



TrashTag

If you can't take it, TAG IT!



Design Presentation

CS 410 Fall 2025 Team Iron

Table of Contents

1

Part 1: The Vision

- Team Bio: Get to Know Us
- Background



2

Part 2: The Societal Problem

- Problem Statement: Reporting Disconnect
- Who is Affected?
- Problem Characteristics
- Current Process Analysis: The Reporting Breakdown



3

Part 3: Our Solution

- Solution Statement: Introducing TrashTag
- Solution: What does it do and What does it not do?
- Solution Flow
- Competition Matrix: Where do we fit in?



4

....

Part 4: Project Roadmap

- Tools and Technologies: Solution Architecture
- Risk Assessment and Mitigation: Our Strategy for Success
- Appendix: References and Definitions



Team Bio



J. Scott Zumwalt
Team Lead



Sara Perez
Front End Developer &
Document Specialist



Emily Rick
Full Stack
Developer



Teddy Kovacs
Back End Developer &
Database Design



Luca Brooks
Back End Developer &
Test Analyst



Adam Daif
Full Stack Developer
& GIS Specialist



Ryan Fee
Full Stack Developer

Background

- Over the past 36 years, volunteers in the state of Virginia have removed approximately 7.1 million pounds of litter (Chesapeake Bay Foundation, 2025).
- It can take hundreds of people to search an area for all the trash and dumping (KUT News 2023)
- Oversized items, such as mattresses, tires, and appliances, create challenges for individuals lacking equipment to haul and dispose of them safely.



Background (cont.)



- The accumulation of waste has led to approximately 100,000 marine animal deaths annually (Environmental Volunteers, 2023).
- Illegal dumping has causes an estimated drop of property values by 7% - 10% (City of Hampton, n.d.).
- Approximately 21% of beach goers report they have been injured from beach litter. (Science Direct 2016)
- When people see litter or dumping they are more likely to litter or dump more in that area. (Allegheny Front 2016)

Background (cont.)

- Litter makes tourist destinations less attractive and causes an estimated drop in revenue by 38% in areas with litter. (Keep Texas Beautiful)
- Texas has spent \$50 million in litter clean up. Costs paid for by local governments. (Keep Texas Beautiful)

.....



Problem Statement

The communication gap that keeps trash on the map!

Independent organizations and local governments struggle to efficiently locate and remove litter in outdoor recreational areas such as parks, rivers, lakes, and beaches. Without knowing locations and characteristics of waste items, volunteer efforts can be left unprepared and ineffective. Communities lack a live reporting system to connect citizens with organizations capable of safe and efficient waste removal efforts.



Problem Characteristics

Identifying the Critical Gaps

01

Resources

- Organizations struggle to track illegal dumping.
- Items too much for individuals.
- Users and Litterers alike may or may not have adequate knowledge of proper disposal options.

02

Communication

- Users don't know who to contact regarding trash.
- Users lack tools focused on organizing cleanup efforts.
- User reports come in one at a time and require coordination within cleanup organizations to increase efficiency.

03

Convenience

- Users can't communicate in the moment when they see the trash.
- They've forgotten by the time they return home.
- Litterers often dump out of convenience on private or public property

04

Complexity

- Users reach out to orgs via email/social media which may get lost or go unnoticed.
- Thus, users contact multiple orgs at a time to ensure attention



Who is Affected?

Focusing on Those Impacted the Most

01

The Environment

- Open dumping landfills negatively impact the environment by contributing to pollution via toxic chemicals.
- These landfills account for at least 40% of all global waste.

02

Local Governments

- Local governments spend millions of taxpayer dollars annually on litter clean up.
- In Virginia alone, 3.5 million dollars is spent to clean the state's roadways.

03

Environmental Organizations

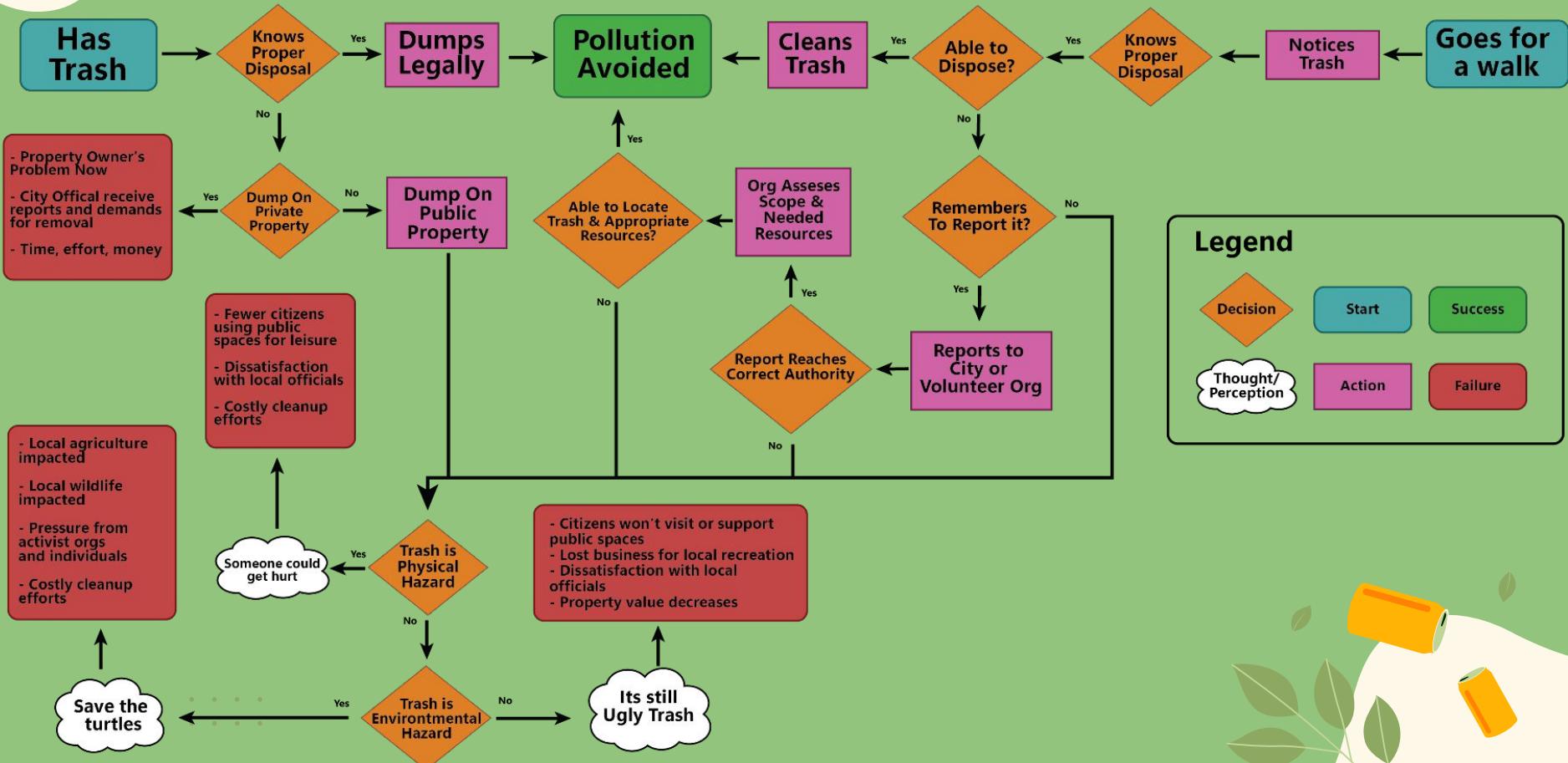
- Safety risks often put volunteer efforts at a significant disadvantage.
- Rising annual costs are another factor in turning away volunteers and organizations from cleaning up litter.

04

The General Public

- Excess litter creates various health hazards and diseases.
- Litter also negatively impacts waterways, communities' aesthetic value, and the cleanliness of natural areas.

Current Process Flow





Solution Statement

TrashTag aims to improve the litter and waste cleanup process by developing a mobile application where users can photograph and report piles of waste, give their exact locations, and connect with cleanup groups that are well-equipped to handle the cleanup process in order to improve environmental wellbeing and preserve nature's beauty for the public eye.

We are committed to helping the environment and the public by providing a resource that clearly highlights the location, extent, type and weight of the waste as well as provides updates regarding existing cleanup efforts, dangers and geographic littering patterns to help cleanup crews allocate their time and resources more effectively.



Solution Characteristics

Live Reporting and Mapping:

- Users snap a picture of the litter and geotag it in the app for it to be uploaded to an interactive map.
- This allows organizations to properly allocate time, resources, staff, and funding.

Litter Report System

- The images provide users with a visual understanding of the problem.
- This allows them to prepare resources for proper clean up.

“Litter Hero!”

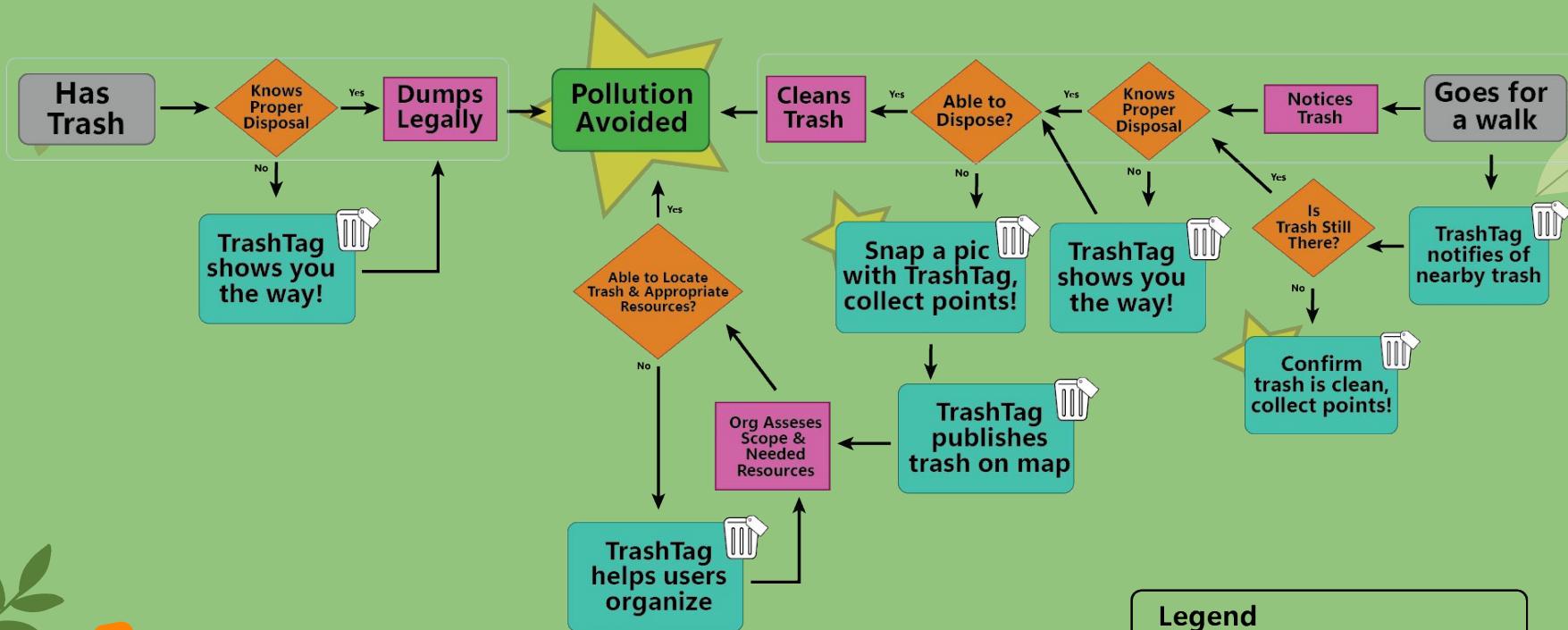
- A reward system for users who successfully clear litter locations from the map.
- This allows users track their progress and notice measurable impact.

Close the loop

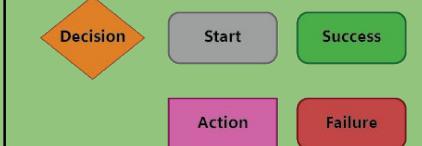
- When users are near reported trash they receive a request to verify the trash is still there or if its been previously cleared.



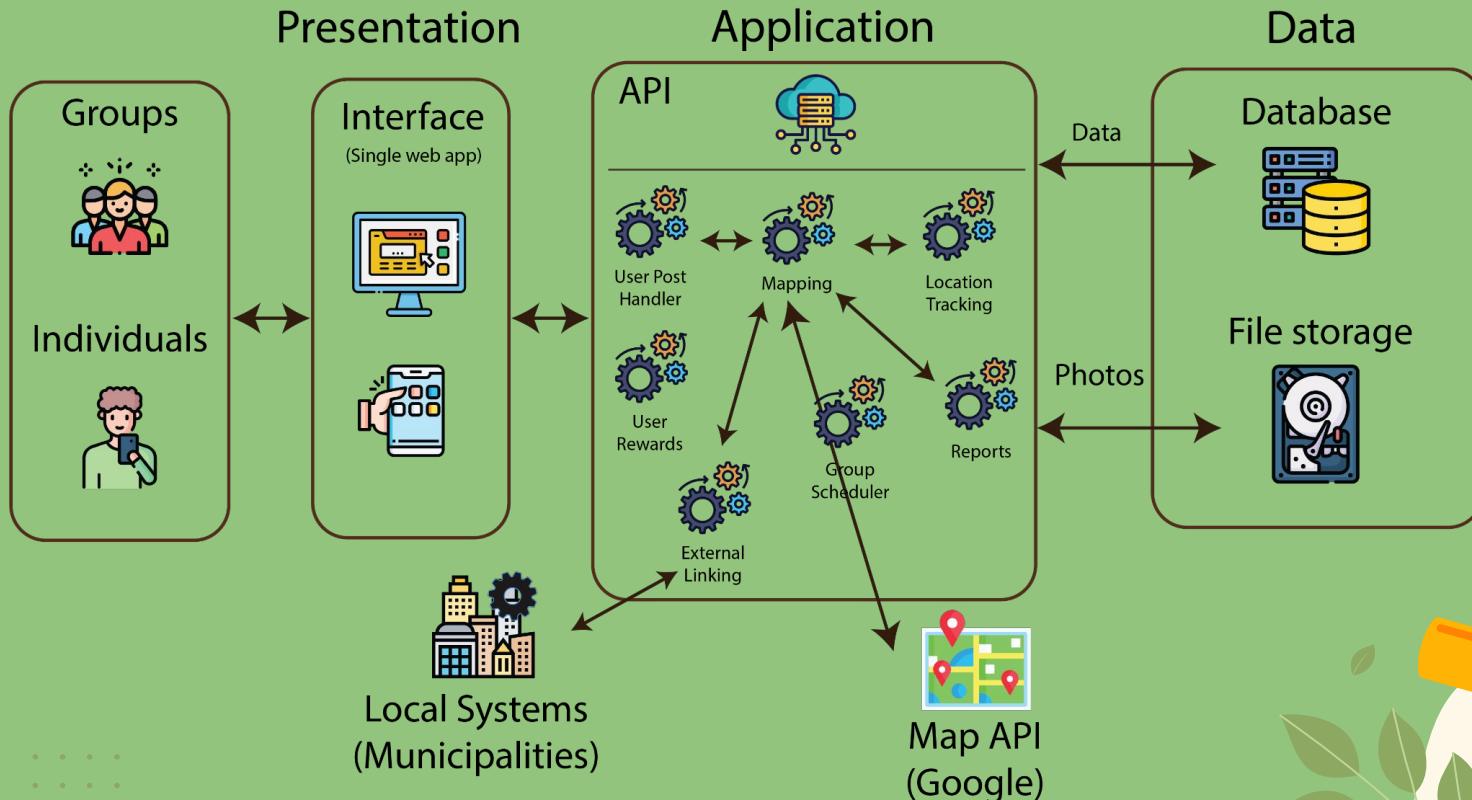
Solution Process Flow



Legend



Major Functional Component Diagram



Solution Characteristics: What Will It Do?

- Live Litter Reporting and Mapping
- Ranking System for Active Report and Cleanup Users
- Updates Regarding Cleanup Efforts For Each Report
- Images of Litter for Cleanup Crews to Accurately Gauge Its Scope
- Collaboration Space for Other Users to Provide Information and Updates
- Direct Connection Between Reporters and Cleanup Crews
- Mapping Tools to Scope All Reports in a Geographic Area
- Users Receive Alerts When Near Reported Litter to Verify If It's Gone or Still There
- Scheduled Clean ups

.....



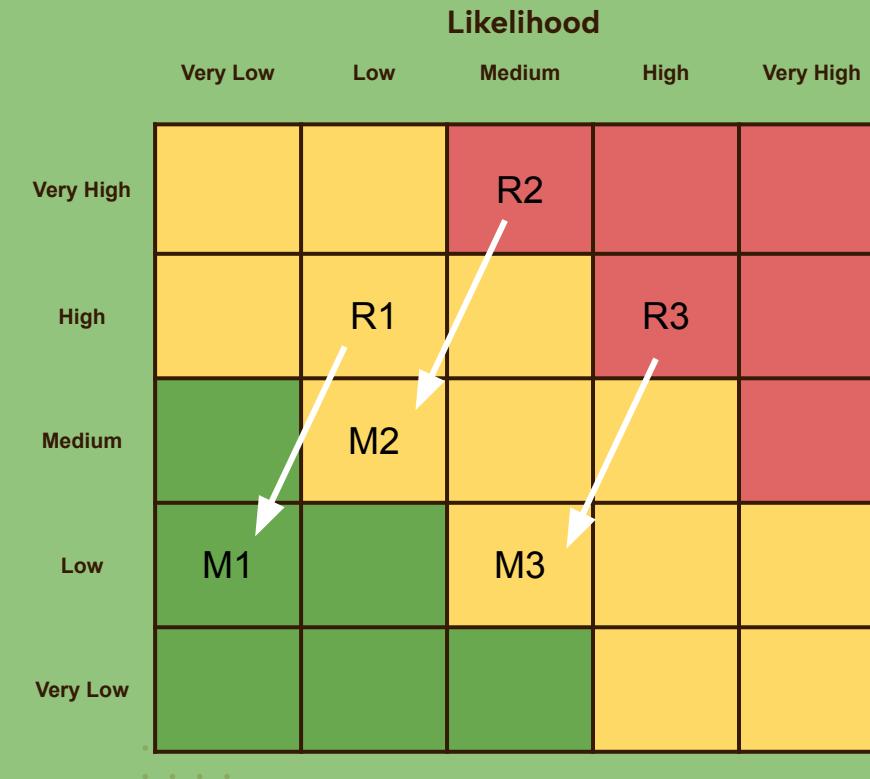
Solution Characteristics: What Will It Not Do?

- Provide Tangible or Monetary Rewards for Active Users
- Guarantee a Cleanup Response
- Law Enforcement and Penalizing Illegal Littering
- Replace Emergency Service Reporting (e.g., chemical waste)



.....

User Risks & Mitigation



R1: False entries entered that are not trash.

R2: Minimal/no clean-up organizations in the area to handle tagged trash.

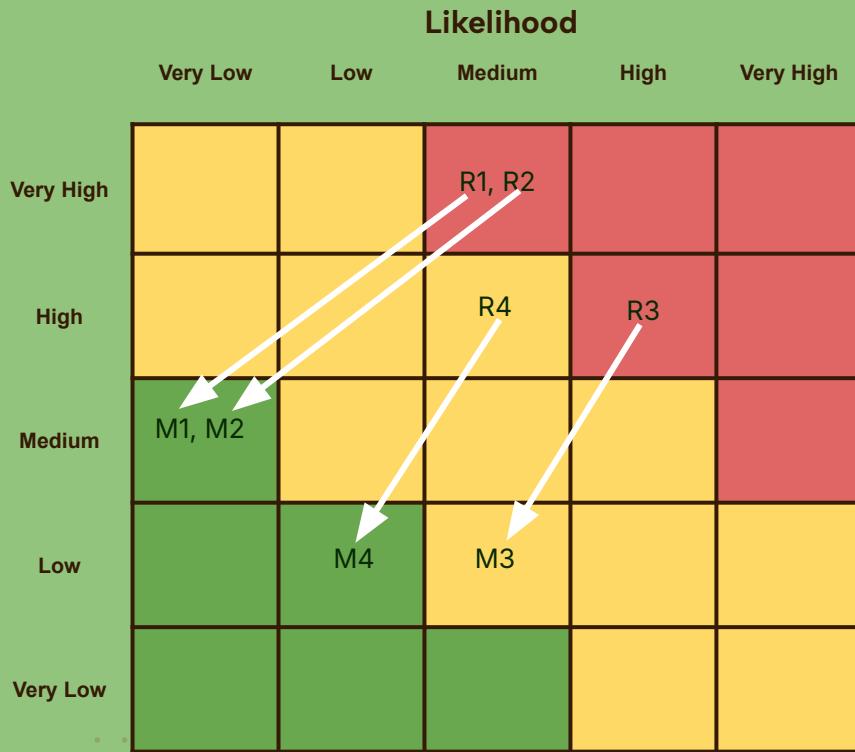
R3: Minimal/no users installing or using the app.

M1: Entries are verified by other users with location based notifications.

M2: Users can organize themselves. Users near tagged items receive requests to join ad hoc groups.

M3: Organization outreach/advertising

Customer Risks & Mitigation



R1: Does not integrate well with existing city/org workflows causing limited adoption

R2: Misallocation of crews due to bad/duplicate pins hurting budgets and staff morale

R3: Difficulties proving impact to local officials and donors.

R4: Budget surprises due to usage spikes and/or excessive storage needs

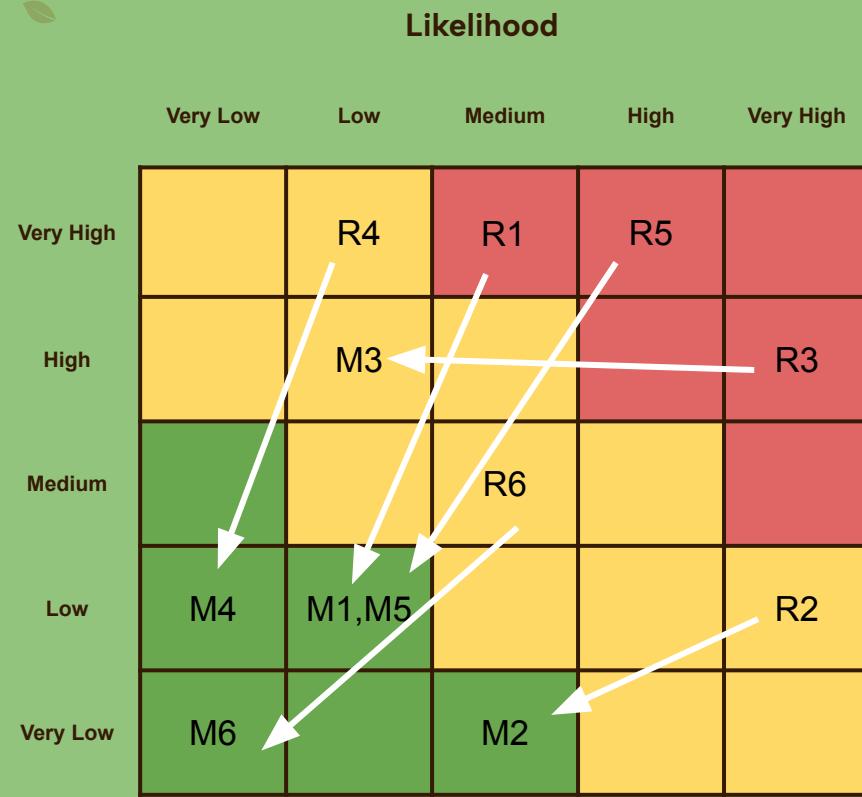
M1: Pilot by locale; API bridges for tailored implementation; Limit categories to not exceed capabilities

M2: Validate before dispatch recommendation; Confidence scoring; User cooldowns for inaccurate reporting

M3: Before/After photos; Outcome dashboard, Service Level Agreement (SLA) tracking

M4: Spending dashboard; Annual Total Cost of Ownership (TCO) quotes; Spending lock on non-critical features; Usage caps

Technical Risks & Mitigation



R1: Servers are down

R2: User refuses to share location

R3: Wifi connection is lost

R4: App deletes trash that still exists

R5: App presents trash that no longer exists

R6: Individual accounts are hacked

M1: Utilize reliable hosting, a backup DNS, uptime monitoring and data backups.

M2: Clarify their location is private data that will not be shared & allow choosing location on map.

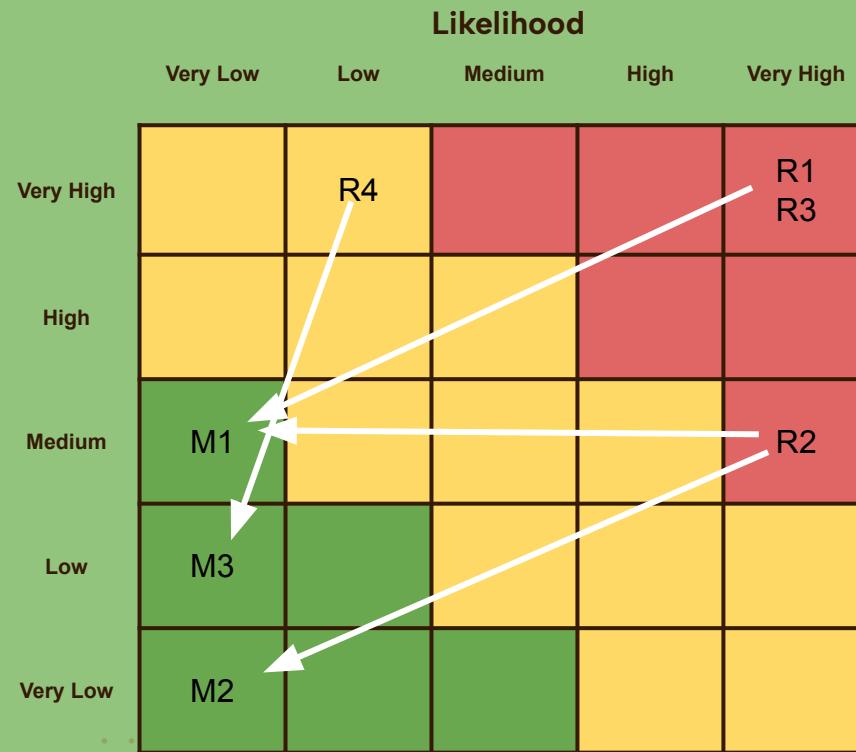
M3: Add offline data persistence & auto-sync: save posts locally & publish when connection returns.

M4: Trash report not deleted until cleaner confirms.

M5: Nearby users are asked to update trash's status. Once enough users report it's removed, it is no longer displayed in the app.

M6: Use best practices for cybersecurity & reporting

Legal & Security Risks & Mitigation



R1: Users may trespass onto private property during cleanups

R2: Users may use the platform to organize crime

R3: Users may get hurt during the cleanup

R4: A data leak would likely reveal a user's location

M1: Users will have to agree to an End-User License Agreement (EULA) to use the platform that makes clear that the platform does not assume any responsibility for any injuries or arrests obtained through use of the platform

M2: Users who violates the EULA will be banned from the platform permanently

M3: User data will be encrypted to avoid data leaks revealing the location of users

Competition Matrix

Features	TrashTag	Clean Something For Nothing	Pirika	Litterati	City 311 app
Report trash	✓	✓	✓		✓
Upload Geotagged photos of trash	✓	✓	✓	✓	
Interactive map	✓	✓	✓	✓	✓
Scope Indicator	✓	✓			
Reward System	✓	✓			
Organize Groups	✓	✓		✓	
Verify Cleanup	✓				
Scheduled Cleanups	✓				
Resources on Proper Dumping	✓				✓



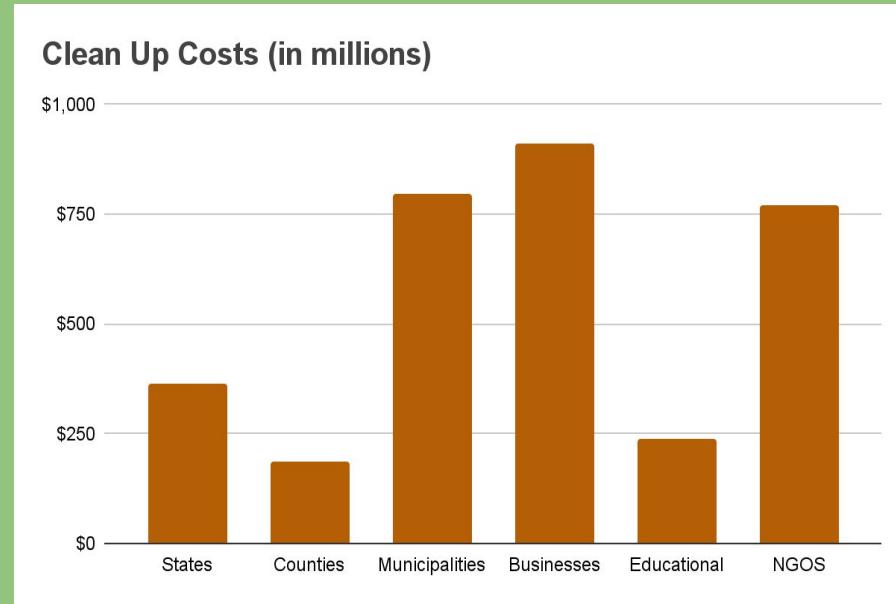
Development Tools



Development Environment	VS Code
Version Control	Git, GitHub
Continuous Integration and Deployment	GitHub
Frontend Languages	JavaScript (React Native)
Backend Languages	C# and .NET
Cloud	Azure

Benefits to Customers

- **Local Governments, Businesses, and Environmental Organizations**
 - Cut back on the amount of money spent on annual litter clean up.
 - Quickly track affected areas and efficiently organize volunteers groups to help clean these areas.



Source: Litter in America Results from the Nation's Largest Litter Study^[15]



Benefits to Customers

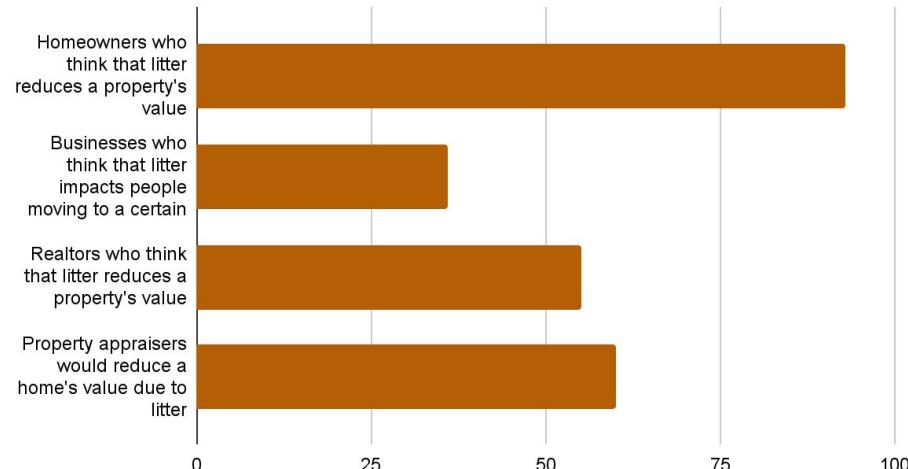
- Local Recreational Organizations
 - Can coordinate via the app with users about local volunteer efforts.
 - Can use the app to locate trash within parks and recreational areas, keeping them clean and in turn helping local businesses and other parks thrive.^[16]



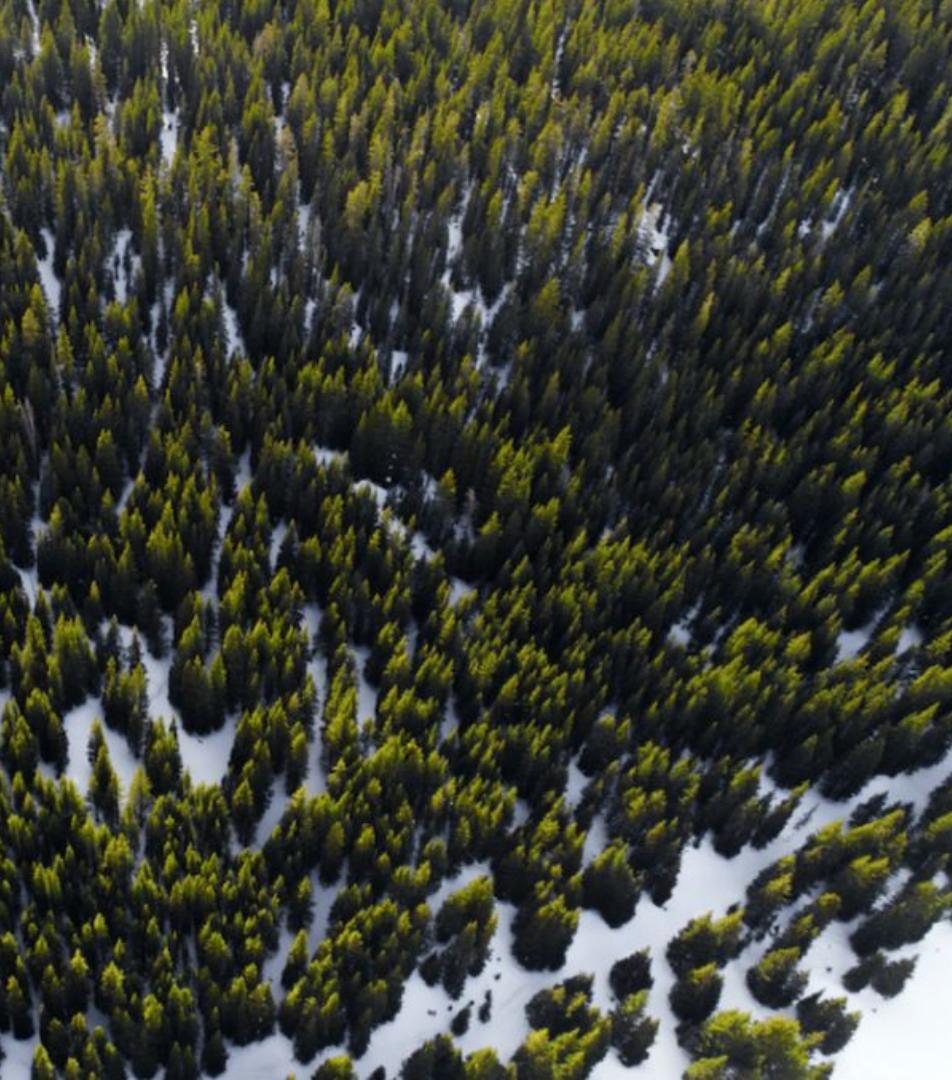
Benefits to Customers

- Nature Enthusiasts and Local Communities
 - Able to connect users with likeminded people to make their communities better and raise the value of it.
 - Lets users track down trash and connect with the proper authorities if heavy equipment is required to remove it.

Litter's Impact on Housing



Source: Litter in America Results from the
Nation's Largest Litter Study^[15]



Benefits to Customers

- **Nature and the Ecosystem**
 - Makes previously littered areas more habitable for animals and plant life.
 - Benefits human health by reducing waste and landfill emissions.



User Roles

- **Citizens:** Community Members who report litter by uploading photos, marking severity levels, collaborate in cleaning events, and earn rankings as rewards for their initiative efforts.
- **Organizations:** Non-profit environmental organizations that organize and allocate their resources to successfully remove litter from Litter dense areas.
- **Local Government:** Government staff who benefit from the platform by reducing cleanup costs and optimizing waste management. They view litter trends, density heavy areas, and gather statistics for appropriate budget planning and future policy decisions. User information is protected and remains anonymous to government users.
- **Administrator/Moderator:** Platform managers who ensure system integrity and quality remain intact. The administrators will be responsible for user account management, removing inappropriate and/or duplicate reports, and responding to community flagged submissions. This ensures the platform provides accurate data analytics for all its users.

User Stories

As a Citizen,

- I want to upload photos of litter I find so that others can see the issue and take action.
- I want to mark the severity level of the litter so that the cleanup can be prioritized.
- I want to join or create local cleanup events so that I can help improve my community.
- I want to earn rankings or recognition for my contributions so that I stay motivated to participate.
- I want my personal information to remain private so that I can safely report issues without fear of exposure.



User Stories



As an Organization (Non-Profit Environmental Group),

- I want to view reported litter areas so that I can identify where help is needed most.
 - I want to allocate volunteers and resources efficiently so that cleanup operations are effective.
 - I want to track the success of cleanup events so that I can measure our environmental impact.
 - I want to collaborate with citizens and local government through the platform so that we can act together.
- 
- 

User Stories

As a Local Government,

- I want to view aggregated litter trends and density maps so that I can identify problem areas.
- I want to access statistics about litter reports and cleanups so that I can plan budgets and policies.
- I want citizen data to remain anonymous so that privacy laws and ethics are upheld.
- I want to receive periodic reports about cleanup progress so that I can track the impact on municipal costs.

User Stories

As an Administrator,

- I want to review user-submitted reports so that I can remove inappropriate or duplicate data.
- I want to respond to post reports from users so that the platform remains trustworthy.

As a Moderator,

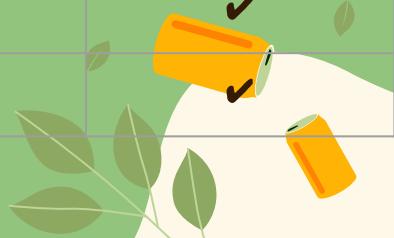
- I want tools to correct or delete false or spam submissions so that data analytics remain accurate.

Feature Table

Category	Features	Citizens	Organizations	Government	Admin/Mod:
Litter Reporting	Report Litter Location	✓	✓	✓	
	Upload Photos	✓	✓	✓	
	Report Litter Type	✓	✓	✓	
	Mark Severity Level	✓	✓	✓	
Mapping	View Litter Map	✓	✓	✓	✓
	Litter Density Map	✓	✓	✓	✓
	Filter by Type	✓	✓	✓	
	Filter by Location	✓	✓	✓	
⋮	⋮	⋮	⋮	⋮	⋮

Feature Table

Category	Features	Citizens	Organizations	Government	Admin/Mod
Community Engagement	Coordinate Cleanups	✓	✓	✓	
	Participate in Cleanups	✓	✓	✓	
	Mark Location as Cleaned	✓	✓	✓	✓
	Proximity Cleanup Alerts	✓	✓	✓	
	Verify Cleanup Status	✓	✓	✓	✓
	Flag Suspicious Content	✓	✓	✓	
	View Impact Statistics	✓	✓	✓	✓
	Gamification/Rewards	✓	✓		
	Top Contributors	✓	✓		

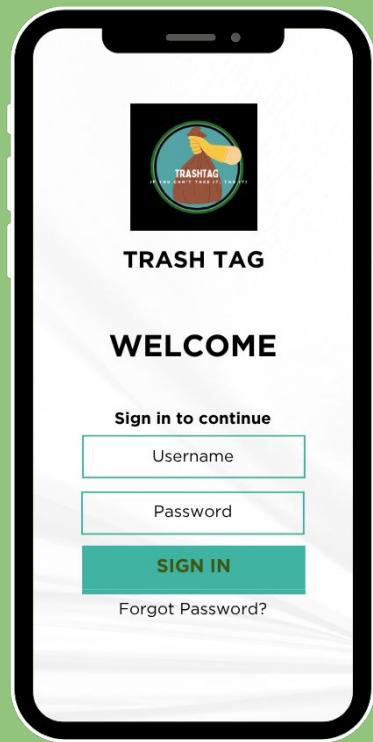


Feature Table

Category	Features	Citizens	Organizations	Government	Admin/Moderators
Analytics	View Litter Trends		✓	✓	✓
	Download Reports		✓	✓	✓
	View Density - Heavy Litter Analytics		✓	✓	✓
Platform Moderation	Review Flagged Reports				✓
	Remove Duplicate and/or Suspicious Reports				✓
	Manage User Accounts				

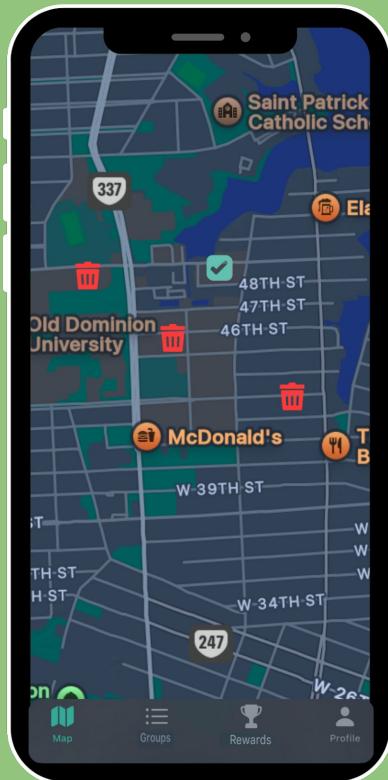
UI Mockups

Login Screen



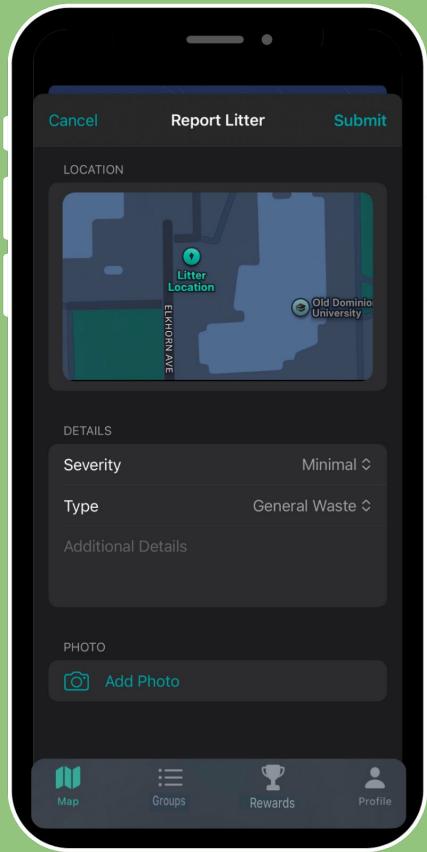
UI Mockups

Trash Map Screen



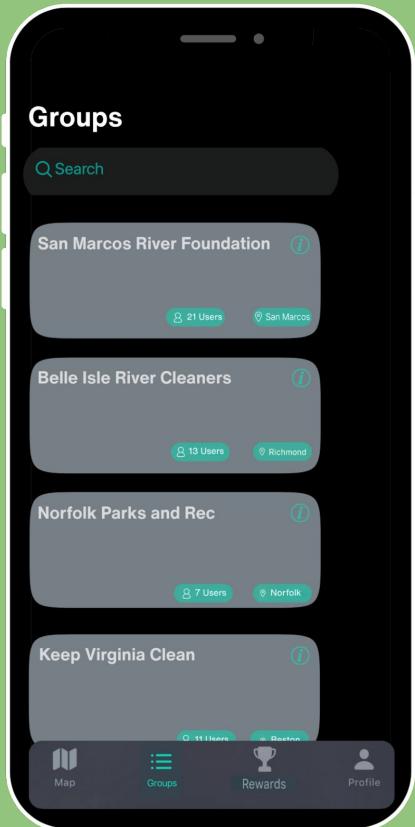
UI Mockups

Trash Report Screen



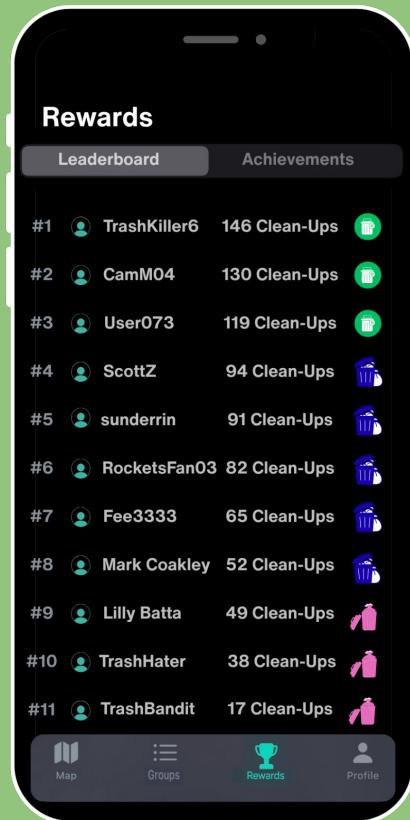
UI Mockups

Groups Screen



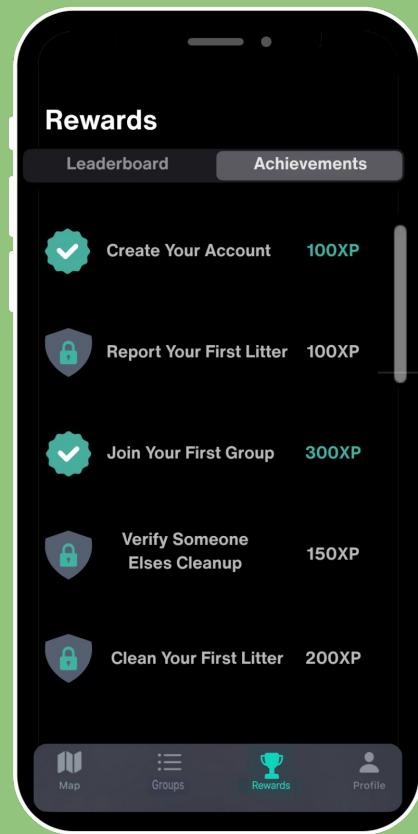
UI Mockups

Rewards Screen



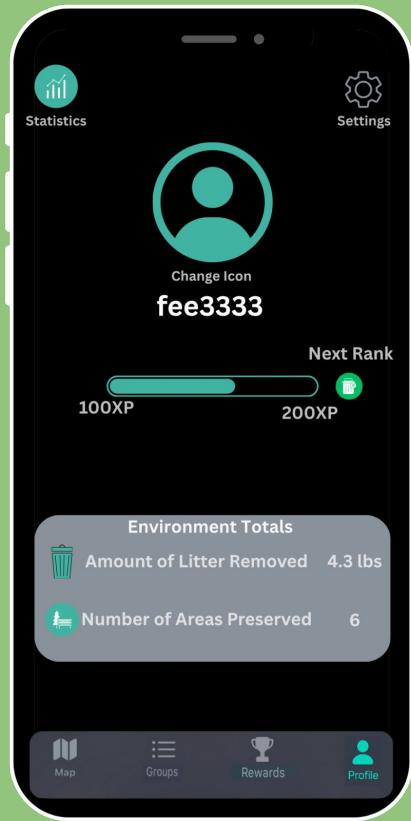
UI Mockups

Rewards Screen #2



UI Mockups

Profile Screen



Work Breakdown Structure

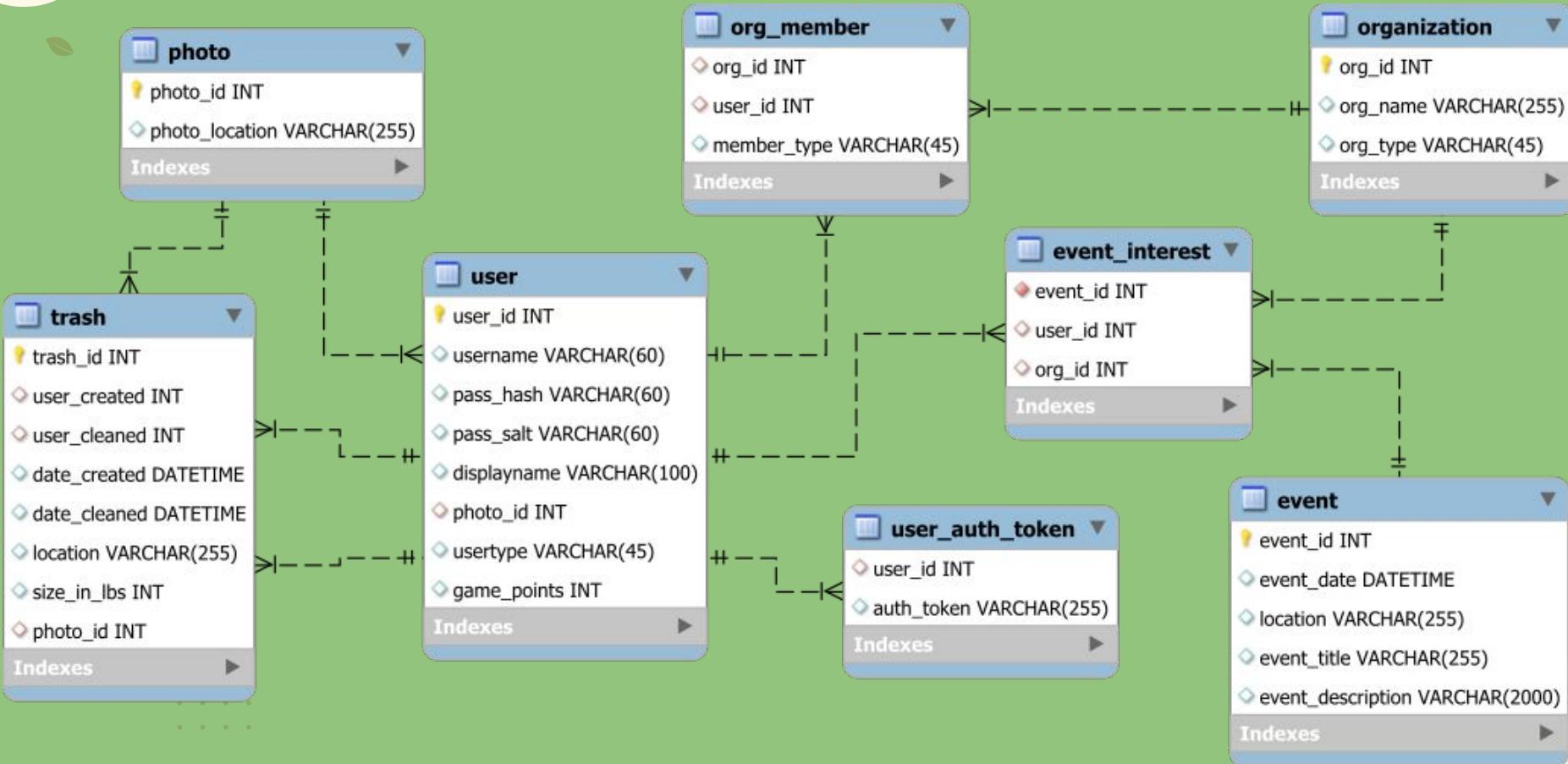


Algorithms

Find nearby users to suggest a clean up group.
Show nearby trash reports.



Database Schema



Sprint Breakdown

First Sprint

Goal: Minimum Viable Product

Client:

- Display Google Map from API
- Capture Image from Camera
- Verify location data exists
- Upload to API

API:

- Accept upload of image
- Verify location data exists
- Save data to database
- Serve location data for map display

Second Sprint

Goal: Authorization and Authentication

Client:

- Create user account
- Setup profile
- Edit profile
- Login

API:

- Accept new account info
- Save user profile data
- Handle login
- Endpoints enforce login

Conclusion

- Littering is a continuous issue prevalent in our society that affects our environment, governments, and communities.
- **The problem:** Due to the immense communication gap between citizens who see litter and cleanup organizations equipped to remove it, these organizations waste more time searching for litter rather than investing that time removing it.
- **Our solution:** A live reporting platform that closes that gap and facilitates communication through a live mapping system.
- **Engagement:** Motivating communities to “see it, report it, and clean it” through positive engagement strategies and healthy competition
- **Our vision:** By empowering communities to report litter locations, we can successfully close that gap, allowing cleanup organizations to spend more time actively removing litter rather than wasting time searching for it. This platform will transform civic duty into an engaging community movement with our powerful platform components.



References

1. "Volunteers Gather Over 16,000 Pounds of Trash from the San Marcos River." *Corridor News*, 13 Apr. 2020,
<https://smcorridornews.com/volunteers-gather-over-16000-pounds-of-trash-from-the-san-marcos-river/>
2. Fawaz, Maya. "Hundreds of Volunteers will fan out on San Marcos waterways Saturday to clean up trash." *Kut News*, 3 Mar. 2023,
<https://www.kut.org/energy-environment/2023-03-03/hundreds-of-volunteers-will-fan-out-on-san-marcos-waterways-saturday-to-clean-up-trash>
3. "54th San Marcos River Rendezvous Clean Up." *Texas Rivers Protection Association*,
<https://txrivers.org/texas-river-blog/54th-san-marcos-river-rendezvous-clean-up/>. Accessed 23 Sept. 2025.
4. Mendoza, Madalyn. "San Marcos River litter 2018." *My San Antonio*, 31 May 2018,
<https://www.mysanantonio.com/news/local/slideshow/San-Marcos-River-litter-2018-181939.php>
5. Earth Day. "How Our Trash Impacts the Environment." *EarthDay.org*, updated 22 Sept. 2025,
www.earthday.org/how-our-trash-impacts-the-environment/. Accessed 30 Sept. 2025.
6. thomas. "How Does Littering Affect the Environment?" Texas Disposal Systems, 1 Feb. 2024,
<https://www.texasdisposal.com/blog/the-real-cost-of-littering/>.
7. "On This 52nd Annual Earth Day, What Is the State of Litter in Virginia?" VPM, 22 Apr. 2022,
<https://www.vpm.org/news/2022-04-21/on-this-52nd-annual-earth-day-what-is-the-state-of-litter-in-virginia>.
8. "Cleaning Litter along Arkansas Roads Costs Millions in Taxpayer Money." Thv11.Com, 28 Oct. 2021,
<https://www.thv11.com/article/news/education/arkansas/litter-costs-arkansas-taxpayers-millions/91-38fe040f-82c7-4698-a34a-d8cf7d77de34>

References (cont.)

9. Garza, Ariana. "More than \$40 Million Taxpayer Dollars Spent Annually on Texas Litter Cleanup." KTXS, 25 Mar. 2014, https://ktxs.com/news/abilene/more-than-40-million-taxpayer-dollars-spent-annually-on-texas-litter-clean-up_20160517100457192.
10. Picking up Litter: Pointless Exercise or Powerful Tool in the Battle to Beat Plastic Pollution?, 2018, www.unep.org/news-and-stories/story/picking-litter-pointless-exercise-or-powerful-tool-battle-beat-plastic.
11. Lara. "The Economics of Litter." Keep Texas Beautiful, 10 Oct. 2024, ktb.org/ktb-blog/the-economics-of-litter/#:~:text=Infrastructure%20Impacts,million%20deficit%20in%20infrastructure%20investments.
12. "How Litter Harms Humans, Animals, and the Environment." Fire & Ice, <https://indoortemp.com/resources/how-litter-harms-humans-animals-environment>. Accessed 12 Oct. 2025.
13. Campbell, Marnie L., et al. "Human Health Impacts from Litter on Beaches and Associated Perceptions: A Case Study of 'Clean' Tasmanian Beaches." Ocean & Coastal Management, vol. 126, Jun. 2016, pp. 22–30. ScienceDirect, <https://doi.org/10.1016/j.ocemarman.2016.04.002>
14. Blouin, Lou. "The Psychology of Littering." The Allegheny Front, 8 Jan. 2016, <https://www.alleghenyfront.org/the-psychology-of-littering/>.
15. Litter in America Results from the Nation's Largest Litter Study, www.hampton.gov/DocumentCenter/View/308/litter-factsheet-costs?bidId=. Accessed 12 Oct. 2025.
16. How to Reduce Litter In Your Parks, <https://www.miracle-recreation.com/blog/reduce-litter-in-parks/>
17. The Economics of Litter, [https://ktb.org/ktb-blog/the-economics-of-litter/](http://ktb.org/ktb-blog/the-economics-of-litter/)

Appendix



Application Programming Interface (API): A set of rules that allows different software programs to communicate with each other and share data or functionality.

RDBMS (Relational Database Management System): A database system that stores data in tables and organizes relationships between them.

Metadata: Data that describes other data, such as when a file was created, who created it, or what type it is.

Geotagging: The process of attaching location information to digital content, so it can be linked to a specific place on a map.

