Review Article

Animal Detection in Farms Using Deep Learning

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Abstract-

Agriculture is the most significant sector of the Indian economy, the problem of wild animals damaging crops has recently become a significant societal concern. So far, many of the farmers rely on guards to guard their crops which increases the overhead costs. But because of the present environment, crop failure rates have substantially increased. Debt in agricultural sector has increased tremendously. In these circumstances, a farmer cannot anticipate additional crop devastation and cannot afford to raise agricultural expenditures. The goal of this research is to develop an algorithm to recognize animals that trespass on agricultural property. Since there are enormous number of various animals physically distinguishing them can be a troublesome undertaking. This calculation arranges animals in view of their pictures so we can screen them more proficiently and blast a Siren when the animal is detected so that the animal scatters away. This can be accomplished by applying MOBILENET SSD algorithms which is a powerful real-time object detection algorithm. MOBILENET SSD detects an object with the help of the features of deep convolutional neural network.

Keywords: *Animal Detection, Image Processing, Real-time Object Detection, MOBILENET SSD, Deep Convolutional Neural Network.*

1. Introduction

Agriculture meets the food demands of the population and provides various raw materials for different industries. Interference of animals in agricultural lands causes a huge loss of crop. Crop damage due to raiding wild animals has become a major issue of concern these days, small farmers can even lose up to half of their yield to animals and they cannot take any harsh measures due to the strict wildlife laws. Computer vision is applicable to many fields like medical field, robotics, remote sensing, machine vision, content-based image retrieval. Computer vision is the study of how to simulate some of the complexity of the human visual system so that computers can recognize and analyze objects in images and videos in a way that is comparable to how people do it. OpenCV, a sizable open-source library for image processing, machine learning, and computer vision, is now a key component of real-time operations. Using OpenCV, one can analyze photos and videos to recognize objects, people, and even human handwriting too. In this project, we proposed a new and cost-effective solution for agriculture security from animals. It is a proactive solution which gives alerts to the farmers when animals come near to the farms. It also causes certain siren to be played whenever any animals are detected and is directed towards the animal to scare them away. Here, we are implementing a solution that recognizes animals when it is captured on camera.

2. Objective

The objective of this project is to develop a real-time animal detection system for farms using MobileNet SSD (Single Shot Detector). The system should be able to detect different types of animals such as elephants, leopards, and pigs in the farm surroundings using a live video feed from a camera. And to protect the farming area from wild animals and moreover to protect them by driving them away rather than killing them. The research also aims to protect human lives from animal attacks. In the area of deep learning, we are using an integrative methodology to provide a preventing and repelling system for crop insurance against animal attacks.

3. Literature Survey

1] Parikh, M. et al. "Wild-Animal Recognition in Agriculture Farms Using W-COHOG for Agro-Security." (2017).

Computer Vision is applied in agriculture field for food grading, disease identification of the plants and agro-farms security. Huge crop damage is caused by the wild animal attacks on the agriculture farms. Here are some traditional techniques followed by the local farmers, but which are not effective. This problem can be solved using computer vision techniques. In this paper, we proposed an algorithm to detect animals in a given image. WCoHOG is a Histogram oriented gradients-based feature vector with better accuracy. It is an extension of Co-occurrence Histograms of Oriented Gradients (CoHOG). In this paper LIBLINEAR classifier is used in order to get better accuracy for high dimensional data. The experiments were conducted on two benchmark datasets called Wild-Animal and Camera Trap dataset. Experimental results prove that W-CoHOG performs better than existing state of the art methods.

Summary: This journal discusses about the Computer Vision and its application in the field of agricultural safety.

[2] S. Yadahalli, A. Parmar and A. Deshpande, "Smart Intrusion Detection System for Crop Protection by using Arduino," *2020 Second International Conference on Inventive Research in Computing Applications (ICIRCA)*, Coimbatore, India, 2020, pp. 405-408, doi: 10.1109/ICIRCA48905.2020.9182868.

Agriculture is still one of the most crucial sectors of the Indian economy. It is important for human survival as well as economic growth. Traditional systems like humanoid scarecrows are used even today in an agricultural field to stop birds and animals from disturbing and feeding on growing crops. There are many loopholes in such ideas and so enhancing agricultural security has become a major issue these days. Thus, this paper focuses on proposing a system which detects the intruders, monitors any malicious activity and then reports it to the owner of the system. It acts as an adaptable system which provides a practicable system to the farmers for ensuring complete safety of their farmlands from any attacks or trespassing activities.

Summary: This journal helps us in understanding the use of AI and its integration with motion detector and IR sensor to the agricultural field.

[3] Howard, Andrew & Zhu, Menglong & Chen, Bo & Kalenichenko, Dmitry & Wang, Weijun & Weyand, Tobias & Andreetto, Marco & Adam, Hartwig. (2017). "MobileNets: Efficient Convolutional Neural Networks for Mobile Vision Applications."

We present a class of efficient models called MobileNets for mobile and embedded vision applications. MobileNets are based on a streamlined architecture that uses depth wise separable convolutions to build light weight deep neural networks. We introduce two simple global hyperparameters that efficiently tradeoff between latency and accuracy. These hyper-parameters allow the model builder to choose the right sized model for their application based on the constraints of the problem. We present extensive experiments on resource and accuracy tradeoffs and show strong performance compared to other popular models on ImageNet classification. We then demonstrate the effectiveness of MobileNets across a wide range of applications and use cases including object detection, fine grain classification, face attributes and large-scale geo-localization.

Summary: In this paper, we learn the about MobileNet SSD (Single Shot Detection) which we have extensively used in our project. It offers massive gains in efficiency over models like ResNet, etc. and therefore can be used in low end hardware devices.

[4] Deshpande, Abhinav. (2016). Design and Implementation of an Intelligent Security System for Farm Protection from Wild Animals. 5. pp.2319-7064.

Crops are vulnerable to wild animals. Therefore, it is very important to monitor the nearby presence of animals. Then the actuation of various devices should follow to repel the hazardous animals. Traditional methods have been widely applied depending on the kinds of produce and imperiling animals. In this paper, we propose a method to protect farms from wild animals via ubiquitous wired network devices, which is applied to farm along with traditional methods to improve the protection performance. Operational amplifier circuits are utilized mainly for the detection of animal intrusion from the outside of farms. The proposed monitoring scheme is to provide an early warning about possible intrusion and damage by wild animals.

Summary: In this paper, we learn about animal detection and protection of crops using embedded systems.

4. Objective

The project's main objective is to protect the farming area from wild animals and moreover to protect them by driving them away rather than killing them. The research also aims to protect human lives from animal attacks. In the area of deep learning, we are using an integrative methodology to provide a preventing and repelling system for crop insurance against animal attacks**.**

5. Existing System

Since most of the farms in India are small, most farmers rely on medieval techniques like using a scare crow or relying on guards to monitor crops. More recently, crops are also being protected using electric fencing, but it can be highly cost inefficient which a small farmer cannot afford. Even if they can afford it, in most cases it is illegal to use such fences which governments uses as a measure to conserve the wildlife population. In busy seasons like the harvesting time, it can get difficult to have a guard, guarding and monitoring the crops from animals.

Disadvantages Of Existing Methods: High Cost, Prone to Seasonality, are highly inefficient, Requires costly Equipment's and Infrastructure.

6. Proposed System

The proposed system uses MOBILENET SSD algorithm to detect real-time object.

6.1. Mobile Net

MobileNet is a class of well-organized models called for mobile and embedded vision applications. This class of models is built on an architecture that is condensed and builds thin deep neural networks using depth-separable convolutions. It decomposes standard convolution into depth convolution and a 1×1 convolution known as point convolution. Deep convolution applies one filter to each input channel in the case of MobileNet. The point convolution then generates a 1×1 convolution to combine the outputs of the depth convolution. A typical convolution just requires one step to filter the inputs and combine them to create a new set of outputs. However, the depth-separable convolution divides it into two layers, one for filtering and one for combining, respectively. The computation and model size are significantly reduced by this factorization.

6.2. SSD (Single Shot Detector)

The term SSD stands for Single Shot Detector. The SSD method relies on a forward convolutional network to create a set of fixed-size bounding boxes and a score for the presence of object class instances in those boxes. Non-maximal suppression is then used to obtain the final detections. Fields contain offset values (cx,cy,w,h) from the default field. With a value of 0 set aside for the background, the score includes confidence ratings for each of the object types that are present. SSD represents multi-reference and multi-resolution detection techniques. Using a set of anchor boxes with various dimensions and aspect ratios defined at various points in the image, multi-reference approaches anticipate a detection box based on these references. Object detection is made possible by multi-resolution approaches at various scales and network layers. The SSD network uses an algorithm to detect several item classes in photos by generating a confidence score related to the presence of any object category in each default field to better fit the shapes of the items, it also modifies the boxes. Because it does not resample functions for bounding box hypotheses, this network is appropriate for real-time applications.

6.3. MobileNet SSD

This object identification model called MobileNet SSD uses the input picture to determine the output bounding box and object class. With MobileNet as its foundation, this Single Shot Detector (SSD) object detection model can quickly recognize objects that are tailored for mobile devices. Without the need of a separate area proposal network, the MobileNet SSD technique detects many objects in an image using a single neural network. To predicting the positions and classifications of items in a picture, it employs a method known as "multibox" detection. Because of its swiftness and effectiveness, the MobileNet SSD algorithm is a good choice for real-time object recognition on mobile devices. It has been employed in many different applications, such as object identification, face detection, and pedestrian detection. Overall, MobileNet SSD is a strong and adaptable algorithm that has shown promise for mobile object recognition. It is a popular choice for a variety of applications due to its speed and efficiency.

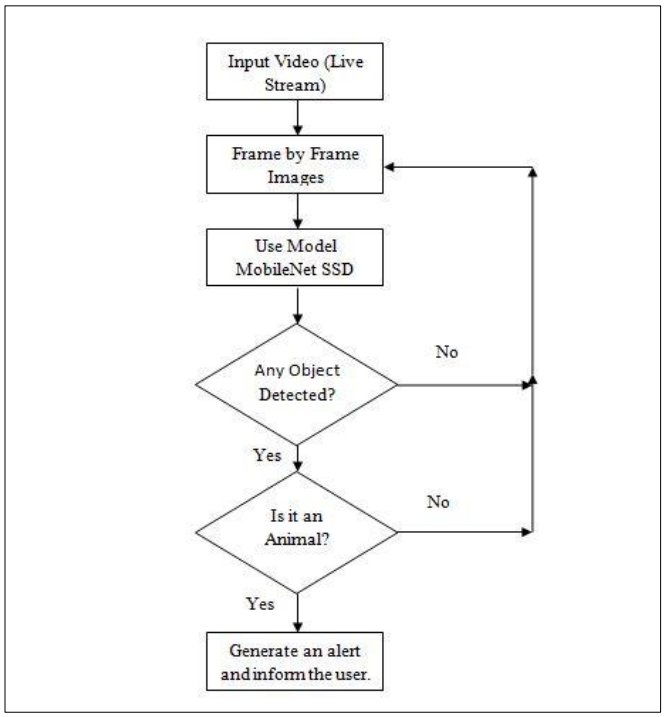

Figure 1. Working Model of Proposed System

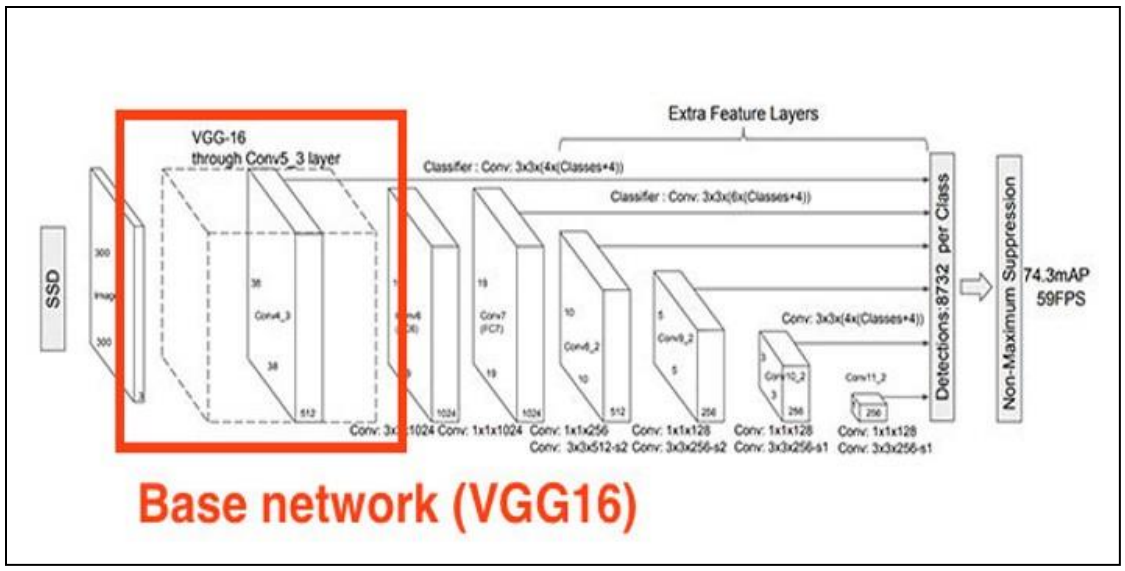

Figure 2. MobileNet SSD Architecture

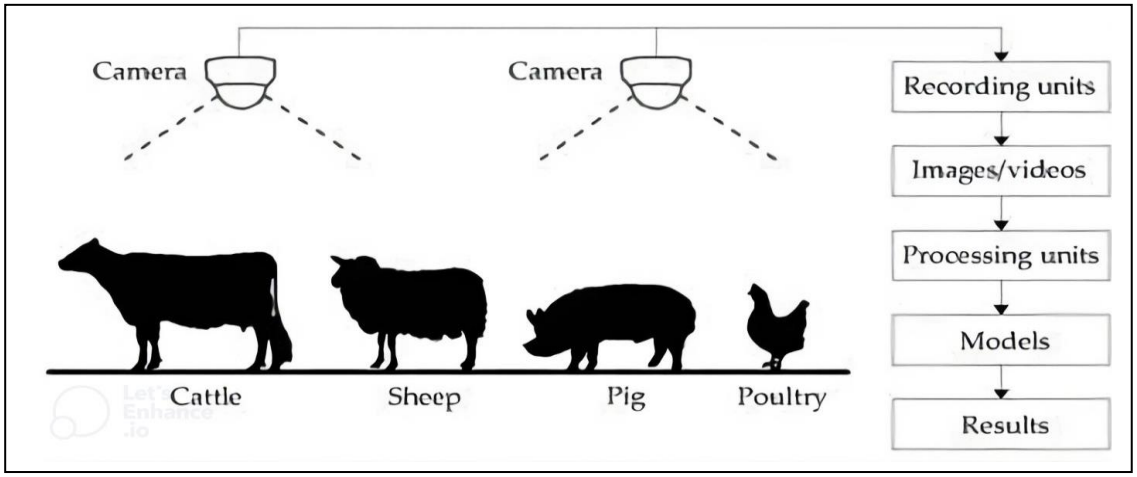

Figure 3. Flowchart of Working Model

• We suggest an AI-based surveillance system to look for and track any animal's presence.

• It is convenient to set up a camera at the potential entry points for animals.

• To process the camera stream, the system employs OpenCV's computer vision module.

• To find the animals in the farms, MobileNet SSD (Single Shot Detector), a pre-trained model, is employed. The MS COCO picture dataset is used to train the model.

• When an animal is found, a siren is activated, which the animal may find alarming.

• It can also alert the farmer, allowing him or her to promptly take the necessary measures.

6.4. Advantages of Proposed Method

- Lower cost to operate
- Seasonality does not affect at all
- Does not require very high performance or costly hardware(s).
- Are very efficient

7. Dataset

MobileNet SSD is a pre-trained model. The model is trained on MS COCO image dataset. The MS COCO animals' dataset has 328,000 images of animals and 201 classes.

8. Results and Discussion

Our application in action

Figure 4. Animal Identified (Lion) Siren played.

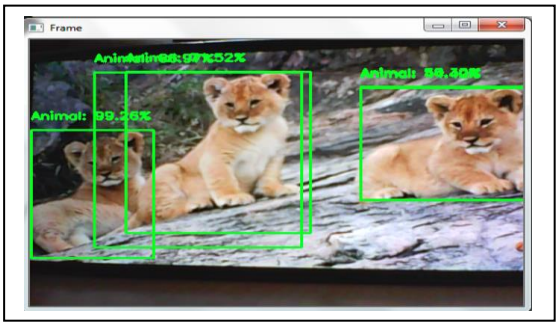

Figure 5. Multiple Animals Identified (Cubs) Siren played

Figure 6. Rear-view of a Animal Identified (Elephant) Siren played.

- The suggested technique offers a fresh method to find any encroachment in farms.
- Neural networks have been used to accomplish this strategy.
- With the deep neural network architecture, we have successfully created a deep learning model that can identify each animal on the farm.
- A net frame rate of about 18 frames per second was what we were able to achieve.

9. Conclusion

At the present, the problem of wild animals damaging crops has developed into a major socioeconomic problem. It needs serious thought and a strong arrangement. Given that this project intends to address this problem, it expresses a remarkable societal relevance as it plans to resolve this issue. As a result, we have designed a cleverly constructed agricultural protection and observation-based framework that requires little maintenance and uses less energy. The main goal is to prevent crop shortages and protect the area from wild animals, which pose a serious threat to rural areas. Such a framework will be helpful to the ranchers and farmers in protecting their fields and plantations, saving them from serious financial setbacks and also from futile efforts they make to defend their farms. Also, this framework will assist them in achieving higher harvest yields, which will lead to their financial prosperity.

10. Future Scope

The methods to scare away the intruders can be changed in future. We may even employ High intensity flashing lights instead of just a siren to do so. It can also be embedded in an IoT based system for easy utilization.

11. Acknowledgement

I Would like to express my gratitude to Mrs. V. Geetha Asst. Professor, our guide, for her invaluable guidance, support, and encouragement throughout the entire research process. Her expertise and insights have been really helpful in shaping our research.

We are also deeply thankful to our institution for providing us with the resources and facilities necessary to conduct this research. The support from our Dept of CSE has been invaluable in helping us navigate the challenges of academic research.

12. References

[1] Parikh, M. et al. “Wild-Animal Recognition in Agriculture Farms Using W-COHOG for Agro-Security.” (2017).

[2] S. Yadahalli, A. Parmar and A. Deshpande, "Smart Intrusion Detection System for Crop Protection by using Arduino," 2020 Second International Conference on Inventive Research in Computing Applications (ICIRCA), Coimbatore, India, 2020, pp. 405-408, doi: 10.1109/ICIRCA48905.2020.9182868.

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[4] Deshpande, Abhinav. (2016). Design and Implementation of an Intelligent Security System for Farm Protection from Wild Animals. 5. pp.2319-7064.

[5] M. Gogoi and S.R. Philip, “Protection of Crops from Animals using Intelligent Surveillance System,” Journal of Applied and Fundamental Sciences, vol.1, no.2, pp.200- 206, 2015.

[6] S. Pandey and S. B. Bajracharya, “Crop protection and its effectiveness against wildlife: A case study of two villages of shivapuri national park, nepal,” Nepal Journal of Science and Technology, vol. 16, no. 1, pp. 1– 10, 2015.

[7] V. Bavane, A. Raut, S. Sonune, A. Bawane, and P. Jawandhiya, “Protection of crops from wild animals using intelligent surveillance system.”

[8] R. Bhardwaj, K. Bera, O. Jadhav, P. Gaikwad, and T. Gupta, “Intrusion detection through image processing and getting notified via sms and image,” 2018.
2009.