ECE:5550 Internet of Things

The Smart Trail Camera

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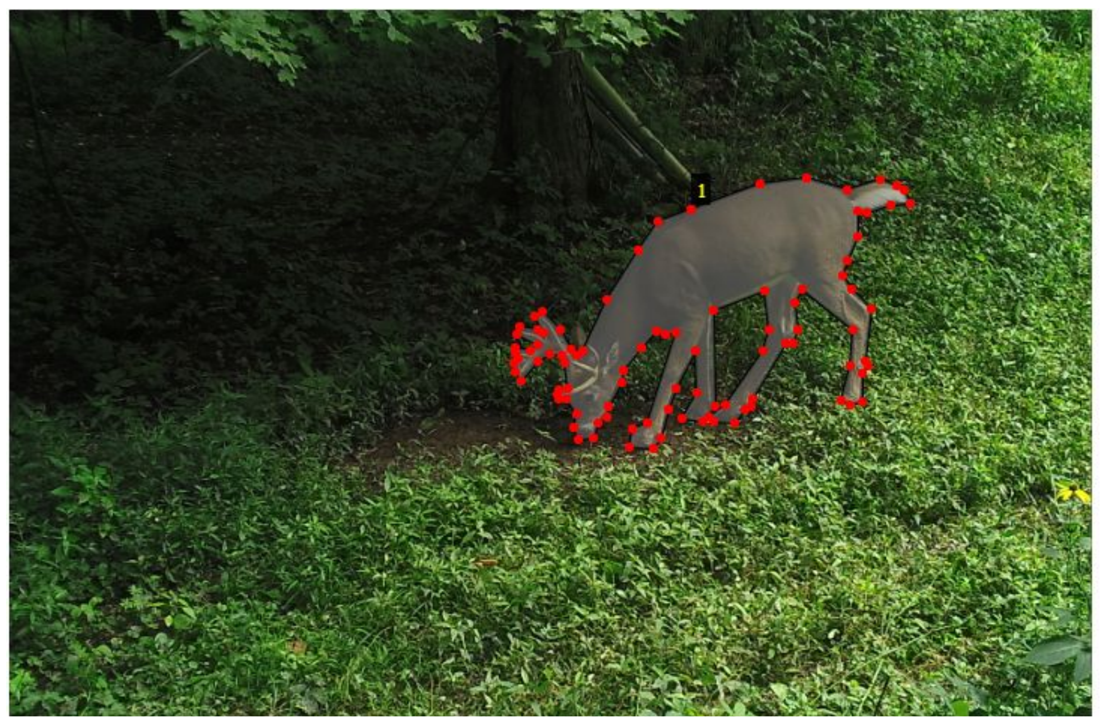
Abstract

Trail cameras are remote, motion-controlled cameras that are often used by hunters and other wildlife enthusiasts to monitor wildlife. The goal of this project is to increase the effectiveness of current trail cameras and to provide a way for wildlife enthusiasts to easily and intuitively analyze the data that their images provide. Our group worked on three fronts to achieve these goals, and this poster explains these fronts and what we were able to produce.

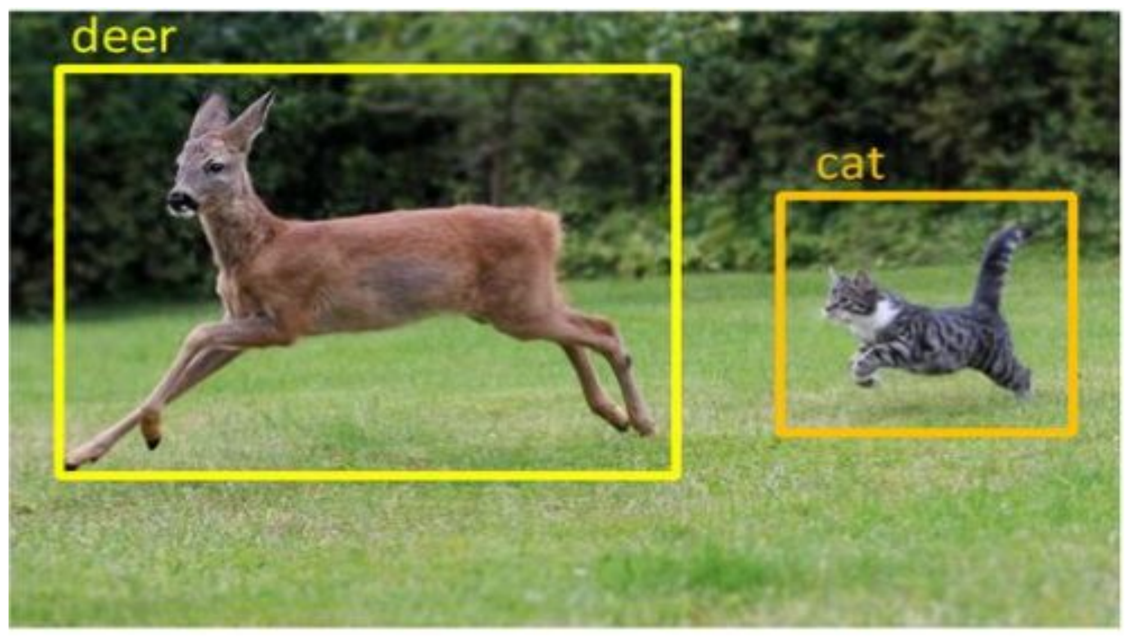
Image Processing

To increase the effectiveness of current trail cameras, we designed a system to recognize whether a picture has a deer in it. Our image processing involves creating training data from the pictures of deer acquired by the trail camera and manually tracing around the deer in each picture with VGG image annotator. This process collects JSON image data on the individual pixels when the Deep learning model is training. This the model then learns that the deer have these types of pixels and compares them to a future image's pixels to know if a deer exists in said picture. Our model used a training sample of 60 images as a starting point.



Object Detection

Object detection will inevitably be seen after our AI model finishes training on the data we gave it by running a detection accuracy program. This object detection will then be tested on a larger amount of images with and without deer and given an accuracy rating based on if it can repeat the name given to the JSON training data, which was just "Deer" for each deer within those 60 training images mentioned above. Because our model is comparing individual pixels, if it finds enough clustered pixels like the ones inside the traced deer, the result on our accuracy check program will then read "Deer", and mark the image with the "Deer" tag.

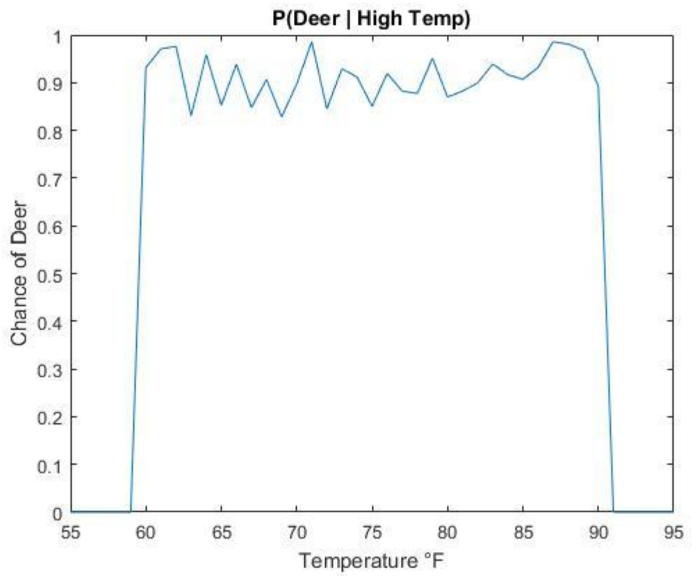


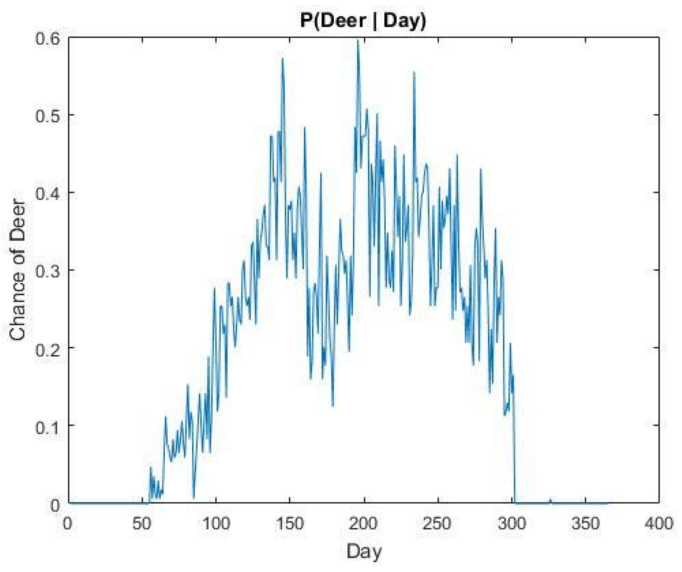
Data Analysis

The pictures coming from trail cameras are great sources of information for their users. Using Bayes Theorem, we can interpret this information to form a model predicting the likelihood of spotting wildlife. The following equation is the basis of our model.

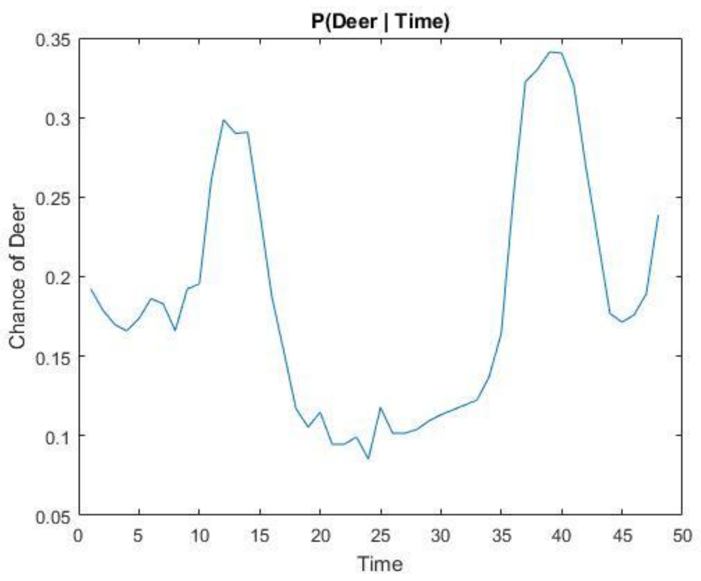
$$P(\text{Deer} \mid \text{Time, Day, Temp}) = \frac{P(\text{Deer}) * P(\text{Time} \mid \text{Deer}) * P(\text{Day} \mid \text{Deer}) * P(\text{Temp} \mid \text{Deer})}{P(\text{Time, Day, Temp})}$$

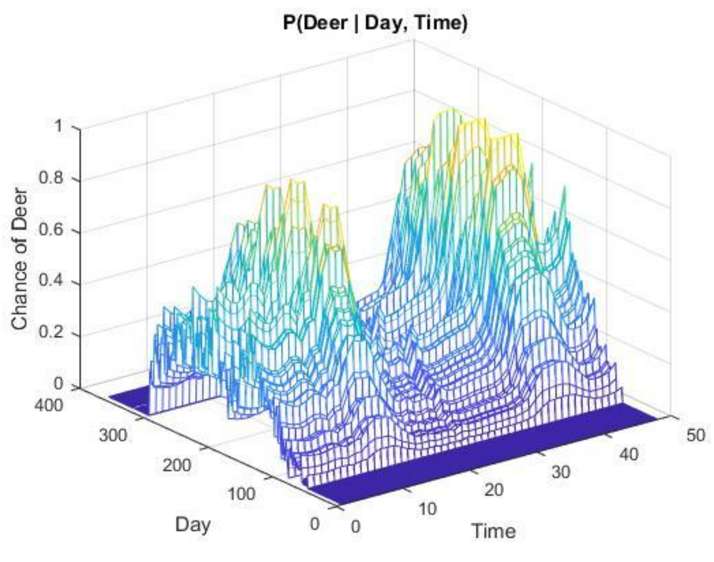
This equation can be used to give us the probability of seeing a deer at a given time, day of the year, and temperature. Before we ran this as a three variable system, we created models using each variable individually. Our first set of results are shown in the graphs below.





As you can see, our model based on temperature doesn't show much correlation to the likelihood of spotting a deer. The day of the year, however, does show at least some correlation. In the middle of the summer the likelihood of seeing a deer is lower than at the season change from spring or to fall. This graph shows a large variance in our data, and we believe that this is due to the size of our data sample. We expect that using a larger data sample would smooth out these sharp spikes.
These final two graphs show a model based solely on the time of day and another with time of day and day of year combined.





We can see a sharp correlation between the chance of seeing a deer and the time of day. Deer are more active during the early morning or late evening, but they are very inactive in the middle of the day. Seeing that we had a strong correlation with time of day and day of year, we decided to run our Bayesian theorem on these two variables. The results are shown in the 3d mesh plot above. We are very confident that this model shows an accurate representation of our when deer are active.

User Interface

A single page web-application created with Vue is included as part of the whole predictive deer-tracking package. This interface serves as a means to communicate the predictive results calculated with the Bayesian model to the user. A standalone feature is also included: anyone navigating the application can choose to enter in their pictures along with the Zip Code of where the pictures were taken. Under the hood, each image will be parsed for it's date. For each image, an API call to the NOAA web service is made to gather the associated average temperature on the day that image was taken. This data is then used to create the Bayesian model.

Future implementation will include a better graphical representation displayed to the user, as well as the ability to login and host images.

Conclusion

In the end, we were able to create a user interface to allow users to conveniently access their data as well as upload new images. Using the uploaded images, we can create an accurate model to predict the user's chances of seeing a deer. Although we did make progress towards recognizing images of deer, our detection model is still being created, so we can't account for its validity. That being said, we are proud of what we were able to accomplish and believe that we succeeded in enhancing and expanding upon the usefulness of trail cameras.

Acknowledgements

A special thanks goes out to our friend Steve Samec. Steve supplied our group with over 80,000 wildlife photos that we used throughout this project.
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