SMART CROP PROTECTION USING MACHINE LEARNING

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ABSTRACT

Nowadays, animal detection has become a difficult task, especially in huge and distant places. Classic methods of animal detection, such as human surveillance and traps, as well as electric fences, are frequently ineffective and can hurt animals. There has been an increase in utilization of employing machine learning techniques for animal detection in recent years. We have analyzed two machine learning algorithms that have been found to be successful for animal detection are convolutional neural networks (CNNs) and support vector machines (SVMs). Using CNNs and SVMs, this study confirms a novel technique to animal detection. CNNs are used to extract features from animal visuals, while SVMs are used to classify the images according to various animal categories. CNNs are an effective technique for detecting animals. On a range of animal detection datasets, they have been confirmed to produce state-of-the-art results. CNNs are projected to being much more potent and effective at spotting animals as they advance. There are various machine learning methods that can be utilized for animal detection in addition to SVMs and CNNs. The field of animal detection is rapidly developing.

Keywords: *Convolution Neural Networks (CNN), Machine Learning techniques, Support Vector Machine (SVM), Animal Detection, Animal detection.*

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1. INTRODUCTION

Agriculture is vital to the economy in many countries all over the world. Despite economic progress, agriculture remains the economy's backbone. It contributes to the country's GDP. Agriculture produces food for humans as well as a variety of raw materials for industries. Animal invasions and fires in agricultural areas, on the other hand, will result in significant crop loss. The crop will be completely destroyed. A significant number of farmers will lose their livelihoods. To avoid financial losses, agricultural fields and farms must be protected from animal and fire damage. Traditional methods for detecting animals in complex settings, such as rule-based algorithms and image thresholding, are frequently unsuccessful. To preserve the safety of animals and farmlands, it is vital to protect crops from animal danger while redirecting animals without causing agricultural damage. To address this issue, we aim to conduct a study in which we will develop a method to prevent animals from entering the farm. This project's main goal is to construct an automatic non-lethal deterrent system on the farm in order to reduce animal and fire losses. These deterrents safeguard the crop and animals from injury, increasing agricultural yield. The embedded development system will not hurt animals or humans. The goal of the project is to create a smart security system for agricultural safety. When compared to other wildlife monitoring approaches, camera traps are the most successful and cost-effective alternative for a number of species have recently been proved to be extremely effective in image categorization and object recognition.

CNN is a well-known deep learning model. CNN's basic structure involves convolution, pooling, and classification. SVMs are a form of supervised machine learning technique that can be used for classification and regression applications. SVMs can be used in animal detection to categorize photos or recordings of animals into distinct categories. They can also be used to detect the presence of animals in a picture or video, even if the animals are not the focal point. SVMs operate by locating a hyperplane that connects data points from various classes as far apart as possible. Here we employ CNN and SVM algorithm in animal detection to classify and predict the animal invasion with high accuracy and robustness. Machine learning is becoming increasingly popular for crop protection from animals, and it is possible to develop automated non-lethal deterrents instead of deadly devices for crop protection from animals. One use of machine learning for crop security is developing a system that detects animals in the field and then uses automated deterrents to keep them away from the crops.

This might be accomplished by the implementation of computer vision systems and sensors that detect the presence of animals and then activate deterrents such as loud noises, bright lights, and even water jets, as well as other automated deterrents that can be employed to scare the animals away. This can be done using Support Vector Machine (SVM) which is used for both classification and regression. In recent years however, deep neural networks, especially convolutional neural networks (CNN), have proven to be very effective in learning from existing data, achieving remarkable results in image classification. Thus, by taking images of animal dataset as input data, CNNs can automatically classify animal into the relevant categories. Figure 1 depicts the animal classification system using CNN layers. Additionally, we can identify the type of animal causing crop damage and then design a proper deterrent for each animal, as well as alert farmers when there is a risk of animals destroying their crops. We may also use the random forest algorithm and CNN to identify frequent patterns and to find trends in animal behaviour. If the animal tends to come to the crop at specific times of the day, we can develop a non-lethal deterrent that activates at those times to keep the animal away from the crop.

2. LITERATURE SURVEY

S.NO	Journal Paper Title with Author	Works carried out	Information gathered relevant to your project
1.	**"A Study on the Detection of Cattle in UAV Images Using Deep Learning"** by **Jayme Garcia Arnal Barbedo**, **Luciano Vieira Koenigkan**, **Thiago Teixeira Santos** and **Patricia Menezes Santos**, Embrapa Agricultural Informatics, Brazil, Embrapa South-east Livestock, Sao Carlos, Sao Paulo, Brazil, published on 10 December (2019).	With the advent of deep learning, and in particular, extracting relevant information from aerial images in cattle farming.	Characterization of deep learning.
2.	**"Detection of animal intrusion using CNN and image processing"** K Bhumika, G Radhika and CH Ellaji, Department of Computer Science and Engineering, School of Engineering and Technology, Sri Padmavathi mahila university (Tirupati), India, published on 23 December (2022).	The deep learning concept of convolutional neural networks, a subfield of computer vision.	Brief information about CNN.
3.	Ren, S., He, K., Girshick, R., Sun, J.: **"Faster**	They work on Fast	Understanding the diversity

	R-CNN: Towards Real – Time Object Detection with Region Proposal Networks” In: NIPS. Pp. 91–99 (2015).	R-CNN to classify data based on the regions.	and various use of image processing in animal detection.
4.	**“VERY DEEP CONVOLUTIONAL NETWORKS FOR LARGE-SCALE IMAGE RECOGNITION”** Karen Simonyan & Andrew Zisserman, Visual Geometry Group, Department of Engineering Science, University of Oxford, published on April 10 (2015).	They investigate the effect of the convolutional network depth on its accuracy in the large-scale image recognition setting.	Implementation of CNN in a large-scale.
5.	A.K. Vishwakarma, G.K. Mishra, and A.K. Singh published "A Support Vector Machine Based Approach for Animal Detection in Remote Sensing Images" in 2016.	SVM-based approach for detecting animals in remote sensing photos is explained in this research.	Information on SVM technique in detections.

3. METHODOLOGY

3.1 PROBLEM IDENTIFICATION

Design a machine learning algorithm to identify animals that encroach on agricultural land and alerting the farmer, thus safeguarding both animals and crops based on its characteristics and properties. This is possible with our solution, where we use machine learning techniques like CNN and SVM. CNN is used for the extraction of features and SVM is used for both regression and classification.

3.2 PROPOSED WORK

The "Smart Crop Protection using Machine Learning" defines its goals and scope during the project's initial genesis phase. The creation of a project team, the identification of stakeholders, and the creation of a project plan all fall under this phase. To guarantee effective implementation, a project schedule and budget are also prepared.

- **Data Collection and Preparation-** Create a labelled dataset of visuals featuring the creatures you want to detect. Annotate each photograph with bounding boxes or labels denoting the animals' status and class. For model creation and evaluation, divide the dataset into training, validation, and test sets.

- **Preprocessing-** Resize all images to a consistent measure to ensure that the CNN generates uniform input. Normalize pixel values so that they have a zero mean and a unit variance. To enhance the model robustness, enhance the training data with techniques such as randomized rotations, flips, and translations.

- **CNN for Animal Detection-** Create a CNN model to detect animals. You can utilize well-known frameworks like in the TensorFlow or PyTorch. Using the labelled dataset, train the CNN. CNN will be trained how to identify animals in visuals. To improve the model's performance, use the validation set to fine-tune it.

- **Feature Extraction-** Deploy the trained CNN to extract features from the testing set's images. These features can be obtained as flattened vectors or from a layer immediately before the final classification layer.

- **SVM Classifier-** Using the retrieved features from the CNN, train an SVM classifier. Based on these characteristics, the SVM is going to determine whether or not an image contains an animal. For enhanced accuracy, employ cross validation to fine-tune the SVM parameters. Feed the features extracted from CNN detection into the SVM classifier. The SVM will then decide whether or not the recognized object is an animal.

- **CNN Model Training-** The CNN model must then be trained using the provided animal dataset. By changing its internal settings, the model develops the ability to identify and categorize waste elements throughout training. Typically, a high-performance computer environment is used for the training process, which might take many hours or days depending on the amount of the dataset and the complexity of the model.

- **Integration and Trigger-** Create a system that receives input from a camera or other sensors to capture real-time images or motion pictures. Preprocess the new provide information to match the CNN's planned format.

- **Model Evaluation-** Evaluating the CNN-SVM model's performance on the test set and measure metrics.

- **Integration and Deployment-** Use the trained CNN model to predict animal classes in new images and pass the features of the predicted images to SVM classifiers for final classification.

- **Animal Detection-** Run the previously processed information through the CNN in real-time to detect animals. If an animal has been found, the CNN will classify it as positive.

- **Continuous Monitoring and Maintenance-** Monitor the model's real-world performance on a regular basis and upgrade the model as required.

3.3. PROPOSED WORK MODULES

Our project aims to increase the precision and efficacy of animal detection and driving it away. To identify animal and classify it into the appropriate categories, this system employs a deep learning model that has already been trained. Preparation, instruction, testing, deployment, and maintenance are the key steps that must be taken.

Here we use different data model sets. The first model involves pre-processing the data, segmenting it, extracting its features, and then classifying it before storing it in the database by using CNN which classify and segregate the data in an accurate manner. In contrast, the second model uses pre-processing to partition the data after it has been collected from a live scene and finally stores the extracted features in the database. The data from the second model will be compared to the data from the first model using the SVM which provides a hyper plane that gives an appropriate results. If no similarity is found between the data, the system recognizes it as new data and stores it, whereas if a match is found, the system analyses the animal's type and the detected motion is notified to the user. This might be accomplished by the implementation of computer vision systems and sensors that detect the presence of animals. As a first step, our project intends to develop and demonstrate a prototype that allows farmers to monitor their land without having a permanent physical connection to it, while also ensuring the safety of both crops and animals. The goal of this monitoring system is to detect any intrusion in real time. With this project, we hope to establish and develop a low-cost secure monitoring system. As it is user-friendly and cost efficient this will definitely work tremendous in the market other than the existing models.

4. CONCLUSIONS

In this project, we proposed a system for animal detection that combines CNN and SVM. We demonstrated that the system can recognize animals with great accuracy. The technology could be utilized for a variety of purposes, including wildlife monitoring, animal conservation, and traffic safety. However, there are still certain issues that must be solved. The system, for example, may be responsive to variations in lighting and position and additionally, the system requires a huge image collection for training. This experiment demonstrated the viability of using CNNs and SVMs to create an animal detection system capable of activating non-lethal deterrents. The device is capable of detecting animals with high precision and triggering nonlethal deterrents in response to animal detection. The device might be used to protect crops from animal damage, keep animals out of restricted areas, and keep animals away from people. The technology might potentially be used to track animal movements and monitor animal numbers.

5. FUTURE WORK

In the future, we have planned on investigating the system on a wider variety of animals and in different ecosystems, as well as to activate respective non-lethal deterrents based on animal prediction. Examine how transfer learning can be used to increase the accuracy of animal detection models. This entails training a model on a large dataset of other item photos, such as automobiles or faces, and then fine-tuning the model on a smaller collection of animal images. To increase the diversity of the training dataset, use data augmentation strategies. This entails making new photos by applying alterations such as rotation, cropping, and flipping to existing images. Create real-time detection methods for animals. This might be performed by combining CNN-SVM models or by employing a new machine learning technique totally. Deploy the animal detection models to a web application or mobile app. Users will be able to readily identify animals in their surroundings as a result of this.

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