USING ARTIFICIAL INTELLIGENCE TO MONITOR INSECT POPULATIONS DURING A PANDEMIC

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Introduction and Background

- In the last 50 years, it is thought that Insect populations have been reduced by half, and 40% of all insect species could be facing extinction [1].
- Meanwhile, in recent years Artificial Intelligence (AI) has quickly increased in popularity, thanks to increased funding and improved technology.
- Artificial Intelligence is a automatically generated algorithm that is trained to do a specific task that Humans can do. Examples can vary from speech recognition, image recognition and decision making.
- This project looks to see if there is an easy way to monitor insect levels, using AI and image recognition. This is done by measuring insect biomass on vehicles before and after a journey.
- The time frame of interest is during a systemic shock to human activities, such as a pandemic. This can help provide information whether an event such as this affects insect populations, and if so, help formulate ways to protect them.

Summary of Aims:

- Create a program that can quickly count the number of insects in an image/ video.
- Decide on a Region of Interest (ROI) when determining and finding insect impacts
- Ensure false identifications are handled by increasing accuracy and applying filters.
- Justify the use of Artificial Intelligence by comparing it to other methods.
- Create a program that isolates the region of interest
- Research and determine the parameters and metrics of measuring insect populations
- Gather data for a small study to determine the overall effectiveness of the program

Acknowledgments:

I would like to thank Dr Cristiano Palego and his research team for their advice and guidance over this project.

Approach and Results:

- To attempt to identify insect impacts, Matlab was used to determine and highlight small dark circular spots.

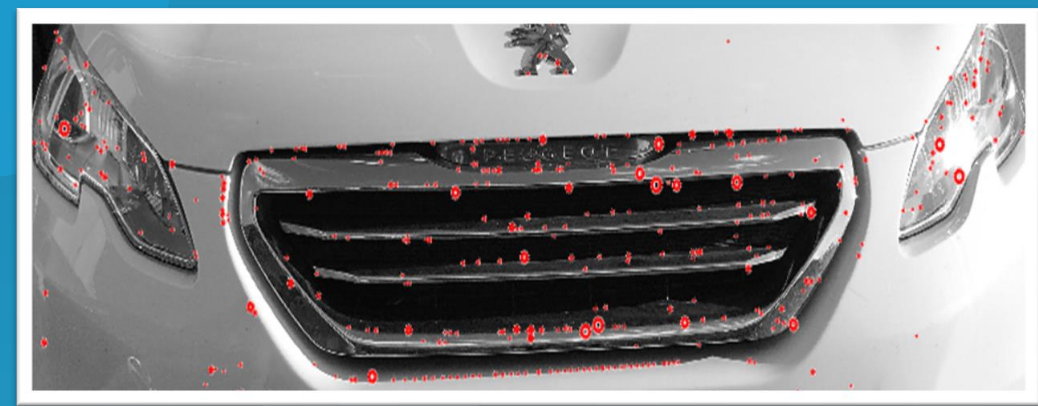

Figure 1: Detecting circles in Matlab

- However, it was found that this approach identified many circles that were not insects. The following filters were applied to help remove false Identifications:
  - Colour range
  - Size of potential impact
  - Comparison to previous picture
  - Close proximity of each other

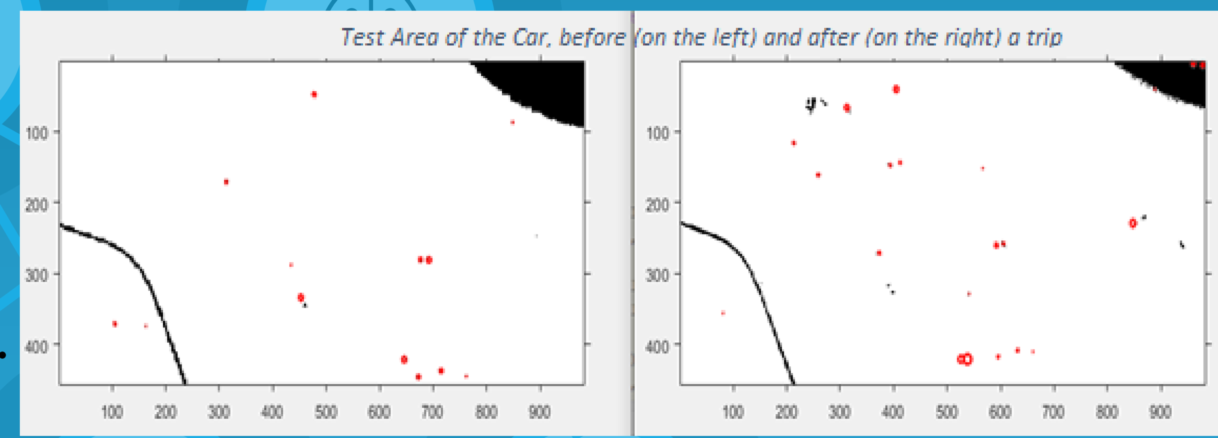

Figure 2: Comparison of the same area of the car before and after a trip

- Due to most cars coming in a variety of shapes, the number plate area was decided as the best area to detect insects.
- After applying these changes, the number of false identifications decreased.

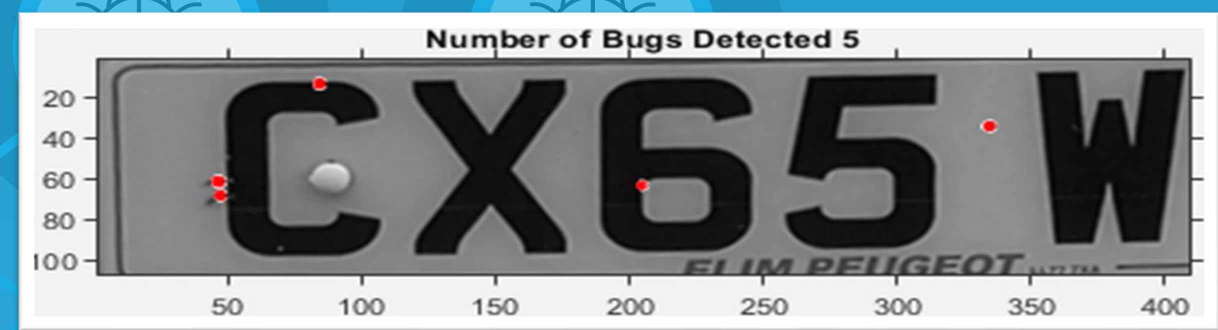

Figure 3: Detecting Insects on a Number Plate

- To measure how well this performed the F1 Measure along with accuracy was recorded.
  - F1 Measure = 75%
  - Precision = 60%
  - Recall = 100%
  - Accuracy = 98.6%
- To ensure the data gathered is validated, the following variants needed to be considered:
  - Size of the Number Plate
  - Time of Year
  - Location
  - Length of the Journey

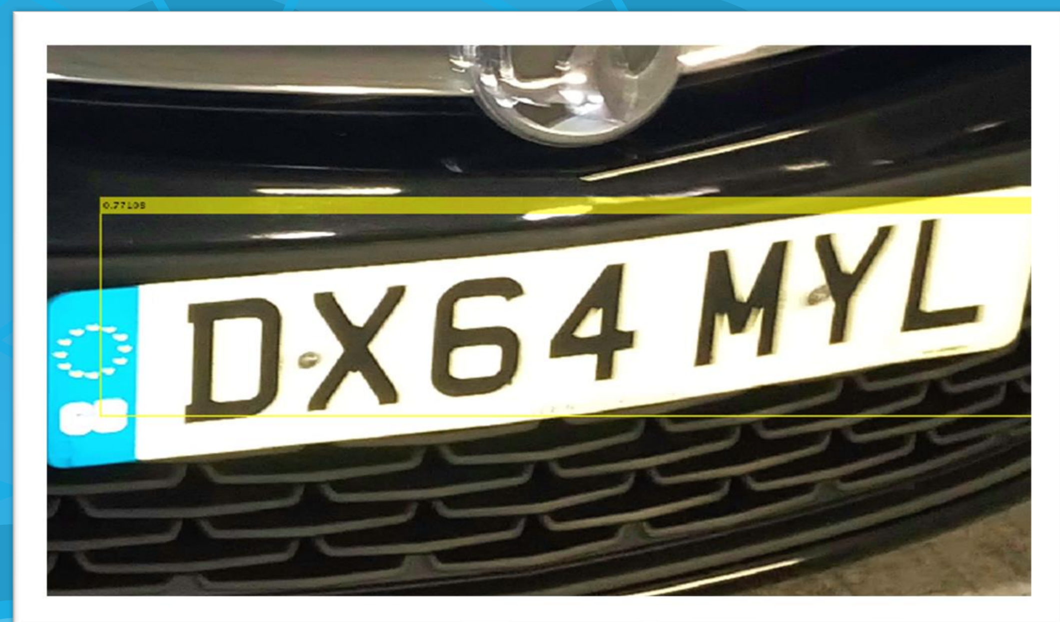

Figure 4: Using YOLOv2 to detect a Number Plate

- The next step was to find and extract the number plate region. To classify the number plate, the object detection Algorithm You Only Look Once (YOLOv2) was used.

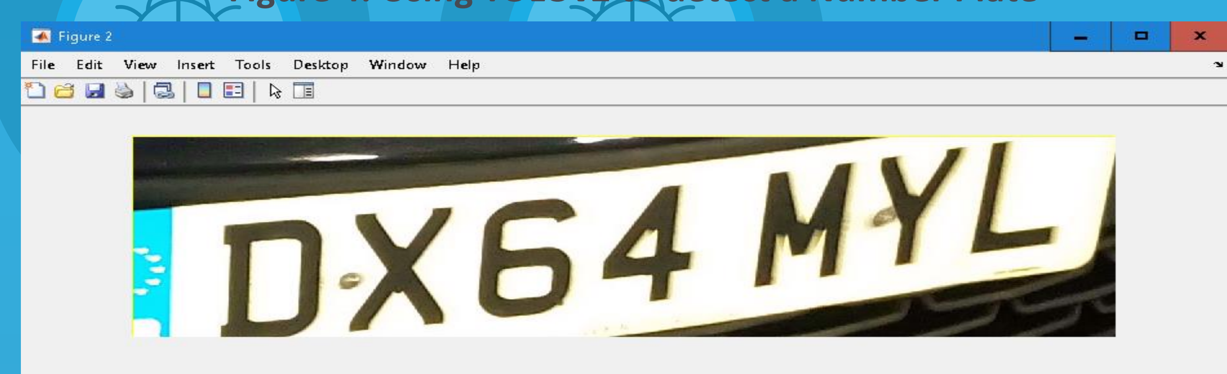

Figure 5: Extracting the Number Plate

- The images used in training and testing the classifier had the following features:
  - Taken in landscape format
  - Images taken in a light environment
  - Images are resized to 1200x900, with an aspect ratio of 4:3
- 100 images were used for training the classifier. In addition to this, augmented data was added, to help improve the overall accuracy. This meant the same images were used, however, they were rotated or had a change in contrast.

Results Continued:

- The last step in creating the program was to test to see how effective the number plate detection software was. To do this the classifier was run against the training data to obtain an average score.

```
AverageScore =
  single
  0.7550
```

- However. this result does not show how well it copes with variance. Therefore, the classifier was then run against testing data.

```
AverageScore =
  single
  0.7624
```

- To obtain an overview of how well the entire program detects insects, a short study will be undertaken. This would involve taking pictures of buses before and after their journey and determining whether the program can count the number of insects.

Conclusions:

By using a mixture of Artificial Intelligence methods and image analysis techniques, it is possible to create a program that can determine and detect insects on a number plate region. However, a number of constraints are present to make sure the accuracy is high.

- The images need to be at least 1200x900 to enable insects to be visible.
- To remove unwanted areas of the car, when isolating the number plate the image must be taken from a straight on angle.
- The images need to be taken during the day in a bright location to again make insects visible.

This could make collecting data on a large scale difficult, due to a need for increased resources and time. Therefore, additional approaches will need to be investigated, such as pose estimation that can straighten the number plate, and object detection to identify insect impacts.

References:

[1] P. D. Goulson, "Somerset Wildlife," [Online]. Available: https://www.somersetwildlife.org/sites/default/files/2019-11/FULL%20AFI%20REPORT%20WEB1_1.pdf.

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