Automatic detection of flying bird species using computer vision techniques.

R.Vishnuvardhan*1, G.Deenadayalan2, M.V.Vijaya Gopala Rao2, Sheetal P JadHAV2, Adithya Balachandran2

1Department of Mechatronics engineering, Sri Krishna College of engineering and technology, Coimbatore, India
2Department of Mechanical Engineering, Hindustan Institute of Technology and Science, Chennai-603103, India

Abstract--Bird population is an important factor that may affect ecology of the an area. The main aim is to create a solution for counting different species of birds present in an area and classify them into categories. There are around 1300 species of birds found in India and there can be chance that a new species which remained unidentified till now. We can calculate the number of bird species available in a locality and keep a track whether any species are in risk of being endangered. Calculating the bird population can help the ecologist to search the problem which may endanger them. Manual labor for counting and searching for new species is time consuming and error prone. In the present work, The method of solution is to create a computer vision system using machine learning techniques or deep learning method for a better accurate results. Automatic Bird detection system is primarily useful in providing optimal bird count in region with counting, the system also classifies the bird based upon its species and features, after detecting the bird, the segregates the data according to the bird’s features. This data which is stored in the database can be accessed by scientists, photographers, and also by surveying units as this data provides important information about the number of birds in the area, the type of birds, Their features, and also this data helps scientists in predicting the environmental changes in the particular area by analysing the type of birds visiting the area based upon seasonal changes.

1. Introduction

Automatic bird detection is a method that solves different problems that arises due to birds and for an ornithologist who wants conduct a research. Collecting bird population data is useful for certain situation like for a farmer who is planting crops nearby or a scientist who studying migration of birds. Surveying the bird population around an area is a huge task as we are trying to identify an bird which is moving constantly. There are several other factors such as lighting we should look into. Our main objective is to count different species of birds available in that locality or find a new species that may be unidentified by the others. In the proposed research work, a 360 degree camera for counting the birds and for taking a photo we are using another camera for taking better pictures for publications. Recently there several computer vision algorithm for image processing but we are using convolutional neural networks for differentiating different birds species. We are using different counting methods for birds such as timing, mixed and other relative and appropriate methods would be applied for further improvement in the working of the neural engine.

2. Methods Used for Detection

The convolutional neural networks are employed for the process of “Identifying” and "Classifying”. Also, The CNN’s are most commonly applied for visual imaging purposes. Initially, The sample datasets (Pictures of birds which are of the similar species, this method is repeated for
different species as well) are fed into the neural networks and after learning, the neural networks is tested. The CNN is a part of deep learning which a vast field in itself is.

The deep learning forms the basis of all the neural network operations. At this level, the neural engine is provided with lots of test data through which the neural engine develops a sense of perfection and accuracy in terms of identifying and classifying the bird species. Further, At machine learning level, the efficient algorithms are applied which further empowers the neural engine to learn and improve their performance as they are exposed to more data.

Finally, the artificial intelligence acts on the process data in order to efficiently segregate the acquired bird data with respect to their species and type in the database.

Furthermore, computer vision methods like Faster R-CNN (Regression CNN), and object tracking could be employed for the better performance of the neural engine.

![Fig.1: Layers of Computational Intelligence](image)
Fig. 2: R-CNN Working.

Fig. 3: Working of the convolutional neural network.

The Execution window(Output):

Fig. 4: Execution window
Working Of The System:

The working of the proposed system is the culmination of various hardware gadgets and a wide variety of software solutions which are employed for a better and faster recognition of the birds and also for the photography and database recording purpose.

In the base model specified (fig 4), Various equipments are placed for different operations which are explained below. At the heart (controller) of the system, a powerful multicore processor equipped with the most efficient and faster SSD storage option which helps in faster data acquisition, data transfer rate, and also this storage option helps in the faster task execution of the neural engine. Technically, the working of the system is such that, at the first place, the bird is detected by a high speed camera using the convolutional neural network concept, and furthermore the specific height of and spot of the bird are calculated and coordinated by the controller. This coordinates of the bird is based on the movement of the bird using Fast R-CNN method, further after specifying the bird coordinates in the virtual vicinity of the system, the particular or the nearer camera gimbal is moved to that particular coordinate facing the bird and the snapshot the bird is taken. The movement of the camera gimbal system is enabled with the help of internal movement of the electromagnetic chuck which attaches to the specific camera gimbal section based on the input bird coordenated provided by the controller. The magnetic chuck is moved vertically inside the pole using the miniaturised magnetic V-Belt which holds the chuck using electromagnet. This particular electromagnetic force is only applied until the chuck reaches the specific camera gimbal section. Thereafter, the belt electromagnetic force is gradually weakened and the metal of the chuck is attracted magnetically by the magnetic force applied by the electromagnetic section ring. After the magnetic chuck holds the section ring, the rotary actuator rotates the section ring in the bird coordinate direction specified by the controller. The gimbal places the camera (which is equipped with object tracking) in the proper position so as to get a clean snapshot of the bird. After the photograph of the bird is captured the snapshot is studied and classified with respect to its species, type, and colour and is segregated in the database in order of its species name and the respective species common name. This database is uploaded to the main server (of the respective organisation who is handling the selection system) using wireless, or wired transmission systems. Further, if any new species is found then the details of the bird are noted and a public opinion is posted by the server in order to name the bird. The
power supply to the system is provided by the flexible solar panels which are slightly thicker than the size of the human hair hence accounting for the lightweight capability of the solar panel. The number of solar panels are placed taking into consideration the total power consumption of the system (which consists of 4 normal cameras with small gimbal motors, 1 High speed camera, 2 rotary actuators (1 for internal belt movement and 1 for gimbal section rotation), control unit). To enable light to reach to the solar panels (as they are placed in a curved manner), the light aggrandisers (2 no’s) are placed so as to increase the light incident area. The system is rugged enough as the controller unit casing and the solar panels used are whether resistant, the cameras are equipped with strong casing which are also whether resistant. These features enables the system to be used in any environment.

![Proposed Model Specifications](image)

**Proposed Model Specifications**

The model involves various components which are efficient in producing the desires result. The flexible solar panels consisting of mono and polycrystalline solar cell has an open circuit voltage of 94.4V and optimum power voltage of 80V with optimum operating current as 1.25A. The peak power rating is 100W and the weight is 5KG(Approximately). These solar panels are highly efficient and are light in weight and flexible, also these are mostly unbreakable as they are no glass elements. These solar panels are enough for keeping the automated system in running condition and also to portably supply power to the system in any outdoor environment. The second component required in the proposed model is a high speed camera. This high speed camera has a resolution of 1280 x 1024 pixels with maximum recording speed of 10,000 fps and a shutter speed of 2.14 microseconds (User Selectable). This high speed camera is portable and easy to use and consists of an on-board image measurement. Also, these cameras come with a high speed electronic shuttering thus enabling these cameras to provide high quality images of the objects which are moving faster. A set of four small portable cameras of 12 megapixel resolution and an aperture of f/1.2 are used these are waterproof and are made rugged in terms of construction. Also, a set of four 3-axis gimbals are used for the small portable cameras, these help the camera to stay stable at any axis and makes shooting easier at different angles easier. The gimbal has a load capacity of 0.36 kg to 1.77 kg, also the gimbal has a rotation range of 360 degrees (Pan, Tilt, Roll) and a follow speed of 120 degrees/s (Pan, Tilt, Roll).

![Signal Flow Diagram](image)
3. Conclusion

The data sharing platform is completely designed and the base tracking and detection code has been tested and the results are provided. The data sharing provides a one stop information base for data related to birds and their features like the species, and the detailed information about their features is applied to the respective birds as they are detected and stored in the database. The bird species and their features are already stored in the memory of the controller unit and as the birds are detected, the respective data is applied for the birds.

The blend of an efficient and rugged hardware with an intelligent neural engine are equipped to perform the automatic detection of the birds and also the photographs obtained are sharp enough which would help in the field of wildlife photography. Also the bird data helps scientists to study about the environmental changes based on the bird population patterns and also helps the scientists to predict the weather phenomena. Finally after the analysis is complete the results should be ready to be published.

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