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Wild Animal Detection and Alert Generation system through AI

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Abstract:

Crops are susceptible to animal attacks. Preserving farmland has become an intricate problem in recent times. Consequently, be on the lookout for any creatures that could do more damage to the harvest. The wildlife that calls the protected area home are Over time, the grain crop has been subjected to persistent attacks, making its protection a top priority. The problem has been addressed in a way that renders the methods already in use inefficient; in this study, we suggest a methodology to safeguard farms from wild animals without damaging them, thereby building a system that takes into account the demands of those creatures (deer, nilgai, wild boar, etc.). In order to find the animal and get it to run away from the farm, it makes a noise that gets its blood pumping. Then, it automatically starts tossing stones at the animal to scare it away. The proposed monitoring program aims to alert farmers in advance of any possible crop damage caused by wild animals. In order to address this issue, the suggested model utilizes the MOBILE NET model to create an IoT and AI-based system that can detect the early arrival of wild animals. When wildlife is spotted, the relevant authorities and nearby residents are notified through Whatsapp and loudspeakers.

Keywords: Deep learning, Computer Vision , Open CV, Mobile Net, Wild Animal Detection

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I. INTRODUCTION

Agriculture is the main source of livelihood of many people in different parts of the world. Unfortunately, farmers are still dependant on conventional techniques that have evolved hundreds of years ago. Due to this the yield of crops are becoming low. Also there are a number of factors that contribute to the low yield of crops animal intrusion is also one among them. In recent years' wild animals are special challenge for the farmers throughout the world, Animals like wild boars, elephant, tiger and monkeys etc. cause serious damage to crops by animals running over the field and trampling over the crops. It causes the financial problem to the farmers. Farmers with large area of agricultural lands find it very tedious to irrigate their land manually. Crop damage caused by animal attacks is one of the major threats in reducing the crop yield. Due to the spread of cultivated land into prior animal habitat, crop raiding is becoming one of the most problematic antagonizing human wildlife partnerships. Deforestation happens as a consequence of overpopulation, which in turn causes scarcity of resources like food, water, and shelter in forested regions. So, Animals interference in residential areas is increasing day by day which affects human life and property causes human animal conflict but as per nature's rule every living creature on this earth has important role in ecosystem. Agriculture is the backbone of the economy but because of animal interference in agricultural lands, there will be huge loss of crops. Elephants and other animals coming in to contact with humans, impact negatively in different manners such as by depredation of crops, damage grain storage, water supply, buildings and other assets, wounding and killing of humans. Farmers in India face serious threats from pests, natural calamities &damage by animals resulting in lower yields Traditional methods followed by farmers are not that effective and it is not feasible to hire guards to keep an eye on crops and prevent wild animals. Since safety of both human and animal is equally vital. So, animal detection system is important in farm area.Since from the preliminary stage of agriculture, wild animals were a big threat to the human kind and agricultural lands. Crop fields located next to forest areas have an extremely high incidence of man-animal attacks. In Himachal Pradesh, every year there was a 30 percent to 40 percent of the crop were being damaged by wild animal. Because of the over population, people are inhabiting forest regions and are being transformed into agricultural and pastoral land. This has led to encroachment into wildlife areas. This resulted in man-animal conflict over the previous years. In Africa, nearly 80% of the people are highly dependent on agriculture and it is the sole source of profession. Demand for land and falling crop yields in the 21st century have prompted people to seek out previously undeveloped territory, particularly in forested regions. This has led to an increase in human-wildlife conflict. Electric fences, chemical or organic substance spraying (e.g., "rotten egg smell"), and gas cannons are some of the current and existent ways used to address this issue, although the latter often requires authorization from the local authorities. Other traditional methods used by the farmers are using shot guns or gas guns, balloons, string & stone etc. these types of solutions are usually cruel and are not completely effective. However, they also require a huge amount of installation and remittance cost which poor people can't afford it and even some of the approaches may produce environmental pollution generating effect on both humans and animals.

[1] One of the most prevalent issues nowadays, according to J.Dhillipan et al., is wildlife getting into populated areas. The shrinking space for wild animals to roam is the root cause of this problem. It creates great loss to property when wild animals enter in to the residential space. Using the Internet of Things (IoT), this paper proposes a cheap monitoring system. In order to ensure that an animal has been incorporated into the system, MATLAB is used to track images that enter the agricultural field. After that an alert has been generated by using GPRS and GSM. It also hazards the wild animal by means of creating alarm.

[2] Conflict between humans and other animals has long been a problem in agriculture and beyond, as Billi Bhargav et al. pointed out in their introduction to human civilization's early stages. In addition, a quick and effective remedy is needed. As a result, this project serves as a last resort for ridding farmlands of wild animals. As a result, this low-cost automated system can be powered by solar plates during the day and by a battery at night, so avoiding crop loss. at the same time keeping the farmlands safe from predatory animals and other outsiders. This system will also be helpful in protecting houses of farmers and nearer to the forest areas and save them from significant damage to their lives and properties. However, this system helps in achieving better yield of crops leading to the development of the nation.

In order to improve deep learning models' ability to identify nearby or similar objects, Shubham gade et al. [3] suggests combining K-nearest neighbor with Pearson correlation variables. The writer A comprehensive examination of the dataset is conducted to preprocess the attributes according to their requirements in order to redistribute dynamic power among the charging ports in electric vehicle charging stations. In order to remove unnecessary columns and build correlations, the author uses the Pearson correlation matrix in the preprocessing step. One possible outcome of the author's proposed system is a full battery recharge for the vehicle, as it is designed to redirect power to the charging connection. The developed model uses the K-Nearest neighbor algorithm to choose the fast charging port with the lowest remaining battery percentage. Incorporating the model of the deep belief neural network that is already based on the data. Based on K-nearest neighbors, this approach will assist in effectively finding the animals that look most similar.

II. LITERATURE SURVEY

[4] xinbo chen et al. discuss about field sampling and laboratory chemical analysis, this study applied the semi-supervised regression model of Bayesian co-training to estimate the heavy metal content of encrypted sample locations. For the purpose of evaluating the potential for pollution at both actual and anticipated sampling locations, the author used the artificial fish swarm algorithm to choose the MKSVM's parameters. This provided an assessment of soil heavy metal pollution in the main agricultural areas of Wuhan, which was further characterized using ArcGIS software. The conclusions are as follows: (1) By substituting the basic learners of COREG co-training with Bayesian regression, the regression performance of the model was greatly improved. When using the Semi-BR model to predict the heavy metal content in soil, it effectively avoids the overfitting issues caused by using neural networks for prediction.

[5] Recent research by Mohaimenul Azam Khan Raiaan et al. presents a fresh perspective on the challenges caused by animal extinction and its effects on farming. The research successfully achieves real-time detection and classification of endangered and harmful animals in farming using a sophisticated object-detection system that combines the ESP32-CAM and the YOLOv8 model. With an efficiency rate of 96.65% and a sensitivity rate of 92.44% on the unseen test dataset, the system's remarkable performance is clearly demonstrated by its accuracy and efficiency.

[6] Kiruthika S et al. introduced that agriculture is the foundation of the Indian economy, protecting it is author's primary responsibility. The proposed work has utilized a Camera sensor, which effectively detects intruder movement. In addition, a camera is used here, so the entry and exit times are recorded. This concept of protecting crops is simple to adopt and can be done so without harming humans or animals. Additionally, the comparatively inexpensive cost of the system's components makes it practical.

[7] This system's proponents, C. Laxmana Sudheer et al., argue that the fast data transmission made possible by the Internet of Things allows irrigation systems to function more autonomously. One major advantage of IoT is that data can be sent even when clients aren't online. Then, once a client is online, they can access the data that has already been sent. So that they can analyze the daily changes in the atmosphere and boost agricultural productivity. In addition to bolstering their financial stability, this method will help them increase crop production.

[8] feshalbhai naguji et al. proposes an AI and blockchain-based land registry system for agriculture and industry 5.0 to solve the challenges faced by traditional land registry systems. The proposed system offers a land registry system that is more efficient, open, and secure, which can be advantageous for both individuals and the economy overall. First, a standard land registry dataset is employed to efficiently bifurcate the fraudulent and non-fraudulent land data. To achieve this, the land registry dataset is subjected to binary classification using a variety of artificial intelligence algorithms, including Light BGM, XGBoost, DT, LR, and SVM. The fraudulent data is discarded from the proposed system, and only non-fraudulent data is forwarded to the blockchain-based land registry system.

[9] Research in the Pakistani urban district of Kasur is detailed by Lei Feng et al. This is the conclusion that follows from its main points. LULC change detection revealed a 9.8% gain in built up land use at the expense of -4.2% decline in agricultural land use from 1988 to 2022 Furthermore, vegetation

spectral indices (NDVI and EVI) also confirmed the negative seasonal relationship with LST with an improved polynomial R2 range from 0.6 to 0.7 in all respective years. Furthermore, NDBI demonstrated a positive correlation with LST, which was statistically significant (p 0.001) and had a polynomial R2 value between 0.6 and 0.7. interactions.

[10]. G. Gopperumdevi et al. describe how people in rural India face serious dangers, such as animal and bird damage. Hence, to overcome this issue author have designed a system in which sound is played to scare the animals and birds so that they will automatically run away. The GSM module makes a call to the farmer to alert him. For these reasons, the proposed system is both practical and inexpensive for the farmers. In addition to safeguarding agricultural areas, the planned system is safe for humans and other animals. Limitations/Future Scope:

[11] Senthil G. A et al. introduced fast-paced world, the life of living beings is miserable. To cope with their authorll-being the people started evolving in cultivation land and turned it into real estate. Forests, which are home to many species of wild animals, come next. Those habitats are turned into human habitats. Thus, the issue develops because wild animals are migrating to residential areas that do not provide adequate habitats for them.

[12] B. Hanumanthu et al. narrate the main aim of this project is to protect the crops from wild animal attacks. The most essential need for all living things is food. Agriculture is the primary source of author's food, either directly or indirectly. The security of the agricultural land is crucial today. Animals are frequently destroying crops on farms, resulting in significant losses for farmers. Farmers struggle with a different kind of difficulty every day. An animal detection system has been created to identify the presence of animals in order to address this issue. without injury, issues a warning and directs the animal. The equipment is set up to scan the entire region continually for any animals. Animals can hear at particular frequencies. A motion detector, an electrical device that uses a sensor to detect nearby motion, is used in this circuit.

[13] Akanksha Mishra et al. explain repelling animals is crucial in protecting agricultural regions from the negative impacts of wildlife encroachment, which result in crop devastation and financial failures. Conventional approaches are constrained, necessitating the development of novel alternatives. It is recommended that SARD create a deterrent system that uses the Internet of Things (IoT) and artificial intelligence (AI) to ward off dangerous creatures that have evolved to adapt to their environment. The SARD gadget incorporates advanced technology, including an intelligent animal deterrent device with real-time animal identification capabilities.

[14] The animal detection project, as described by Mrs. T. Sindhiya et al., is a significant step forward in aiding wildlife conservation efforts and resolving the complex issues caused by human-wildlife conflicts. By leveraging state-of-threat deep learning algorithms, author have developed a robust system capable of accurately identifying and categorizing various animal species within surveillance footage. The author's method has the ability to reduce dangers to humans and wildlife because it works in real-life situations.

[15] Mrs. D. Maalini et al. Animal detection using CNN in agriland can be a powerful tool for farmers to monitor and manage their livestock. Train a convolutional neural network (CNN) to identify unique traits of different animals, and farmers will be able to keep tabs on their cattle with pinpoint accuracy. In addition to enhancing management and productivity, this can aid farmers in spotting possible health and safety concerns at an early stage. However, it's important to note that the success of animal detection using CNN in agriculture land depends on the quality and quantity of the data used to train the model, as authorll as the accuracy of the model itself.

III PROPOSED METHODOLOGY

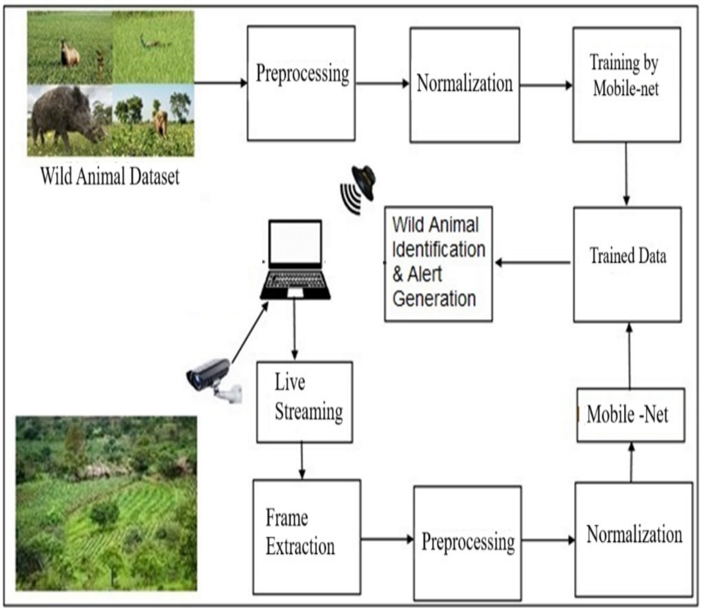


Figure 1: Proposed methodology

The method that has been suggested to establish a Wild Animal Detection System depicted in the system overview in Figure 1 up top. The suggested method was based in part on the execution of the procedures detailed below.

Step 1: Dataset Generator: The first step is to use OpenCV to capture pictures of the various wild creatures that have invaded the farm. In order to verify the model's detection capabilities, the Video Capture method in the CV2 package shoots pictures of the target wild animals. Every single image of an untamed animal is kept in the dataset folder. A variety of animals, including monkeys, peacocks, deer, porcupines, warthogs, and leopards, are modeled in the model. A folder is created to hold all of the acquired animal photographs, which will be utilized in the subsequent model process.

Step 2: Data Labelling: Here, the labeling software is employed to assign labels to the photos that were collected in the previous stage. By importing the image into the labeling software, the user can indicate the coordinates of the top right corner and the bottom left to create x1, y1, and x2, y2 of the bottom right corner, respectively, of the rectangle. To train the model using a deep learning network called MobileNet, the acquired coordinates are saved in an.xml file.

Step 3: *Installation of APIs*: This Google Colab instance requires the TensorFlow Object Detection API, which must be installed first. To accomplish this, you'll need to execute a few installation instructions after cloning the [TensorFlow models repository](https://github.com/tensorflow/models). The following code portions can be run by clicking the play button. The next step in downloading and extracting cuDNN files is to install the conda environment. Next, grab the tensorflow models repository file from GitHub and clone it. After that, the Object Detection API was installed.

Step 4: *Upload Image Dataset and Prepare Training Data*: Here, we'll get the TensorFlow training data ready by uploading our training photos and running the scripts for TF Record generation. Once we have uploaded all of our photographs, we can divide them into separate folders for training, validation, and testing. Then, we can execute the scripts that will create TF Records from our data. To begin, on our local PC, create a single folder named "images.zip" and bundle all of our training images and XML files into it. Please ensure that the files are located inside the zip folder. After uploading, we need to execute certain commands to extract the zip file and configure our picture folders. In this particular instance, the file system's /content subdirectory is where these directories are generated. To access the file system, we can use the "Files" icon located on the left side of the screen.

Step 5: *Split images into train, validation, and test folders:* Locate our "images.zip" file among the listed ones; it's the folder icon on the left side of the screen. Unzipping the dataset and making folders to store the photographs are the next steps after uploading the dataset. In this particular instance, the file system's /content subdirectory is where these directories are generated. To access the file system, we can use the "Files" icon located on the left side of the screen. The following step is to divide the photos into three sets: train, validation, and test. The purpose of each set is as follows: Ride the rails: The photos utilized to train the model are these very ones. The neural network is fed a batch of photos from the "train" collection at each training stage. Objects in the photos are classified and their locations are predicted by the network. The loss is computed by the training method, which then uses back propagation to modify the network weights.

Validation: The training algorithm can utilize images from the "validation" set to verify how well training is going and to tweak hyperparameters (such as learning rate). These photos, in contrast to the "train" images, are only utilized on a periodic basis throughout the training process, specifically, once every specific number of steps. Warning: The neural network will never view these pictures while it is being trained. The ultimate testing of the model's accuracy is meant to be done by a human using these.

Step 6: Create TF Records: The last step is to transform the photos into TF Records, a data file format that TensorFlow uses for training. Automated data conversion to TF Record format is being accomplished by means of Python programs. We must first establish a class label map before we can run them. You can generate a class list in a "labelmap.txt" file using the code portion below. Put a new line after each of our classes (such as "Lepord," "Tiger," or "Elephant") and replace the words "class1," "class2," and "class3" with them. To run the code, hit the play button. The result is a "labelmap.txt" file that specifies which classes the object detection model should look for.

Step 7: Set Up Training Configuration : We are configuring the training of an SSD-MobileNet model in this section. Here, we're naming the TensorFlow 1 Object Detection Model that we'd like to employ as our starting point. An accompanying configuration file for each model specifies where to find certain files, allows the user to alter training parameters (such learning rate and total number of steps), and more. We are making changes to the custom training job's configuration file. In the first part of the code, you can see a list of models that are available in the TF1 Model Zoo. Following that, you can see the filenames that will be used to download the model and configuration file. Keeping track of which model is being used and adding more models in the future becomes much easier with this setup. Put the name of the model we want to use for training into the "chosen_model" field. The "ssd-mobilenet-v1-quantized" model is now selected to be used. After that, specify the parameters for the pre-trained model and the configuration file, and then press play in the following three steps to download them.

After getting the model and configuration files downloaded, the next step is to add some general training parameters to the configuration file. Training phases are controlled by the following variables:

number of steps: The overall number of steps to train the model using. For an initial target, 40,000 steps is a solid choice. If, once training is complete, we see that the loss measures are still going down, we can add extra stages. Training takes longer as the number of stages increases. Additionally, training can be terminated before the designated number of steps if the loss level reaches a plateau. batch_size: The picture count for each training run. Although training a model with a higher batch size requires fewer steps, the size can only be as big as the GPU RAM that is available for training. It is generally recommended to use 16 GPUs for Colab instances. (Used exclusively for training that takes quantization into account) quant_delay_steps The training algorithm will then imitate quantization by inserting "fake" quantization nodes into the network after these many steps. Halving the total number of training steps is a decent place to start. [This article](https://neuralet.com/article/quantization-of-tensorflow-object-detection-api-models/) has more details.

At this stage, you also provide additional training data, such as the total number of classes, the location of the configuration file, and the file containing the pre-trained model. In order to apply the training parameters that we have just defined, we will need to edit the configuration file. In order to create our own "pipeline_file.config" file, the following code will automatically edit the downloaded.config file to include our specific parameters. Combine the default pipeline file with our dataset, model checkpoint, and training settings to create a custom configuration file. The subsequent block updates the training script such that checkpoints are saved every 1000 steps. If we want to store checkpoints more or less frequently, we can change 'num_eval_steps' accordingly. You can view the mobile-network architecture in figure 2 .

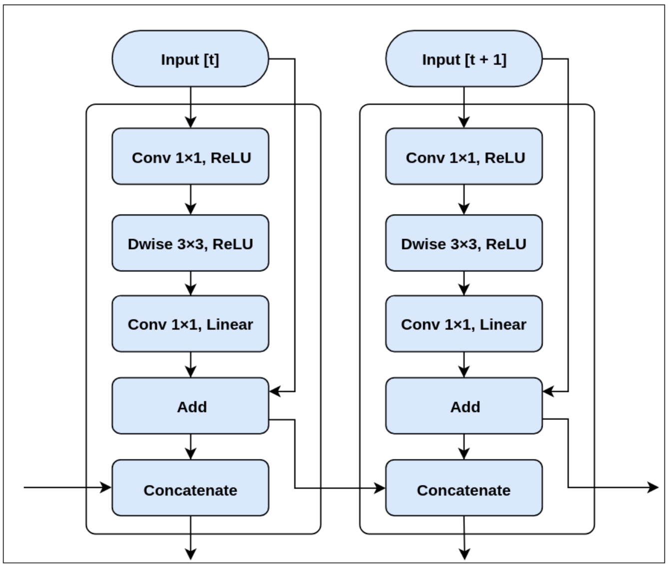


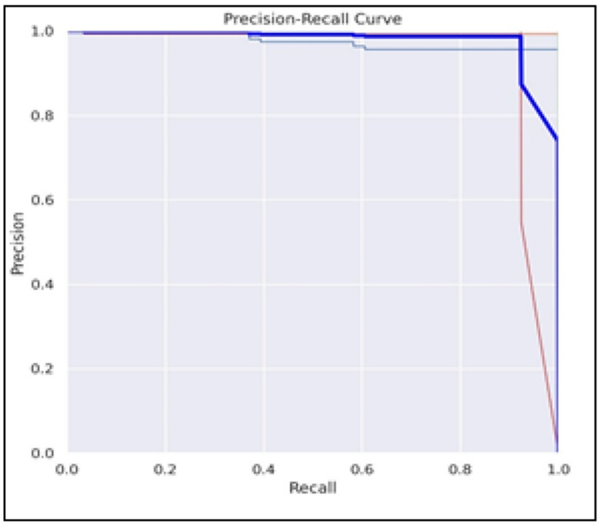
Figure 2: Mobile net architecture

Step 8: Train Custom TF1 Animal Detector*:* Our object identification model training has begun! In order to train the model, the TF Object Detection API's "model_main_tf2.py" script is utilized. All of the arguments and parameters needed by'model_main_tf2.py' have previously been defined in earlier portions of this Colab. Time required for training can range from two to six hours, with exact timing dependent on model, batch size, and total number of steps. For the purpose of running model tests, this will generate a.tflite file.

Step 9: Testing the model for Wild Animal Intrusion : In this stage, the Python software uses the Droid Cam app, which is compatible with both laptops and mobile phones, to record video and, by extension, frames from the mobile phone's camera. In order to identify the creatures in the live video frames, the trained model file. tflite is utilized. The system notifies the appropriate authorities of the animals' whereabouts and also notifies nearby residents via sound to be on the lookout.

III. RESULTS AND DISCUSSIONS

The Anaconda framework, Python, and the Spyder IDE were utilized in the development of the proposed solution for Wild Animal Detection and Alert Generation system through AI. The development computer comes with 8 GB of primary RAM and 1 TB of auxiliary memory. The practicality of the proposed idea has been assessed after taking several things into account. We describe the study's experimental findings here.



The obtained results for confusion matrix are depicted below in the following figures.

Figure 3: Recall-Confidence Curve

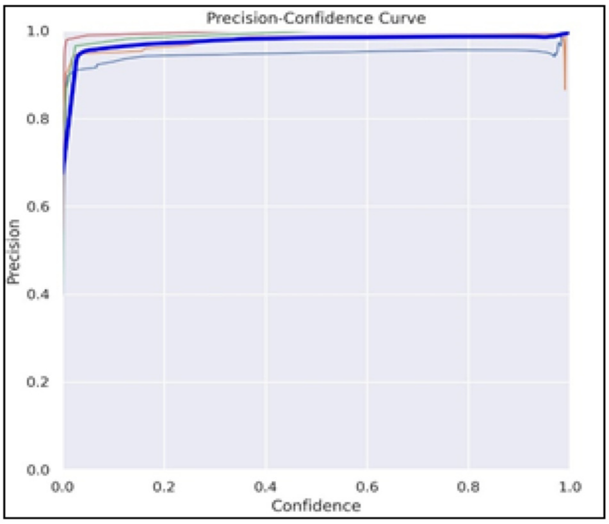


Figure 4:Precision-Confidance Curve

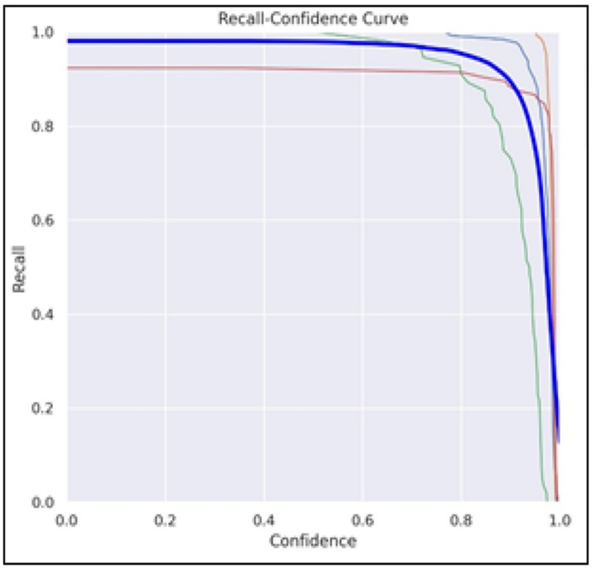


Figure 5: Recall-Confidence Curve

IV. CONCLUSION AND FUTURE SCOPE

The conflict between humans and other animals has been a major problem in agriculture and for humanity as a whole from the dawn of civilization to the present day. In addition, a quick and effective remedy is needed. As a result, this project serves as a last resort for ridding farmlands of wild animals. So, this mechanized equipment can prevent agricultural damage by producing noise and hurling stones at wild animals. at the same time keeping the farmlands safe from predatory animals and other outsiders. Farmers' homes and those located close to forest regions will also be better protected by this method, reducing the risk of serious harm to their lives and possessions. Nonetheless, this structure fosters a harmonious coexistence with the natural world and its inhabitants. The proposed model has the potential to be used on actual farmland in the future. This model has the potential to be improved such that it may function as a mobile app linked to a live cloud, allowing farmers to observe real-time data.

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