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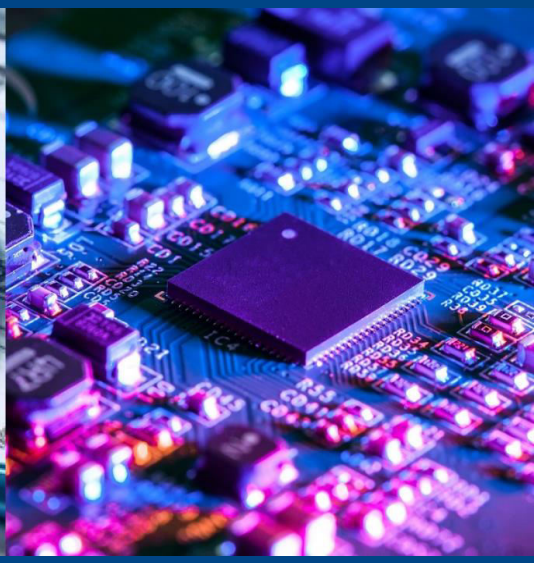

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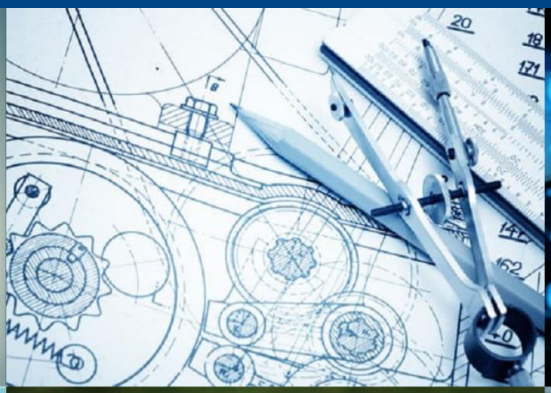

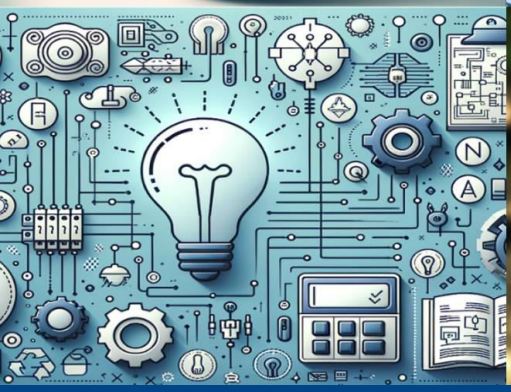

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Campus Compass Navigation System for Vivekananda Global University, Jaipur

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ABSTRACT: Getting around a university campus is an often confusing, time-consuming task for an arriving student. Vivekananda Global University (VGU) has a large and varied campus, made up of many structures that look very much the same. These include the Tech Block, the Academic Block, and the Administrative Block; several types of student housing; and a number of very different-looking structures that house the university's various facilities, including a mess, a large rock-climbing wall, and three very different-looking main gates leading in and out of the campus. Even the well-acquainted seem to get lost occasionally. This, then, is the context for the Campus Compass project. The project aims to use contemporary web and mobile software to serve a useful purpose that fits the contexts of both the university and its students.Campus Compass aims to give a simple, customized navigation experience to students, staff, and guests on the grounds of the institution. Using 3D models, the ability to navigate fully inside and outside buildings, and a location search engine, it takes users to their programmed destinations—and promises to do so efficiently. The app includes elements that make it much more than just a high-tech wayfinding system. It offers a personalized experience; it can use your class schedule to time its navigational suggestions. It can also tell you where classes and offices are, which might be more relevant now than it was when we were in school.The project requires a total assessment of the campus layout, a nearly unreal task given the unevenness and range of heights over the 100-plus acres. The next step, once the layout has been considered in its totality, is to create accurate, to-scale 3D models of significant structures within their real context over the same range of heights. After this, the platform is to be built using such modern web and mobile technologies as Three.js and WebGL for the web version and either Flutter or React Native for the mobile version. Refinement of the system and assessment of its reliability will happen in tandem with user testing.Campus Compass will (1) significantly improve time management, (2) reduce confusion, and (3) enhance the overall campus experience at VGU. It will also support emergency response efforts by (4) enabling faster navigation to key locations on campus. Future developments could include (5) real-time indoor positioning, (6) multi-language support, and (7) integration with other campus systems, such as event notifications and announcements. Overall, Campus Compass will contribute (8) toward a smarter, more student-friendly, and technology-driven campus.

KEYWORDS: Campus Navigation, 3D Map, Vivekananda Global University, Web Application, Mobile Application, Internal Navigation, Classroom Finder, Campus Management System

I. INTRODUCTION

College campuses are dynamic environments where academic, administrative, residential, and recreational functions are spread over large areas. Vivekananda Global University (VGU) is a campus of such kind, with multiple key structures, including the Tech Block, Academic Block, Administrative Block, hostel buildings (Singar 1, Singar 2, and Singar 3), mess facilities, gyms, and multiple entry points set over a large area. As the campus keeps growing, finding one's way between the various locations becomes more and more challenging—especially for freshers, visitors, and sometimes even faculty. One of the common problems faced by students is finding the particular classrooms or offices that they have to go to. This problem is exacerbated by the fact that classes are often scheduled in different blocks and at different times. It often takes students a good while to find the class or administrative office they're supposed to be in. This is all too frequently the case with me. Another variation of the problem is framed in terms of time.

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Long-standing techniques like simple signboards, printed maps, or spoken directions from friends fall short of serving the fast-paced academic world. When every other aspect of daily life is being transformed by smart solutions, can't campus navigation get with the program too? Today's tech-savvy students expect more than the old low-tech way of getting around. Enter "Campus Compass," an all-inclusive resolution to this directional dilemma. It's envisioned as both a web-based and a mobile application completely capable of delivering the VGU campus as a 3D visualization unto the user's device. From there, it can render real-time navigation assistance.

Students will not only be assisted in finding classrooms, professor cabins, offices, and hostels but will also be helped to locate the mess, gym, and important gates by the application. Campus Compass offers internal and external navigation and personalized maps based on class schedules to help with this. For the ease of navigation, Campus Compass also offers QR code-based location scanning. Real-time updates will also be provided via the application. With these features, Campus Compass aims to provide a seamless navigation experience for users.

This paper presents the idea, design, and development process for Campus Compass, a smart and personalized navigation system that greatly enhances the living experience of people on campus. We are all too aware of the real-world problems faced by students and faculty when trying to find their way around campus. A system that helps with this very basic daily task has the potential to make the educational environment more connected, more efficient, and more friendly.

II. PROBLEM STATEMENT

For students, staff, and visitors, finding one's way around a large university campus has always been a challenge—especially when the campus layout is intricate and facilities are scattered throughout various locations. Vivekananda Global University (VGU) stands as a prime example of such a campus. It has not only a Tech Block and an Academic Block but also an Administrative Block. These are just some of the many facilities located on campus. (Singaar 1, 2, and 3).

Even newcomers to the camp are often challenged and bewildered when they first attempt to find their way around. Fittingly, VGU was awarded the 2021 Architect India Award for Best University.

VGU has many facilities, but the Student Council knows the ins and outs—literally and figuratively. This council was started in order to help students locate important facilities and to help campus denizens find their way around.

For example, a class in mathematics might be held in the Tech Block, while a class in environmental studies could be located in the Academic Block. Stumbling around without a map can waste a big chunk of class time. During my first few weeks at Gallaudet, I spent up to 10 minutes trying to find a classroom I was supposed to be in for a morning session. Even after asking for help and being given directions, I could never remember the route well enough to use it confidently again. Once I was in class, I was too tense to focus on the important lectures. And it was no better when I was looking for the mess, the gym, or any of the administrative offices. Following labyrinthine paths through a complex of buildings could exhaust both my partner and me.

Old-school ways of directing people, such as using paper maps, notice boards, or asking for directions, aren't very good. They are not very effective, and in many cases, they are quite outdated. They don't give you any help that is personalized to your immediate situation; for instance, they don't help you figure out the best way to get from where you are to where you need to be at this moment.

Without an organized navigation system, students experience needless stress, being late, and working inefficiently, which directly undermines their grades and the quality of their time on campus. And in emergencies—when every second counts and clear heads are hard to come by—a system that gets people to medical rooms, emergency exits, and security offices in a reliable, quick, and understandable manner could make the difference between life and death.

For that reason, a strong necessity exists for a smart, real-time, easy-to-use navigation system on the lines of Campus Compass. Such a system would 3D visualize the campus, have search capabilities for any location, provide both internal and external navigation and, most importantly, have several personalized features. The features and capabilities

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of such a system would, in effect, guarantee that any student or staff member could traverse the campus with ease and efficiency.

Objective:

The primary objective of the Campus Compass project is to design and develop a comprehensive, user-friendly, and efficient navigation system tailored specifically for the Vivekananda Global University (VGU) campus.

The system seeks to solve the typical problems experienced by students, teachers, and guests who are trying to find various classrooms, sectors, offices, dorms, and pleasure facilities spread across the big, intricate layout of the campus.

The project fundamentally aims to construct a three-dimensional digital map of the whole university, bestowing upon it a genuine visual representation of the campus spaces, both inside and outside. With this interactive experience that the user can undertake, the spatial relations, the layout of the various buildings, and the way all these structures fit into the surrounding topography, etc., can be comprehended in a manner that is quite a bit more intuitive than a 2D map or a static signpost.

Another primary aim is to allow for personalized wayfinding that accommodates users' diverse needs. A student, for instance, might program the app to use the class schedule as a basis for determining the next class destination.

Real-time location services and QR code scanning will also be integrated into Campus Compass. Users will be able to scan QR codes placed at different campus locations and receive instant directions to their destination. This should make the campus easier to navigate for everyone, including those who may not be comfortable with using digital maps.

The initiative also seeks to enhance the time efficiency of students and staff. The goal is to enable them to spend less time searching for places and more time in the activities for which they came to campus, such as attending lectures or participating in recreational activities. When emergencies arise, it is of utmost importance that the time spent reaching safety is minimized, which could make the Campus Compass a lifesaver when used in emergency situations.

The final aspect of the setup is the scalability and adaptability of the system. This means that as VGU continues to grow and add new buildings or facilities, the platform can easily be updated to include these new structures without needing any sort of overhaul or major redevelopment effort.

In brief, Campus Compass aims to provide an intelligent, integrated, and very much working navigation solution that makes the campus environment more convenient, safe, and satisfying for

Scope

The Campus Compass project has a very clear and focused scope — the design, development, and deployment of a comprehensive navigation system specifically for Vivekananda Global University (VGU). As the system is being built, it will cover all major academic, administrative, residential, and recreational areas within the university's physical campus. This is a fairly large set of geographical features, which includes, among many other places, the Tech Block, the Academic Block, the Administrative Block, and all three of the hostel buildings — Singar 1, Singar 2, and Singar 3.

The system will furnish a three-dimensional visualization of the buildings' external structures and internal layouts, enabling users to navigate easily and without confusion from one space to another. Both web-accessible and mobile-device platforms will host the application, offering students, faculty, and visitors the flexibility and access they need to utilize this tool.

Campus Compass will have things like these:

1. Campus map
2. Functions for navigation
3. Information about campus buildings and services
4. Method to connect with other users
5. Additional function that is not fully envisioned yet, but which the developers believe might be needed

It is possible to crawl a functioning web page and then use the information gathered to build a map. This approach was taken in the summer of 2013 when a web map of the entire campus was constructed.

Location Query: This allows users to look for distinct spaces such as classrooms, academic offices, residential halls, and other amenities.

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Navigation: Providing specific directions both within and outside the campus structures.
Map Personalized Integration: Students linking their class with the navigation system for quick access to the classroom locations.
QR Code Assistance: Allowing for immediate location assistance and direction guidance by using QR codes positioned at critical junctures to enable simple scanning.

Navigating Emergencies: Aiding users in the rapid identification of life-saving egress routes, critical care stations, and protective service posts

At first, the plan is to just use offline maps and whole-institution Wi-Fi mapping for all positioning and navigation tasks, but the work has been set up so that (1) future improvements will be easy to implement and (2) they're not limited to any one technology or approach. Several reasons based on current and future usability suggest this plan.
The extent of this portion of the project includes not only the campus map but also the regular, uncomplicated updating of said map. If a new building goes up, or if a current building is repurposed (e.g., a room formerly occupied by a humanities course is now used for a laboratory), the map must be accordingly modified. This is not a big deal, by and large, but part of what makes it a "not-big-deal" is that there exists a simple way for authorized university personnel to update such information on the map. That is a thing I shall be developing.

To sum up, Campus Compass is not simply a navigation tool. It is positioned as a foundational part of VGU's movement towards a smarter, more connected, and technology-driven campus ecosystem.

III. RESEARCH METHODOLOGY

Ensuring accuracy, usability, and scalability in the Campus Compass navigation system means following a clear and systematic methodology in its development This methodology combines the surveying of the campus with the researching of technologies that might be used or adapted for use in the system. It also combines system design, system development, system testing, and the integration of user feedback.

The first step is an exhaustive data survey and collection exercise at the Vivekananda Global University (VGU) campus. Manual mapping is carried out for all blocks, hostels, administrative buildings, recreational zones, gates, and key landmarks, using a combination of building blueprints, campus layouts, and on-site verification. Special emphasis is laid on internal spaces like classrooms, offices, and corridors to make sure that internal navigation is both accurate and realistic.

After collecting the data, the next phase shifts to 3D modeling and map creation. With the aid of tools such as Blender, SketchUp, and Three.js, a finely wrought 3D model of the campus is made. This model encompasses not just the external edifice (buildings, roads, gardens) but also an internal spatial reality (hallways, rooms, staircases). The aim is for the user to have an experience not just of visualization but also of immersion and intuitiveness.

System design and architecture planning is the third phase. For rendering 3D models, Campus Compass's web version will employ HTML5, CSS3, JavaScript, and WebGL. For the mobile app, either Flutter or React Native will be used as the cross-platform framework to ensure compatibility with both Android and iOS devices. For the backend server—doing the data storage, QR code mappings, and updates—we will decide between Firebase and a lightweight Node.js server.

The fourth phase is development and integration. Simultaneously, the frontend and backend modules are developed, and then the features are integrated:

- Location search
- QR code scanning
- Turn-by-turn navigation
- Personalized scheduling.

After the basic system is established, we proceed to the fifth phase: testing. We conduct both alpha testing (internal testing) and beta testing (using students and faculty) to uncover and identify virtually all usability issues, bugs, and

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areas needing improvement. We pay special attention to the user interface's elegance and simplicity, the system's speed, and the accuracy of its navigation.
In the end, based on the feedback received, adjustments are made before the official launch. Plans for maintenance include not only regular updates but also the addition of features (such as AI-based navigation) and the expansion of the map database to accommodate the university's growth.
This methodical structure guarantees that Campus Compass is useful, focused on the user, and well-prepared for the changing requirements of the VGU community.

IV. SYSTEM DESIGN

The Campus Compass system is built to provide a user experience that's smooth and interactive, with an appropriately efficient back end, and with plenty of room for expansion. It has so-called modular design, which means that several interconnected components within the system can work together, or not, as the situation demands them to do, and without much trouble.

The 3D Campus Map Module is at the heart of the system. This module bears the responsibility for producing the detailed three-dimensional rendering of Vivekananda Global University's structures, interior passages, and exterior points of interest. Components such as Three.js and WebGL are employed to create these interactive 3D web environments, whereas the mobile app utilizes Flutter or React Native in conjunction with Unity3D or similar native 3D engines to realize the visualizations in an optimized way.

The Navigation and Routing Engine calculates the most efficient routing from one to two points. It supports both external routing (moving between buildings) and internal routing (finding specific rooms inside a building). The routing algorithm uses a graph model where different points (classrooms, offices, etc.) are represented as nodes, and the paths between them are edges with distance and accessibility as parameters.

The Search and Directory Module allows users to rapidly locate particular places, like classrooms, faculty offices, hostels, mess areas, gyms, or main gates. This module is connected to a backend database that is either hosted on Firebase or MongoDB, and that contains all the spatial and metadata about the campus facilities.

The QR Code Integration System is another critical piece of the puzzle. Each key location on campus will have a devoted QR code. When a user scans the QR code with the app, they will instantaneously uncover the location of the QR code and the path to the next key location, with turn-by-turn navigation to get them there.

Students can personally set up the Personalization Engine to work with their class schedules. In conjunction with the upcoming lectures or meetings, the Engine can generate automatic navigation suggestions.

The final piece is the Admin Panel, which is crafted for only the authorized university personnel to do updates on certain location data, such as uploading new building maps, or editing any information that might need a simple update.

The best part about the Admin Panel is that it does not require any coding knowledge.
Every module interacts through a secure API Layer, which guarantees fast, safe, and reliable communication between the user interface, server, and database.

V. KEY FEATURE

Vivekananda Global University's Campus Compass application is the solution to an age-old problem: How do you find your way around a new place? The smart application works across the smart campus—from its ziggurat-like tilt-up buildings to several planned architectural spaces yet to come online. Even as the university itself navigates the rough road toward the future, the app happily remains in the present and is a work in progress itself.

1. 3D Interactive Campus Map
The university's highly detailed 3D model is provided by Campus Compass. The external areas and internal spaces have realistic views. Virtual users can get a much better understanding of the building layouts and locations by using

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the model. Traditional 2D maps just can't compete. Users can zoom in, and out, and rotate the model. They have almost limitless exploration opportunities.

2. Real-Time Navigation Assistance
The application allows for turn-by-turn navigation to be used, which enables users to choose a destination and then receive directions in a step-by-step manner. This is used for moving between not just the Tech Block and the Academic Block, but also the hostels—at least when those directions are necessary. And it works, with ease and reliability.

3. Internal and External Navigation
In contrast to simple mapping systems that plot only the outdoor reaches of a site, Campus Compass lays out pathways for indoor navigation, helping users find their ways to specific classrooms, seminar halls, or administrative offices in a building's byzantine architectural arrangements.

4. QR Code-Based Location Identification
QR codes placed all over the campus allow users to find the campus' current location at any time. When a user scans a QR code using the app, they can have the app help them navigate to another location on campus without the user needing to input the starting point manually.

5. Personalized Mapping and Scheduling Integration
Users can connect their class schedules to the Campus Compass application. Given the next scheduled class or event, the app automatically recommends the optimal route to take, conserving precious minutes and cutting down on the uncertainty that plagues so many college students.

6. Search and Directory Services
An intelligent search function enables users to swiftly locate any facility they need—be it a hostel, mess hall, gymnasium, administrative office, or an actual classroom number—thus rendering the system both accessible and efficient.

7. Emergency Navigation
Users can effortlessly find critical areas such as medical rooms, security offices, and emergency exits in times of panic, thanks to the app's dedicated quick-access features. This ensures that even when seconds count, safety is within reach for all individuals on campus.

8. Multiplatform Access
You can access the application through web browsers and mobile devices, whether they run Android or iOS. This makes the app super convenient and extremely usable for almost anyone.
These features collectively work to boost the quality of the campus experience, making VGU a smarter,

Benefits
Bringing Campus Compass to Vivekananda Global University (VGU) bestows many benefits, most notably improving the experience of students, faculty, visitors, and the administrative staff on the VGU campus. The app alleviates many of the common problems that individuals face when trying to find their way around campus. And in doing so, it accomplishes three important tasks: It makes the VGU experience more convenient; It saves time; It fosters a more organized campus.

1. Time Efficiency
One of the most immediate advantages is the substantial lessening of the time put into the search for classrooms, offices, or facilities. Students can access their classes in a timely fashion without squandering precious minutes trying to pinpoint buildings or particular rooms. Likewise, visitors and newly enrolled students can find their way around the campus without needing any help.

2. Improved Academic Performance
Students can attend entire lectures without missing important content if there are no delays or confusions in getting to class. This consistent staying-in-the-middle-of-punctuality leads to very good academic performance. And the overall discipline of the student body in terms of going to class on time is greatly enhanced.

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3. Enhanced User Experience
The maps and navigation in the app provide a user experience that is not just modern but also captivating. These are not your ordinary maps, but 3D interactive maps that come alive! And speaking of alive, the real-time navigation says (not sings, as it isn't that kind of app) in a gentle, not annoying voice, "This is where you are now, and this is how you get to your destination quickly and easily, without freaking out and without getting lost as you once did on your way to that 8 a.m. class in Red Gym."

4. Safety and Emergency Response
In emergencies, rapid access to medical centers, security offices, and emergency exits through Campus Compass ensures swifter response times. This can be lifesaving in a medical emergency, during a fire drill, or some other urgent situation, making the campus safer overall.

5. Reduced Staff Workload
Technical personnel and security staff used to spend a lot of time guiding students and visitors who were lost. With Campus Compass, we eliminate a tremendous amount of that manual assistance, thus allowing staff members to concentrate on more vital things that can help improve operational efficiency and the bottom line.

6. Better Visitor Management
Navigating an unfamiliar campus is often difficult for parents, guests, and external visitors. Campus Compass guarantees that these individuals can achieve uncomplicated success when trying to reach events, faculty offices, and various other campus facilities.

7. Scalability and Future-Proofing
The platform is meant to be updated easily with new structures, new room assignments, or new locations for events. This provides assurance that the university system will remain useful as the institution grows and changes.

To summarize, the way people interact with the VGU campus is being revolutionized by Campus Compass. Navigation is now more seamless, instantaneous, and accessible. And the whole experience—because it is built on technology, and because it is an increasingly technology-driven campus—promotes a kind of environment that is bound to make even non-techie students more comfortable with working in a tech-fueled world.

VI. CHALLENGES AND LIMITATIONS

Challenges and Limitations:
Even though Campus Compass strives to provide an efficient navigation system for Vivekananda Global University (VGU), there are a number of limitations and challenges we need to address during the development and implementation of the system.

1. Accuracy of Indoor Navigation
Accurate positioning in buildings is one of the main difficulties faced by indoor navigation systems. In contrast to outdoor GPS, which relies on satellite signals, indoor GPS must obtain its signals from systems like Wi-Fi or Bluetooth, which are sometimes weak or unreliable, giving the user a poor outdoor experience. Even with accuracy-enhancing technologies like Wi-Fi fingerprinting or use of QR codes for check-in, obtaining perfect accuracy in all areas of a large, multistory building is itself a challenging engineering problem.

2. Data Collection and Maintenance
The undertaking to keep the entire campus mapped in 3D and in very precise detail up to date is a significant one. You can see this from the sheer volume of what has to be kept current. And what has to be kept current is not itself static. At any time, just consider these circumstances:Esp in terms of data management and administrative coordination, it is a challenge to keep an "up-to-date, detailed 3D map" of the "entire campus" as well as the "precise location of rooms, departments, and buildings within the" whole and half a dozen changes in between.
- Try doing this, too, when people move from one department to another or when part of the campus moves outside or better inside to a different part.

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- Also try this while constructing new buildings adjacent to or a little ways off from existing ones—while designing these with the totally understandable and desirable goal of making really serious statements about the possibility spaces offer for changes in "living, learning, research, and service."

3. User Adoption

The application is meant to be user-friendly, but there may be some difficulty for some users while they get accustomed to its use, especially for less tech-savvy individuals. Ensuring that the system is widely adopted and that its users understand its considerable features and benefits may require substantial time and effort.

4. Internet Connectivity Issues

App real-time features such as location tracking and updates rely heavily on a steady internet connection. If the user is in an area with no or weak Wi-Fi, some app features may not work well. The app allows for some offline access to real-time maps, but without a steady connection, real-time navigation and updates cannot reliably be accessed.

5. Cost and Resource Allocation

Building, and keeping in working order, a complex system like Campus Compass is a steep investment in both time and money. For a university with not a lot of either to spare, coming up with both the funding and the technical experts necessary to assemble the system in the first place and then keep it operational is a tall order.and rigorous testing, it is possible to develop intelligent systems with high levels of usability and user trust, which can convincingly achieve the four goals outlined earlier—to assist human intelligence, to do work in ways that humans find acceptable, to work seamlessly as an integral part of human undertakings, and to work in ways that permit human oversight.

VII. CONCLUSION

Vivekananda Global University (VGU) is moving toward the development of smarter institutions with the recent launch of Campus Compass. Navigation is a fundamental problem that all sorts of institutions of higher education face. Among other things, Campus Compass addresses that. But it also promises to carry VGU to the next level in time management and safety, delivering a user experience that is, in all likelihood, better than bypassing the system altogether and asking strangers on campus for directions.

The system's core differentiator is its personalized schedule integration that enables students to find classrooms using their individual timetables. It updates in real-time. The maps can be accessed offline. The system is scalable, with designs for the future in mind as the campus grows or new facilities are added. All of this is in service to the user. This is a way of saying that the system's core is not simply a map that shows buildings and paths but a scaffolding that enables users to find their way to a less than 2% error rate.

The project is confronted with specific difficulties, among them achieving indoor navigation of high accuracy and enabling smooth user adoption. These problems are being tackled in the real world by the project team through two methods: ongoing improvements and regular feedback from users. If the accuracy issues, user interface design problems, and other bugs that have surfaced in the pilot version can be adequately resolved, Campus Compass is very much on track to become an essential, even lifesaving, tool for everyone moving about the VGU campus.

Ultimately, the Campus Compass project will serve the university's long-term goal of transforming into a contemporary, technology-oriented establishment that values the well-being and ease of students and employees. This initiative also lays the groundwork for what could be substantial growth. We may add to the app's functionality smart features, such as AI-based route optimization, and event notifications that will help users make the kind of dynamic decisions I mentioned earlier. And we are exploring the possibility of integrating the app with other campus services.To sum up, Campus Compass will surely be a revolutionary development for Vivekananda Global University, making on-campus navigation unfailingly easy for all. It will allow all users to concentrate on their aforementioned missions rather than wasting time seeking byzantine structures and illogical formations of rooms.

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