Bird Recognition and Prevention Safety Using Artificial Intelligence

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Abstract— Bird strikes are dangerous for aircraft due to the relative speed of the plane with reference to the bird and it became an important part of airport safety. Airports are usually located in the area that has a large area of undeveloped land and birds are usually attracted to a large undeveloped land. The chances of bird strike are more especially at lower altitudes and that too while landing and take- off. In this paper, we are using artificial intelligence for bird recognition, and analyses of different types of application and also the bird identification technology in the current airport bird prevention. The risk of bird strikes is calculated for birds expected to cross the extended runway center line and to cause aircraft damage upon impact. By specifically targeting these birds and excluding birds surviving on the runway which are taken care by the local wildlife control.

Keywords: Airport, Bird Strike, safety, risk, damage collision avoidance, Artificial Intelligence

I. INTRODUCTION

Bird Strike is common and can be a significant threat to aircraft safety. A bird strike is defined as a collision between a bird and an aircraft and it occurs during any phase of flight, but are most likely during the take-off, initial climb, approach and landing phases. Since most birds fly mainly during the day, most bird strikes occur in daylight hours as well. The problem of bird strike aircraft is a difficult problem in the safety management of the world aviation industry today. With the development of information technology, airport technicians from various countries have proposed corresponding technical optimization methods and equipment by means of the Internet of Things and artificial intelligence for bird recognition which can reduce the inefficiency and errors caused by manual control in the traditional bird driving. This paper focuses on the application of artificial intelligence technology in the bird identification phase of the current airport bird control process. The artificial intelligence recognition of birds mainly includes two characteristics, including the recognition of bird chirps and bird body features.

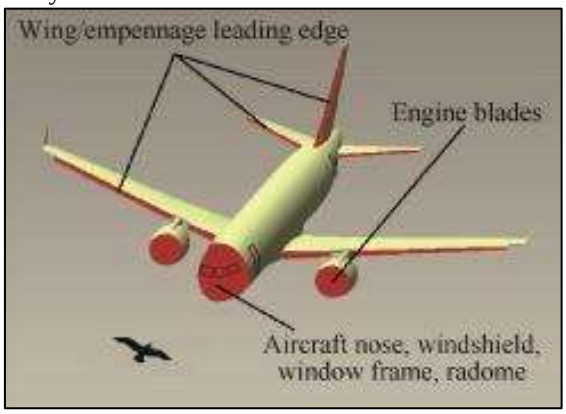

Fig. 1: Design of aircraft structures against threat of bird strikes

The main purpose of the existing airport bird identification technology is to realize the identification of birds in the airport, and to record and analyses the bird population, so as to provide help for subsequent targeted bird driving.

II. LITERATURE REVIEW:

Depending on the country, average bird strike in India as of year 2018, the airport recorded a total of 85 bird hits, the highest since 2014; i.e. one bird strike per 922 flights. While the Indian regulator keeps a track of annual bird strikes at Indian airports, what is critical is the rate of strikes. For instance, in 2014, Delhi topped the government list of most critical airports for wildlife strikes (largely bird strikes) with 142 incidents, followed by Kolkata with 62 strikes, Mumbai at 60 strikes and Ahmedabad at 54 strikes.

Fig. 2: Bird Strike Air India A320 Neo

III. DATA PROCESSING REGARDS BIRD STRIKE USING ARTIFICIAL INTELLIGENCE

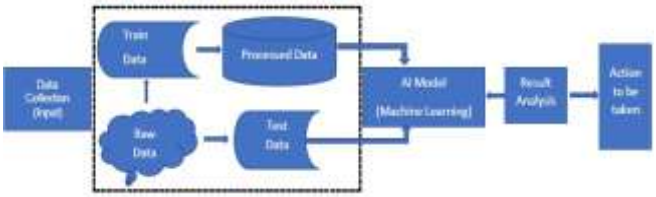

Fig. 3: Block diagram of Bird strike using Artificial Intelligence

In data collection stage, will collect non-structured data, including images, texts, and voice. In this stage, the first pre-processing is carried out, which is extracting data fit for the purposes and functions of the AI to be developed.

In data Processing stage, the collected data are converted in order to enter them in the machine learning

model, including filling or deleting missing values, selecting or deleting data properties, combining existing data properties, and converting raw data into a designated type as needed. In data Analysis stage, data are analysed to be applied to AI, including exploring standardized data patterns, data mapping, extracting data based on exploration and inference, and data learning using some of the data. Image data collection and pre-processing using python libraries as shown in below snippet code.

```
TrainPath = "//Users//sunil//Desktop//Patent_Paper//PlanesBirds//Train"
ValidatePath = "//Users//sunil//Desktop//Patent_Paper//PlanesBirds//validate"
TestPath = "//Users//sunil//Desktop//Patent_Paper//PlanesBirds//Test"
```

```
train_batches = ImageDataGenerator(preprocessing_function=tf.keras.applications.vgg16.preprocess_input) \
    .flow_from_directory(directory=TrainPath, target_size=(224,224), classes=['Birds', 'Planes'], batch_size=10)

valid_batches = ImageDataGenerator(preprocessing_function=tf.keras.applications.vgg16.preprocess_input) \
    .flow_from_directory(directory=ValidatePath, target_size=(224,224), classes=['Birds', 'Planes'], batch_size=10)


test_batches = ImageDataGenerator(preprocessing_function=tf.keras.applications.vgg16.preprocess_input) \
    .flow_from_directory(directory=TestPath, target_size=(224,224), classes=['Birds', 'Planes'], batch_size=10)
```

```
Found 400 images belonging to 2 classes.
Found 326 images belonging to 2 classes.
```

IV. BIRD IDENTIFICATION AND CONTROLLING TECHNOLOGY IN AIRPORT:

The main purpose of the existing airport bird identification technology is to realize the identification of birds in the airport, and to record and analyse the bird population, so as to provide help for subsequent targeted bird driving. Bird identification based on bird song identification will be difficult to achieve the required recognition speed. The existing bird recognition technology is mainly divided into two types: bird chirping recognition and bird body recognition. Due to the high security requirements in the airport and Internal more restrictions on various types of machinery and equipment, image recognition and artificial intelligence for bird body recognition is more suitable for the current bird identification requirements for bird control in the airport. Capturing the Bird and plane images from above collected data as below.

A. Bird strike risk assessment process.

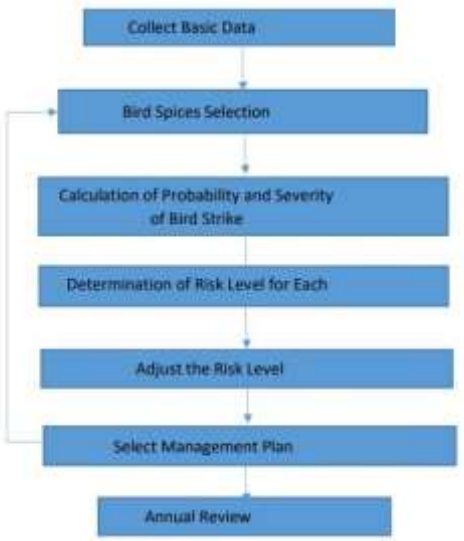

Fig. 4: Airport bird strike risk assessment process.

1) Collect Basic Data: Investigate the quantity, flight height, distribution range and cluster situation of bird species, which living in the airport and its vicinity of 8km
2) Bird Species Selection: Select a Bird Species for detailed risk assessment
3) Calculation of The Probability and Severity of Bird Strikes: Calculate the Probability and Severity of Bird Strikes according to the Cluster, coefficient, flight altitude risk coefficient, activity range risk coefficient, comparative quantity and comparative weight
4) Determination of Risk Level for Each Species: Determine the location of different species of birds on risk assessment matrix
5) Adjust the Risk Level: Adjust the Risk Level of individual bird species according to the actual situation in airport
6) Select Management Plan: For high danger bird species, determine the time table to take specific preventive measures and for moderate danger bird species, develop preventive measures and pay attention to prevention in daily life
7) Annual Review: At least one per year, recalculate the risk levels based on the new date obtained and determine if the management actions are effective in reducing strike numbers.

Using sequential model to predict birds and airplanes as shown below.


```
model = Sequential([
    Conv2D(filters=32, kernel_size=(3, 3), activation='relu', padding = 'same', input_shape=(224,2
    MaxPool2D(pool_size=(2, 2), strides=2),
    Conv2D(filters=64, kernel_size=(3, 3), activation='relu', padding = 'same'),
    MaxPool2D(pool_size=(2, 2), strides=2),
    Flatten(),
    Dense(units=2, activation='softmax')
])
```

Below is the model output with 100% accuracy

```
Epoch 17/20
40/40 [==============================] - 247s 6s/step - loss: 5.0366e-08 - accuracy: 1.0000 - val_loss: 0.2684 - va
l_accuracy: 0.9632
Epoch 18/20
40/40 [==============================] - 245s 6s/step - loss: 4.6193e-08 - accuracy: 1.0000 - val_loss: 0.2700 - va
l_accuracy: 0.9632
Epoch 19/20
40/40 [==============================] - 244s 6s/step - loss: 4.2021e-08 - accuracy: 1.0000 - val_loss: 0.2707 - va
l_accuracy: 0.9632
Epoch 20/20
40/40 [==============================] - 248s 6s/step - loss: 3.9339e-08 - accuracy: 1.0000 - val_loss: 0.2724 - va
l_accuracy: 0.9632

[24]: <tensorflow.python.keras.callbacks.History at 0x7fb9405ba410>
```

B. Flow Chart of airport bird strike process.

Below figure represents the flowchart of airport bird strike process. In stage 1, will collect data from the camera such as images, texts, and voice. Then will compare the captured object is airplane or bird. If it is bird then display the message bird is detected and if not then display the message as Airplane is detected. After displaying the message, if bird is coming towards the plane then Action to be taken else not. If nothing detected then display "unidentified object"

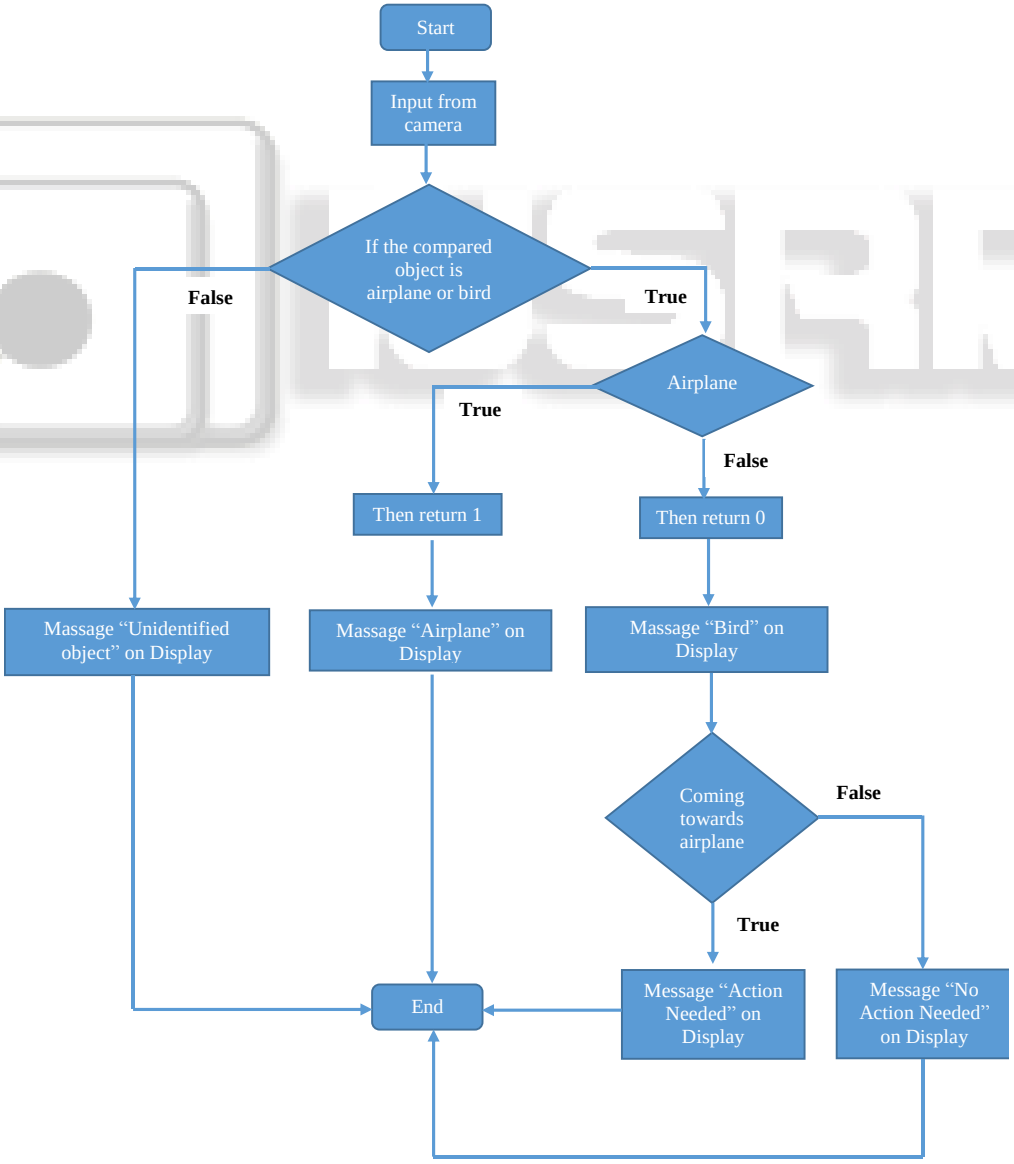

Fig. 5: Flow chart of the airport bird strike process.

V. APPLICATIONS:

These are following applications where we can use the system.

- Airport ground
- Airplane In SSLF
- High buildings or sky scrapers
- Harvesting area
- Formula 1 cars
- Rocket Launching stations

VI. CONCLUSION:

Bird Strike put the lives of aircraft crew members and their passengers at risk. The study suggests that machine learning techniques make it possible to predict the cause of airplane crashes. Collisions between birds and aircraft pose a serious risk to aviation. They mostly influence airport and aircraft operations and the efficiency of the air traffic management system. Furthermore, with their potential for severe damage and accidents, they pose a threat to aviation safety and a significant cost to the airline industry. Bird-strike aircraft accidents cost too much morbidity, mortality and financial cost in aviation.

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[6] management Bin Guo et al 2020 IOP Conf. Ser.: Earth Environ. Sci. 565 012092
[7] Analysis of Risk-Based Operational Bird Strike Prevention
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