Flower Recognition Program

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Westerns Governors University – Computer Science Capstone

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Letter of Transmittal

Dear Executive Director of Horticulture and Executive Director of Public Relations,

[redacted] in [redacted] have world-renown botanical gardens and atrium. Both have over 3 million visitors yearly. The atrium boasted a stunning 50,000 to 100,000 flowers ranging around 5 to 50 different types of flowers at a given time. Botanical gardens and atrium layout and theme can change up to 7 times a year. An overwhelming amount of the casino guests has asked a question to the type of flowers that are on the casino property. With no dedicated employee with knowledge of the flowers on site after the installation of the Ikebana (arranging of flowers). The guests have turned to the hotel and casino staff to ask their questions. As one can imagine not all the staff are knowledgeable of the Ikebana installments. There were thoughts of placing signs to show the guests of the type of flower they are looking at but there were concerns that the signs would obscure the flowers and take away from the natural beauty. Also, due to the installments being changed regularly new signs would have to be made creating a recurring cost. Which is why we should be looking into an advanced technological solution.

The proposed solution is to create software that can be used on a series of interactive kiosks. The software would be able to receive an image or images from the guest and tell the guest what kind of flower is in the image. This can be accomplished by using machine learning. By using machine learning a program can be trained to be able to take in an image of a flower and with high accuracy output the type of flower that is in the image. This software will be placed within a very easy and intuitive interactive program. This program with a simple user interface will be able to connect to the user device. The program will give the user the ability to select an image. The image will show on the user interface. When the image is loaded into the program the program will make a prediction of what type of flower is in the image. This program would be called the Flower Recognition Program. The data (flower images) that will train the machine learning algorithm will intentionally come from the free data site Kaggle.com. This data set will consist of 5 flower types. After the program is in place the machine learning algorithm will continue to learn from a web scrapper of future flowers that will be used in the botanical gardens and atrium. These images that guests use will also be used to help improve the

accuracy of the machine learning algorithm. The casino's security cameras will also be used to gather more images to train the algorithm. This solution will solve several if not all the concerns of the guests and hotel and casino management.

One of the top priorities of a hotel and casino is to create the greatest possible experience for the guests. Currently, the casino has guests that want to know more about the floral art installments. Due to the unanswered questions and no effective way to answer those questions the casino is not giving the best experience. The Flower Recognition Program would be the solution to create the best experience for the guests. This technological solution will not only benefit the guest but will also the casino and hotel. This will solve the issues by placing signs that might obstruct the view of the flowers. This will be accomplished by placing the kiosks at the entrances and/or exits of the botanical gardens and atrium. This will also have a very minimal recurring cost and would save much more than the cost of placing signs to identify the flowers. Also, this solution will limit the number of guests asking hotel and casino employees questions about the flowers. This will improve the overall productivity of the employees by keeping them focused on their duties.

After looking into several methodologies to see which one would be best suited to this project the waterfall methodology was chosen. Because this project has well-defined goals and well-defined requirements before the project will start. This project will be created by a minimal team. The steps of the development cycle with being linear. Also, the project should not have any major changes in requirements or goals. Due to this understanding, the waterfall method would be the best suit for this project.

The budget for this program will be minimal. The software using will be made in house and any 3rd parties' libraries open-source with no constriction on commercial use. For the most part, the only major cost will be the initial cost for the kiosks. The kiosks should cost about $200 to $300 per machine. The project would like to start out with 5 kiosks. A total of $1,000 to $1,500 for the kiosks. One of the kiosks' computers should have a graphics card. This will significantly cut down on the time to train the algorithm. The graphics card will cost around $650 to $1,000. This will bring the total initial cost of the project to be around $1,650 to $2,500.

This project does not have any obvious negative impact. This project will create greater guest satisfaction. Solve the issue placing signs to describe the types of flower displayed and the theorized recurring cost associated with the signs. Employees will be able to be more productive due to have fewer questions asked of them about the flowers. The technology can also have the added benefit to bringing more guests to the hotel and casino causing them to partake in the casino attractions increasing profits. This project can also increase the social media impact in a positive way. The guests will likely post the pictures of the flowers on to various social media platforms increasing the casino's internet impact.

The ethical and legal ramifications are negligible. This program does not use and sensitive data or collect any data from the user in the long term. The initial data to initially train the algorithm is free to use. The images that the guests give the program to identify the type of flower is stored temporally. The images are used to improve the algorithm. After the algorithm is trained with the images the images are deleted from the hard drives. Making the images the sole property of the guest.

My experience to help guide this program to succeed come in education. I have an AAS in Computing and information technology with an emphasis on software programming. This with help in the development of the UI and logical of the program. I also have an AS, in biology, this should help to identify the important feature of the flowers in order to train the machine learning algorithm.

Thank you for your time,

Eli Armstrong

Executive Summary

Opportunity statement

The guests of our world-class casino and hotel have an increasing interest in the flower display for our guest enjoyment. The guests want to know the types of flowers that are in the botanical gardens and atrium. Currently, there is no practical application to answer these questions. Due to the casino and hotel not being able to answer these questions, the guests are not the best possible experience. There have been talks of a few whys to solve the problem. There were talks of placing signs to described the flowers, but this seemed to be impractical. One reason this is impractical is because of the sheer number of types of flowers that some of the displays contain. The signs can obscure the displays. Another reason is due to the frequent changes in the displays. Due to the flowers being changed out regularly new signs will have to be made creating a recurring cost. A technological solution was proposed to answer the guest's questions and make it so no signs will need to identify the flowers. This technological solution would be a program with a graphical user interface (GUI) that would be able to receive a picture for the user (casino guest) and tell the user what type of flower is in the picture.

Customer needs

The guests (customers) have questions about the types of flowers that are currently in the botanical gardens and atrium. They have tried to ask the staff of the casino and hotel but the staff is not very knowledgeable in botany and usually unable to answer the question. In order to address this concern and give the guest the best experience possible a GUI program should be made to solve this problem. This simple and intuitive GUI application would be housed in a kiosk with a touch screen and will have wires to connect to the guest's device (such as a phone or camera) and the user can select an image from there device. The GUI program will then use a machine learning algorithm that was trained with thousands of images of

flowers to predict the type of flower the user has presented. This will provide a fun and interactive way for the customer to get their questions answered to what type of flowers are in the botanical gardens and atrium.

Current or Existing Systems

Currently, there are no systems in place to help the guests get their questions about the flowers answered. Occasionally there will be a gardener tending to the flowers that would be able to answer some guest questions. The gardener is only on the ground every couple of days and only for a few hours. This is obviously not enough time to satisfy the guests' demands. Especially with a business that operates 24 hours a day.

Data

To start out training the machine learning model need to predict the type of flower. Data set of images from Kaggle.com (The data can be download[redacted]). These images comprise 4,242 images. The images consist of images of daisies, roses, sunflowers, tulips, and dandelions. The Executive Director of Horticulture has agreed to uses these types of flowers for the November-December installation. Their team is excited about the challenge. It will be a summer theme in the winter. In the collection of 4,242 images, 769 are daisies, 1055 are dandelions, 784 are roses, 734 are sunflowers, and 984 of the images are tulips. 200 hundred of each type of flower will be removed from the collection and used to test the flower image prediction algorithm. This is how the program will gauge its accuracy. For future installment of flowers, wee will use the casino's ultra-high definition security cameras to cotinine to train the flower image prediction algorithm. The casino's cameras will be able to take several thousand photos from multiple different angles. These images will provide more than adequate data to continue training and test the algorithm.

Methodologies of the project

The waterfall method would be well suited to this project. Due to this project consisting of only one person. The other reason the waterfall method would be well suited is due to how the goals and requirements of the project are known and have a high likelihood of not changing in the future of the initial launch of the project. This method was also chosen to keep a constant timeline. Because the goal of the project is well defined there should be no need to repeat any of the six steps of the waterfall methodology. After the project is complete and is in the maintenance step another methodology may be considered to improve the program or add features to enhance the user experience even more.

Deliverables

The Deliverables will include source code for the training models and the GUI/prediction program. The program will be compiled into an executable for a simple startup process that virtually anyone will be able to get up and running such a casino staff. The GUI/prediction program will be a stand-alone that will not need to be connected to any outside sources such as the internet. The computers running the program can use the casino's intranet to simplify and monitor the computers but these should not be necessary if this feature is wanted. Other deliverables will be the training model file(s) and any other files necessary for the program to work properly. Unlike other machine learning-based projects this program will not have any need for programs the clean the data prior to utilizing the data. The image data should be unchanged before the machine learning algorithm is used. This is due to the fact the user images are not clean when fed to the program.

Plan for implementation and anticipated outcomes

Step one: will be to find images of flowers. There will need to be a least 500 images of each type of flower for training proposes. There will need to be at least 200 more images of each flower type to test the image recognition program for accuracy. The images will need to be of several different angles and positions of the flowers. This will help is getting the best possible accuracy of the program.

Step two: will be researching the technologies to train and implement a machine learning algorithm. This algorithm will need to be able to handle processing images. There are a few image recognition algorithms. So, multiple algorithms will be tested to find one that is most suited for the recognition of flowers. Image machine learning algorithms can take millions of parameters into consideration so well accomplished algorithms will be constered first.

Step three: will be to take into consideration the parameters of each algorithm and find witch parameters are not needed to and to find which parameters are more important when identifying flower types.

Step four: will be to train each of the algorithms with the 4,242 images. Then evaluate their accuracy based on the test images.

Step five: will be to manually test each algorithm manually with a set of images that will test the algorithm for the typical cases of images to expect and some outliers.

Step six: will be to choose one of the tested algorithms. This will be designed from the results of step four.

Step seven: will be to develop a GUI application the is simple and easy to use. The GUI will be minimal that will keep navigation simple to avoid any unnecessary confusion.

Step eight: will be to load the program into the computers (kiosks) that the guest will have access to.

Step nine: with be to see how the users of the program interact with the program and make adjustments as needed.

The anticipated outcomes will be to create an intuitive GUI application that uses an image recognition algorithm. The program will need to be able to correctly identify the flower types to an acceptable margin (at least 80% or greater).

Validating and verifying the Program

The validating process will be simple. During the training of the data (images) goes through several epochs (recurring training phases) when the chosen algorithm has completed an epoch a model is created. The model is tested against 1000 images (200 images of each flower type). A percentage is given to how correct the model was at guessing correctly. The model is then reused for the next epoch to try to get a better percentage. This with some manual tests of the image chosen at random from the internet to get a more human insight to the accuracy of the program. will be how the program is validated and verified.

The development environment and costs

The project has very little cost. The software used to create the program will have no associated cost. The real coast will come from the hardware needed and the cost of labor from the program/designer which is already a salaried employee. The environment with the standard tools provided with python (3.6) such as IDEL. The GUI design will most likely be made in PyQt5. Both of these base applications are free of charge. Any third parties libraries that may be utilized will also be free of charge. The data set is also free from Kaggle and the images are no longer need once the model is trained. The real costs are kiosks (computers) and one graphics card to train the models. This will be a standalone program and will not need any web hosting or additional recurring costs. The cost break-down is provided below.

Item	**Cost per unit**	Total
kiosks (computers)	200 to 300 dollars	5 units would cost: $1,000 to $1,500
the graphics processing unit (GPU)	650 to 1,000 dollars	Only one would be needed: $650 to $1,000
Programmer/Designer	5,000 per month	Project is expected to take 2 months: $10,000
		Grand total: $11,650 to $12,500

With the Programmer/Designer witch is a salaried employee to cost that would need to be budgeted will be around $1,650 to $2,500.

Timeline

For this project, a timeline of two months is allocated to the starting November 1st, 2019 and ending December 1st, 2019. A break-down of the weeks is listed below.

10/1/2019 to 10/8/2019:

The requirements of the project and the goals are discussed with stakeholders to get a clear idea of what the project should accomplish. The budget should be approved and the project greenlit. At this time the computers will also be bought that will be running the program and train the models.

10/9/2019 to 10/23/2019:

Data collection will be again finding a dataset with a flower to train a flower image prediction algorithm. Also, during this time research on machine learning technologies will be conducted. Leaning and following tutorials in creating an image processing and prediction algorithm will be within this phase of the deployment phase. No dependencies are needed.

10/24/2019 to 11/8/2019

Within these two weeks, several flower image prediction algorithms will be trained and tested to find the best fit when it comes to identifying the flowers. Several factors will be looked into such as the speed the algorithm predicts, the time it takes to train the algorithm, and the accuracy of each algorithm.

11/9/2019 to 11/17/2019

An algorithm will be chosen and the GUI program will be developed around it. The GUI will be easy to use and will accept images from the user of the program. The GUI/prediction program will be a stand-alone executable.

11/18/2019 to 12/1/2019

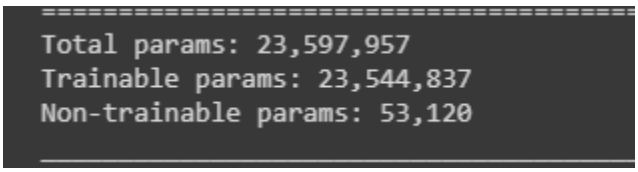
Final testing on the program will be conducted. The program will be loaded into computers and test for any abnormalities. The computers will be set up at the entrances and exits of the atrium for the guests to enjoy on 12/1/2019.

Design and Development

Descriptive methods

There is a multitude of descriptive methods that are used on the images. Due to the nature of machine learning algorithms, we are not able to just program parameters of images specifically tailored to flower images. That would defeat the purpose of the machine trying to learn. One of the core principals of machine learning is to have the computer try to figure out what constitutes a flower and the flower type. That being said when it comes to creating a machine learning algorithm there can be anywhere from hundreds of thousands to ten's of million parameters to be considered when training an image recognition algorithm. Because of this multiple descriptive methods are factors to see which generalized image parameters are not needed such regression and other descriptive methods. Some are multialgorithmic classifiers that are used for image data. The descriptive method regression is to find if there is a correlation to a group of parameters to a correct response. During the training, four image recognition algorithms were taken into consideration. The four algorithms where ResNet, InceptionV3, DenseNet, and SqueezeNet. Each algorithm had its own set of parameters that are used to create its model.

ResNet uses a total of 23,597,957 parameters after using several descriptive methods to find which parameters were of not useful 53,120 parameters where find to be not useful when identifying flowers in images. Below is the output of the ResNet parameter testing.



SqueezeNet uses a total of 725,061 parameters after using several descriptive methods it was noted that all the parameters whereof some significance. Below is the output of the SqueezeNet parameter testing.

```
Total params: 725,061
Trainable params: 725,061
Non-trainable params: 0
```

DenseNet uses a total of 7,042,629 parameters after using several descriptive methods to find which parameters were of not useful 83,648 parameters where find to be not useful when identifying flowers in images. Below is the output of the DenseNet parameter testing.

```
Total params: 7,042,629
Trainable params: 6,958,981
Non-trainable params: 83,648
```

The last image machine learning algorithm used was Inception version 3. As you can see this algorithm uses 21,813,029 parameters and it was found that 34,432 were of no consequence to the recognition of the flower images.

```
Total params: 21,813,029
Trainable params: 21,778,597
Non-trainable params: 34,432
```

Non-descriptive method

The non-descriptive method use four image recognition algorithms above all use some type of neural network. Neural networks have been the leading technology in image recognition machine learning software. The Neural network algorithms chosen for this project are the leading lightweight open source algorithms. 20 million parameter does not seem very lightweight but there are some with over 60 million parameters. Neural networks have the ability to take in several parameters and based on their model are able to output a response. Which makes it perfect for flower recognition.

Dataset

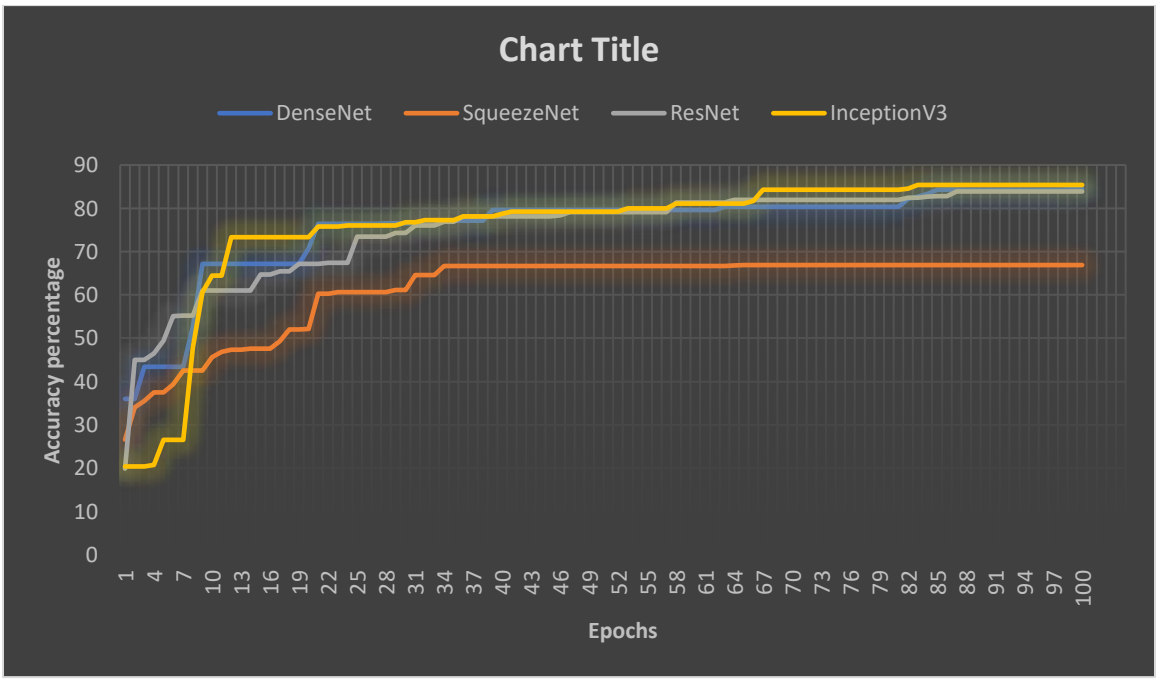
The data set used to start the initial train of the flower image recognition models was from Kaggle.com (You can download the dataset [redacted]). This data set has 4,242 images. In the dataset of images, there are 769 are daisies, 1055 are dandelions, 784 are roses, 734 are sunflowers, and 984 of the images are tulips. These images will be used to create the initial models for the flower image recognition program. Later as new flower installations are placed the casino's security cameras will be used to update the model with the new flowers in the displays.

Decision and support

Each algorithm was trained put through 200 epochs. It took a GeForce GTX 970 for about 3.5 hours to train each algorithm's model. About 14 hours total to make a model from each algorithm. All the algorithms were able to find their highest accuracy model before 100 epochs. Each of the algorithms was tested by 1,000 images during each epoch to determine accuracy. InceptionV3 had the highest accuracy of all the algorithms at 85.4% at epoch 83.

DenseNet had an accuracy of 84.5% at epoch 99. ResNet had an accuracy of 84.0% at epoch 87. SqueezeNet had the lowerest accuracy at 66.9% at epoch 65.

The Chart Below shows the accuracy of each algorithm after each epoch. Only improvements are shown. After some epochs, the accuracy would go down.



After the models from the algorithms were trained manual testing was conducted. This was the final step in choosing the algorithm that would be used for the final program.

The images of flowers are listed below were randomly selected from google images for test proposes. The results from testing the image from each algorithm are listed below the image.

Dense - Prediction: daisy, Probability: 100.0

Squeeze - Prediction: daisy, Probability: 99.98050332069397

Inception - Prediction: daisy, Probability: 100.0

ResNet - Prediction: daisy, Probability: 99.99958276748657

Dense - Prediction: dandelion, Probability: 99.99595880508423

Squeeze - Prediction: dandelion, Probability: 99.96079802513123

Inception - Prediction: dandelion, Probability: 99.99998807907104

ResNet - Prediction: dandelion, Probability: 99.99997615814209

Dense - Prediction: tulip, Probability: 99.99420642852783

Squeeze - Prediction: tulip, Probability: 80.21308183670044

Inception - Prediction: tulip, Probability: 99.61130619049072

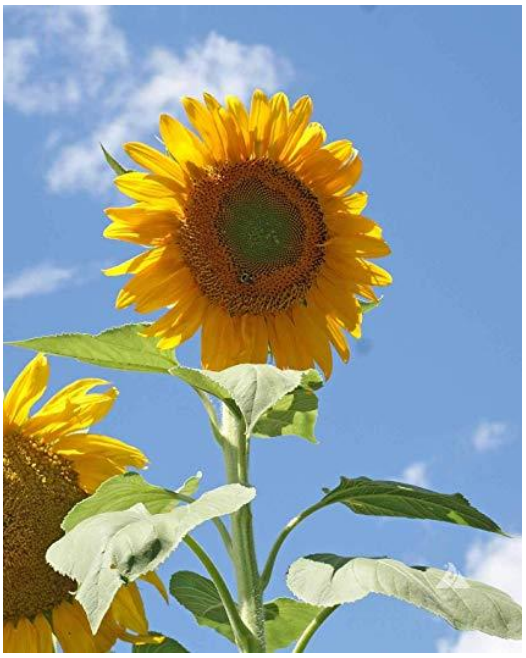
ResNet - Prediction: tulip, Probability: 99.99642372131348

Dense - Prediction: dandelion, Probability: 99.99984502792358

Squeeze - Prediction: dandelion, Probability: 99.99473094940186

Inception - Prediction: dandelion, Probability: 99.9998927116394

ResNet - Prediction: dandelion, Probability: 100.0



Dense - Prediction: sunflower, Probability: 100.0

Squeeze - Prediction: sunflower, Probability: 99.99635219573975

Inception - Prediction: sunflower, Probability: 100.0

ResNet - Prediction: sunflower, Probability: 100.0

Dense - Prediction: tulip, Probability: 99.99988079071045

Squeeze - Prediction: tulip, Probability: 99.17885661125183

Inception - Prediction: tulip, Probability: 99.99995231628418

ResNet - Prediction: tulip, Probability: 99.9991774559021

The example images above were to show typical cases. All the algorithms were able to correct most of the time with around 99% confidence score (Probability). One image was supposed to be a typical case of a rose with a pink background (seen below), but it seemed to trip up some of the algorithms.

Dense - Prediction: rose, Probability: 96.88228368759155

Squeeze - Prediction: tulip, Probability: 99.9996542930603

Inception - Prediction: tulip, Probability: 99.52229857444763

ResNet - Prediction: rose, Probability: 75.90500116348267

As you can see the only two of the algorithms guessed correctly DenseNet and ResNet. The other two guess wrong with high certainty that the flower was a tulip. Which placed the InceptionV3 and SqueezeNet out of the running. Two more images were tested and were to be treated as edge case images. One was an image full of roses and the other contented roses with another type of flower not trained into the model. These images are seen below.

Dense - Prediction: rose, Probability: 99.43245053291321

Squeeze - Prediction: tulip, Probability: 99.99117851257324

Inception - Prediction: tulip, Probability: 46.61778211593628

ResNet - Prediction: rose, Probability: 94.50526833534241

Dense - Prediction: rose, Probability: 99.82319474220276

Squeeze - Prediction: rose, Probability: 99.50475692749023

Inception - Prediction: rose, Probability: 99.36767220497131

ResNet - Prediction: tulip, Probability: 83.49438309669495

The image with the image full of rose you can see that SqeezeNet and InceptionV3 both were not able to guess the image correctly. DenseNet and Resnet were both able to guess correctly. The second image (image with two types of flowers) ResNet guessed the image was a tulip. Due to DenseNet's algorithm seemingly being well suited to the recognition of flower it was chosen for the program's machine learning algorithm. The algorithm is not perfect but even when given an image of this it does not have a high confidence score such a the rose below. It was still able to guess correctly.

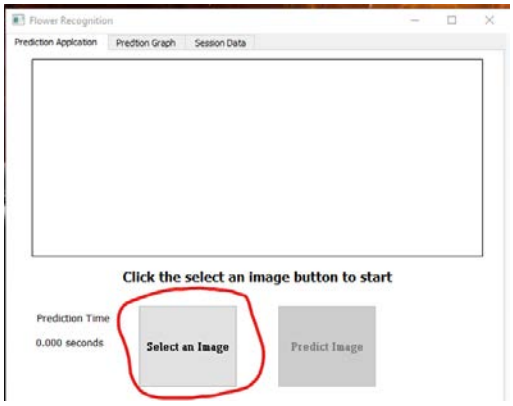
Dense - Prediction: rose, Probability: 64.94231820106506

Data exploration, cleaning, inspection, and wrangling data

The Data is of raw jpg, jpeg, and png image files. Data exploration is just finding images that fit the type of flower that is going to be in the botanical gardens and atrium. There are serval million factors that go into how a computer sees an image and how it figures out what is in the image. To display those factors word take a graph that would be incomprehensible for humans. Plus when it comes to Neural networks such as this flower image recognition program a lot of the learning is thought of as a “Black box”. The connections that are made would be like trying to trace recursion one million levels deep. This makes it very hard to show meaningful visualizations that are human-understandable when it comes to image recognition. There is no need to clean or format the data on data. The program will take in the image as is and give its best guess using the 7,042,629 parameters. The initial data set was from Kaggle (You can download the dataset[redacted]) for future datasets the casino's cameras will be used to capture image data of flower to re-train the model.

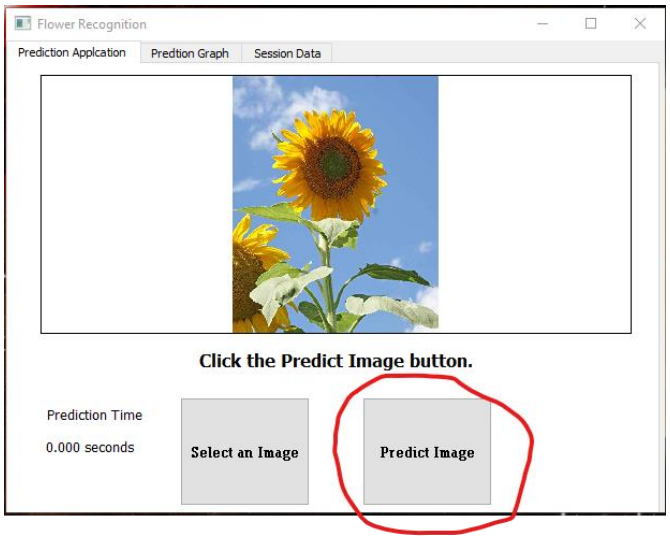
Interactive queries

Users are able to click a button that opens a file explorer (The select image button).

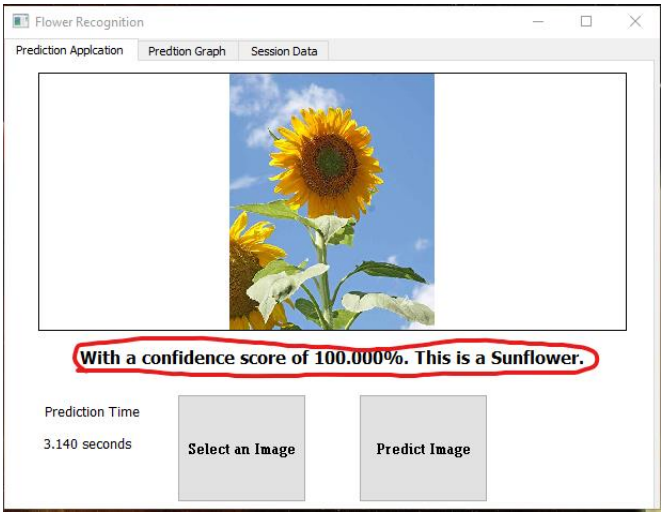


This file explorer only sees image files and folders (here we select the sunflower).

This image is placed on the GUI and the predict image button is now enabled and able to be pressed.



Once click the flower recognition program using the model created from the DenseNet algorithm is used to make a prediction. The user is shown the confidence score and the guess of the type of flower that is in the image.



Machine learning methods and algorithms

As stated in other sections the program uses a neural network for the predictions. The simplified propose of a neural network is to find patterns. The machine learning algorithm used for the program has also been stated. It the DenseNet algorithm. It a type of convolutional neural network (CNN). CNN's are used primarily for visual image data. DenseNet is short for densely connected convolutional networks. What is different from this DenseNet and other CNN is that it makes shorter connections between its layers. By doing this it is able to reduce some redundant connections (Ruiz, 2018). This makes it so that fewer parameters are needed. We can see this when we compare the ResNet parameters (23,597,957) compared to the DenseNet parameters (7,042,629). The DenseNet model is able to be continued to be trained with more images of flower and with a greater number type for future application of the program.

Accuracy of the program

During the training of the flower image recognition program to create a model the algorithm is continuously checking its accuracy. Of the 4,242 images used to train the model 200 images of images were taken out from the 4,242 and used to test for the accuracy of the model. During the training of the DenseNet algorithm, the model it produced was 84.4792% accurate. An in manual testing of 10) images (shown in the decision and support section the DenseNet algorithm was 100% accurate.

Security features

The program is simple and did not need too many security features. The main security feature of the program is the file explorer. The file explorer opens up and filters out any files that are not png, jpg, jpeg, or folders. This prevents the user from seeing any other file types on the computer. Another security feature is that the program does not need to connect to the internet or any outside resources. This prevents any bad actors from trying to get into the casino intranet systems. The OS will be handling most of the security. The user account on the OS will be basically only allowed to run the program and the file explorer.

Monitor and Maintenance

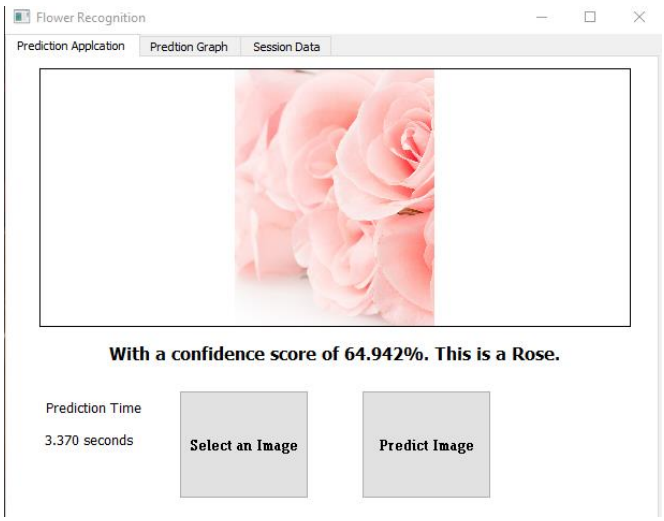
At the end of every user session, a log file is created if it does not already exist or is appended too. This log file shows session data for when the program was up. The log file has the date and time the session ended, how many predictions were made during the session, and of the predictions made were the flower types that were guessed. This will help us understand what flowers the users are most curious about. Maintenance is done after the removal of one flower display and before the next flower installation. During this time new flower images are

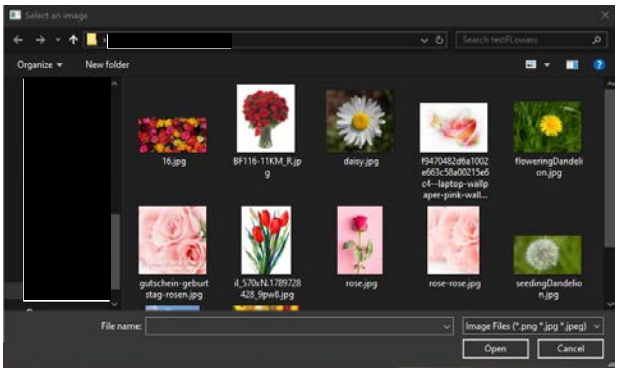
taken and the model retrained with the images. Then tested by the algorithm and manual testing with a small test group of images just like the initial training test.

Dashboard

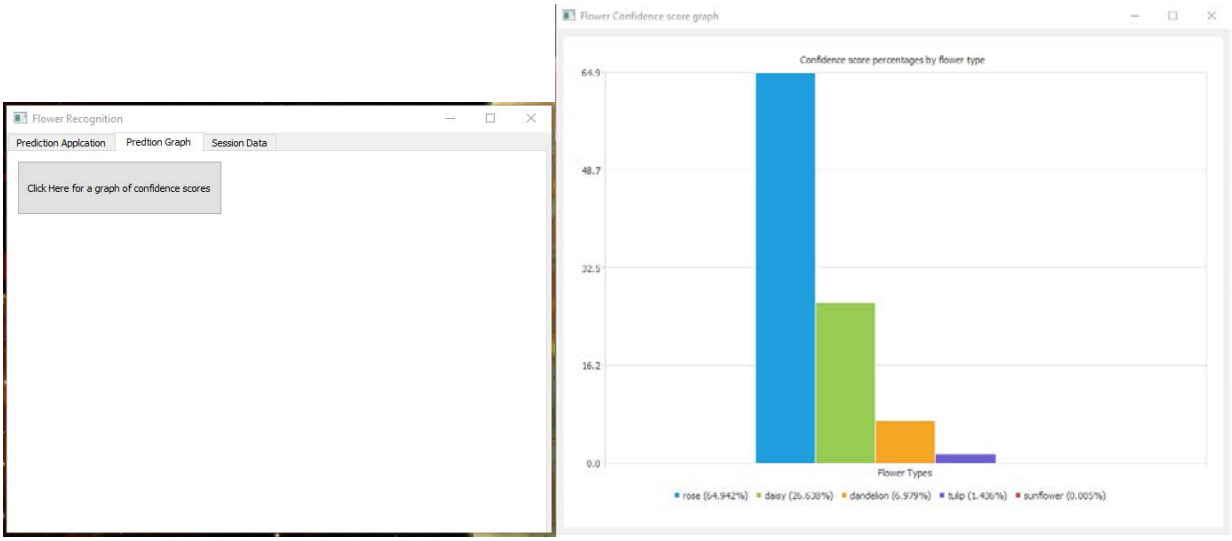
The GUI for the user application is a user-friendly and functional dashboard. The program has several visualizations. The opening window has three tabs at the top of the program. The first tab is the first tab the user sees.

On the main tab, the user has two buttons a select image button and a predict image button. The select image button opens up a file explorer to select the image of a flower to be predicted. The second button is to run the prediction algorithm on the selected image. The main tab has three visualizations. The first being the data (image) the user selected being display. The second being the confidence score and what the program guess of the flower type. The third is the prediction time it took the computer to make its guess. The time to guess is based on the hardware the program is on. The image below is of the first tab and file explorer.

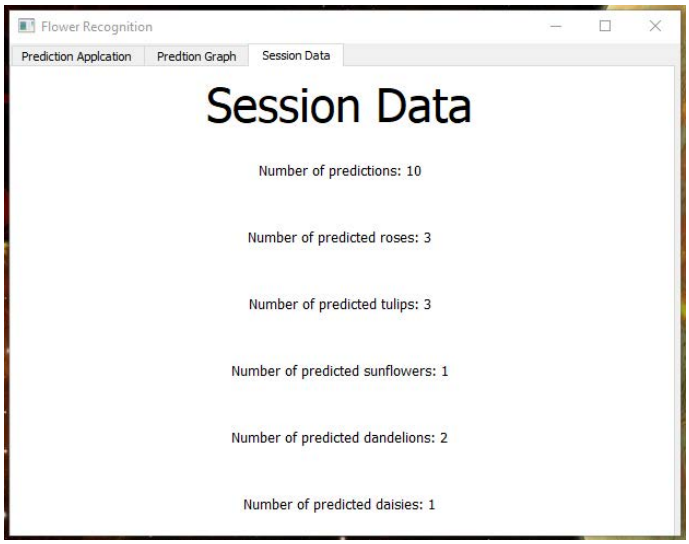




The second tab has a button to show the fourth visualization. The fourth visualization is a bar graph that is shown when the button in the second tab is clicked. The bar graph shows how confident it is the user's image is a type of flower. In this case, the program is 64.942% confident that this flower is a rose, 26.638% confident that it's a daisy, 6.979% confident this it is a dandelion, 1.436% confident it is a tulip, and 0.005% confident it is a sunflower. The graph is updated after each flower prediction.



The last tab shows the current session data and the fifth visualization. It shows the number of predictions made in the session so far and of the predictions of how many guesses were of each type of flower.


Flower Recognition
Prediction Applcation
Predtion Graph
Session Data
Session Data
Number of predictions: 10
Number of predicted roses: 3
Number of predicted tulips: 3
Number of predicted sunflowers: 1
Number of predicted dandelions: 2
Number of predicted daisies: 1

Business Documentation

Business requirements

The goal of this product was to help answer the questions of the guests of the casino and hotel. The guest wanted to know what type of flowers are in the botanical gardens and atrium. The casino wanted to do this without using signs that could obscure the view of the flowers. A technological solution was implemented that satisfied the requirement of creating a machine learning program that would be able to use a user given image and give an accurate guess to what type of flower was in the image. This was to be housed in a simple to use GUI. The program was created and meets all of the requirements stated above.

Datasets

The dataset that was used to create the program was from Kaggle (You can download the dataset [redacted]). The data was not cleaned. The data was of images and the image data was in its raw form when used by the program. A data scrapper was not needed to collect the data. So, no extra code or executable was needed in the collection and processing of the data.

The code

The code used is several libraries to help create the program. Tensorflow (1.14 and 1.15) was used for the backend of the machine learning foundations. Keras was used as a wapper of the TensorFlow library. Keras was also used to create the model file (.h5). OpenCV library was

used in the code to help with processing and using image data. ImageAI is the final library used for the creation of the machine learning algorithm. This library was kind of a wapper for all the aforementioned libraries. This made it easy to train and create a model. Also, it helped in using the model for predictions. The GUI aspects of the program were made using a python library called PyQt5 it a collection of GUI objects to create user interfaces. The code itself can be found in a py file called [redacted] that was turned in with this write up.

Assessment of the hypotheses

The hypotheses for this project is stated as follows. Can a machine learning algorithm be use used to predict with high accuracy the type of flower in an image? I believe that is a resounding, yes! With the amount of data given to the DenseNet algorithm to achieve an accuracy of about 85% is pretty good. Also, in the manual testing, the algorithm was able to predict 100% of the image I gave it. I believe the hypotheses should be accepted based on the results of the program.

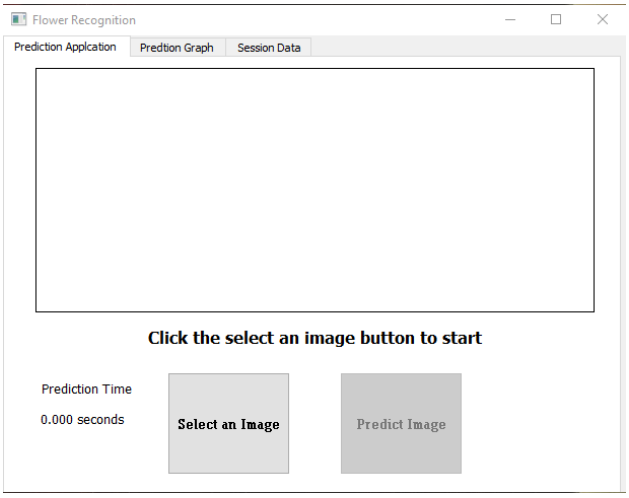
Assessment of accuracy

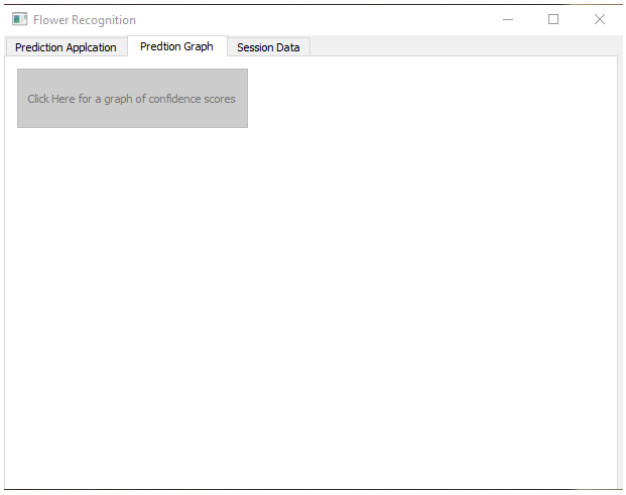
As stated a few times in the write-up. The accuracy that the project was looking for was above 80%. This would ensure that a good portion of the images the program was given would be correctly guessed by the program. In the testing phase of the model training, the model was about 85% correct. When I gave it a typical image and some edge case images the algorithm was able to 100% correctly guess the type of flower in each image. Due to this the accuracy of the program is deemed acceptable.

Revisions and optimization

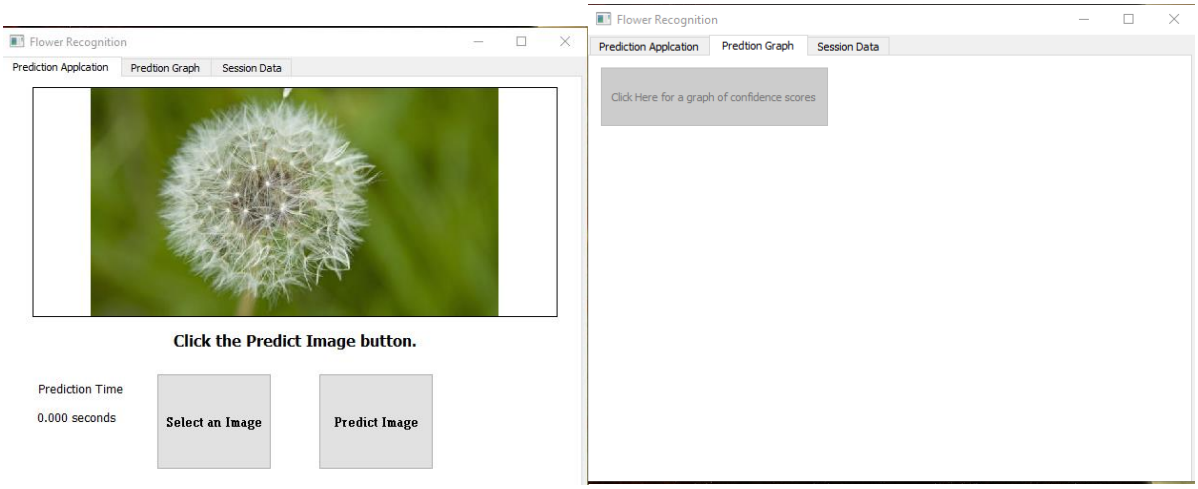
The main optimization made to the program in the GUI. Some of the buttons were able to be pressed when they were not supposed. The buttons were the predict image button on tab one and the click here for a graph of confidence scores button on the second tab. The revision was to set these buttons to not enabled and are only enabled when it is safe to do so.

These are images of the buttons not being enabled because there is not image to predict and the guess has not been made.

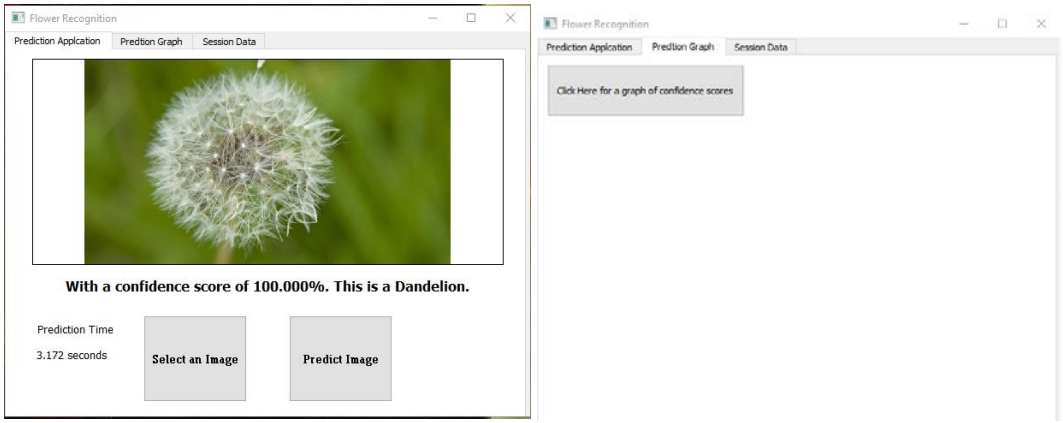




Now there is an image select the predict image button is enabled but the button to create a graph is not enabled due to the predict image button pressed creating the data for the graph.



Now the graph button is enabled because now there is data to populate the graph with data.



Source code and executable file(s)

The code and executable file can be found in the Capstone Project Program folder. Inside the Capstone ProjectPprogram folder. There are two folders one labeled executables and the other labeled Source code. These will need to be download from a google drive see the next section (Quickstart guide (first way)).

The executables folder has four files and one folder:

1. [redacted] file
2. [redacted]json
3. [redacted].exe
4. log.txt
5. A bunch of images of flowers for the evaluator to test the program.

The source code file has:

1. a py file that is the source code.

Quick start guide

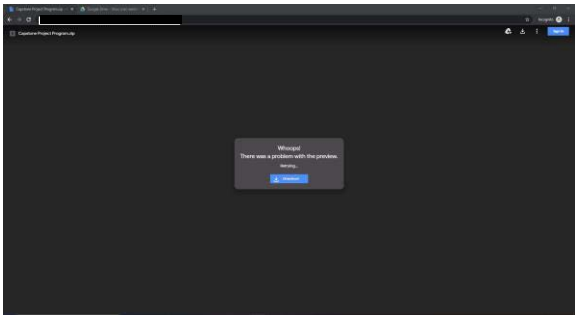
There are two ways to get the program up and running one is by an executable file which is the first way and the other is by installing dependencies and using IDEL to run the program (there is a video I created to set up the second way).

First way:

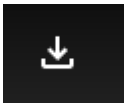
Because WGU file upload system only allows 200 MB per file and my executable is 340 MB you will have to download the program folder from a google drive. Below is the link and instructions to download the files.

[redacted]

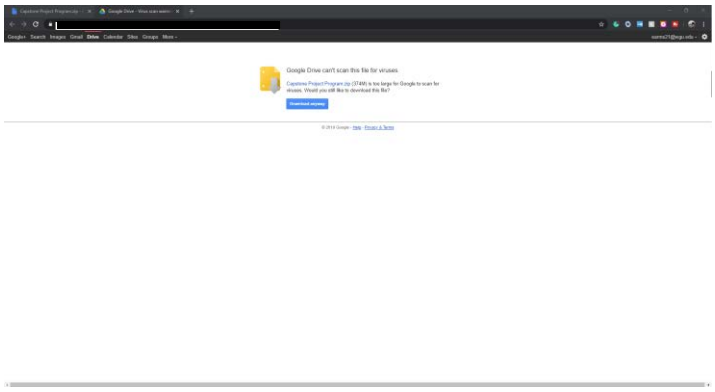
You might see one of two web browser windows when you click the link



OR

Either way, click the symbol that looks like this  on the top right-hand corner of the web browser.

The screen will show this: Click the blue Download anyway button to start the download.

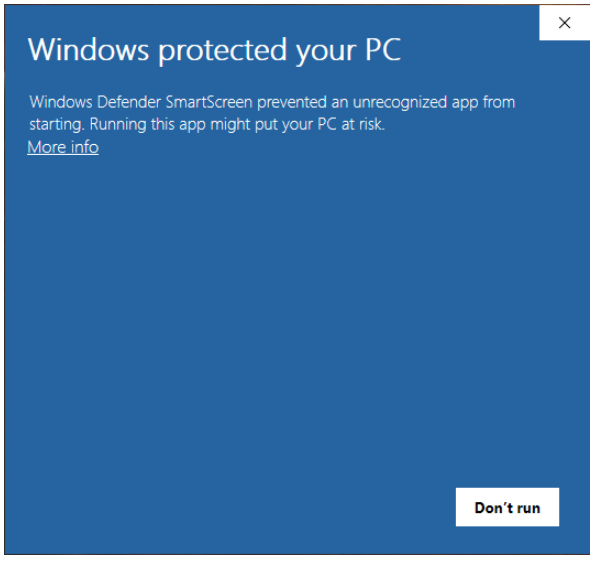


Here is the link again.

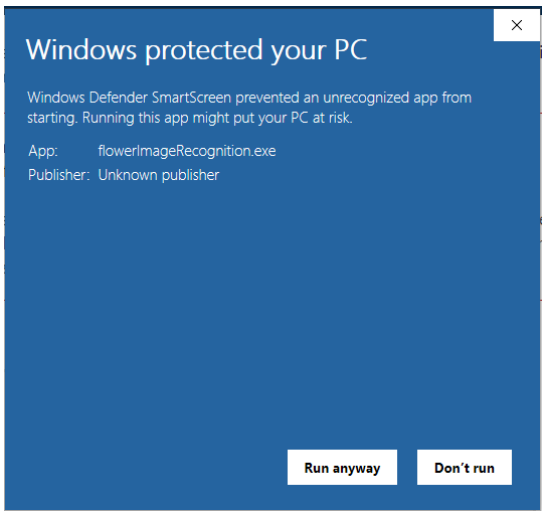
[redacted]

1. Unzip the file
2. Open the Project Program folder.
3. Open the executables folder.
4. Dubble click the [redacted].exe (wait a few moments it takes a few seconds to start up this depends on your machine capabilities and the program is checking to see if you have a compatible GPU for GPU acceleration)

   You may see this pop up:



   Click More info in the text and then it will look like this:



Click the Run anyway button.

Click the Run anyway button. Wait a few seconds the program takes a few moments to start up.

5. Once the program is up and running click the select image button. You can select an image from the flowers folder or one of your choosing (you may want to download an image from the internet to test the program) Please use images of sunflowers, tulips, roses, dandelions (you can use images of both types of dandelions), and daisies.
6. Then hit the predict image button (This can take a few seconds depending on your machine). This will give you a result.
7. Explore the other tabs.
8. Have fun.

Second way:

The second way has a video to follow at this youtube link:

[redacted]

Cited Works

Ruiz, P. (2018, October 18). Understanding and visualizing DenseNets. Retrieved December 17, 2019, a website, from https://towardsdatascience.com/understanding-and-visualizing-densenets-7f688092391a.

Mamaev, A. (2018, June 28). Flowers Recognition. Retrieved December 1, 2019, from a website, https://www.kaggle.com/alxmamaev/flowers-recognition.