

CemeterEase: A GIS-Based Cross-Platform System for Cemetery Plot Inventory Management and Navigation

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Abstract: CemeterEase is a Geographic Information System (GIS)-based cross-platform tool designed to update how cemetery plot inventory and navigation are managed. Manual methods using paper records and outdated maps often lead to hassles, such as administrators spending about 7.7 hours a week, visitors taking 21.5 minutes to find a grave, and losing 10-15% of records each year. As a student-led effort, we have combined web and mobile tech with features like interactive maps, real-time plot checks, GPS navigation with voice directions, QR codes and shareable links, a helpful FinisBot chatbot, and automatic client accounts with text/email alerts. Administrators can handle bookings, staff, and events through a handy dashboard, while clients can view their plots offline. We've added security with role-based access and data protection. Built with Agile methods and tested at Finisterre Gardenz, our surveys show admin time dropped by 80%, visitor searches now take 4.5 minutes, and users rate ease of tracking at 4.6/5 and 5/5 (agents). This makes cemetery management more accurate, efficient, and user-friendly, though it still has areas for improvement.

Keywords: Cemetery Management, Geographic Information System (GIS), Cross-Platform Application, Navigation System, User-Centered Design.

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I. INTRODUCTION

Cemeteries mean a lot to us in the Philippines—they're where we remember and honor our loved ones with cultural, spiritual, and historical vibes. However, maintaining their order has become challenging due to the reliance on outdated paper records and maps. At Finisterre Gardenz, the site chosen for the study, administrators told us they spent about 7.7 hours a week on paperwork, and sadly, 10-15% of those records were lost each year. During All Saints' and All Souls' Day, staff constantly required up to thirty minutes to accompany each visitor to the designated grave site, while visitors wandering on their own averaged 21.5 minutes, leaving them tired and upset. Sales agents also experienced difficulties, spending 14.5 minutes per client just to check plot availability, a factor that noticeably reduced the rate of sales transactions.

That's why we teamed up to create CemeterEase, a Geographic Information System (GIS)-based tool that works on the web and mobile devices. We worked on it step by step with Agile, focusing on the look, maps, and navigation. It provides

live plot updates, GPS directions with voice guidance, QR codes and shareable links, and a FinisBot chatbot for quick answers. The administrator can manage bookings, staff, and events, and family clients can check their plots offline using cached data on their devices. We added security features, including role-based access controls and data protection, to keep data secure. From our surveys, admin time dropped by 80% to around 1.5 hours, visitor searches went down to 4.5 minutes, and administrators rated tracking 4.6/5, while agents rated it 5/5 for sales.

Adapting CemeterEase to other cemeteries may require adjustments to accommodate different layouts, and offline access is currently limited to data saved or cached directly on your device. As a collaborative project between St. Cecilia's College-Cebu, Inc. students and faculty, tested at Finisterre Gardenz, we are committed to enhancing cemetery care with greater efficiency, accuracy, and respect.

Table 1. Comparison of Manual and CemeterEase Performance.

Aspect	Before CemeterEase	With CemeterEase
Admin Time (Weekly)	7.7 hours (avg.)	~1.5 hours (est.)
Visitor Search Time	21.5 minutes (avg.)	4.5 minutes (avg.)
Agent Response Time	14.5 minutes (avg.)	<1 minute (reported)
Record Loss	10-15% annually	<1% (reported)
Tracking Satisfaction	N/A (manual)	4.6/5 (admin), 5/5 (agent)

This leads to exploring existing solutions in the next section.

II. RELATED WORK

Cemeteries are more than just quiet spots—they are where we feel tied to our past and loved ones. People worldwide have been thinking about how to manage them better with digital tools, and we have examined some of these ideas to shape what we are doing. In the Philippines, researchers from Negros Occidental developed a GIS-based system to clean up cemetery records and demonstrated that digital mapping can reduce errors [1], though they did not specify how much time it saved. At Manila South Cemetery, another team tried an online search tool, but visitors still got stuck, sometimes wandering for more than 20 minutes because the navigation was inefficient [2].

Elsewhere, people in Sivas, Turkey, built a system linking maps with city records, making grave lookups easier and cutting wait times by about 30% [3]. In Malaysia, a team used geospatial tricks to sort out crowded cemetery layouts, which helped a lot, but live updates weren't part of it [4]. We have also learned from local voices and global thinkers who say cemeteries matter for health, heritage, and feelings—ideas that have inspired us through studies such as [5], [6], and [7].

These efforts have made progress, but we spotted some gaps. Most focus on basic record-keeping or searches, leading to unreliable navigation and limited adoption on mobile platforms. Real-time tracking and voice help or chatbots are missing. That's where CemeterEase comes in—our cross-platform tool offers live plot checks, GPS that drops search time from 21.5 to 4.5 minutes per our Finisterre tests, QR codes, and a FinisBot chatbot. Our dashboard lets administrators and staff take charge fast, and navigational maps support family clients—things we didn't see in these other works.

Table 2. Comparison of Existing Systems and CemeterEase.

Feature	Gonzaga et al. [1]	Gamaz et al. [2]	Sari et al. [3]	Abdullah et al. [4]	CemeterEase
GIS Mapping	Yes	Partial	Yes	Yes	Yes (interactive)
Navigation Support	No	No	No	No	Yes (GPS, voice)
Real-Time Updates	No	No	No	No	Yes
Mobile/Offline Access	No	No	No	No	Yes (cached)
User Satisfaction	Not measured	Not measured	~30% time reduction	Not measured	4.6/5 (admins), 5/5 (agents)

This groundwork highlights how CemeterEase addresses these gaps, leading to our methodology next.

III. METHODOLOGY

We adopted the Agile methodology, allowing short, focused development phases with iterative feedback and continuous refinement. It was a perfect fit for our project, bringing together administrators, staff, and visitors at Finisterre Gardenz to shape the design and test at every step. Over 10 weeks, we worked through five 2-week sprints, with stakeholders discussing in about 60 hours each sprint to make it happen.

In Sprint 1, we focused on user logins, setting up a secure system with JWT and role-based access control (RBAC), and testing API endpoints using Postman. We also built dashboards for admins and staff using React, Tailwind CSS, and React Query to efficiently fetch data. Sprint 2 brought the GIS plot inventory and reservation system to life—using React

Leaflet to turn MySQL data into dynamic map layers and linking CRUD operations to the backend with Axios and Vanilla PHP.

Sprint 3 leveled up our maps with interactive navigation, turn-by-turn routing, and voice guidance thanks to the Valhalla Routing API. We even added a walkable path feature for Finisterre, boosting routing accuracy by 30% after some map rendering tweaks. In Sprint 4, we fine-tuned a mobile-friendly interface with Capacitor.js for Android and iOS, adding offline support with Dexie.js so users could use it anywhere. Sprint 5 focused on sharpening performance—cutting API latency by 25%—and enhancing security with rate limiting, reCAPTCHA v3, honeypot validation, and filters for XSS and SQL injection. Regular feedback sessions kept everything steady and reliable.

Our teamwork and technical skills helped us reduce weekly admin time from 7.7 hours to 1.5 hours, providing a foundation for our upcoming goals.

➤ *System Architecture*

The CemeteryEase System is built on a two-component architecture: a web application for administrators and a mobile application for visitors and families. The web app serves as the control panel where administrators manage burial records, plot information, reservations, and events through an organized dashboard. On the other hand, the mobile app focuses on user accessibility, helping visitors locate graves and navigate within the cemetery through GPS and map-based guidance.

Both platforms are linked to a centralized database via a RESTful API, ensuring data remains consistent and up to date in real time. The system follows a three-layer architecture:

- **Presentation Layer (Frontend)** – This layer handles the user interface and user interactions, designed for both web and mobile environments.
- **Application Layer (Logic or Middleware)** – It processes system operations such as authentication, routing logic, access controls, reservation processing, data requests, and API communication.
- **Data Layer (Backend)** – This layer manages secure storage and retrieval of cemetery data, including plot details, client records, and reservation logs.

This setup keeps the system organized, scalable, and secure. It ensures that updates made on one platform are instantly reflected on the other, enabling smooth coordination between cemetery staff and visitors.

➤ *Development Tools and Environment*

We utilized advanced development tools to make CemeteryEase flexible and easy for everyone to use. On the web side, we relied on PHP for the backend, while React and TypeScript built a highly reliable user interface. We integrated the Radix UI primitive library for universal accessibility and Tailwind CSS for quick, sharp styling, which optimized development time. React Query and Axios handled data fetching and API calls, and React Router v7 enabled fluid, uninterrupted inter-page routing. For maps, React Leaflet and the Valhalla Routing API provided interactive routes with handy turn-by-turn directions, and Cloudinary was used for centralized image storage. To ensure data integrity, we used React Hook Form together with Zod Resolver for secure form handling and validation. Dexie.js for offline data when the signal drops, Zustand for application state management, Framer Motion for animations, Vite to speed up our development process, and React QR Code to generate dynamic, real-time QR codes. Capacitor.js helped us build a cross-platform mobile app and tap into features like GPS, while TanStack Virtual ensured optimal rendering performance by limiting elements to the viewport.

For security, we implemented strict security measures — using dotenv to hide sensitive credentials, CORS headers to guard our APIs, password_hash() to keep passwords safe, rate limiting to stop spam in its tracks, and JWT for smooth, secure logins. Vanilla PHP with PDO helped prevent SQL injection, while input sanitization with filter_var and htmlspecialchars blocked any XSS trouble. Role-based access control (RBAC)

ensured everyone saw only what they needed, and reCAPTCHA v3, combined with a honeypot field, prevented automated form submissions. We set our sights on a 2-second response time and 24/7 uptime to support Finisterre Gardenz and ensure scalability.

➤ *Key Features*

Our system offers refined features such as real-time plot checks, secure burial records, fast reservation processing, GPS maps with voice guidance, and admin tools for staff and events. We implemented QR codes for sharing links, a Finis-Bot chatbot for quick questions, offline access for saved data, and PDF reports. Security comes with role-based access, and we learned from surveys—like cutting staff time per visitor from 15 to 3.9 minutes.

It is tailored for Finisterre but may need minor configuration adjustments elsewhere, and it doesn't handle payments. As a St. Cecilia's College-Cebu, Inc. student-faculty team, we're turning cemetery care into a digital win.

IV. RESULTS AND DISCUSSION

At Finisterre Gardenz, CemeteryEase completely changed how things worked. Before, everything depended on stacks of worn-out papers and old maps that were hard to read or often went missing. Back then, administrators and staff wrestled with records that kept vanishing or blurring, and finding a grave could drag on for up to 30 minutes—especially on All Saints' Day, when crowds gathered. We saw the struggle up close, and it encourages us—the student-faculty team from St. Cecilia's College-Cebu, Inc.—to come up with something better.

With CemeteryEase, administrators can now monitor and update plots in real time. Their weekly workload dropped from 7.7 hours to just 1.5 hours—an 80% reduction—and record loss fell from 10–15% to less than 1%, largely due to the Agile refinements we applied during development. Cemetery staff also achieved significant efficiency gains, reducing visitor handling time from 15 minutes to 3.9 minutes. They rated the GPS navigation feature 4.75 out of 5 for reliability, while sales agents completed client verification tasks in under a minute (previously 14.5 minutes) and gave the interactive map system a perfect 5/5 rating for usability.

Visitors experienced significant improvements with CemeteryEase. Before, they'd spend 21.5 minutes locating a grave, but now it's turned down to about 4.5 minutes—and users are satisfied; they have rated it a solid 4.8 out of 5. Many elderly visitors shared with us that the voice-guided navigation reduces physical burden, making difficult visits more manageable. The mobile app's interactive maps and QR codes simplified sharing grave locations, while the FinisBot chatbot provided instant, clear answers—eliminating confusion quickly.

Keeping the users' data safe was a big deal for us. We added encryption and role-based access to keep data private, and the system delivers a reliable 2-second response time and

continuous 24/7 service availability. Supplementary functionalities, such as automated event alerts and PDF reports, also helped clear up any confusion between staff and visitors.

That said, CemeterEase is still tuned for Finisterre Gardenz, so it might need some tweaking for other cemeteries—offline access only works with saved data right now, and there's no payment option yet. Still, our pilot at Finisterre showed it can turn a messy, old-school process into something smooth and respectful. It feels like a solid step toward making cemetery care better and honoring those who rest there.

V. CONCLUSION AND FUTURE WORK

CemeterEase was developed through the joint efforts of students and faculty at St. Cecilia's College-Cebu Inc. as part of a project to modernize cemetery management. Its pilot run at Finisterre Gardenz showed clear improvements in daily operations. Administrative work that used to take around 7.7 hours a week was reduced to just about 1.5 hours, and the time needed to locate graves dropped from an average of 21.5 minutes to about 4.5 minutes. User feedback also showed strong approval—families gave the mobile app a 4.8 out of 5 rating for its GPS and QR code features, administrators rated the tracking system 4.6 out of 5, and agents rated the sales tools a perfect 5. The addition of the FinisBot chatbot, combined with a secure role-based access system, also helped cut record loss from 10–15% to under 1%, even during busy occasions like All Saints' Day.

The system's current performance validates the effectiveness of CemeterEase, yet we remain committed to further development to fully realize the solution's potential. Currently, the system is optimized for Finisterre Gardenz, and its offline access is still tied to saved data, with no payment option yet in place. That said, we are ready to proceed with additional features if we have the time and input to meet the system's needs—right now, we have focused on what Finisterre Gardenz asked for, like real-time tracking and GPS. Looking ahead, we're eager to hear from users and add features such as full offline syncing, payment tools, and AI integration to provide predictive operational analytics for resource forecasting and optimization. Our next step is to try it out in other cemeteries and to develop it based on feedback from different stakeholders. We dream of shaping CemeterEase into a growing, respectful way to manage cemeteries worldwide, one step at a time.

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