

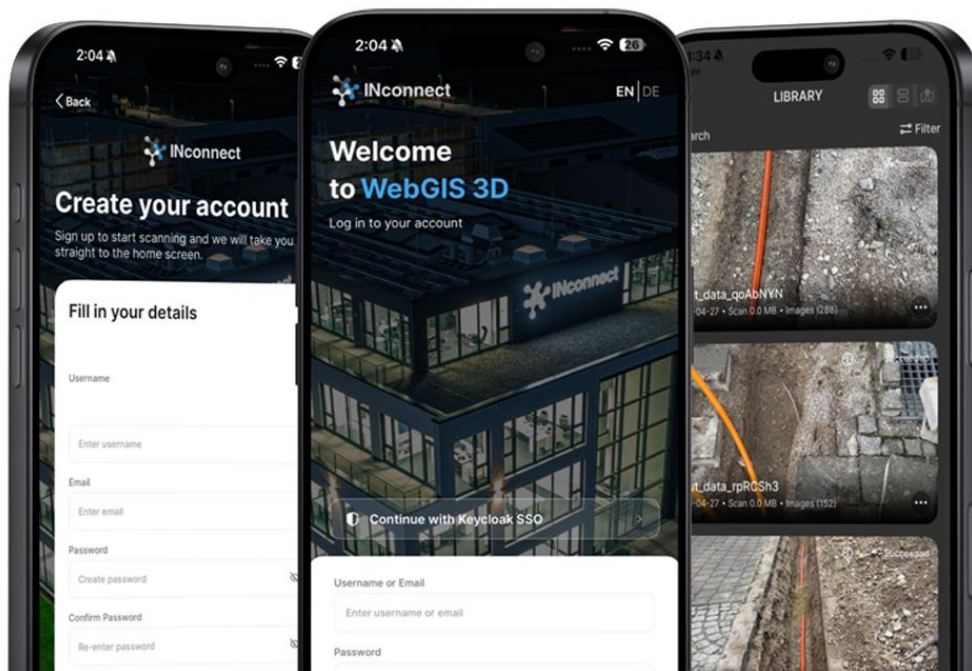
WebGIS

3D Construction Site Scanning & Analysis Platform

Mobile · iOS

LiDAR · Photogrammetry

GIS · 3D Mapping



CASE STUDY

Platform: iOS (iPhone with LiDAR Sensor)

Industry: Construction & Civil Engineering

Technology: Swift · UIKit · RealityKit · ARKit · Metal

Backend: Python · Django REST Framework · AliceVision

1. EXECUTIVE SUMMARY

WebGIS is a cutting-edge iOS mobile application that transforms the way construction companies survey and document active construction sites. By harnessing the built-in LiDAR sensor available on modern iPhones, WebGIS enables field engineers to capture richly detailed **point clouds**, geotagged photographs, and precise GPS coordinates in a single scanning session — eliminating the need for expensive traditional survey equipment and lengthy post-processing workflows.

Raw scan data is automatically packaged and uploaded to a secure cloud backend, where an admin dashboard powered by **AliceVision photogrammetry** reconstructs photo-realistic **3D models** in industry-standard USDZ and GLB formats. The platform also generates **GeoTIFF map overlays** so that every scan can be precisely located on a geographic map — a capability not found in competing solutions.

App Name	WebGIS
Platform	iOS (iPhone with LiDAR — iPhone 12 Pro and newer)
Max Scan Range	Up to 100 meters per session
Output Formats	Point Cloud · USDZ · GLB · GeoTIFF
Target Industry	Construction & Civil Engineering
Deployment	Mobile App + Cloud Backend + Web Admin Dashboard

2. PROBLEM STATEMENT

Construction site surveying — particularly for trenches, foundations, and earthworks — has historically been a slow, labor-intensive, and error-prone process. Traditional workflows suffer from several critical limitations:

- **High cost of conventional survey equipment:** Total station instruments, GPS rovers, and drone-based LiDAR rigs require significant capital investment and trained operators.
- **Slow turnaround:** Field measurements are recorded manually, then re-entered into desktop software, introducing delays of days or even weeks before actionable data is available.
- **Fragmented deliverables:** Existing mobile solutions typically produce either a 3D model *or* a point cloud, but rarely both — and almost never alongside a GIS-ready geospatial file. Teams are forced to stitch outputs from multiple tools.
- **No live spatial context:** Traditional tools do not record precise GPS coordinates tied directly to each captured image, making it difficult to verify exact scan locations on a project map.
- **Volume and distance measurement gaps:** Field teams lack easy tools to measure excavation volume, trench depth, or surface area directly from captured data without expensive post-processing software.

3. SOLUTION OVERVIEW

WebGIS delivers an end-to-end scanning, processing, and analysis pipeline accessible from a standard iPhone. The solution is divided into three tightly integrated layers:

■ Mobile Scanning App

Field operatives launch the app, log in, and begin a scan. The iPhone LiDAR sensor captures a dense point cloud while the camera captures overlapping photographs with embedded GPS metadata. All data is bundled as a compressed ZIP and uploaded wirelessly.

■ ■ Cloud Processing Backend

A Python / Django REST Framework backend receives the upload, unpacks assets, and triggers the AliceVision photogrammetry pipeline to reconstruct a full 3D model. Outputs are stored and made available via the admin dashboard.

■ ■ Web Admin Dashboard

Project managers and engineers access a browser-based dashboard to review scans, interact with the 3D model, take measurements from the point cloud, and download GeoTIFF files for GIS integration.

4. USER FLOW

Step 1 — Sign Up / Log In	A field engineer downloads the WebGIS app and creates an account or logs in with existing credentials. Role-based access controls determine dashboard permissions.
Step 2 — Initiate a Scan	The user taps 'New Scan' and points the iPhone at the construction site. The app activates the LiDAR sensor and rear camera simultaneously.
Step 3 — Capture Point Cloud & Images	As the operator walks the site (up to 100 m), the app builds a real-time point cloud and captures overlapping photographs. Each image is tagged with live GPS coordinates via Core Location.
Step 4 — Review & Upload	On scan completion, a summary screen shows the captured point count and image thumbnails. The user confirms and the app packages data into a ZIP file for upload.
Step 5 — Backend Processing	The backend receives the ZIP, extracts assets, and runs the AliceVision photogrammetry pipeline to produce USDZ and GLB 3D models, alongside a GeoTIFF generated from the image snapshots and GPS data.
Step 6 — Dashboard Analysis	Administrators open the web dashboard to view the 3D model, interact with the point cloud, and perform distance, area, and volume measurements by clicking specific points in the point cloud data.

5. KEY FEATURES

<p>LiDAR Point Cloud Capture</p> <p>Leverages the iPhone's native LiDAR sensor via ARKit to generate dense, accurate 3D point clouds of construction trenches and structures in real time.</p>	<p>Geotagged Image Capture</p> <p>Photographs are captured simultaneously with the point cloud and stamped with precise GPS coordinates, altitude, and heading using Core Location.</p>
<p>AliceVision Photogrammetry</p> <p>Uploaded images are processed server-side through the AliceVision pipeline, reconstructing a photo-realistic 3D model from multi-view stereo techniques.</p>	<p>3D Model Export (USDZ & GLB)</p> <p>Final models are exported in USDZ (Apple AR) and GLB (web/cross-platform) formats, enabling viewing in AR on-device or in any WebGL-capable browser.</p>
<p>GeoTIFF Generation</p> <p>Using model snapshots and GPS coordinates, the backend produces a GeoTIFF raster overlay, allowing scans to be imported into any standard GIS software.</p>	<p>Map View of Scan Locations</p> <p>Each scan is pinned on an interactive map so project teams can instantly see where on the site each capture was taken.</p>
<p>Point Cloud Measurements</p> <p>The admin dashboard allows users to click any two points within the point cloud to measure distance, cross-sectional area, and excavation volume.</p>	<p>100-Metre Scan Range</p> <p>A single scan session covers up to 100 meters of site length, sufficient for most trench and foundation survey requirements.</p>
<p>Offline Local Storage & Smart Sync</p> <p>All scan data — point clouds, images, and GPS metadata — is saved locally on the device. When the user comes online, the app automatically syncs and uploads pending scans to the backend, ensuring no data is lost on sites with poor connectivity.</p>	

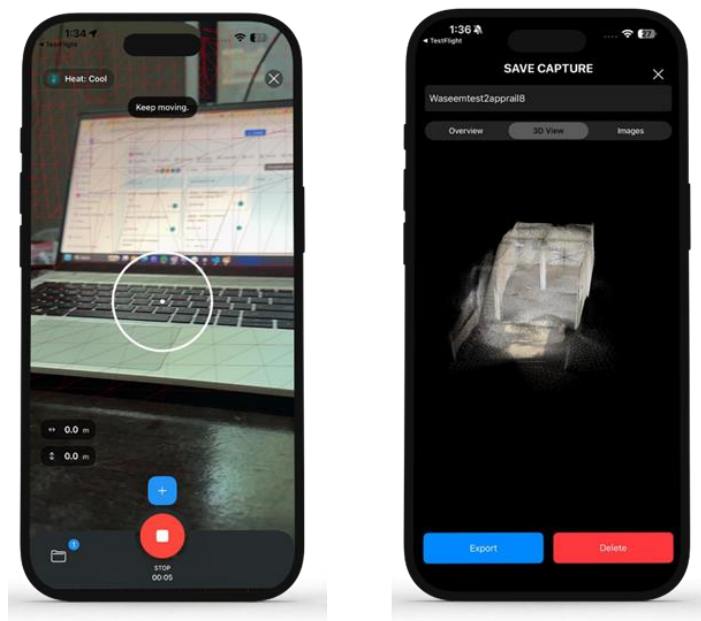


Figure 1 — Real-time LiDAR scan view on iPhone

6. TECHNOLOGY STACK

Layer	Technology	Purpose
iOS App	Swift · UIKit	Core app architecture & UI
3D Rendering	RealityKit · Metal	Real-time point cloud rendering & AR scene
Sensor Fusion	ARKit · Core Location	LiDAR depth capture & GPS tagging
3D Model Pipeline	AliceVision (Meshroom)	Photogrammetry — SfM & MVS reconstruction
iOS Photogrammetry	Photogrammetry Session (iOS)	Native Apple photogrammetry fallback
Backend API	Python · Django REST Framework	REST API, data ingestion, job orchestration
Admin Dashboard	Django MVT Templates	Web-based project & scan management UI
3D Export	USDZ · GLB	AR & web-compatible model delivery
Geospatial Output	GeoTIFF	GIS-compatible raster map overlay
Data Transfer	ZIP packaging	Efficient bulk upload of scan assets

7. SYSTEM ARCHITECTURE

WebGIS follows a **client–server architecture** with a clear separation between the mobile data-capture layer and the server-side processing and presentation layer.

- **Mobile Client (iOS):** Handles all real-time sensor interaction. ARKit drives the LiDAR point cloud; Core Location records GPS; RealityKit and Metal render the live 3D preview. On session end, assets are zipped and Posted to the REST API.
- **REST API (DRF):** Receives the uploaded ZIP, validates it, extracts images and point cloud data, and enqueues a photogrammetry job. Returns scan status and model download links once processing is complete.
- **Dual Photogrammetry Pipeline:** The backend runs the AliceVision / Meshroom pipeline (Structure-from-Motion + Multi-View Stereo) on uploaded images to produce a dense, textured 3D mesh. In parallel, Apple's native iOS Photogrammetry Session is also used, combining both outputs to maximize model fidelity and completeness. Final exports are delivered in USDZ and GLB formats.
- **GeoTIFF Generator:** Using the GPS-tagged snapshot and coordinate bounding box, a geospatial raster file is created and georeferenced for direct use in QGIS, ArcGIS, or similar GIS platforms.
- **Admin Dashboard (MVT):** A Django template-based web interface allows staff to browse scans, view 3D models in-browser, inspect the point cloud, and export files.

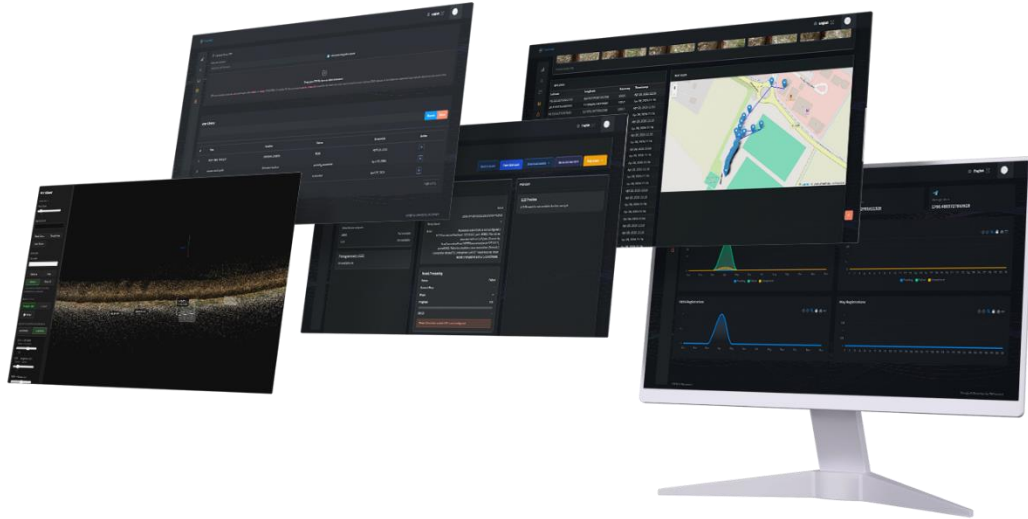
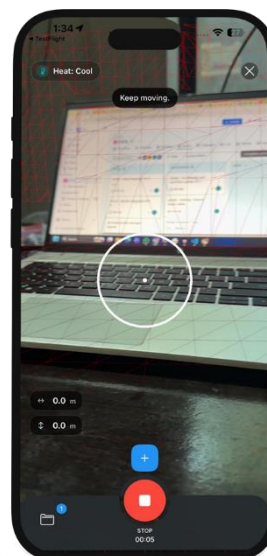
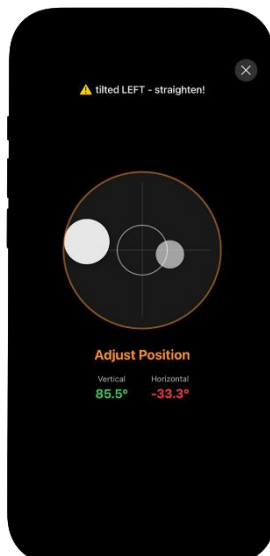
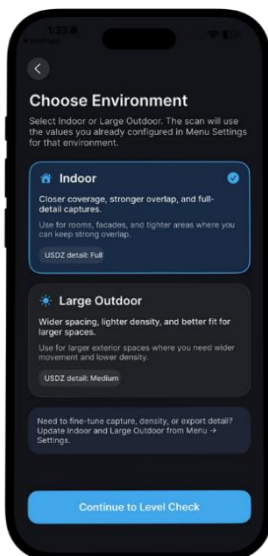
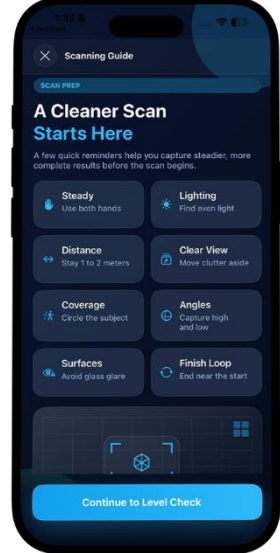
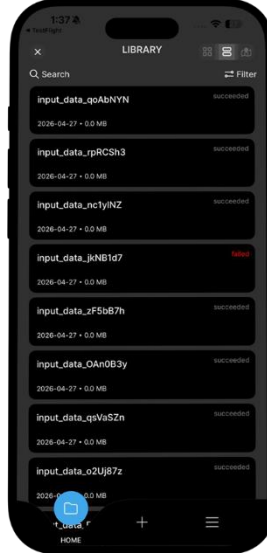
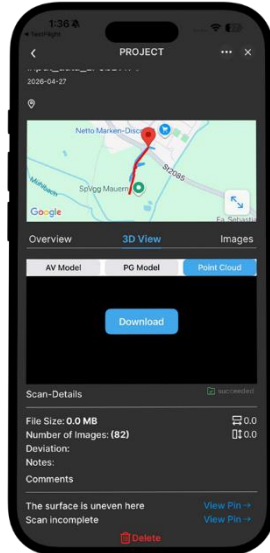
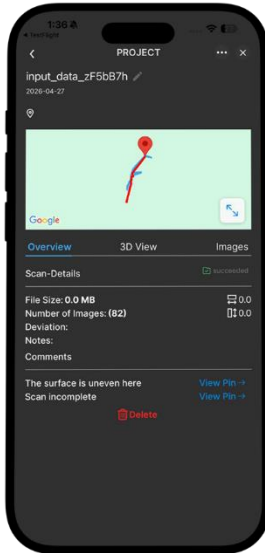
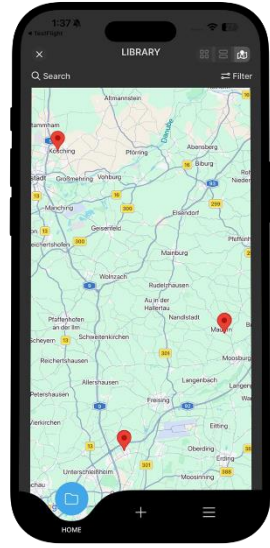
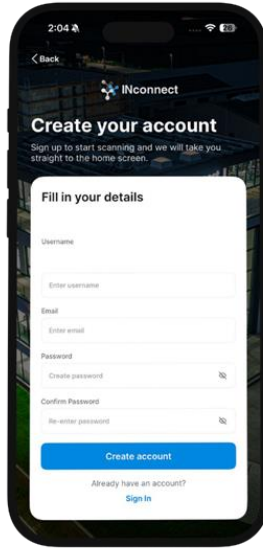
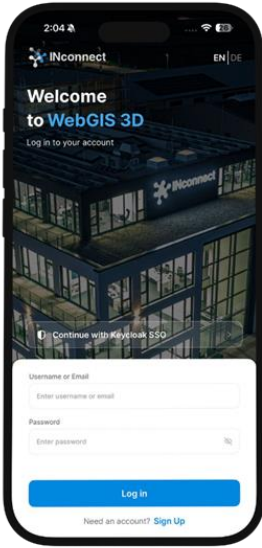


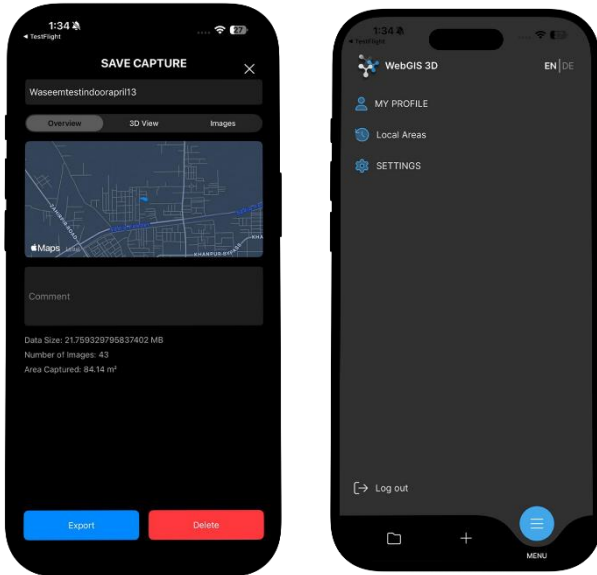
Figure 2 — Admin dashboard showing point cloud with distance/volume measurement

8. TECHNICAL CHALLENGES & SOLUTIONS

Real-time Point Cloud Rendering	Rendering millions of LiDAR points at 60 fps on a mobile device demanded careful GPU memory management. Metal shaders were used alongside RealityKit scene graphs to maintain performance while preserving point cloud fidelity.
GPS Accuracy in Obstructed Environments	Construction sites — especially deep trenches — can degrade GPS signals. The app uses sensor fusion (GPS + ARKit world tracking) to interpolate positions when satellite lock is momentarily lost.
Large Data Upload Reliability	Scans up to 100 m generate significant data volumes. Chunked multipart upload with retry logic was implemented in the iOS client to handle connectivity dropouts common on active construction sites.
Photogrammetry Processing Time	AliceVision pipelines are computationally intensive. Asynchronous job queuing was implemented on the backend so users receive a notification when their 3D model is ready, rather than waiting on a blocking request.
GeoTIFF Coordinate Alignment	Aligning the photogrammetry model snapshot with real-world coordinates required careful homographic transformation. Image EXIF GPS metadata is used as ground control points during GeoTIFF georeferencing.

9. APP SCREENSHOTS





10. COMPETITIVE ADVANTAGE

Feature	WebGIS	Typical Competitors
Point Cloud Capture	Yes	Most
3D Model — Dual Pipeline (AliceVision + iOS)	Yes — both pipelines	Single pipeline or limited
Both Point Cloud + 3D Model together	Yes	Rarely both
Simultaneous Capture Stability	High — engineered for stability	Often drops or degrades
Output Quality (Model + Point Cloud)	Superior — consistent quality	Inconsistent results
GeoTIFF Generation	Yes	Some competitors offer this
Live GPS Coordinates per Image	Yes	Partial or post-processed
Map View of Scan Location	Yes	Rarely available
Distance / Volume / Area Measurement	Yes — from point cloud	Limited or desktop-only
Offline Capture + Auto Sync	Yes	Mostly online-only
Mobile-first — no specialist hardware needed	Yes	Often needs specialist kit

WebGIS Winning Edge

While some competitors offer point cloud capture or GeoTIFF output individually, WebGIS stands apart on two fronts that directly impact the reliability and usefulness of construction site data:

1. Stability — Simultaneous LiDAR point cloud capture and image recording run concurrently without degrading either data stream. Many competing tools struggle to maintain this without frame drops, misalignment, or data loss.

2. Superior Output Quality — By running both the **AliceVision photogrammetry pipeline** (server-side SfM + MVS reconstruction) and Apple's native **iOS Photogrammetry Session**, WebGIS produces higher-fidelity, more detailed 3D models than any single-pipeline alternative — giving construction teams output they can confidently rely on for measurement, documentation, and project reporting.

11. CONCLUSION

WebGIS represents a significant leap forward in mobile construction site documentation. By combining Apple's LiDAR hardware with a dual photogrammetry pipeline — AliceVision on the backend and Apple's native iOS Photogrammetry Session — WebGIS consistently delivers higher-quality 3D models than any single-pipeline alternative, without requiring specialist survey equipment.

Its core engineering strength lies in the stability of simultaneously capturing a dense LiDAR point cloud and geotagged imagery in a single pass — a challenge that competing tools frequently fail to handle reliably. Paired with GeoTIFF generation, interactive map views, and cloud-based measurement tools, WebGIS gives construction companies a comprehensive and dependable digital record of every stage of their site — faster, cheaper, and more accurate than existing alternatives.

WebGIS — Scan smarter. Build better.