

Animal Movement Detection along with Differentiation and Alert Processing in Farm Lands

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Abstract

Every life on land depends on food for living. The source of major availability of food is agriculture. Farmers and agricultural lands are exposed to lot more difficulties currently. One among them is intruders in farm fields. Animal intruders cause a tremendous amount of destruction to crops on field. The proposed system helps in detecting large animal movements using frame differentiation in OpenCV. Motion detection algorithm helps in detecting the movements of animals. OpenCV deals with computer vision operations. Frame differentiation is used to fetch differences between still and movable frames. Working on with Movidius Neural compute stick connected to raspberry Pi which used to fetch the category of animal approaching using image classifier and corresponding actions could be taken on time. Once motion is detected and alert sound is generated and hence the owners could be made aware of happenings. Movidius stick is used to learn artificial intelligence at the edge. Other applications involve, motion detection in military boundaries.

Keywords: OpenCV, Frame differentiation, Video Processing, image classifier, neural compute stick

1. Introduction

Agriculture fields and farms require well-developed protection to prevent animal encroachment at inopportune times. The existing protection is already high-maintenance and has a complex structure. Fencing is used to cover farmland in order to promote or enhance the protection aspects of the crops planted. However, thorny fence is insufficient to prevent the entry of animals that do more harm to crops without being noticed. The animal

encroachment creates massive financial losses in crop production. Animals graze in the fields according to their needs and the availability of food. Preventing animal ingress could boost crop yield and improve the financial situation of farmers or landowners who have big farms or areas that are vulnerable to animal attack. The first half of the project assists in detecting movement and sounds an alarm to alert the owner of the encroachment. The suggested solution makes use of Python scripting and the PyCharm Integrated Development Environment. The next half deals with Movidius stick attached to Raspberry Pi detecting the type of animal approaching. Movidius neural stick makes use of image classifier technique with inbuilt package to detect what type of animal approaching. Hence from the analysis the owner could make appropriate protection without any delay. The procedure considered is to build a fence-like structure with built-in possibilities to monitor animal movements. Once the movement has been predicted, an alert sign must be produced to notify the farm field owners of the illegal entry. Direct safety measures must be made available to farmers or field owners so that prompt actions can be taken. In considering the proposal, these modules fall under precautionary provocations. The proposal's real content is divided into many steps.

- Animal movement is predicted using a motion detection algorithm based on machine learning technology's core architecture.
- A camera is required for movement prediction.
- Once the camera receives data, the object or animal under monitoring is classified as a victim and an alarm sound is emitted whenever little to large motions are detected in the defined contour region.
- This proposal considers a movement detection technique based on frame distinction.
- The variety of animal like pig or elephant is differentiated using Movidius stick to collect precautionary activities.

2. Related Work

Motion detection algorithm and Movidius neural sticks are used in many real-time applications as discrete character modules.

Muhammed, F et.al., [1] Movidius stick has been implemented in hand gesture identification using image classification. For zooming in & out, scrolling up & down. Embedded system accuracy is measured using neural stick. Using AlexNet this system got 99.6% better outcome.

- The main difference between this system and the proposed system is that It's of different hand gesture movements accuracy and not corresponds to agriculture.
- Wrong accuracy identification has also occurred as an obstacle.

Jong,K et.al., [2] The modal for studying hand movements and the system's response to those movements in terms of the essential actions in a current system.

The problem faced by the system is that

- The precision with which the hand motions are predicted may vary slightly. As a result, the essential assistance cannot be obtained at the ideal time.

Nanditha,D et.al., [3] Through classification of animals using toy images work, researcher have developed a supervised, based categorization system for classifying real-world animal photos. To account for elements other than the actual look of animals, the classification model is trained using toy representations of animals.

- The system is of similar idea. But the fact is that is was not intended for differentiation of animals in farm lands and the system hasn't met with any problem statement related to the proposed system to solve with

Anikt,C et.al., [4] The current approach Human Computer Interaction using Hand Gesture and Voice is for predicting hand movements in order to fetch mouse movements is being investigated. HCI is used in the system (Human Computer Interaction). Rapid Manual Tracking is used in the proposed system to avoid blur scale and to capture hand movements, as well as a voice command module to get a reaction on work. Human endurance is a little complicated with computer-based visual techniques. In order to consider motion detection, HCI is involved in the gesture analysis process.

- Replication of gestures cannot go right all time.
- Changes in postures could lead to error come precheck-ups.

Eon,K et.al., [5] One of the previously available systems is a robot that captures motion with a voice assistant while driving in a noisy area. Outlier robust generalized side lobe canceller technique is used to eliminate noise. The summaries to overcome the error have also been prepared to find the barriers in the middle of the road trip.

- The heading angle is the flaw in the technique.

- A fluctuation or mispronunciation in voice and words could lead to misunderstandings between the robot and the passenger.

Andreas,P et.al., [6] Object detection with Raspberry Pi3 and Movidius Neural Network Stick. The goal of this paper is to look at a system for object detection and classification that works even with limited computer resources and time. This system is built using a low-cost Raspberry Pi 3 with the Raspbian Stretch operating system. To drastically cut the classification computation time, the neural network is outsourced to the business Movidius, that provided a neural computer stick. However, the cost is not managed prominently.

- Implemented for object detection rather than animal image detection however classifications are same as of the proposed system.

Sandar,W et.al., [7] The following study discusses the use of a skeleton model to detect motion Highly-priced wearable sensors and illuminator array were employed to assemble the 3-D human skeleton version in recognition system in current paintings using RGB-intensity cameras. The method uses a deep neural network framework to obtain a high-accuracy representation of human mobility in both indoor and outdoor locations.

- It is more prominent way of capturing motion however not cost friendly as of the proposed system.

Perry,X et.al., [8] Using an Arduino microcontroller, a six-degree rotating robot picks up 2D objects from the surface. The distance between the robot and the objects is calculated using ultrasonic sensors. The inverse kinematic algorithm is used to make robot arms rotate in different degrees. The following are the major components used in detecting object infiltration using a robot:

- Raspberry Pi
- Amazon Echo Dot
- Motor driver

The robot is controlled by an Amazon Echo Dot and a speech recognition system. To obtain control over the robot, an Artificial Neural Network was deployed.

- The robot is employed for capturing objects to help for people of cities and not intended to interview with the proposed system dealing with agricultural lands.

3. Proposed Work

In terms of code implementations, the proposed approach acts as a remedy for safety problems with regard to field fence. The countermeasures that can be taken to avert this vary depending on the type of animal. The animals are supposed to be allergic to a certain sound or odor. This requirement can be met by incorporating sensors within the fields.

The movement of the animals is recorded, and a resistant noise alarm is triggered to inform the farm or field owners. Regardless of labor, the fundamental goal is to draw attention to animal encroachment. In order to pass out message to some known help, GSM adoption on raspberry pi could yield the results. The intrusion details and animal type could be passed on prior, so that major destruction to crops could be avoided. working on with future, the type of animal causing intrusion could be identified and regarding prevention measure could be taken.

The entire design of the source code is based on machine learning using frame differentiation and the motion detection method package in OpenCV. In the proposed work, a security camera is mounted on fencing, and if animals approach the fence or attempt to enter the fields, the camera recognizes their movements and automatically sounds a buzzer until the farmers interpret the intrusion alarm. Once alarm strikes, particular message regarding intrusion is sent to people for seeking help. In addition, the type of animal trying to trespass is found out which helps in bringing out particular precautions to make the animal move away as soon as possible. The camera is mounted on the fence in this work.

Similar project with a slight varying procedure comes in line with image classifier that deals with object movements [6]. Image classification comes under supervised algorithm where the system learns the ideas by particular samples that are given as the input to the system for analyzing.

The working part entails mounting cameras on fences to capture animal activity with Python OpenCV, and then analyzing the data. Using the Python OpenCV packages, alert sound is aroused. Classification of images of animals is done by movidius stick connected to raspberry pi with image classifier. The stages are as follows:

- Detecting movement with OpenCV in Python.
- Contour detection Alert sound packages
- Differentiation of types of animals

Sending additional messages for help requirements.

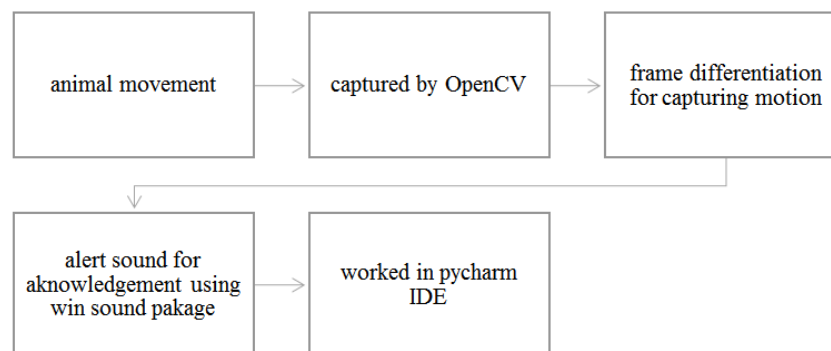


Figure 1. Movement prediction steps

Figure 1. Specifies the steps involved while working with capturing the movement of animals. Motion detection is the process of predicting little or large changes in fixed frames that may be detected by a moving body. Parameters are a regular occurrence in computer technology, particularly in laptop imaginative and prescient. A number of values can be assigned to each parameter. Many factors will influence the appropriate fee. it's out of our reach to adjust every price to a certain case.

3.1 Converting grayscale to color

It is vital to obtain the grey scale reading in order to gain a thorough understanding of the image or video being processed. It's a good idea to convert images to grayscale before doing anything with them. Working with these kinds of photographs is far less difficult and more important. Alternatively, noise generated by the digicam and by the lighting should be minimized. In this part gray scale readings are got to make use of them during night time since no light would be found. Smoothing is a typical term for it.

```
gray = cv2.cvtColor (frame, cv2.COLOR_BGR2GRAY)
```

3.2 Threshold Implementation

The goal of this phase of the procedure is to keep the pixels that exceed a certain threshold. The goal is to modulate the image, or to have two viable options. Those who cross the line will become white pixels, while those who do not will become dark pixels. This may make it easier to locate the moving object. There's a way to apply a threshold in OpenCV.

```
_,thresh=cv2.threshold(blur,20,255,cv2.THRESH_BINARY)
```

3.3 Detection of Outlines

It is far essential to recognize the outlines or blobs as soon as the image with black or white pixels is presented. A blob is a collection of pixels that are related to one another, i.e., it has neighbors with the same cost. While we're on the subject of neighbors, those who are next door are miles away. The following are the modules that make up a complete proposal:

- Movement capturing
- Alert Generation
- Image classification

3.4 Movement Identification

This module describes how to use OpenCV to predict movement. PyCharm is the IDE that was initially utilized. The package used for motion detection is OpenCV for computer vision. To forecast movement, two camera frames are employed. For nighttime coverages, grey and blur photographs have been verified.

3.5 Alert sound generation

This module exhibits the sound that is exposed when animal movement is predicted. The alert sound is essential to keep the user informed about what is going on in the farm/field. For alarm sound effects, the PyCharm package in sound has been imported. The package is imported in order to provide a better sound effect for quick response.

3.5.1 Sound packages

The win sound package provides access to the basic sound producing tools provided by Windows structure. There are several constants and functions in it. The laptop speaker emits a beeping sound. The speaker runtime error is reported if the device is unable to produce sound. Use the Platform Application programming interface underlying Message Beep capability to replace a message sound with the standard beep sound. The name of a WAV file is the sound parameter. This emits a unique sound from the register. Which sound to play is specified by the sort argument. Easy beep is produced at cost -1. If a genuine cannot be played in any other circumstance, that is the exact last fall returned.

3.5.2 Hardware- camera

Cameras like closed-circuit television is used for video surveillance in agriculture fields. They are used for capturing animal motion. these cameras are accessed using OpenCV

and once movement is predicted alert sound goes on so people could be aware that some animal is entering.

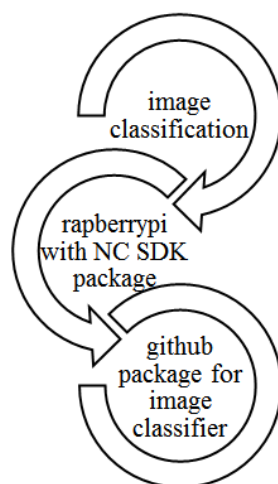


Figure 2. Steps in image classification

Figure 2. Specifies the steps involved while working with classifying the images of animals. As of now raspberry pi with movidius has moved on with NC SDK installation and image classification with tabby cat image in the given proposed system.

3.6 Image classifiers

If the attacking animal type is not known to the concerns, the safety measures could not be taken in a consecutive manner. Attacking animals might be elephant, pigs, and so on. Image Classification is done using movidius neural stick that exhibits different packages that provide clear details about the animal that is being fed into its memory. As in deep learning several sample photos have been analyzed and the perfect variations are to be noted for accuracy and performance.

The workspace involves:

- NC SDK
- NCAPPZOO
- Git Hub package for image classifier

3.6.1 NC SDK

NC SDKs is used for deploying Deep Neural networks with working models based on the type of processes proposed. It has two processes. One is it provides tools for doing

profiles, tune sounds and compile deep neural networks for a complete system. NCAPI is used to access the hardware of any neural networks for inferences. NC SDK has those huge packages packed with it. They include, accessing more graphs on one device, line by line input and outcomes, supported by NCAPI. It has two versions of it. Both are incompatible

3.6.2 NCAPPZOO

Neural Compute Application Zoo is a collaborative repository with a large number of content creators and maintainers. All ncappzoo content is open source and available for others to download, experiment with, alter, build upon, and learn from. In the repository, there are three branches. Master branch, ncsdk2 branch, ncsdk1 branch.

3.6.3 Git Hub package for Image classifier

To make a copy of a repository in GitHub git clone module is used. When cloning happens not like other modules that give single required document, clone gives the complete file. It might occur only once at the start. Cloning is done to interact with the available systems in a polite way. Here git hub is used to pick up packages required for moving the work with neural stick. Cloned files need not be cloned again to make any updation It is handier. Here the proposed system is going to access the ncappzoo from GitHub.

3.7 Raspberry Pi3

The Raspberry Pi is a minimized Arduino board like structure that fixes to system monitor using HDMI portal and makes use of available keyboard and mouse. It is cost efficient. To produce screening of raspberry pi, this proposal includes Xming screener. It allows to project a graphical Linux program that basically runs on remote Linux server. Putty is used for SSH configuration to enable. Thus, Raspberry pi setup is made. OpenCV package requirement is satisfied.

3.8 Movidius Neural stick 2

DNN's drive used for understanding Artificial intelligence is called Movidius stick. The Movidius Visual Processing Unit, a low power, high performance device, powers the neural compute stick, helps in classifying the images based on the given types. Classification is done by already given inputs like sample photos which are then analyzed thoroughly for improvement of accuracy and performance. The accuracy between the pictures is captured using samples. Once the accuracy between the different images is captured, comparison could

be made so that type of animal approaching could be classified. The accuracy ranges in percentage. The stick gives accuracy in multiple choice such that which has the highest percentage accuracy is considered to be predicted animal.

3.9 Caffe

Caffe is a deep learning framework that prioritizes modularity, performance, and expression. Application and innovation are encouraged by expressive architecture. Models and optimization are configured rather than stiff-coded. A convolutional neural network of 18 layers deep is called SqueezeNet. The ImageNet database contains an already trained version of the network that has been trained on more than a million images. SqueezeNet helps in improving accuracy. Unclear images could be accessed and output is got using SqueezeNet

4. Results and Discussion

Using python OpenCV package and a field implemented camera, the motion of large animal is captured.

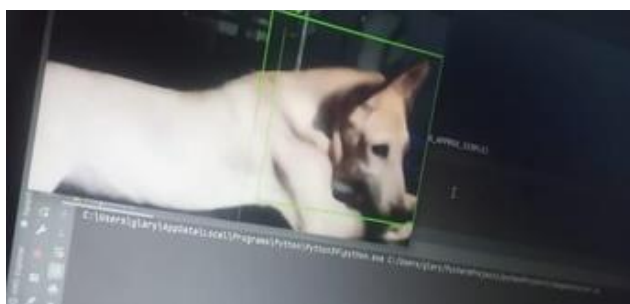


Figure 3. Animal motion detection

Figure 3 specifies the motion detection done using OpenCV in PyCharm IDE. The difference between static and movable frames are fetched to find any movement occurring while monitoring. The camera measurements of animal motion are anticipated using a contour analysis with a rectangular framework. The user would be informed of the incursion condition since an alert sound would be generated.

Table 1. Accuracy of OpenCV

Method	Accuracy
Movement prediction- animal within 10 meters of camera	99% movement prediction by OpenCV

Range of movement	51 x 51 mm
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Table 1 represents the accuracy of OpenCV when comes to capture movements within a particular range.

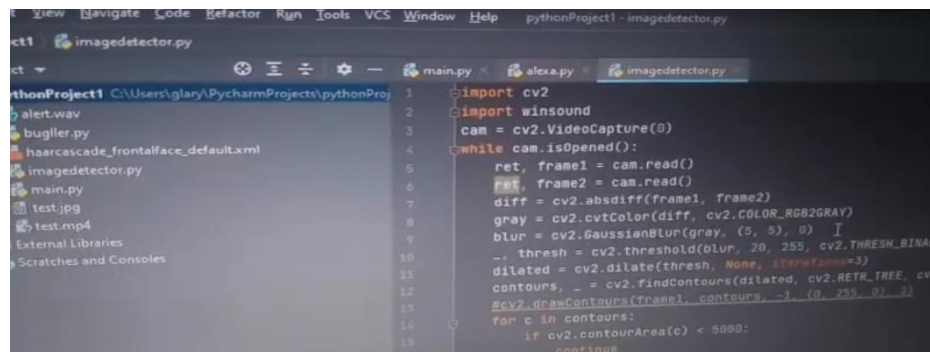


Figure 4. Python coding

Figure 4 represents the python coding for capturing movement of animals. Alert sound is imported by win sound package for particular buzzer sound.

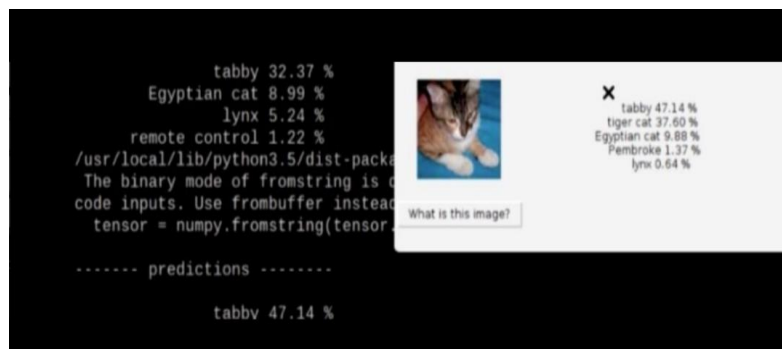


Figure 5. Image classifier for cat

Figure 5 represents the classification working of movidius neural stick when connected to raspberry pi.

Table 2. The outcome accuracy of image classifier

Name	Accuracy
tabby	32.37%
Egyptian cat	8.99%

lynx	5.24%
Remote control	1.22%

Table 2 Specifies the accuracy variation of cat's images when accessed. The maximum accuracy is the result produced.

Table 3. The speed of working of NCS (Neural Compute Stick)

Category	Result
speed	3-4 seconds per image per core. On ImageNet 395% to 545% speedup.

Table 3 specifies the speed rate at which the NCS works with image classification. Future implementation includes GSM connection to raspberry pi for transferring messages to alert people for help. GSM connection require adequate tower accuracy prevailing around the area of farm. It's easy to get help with the help of GSM transferring messages.

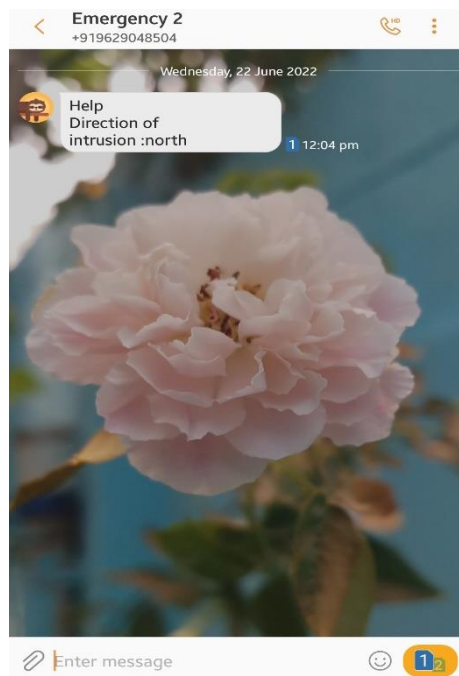


Figure 6. Example of GSM message

Figure 6 represents the example picture of GSM sending the message to the input number for help. Raspberry connection with GSM helps in transmitting message to owners or

people who could provide help. Another improvement is the proposed system will be implemented with sensors that can identify which animal would be scared of which sound in order to take early precautions. The flex audio player manager helps to provide various sound features for different requirements. What has to be played in loop is made to run in loop like an alarm. Can be controlled by implementing stop method. Those audios that have to be played only once are played only once. No looping occurs after the implementation.

5. Conclusion

Farm protection with fencing like structure with mounted camera and capturing movements of animals is implemented. Alarm beeping for alerting people using python package is worked out. Movidius stick implementing classification of animals for precautionary activities is under pre-ready stage with minimum samples. As future implementation GSM could be implemented along with raspberry pi. Sound effect for different animals is to be adopted. Total cost might fall around 19000 Indian rupees. Could be implemented in military sectors for securing the border line.

The accuracy when compared to other system is low however the entering animals that damage the crops are limited, hence only little accuracy is required while predicting the animal to take precautionary activities. As for the cat classification 33% is enough since only the precautionary solution is more valid. The system architecture is more simple than other systems since requirement of hardware is less except for raspberry pi, movidius stick and camera. Working on with combining the movement prediction and identification or classification in single module implementation. Without classification, movement prediction is of 99% accuracy when some moving object is nearest to the fence and alert sound goes on immediately without any errors. Hence immediate actions could be taken on time. Agriculture fencing structure is not so strong as of now. Cost friendly as of movement prediction but with raspberry pi and movidius stick it reaches a bigger cost however working on with classification in different norms to reduce cost. With particular maintenance this project can satisfy its current work more prominently.

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