

PRD

UrbanWild: Wildlife Tracking in Urban Areas

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Last Updated: 12 Dec 2022



Photo Credit: Steve Winter/National Geographic

Vision

UrbanWild (UW) is a tool that uses machine learning to track, map, and analyze animal behavior in relation to human activity in order to reduce human-wildlife conflict in urban environments.

Background

Problem

As human development spreads, urban wildlife often comes into conflict with people, usually to the detriment of the urban wildlife population. Examples include mountain lions trying to find a mate or new territory being struck and killed crossing the Los Angeles freeway system¹, neighborhoods posting panicked messages about coyotes on NextDoor leading to city decisions to eradicate them², and bears being euthanized for being habituated to humans³.

Motivation

The percentage of people in the United States living in urban areas has increased every year, reaching current levels of over 80%⁴. With this increase has been a corresponding rise in conflicts between wildlife living in urban areas and human development. Governments and environmental groups have begun to recognize the importance of promoting better coexistence between humans and wildlife in urban areas and are working together toward this goal⁵. Therefore, it is important to make accurate and timely insights available so that governments, organizations, and individuals can make beneficial decisions for both people and wildlife.

Target Audiences

State and local government offices, urban planners and policymakers, wildlife conservationists, and environmental research groups

Existing Solutions

The use of AI to identify wildlife is not new, but it is not a tool currently widely used in urban environments. In general, AI is used for very specific conservation purposes, such as seabird conservation⁶, wildlife monitoring in remote locations⁷, or poaching detection⁸.

¹ <https://wildlife.ca.gov/Conservation/Mammals/Mountain-Lion#56231950-conservation-and-management>

² <https://www.kcet.org/redefine/arcadia-may-begin-killing-coyotes>

³ <https://www.newsweek.com/500-pound-bear-euthanized-after-125-mile-journey-home-1632626>

⁴ <https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural/ua-facts.html>

⁵ A notable recent example is the new Wallis Annenberg Wildlife Crossing in Southern California: <https://annenberg.org/initiatives/wallis-annenberg-wildlife-crossing/>

⁶ <https://ccal.ucsc.edu/>

⁷ <https://conservationmetrics.com/wildlife-monitoring-tools/>

⁸ https://rfcx.org/our_work#poaching

Market Research

Competitor Landscape + Differentiation

There are other AI-based wildlife monitoring systems in place, but they predominantly rely on technologies solely suited for non-urban locations: trail cameras, acoustic monitoring, tracking collars, etc. These competitors are often located within research institutions such as universities. UW will be different in that we will work independently with different organizations focusing exclusively on urban wildlife monitoring, and we will leverage monitoring systems already in place, such as public surveillance cameras and external home security cameras.

Market Opportunity

UrbanWild is a B2B or B2G solution, and as such, will be monetized through government, state, and local contracts. Currently, there are no AI/ML-based solutions that are solving this problem on a wide scale, so there is a broad opportunity to implement UW in different locations.

Strategic Considerations

- UrbanWild will require considerable external partnership development in order to access resources in other domains.
- UrbanWild will also require substantial funding - grants and external investors have been obtained.
- UrbanWild's adoption by conservationists, governments, and others will determine its success - which means the UW model and application need to provide extremely accurate and effective data packaged in a simple and intuitive interface.

Why Now?

- **Increasing awareness and concern about the impacts of urbanization on wildlife populations.** As urban environments continue to expand, the interactions between humans and wildlife are becoming more frequent and complex. This is leading to an increased interest in understanding and conserving urban wildlife populations, and the UrbanWild application can provide a valuable tool for supporting these efforts.
- **Growing availability and accessibility of machine learning technology.** Machine learning is a powerful tool for understanding and analyzing complex data sets, and its applications are becoming increasingly available and accessible. UrbanWild would leverage machine learning to provide detailed and accurate data on urban wildlife populations, and the availability and accessibility of this technology make it a good time to develop and deploy the application.
- **Ongoing need for studies that evaluate the impact of human development on urban wildlife** (and vice versa). As conducted today, studies are expensive and take a long time. Having access to a machine learning solution would improve decision-making processes, speed the completion of studies, as well as reduce costs for taxpayers and others.

Ideas

Goal: Reduce human-wildlife conflict and support urban wildlife conservation by providing critical information about urban wildlife populations in relation to human development.

UrbanWild is intended to be used with available human population data (current and historical) and other urban planning information to pull meaningful insights into human/urban wildlife overlaps.

Features of UrbanWild:

- **Machine learning-powered animal identification:** UrbanWild uses machine learning to accurately identify and count animals in photos and videos from public cameras, allowing it to quickly and easily catalog the types and numbers of animals present in a given location.
- **Mapping and visualization of urban wildlife populations:** UrbanWild maps the locations of identified animals and visualizes the data in an intuitive and easy-to-understand format. Users can see the distribution of urban wildlife in an area and identify potential hotspots for conservation efforts or interventions.
- **Comparison to human development data:** UrbanWild compares the locations and movements of urban wildlife populations to the developments of human populations (population density, road/highway construction, housing, etc). Users can see how the two populations interact and gain valuable insights.
- **User-defined analysis:** UrbanWild allows users to select specific animals or locations to analyze, providing more focused and detailed insights. Users gain a better understanding of the interactions between humans and urban wildlife in specific areas by generating maps, charts, and other graphics to aid in visualization.

Benefits of UrbanWild:

- **Improved understanding of urban wildlife populations:** UrbanWild provides detailed and accurate data on urban wildlife populations, allowing users to gain a better understanding of these populations and their interactions with human populations.
- **Increased efficiency for conservation efforts:** By providing detailed insights into the interactions between humans and urban wildlife, UrbanWild can help governments, policymakers, and conservationists target their efforts more effectively, resulting in better outcomes for urban wildlife populations at less cost.
- **Accessible and user-friendly:** UrbanWild is easy to use, with a simple interface and intuitive visualizations of the data.

Sample Use Cases:

- **Wildlife Corridors:** More efficiently determine where to place a wildlife corridor. Streamlining this aspect of the project could save millions of taxpayer funds.
- **Designing and Preserving Greenways:** Determine where a proposed development might significantly impact local animal populations or where existing green space is critical to animal populations, for the purpose of influencing development in those areas.
- **Tolerant Coexistence:** Identify locations where there is a significant overlap between humans and urban wildlife in order to educate/intervene. Ex. determining where locking garbage cans should be deployed, or where/what type of fencing should be used.
- **Population Monitoring:** Identify the presence of new/increased/decreased populations of animals in urban areas.

Users

Personas + Needs

Persona 1: Government agency

- As a state government agency, I want to be able to locate areas best suited for wildlife corridors so I can reduce the number of animals killed on freeways or other roadways.
- As a city government agency, I want to be able to locate areas where urban wildlife and humans are coming into conflict so that I can establish local mitigation efforts to reduce these conflicts.
- As a city government agency, I want to be able to locate urban wildlife populations so that I can ensure critical greenways are created or maintained, free from development.

Persona 2: Private urban development agency

- As a private urban development agency, I want to be able to identify the potential impacts of new developments on local urban wildlife so that I can create developments that have a positive impact on the local wildlife population.

Persona 3: Conservation group

- As a conservation group, I want access to current data about urban wildlife so that I can work with government, development, and research groups to improve the lives of both urban wildlife and people.

Persona 4: Researcher

- As a researcher, I want access to current data about urban wildlife so that I can monitor changes in specific animal populations.

Pain Points

For all personas, the biggest pain point is the current lack of easy access to accurate, robust data without commissioning large, expensive studies.

User Flow A

1. The user opens the UrbanWild application and is presented with the main menu, which allows them to access the different features of the application, including "Search by Animal," "Search by Location," and "Custom Query".
2. The user selects "Search by Animal" and is presented with a list of animals currently in the database, along with additional choices for visualizing the animals, including by location, date range, heatmaps of population density, etc. The user is also prompted for their output preferences (specific types of visualizations, raw data, etc.). These options may vary based on the user's query.
3. After making their choices, the user's query result is delivered to them in the manner they requested. If certain visualizations are chosen, the option to overlay current/historical human development data is presented.

User Flow B

1. After opening the application, the user selects the "Search by Location" feature and is asked for location data. This can be in the form of GPS coordinates, location names, zip codes, with a radius choice in miles/km.
2. The resulting map shows the types of urban wildlife present and their locations, as well as overlays containing data about human development.
3. The user can select specific animals or refine the location to analyze in more detail, and the application displays visualizations and analysis tools to help the user gain insights.
4. The user can download/output the data in the format they desire.

User Flow C

1. After opening the application, the user selects the "Custom Query" feature and is asked for their custom parameters and desired visualization/output formats.
2. The user can then view the results of their query in their desired format.
3. The user can then choose to overlay current/historical human development data.
4. The user can then choose to download or output the data in a format they indicate.

Solutions

MVP Feature Description

UrbanWild will contain the following specific features:

- Query: Search by Animal
- Query: Search by Location
- Query: Custom Query
- Visualization: Ability to visualize data in multiple formats including charts, heatmaps, etc.
- Visualization: Ability to overlay animal data with data from selected human population maps or datasets
- Output: Ability to generate/output data visualizations suitable for digital or print
- Output: Ability to download/export raw data results

Feature Prioritization

MVP features:

1. Ability to query datasets of urban wildlife by animal, by region, or with custom parameters: this is the backbone of the product.
2. Ability to overlay animal data with data from selected human population maps or datasets: This is the next layer of data required to pull insights.
3. Ability to download/export raw data results
4. Ability to generate/output data visualizations suitable for digital or print: This feature requires the raw data feature to be working.

Future features:

1. Predictive analytics: use historical data and ML to predict areas of concern. ML will be used to find historical and current documentation of people/animal conflicts from public news reports and compare that to historical human population information.

Architecture

UrbanWild consists of a combination of machine learning algorithms, data storage and management tools, user interface components, and visualization tools.

MVP Technical Requirements

- Machine learning models trained to accurately identify and count animals in photos and videos.
- Pipelines for importing new data from external sources
- Pipelines for passing data to the model for classification
- Software for data processing/cleaning to prepare data for classification
- A database for urban wildlife population and human population data.
- A mapping/visualization engine to display the data in an intuitive and easy-to-understand format.
- A user interface that allows users to select specific animals or locations to analyze and access the application's analysis and visualization tools.

- A server or cloud infrastructure to host the application and support its machine learning and data management needs.

Implementation

There are several implementation stages for this product.

1. **Data understanding:** initial sources for data will be collected and evaluated.
2. **Data gathering:** the initial dataset for recognizing and counting urban wildlife will need to be gathered, cleaned, and labeled. The dataset will be focused on specific species of animals so that the final model is tuned to specifically recognize urban wildlife examples.
3. **Model training/evaluation:** The initial classification model(s) training will need to be performed. This includes feature selection, algorithm choices, hyperparameter tuning, loss function establishment, use of cross-function validation, and subsequent model evaluation of error rate, bias/variance, fitting, etc. Different models may be employed based on data sources (still images, video, audio).
4. **Initial model deployment and database generation:** The ML model will be deployed and used to generate a database of information about urban wildlife populations. The model and database will be cloud-hosted on Azure.
5. **Data pipeline establishment:** Establishment of ongoing data ingestion, cleaning, and classifying pipeline to ensure up-to-date wildlife population numbers in the database.
6. **Backend development/API integration:** Integration with other external data sources (such as human population data/development data) that will be pulled into the database.
7. **UX/UI development:** The creation of a simple and intuitive interface for using the model, including establishing output visualization options (charts, graphs, heatmaps, etc).

Dependencies

Data Sources:

- Access to images and video from urban public cameras that can track wildlife, such as traffic cameras, surveillance cameras, or Ring. Future improvements could include public sources of audio recordings.
- Access to existing human development data gathered by outside organizations.
- Access to historical databases of urban wildlife data.

Subject Matter Experts:

- UrbanWild will need to engage urban development and conservation researchers who can act as subject matter experts in the selection of features for the ML model and application.

Stakeholders

Investors: Microsoft AI for Earth⁹, U.S. Fish & Wildlife Service (grant), California Department of Fish & Wildlife (grant)

Product Manager: Hollis

Project Manager: Sangita

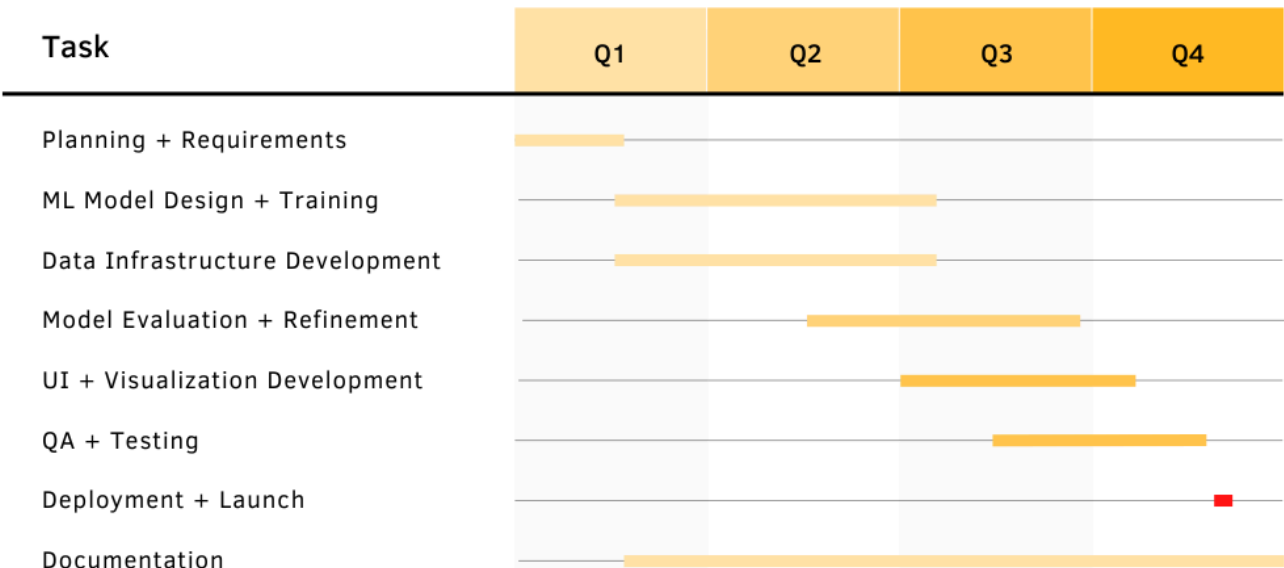
Legal: Lorraine

Partnerships/Outreach Manager: Francis

Marketing/PR: Anthony

⁹ <https://www.microsoft.com/en-us/ai/ai-for-earth>

Roadmap



Success Metrics

Success metrics include:

- Model performance. This can be measured via model accuracy, precision, error rates (AUROC), reliability, ongoing performance monitoring, etc.
- Application performance. This can be measured by benchmarking acceptable speeds for retrieving and displaying data, and then maintaining or improving those benchmarks
- Adoption and usage of the application by conservationists, researchers, and others. This can be measured using the number of users for each group, most likely using Monthly Active Users.
- Usability and user satisfaction with the application. This can be measured through surveys or user testing, where users are asked to evaluate the application's ease of use and overall satisfaction with its features and functionality.
- Impact of the application. This can be measured through feedback from those who use the application, as well as through the collection of data on the success of conservation efforts in areas where the application has been used.

Projected Cost

The projected cost is still being evaluated. Grants and support from external investors are expected to cover most costs.

Caveats/Risks

- As with any ML model drawn on real-time data, constant monitoring for concept or data drift will need to be performed.

Other Areas for Investigation

- Continue searching for additional datasets that enhance the insights drawn from our platform.
- Consider allowing individuals to opt-in their trail cam images or individually gathered data into our dataset.