

Machine learning based activity detection in large fields through video surveillance

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Abstract— Monitoring human and animal activities in large fields and farms is crucial for ensuring crop safety and overall security. This paper presents an intelligent surveillance system designed to automatically detect and classify human and animal activities in agricultural environments. The system is also adaptable for use in various other settings, such as retail shops, banks, and wildlife monitoring. Upon detecting any activity, it immediately sends an automated alert to the user and initiates video recording of the incident. The proposed implementation aims to enhance security, reduce the need for continuous manual monitoring, and optimize storage usage by recording only relevant events.

Index Terms- Human detection, animal detection and alert system.

I. INTRODUCTION

In recent years, the need for intelligent and automated surveillance systems has grown significantly across various domains, including agriculture, retail, banking, and wildlife monitoring. In the agricultural sector in particular, the safety of crops and farmland is often compromised due to unauthorized human intrusion or the presence of wild animals. Traditional surveillance methods rely heavily on manual monitoring, which is both time-consuming and inefficient, especially in large and open fields.

With advancements in computer vision and artificial intelligence, it is now possible to develop smart surveillance systems that can automatically detect, classify, and respond to different types of activities. This paper introduces an intelligent surveillance system specifically designed for monitoring human and animal activities in farms and large fields. The system continuously analyzes live video feeds, identifies the type of activity occurring, and instantly notifies the user when a relevant event is detected. Additionally, it initiates video recording only during such events, thereby optimizing storage and reducing unnecessary data collection.

Beyond agriculture, the proposed system is adaptable and can be deployed in other security-sensitive environments such as retail stores, financial institutions, and wildlife conservation zones. By

automating the process of detection and alert generation, the system significantly reduces the dependency on manual supervision and enhances overall security.

Our proposed system uses this learning-based object detection framework to identify certain objects in real-time using any camera inputs. It contains a pretrained model MobileNetSSD to identify and detect objects such as birds, sheep, cow, horse and humans and checks for any activity. System continuously captures frames from camera inputs and processes them through the pretrained model and checks it in their dataset if the object is detected then it immediately sends a whatsapp message to the given user. This integration of computer vision and real-time object detection and communication enhances automations making systems highly applicable for surveillance, wildlife monitoring, security applications.

This paper utilizes OpenCV[1][2] for real time video capturing and object detection. OpenCV has efficient image processing power to support the integration of deep learning models, so we used a model MobileNetSSD[3], which is widely used in object detection tasks like animals, vehicles, humans etc. imutils library is employed to normalize image manipulation while running the code. The libraries like pywhatkit and pyautogui which are used to facilitate automated whatsapp messages , which give access to real time alerts on object detection. Also used pynput to use smooth keyboard automation to send messages. On combining all of these things we made a real time monitoring setup.

II. LITERATURE SURVEY

Vaishnavi Patil et.al [1] through this paper study the ways in which opencv can be utilised. This study addresses the capabilities of the opencv library using the c++ language by using it in practical applications and also addresses some challenges like real-time processing for IoT devices, and the integration of deep learning with computer vision. Qingyun et.al [2] undertook this study to analyse the effectiveness of AI and Open cv in security situations. This paper tells a

very practical and innovative approach to use AI and OpenCV to help in customs (border security) and also to help with public health safety during the Covid-19 Pandemic.

Rajnandini Chaudhari et.al [3] Proposed a real-time object detection system using MobileNet-SSD, optimized for mobile and embedded devices. The research paper is based on Object Detection Using MobileNet-SSD for real time object detection achieving high accuracy ,performance and efficiency on low-end devices, used in surveillance, autonomous vehicles. Lochan Basyal et.al [4] Proposed a real-time face recognition system using OpenCV and Python for human identification, and store user data in SQLite studio and PHPMyAdmin applications in security, surveillance, and more. Parveen malik et.al [5] described YOLO framework models used. The IP102 dataset is focused. Steps involved. A. Performance Metrics in Object Detection, B. Data-set Preparation, C. Comparison of YOLO Models, D. Performance MetricsAnalysis, E.Model Explainability. Machine learning and algorithms are also useful.

Xiaoxiao Bian et.al [6] proposed a medical waste classification system utilizing OpenCV and SSD-MobileNet for the 5G era.The paper proposes automatic medical waste classification system using OpenCV and MobileNet-SSD . use machine learning for detection, deep learning for classification and background subtraction algorithms for better accuracy . Achieves average recognition of the medical waste with 98.5% accuracy in 52 milliseconds.

Chen Gao et.al [7] have constructed a visual object detection and tracking system from the MobileNet-SSD algorithm that detects people and vehicles in real time on mobile platforms without any GPUs. The multi-pan-tilt architecture in the system allows tracking of multiple objects simultaneously. The experiments show the system has a high detection rate and real-time tracking capabilities that could lend itself to intelligent monitoring and use on unmanned platforms. Rohit Kumar et.al [8] proposed this paper to study and analyse the methodology to detect objects in real-time. This study presents a framework for real-time object detection on roads, and also mentions that such frameworks need to be efficient as well as scalable, especially in self-driving vehicles. This paper is very likely to help the respective field in research. Chen Li et.al [9] presents a research paper on detection of fruits using the SSD model. The model processes images, identifies oranges, and marks them with a rectangle in real-time detection, even when fruits are partially hidden by leaves. Nilamadhab Mishra et.al [10] proposed this paper to highlight the

potential of automated technology in security situations. This study addresses the potential of efficient technology in improving security in border-like situations by being faster as well as less resource intensive. But it also addressed complex topics about this technology's ethical usage. Manoranjan Paul et.al [11] reviewed a critical survey of various human detection approaches in surveillance video, covering background subtraction, optical flow, and spatio-temporal filters for detecting motion. They also discussed shape and texture-based motion perception methods for human recognition, commonly accepted datasets, security applications, and future directions. Vaishnavi Patil et.al [12] presents a paper on object detection as a computer vision technique that helps identify and locate objects in images. Object identification technology has the ability to relieve people from regular jobs that robots can carry out more quickly. Mohan Chandu et.al [13] developed a real-time crop protection system using YOLOv7 to detect wildlife causing damage to crops. The system detects these animals via live streaming video feeds, processes the detections, and initiates a response through automated deterrents such as alarms or sprinklers. The system is designed to be cost-effective, eco-friendly, and flexible in order to assist farmers in reducing crop losses and security. Mone, Shubhada et.al [14] The paper entitled "Smart Video-Based Threat Analysis and Detection using CNN" analyzes the use of CNNs for real-time threat detection in video surveillance by enhancing security through video footage analysis and alerts generation for suspicious activities. Muhammad Syafiq et.al [15] Use of Arduino UNO as microcontroller, more effective and dependable security measures to look after crops and farmers, ESP32-CAM and PIR sensor used. PIR sensor->Motion detected->capture through ESP-32CAM->Intruder detection->alert notification. detection of stray animals is now possible. Pallavi S. Bangare et.al [16] presents a research paper on a real-time security system that detects objects and differentiates humans from non-living items using image processing and sends alerts via email/message to users.

III.METHODOLOGY

The proposed system follows proper methodology for real-time object-detection and alert notifications.

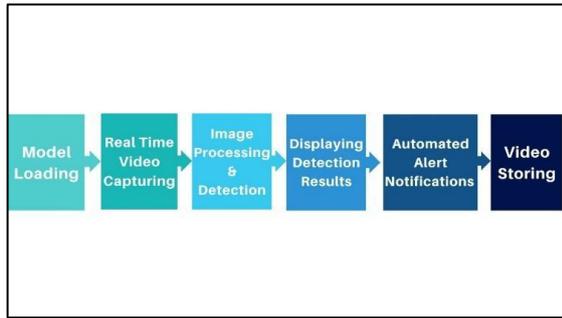


Figure (1). Methodology

1.Model loading-

At first it loads a pre-trained model MobileNet(SSD) single shot detector which is referred from (https://medium.com/@thakurav_nish2313/real-time-person-detection-and-whatsapp-notification-using-python-a1c93f7a04c10), which is trained through COCO dataset, it is loaded through opencv deep learning module make it more efficient and accurate for object detection. This model is trained through the COCO dataset. This dataset includes around 80 object categories and it contains over 330000 images for object detection.

2.Real-time Video Capturing-

Now real-time video capturing is done by any video camera inputs like webcam, mobile cameras or surveillance cameras .

Image capturing takes place when the video is loaded in the system from the camera it continuously processes it and captures every frame of the video and passes it to the model for detection.

3.Image-Processing and Detection.

Now the processed images which we took from video and passed it through model now the model analyse each and every frame and checks for detection certain values are assigned for detection for example different id are assigned for different things like human has id=15 bird id=3 similarly for cows sheep and horses and on that id data regarding those object is saved and frames are checked if there contains any data regarding that id and gives result accordingly if frames matches 50% of id data the detection is considered successful and information is passed.

4.Displaying Detection Result-

Now detected objects are displayed in real-time on the camera screen by overlaying bounding boxes and

labels on processed frames. This is carried out through opencv, which makes it effective real-time monitoring.

On activity detection it displays the name of the object in the same camera window for understanding.

5.Automated Alert Notifications-

On successful detection an automated alert notifications are sent to user , if detected objects makes values of (bird, cow, sheep, horse or human) then the message is generated according to it .to do such things a python libraries like pywhatkit and pyautogui are used to send messages automatically to given phone number .

such a comprehensive methodology ensures efficiency in our system and helps to enhance security and monitoring capabilities.

6.Video Storing- Since in surveillance cameras full-time video recording is stored which occupies lots of space but in this system it only records for limited time after any activity is detected.

Therefore on certain detection it will start video capturing and will be stored in the recording folder in the system.

IV. RESULTS AND FINDINGS



Figure (2). Human detection



Figure (3). Alert message for human detection.

Results-

1.Human detection- if any human like thief, attacker, kidnapper tries to do some activity now can be

detected and immediate messages can be sent through whatsapp as shown in above images.

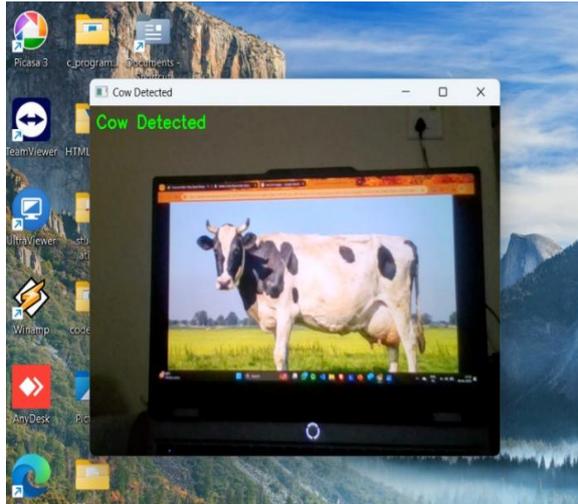


Figure (3). Alert message for human detection.



Figure (5). Alert message for cow detection

2.Cow detection- Similarly if user have great fields and farms and suddenly bunch of cows or cow try to enter in your which can cause harms to your fields can be stopped through detection by sending message as shown in image.

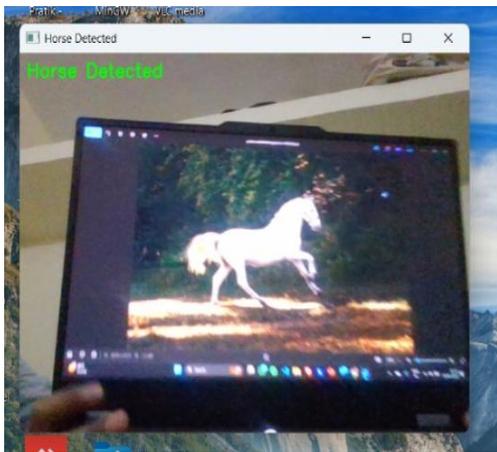


Figure (6). Horse detection

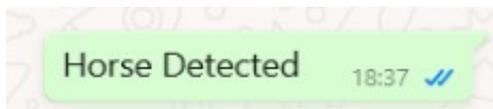


Figure (7). Alert message for horse detection

3.Horse detection- If a horse tries to enter in field and starts eating crops such activities can be stopped by this system by detection as shown in above image and automated alert message is send to user.



Figure (8). Sheep detection



Figure (9). Alert message for sheep detection

4.Sheep detection- If sheep mistakenly enter your storage rooms or fields having crops which can be eaten by sheep to stop such activities a real time alert message can be sent to the user to stop it. As shown in the above image.

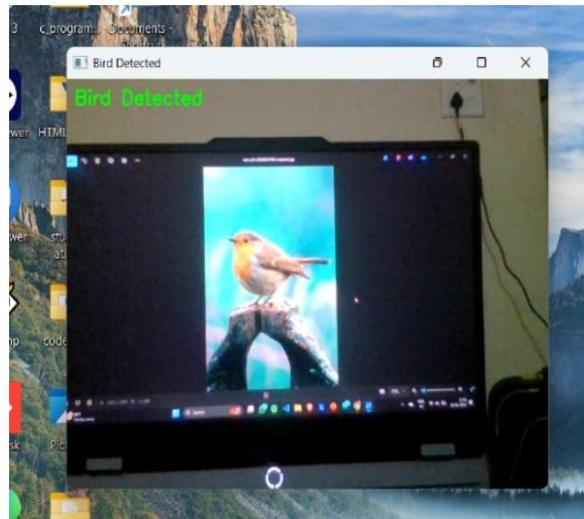


Figure (10). Bird detection



Figure (11). Alert message for bird detection

5- Bird detection- As we are aware that the scarecrows used to keep crows away, means they can cause harms to fields so if any crows or any birds tries to attack field in bunch it can cause huge loss to farmer so to stop such attacks, bird detection helps and send

automated alert message to user as shown above.

Name	Date modified	Type	Size
models	07-01-2025 10:19 PM	File folder	
myEnv	07-01-2025 10:08 PM	File folder	
output	07-01-2025 03:34 PM	File folder	
recordings	10-02-2025 11:05 PM	File folder	
detected_frame	10-02-2025 11:04 PM	JPG File	39 KB
human_detection.py	02-02-2025 06:36 PM	Python File	3 KB
humandetect2.py	02-02-2025 06:55 PM	Python File	5 KB
PyWhatKit_DB	10-02-2025 11:04 PM	Text Document	5 KB
recording.py	10-02-2025 11:03 PM	Python File	6 KB
send_button	10-02-2025 11:00 PM	JPG File	2 KB
tempCodeRunnerFile.py	26-01-2025 07:21 PM	Python File	3 KB

Figure (12). Video storing



Figure (13). Playing stored video

6. Video Storing-

Normal CCTVs or surveillance cameras capture video and full-time video recording is stored in the device but in this system we all capture video only when some kind of detection occurs on your place and it captures till a certain amount of time which will work as proof of unusual activity and will save storage of the system.

V. CONCLUSION

This research gives an efficient and real-time threat detection system using machine learning and computer vision techniques. By using pretrained models and libraries like MobileNet-SSD and OpenCV, the system successfully detects human and animal activity in large fields, farms, and shops, providing real-time alerts to users. The system of sending automated WhatsApp notifications enhances its practical uses for security and surveillance for farmers, banks, wildlife monitoring etc. The findings says that this approach can help to reduce crimes like theft, other security threats, and animal intrusions in fields, and ultimately reducing financial losses and improving monitoring efficiency. Future work can explore improving model accuracy, expanding the system to recognize a large view range of threats and can be improvised in better ways.

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