VIVEKANAND EDUCATION SOCIETY'S INSTITUTE OF TECHNOLOGY

Department of Computer Engineering

Project Report on

Bird Strike Analysis and Prediction

In partial fulfillment of the Third Year, Bachelor of Engineering (B.E.) Degree in Computer Engineering at the University of Mumbai Academic Year 2019-2020

Submitted by
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Anmol Vaswani
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Project Mentor
Prof.Kajal Jewani

(2019-2020)

VIVEKANAND EDUCATION SOCIETY'S INSTITUTE OF TECHNOLOGY
Department of Computer Engineering

Certificate

This is to certify that ***Naren Khatwani, Adithya Shrivastava, Anmol Vaswani, Vanshika Khanna*** of Third Year Computer Engineering studying under the University of Mumbai have satisfactorily completed the mini project on "***Bird Strike Analysis***" as a part of their coursework of Mini Project for Semester-VI under the guidance of their mentor ***Prof. Kajal Jewani*** in the year 2019-2020.

This mini project report entitled **Bird Strike Analysis and Prediction** by (***Author Name***) is approved for the degree of _____ (***Degree details***).

Programme Outcomes	Grade
PO1,PO2,PO3,PO4,PO5,PO6,PO7 , PO8, PO9, PO10, PO11, PO12 PSO1, PSO2	

Date:

Project Guide: Internal and External

Mini Project Report Approval
For
T. E (Computer Engineering)

This mini project report entitled (***Title***) by (***Author Name***) is approved for the degree of T.E Computer Engg.

Internal Examiner

External Examiner

Head of the Department

Principal

Date:
Place:

Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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(Signature)	(Signature)
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(Naren Khatwani- 31)	(Adithya Shrivastava- 62)
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(Signature)	(Signature)
---	---
(Anmol Vaswani- 73)	(Vanshika Khanna- 30)

Date:

ACKNOWLEDGEMENT

We are thankful to our college Vivekanand Education Society's Institute of Technology for considering our project and extending help at all stages needed during our work of collecting information regarding the project.

It gives us immense pleasure to express our deep and sincere gratitude to Assistant Professor **Prof (Mrs) Kajal Jewani** (Project Guide) for her kind help and valuable advice during the development of project synopsis and for her guidance and suggestions.

We are deeply indebted to Head of the Computer Department **Dr.(Mrs.) Nupur Giri** and our Principal **Dr. (Mrs.) J.M. Nair** for giving us this valuable opportunity to do this project.

We express our hearty thanks to them for their assistance without which it would have been difficult in finishing this project synopsis and project review successfully.

We convey our deep sense of gratitude to all teaching and non-teaching staff for their constant encouragement, support and selfless help throughout the project work. It is great pleasure to acknowledge the help and suggestion, which we received from the Department of Computer Engineering.

We wish to express our profound thanks to all those who helped us in gathering information about the project. Our families too have provided moral support and encouragement at several times.

Computer Engineering Department

COURSE OUTCOMES FOR T.E Mini Project

Learners will be to,

Course Outcome	Description of the Course Outcome
CO 1	Able to apply the relevant engineering concepts, knowledge and skills towards the project.
CO2	Able to identify, formulate and interpret the various relevant research papers and to determine the problem.
CO 3	Able to apply the engineering concepts towards designing solution for the problem.
CO 4	Able to interpret the data and datasets to be utilized.
CO 5	Able to create, select and apply appropriate technologies, techniques, resources and tools for the project.
CO 6	Able to apply ethical, professional policies and principles towards societal, environmental, safety and cultural benefit.
CO 7	Able to function effectively as an individual, and as a member of a team, allocating roles with clear lines of responsibility and accountability.
CO 8	Able to write effective reports, design documents and make effective presentations.
CO 9	Able to apply engineering and management principles to the project as a team member.
CO 10	Able to apply the project domain knowledge to sharpen one's competency.
CO 11	Able to develop professional, presentational, balanced and structured approach towards project development.
CO 12	Able to adopt skills, languages, environment and platforms for creating innovative solutions for the project.

Chapter 1: Introduction

1.1 Introduction to the project

1.2 Motivation

1.3 Problem Definition

1.4 Relevance of the Project

1.5 Methodology used

Chapter 2: Literature Survey (with citation of references)

2.1 Journal Papers or books / Book Chapters

2.2 Patent search (you need for study 3-4 patents related to your project, summary of the patent should be included in this chapter) Links 1. European Patent: http://worldwide.espacenet.com/, 2. US patent: http://patft.uspto.gov/netahtml/PTO/index.html

2.3. Inference drawn

2.4 Comparison with the existing system

Chapter 3: Requirements

3.1 Functional Requirements

3.2 Non-Functional Requirements

3.3 Constraints

3.4 Hardware & Software Requirements

3.5 System Block Diagram

Chapter4: Proposed Design

4.1 System Design / Conceptual Design (Architectural)

4.2 Detailed Design (DFD, Flowchart, State Transition Diagram, ER Diagram, etc...)

4.3 Project Scheduling & Tracking using Time line / Gantt Chart

Chapter 5: Implementation

5.1. Methodology applied

5.2. Algorithms implemented

5.3 Datasets source and utilization

5.4. Screenshots (GUI) of the project

Chapter 6: Testing

6.1. Test cases

6.2. Test Results

Chapter 7: Result Analysis

7.1.Evaluation measures

7.2 Input Parameters considered

7.3. Graphical and statistical output (with Explanation)

7.3 Comparison of results with existing systems

7.4 Inference drawn

Chapter 8: Conclusion

8.1 Limitations

8.2 Conclusion

8.3 Future Scope

References (papers + books + Patent)

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CD

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1.Introduction:

1.1 Introduction to the project

A bird Strike can be defined as a collision between a bird species and the aircraft engine . A bird strike can result in various mishaps such as crash landing of aircraft or an aircraft getting stalled which may lead to some unavoidable circumstantial landing situations. In order to prevent such mishaps from happening in the near future we propose an idea of predicting future bird strikes and analysis of the previous years data of bird strikes. The data of the previous years will be analysed and will help in improving the accuracy of prediction of bird strikes that might occur over the period of next five years. The prediction and analysis would be based on the parameters such as phase of flight, period of the day or altitude. Numerous other parameters like bird species and size of bird species can also be analysed through which there can be a pattern established which will not only help us understand the birds' migration route but also help prevent any bird strikes in future. The prevention of bird strikes through prior prediction can save a lot of lives that might be at stake. The algorithms that can be used for prediction would be linear regression, random forest algorithm and time series analysis.

1.2 Motivation

Motivation for any project is not just needed by a single team member. It is a joint effort which has to be taken by each member of a project team. Similarly in our project, each of the team members wanted to give something back to the society and we all collectively decided that civil aviation is an industry which is booming a lot in current times, however it also needs advancements in the direction of bird strike prevention as it is type of incident that needs constant attention, since it not only compromises the aircraft safety but also leads to loss of wildlife.

1.3 Problem Definition

The aim of our project is to analyze past years bird strike data with respect to phase of flight, time of day, pilot warning status and various other parameters.The model will make predictions about the occurrence of bird strikes in future years in order to make important decisions to avoid future occurrences of bird strikes.

1.4 Relevance of the project

For the aviation industry, aircraft and passenger safety is of utmost importance. Bird strikes pose a threat to the same. Therefore, a system that predicts the occurrence of these bird strikes and

analyses the parameters that affect their occurrence would be of great assistance to the aviation industry in preventing future bird strikes, thereby increasing flight safety.

1.5 Methodology used:

The main objective of the methodology applied is to analyze the Bird Strike data obtained from Kaggle by a Data Scientist at Travelport Atlanta, Georgia, United States and use it for the betterment of passengers as our vision is to make the Air traffic controllers aware of the advancement in technology which can benefit them in not only increasing the rate of avoiding bird strike occurrences but also give them the opportunity to increase the probity among the community of passengers and airlines . The databases for both the survey results have been provided for further study. It aims to take crucial decisions in the aviation industry related to the flight plans.

2. Literature Survey:

2.1 Journal papers or books/Book Chapters:

- Computational methods for bird strike simulations- A review
  Published in : Computers and Structures, Volume 89, Issues 23-24
- Serious bird strike accidents to military aircraft : updated list and summary
  Published in : IBSC Proceedings:Papers and Abstr.25(Amsterdam Vol.1)
- The influence of bird-shape in bird-strike analysis
  5th European LS-DYNA users conference, Birmingham, 2005
- Bird Strike damage analysis in aircraft structures using Abaqus/Explicit and coupled Eulerian Lagrangian approach
  Published in : Composites Science and Technology 71(4),489-498, 2011
- Models and methods for bird strike load predictions
  Wichita State University

2.2 Summary of the Patents:

i.Integrated Bird-Aircraft Strike Prevention System – IBSPS:

The ability to integrate all IBSPS equipped airplanes significantly increases area coverage and enhances the safety of Air Traffic System. Because the IBSPS is capable of being airborne, the aircraft will be protected from bird-strikes throughout the entire flight, even in absence of ground systems. The advantages of the system include the ability to prevent bird strikes and instantaneously compute an alternative course or action necessary to avoid the bird-aircraft impact. An airborne apparatus that employs an advanced computer to analyze bird and aircraft

positioning data, programmed to issue a warning about an impending strike, thereby creating the ultimate Bird-Aircraft Strike Prevention System. This system will constantly process the bird positioning data gathered by the Radar/Infrared sensors. In case of a bird-aircraft strike danger the system will immediately alert the pilot as well as Air Traffic Control, and, compute the necessary course correction required to avoid the collision.

ii.All-dimensional airport bird collision avoidance system based on Internet of Things:

The all-dimensional airport bird collision avoidance system is composed of an airport bird collision avoidance monitoring center and a plurality of airport bird information acquirers. The airport bird collision avoidance monitoring center comprises a Zigbee wireless network coordinator, a monitoring base station, a central controller and an early warning device. The utility model discloses an all-dimensional airport bird collision avoidance system based on the Internet of Things. The airport bird information acquirers include a radar detector, an ARM (advanced RISC machine) microcontroller, an electronic compass, a Zigbee communication module, a power supply and a bird repelling falcon. The all-dimensional airport bird collision avoidance system based on the Internet of Things has the advantages of simple structure, wide coverage range, high efficiency, convenience in management and the like, good all-dimensional bird monitoring and collision avoidance control can be performed in airport areas to be monitored, early warning and bird repelling can be quickly realized, instantaneity is good, implementation speed and control accuracy are high, and bird repelling effect is good.

iii.A system safety evaluation method based on bird impact:

The invention finds out the weak links of the airborne system and the equipment thereof in the bird collision resistance, points out the design changing direction, thereby adopting protective measures in the airborne system design to reduce the harm to the airplane caused by the bird collision as far as possible, so as to show that the design of the airborne system of the airplane can meet the requirements of the airworthiness clause. The invention discloses a system safety evaluation method based on bird impact, which is characterized in that the method comprises the following steps of: determining a bird impact hazard area, establishing a bird impact damage model, identifying equipment independent damage, system modification or structure protection design, and result evaluation.

2.3 Inference drawn:

The advantages of the system include the ability to prevent bird strikes and instantaneously

compute an alternative course or action necessary to avoid the bird-aircraft impact. The inventions discloses a system safety evaluation method based on bird impact. The present invention is directed to a bird collision avoidance system, wherein the bird collision avoidance system is installed on an aircraft and comprises a bird detection unit and an associated bird repelling unit. According to bird condition data acquired by an airport bird detection radar in real time, relative height difference between flying birds and airplane take-off and landing tracks, the maneuverability of the birds, distances of the flying birds deviated from runways and other factors are comprehensively considered in different stages in the take-off and landing processes of the airplane, and the bird strike probability is estimated in real time.

2.4 Comparison with the existing system:

Measures to mitigate the hazards require accurate data about the species involved. No DNA based identification methods i.e. DNA barcoding are used to identify the species whereas the proposed methodology takes into account the wildlife species and their size as well. The main disadvantage of the existing approach is that these cause small time-step and loss of accuracy. This methodology reduces the time-step and increases the accuracy. By the proposed method, bird strike accidents and accident proneness can be effectively avoided, and the safe take-off and landing of flight is guaranteed.

3. Requirements:

3.1 Functional requirements:

1) Percentage of bird strikes in India.

2)Average altitude at which the bird strikes have occurred and number of distinct bird species.

3) No. of cases where the pilots were/were not given a prior warning for a bird strike occurrence.

4)Prediction compulsion related to time of the day.

5) Damage cost trend compared to the size of the bird over the period for which the data is being made available

6)Relation between bird strikes and phase of flight

7)Number of bird strikes taking place yearly

8)Prediction of bird strikes in the forthcoming years

9)Precipitation Status Analysis

10)Remains of Wildlife Corrected

11)Monthly Analysis of Bird Strikes

12)Average speed of aircrafts in the event of a bird strike.

13) Provide an interface to add new data to both the datasets provided.

14) Easy to use interface

15)Confidentiality of user's personal details

3.2 Non-functional requirements:

- Soothing theme
- Good organisation of data
- 24/7 availability
- Operating constraints(Can only be run on Windows and Mac OS)

3.3 Constraints:

The application can only run on Windows operating systems or on Mac OS.

3.4 Hardware and Software Requirements:

Major Libraries Used:

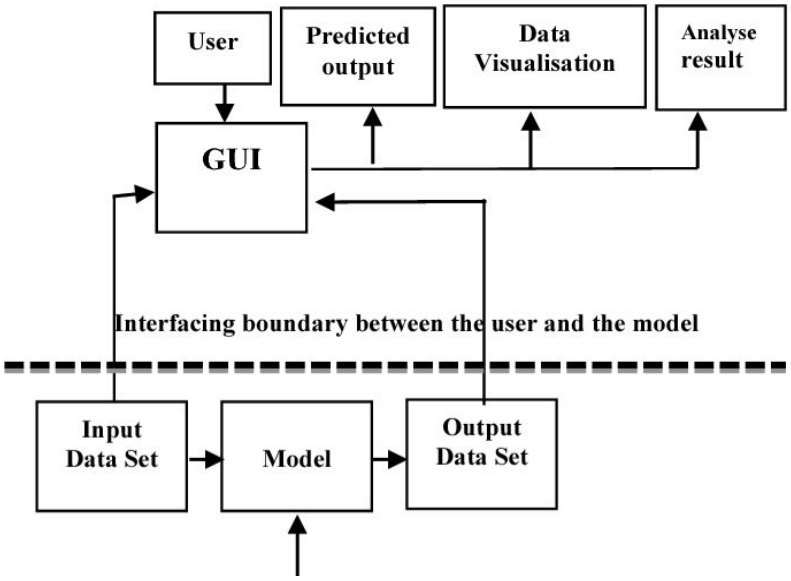
- Pytesseract
- Matplotlib
- Plotly
- CanvasTkAgg
- Tkinter
- Pandas

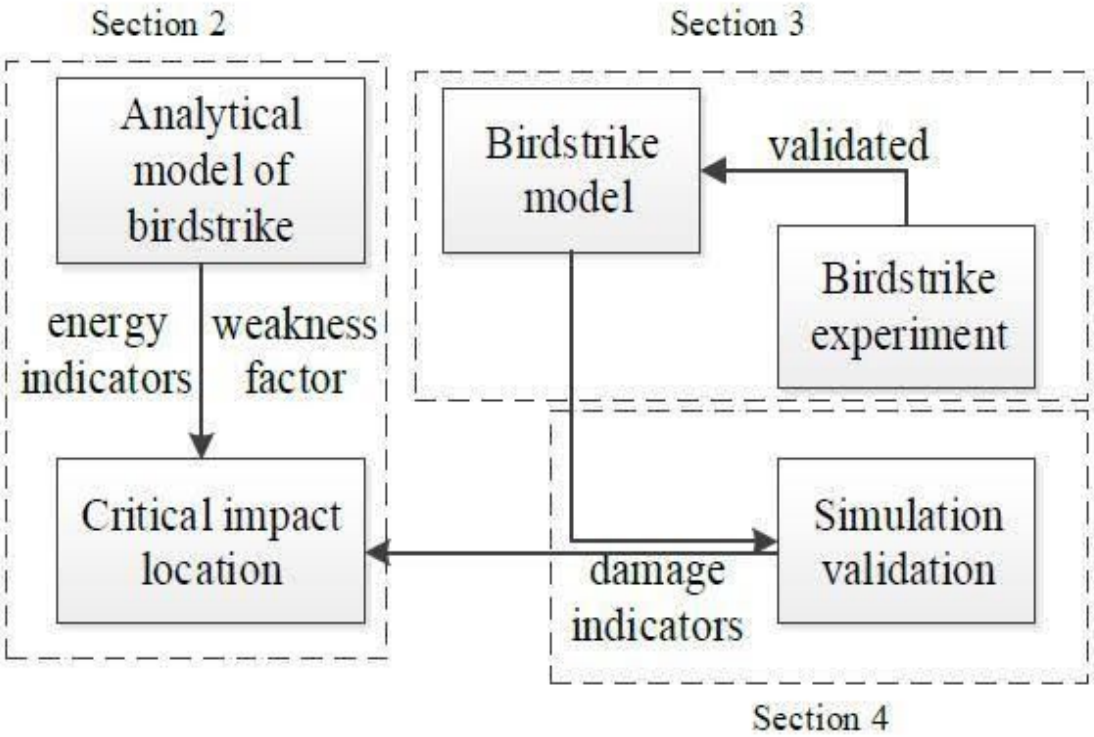
IDE used to make our project : Spyder

Operating System : Windows/Mac OS

Other requirements : Xampp Server

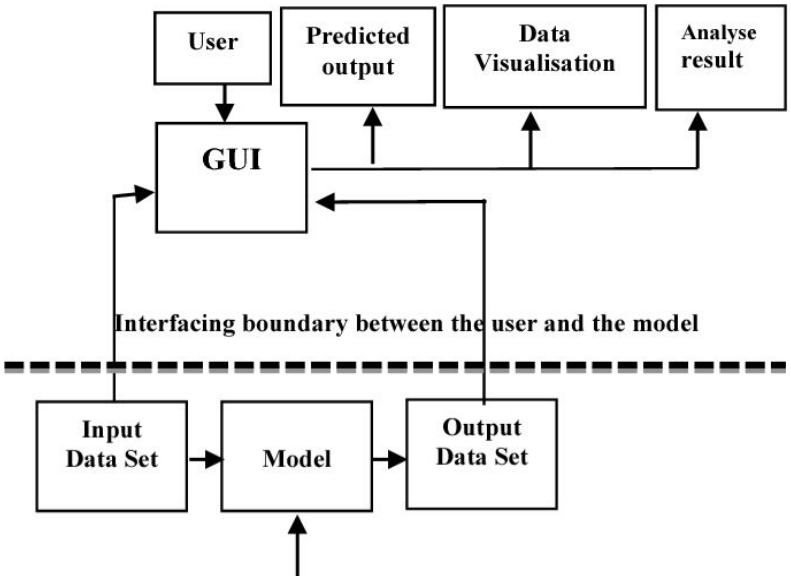
3.5 System Block Diagram:



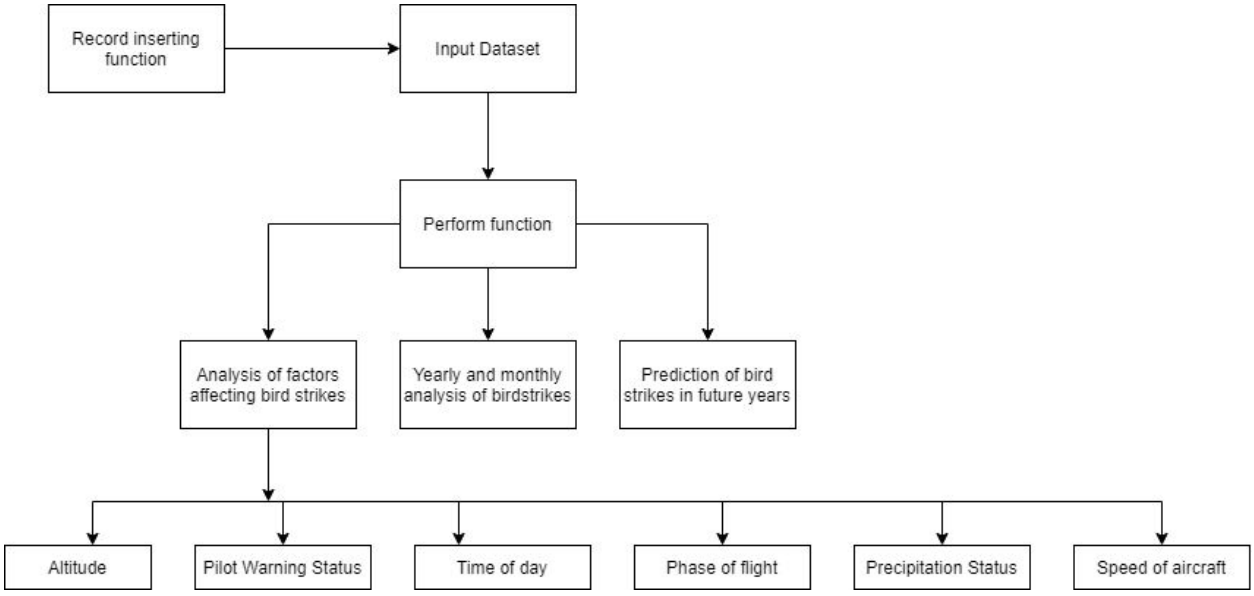


4. Proposed Design:

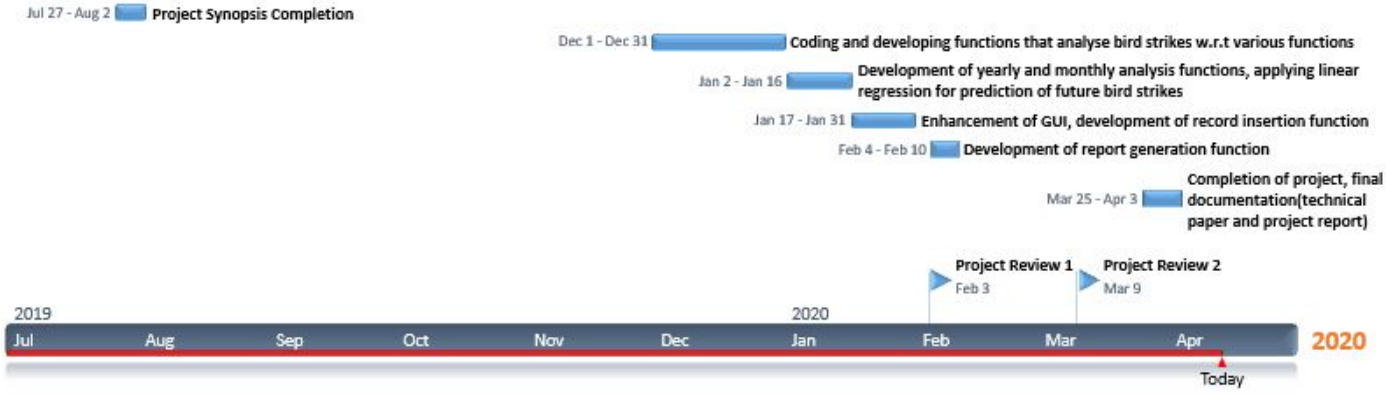
4.1 System Design/Conceptual Design:



4.2 Detailed Design:



4.3 Project Scheduling and Tracking using Timeline:



Task 1: Project Synopsis Completion

Duration : 25th July 2019-2nd August 2019

Task 2: Coding and developing functions that analyse bird strikes with respect to various factors

Duration : 1st Dec 2019-31st Dec 2019 (1 month)

Task 3: Development of yearly and monthly analysis functions, applying linear regression for prediction of future bird strikes

Duration : 2nd Jan 2020-16th Jan 2020 (15 days)

Task 4 : Enhancement of GUI, development of record insertion function

Duration : 17th Jan 2020- 31st Jan 2020 (15 days)

Milestone 1: Project Review 1

Completion : 2nd Feb 2020

Task 5 : Development of report generation function

Duration : 4th Feb 2020-10th Feb 2020 (1 week)

Milestone 2 : Project Review 2

Completion : 9th March 2020

Task 6 : Completion of project, final documentation(technical paper and project report)

Duration : 25th March 2020-3rd April 2020(10 days)

5. Implementation:

5.1 Methodology applied:

The main objective of the methodology applied is to analyze the Bird Strike data obtained from Kaggle by a Data Scientist at Travelport Atlanta, Georgia, United States and use it for the betterment of passengers as our vision is to make the Air traffic controllers aware of the advancement in technology which can benefit them in not only increasing the rate of avoiding bird strike occurrences but also give them the opportunity to increase the probity among the community of passengers and airlines . The databases for both the survey results have been provided for further study. It aims to take crucial decisions in the aviation industry related to the flight plans.

Data Collection:

For the collection of datasets the factors taken into consideration are as follows:

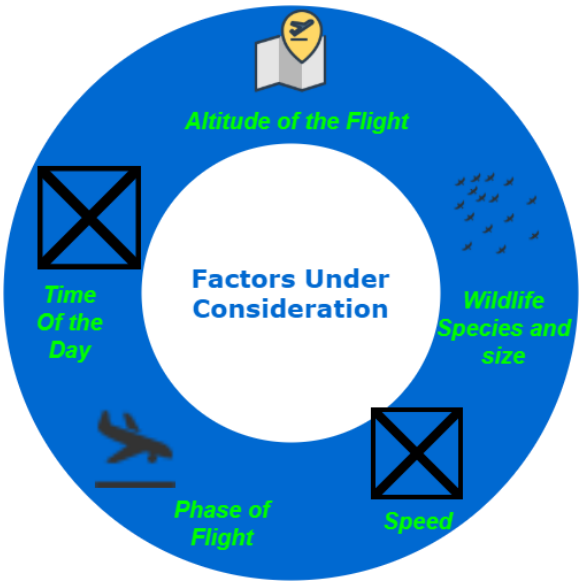
1.Altitude/Feet above the ground.

2.Phase of flight

3.Wildlife size and species

4.Time of the day

5.Speed



Factors under consideration for bird strikes

The detailed description of the above parameters is given as follows:

- Altitude/feet above the ground:

We can substantially reduce the mean probability of bird strikes by increasing the height of flights. About 66% of bird strikes that cause substantial damage to aircraft occurred at approximately less than 500 feet.

- Phase of flight:

The probability of bird strikes is also dependent on the phase of flight. These may occur during the take-off, initial climb, approach and landing phases because of greater number of birds in flight at lower levels.

- Wildlife species and their size:

Bird Strike is the term which is often expanded to cover wildlife strikes with ground animals or bats. Damage caused to the aircraft and its effect on the flight are closely correlated to the kinetic energy derived from the mass which is determined by the bird species.

- Time of the Day

Bird Strikes largely depend on the time of the day at which it can occur that is dawn, day, dusk and night. More Bird Strikes occur during daylight hours than at night. Whereas for the strikes that occur above 500 feet altitude are more common at night than during day during the bird migration season.

- Speed

Speed is slower at the initial and landing phases of the flight. These are the phases where bird strikes take place and speed plays an important role in these strikes. In order to measure bird velocity, usually the time of flight of the bird between two spatial points is measured.

5.2 Algorithms implemented:

1.Linear Regression:

Linear Regression is a statistical approach for modelling the relationship between a dependent variable with a given set of independent variables:

- Plot the points
- Sample regression line
- Create a best fit line(line which minimizes the error, i.e. it should have minimum difference between the actual and predicted values).

2.Logistic Regression:

Like all regression analyses, logistic regression is a predictive analysis.Logistic regression is used to describe data and to explain the relationship between one dependent binary variable and one or more nominal, ordinal, interval, or ratio-level independent variables.Unlike linear regression, logistic regression can lead us to only two answers: yes or no. This is achieved using a sigmoid curve.

3.Time series analysis:

It consists of the following steps:

- Source your data
- Wrangle your data
- Exploratory Data Analysis
- Trends and seasonality in time series data
- Identifying Trends
- Seasonal patterns
- First Order Differencing
- Periodicity and Autocorrelation

Random Forest algorithm is a supervised classification algorithm. We can see it from its name, which is to create a forest by some way and make it random. There is a direct relationship

between the number of trees in the forest and the results it can get: the larger the number of trees, the more accurate the result. But one thing to note is that creating the forest is not the same as constructing the decision with information gain or gain index approach.

5.3 Datasets source and utilization:

Data is obtained from Kaggle by a Data Scientist at Travelport Atlanta, Georgia, United States.

It aims to take crucial decisions in the aviation industry related to the flight plans.

Input Parameters:

1.Altitude/Feet above the ground.

2.Phase of flight

3.Wildlife size and species

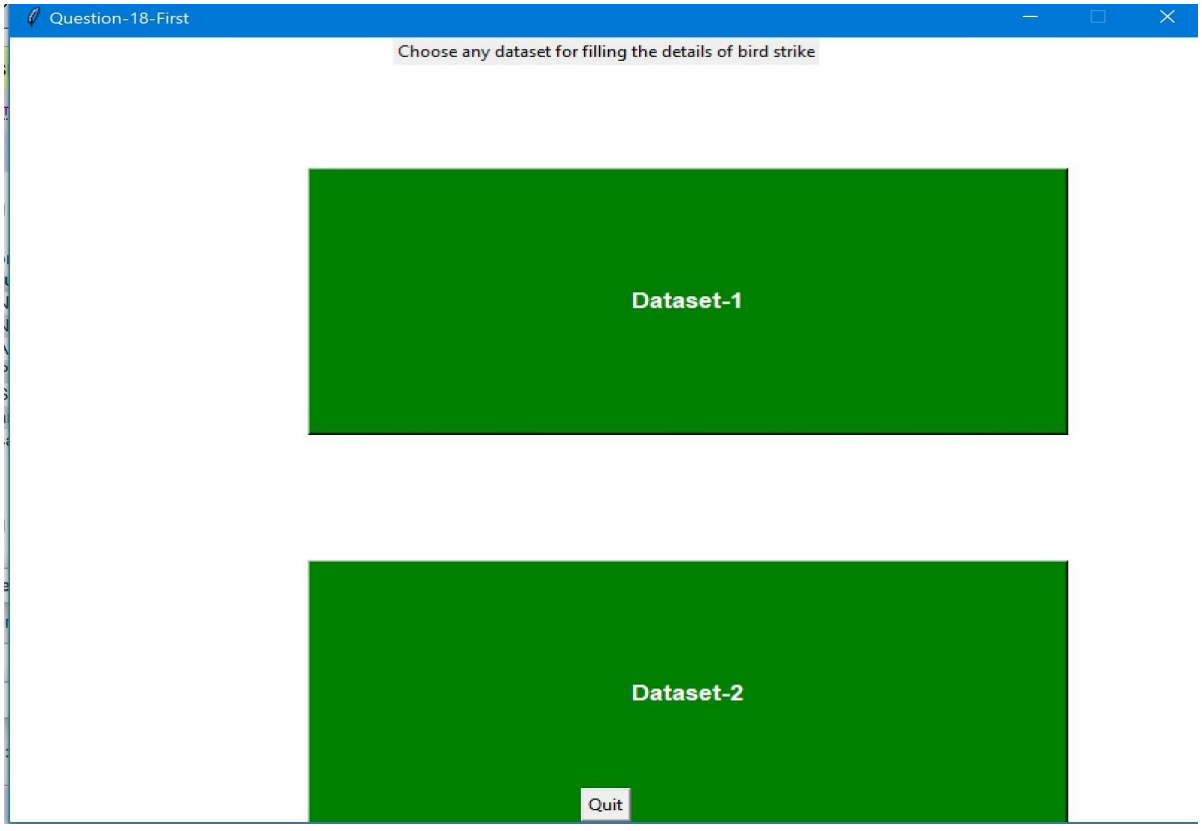
4.Time of the day

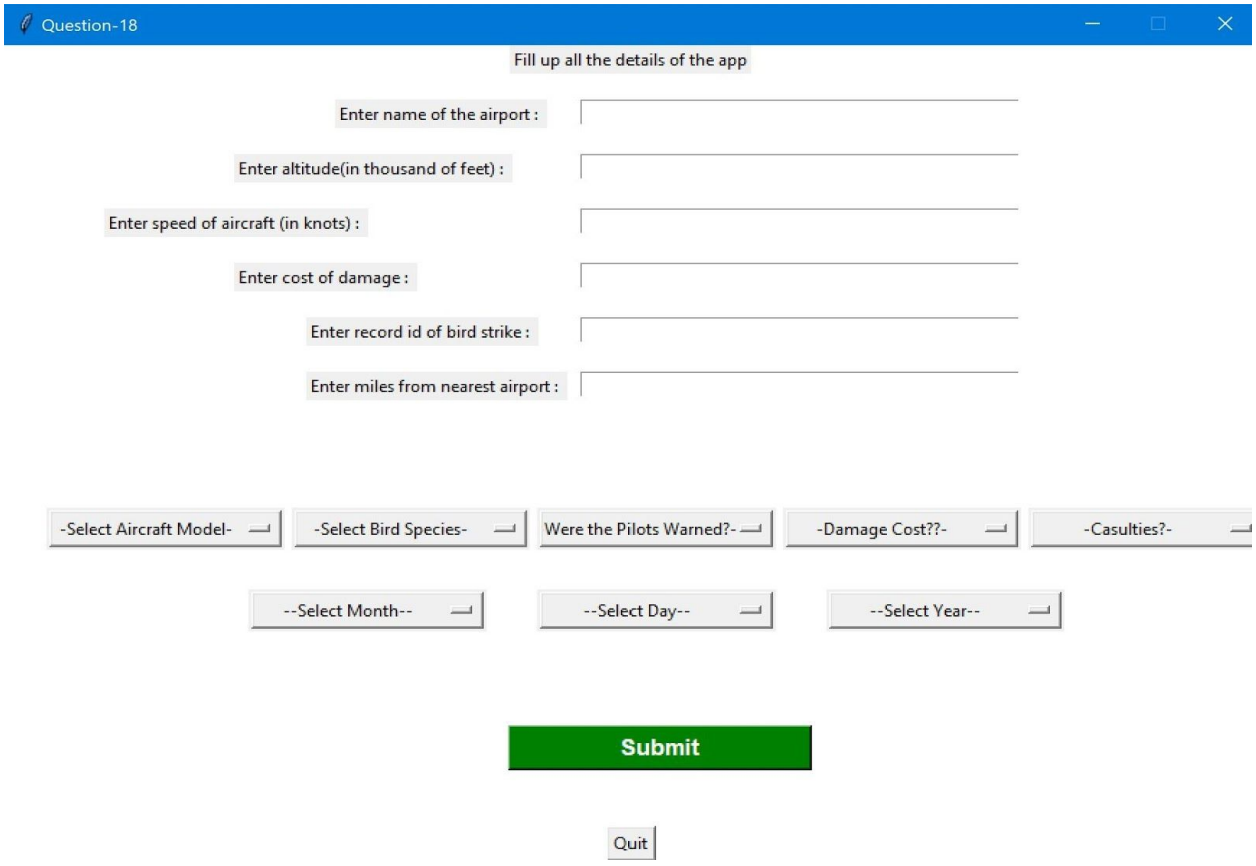
5.Speed

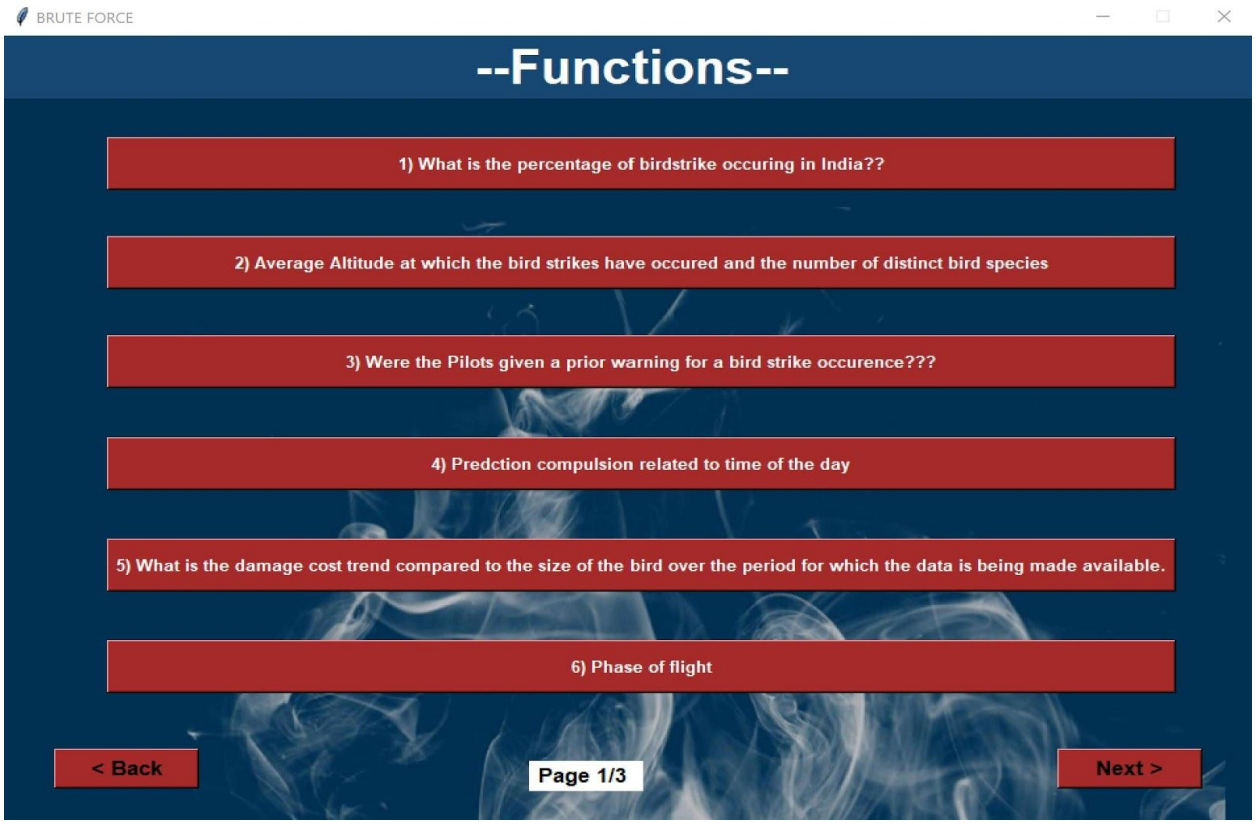
Output : Prediction of the no. of bird strikes

5.4 Screenshots(GUI) of the project:


BIRD STRIKE ANALYSIS
Welcome Naren
"If we have data, let's look at data. If all we have are opinions, let's go with mine."
- — Jim Barksdale
Fetch Raw Data
Insert Record
Perform Function
Report Generation
Back


Question-18-First
Choose any dataset for filling the details of bird strike
Dataset-1
Dataset-2
Quit


Question-18
Fill up all the details of the app
Enter name of the airport :
Enter altitude(in thousand of feet) :
Enter speed of aircraft (in knots) :
Enter cost of damage :
Enter record id of bird strike :
Enter miles from nearest airport :
-Select Aircraft Model-
-Select Bird Species-
Were the Pilots Warned?-
-Damage Cost??-
-Casulties?-
--Select Month--
--Select Day--
--Select Year--
Submit
Quit


BRUTE FORCE
--Functions--
1) What is the percentage of birdstrike occuring in India??
2) Average Altitude at which the bird strikes have occured and the number of distinct bird species
3) Were the Pilots given a prior warning for a bird strike occurence???
4) Predction compulsion related to time of the day
5) What is the damage cost trend compared to the size of the bird over the period for which the data is being made available.
6) Phase of flight
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BRUTE FORCE
--Functions--
7) Number of Birdstrikes taking place yearly
8) Prediction of Birdstrikes in the forthcoming years
9) Precipitation Status Analysis
10) Remains of Wildlife Corrected
11) Monthly analysis of birdstrikes
12)
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BRUTE FORCE

--Functions--

7) Number of Birdstrikes taking place yearly

8) Prediction of Birdstrikes in the forthcoming years

9) Precipitation Status Analysis

10) Remains of Wildlife Corrected

11) Monthly analysis of birdstrikes

12)

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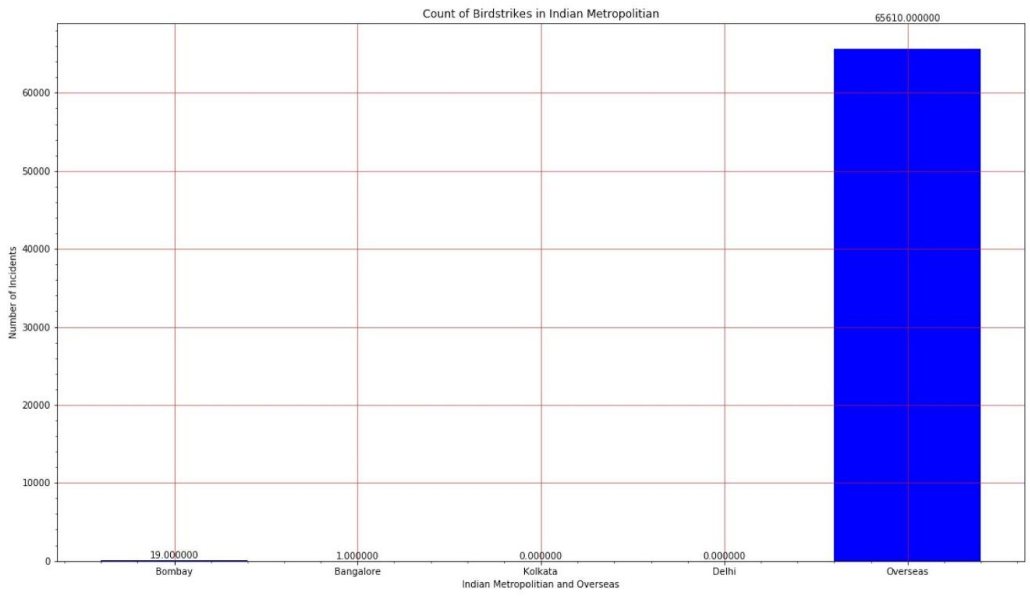
Next >

Question-1

Percentage Birdstrikes in Mumbai	Percentage Birdstrikes in Bangalore	Percentage Birdstrikes in Kolkata	Percentage Birdstrikes in Delhi
0.02895900015241579	0.0	0.0	0.0



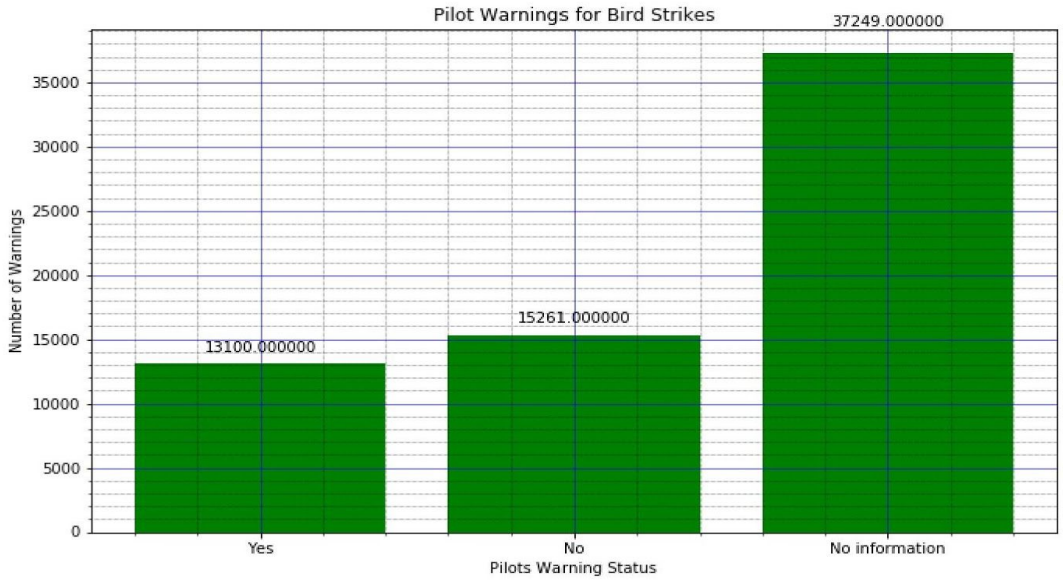
Quit

Question-3

Percentage of pilots not warned

23.260173754000917

As we can see from this graph,
in majority of the cases pilots were not warned
and therefore we must ensure that pilots are warned of birdstrikes in advance



Quit

Question-4

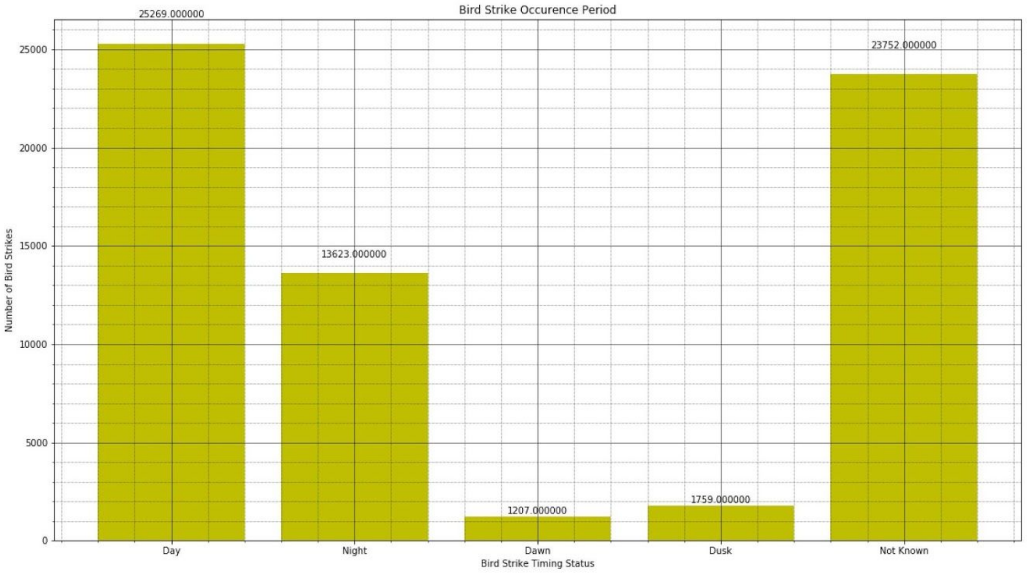
No. of birdstrikes during day **38.51394604481024**

No. of birdstrikes at night **20.763603109282123**

No. of birdstrikes at dawn **1.839658588629782**

No. of birdstrikes at dusk **2.6809937509525987**

Flights taking off during time of day with maximum bird strikes should be compulsorily warned



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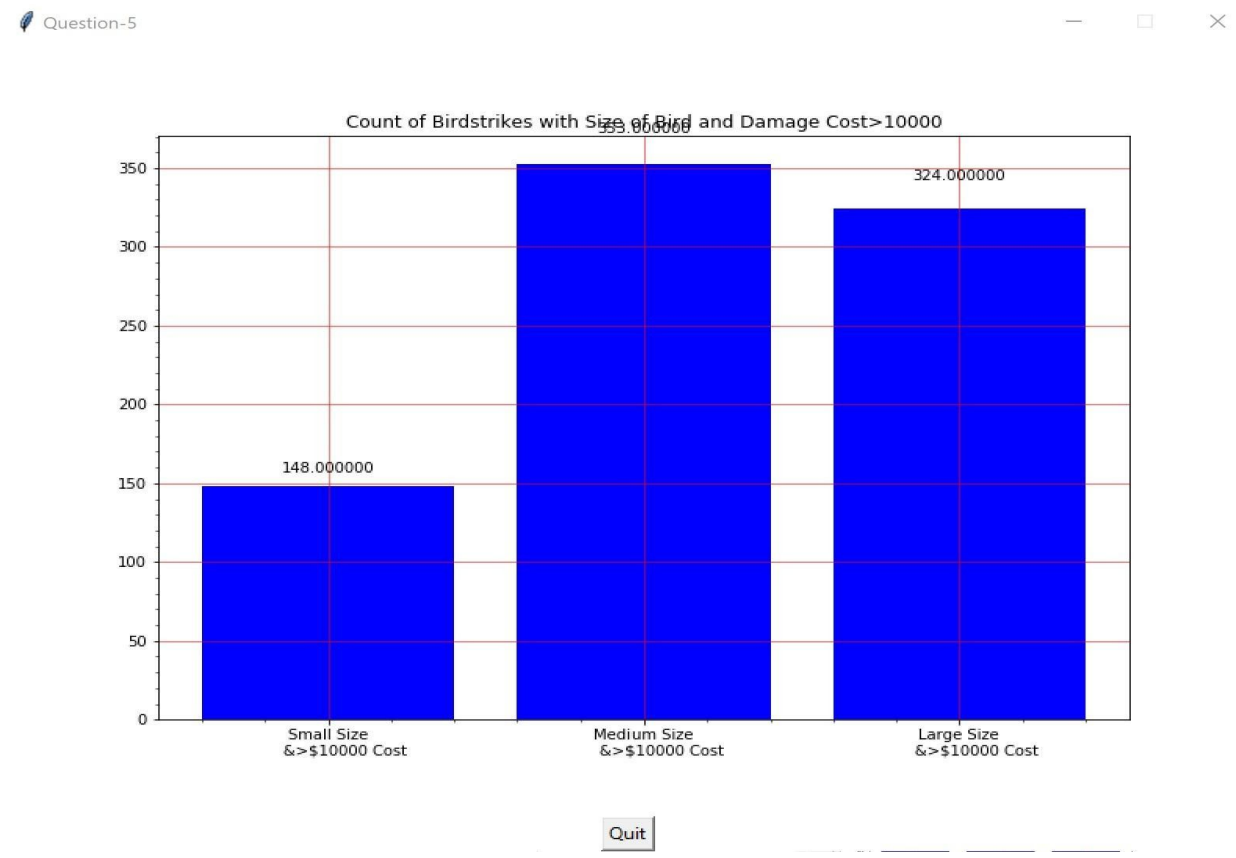
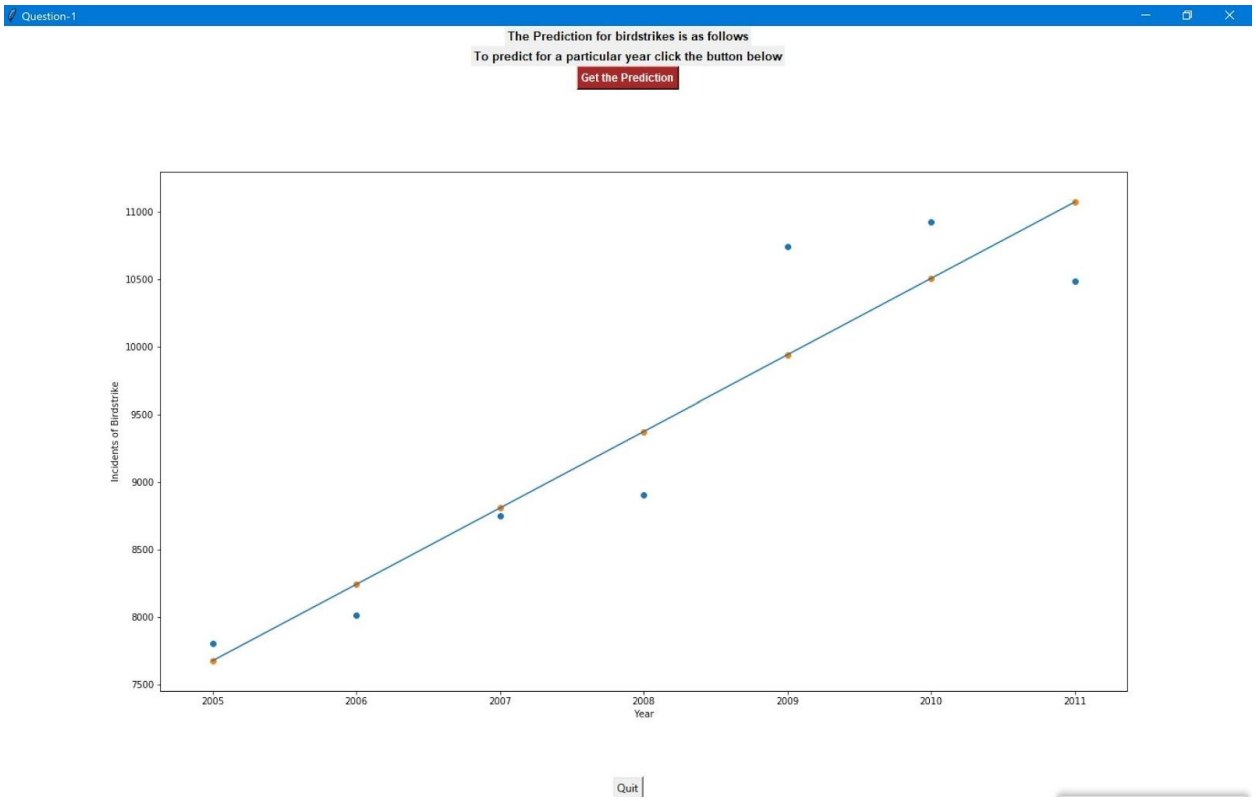
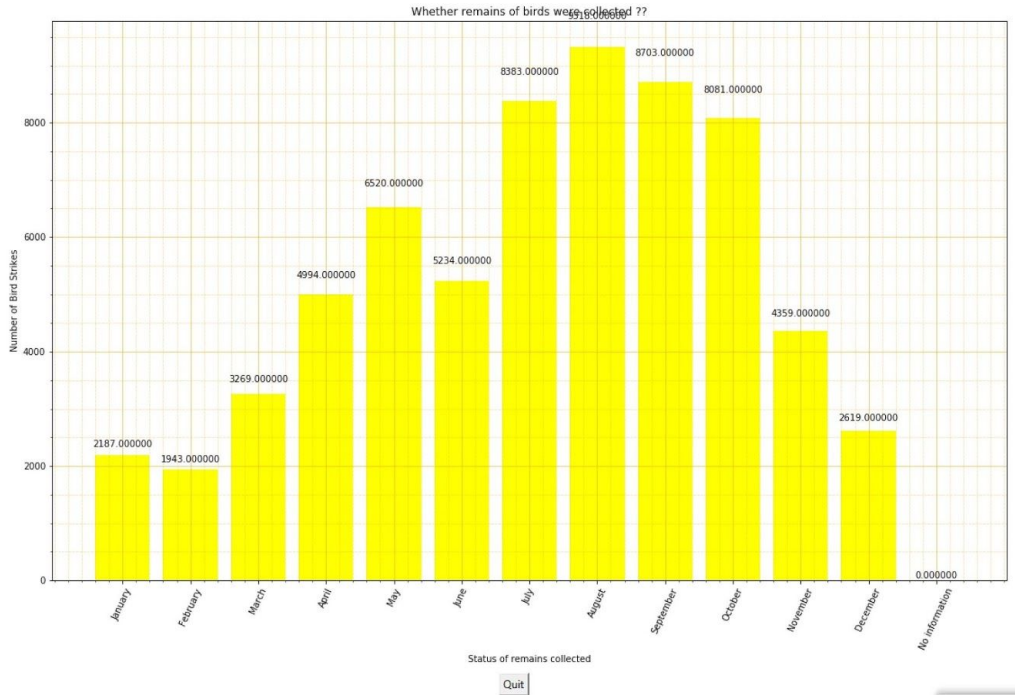

Question-5
Count of Birdstrikes with Size of Bird and Damage Cost>10000
353.000000
324.000000
148.000000
350
300
250
200
150
100
50
0
Small Size
&>$10000 Cost
Medium Size
&>$10000 Cost
Large Size
&>$10000 Cost
Quit


Question-1
The Prediction for birdstrikes is as follows
To predict for a particular year click the button below
Get the Prediction
Incidents of Birdstrike
11000
10500
10000
9500
9000
8500
8000
7500
2005
2006
2007
2008
2009
2010
2011
Year
Quit

Question-10



Quit

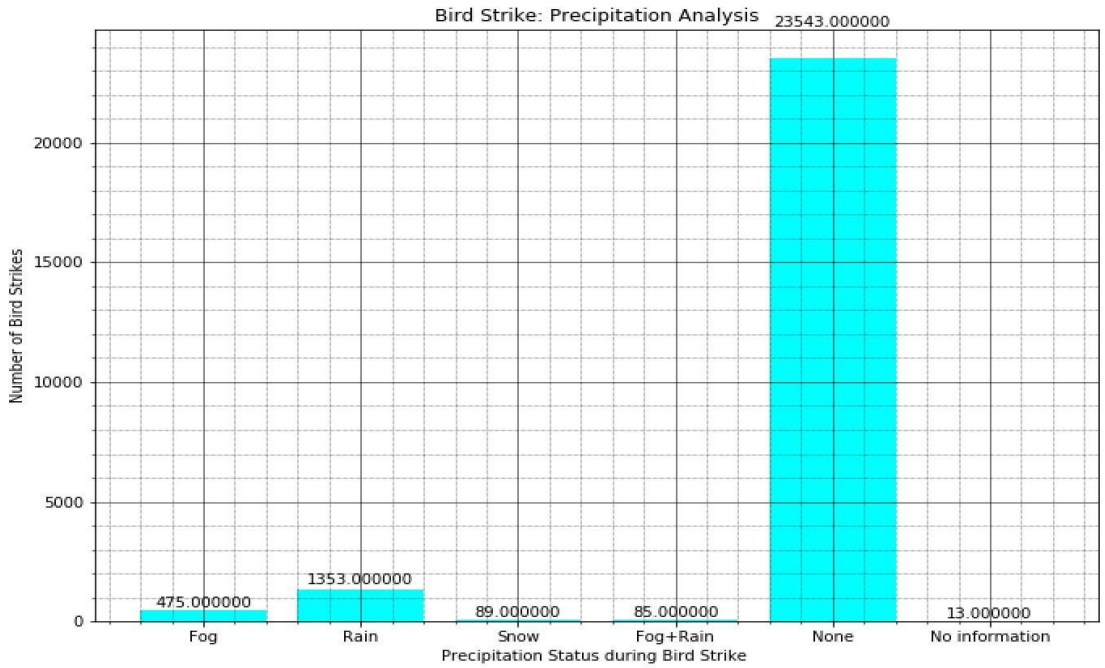
tk

Prediction of Number of Birdstrikes

Type your Number:

Get the Prediction

Question-9



Quit

6.Test Cases:

6.1 Test Cases:

As the number of bird strikes may reduce in future due to improvements in technology, therefore linear regression may not be able to accurately predict the number of bird strikes. Therefore, the random forest algorithm is a better algorithm for making predictions in such a case. We have applied the random forest algorithm to make predictions of bird strikes at Mumbai airport.

6.2 Test results:

The random forest algorithm predicted no. of bird strikes at Mumbai airport with an accuracy of approximately 80%.

7. Result Analysis:

7.1 Evaluation measures:

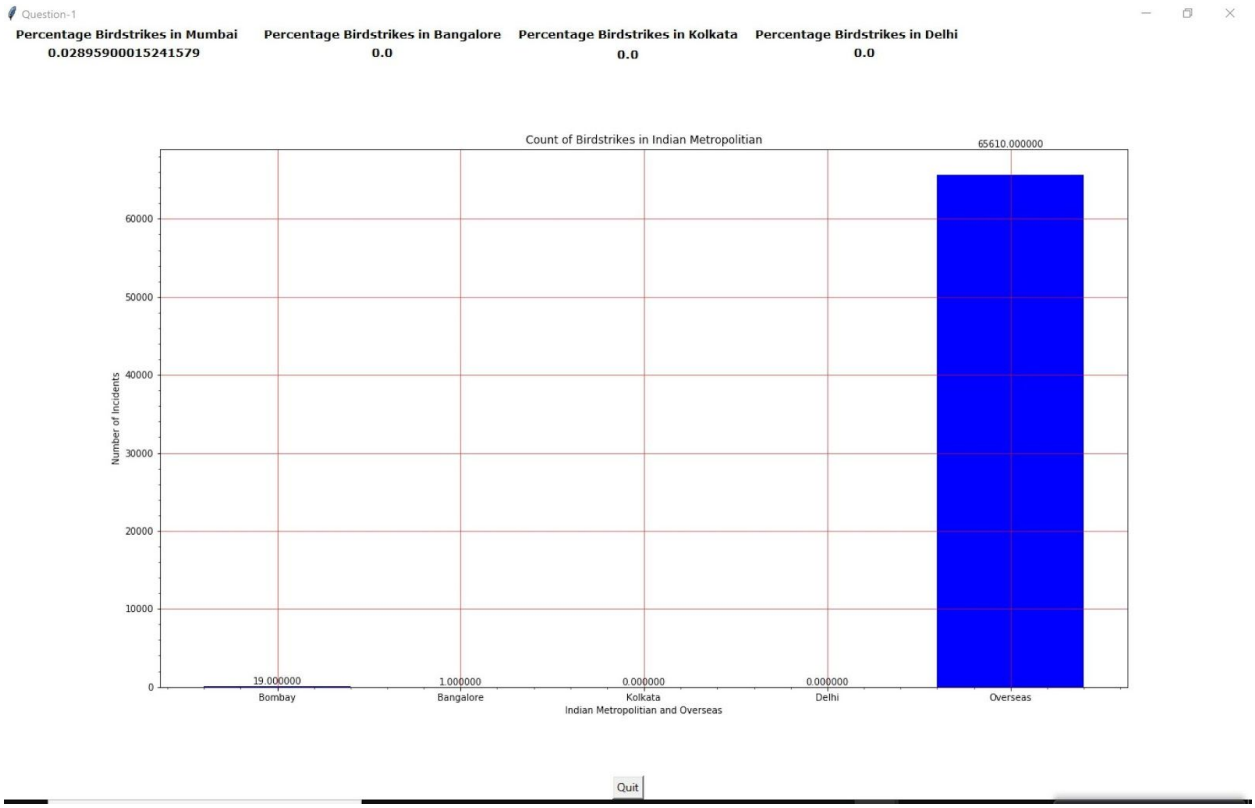
To evaluate the performance of the predictive linear regression model, the number of bird strikes in the years from the available data were predicted using the model and compared with the actual values. The model was found to have a high level of accuracy.

7.2 Input parameters considered:

The number of bird strikes have been analysed with respect to the following factors:
1.Pilot Waring Status
2.Time of day
3.Phase of flight
4.Precipitaion Status
Other than this:
1.The damage cost trend has been analysed with respect to size of birds
2. The number of cases have been found for each month where the remains of the involved bird could be collected
3.The average altitude and average speed of aircrafts during bird strikes have been found

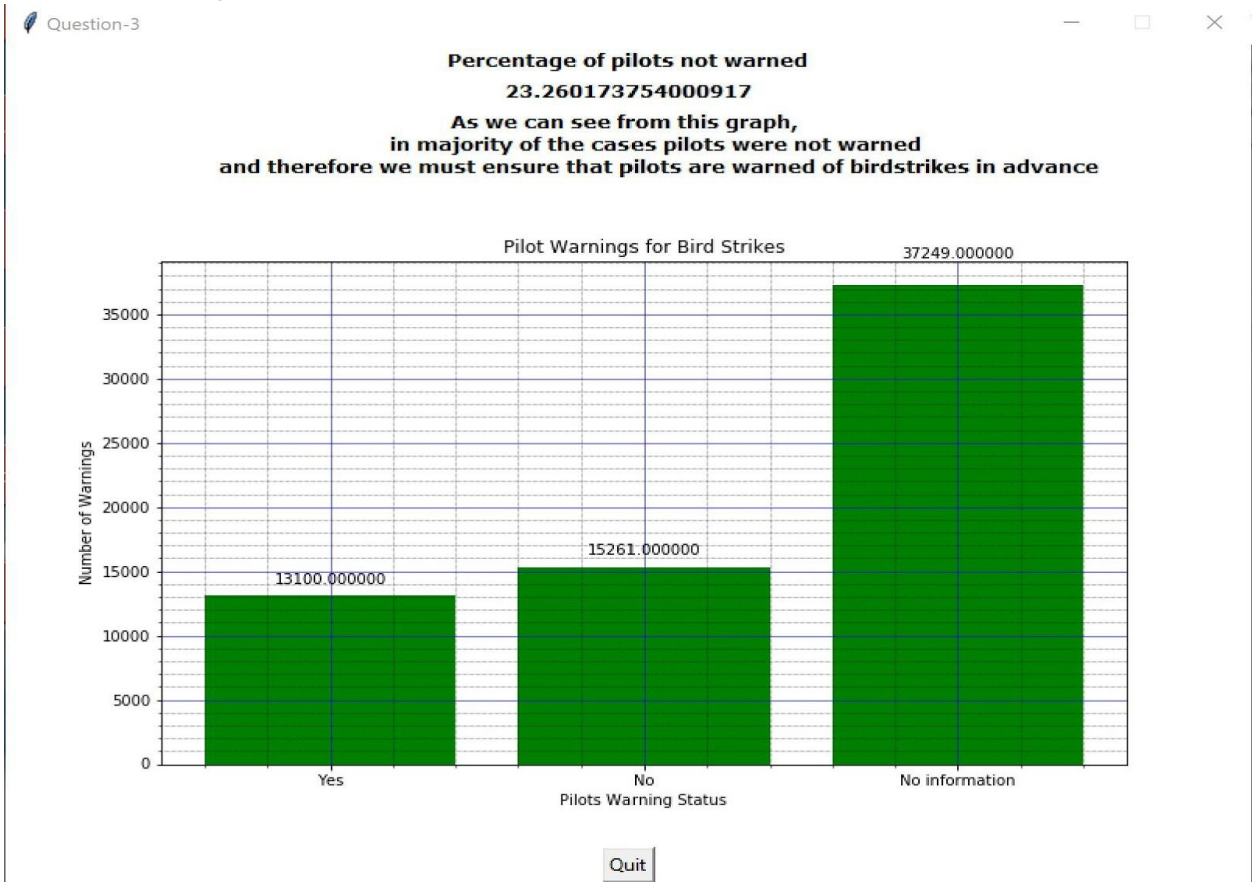
7.3 Graphical and Statistical Output:

1.No. of bird strikes in India:



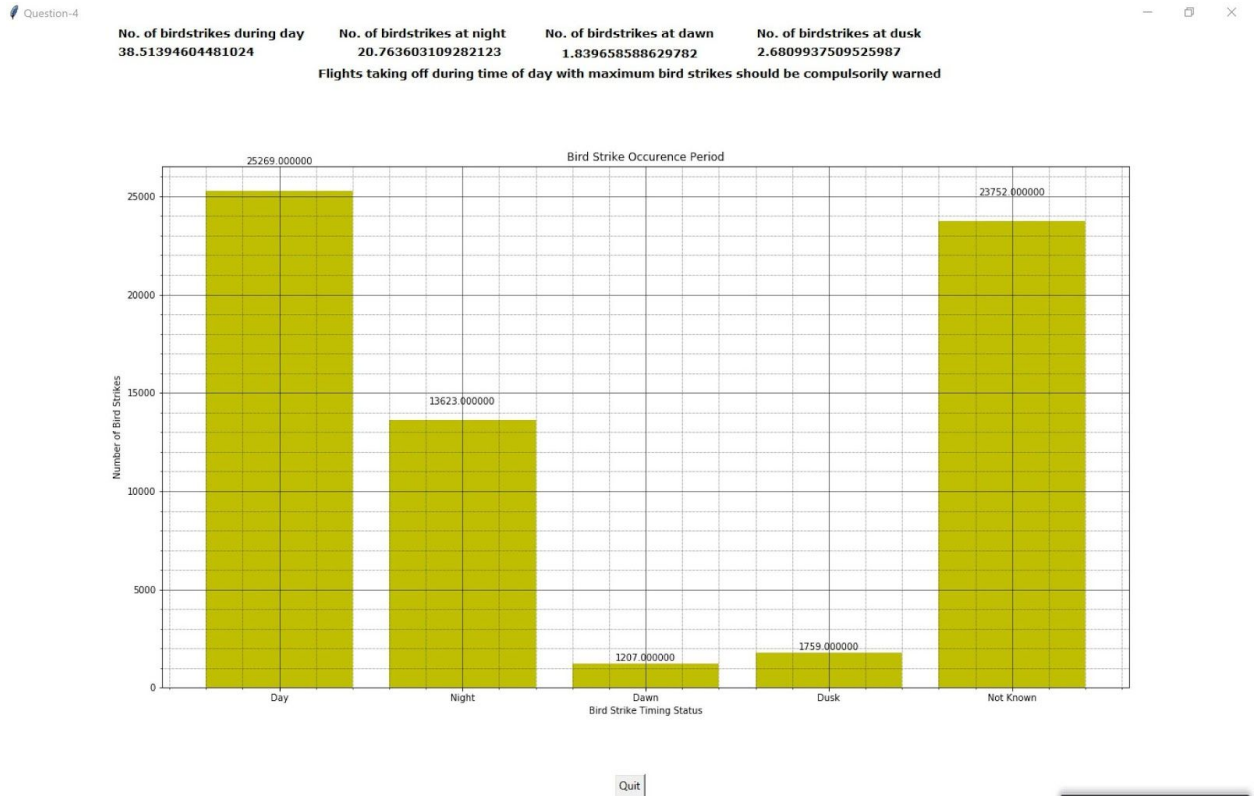
The graph shows that India has incidences of bird strikes in comparison to the world statistics. From 2005 to 2011, there have been only 19 cases of bird strikes in India's metropolitan cities, all of which occurred at Mumbai airport.

2.Pilot warning status:



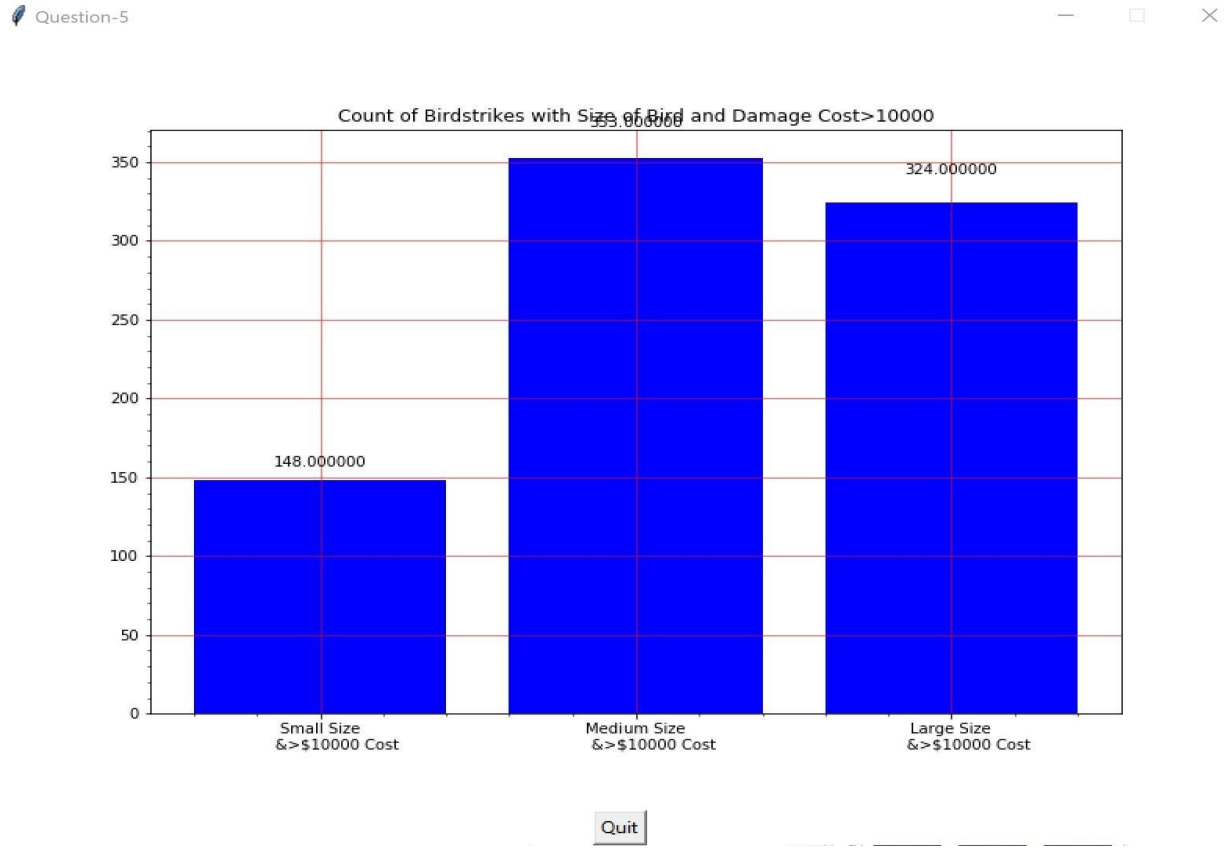
It can be inferred from the graph that in the majority of the cases, pilots have not been warned in advance about the possibility of occurrence of bird strikes or information is not available as to whether the pilots were warned or not, indicating that warning in advance reduces the probabilty of occurrence of bird strikes.

3. Time of day:



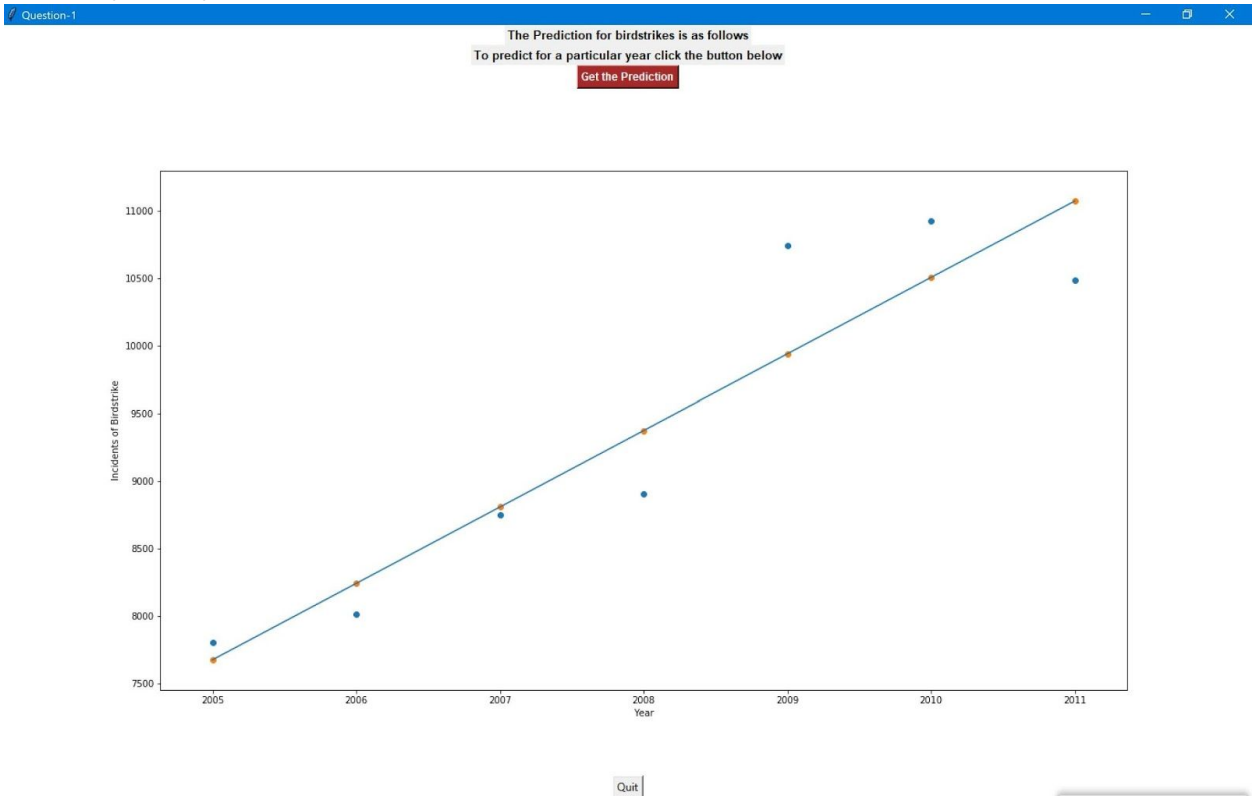
It is clear from the graph that most occurrences of bird strikes are during the day time. Therefore in day time flights, pilots should compulsorily be warned about the possibility of bird strikes.

4. Damage cost trends with respect to size of bird:



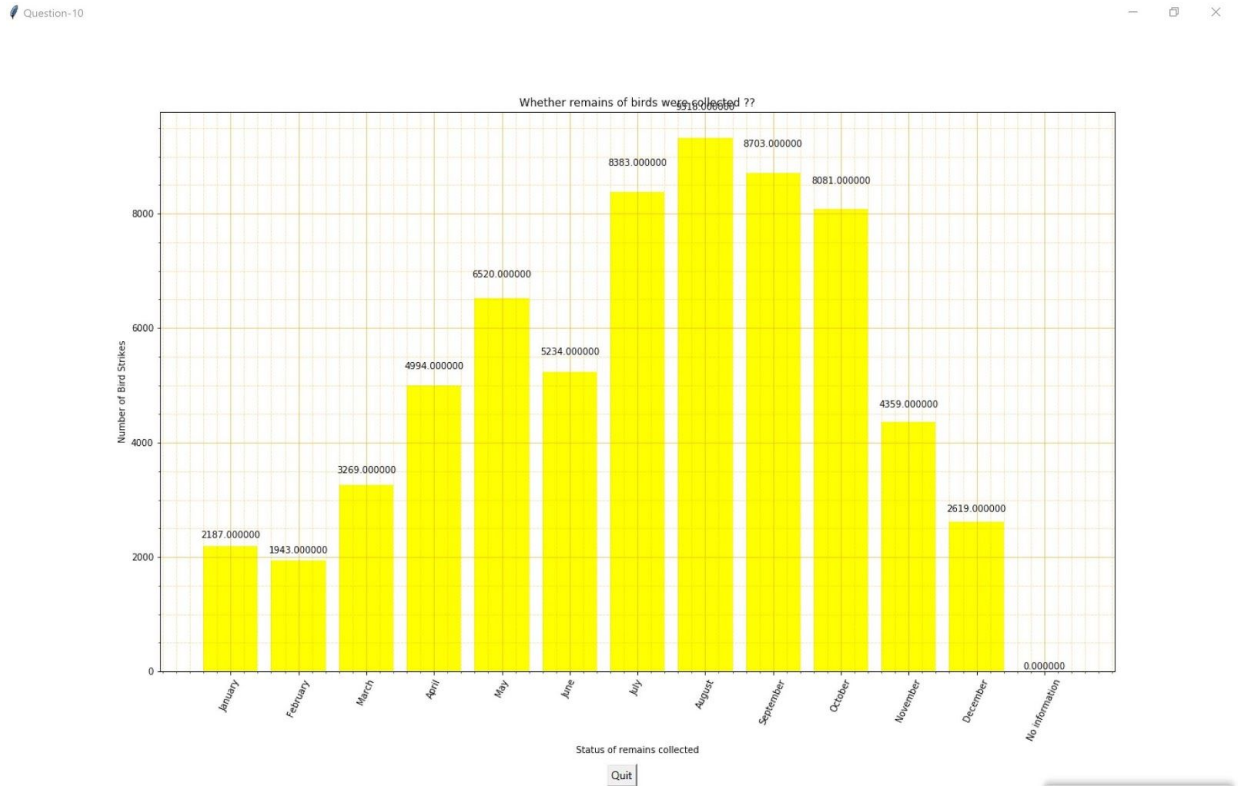
According to the graph, the number of cases where the damage cost is greater than $10000 are maximum for medium size of birds, less for large size of birds and least for small size of birds. Thus, we can see that there is no fixed trend between size of bird and damage cost. We conclude that damage cost is independent of the size of the bird.

5.Yearly analysis of bird strikes:



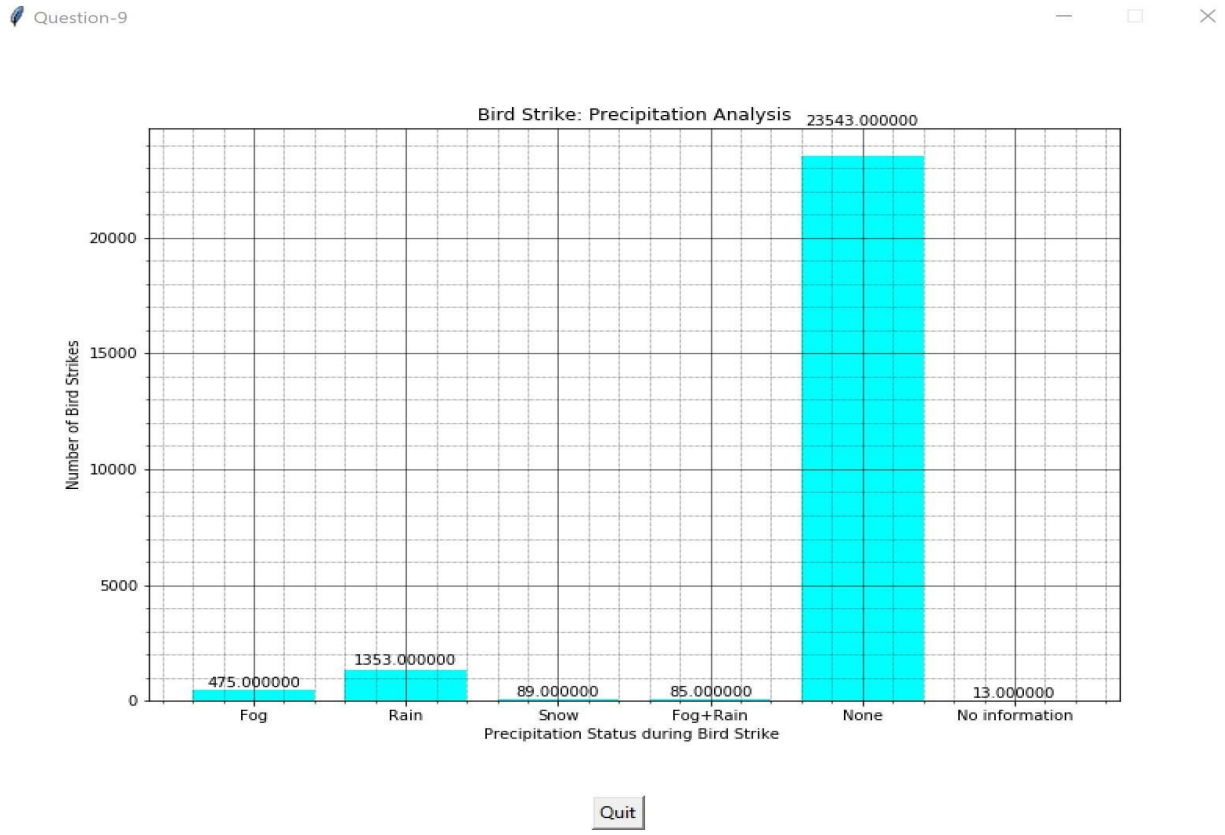
It can be observed that according to the available data, the number of bird strikes have increased over the years. The values predicted by the linear regression model are close to the actual values.

6. No. of cases where remains of birds were collected:



It can be inferred from the graph that in most cases the remains of birds have been collected.

7.Precipitation status:



The graph shows that the maximum occurrences of bird strikes are in clear weather, i.e. in the absence of rain, fog and snow. Some of the incidences of bird strikes were in rainy weather, a few incidences in fog and minimal number of incidences during snowfall and in cases where there was fog and rain both.

7.4 Comparison with the existing systems:

Currently, airports mainly rely on repelling birds in order to avoid the occurrences of bird strikes. Also, pilots take care of factors such as speed and altitude. While these methods may be effective, it is still not possible to know when or where a bird strike would occur as it depends on the position of the bird at the time. However, the system developed in this project analyses the occurrences of bird strikes with respect to several factors and thus can predict when and where the probability of bird strikes would be high so that pilots can be warned in advance, thus making them more alert and thereby reducing the probability of the bird strike.

7.5 Inference:

As the developed application has high accuracy and takes multiple factors into consideration, it can be used as an effective tool in accurately predicting the probability of occurrence of a bird strike during a particular flight and can thus help to prevent the bird strike.

8. Conclusion:

8.1 Limitations:

- If speed of the aircraft or the bird is too high, then prediction may fail, as it cannot cater to such high speeds.
- The species of the birds that were involved in the accident is difficult to know.
- There are many situations in which the pilot is unaware or uninformed about the bird strikes that may take place,
- so in such situations the predictions are of not much use.
- Since these are just predictions based on previous data, so with the changing environmental conditions it is difficult to predict accidents based on previous data.

8.2 Conclusion:

- We can use various algorithms of machine learning and technologies and put them to use for such actual life problems.
- Based on previous data , we can predict whether or not the accidents will take place by using machine learning algorithms and technologies.
- By making this project we have come across various aspects of machine learning and learnt how to apply them to real life situations and problems.
- We can thus use machine learning algorithms in an efficient way , thus contributing to the betterment of the environment and maintaining the balance of the ecosystem.
- We can thus help the aviation industry to reduce the number of possible accidents by making such platforms where they can get the prediction of the accidents that may take place.
- We can also help maintain the ecosystem by trying to reduce the number of accidents thus saving the species of birds.

8.3 Future Scope:

- By learning the application of machine learning algorithms and technologies, we can now apply them in various fields like agriculture, medical industry, weather estimation etc where dynamic results are required based on the training of already available dataset.
- By making such projects we can contribute significantly to the maintenance of the balance of the ecosystem, by making people and authorities aware of any accidents that may take place in a situation based on previous data.

With the development of new technologies in the future that help in the prevention of bird strikes, the number of occurrences of bird strikes might reduce in the future. Therefore, after a certain number of years the predictions made by linear regression may not be accurate. Therefore, random forest algorithm can be used for making more accurate predictions about the number of bird strikes in future years. This has been implemented for Mumbai airport by analysing only the required selective rows from the dataset.

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