Experience66

Requirements
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Overview:

The purpose of this document is to outline requirements and begin demonstration of the feasible aspects of the Route 66 Companion application

The undersigned agree that this document defines the baseline requirements for the project

Team: Manjot kaur Client: Mike Taylor Mark Manone Sean Evans

Date: 11/25/2025

Table of Contents

Introduction

Route 66, also known as the "Mother Road," is more than a highway — it's a living record of America's history, culture, and identity. As it nears its 100th anniversary, millions of travelers, historians, and enthusiasts are getting ready to celebrate its legacy. From quirky roadside stops to the deep histories of Indigenous communities, Route 66 holds countless stories worth preserving and sharing. Yet in today's digital world, much of this heritage stays hidden in archives, out of reach for the people traveling its path.

Problem

Access to Route 66's historical materials is limited to static systems like CONTENTdm. These platforms are strong in data storage but not designed for travel use or mobile discovery. Cline Library's Special Collections and Archives (SCA) at Northern Arizona University holds over 100,000 digitized items — photos, oral histories, maps, and manuscripts — but travelers have to know exactly what to search for and where. This gap between place and content means many visitors miss out on the stories behind what they see. The current system lacks features like location awareness, mobile access, and interactive storytelling. Library staff, while skilled and dedicated, are limited by the tools available and the need for manual curation.

Goal

To close this gap, we are creating a mobile app called Route 66 Companion that brings historical content to users based on their location. Whether traveling the road or exploring from home, users can view photos, hear oral histories, and explore materials linked to specific places.

Key features include:

- Geofenced content based on GPS (using mapbox)
- Interactive maps and photo galleries
- Audio playback of oral histories
- Admin dashboard with data and visual reports
- Optional navigation to nearby attractions and upcoming sites

Impact

The Route 66 Companion turns archives into an interactive travel experience. By connecting history with geography, it helps users discover and connect with the stories of the road in a personal way. For Cline Library, it expands public reach, boosts engagement with collections, and offers insights from user data. For travelers, it transforms a simple drive into a guided trip through time. This project is not just about making an app — it's about keeping Route 66's stories alive and accessible for everyone, everywhere.

Meet Our Sponsors

One of our Sponsors is Mike Taylor whom is the Head, Technology Strategies & Services at Cline Library. Our second Sponsor is Mark Manone who is a Professor of Practice working in the Department of Geography, Planning and Recreation and Director of Geospatial Research and Information (GRAIL). They had come together in collaboration with the route 66 celebration coordinator in the effort to establish a much more meaningful and interactive way for users to be able to intune with the route, serving as an new updated forum for the 100 year anniversary. They work in different backgrounds but share enthusiasm for infogeography which is brought on by this proposal.

Problem Statement

Cline Library's Special Collections and Archives (SCA) at Northern Arizona University houses over 100,000 digitized materials, including photos, maps, manuscripts, and oral histories, focused on the culture and stories of Route 66. These resources are preserved in CONTENTdm, a static archival platform designed primarily for researchers, not travelers. While effective for data storage, CONTENTdm lacks the mobility, interactivity, and location awareness needed to engage users who are exploring Route 66 on the road.

Currently, SCA's workflow revolves around:

1. **Digitization** – Archivists digitize physical materials such as images, maps, and recordings.
2. **Metadata Creation** – Each item is cataloged with descriptive metadata for searchability in CONTENTdm.
3. **Archival Storage** – Materials are uploaded and stored in CONTENTdm for long-term preservation.
4. **Public Access** – Users access materials via keyword search through the CONTENTdm web interface.

This process effectively supports academic research but not spontaneous exploration or location-based discovery. Travelers must already know what to look for; there's no easy way to discover stories connected to where they are. The system operates independently of modern navigation tools, creating a disconnect between digital content and the physical journey.

Core Problems and Inefficiencies

- **Limited Discoverability**: Users must search by keyword, leaving most travelers unaware of the materials tied to their current location.
- **No Location Awareness**: CONTENTdm cannot link materials to GPS coordinates or automatically surface content near the user.
- **Static Access**: The system is web-based and not optimized for mobile or offline use, making it impractical for travelers without reliable connectivity.
- **Manual Curation**: Library staff must manually curate content for exhibits and users, which limits scalability.
- **Disconnected Storytelling**: Historical materials are fragmented across media types (audio, photo, maps) without a unified or narrative interface.

These limitations prevent Route 66 travelers from connecting with the region's living history as they journey along the highway. SCA's valuable digital assets remain confined to research databases rather than enriching the on-road experience. The absence of location-based discovery and built-in navigation is the central gap that the **Route 66 Companion** project seeks to close.

Solution Vision

The **Route 66 Companion** mobile app bridges this gap by transforming SCA's static archives into an interactive, location-aware travel experience. The app delivers historical Route 66 content, images, oral histories, and documents, directly to users based on their GPS location. It is both an educational platform and a digital storytelling tool, turning Route 66 into a living museum accessible from any mobile device.

Core Features

- **Geofenced Content Delivery:** Users automatically receive historical materials and oral histories tied to nearby landmarks.
- **Interactive Map Interface:** Built on Mapbox, the app displays key Route 66 points of interest with pins, filters, and story cards.
- **Audio Playback and Transcripts:** Oral histories are playable within the app, with transcripts available for accessibility.
- **Offline Access:** Hybrid caching via SQLite and Mapbox offline tiles ensures functionality in low-connectivity areas.
- **Integrated Navigation:** The app provides built-in navigation and routing along Route 66, guiding users to nearby points of interest without needing an external map app.

Impact and Trade-offs

The Route 66 Companion changes the way SCA engages with the public—shifting from a static repository to an immersive, user-driven experience. The trade-off involves added computational work on the mobile client for live navigation and routing, but it improves usability and independence from third-party apps. The integrated navigation ensures users can explore Route 66 seamlessly without switching contexts.

Alternate Considerations

Alternatives like preloading static datasets or relying solely on ArcGIS were explored but dismissed for limiting scalability, flexibility, and cost-efficiency. The chosen stack, Kotlin + Mapbox + Node.js + SQLite, balances usability, offline capability, and technical feasibility

System Diagram

Project Requirements

Domain-Level Requirements

The Route 66 Companion app is built around the needs of two main stakeholders, travelers and the Cline Library team, with the shared goal of connecting people, place, and story along Route 66. From a domain perspective, the app must deliver a location-aware, accessible, and resilient storytelling experience that merges archival materials with modern navigation. The following domain-level requirements summarize the overarching goals of the system:

D1. **Location-Aware Historical Discovery**
The system must allow travelers to automatically discover photos, audio, and historical notes relevant to their real-world GPS location along Route 66.

D2. **Offline and Remote Accessibility**
Because many Route 66 areas lack reliable service, the system must function offline by caching maps, metadata, and images locally.

D3. **Multimedia Storytelling Integration**
Users must be able to explore the road through multiple media forms, photos, oral histories, and written descriptions, in a unified interface.

D4. **Interactive and Intuitive Mapping Experience**
The app must provide an interactive map where users can see, select, and navigate to Route 66 points of interest in real time.

D5. **Seamless Navigation and Route Planning**
The system must allow users to plan their journey by viewing upcoming attractions, receiving navigation directions, all through in-app navigation systems.

D6. **Archival System Connection**
The system must interface with Cline Library's CONTENTdm API to retrieve historical content dynamically, maintaining data integrity while improving accessibility.

D7. **User-Centered Performance and Design**
The app must provide a responsive, easy-to-use interface suitable for travelers of varying technical abilities, ensuring minimal latency and quick load times even offline.

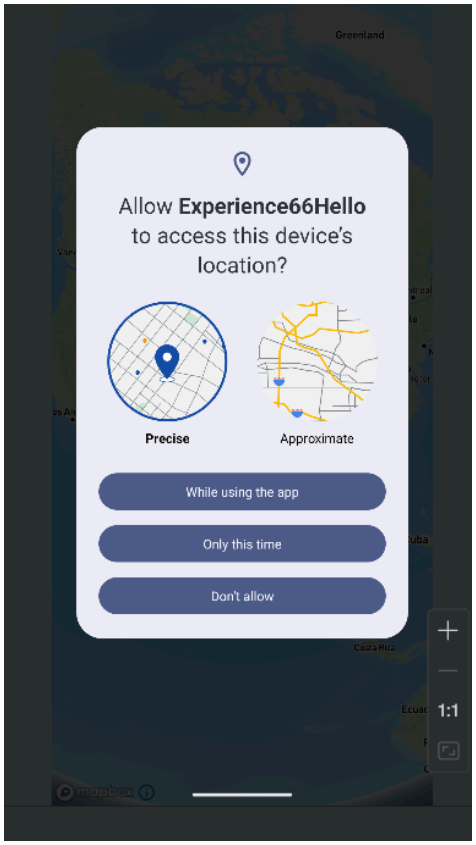
These broad domain goals drive the detailed functional and performance requirements below. Each detailed requirement is tied to one or more domain-level needs, using a numbering system to indicate relationships (e.g., F1.1 supports D1).

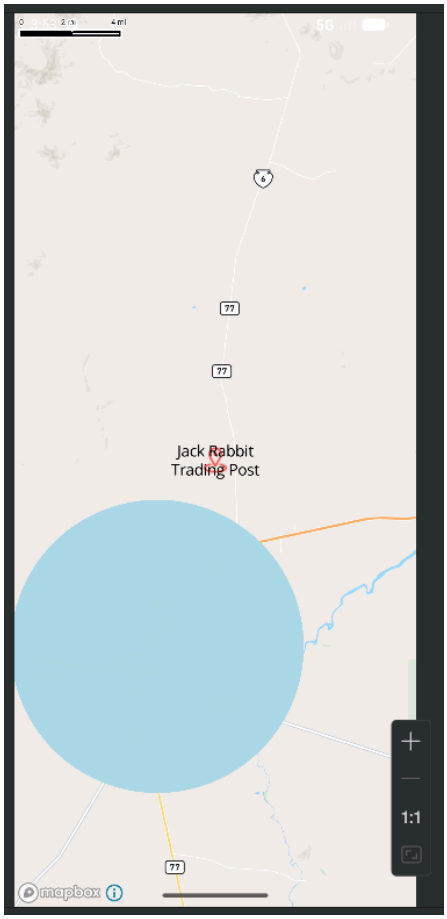
Functional Requirements

The following requirements are organized using the MoSCoW prioritization method (Must, Should, Could, Won't). Each "must-have" feature is accompanied by a prototype plan tied to the existing user stories.

Must-Have Requirements:

F1.1: Automatic Geolocation and Geofencing (Supports D1, D4):
As a traveler, I want the app to automatically detect my GPS location so I can see stories and photos related to nearby Route 66 landmarks.
Acceptance Criteria: When entering a geofenced zone, the app displays relevant photos, notes, and audio for that site.

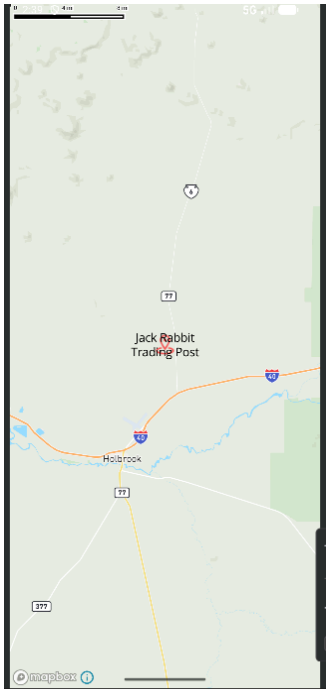




F1.2: Offline Mode with Cached Data (Supports D2):
As a traveler, I want the app to keep working when there's no internet so I can still access maps and information in remote areas.
Acceptance Criteria: Cached maps and metadata remain accessible through SQLite and Mapbox's hybrid offline cache system.
Prototype: No prototype yet…

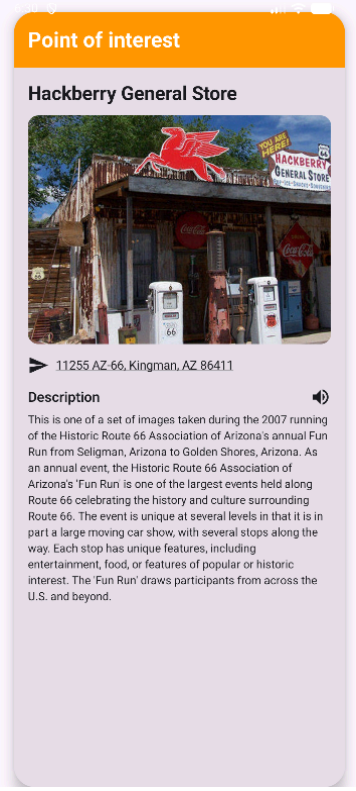
F1.3: Interactive Map and Points of Interest (Supports D1, D4):
As a traveler, I want to see an interactive map with icons for points of interest so I can plan where to stop next.

Acceptance Criteria: The map displays icons, updates as the user moves, and allows clicking for more details.



F1.4: Navigation to Selected Attraction (Supports D5):
As a traveler, I want to receive navigation directions to any selected attraction so I can easily plan my route.
Acceptance Criteria: The app comes with an integrated and seamless navigation system with turn-by-turn navigation to the selected point of interest.

F1.5: Oral and Narrative Storytelling Features (Supports D3, D5):
As a traveler, I want to hear detailed oral histories when I reach a landmark, and also preview upcoming points of interest so I can follow the larger story of Route 66 as I travel.
Acceptance Criteria: When within a geofenced area, the app plays or displays a complete oral history of that location with accompanying media (photos, transcripts). The system also provides a “Coming Up Next” section that lists several nearby points of interest ahead, each with a short summary describing what they are about, without revealing their full details until the user approaches them.



F1.6: Search and Direct Access to Points of Interest (Supports D4, D6):
As a traveler, I want to search for any specific Route 66 landmark or attraction so I can access its stories and media even if I'm not physically near it.
Acceptance Criteria: The app includes a search bar that allows users to type in the name or keyword of a site. When a site is selected, the app displays all related content, including historical data, photos, and oral histories, just as it would if the user had entered the site's geofence. The interface also provides a navigation option to open directions to that location in the user's preferred map app.

Should-Have Requirements

S2.1: Photo Gallery and Media Viewer (Supports D3):
The system should allow users to browse and zoom into high-resolution photos, maps, and documents from CONTENTdm for each site. The gallery should group media by type (historical photos, maps, oral history transcripts).

S2.2: Category and Filter Tools (Supports D4):
The system should let users filter map pins or search results by category (e.g., "Museums," "Historic Gas Stations," "Cultural Landmarks") to help tailor their travel experience.

S2.3: Favorites or Saved Locations (Supports D5):
The system should allow users to save or "favorite" sites so they can revisit stories later, even when offline. This adds lightweight personalization without requiring user accounts.

Could-Have

C3.1: Community Tips and Comments (Supports D3, D5):
The system could allow travelers to leave short tips, reflections, or historical notes for each site, for example, "Great stop for photos!" or "Audio clip was especially interesting." These submissions would be stored locally and later uploaded when the user reconnects, pending moderation by the Cline Library team.

C3.5: Advanced Google Maps / Apple Maps Integration (Supports D5):
The system could integrate more directly with Google Maps or Apple Maps APIs to show Route 66 attractions layered onto the user's existing navigation route. Instead of just linking externally, this would allow in-map overlays that highlight nearby historic sites, display estimated detour times, and recommend stops along the way.

Won't-Have

W4.3: Full Social Media Integration:
Automatic posting or sharing of routes, comments, or media to external social media platforms will not be implemented in this release due to privacy concerns and scope limitations.

W4.5: Multi-Language Translation Support:
Although desirable for future versions, the initial release will support only English-language content. Multi-language text and audio support will be considered for later updates in partnership with Cline Library.

Performance (Non-Functional) Requirements

The performance requirements for the Route 66 Companion app emphasize accuracy, usability, and responsiveness. Because travelers will depend on the app for historical information and navigation, each requirement is intended as a measurable design goal for later testing and refinement. These criteria set the standard for how the final system should perform once implementation and testing are complete.

P1. Data Accuracy:
The app must display accurate and verified information for every point of interest. All titles, descriptions, coordinates, and media should align directly with data provided by Cline Library's CONTENTdm database. This ensures users receive reliable and historically correct information about each site.
Design Goal: 100% data accuracy compared to verified CONTENTdm entries.

P2. Geolocation and Navigation Accuracy:
The system should detect a user's GPS position within approximately ±20 meters of their true location under standard conditions. Geofenced triggers must activate at the correct

landmarks, and navigation links must route to safe, accessible roads through external map apps such as Google or Apple Maps.
Design Goal: All navigation routes and proximity triggers lead users to accurate destinations without misalignment or unsafe detours.

P3. Map and Content Load Speed:
Map tiles and nearby site icons should appear within two seconds of opening the map view, and site details (title, photo, and description) should load within 1.5 seconds of user selection. These expectations aim to maintain a seamless travel experience even in rural areas or during offline use.
Design Goal: Average map and content load times under two seconds in both online and offline scenarios.

P4. Audio Playback Responsiveness:
Audio stories should begin playback within one second of pressing play and resume automatically within five seconds after an interrupted connection. Smooth playback is essential for safety and user experience during travel.
Design Goal: Near-instant audio response with minimal delay when buffering or resuming.

P5. Usability and Learnability:
The app should be intuitive for first-time users. Core functions such as viewing the map, selecting a site, and playing an audio story should be discoverable without instruction. A simple onboarding overlay will highlight key actions during the first launch.
Design Goal: First-time users can complete basic tasks within three minutes of opening the app.

P6. Stability and Reliability:
The system should remain stable during extended offline use. Cached data and maps should remain accessible for at least two hours of continuous operation without crashing or freezing.
Design Goal: Continuous offline stability during active use across multiple sites.

P7. Buffer-Free Data Streaming:
When the user is online, the app should maintain smooth playback of audio and loading of images without noticeable buffering or lag.
Design Goal: No more than a two-second interruption during normal streaming conditions.

P8. Overall System Performance Goals:
The app should provide quick, consistent responses to user interactions, with average response times below 1.5 seconds for most actions. System uptime during normal use should remain above 95% once deployed.
Design Goal: Maintain high responsiveness and consistent functionality throughout extended use.

These performance goals define how Route 66 Companion should behave under typical conditions. While testing has not yet been conducted, these metrics will guide the team's development and evaluation process as prototypes mature, and field testing begins.

Environmental Requirements

The Route 66 Companion application operates under several environmental and integration constraints dictated by both the client and the technical ecosystem in which it must function.

E1. Hardware and Platform Constraints

- The client requires that the system function primarily on **mobile devices (Android and iOS)**, optimized first for Android due to the development team's Kotlin expertise.
- Mobile devices must have **GPS sensors** to enable geofencing and navigation features.
- The application should perform effectively on devices with at least **4 GB RAM and Android 10 (API 29) or newer**, ensuring smooth map rendering and audio playback.

E2. Software and Library Constraints

- The client mandated use of **Mapbox** as the primary mapping and geolocation platform due to licensing compatibility with Northern Arizona University's GIS infrastructure.
- Integration with **Cline Library's CONTENTdm API** is required for retrieving verified archival metadata and media.
- The backend and data exchange layers must adhere to open web standards (HTTPS/REST API JSON).
- **Kotlin** is required for mobile-side implementation; server prototypes may use **Node.js and SQLite** as agreed during technical feasibility review.
- The app must conform to NAU's **information-security and data-handling policies**, including secure API calls, no unencrypted storage of tokens, and proper use of the university's GitHub repositories.

E3. External System Dependencies

- The system depends on stable access to **Mapbox SDK servers** for online map tiles and authentication.
- It also depends on **device-level permissions** (location, network, storage, and audio) being granted by users; without these, critical functionality such as geofencing and audio playback will be limited.

- Integration with **external map apps (Google Maps/Apple Maps)** for navigation must comply with each vendor's API terms of use.

E4. Regulatory and Accessibility Constraints

- Because the app is sponsored by NAU and Cline Library, it must comply with **Section 508** and **WCAG 2.1 AA** accessibility standards—audio transcripts and readable text for visually or hearing-impaired users are mandatory.
- Copyrighted archival content must include correct attributions and usage statements from SCA.
- The system must conform to **NAU's data-retention and privacy guidelines**, ensuring no personally identifiable information is stored without consent.

E5. Environmental and Network Conditions

- The system must remain functional in **low-connectivity or offline environments**, typical of rural Route 66 segments.
- It must handle **temperature and battery constraints** typical of mobile usage during travel (long car trips, GPS on).
- Map data and media should degrade gracefully—display cached or textual data when live downloads are unavailable.

Potential Risks

The Route 66 Companion involves technical, operational, and contextual risks that could affect both development success and long-term sustainability.
Each risk is described with its potential impact and proposed mitigation strategy.

R1 – API Dependency

The project depends heavily on the Mapbox SDK for mapping and geofencing and the CONTENTdm API for accessing Cline Library's archival data. Any future change to these APIs, such as version deprecation, authentication updates, or downtime, could break map tiles or cause data retrieval failures. This risk is of *medium likelihood* and *high impact* because both services are external and outside the team's control. To mitigate this, SDK versions will be locked in Gradle, modular API wrappers will be implemented to simplify future updates, and backup offline map data will be maintained to ensure continuous operation even during outages.

R2 – Offline Data Failure

Since Route 66 includes many rural and low-connectivity regions, users may lose access to map or content data if the offline caching system fails or exceeds device storage limits. This could prevent travelers from viewing nearby landmarks or accessing oral histories while on the road. The likelihood is *high* and the impact *medium*. To mitigate this, the application will use lightweight JSON metadata, compress audio and images for caching, and provide clear UI warnings when offline data capacity is nearing its limit.

R3 – GPS Inaccuracy

GPS errors greater than 20 meters may trigger geofences too early or too late, leading to confusion or missed content. Environmental conditions, signal loss, or hardware limitations can increase this risk. The likelihood is *medium* and the impact *medium*. To address this, a ±20 m threshold will be used to validate triggers, smoothing algorithms will filter unstable readings, and users will have the option to manually view nearby landmarks when GPS readings are unreliable.

R4 – Data Integrity and Copyright

The application uses archival content owned by NAU and external contributors. Displaying incorrect metadata or unauthorized materials could lead to misinformation, copyright violations, or reputational damage. The likelihood of this issue is *low*, but the *impact* is *high*. To mitigate this, all content will come directly from verified CONTENTdm sources, metadata will undergo librarian review, and attributions or copyright notices will be clearly displayed within the application.

R5 – User Privacy

The app requires access to the device's GPS to provide personalized, location-based experiences. Improper handling of this data could raise privacy concerns or violate NAU data-protection policies. This risk is *medium* in likelihood and *high* in impact. The app mitigates this by processing all location data in real time only (no storage or sharing of user locations). It will also include transparent permission prompts and clear privacy statements explaining data use.

R6 – Battery and Performance

Continuous GPS tracking, real-time rendering, and background processes can drain mobile batteries or cause lag, especially on older devices. The likelihood of this risk is *high* with a *medium* impact on usability. Optimization strategies include reducing location polling frequency, suspending background services when the user is stationary, and using Mapbox's *Lite Mode* to lower CPU and GPU demand during long trips.

R7 – Accessibility Compliance

If the app lacks proper accessibility support such as transcripts, captions, readable

contrast, or adjustable font sizes, it may exclude users with disabilities and fail to meet university accessibility standards. This risk is *medium* in both likelihood and impact. To mitigate it, the project will implement WCAG 2.1 AA standards by providing transcripts for all oral histories, ensuring color contrast ratios meet accessibility guidelines, and testing UI readability with assistive technologies.

R8 – Security of Keys and Tokens

Sensitive information such as Mapbox access tokens or CONTENTdm API keys could be accidentally exposed through the app's code repository. If leaked, these credentials could be exploited to access institutional accounts or exceed usage limits. The likelihood is *medium* and the *impact* is *high*. The team will store tokens in encrypted configuration files or environment variables, rotate them regularly, and restrict access to authorized developers only.

R9 – Maintenance and Longevity

After project handoff, ongoing support and updates may be limited due to changes in student involvement or institutional priorities. Outdated dependencies could cause the app to lose functionality over time. This risk has a *medium likelihood* and *high impact*. To address this, detailed documentation, setup instructions, and code comments will be delivered to Cline Library staff, along with a Dockerized environment to simplify rebuilding and testing in future semesters.

R10 – Competition and Redundancy

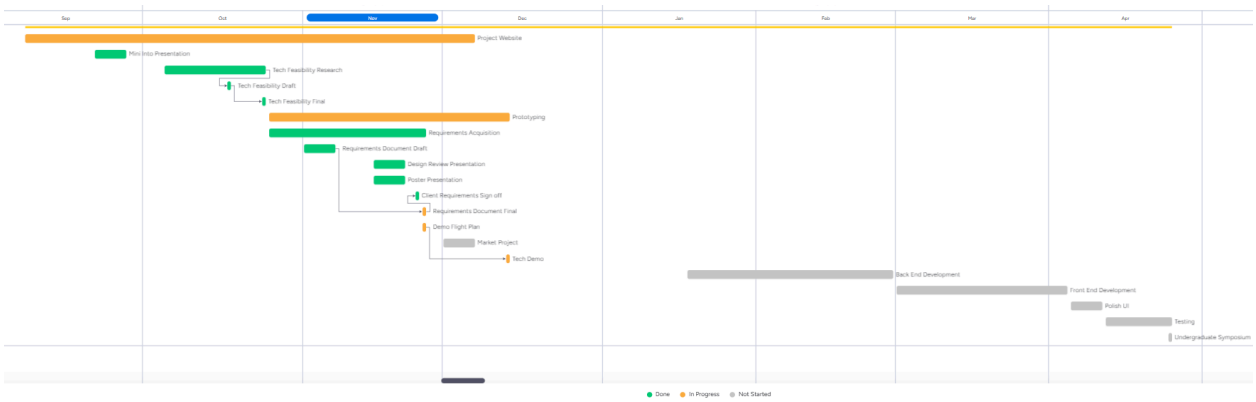
Future commercial or tourism-based apps could replicate the educational concept of the Route 66 Companion, drawing potential users away from NAU's platform. While this risk has a *low likelihood*, its *impact* is *medium* due to potential loss of user interest. The project mitigates this by emphasizing NAU's unique academic credibility, exclusive archival data, and historical storytelling approach unavailable in commercial apps.

R11 – Environmental Disruption

External factors such as extreme weather, road closures, or regional network failures could affect the app's real-time features and user engagement along the route. Although the likelihood is *low* and the *impact medium*, it remains relevant to ensure user safety and reliability. The app will provide offline fallback options, cached data access, and system alerts about connectivity or route disruptions whenever possible.

Project Plan

The project plan outlines the full timeline, phases, and major deliverables for the Route 66 Companion system. This schedule provides a clear roadmap from early research and requirements gathering through design, prototyping, development, testing, and final delivery. The Gantt chart below visualizes these tasks, their dependencies, and their current status, helping ensure the team remains aligned and on track. By mapping each component across the academic year, the plan demonstrates how the project will progress in a structured and manageable way, highlighting completed work, in-progress efforts, and upcoming milestones.



Conclusion

Experience 66, sponsored by Mike Taylor of Cline Library and Mark Manone of GRAIL, is being developed to address the limited accessibility of Route 66's rich historical archives currently stored in static systems like CONTENTdm. Motivated by the upcoming 100th anniversary of Route 66, the project aims to create a dynamic, location-aware mobile application that connects travelers to historical stories, photos, and oral histories based on their GPS location. Built using Kotlin, Mapbox, and Node.js, the app integrates geofencing, interactive maps, and offline functionality to deliver an immersive and educational travel experience. Significant progress has been made in defining requirements, developing prototypes for key features, and establishing technical feasibility through collaboration with sponsors. Moving forward, the project is well-positioned to enhance cultural engagement, extend the reach of Cline Library's collections, and ensure that Route 66's legacy continues to inspire future generations of travelers. Ultimately, the Route 66 Companion bridges the past and present, turning every mile of the Mother Road into an interactive journey through time.