# All Ears Application Design

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## Motivation

African forest elephants (*Loxodonta cyclotis*) are a threatened subspecies of elephant that inhabit the densely wooded rainforests in west and central Africa. These elephants work as ecosystem engineers to clear small trees, allowing the forests to mature, and ultimately sequester atmospheric carbon. Our sponsors, Dr. Christopher Doughty and Ms. Jenna Keany, are studying how forest elephants affect forest structure, climate, and ecosystem function. The biggest issues that forest elephants face are mass poaching incidents, as well as lack of public awareness.

## Solution Overview

All Ears' ultimate purpose is to design a product that will help to increase funding for non-profit elephant conservation groups. To that effect, our intention is to:

Design and create a web and mobile application that will:

- ❏ **Educate** users on importance of elephant ecology,
- ❏ Allow users to **calculate carbon emission,**
- ❏ Allow users to **donate** to elephant protection organizations to offset carbon emissions,
- ❏ Show users recent statistic on elephant **poaching events, and**
- ❏ Allow administrators to update from the **Monitoring of the Illegal Killing of Elephants (MIKE) database.**

## Architecture

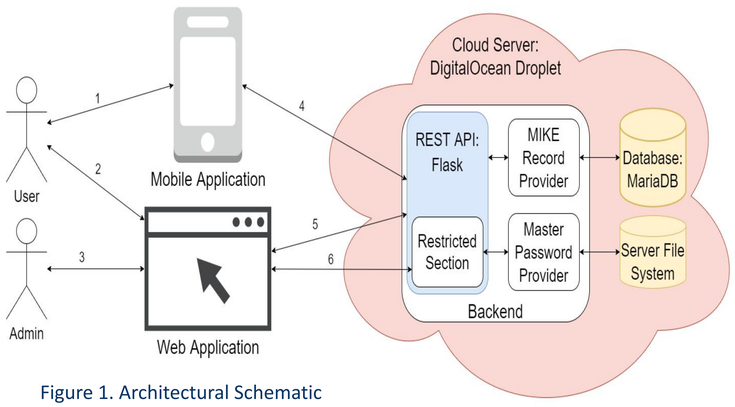


Figure 1. Architectural Schematic

- ❏ Arrows 1 and 2 in the diagram demonstrate a user interacting with the web and mobile application.
- ❏ Arrow 3 demonstrates an admin user logging in to the web-based admin portal.
- ❏ Arrows 4 and 5 demonstrate the mobile and web application communicating with the Flask API getting MIKE record from the MariaDB backend database.
- ❏ Arrow 6 demonstrates the admin accessing the restricted section of the web application which accesses the master password provider from the server file system.

## Key Features

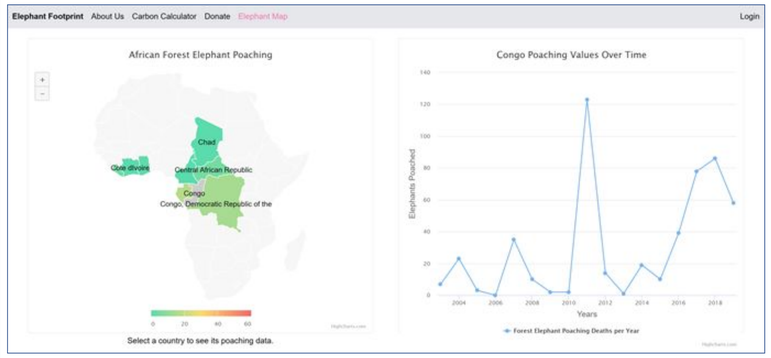


Figure 2. Web Elephant Map (similar map available on mobile application). A map of central Africa with highlighted countries inhabited by forest elephants (Fig 2, left) and information on poaching events and dates that are displayed in a graph (Fig 2, right).

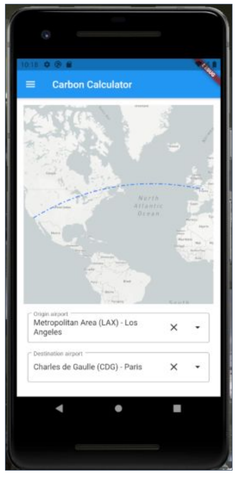


Figure 3. Mobile Carbon Calculator (similar map available on web application). A map with user-selected starting and ending airports that shows the flight path of the most direct route and calculates the carbon emitted by a single passenger during flight using the calculated distance between airports.

| UN Region | UN Subregion | UN Subregion ID | Country | Country Code | MIKE Site | MIKE Site ID | Year |
|---|---|---|---|---|---|---|---|
| Africa | Central Africa | fc | Cameroon | cm | Boumba-Bek | bbk | 2003 |
| Africa | Central Africa | fc | Cameroon | cm | Boumba-Bek | bbk | 2004 |
| Africa | Central Africa | fc | Cameroon | cm | Boumba-Bek | bbk | 2006 |
| Africa | Central Africa | fc | Cameroon | cm | Boumba-Bek | bbk | 2007 |
| Africa | Central Africa | fc | Cameroon | cm | Boumba-Bek | bbk | 2008 |
| Africa | Central Africa | fc | Cameroon | cm | Boumba-Bek | bbk | 2009 |
| Africa | Central Africa | fc | Cameroon | cm | Boumba-Bek | bbk | 2010 |
| Africa | Central Africa | fc | Cameroon | cm | Boumba-Bek | bbk | 2011 |
| Africa | Central Africa | fc | Cameroon | cm | Boumba-Bek | bbk | 2012 |
| Africa | Central Africa | fc | Cameroon | cm | Boumba-Bek | bbk | 2013 |

+ Add Record

Figure 4. Web-only admin accessible features. An administrative login allows access to a backend interface and data administrator alteration, addition, and removal. Includes automatic update tool connected to online MIKE database CSV file download, as well as a drag-and-drop CSV uploader for files not directly affiliated with the main MIKE datasheet.

## Performance

Data accuracy and timing characteristics impact our applications' performance the most.

- ❏ Only appointed administrators are granted data alteration access to decrease potential for introductions of data inaccuracy.
- ❏ High-volume, simultaneous data requests supported to ensure handling of increased application traffic.

## Technologies

| *Requirement* | *Solution* |
|---|---|
| Cross-compatible mobile application | Flutter |
| API for graphical statistics display | Syncfusion, HIGHCHARTS |
| Country selection on elephant map | Syncfusion Leaflet |
| Carbon footprint calculation for flights | Formulas from UK's National Energy Foundation |

## Future Work

- ❏ Expansion of elephant map – countries inhabited by Asiatic elephants and related poaching data.
- ❏ Conversion to French – ease-of-access in countries inhabited by African forest elephants.
- ❏ Carbon Calculator graph – better visual display of carbon emitted versus carbon sequestered by elephants over time.
- ❏ Carbon Calculator flights with multiple stops for more realistic long-distance calculations.

## Conclusion

All Ears has developed a solution using a variety of technologies that is accessible on both mobile devices and web browsers. The solution educates users about the importance of African forest elephants and their situation using data from the MIKE database and recent research from NAU's Megabiota Lab. All Ears' solution also relates the forest elephants' global $CO_2$ footprint to a user's own carbon emissions and gives the user a chance to take action by donating to wildlife conservation organizations.