# UNIVERSIDAD PANAMERICANA

**PROYECTO FINAL**

**AGOSTO - DICIEMBRE DE 2023**

**Procesamiento de Imágenes**

Presenta:


***Alejandra Escallada Martínez***
***Efren Flores Porras***
***Valeria Liv Larumbe Colmenares***


Ante el profesor de asignatura:

**Prof. Miguel Ángel Camargo Rojas**

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**Planification**
The planning phase of this project involved recognizing a specific need and devising a solution for it. We focused on understanding animal vision, acknowledging its significance in helping humans comprehend how animals perceive the world and the consequential impact on their behavior and attitudes.

Having identified this need, we decided to develop a program allowing users to upload an image and choose from various options for various animals' vision.

Next, we focused on delineating the project's objectives and specifying the key features and functionalities of the program. Furthermore, we outlined the necessary resources, establishing a clear timeline for each development phase, while also recognising possible risks (technical, operational, or external) and strategies to mitigate them.

**Definition**
The program will consist of a user-friendly interface featuring an image upload system. Users will have access to a diverse selection of animals for simulation, ensuring a comprehensive analysis and exploration of various visual perspectives. In addition, the program will have a comparison mode, allowing users to examine the differences in vision among unrelated animals and humans.

**Requirements**
To attain the previous, the program must fulfill the following requirements:
- User interface for uploading images.
- List of available animals for selection.
- Image transformation algorithm for each animal.

By addressing these requirements, the proposed program will meet the essential functionalities.

**Design**
The design of the program consists of several key elements:
- Graphical Environment:
    - Using Pygame, we created an engaging environment that integrates distinct sections for default images, user-uploaded images, and a webcam feed.
- Main Menu Navigation:
    - There's a main menu that serves as the user's guide, offering navigation through various of the program's options.
- Image Upload Facilitation:
    - Tkinter is a tool for creating graphical user interfaces that facilitate the image-uploading process, contributing to a more interactive experience.

**Prototype**
For the prototype, we opted for a two-stage approach: a detailed wireframe to map out the user interface and an outline of the image transformation algorithm tailored for each animal.
- Wireframes:

- We opted to create them through text-based descriptions to provide a simplified textual representation of the user interface components.
  - Main menu:

```
----------------------------------------
|       Animal Sight Visualization     |
|                                      |
|              1. Default Images       |
|              2. Upload Image         |
|              3. Webcam Image         |
|              0. Exit                 |
|                                      |
----------------------------------------
```

  - Default images section:

```
----------------------------------------
|            Original Image            |
|   +--------------------------+       |
|   |                          |       |
|   |                          |       |
|   |                          |       |
|   |                          |       |
|   |                          |       |
|   +--------------------------+       |
|                                      |
|           Transformed Image          |
|   +--------------------------+       |
|   |                          |       |
|   |                          |       |
|   |                          |       |
|   |                          |       |
|   |                          |       |
|   +--------------------------+       |
|                                      |
|    Dog   Cat   Bird   Bee   Bat      |
|  Crab  Snake                         |
|           Return to Menu             |
----------------------------------------
```

  - User-upload images section:

```
----------------------------------------
|         Upload Your Image            |
|         [Browse] [Transform]         |
|                                      |
|            Original Image            |
|   +--------------------------+       |
|   |                          |       |
|   |                          |       |
|   |                          |       |
|   |                          |       |
|   |                          |       |
|   +--------------------------+       |
|                                      |
|           Transformed Image          |
|   +--------------------------+       |
|   |                          |       |
|   |                          |       |
|   |                          |       |
|   |                          |       |
|   |                          |       |
|   +--------------------------+       |
|                                      |
|           Return to Menu             |
----------------------------------------
```

- Webcam feed section:

- Image Transformation Algorithms:
  - These algorithms represent simplified models of how different animals see, and they serve as frameworks for the development.
    - Dog sight:
      Dogs have dichromatic vision, meaning they only see in shades of yellow and blue, so the red channel was removed and the green and the blue channels were merged. These two last channels were not modified, they were just kept as the original image.

    - Bees sight:
      It is known that bees have ultraviolet vision, which helps them to detect pollen more easily. Despite not being able to recreate the ultraviolet effect 100% because the channels are modified based on the image's illumination, and it is not possible to detect the natural components of the pollen through the computer, an approximate simulation was made by modifying all three channels of the image; the red channel was more increased, and the blue and green channels were increased in the same proportion.

      Once the channels were modified, they were merged to recreate the ultraviolet effect.

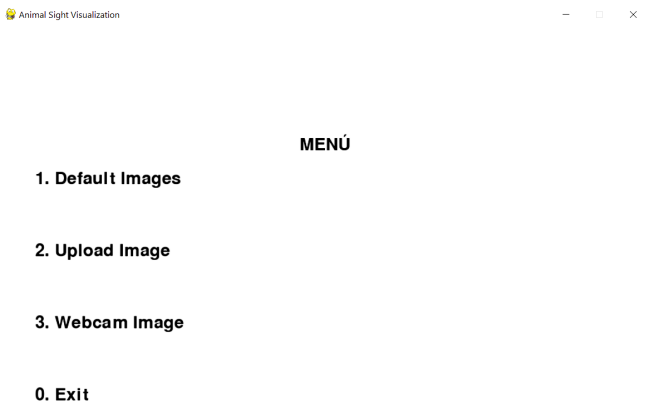
    - Bat sight:
      Despite not having precise information about how exactly the world and what is around us is perceived through echolocation, the vision of bats was represented in such a way the background is black and the outline of the image figure is white.

    - Snake sight:
      Similar to the bee's sight, to create an approximation of infrared vision, all 3 channels of the image were modified. The blue channel was increased to a lesser extent, followed by the green one which was more increased than the blue one, and finally, the red channel, which was increased in a greater proportion than the previous ones.

**Software Development**

1. Create the User Interface:
    a. We employed the wireframes as a blueprint for designing the visual element of the application.
2. Implement Logic:
    a. We developed functionalities that enable users to upload images and algorithms for image transformation based on the selected animals.
    b. We implemented a responsive interface for selecting between different animals.
3. Ensure Correctness:
    a. We implemented data validation and error handling for any data transfer issues, discovered by thorough testing.

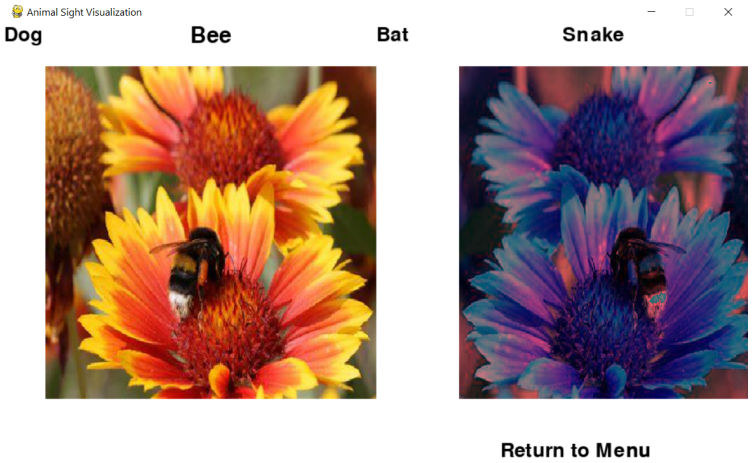
**User's guide**




The main menu includes four primary options: default images, upload images, webcam image, and exit. The default images option allows the user to select from a predetermined library of images, the upload feature allows users to upload their images, and the webcam feature allows users to take pictures.

1. Default Images

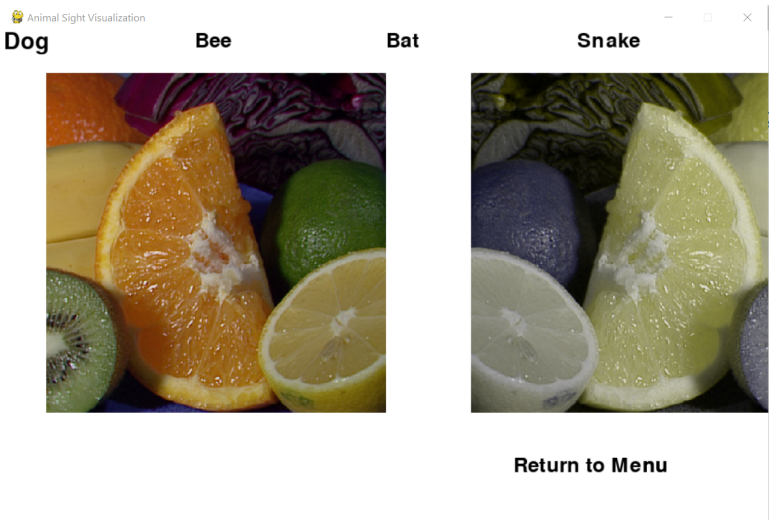
Predetermined image for dog vision.




Predetermined image for bee vision.

Predetermined image for snake vision.

2. Upload images




Uploaded image of fruits in dog vision.

Uploaded image of fruits in bee vision.

Uploaded image of fruits in bat vision.

Uploaded image of fruits in snake vision.

**Testing**

When evaluating our program, we adhere to a three-step approach. Firstly, through unit testing, we meticulously assess the functionality of each component, such as buttons and server processes, to confirm their correct operation. Subsequently, in integration testing, we scrutinize the collaborative functioning of these diverse parts to ensure a seamless and error-free performance. Finally, we conduct a comprehensive trial of the entire program to guarantee user-friendly navigation and overall ease of use.

**Operations and Maintenance**

Following the initial development, the program will undergo continuous operations and maintenance to enhance its capabilities. Routine updates will be implemented to rectify any bugs and introduce innovative features, ensuring a seamless and evolving user experience.

To incorporate additional animals and features into the program, a systematic approach will be adopted. Each animal will be assigned its designated section, promoting an organized structure for seamless integration without disrupting existing functionalities. A collection of images and relevant information for each animal will be compiled to facilitate the integration process. For the introduction of supplementary features, a focus will be placed on ensuring the program's adaptability.

This involves creating well-documented interfaces and application programming interfaces (APIs) to facilitate the straightforward integration of new functionalities, be it advanced image processing algorithms or user interfaces with enhanced interactivity. Regular engagement with user feedback and staying informed about emerging technological trends will guide the inclusion of features that align with user preferences and industry advancements. This practice aims to enable the continuous evolution of the program, offering users a versatile and engaging experience with an expanding array of animal visions and innovative features.