can virtually move within the location, rotating their viewpoint in any direction to observe the surroundings and gain a comprehensive understanding of the administrative block's layout and features. This advanced functionality provides an engaging and realistic way for users to virtually navigate and explore the location as if they were physically present.

VII. Conclusion

In conclusion, the development of a campus compass mobile application using Flutter has numerous benefits for students,staff, and faculty of a college or university. The use of Flutter as the development framework allows for fast and efficient development of the application, with features such as a modern user interface, native performance, and easy integration with other tools and technologies. With the campus compass application, users can easily access information about the campus, such as maps. This can help save time and make it easier for users to navigate the campus, find what they need, and stay informed. The app's data flow encompasses user interactions, data fetching from remote servers or local storage, data processing and management, state management, and rendering of the user interface. The utilization of local data storage ensures data persistence and synchronization. Additionally, the inclusion of accessibility features ensures that the app is inclusive and usable for individuals with disabilities.

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