Animal Monitoring System: YOLO Algorithm and GPS for Real-Time Detection and Location Tracking in Conservation and Farm Environments

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Abstract - Monitoring wild animals is essential. It is key to discovering Their population and Studying behavior as well as habits. At the inception of wild animal monitoring reliance on human effort was high. It was the main method. Despite being time-consuming It Was also dangerous. Safety risks made this method less than optimal. Development Of pattern recognition technology has been continuous. These techniques are crucial. They have enabled automated wildlife detection. This method uses algorithms driven by image Content analysis. Such algorithms have progressed. They have been Advanced due to these developments. However implementation Of current methods often falls short Recognition accuracy remains a challenge Robustness too often fails to meet practical application requirements Based on these considerations we advocate using YOLOv5. The method is field animal detection It has been spotlighted in our study We aim to localize and recognize wild animals. We analyzed the effects of different scenes on recognition accuracy This was especially true for Scenes containing multiple targets. We also focused on scenes with small or occluded targets. Our experiments Were vast. We used a Plethora of them. They were used to confirm the feasibility of this method. This method is entirely reliable. Its ability to deliver accurate results have Been proven.

Keywords: animal detection, deep learning, YOLOv5

I. INTRODUCTION

Human-wildlife conflicts have emerged as the most significant issue, more specifically in rural and areas of conservation where wild encounters pose a grave threat to human as well as wildlife life. The described interactions occur much more often in places where urbanization and agricultural development coincide with the natural habitats of animals, making encounters deadly and causing injuries, which further disrupts the ecosystem. Moreover, illegal trafficking and habitat loss threaten species, which further calls for an effective wildlife monitoring solution.

II. YOLOv5

A key feature of YOLO algorithm is ability to maintain high speed and certain accuracy. It has relatively low chance of confusing background for object .This algorithm can deliver Accurate Classification results for different objects. It Has great versatility. The most fundamental Concept underpinning YOLO series algorithm is division of image into numerous identical grids .These grids predict target landing within them. Each Grid carries multiple parameters. These include the position of object to be found. It Also includes shape of candidate box ,the probability level and type of object to Be found Neural network Of Yolo algorithm will reveal these parameters as target.

Additionally it gathers features around. Especially around This target. Subsequent iterations of YOLO have been based on original YOLO. They have actively integrated new and popular ideas .Also ,they adopted new methods that are helpful and useful. This evolution has led to YOLOv5 model .It boasts A solid performance. The characteristic Of the YOLO algorithm is that It can maintain an accuracy rate At the same time It Has High speed. It has a Relatively low probability of treating the background as an object to be recognized It can give good classification Results for various objects. It also has Strong versatility .Basic idea used by YOLO series algorithm is to divide a picture. It is divided into grids of the same size Those grids will be responsible for predicting one target. Target falls into grid. Each grid contains some parameters. The location of Object to be detected is a parameter. The shape of Candidate box is Another parameter. The probability level is a parameter as well .The type of object to be Detected Is also parameter. Neural network will output these parameters. It does so as target. It then extracts features around target. The Subsequent versions of YOLO are based on original YOLO. They Adopt Popular ideas. They actively Adopt useful ideas and methods . YOLOv5 Model is the result .This model has stable performan

III. Network Structure

Network structure by YOLOv5 involves Following three main parts Backbone Neck and Head. First part replaces SPP using CSP-Darknet53 [3] to enhance performance. For Neck PANet is employed to enhance Network capability [5 ,9]. In Head YOLOv5 adopts Same three detection layers as utilized in prior version. Below is detailed description of Backbones of YOLOv5s. It can be found in Table 1 'From' signifies to layer That parameters will be gathered from. Value of '-1' in there means The previous layer .'Number' signifies number Of modules set To be used. If number is not 1 its size is subject to depth_multiple. Parameters 'depth_multiple' And 'width_multiple' will be brought up again later on. 'Module' is what we call type of module in existence in particular layer. Details are laid out in commonpy file. Out of them 'Conv' is CBS. It has a set up of A Conv2d a BatchNorm2d and SiLU. C3 is another module called CSP. It holds three CBS and a Bottleneck. C3 is different when in neck as well. In addition YOLOv5 takes on SPPF. It replaces the previous SPP And significantly sped up calculation process. The term 'Args' refers to the module's output parameters. Hence it also has an impact on number of Inputs in following layers. Its size will be affected By width_multiple.

IV. Organization of Paper

The paper is organized so that the paper states the case of wildlife monitoring, especially within environments that have conflict-prone human and animal habitats. It begins with reviewing some recent animal detection and tracking technologies, such as YOLO, RCNN, and GPS-based IoT systems. A system has been proposed, using YOLOv5's model architecture back- and neck, and head. The backbone ensures the precise and real-time detection of animals due to multiple layers within object detection. The methodology applied in this discussion is explained with the help of a flowchart from video capture to finally object detection, mentioning the accuracy of the model and what it lacks simultaneously. The discussion continues and keeps at the level of efficiency for YOLOv5, even though there are problems in the availability of data, and the discussion finally ends with the potential ability of the model to reliably monitor the environment from a diverse setting. Last, in finalizing the paper, it takes into account future applications in conservation, agriculture, and urban settings and accordingly quotes several references

V. LITERATURE SURVEY

It presents a literature survey of the different technological approaches to animal detection, tracking, and monitoring. YOLO and RCNN models are found to recognize animals quickly and accurately, as well as LSTM for motion-based alerts. IoT solutions using GPS and sensor networks provide health and location tracking. Together, they demonstrate the potential of technology in improving the management of wildlife and human safety in natural settings.

from	number	module	args
-1	1	Conv	[64, 6, 2]
-1	1	Conv	[128, 3, 2]
-1	2	C3	[128]
-1	1	Conv	[256, 3, 2]
-1	6	C3	[256]
-1	1	Conv	[512, 3, 2]
-1	9	C3	[512]
-1	1	Conv	[1024, 3, 2]
-1	3	C3	[1024]
-1	1	SPPF	[1024, 5]

Fig.1 Network Structure

VI. Proposed System

The YOLOv5 model has performed well in most generic object detection applications, which vary regarding object classes and their variation: humans, animals, traffic signs, and vehicles. This motivated us to design a lightweight species detector for animal species, based on YOLOv5 for detection. It is a great challenge in the enhancement of detection speed and accuracy

VII. Mathematical Model

YOLO (You Only Look Once) is a real-time object detection system based on deep learning model. divides images into grids where each grid predicts bounding boxes and confidence scores for objects. Below is the general formulation of YOLO's object detection model:

Let:

x, y - center coordinates of the bounding box

w, h - width and height of the bounding box

p - probability of object presence

c - confidence score that an object is present in a grid cell YOLO's prediction is based on a loss function combining classification and localization errors:

Loss = (Localization Error) + (Confidence Error) + (Classification Error)/

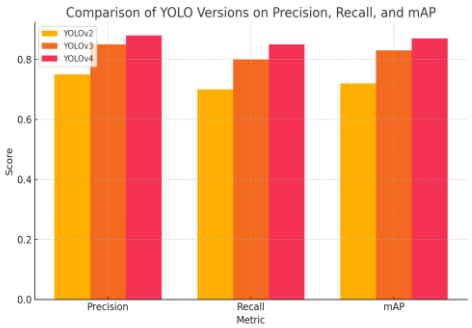

Fig 2. Comparison graph

TABLE I – LITERATURE REVIEW

	Name of Paper	Publisher	Authors	Year	Description	Algorithm Used
1	A Zigbee-Based Animal Health Monitoring System	IEEE conference	Anuj Kumar and Gerhard P. Hancke	2015	This paper shows that changes in temperature negatively affect the health of animals and causes diseases such as foot and mouth disease, swine fever, bovine spongioformencephalopathy (mad cow disease), bovine rhinotracheitis, squamous cell carcinoma, warts, web tear, necrotic pododer -matitis, polio encephalomalacia, hypomagnesaemia, clostridia.Disease and hypo glycemi	Yolov2
2	IOT Based animal tracking using GPS	IEEE Access	V. Sangeetha	2020	The purpose of this project is to track the location of Animal in the zoo or national parks. This system shall comprise a temperature sensor and PIR sensor. The temperature sensor senses the temperature of every animal and PIR sensor senses the human presence inside the animal boundaries or restricted areas.	LSTM
3	Convolutional Network based Animal Recognition using YOLO and Darknet	International Conference on Inventive Computation Technologie	B. Karthikeya Reddy;	2021	This is a very cumbersome task: the detection of animals along with their names. Overcoming this problem, the research work develops a YOLOV3 model for detecting which animal is present in an image provided by a user.	Yolov3
4	An Accurate and Fast Animal Species Detection System for Embedded Devices	IEEE Access	MAI IBRAHEAM , KIN FUN L	2023	Animal species detection methods based on regular Convolutional Neural Networks (CNNs) have been widely applied	YOLO v2
5	Creating Alert Messages Based on Wild Animal Activity Detection Using Hybrid Deep Neural Networks	IEEE Access	B. NATARAJAN1 , R. ELAKKIYA	2023	Surveillance cameras and drones are used to track the movement of wild animals. There is an efficient model that senses the type of animal, monitors its locomotion, and provides its location information. Then alert messages are sent for safety to the people and foresters.	LSTM
6	Detection and Recognition of Animals Using RCNN Algorithm	IEEE Access	Swethaa Prabhu	2023	An animal recognition and tracking system could allow for real-time monitoring of populations and behavior in the wild to be done accurately and reasonably economically, helping with further conservation efforts and research within ecosystems.	CNN
7	WildARe-RCNN: A lightweight and efficient wild animal recognition model	IEEE Conference	Vishwas jain	2023	The system will collect micro-climatic as well as the positional information of the animal and send it to the base station through flooding of data using peer-to-peer network.	RCNN

VIII. RESULTS BASED ON PREVIOUS WORK

Although satisfactory in model performances regarding detection, several improvements are necessary. For example, the dataset is not much diversified, especially in challenging conditions, including nighttime or aerial views, which would affect real application. Certain specific image types with field expert guidance can be advantageous for creating a more realistic dataset. Sample size may be increased with the intention of improving the concentration on smaller targets by the use of shallow neural networks that are especially useful in small animal target detection. Smoothing weight ratios may increase detection accuracy. One may have to sacrifice some of the speed to develop special nets for small targets by simulating human strategies by heuristic rules. When there are fewer data for rare species, this might degrade the quality of training. Multi-label detection on YOLOv5 can classify animals as rare by thinking of similar species and thus increase accuracy. The detection of these species can eventually be made independent as more samples of rare species are obtained.

IX. DISCUSSION

[1] AI-based systems provide superior efficiency cost reduction and scalability. They handle large volumes of customer inquiries quickly and accurately.

[2] Ai performs exceedingly well in routine tasks. It promotes consistency 247 availability and reduces Operational costs. This is done by minimizing human intervention.

[3] Human agents are more effective in addressing complex emotionally charged issues They have emotional intelligence adaptability and personalized engagement.

[4] AI struggles. It struggles with understanding emotional cues. It struggles with providing context-rich solutions. It also struggles with its effectiveness in Sensitive interactions.

[5] Human-based customer service fosters stronger customer relationships. It does so through empathy problem-solving and trust-building. Despite its slowness and costliness.

[6] Review shows a hybrid model. A hybrid model is one which combines AI's efficiency with human emotional intelligence. It combines human problem-solving capabilities. This offers the most Effective solution in optimizing customer service.

X. SYSTEM ARCHITECTURE

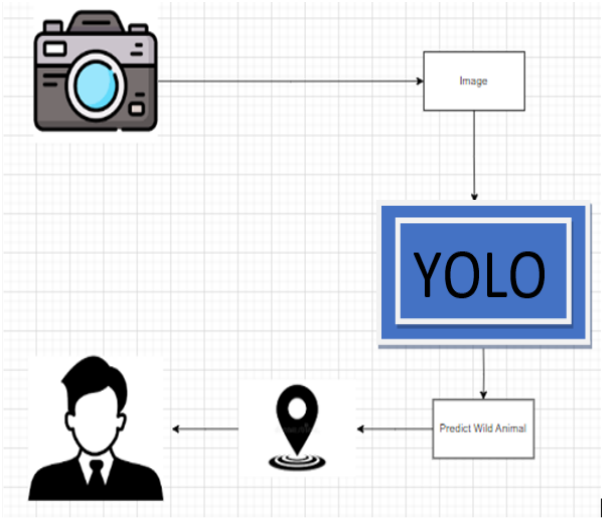

Fig 3. System Architecture

XI. FLOWCHART

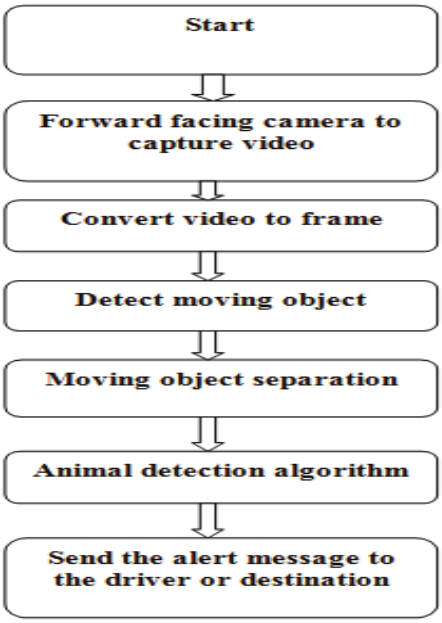

Fig 4. Flowchart for System Working

XII. CONCLUSION

In the face of the challenging needs and tasks of wildlife detection, this article provides a feasible method through Yolov5 algorithm. Specifically, we first revisit the theory of YOLOv5, including its network structure, loss function, training settings. We conduct several experiments to analyze whether this method is feasible, especially for different wild scenes, such as multiple targets, small targets or occluded targets. We have used a large number of experiments to verify the feasibility of this method and achieved a good result.

XIII. FUTURE SCOPE

[1] Conservation Efforts: Enhanced wildlife monitoring using drones and camera traps equipped with AI can help track endangered species and monitor habitats more effectively.

[2] Agriculture: Smart farming technologies can detect animal movement, helping farmers protect crops from wildlife and manage livestock more efficiently.

[3] Urban Wildlife Management: Improved detection methods can assist cities in managing urban wildlife populations, reducing human-wildlife conflicts.

XIV. REFERENCES

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