International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 04 | April - 2023 Impact Factor: 8.176 ISSN: 2582-3930

FARM PROTECTION FROM ANIMALS USING DEEP LEARNING

[1,]*Divya M Angadi*, [2,]*Bhagyashree Chikkamath*,[3,]*Roopa B Jorapur*
Tontadarya college of Engineering Gadag, Karnataka
Corresponding Author: Prof Muktha Patil

Abstract: Agriculture is the most important sector of Indian Economy but the issue of damage to crops by wild animals has turned into an important social issue in current occasions. So far, many of the farmers reply on guards to guard their crops which increases the overhead costs. But, due to current climate conditions, crop failure rate has increased dramatically. Debt in agricultural sector has increased tremendously. In these situations, a farmer cannot expect further destruction of crops and neither can afford increase costs in farming.

Key words: Image Processing, Deep learning, Wild animal attack, Crop protection, animal detection, Classification.

Problem Statement:

Agriculture plays a huge role in India. Animal intrusion in farms causes huge losses in agricultural revenue which a farmer cannot bear, especially if they have small farming areas as majority of the farmers in India. Computer Vision are being increasingly applied in agricultural field for higher productivity by automating tasks. We propose an AI based system which monitors the field using cameras for any intrusion by the animals and alerts the farmer or can even take certain actions on its own.

Existing Method:

Since most of the farms in India are small, most farmers relies 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 populations. Also, in busy seasons like the harvesting time, it can get difficult to have a guard, guarding and monitoring the crops from animals.

Proposed Method:

We propose an AI based surveillance system to detect and monitor the presence of any animal.

A camera can be placed conveniently at location(s) where any possible animal might enter from. The system uses computer vision using OpenCV to process the feed from the camera. Pre-trained model Mobile Net SSD (Single Shot Detector) is used to detect the animals in the farms. The model is trained on MS COCO image dataset. A siren is fired on detecting an animal which can act as a deterrent to the animal. It can also notify the farmer so that he/she can take the concerned action as required in time.

Introduction:

Agriculture meets the food demands of the population and also provides various raw materials for different industries. Interference of animals in agricultural lands causes a huge loss of crops. Crop damage due to raiding wild animals has become a major issue of concern these days. Animals like wild boars, macaques, porcupines, deer, monkeys and bears are extremely destructive and have also caused human casualties in certain occasions. 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. Human-elephant conflict is rising intensely as elephants are a highly conflict prone wildlife species, especially in India. Thus, there is need for a system to detect any intrusion which can help the farmers to drive away these animals as soon as they learn about their intrusion.

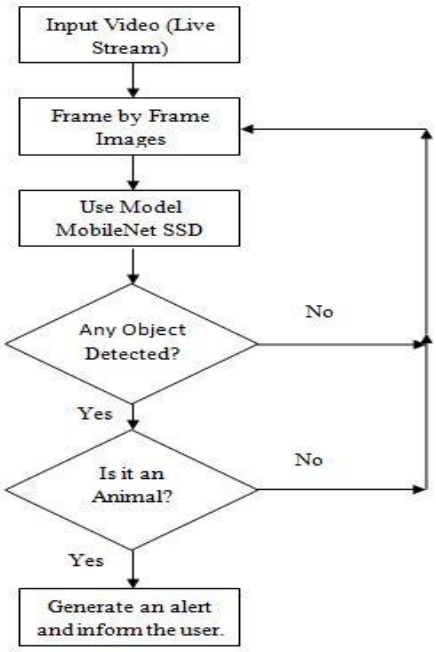
Computer vision is applicable to many fields like medical field, robotics, remote sensing, machine vision, content-based image retrieval. Computer vision solves many problems in different disciplines. Computer vision also applied in the security field to perform automatic surveillance and access control and attendance management. The computer vision can be applied in agriculture field in many ways like disease detection of a tree by examining leaves or flowers or fruits and quality control of agricultural products.

The computer vision techniques can be applied in order to provide security from wild animals in agriculture. In agriculture fields near to forest areas have a severe threat from wild animals, which attacks regularly on farms. These attacks causing huge damage to agricultural crops subsequently causes significant financial losses to farmers.

Some measures are taken by the farmers by installing electrical fences to the farms, big flood lights in the farm. Some even resort to hiring guards. Installing an electrical fence is much costlier to equip huge farms and kills so many animals, which is even illegal in certain places and affects the biodiversity. Other existing techniques also are not effective due to several reasons, cost being one of them.

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 in an attempt to scare them away. Here, we are implementing a solution that recognizes animals when it is captured on camera.

Flow Chart:



Hardware Requirements:

- Processor : I3/Intel Processor
- RAM : 4GB (min)
- Hard Disk : 128 GB
- Key Board : Standard Windows Keyboard
- Mouse : Two or Three Button Mouse
- Monitor : Any

Software Requirements:

- Operating System : Windows 7+
- Server side Script : Python 3.6+
- IDE : PyCharm
- Libraries Used : Pandas, NumPy, play sound, collection, time, imutils, OpenCV
- Dataset : MS COCO Image Dataset

Modules:

Upload (Live): Upload a video as a live feed using a webcam (or any camera attached in a farm).

View: Video can be viewed live in a dialog box.

Pre-processing: Data Pre-processing is a technique that is used to convert the raw data into a clean data set. Cleaning the data refers to removing the null values, filling the null values with meaningful value, removing duplicate values, removing outliers, removing unwanted attributes. If dataset contains any categorical records means convert those categorical variables to numerical values. In this case, we are taking a live video feed in the form of images and resizing them to a standard size.

Identifying Features: We use Mobile Net SSD pretrained model which identifies features in any image using a Convolution Neural Network (CNN) model.

The model: SSD (Single Shot Detector) is a popular algorithm in object detection. It's generally faster than RCNN. SSD has two components: a backbone model and SSD head. *Backbone* model usually is a pre-trained image classification network as a feature extractor.

Here, we will use Mobile Net SSD model to detect the objects. Here, VGG Net is used as a backbone model to extract the features from the images. Convolution layers (CNN) are then used for object detection in the images using the feature map generated by VGG net layer. The model is able to detect multiple objects in any given image. For the purpose of classification, the model uses SoftMax in the last layer. SoftMax takes in a vector of numbers and converts them to probabilities which are then used for image generating results. SoftMax converts logits into probabilities by taking the exponents from every output and then normalize each of these numbers by the sum of such exponents, such that the entire output vector adds up to one.

Prediction: A live video feed is taken in frame by frame as individual images. These images the then fed into the model after pre-processing to detect animals (if any exists).

User Interface: A dialog box opens up while taking in the live video feed. The frames or images from the video are used to detect objects. The objects are then bounded in a bounding box along with a label and the probability of success in also displayed in there. A siren is then played if any animal is detected for a while.

System Design:

Uml Diagrams: UML stands for Unified Modeling Language. UML is a standardized general-purpose modeling language in the field of object-oriented software engineering.

The standard is managed, and was created by, the Object Management Group.

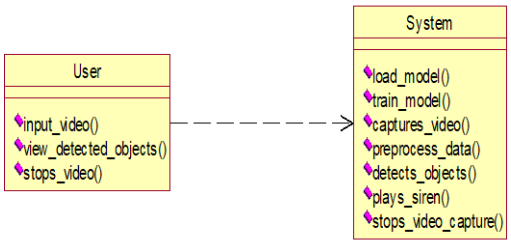
The goal is for UML to become a common language for creating models of object oriented computer software. In its current form UML is comprised of two major components: a Meta-model and a notation. In the future, some form of method or process may also be added to; or associated with, UML.

The Unified Modeling Language is a standard language for specifying, Visualization, Constructing and documenting the artifacts of software system, as well as for business modeling and other non-software systems. The UML represents a collection of best engineering practices that have proven successful in the modeling of large and complex systems.

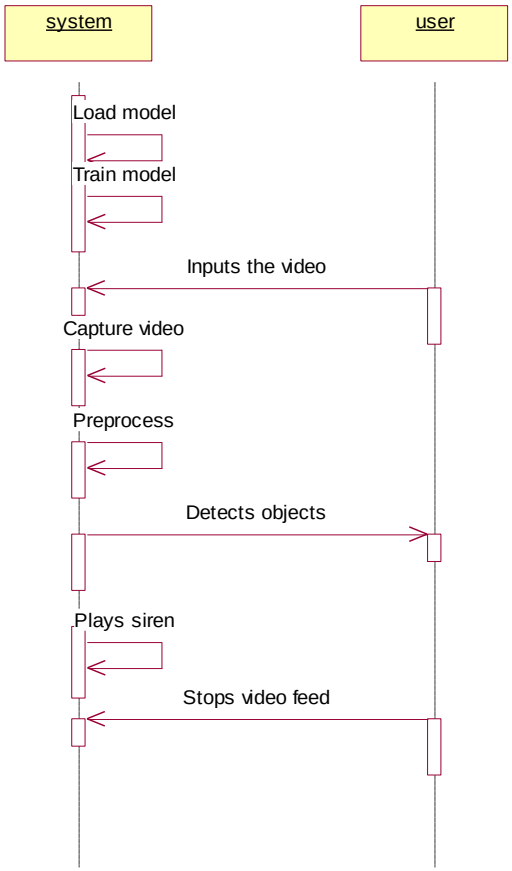
The UML is a very important part of developing objects oriented software and the software development process. The UML uses mostly graphical notations to express the design of software projects.

Use Case Diagram: A use case diagram in the Unified Modeling Language (UML) is a type of behavioral diagram defined by and created from a Use-case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases. The main purpose of a use case diagram is to show what system functions are performed for which actor. Roles of the actors in the system can be depicted.

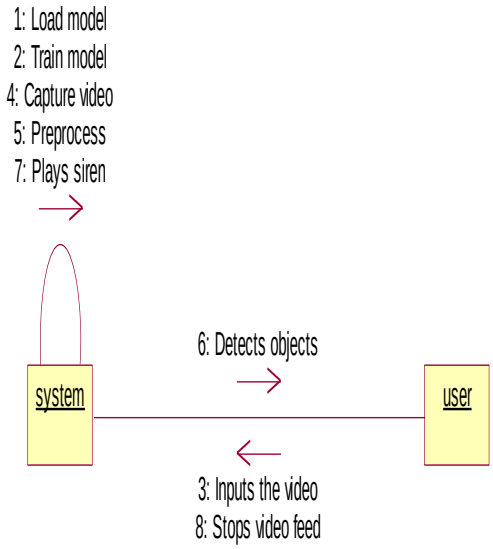
Class Diagram: In software engineering, a class diagram in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among the classes. It explains which class contains information.

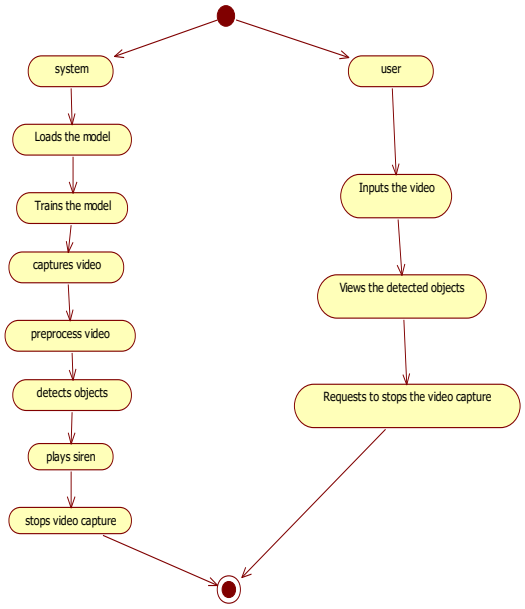


Sequence Diagram: A sequence diagram in Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. Sequence diagrams are sometimes called event diagrams, event scenarios, and timing diagrams.



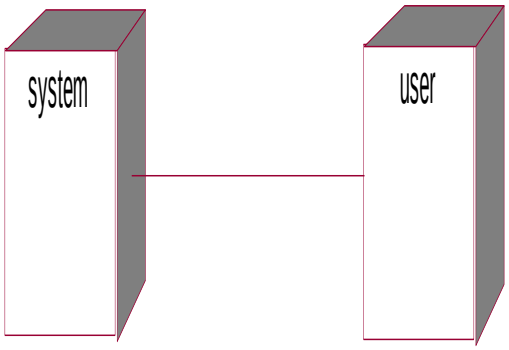
Collaboration diagram: In collaboration diagram the method call sequence is indicated by some numbering technique as shown below. The number indicates how the methods are called one after another. We have taken the same order management system to describe the collaboration diagram. The method calls are similar to that of a sequence diagram. But the difference is that the sequence diagram does not describe the object organization where as the collaboration diagram shows the object organization.



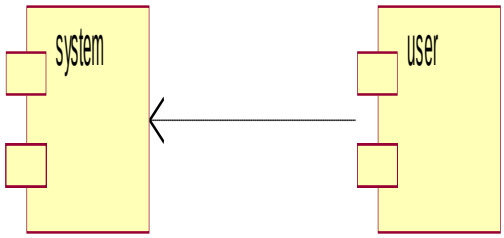


Deployment Diagram: Deployment diagram represents the deployment view of a system. It is related to the component diagram. Because the components are deployed using the deployment diagrams. A deployment diagram consists of nodes. Nodes are nothing but physical hardware used to deploy the application.

Component Diagram: A component diagram, also known as a UML component diagram, describes the organization and wiring of the physical components in a system. Component diagrams are often drawn to help model implementation details and double-check that every aspect of the system's required functions is covered by planned development.



Activity Diagram: Activity diagrams are graphical representations of workflows of stepwise activities and actions with support for choice, iteration and concurrency. In the Unified Modeling Language, activity diagrams can be used to describe the business and operational step-by-step workflows of components in a system. An activity diagram shows the overall flow of control.



Er Diagram: An Entity–relationship model (ER model) describes the structure of a database with the help of a diagram, which is known as Entity Relationship Diagram (ER Diagram). An ER model is a design or blueprint of a database that can later be implemented as a database. The main components of E-R model are: entity set and relationship set.

An ER diagram shows the relationship among entity sets. An entity set is a group of similar entities and these entities can have attributes. In terms of DBMS, an entity is a table or attribute of a table in database, so by showing relationship among tables and their attributes, ER diagram shows the complete logical structure of a database. Let's have a look at a simple ER diagram to understand this concept.

DFD

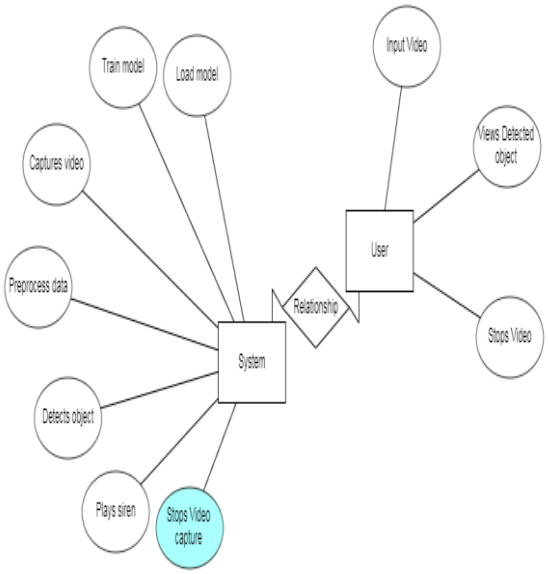
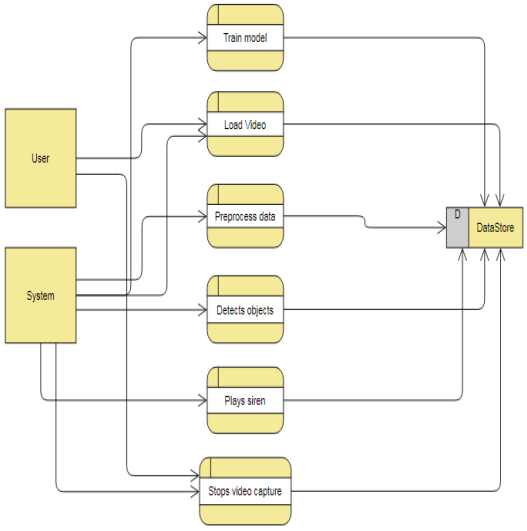


Diagram: A Data Flow Diagram (DFD) is a traditional way to visualize the information flows within a system. A neat and clear DFD can depict a good amount of the system requirements graphically. It can be manual, automated, or a combination of both. It shows how information enters and leaves the system, what changes the information and where information is stored. The purpose of a DFD is to show the scope and boundaries of a system as a whole. It may be used as a communications tool between a systems analyst and any person who plays a part in the system that acts as the starting point for redesigning a system.



Advantages:

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

Disadvantages:

- High cost.
- Prone to seasonality.
- Requires costly equipments and infrastructure.
- Are highly inefficient.

Applications:

- Farming.
- Industries relying on farming.
- Agri Tech industries.
- Government institutions.

Conclusion:

The problem of damaging crops by wild animals has become a major social problem in the current time. It requires urgent attention and an effective solution. The proposed method allows us to detect any animal presence or intrusion in farms using video from any camera device placed in the farms. The object detection model worked almost consistently at 18 frames per second.

It is a cheap and robust system. The siren scares the intruders away as well as it can alert the farmer to take action. Thus, this application can be used to protect crops in the farm. It might be very useful for agricultural purposes instead of traditional methods used today.

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.

[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."

[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.

[9] R. M. Antunes and F. L. Grilo, “Intruder alarm systems-the road ahead,” in Advanced Technologies. IntechOpen, 2009.

Results: