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AN OVERVIEW OF DEEP LEARNING ALGORITHMS FOR ANIMAL DETECTION

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Abstract—Support Vector Machine (SVM), Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), and Local Binary Pattern Histogram (LBPH) are some of the additional methods that CNN takes into consideration when calculating the greatest accuracy. The Convolution Neural Network (CNN) is a model that suggests the classification of the input image of the animal. We are in the process of developing a database of wild animals; our database system is comprised of pictures of each category. The results of this experiment demonstrate that overall results were produced in order to check the impact that various processing images have on the beneficial impact that their output has on other processes. Deep Convolutional Neural Networks, often known as DCNNs, are a way of learning picture features that is both efficient and selective. This technology has been extensively researched and widely used in the field of computer vision and pattern recognition. An investigation into the application of machine learning strategies to animal photographs is presented in this work. The purpose of this research is to improve the accuracy of scene classification.

Index Terms— SVM, DNN, CNN, Resnet50, PCA, Machine learning, etc

I. INTRODUCTION

There are millions of people all around the world who use social networking sites on a regular basis. Examples of real-world applications that could benefit from social network data analysis include buddy referral programs, product recommendations for online retailers, and the identification of individuals suspected of being involved in terrorist activities. Observations were made that the data sizes of social networks were fast growing at an observed rate. In light of this, there is a growing demand for machine learning algorithms that are capable of fast scaling with the amount of examples contained inside the data set. The implementation of these algorithms on huge data sets results in an increase in the computational complexity of the algorithms. It is necessary to do research on these computer algorithms whose training duration does not change regardless of the dimensions of the data under consideration. The majority of learning algorithms are medium-scale algorithms, which base their assumptions on the assumption that data may be retained in memory and examined multiple times. For this reason, it is necessary to implement machine learning algorithms on distributed systems that are capable of reliably classifying data. The nature of the data that is found on social networks is unstructured. One of the things that is required is a process that can accurately identify the data in a shorter amount of time. In order to train a machine learning algorithm with a huge dataset collected from social networks (for example, web logs), it will take many days. The creation, testing, and implementation of such a device that would plainly be prohibitive is required. Due to the extremely large size of the dataset, this enormous cloud computing infrastructure that is spread out throughout the dataset can be utilized for training purposes.

The purpose of this work is to determine the accuracy of a classification of the animals based on their cycle of recognition in order to accomplish the objectives of an animal classification system that makes use of machine learning techniques. When it comes to determining the classification of animals, the identification and recognition of animals is still a difficult process to accomplish at the moment. When

it comes to efficiently delivering an effective challenge to identify the animals in its device recognition process, this may not be a particularly unique technique at this moment. With regard to the implementation of animal detection, the binary pattern is referred to as these tasks [1]. What this means is that the function is translated into a variety of process features, given that a picture of the input may be classified into each of the blocks. Every single figure that is being listed in every single block of that phase might be broken down into a variety of attributes. -- the classifier is a member of a particular category, there are particular characteristics that can be provided as the input image, and the classifier is used to decide whether or not this method is animal-based or not defensible. The method of animal recognition is classified into the animal recognition category, which is further subdivided into numerous fundamental applications, including the following:

The process of verification and identification is a method that frequently necessitates the sharing of the same algorithm classification between both of us [2]. The focus of apps that are similar to the process can be on it. There are a number of different applications that can be distinguished from one another using a method. In the event that they are in difficulties, they can serve as a technique of knowing their mission. They have the ability to take into consideration the important activities of the animals in order to perform a variety of performances there on their recognized cycle. After that, the input (an image of an animal) is influenced by a number of elements, some of which include differences in illumination characteristics, such as a sensory reaction, lenses in its spectrum components, and intensity or camera.

II. LITERATURE REVIEW

An automated image classification method has been developed in this work. This algorithm is able to classify still photographs that contain badgers, while rejecting images that contain other animals. It is possible to check, refine, and optimize the image classification algorithm in order to recognize and categorize six distinct kinds of animals based on still pictures. It will involve verifying, polishing, and calibrating the image classification algorithm in order to make it suitable for use in determining whether or not badgers are present in a particular piece of video footage. The methods that we have developed here have a wide range of applications in the field of wildlife monitoring, specifically in situations when vast amounts of visual data pertaining to a certain species need to contain screening [3].

In this research, the Convolutional Neural Network (CNN) is offered as a method for the classification of the animal photos that are input. This method is comparable to well-known ways of picture recognition, such as the capability to evaluate and contrast the many approaches to selecting which method provides the highest level of accuracy for a particular animal species. The Convolution Neural Network (CNN) is a model that suggests the classification of the input image of the animal [4].

In this study, we evaluated CNN with other methods in order to determine which approach has the highest accuracy when compared to other ways. These methods include "Support Vector Machine (SVM), Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), and Local Binary Patterns Histograms (LBPH)." Our database system is comprised of five classes and fifty photos, while the database itself is comprised of wild creatures. According to the findings of this experiment, comprehensive data were gathered in order to examine a variety of images of the process on the positive influence that their success in other approaches produces [5].

In this particular piece of research, the recognition of animals is one of the fields of research in which only a limited number of successful technologies have been developed, particularly in the field of predator control. The presence of predator animals poses a significant risk to people who are camping or living in outdoor places, and they frequently provide a risk to cattle residing in same areas. As a result of reading this article, it is possible to infer that they are made up of a number of different detection characteristics of a predator species. The primary focus of this method is on the facial features of the animal, particularly the eyes and the ears. Using machine learning techniques such as support vector machines (SVM) and multi-layer perceptron (MLP), a database was constructed by gathering the characteristics of the ears and eyes of ten different animals. Once the animals were classified as either pets or predators, an experimental test was carried out. The results of the evaluation showed that the classification accuracy for MLP was 82%, while the classification accuracy for SVM was 78%, which demonstrates that it is not only useful

for the approach that was proposed but also useful. When taking this method, the face, eyes, and ears of the animal are the primary areas of concentration [6].

In this study, the deployment of smart programs is aimed at defining and recognizing the objects that are associated with wildlife protection and management. When it comes to non-specialists, the methods might be difficult to understand, and the results can be perplexing. We shed light on the methods themselves as well as the types of attributes acquired by these approaches in order to produce effective identifications and consistent classifications. In this context, the term "applied" refers to a method that is used to identify animal species based on data collected from camera traps. Currently, the most advanced method of deep learning is the utilization of convolutional neural networks (CNN) that are embedded into deep learning algorithms. Finally, we measured the relative unfamiliarity of the photos that were not included in the training set. These images were photographs of one of twenty species that were "known" to our CNN. This was in contrast to the images of a species that were "unknown" to our CNN.

Machine Learning (ML) Algorithms for Sentiment Analysis

The authors of the paper[7] developed a process to extensively integrate data mining and qualitative research methods. by thinking about the issues and worries in engineering students' educational experiences while reading their tweets. The authors first conducted a qualitative analysis of samples drawn from over 25,000 tweets related to engineering students' college experiences. They discover that issues faced by engineering students include sleep deprivation, a severe workload, and a lack of social connection. Based on these findings, the authors developed a multi-label classification algorithm to find tweets that reflected the issues faced by the students.

The authors of the paper[8] suggested partially supervised HDP learning, which would enable HDP to guide the model learning process using knowledge that is only partially understood. To address classification issues, HDP uses this partial learning to handle clustering problems, while partly supervised learning simultaneously improves classification accuracy. They used the suggested partially supervised learning approach to HDP in order to find posts (micro-blogs) in an educational context.

The authors of the research [9] suggest a novel use of text categorization to distinguish between significant and unimportant classroom microblogging queries. For this application, extensive experiments are conducted to examine various modeling techniques and pre-processing or weighting setups.

In order to assess user opinions regarding cancer treatment, the authors of the paper[10] propose a two-step research methodology that focuses on both positive and negative emotions, as well as the side effects of care, in user forum posts. They also identify user groupings (modules) and prominent users. They examined word frequency data from user forum postings using a self-organizing chart. They used a network partitioning system aimed at optimizing a stability quality metric and a unique network-based method for simulating user interactions in forums.

In their study [11], the authors talked about privacy concerns related to social media mining networks. The author directly examined the problem from the perspective of criminal incident mining, examining issues such as social media data ownership, legal protection of personal information, anonymous user tools, and some ethical quandaries when gathering data for a specific application, like a crime incident reporting tool.

In order to measure the experiences of diabetes mellitus patients with medical devices and drugs, the authors of the paper[12] created novel data-mining techniques. Self-organizing maps have been used to quantitatively assess forum posts in order to better understand the mood of consumers regarding medications and medical devices. The final product is a set of word lists with both positive and negative word cluster categories that correlate to medical medications and gadgets. The implications of this novel data-mining technique may create new research opportunities for quick data entry, analysis, and gathering, leading to better outcomes and public health solutions.

In their paper[13], the authors presented a scalable user-profiling method that uses the Apache Hadoop framework to extract words and user profiles based on concepts from social media interaction data. The issues have been addressed, and some forecasts have been made by the authors. To enable the creation

and validation of more thorough profiles, they also wish to broaden the profile to incorporate more data sources, including both structured (like transaction logs) and unstructured (like mobile browsing logs).

III. MACHINE LEARNING

Image recognition algorithm can be a (image classifier) if the In 1959, Arthur Samual made a statement on machine learning that "Machine learning is the area of research that offers machines the ability to learn without being explicitly programmed." In 1997, Tom Mitchell described machine learning well. It is "A computer program is said to learn from experience E in relation to some task T and some performance measure P, if its output on T, as calculated by P, improves with experience E." Machine learning is a type of Artificial Intelligence that allows computers able to learn without programmer help [14-17]. Machine learning (ML) plays an important role in critical applications such as data mining, image processing, robotics, etc.

➢ Types of Machine Learning Algorithms

These are three types:

1. Supervised Learning
2. Unsupervised Learning
3. Reinforcement Learning

- **Supervised Learning**

Target variable through number of independent variables is expected. Using set of independent variables, input mapping to desired output is generated with function. All data are labelled and the algorithms learn to predict input data output. It provides output datasets to train the computer. Supervised learning algorithms are examples of regression, decision trees, random forest, KNN etc.

- **Unsupervised Learning**

There is no objective or outcome attribute to predict in Unsupervised Learning. To learn more about the data, it is used to model data structure or pattern. Within this learning, variable input is given without variable output. Uncontrolled algorithms are further broken down into two groups.

Clustering:

Clustering is a technique of finding inherent data groups; K-means is a clustering algorithm.

Association:

It is used for the discovery of rules defining large portions of data. Apriori is an algorithm for the mining of associations.

- **Reinforcement Learning**

Reinforcement Learning is used to train different decisions on the computer. Computer is able to train itself through trial and error on a continuous basis.

It learns from previous experiences, and attempts to make specific decisions. Reinforcement learning is an example of this.

➢ Machine Learning Algorithms used for Classification and Prediction

Classification and prediction algorithms are used to determine which set of categories is to belong to a new example. It is done on the basis of training collection of results, the membership of which group is identified. An example of pattern recognition is classification. It is supervised by type-learning machines.

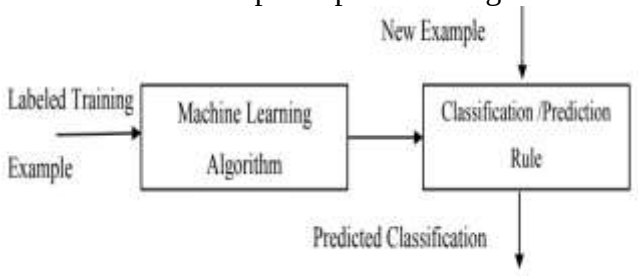

Fig 1: Standard Classifier

A classification-implementing algorithm is called classifier. Classification is binary and multiclass classification of two forms. Binary classification is classification into two classes while classification into multiple classes is known as multiclass. Classification and forecast algorithm is shown in figure 1.
The efficiency of classifiers depends on the data characteristics. There is no single algorithm that works best for problems of all kinds.

- **Advantages Machine Learning**

- Machine learning algorithms are simpler than the human rules / models drawn up.
- Do not require human programmer expert.
- Automated process to search for data explaining hypothesis
- Versatile and inexpensive
- Can be used on any training data

- **Distributed Machine Learning**

Distributed machine learning has become more critical in this Animal Data age. Sequential machine learning algorithms outperform as data increases in terms of length, variety and velocity. Technology is growing rapidly, so high capacity processors, machine-supplied RAMs are possible. Sequential machine learning algorithms have little capacity to leverage modern computing resources. Therefore, distributed machine learning algorithms need to be developed that will minimize the use of maximum computing power as well as the time needed to train the machine learning algorithms.

- **Distributed Machine Learning Framework**

Distributed platform for the machine learning
Mahut[26] is one of the Machine Learning System which is distributed. It runs up on HADOOP's peak. Specific libraries of machine learning algorithms exist in Mahut. In Mahut are implemented sorting, clustering, mining algorithms. Used for storing vast volumes of data.
Another distributed Machine Learning System is Spark[18]. It is used mainly for the analysis of big data in real time. MLib is a library of apache sparks that contains various algorithms for classification, clustering, and pattern mining. It provides high-level APIs in Java, Scala, and Python, and an integrated engine supporting graphs for general execution. It also supports a rich range of higher-level tools that include Spark SQL for SQL and structured data processing, MLlib for machine learning, GraphX for graph processing and Spark Streaming.

- **Streaming Machine Learning**

We use streaming machine learning algorithms to process large quantities of data. Streaming machine learning algorithm reads data stream in real time and applies machine learning algorithms on it. It is defined by high volume and data rate such as social media data, ATM logs etc. In fact, the stream is infinite.
In one step, therefore, review of this data is not possible due to memory or disk inability to retain large numbers of records. As online algorithms are also called streaming machine learning algorithms. Specific machine learning systems are available for streaming. MOA (Massive Online Analysis) is one of the popular API-learning streaming machines. It includes numerous classification algorithms, clustering machine learning. The MOA has its own groups of stream generators.

- **Rationale and Significance of Work**

This problem statement proposes a system that will take care of all three dimensions of animal data (volume, variety & velocity) using distributed Machine Language platform. As big data is processed and stored, additional dimensions, such as governance, security and policies, come into play. Choosing architecture and designing a suitable big data solution is difficult, as there are so many variables to consider.

IV. RECOGNITION OF THE ANIMAL SYSTEM

Image recognition algorithm can be a (image classifier) if the image (or image path) is taken as the outputs of such an image, exactly what image shows from such a procedure. The performance is a class name, to put it another way (fox, wolf, bear, etc.).

- The input image animal pre-processing module is permitted to treat with a sequence of prediction techniques to reduce the impact on the variables that may adversely affect the animal recognition algorithm.
- Extraction block is a component that will be defined in this phase by features used in the reconnaissance stage of the extraction process.
- Learning algorithm (classification)-This algorithm constructs class mark training data and has different characteristics in a predictive model. In this training outcomes to be used on predictive models of a new (previously unknown data) to be estimated from their performance attribute class labels on a system[19].

Output classes can be used discreetly to add their Decision trees, Support Vector Machines (SVM) and many more are classification algorithm types.
A deep learning-based algorithm is to be an extraction stage which is fully processed when the system is passed, whereas many computer vision practices are followed by this pipeline on a phase of their system.

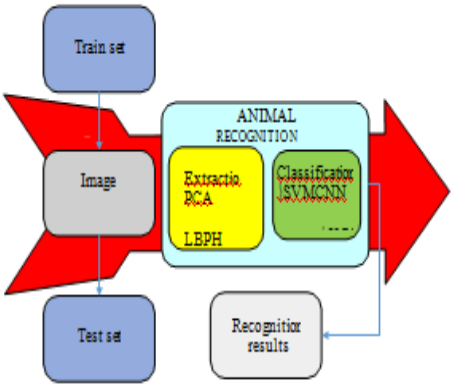

Fig 2: The system for recognition and classification of animals

V. TECHNOLOGIES AND TOOL

It is a complete programming language of high level for general purpose programming use. Python has a built philosophy that accentuates readability of code and strong white space remarkability. Python is a language for decoding, high-level, general-purpose programming. Created by Guido Van Rossum and published in 1991. This language provides definitions that allow for clarified programming on both the large and small scales. Depressed as the pioneer in the language community, Van Rossum was sauntered in July 2018.

- **Introduction to Automation Testing**

Automation testing is a process used to properly validate a software function, and it sees necessities until development is uncontrolled. This type of challenging software uses some scripted categorizations which the tools perform.

- **Python**

Python is a high-level, object-oriented programming language which integrates dynamic semics primarily for web and app development.

In the field of Swift Application Development it is extremely attractive, because it offers dynamic typing and dynamic options. Python is easy and simple to learn, because it requires a unique syntax that focuses on readability. Developers can read and translate Python code much easier than other languages. This lowers software maintenance and implementation costs as it enables developers to function collaboratively without language and barriers to experience.

It encourages the use of modules and packages, which ensures that programs can be re-used through a range of projects in a modular style and code. If we have created a module or kit which we need, it can be scaled for use in other projects and such modules can be easily imported or exported. One of the most promising advantages of this language is that both the standard library and the interpreter (translator) are available free of charge in both binary and source form, as Python and all the required resources are available on all major platforms, there is no exceptionality either. For developers who do not want to think about paying high development costs, it is therefore an attractive choice.

VI. Support Vector Machine

In this method of classifying the samples of hyper planes, splitting the methods into two or more sections, Essentially, it is a procedure to hold the hyper planes only with the largest margin, wherein "margin" is defined as the lowest distance with data sample points to just the hyper plane[5] and [16]. The data points that form margins are called support vectors and describe the final SVM models and hyper-parameters are also a classifier's parameters that are not learned directly from either the training samples in the learning phase but are independently optimized. The goal of optimizing the hyper-parameters is to boost the performance of a classifier and to achieve a better optimization of a training algorithm by generalization.

VII. LBP Approach to Animal Recognition

The LBPH system adopts a distinct approach to its own aspects from the PCA, LDA method. In LBPH, each image is analyzed separately, while the Eigen face approach looks at the entire dataset. The LBPH method is very simple, in the sense of whether we characterized each image locally in the dataset and if a new unknown image is given, we perform this very same analysis on it; results are compared with each image in the dataset. The approach used for the analysis of images does so by classifying local trends at each image position[1]. This methodology based on histograms defines a structure which is invariant to illumination and contrast[20]. The basic principle of Local Binary Patterns is to sum up the local structure in a block by comparing each pixel to its neighborhood [6]. Any other pixel is coded with a bit stream, each having to do with the relationship between the pixel plus one of its neighbors. If the center pixel of intensity is greater than or equal to the neighboring pixel then 1 is denoted as 0 if this condition is not met; Finally, a binary number (Local Binary Pattern or LBP code) is created for each pixel (as low as 01111100). When considering 8-connectivity, 256 combinations [16] and [18] will end up in us.

VIII. Local Response Normalization

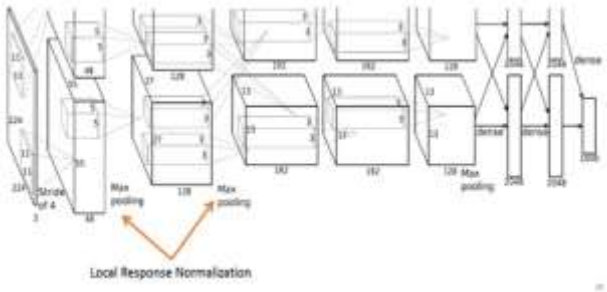

Fig 3: Local Response Normalization

- ReLUs do not usually need normalization inputs to avoid saturation.
- Local Response Standardization is a generalisation aid, however.

➢ **Overlapping Pooling**

- The pooling layers on the outputs of adjacent neurons are outlined in the same kernel map[26].
- Overlapping pooling - s < z
- Improvement with Max-Pooling:
- 0.4 per cent top-1 error rate
- The 0.3 percent top-5 error rates

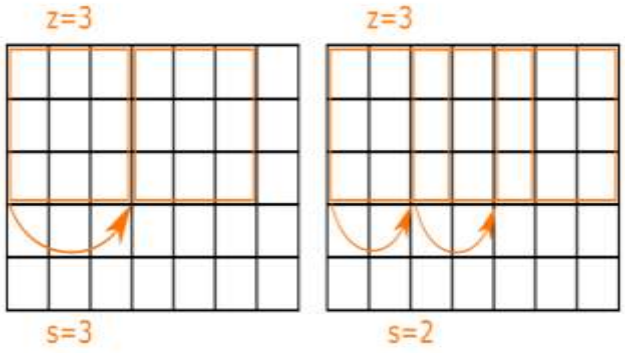

Fig 4: Overlapping pooling Matrix

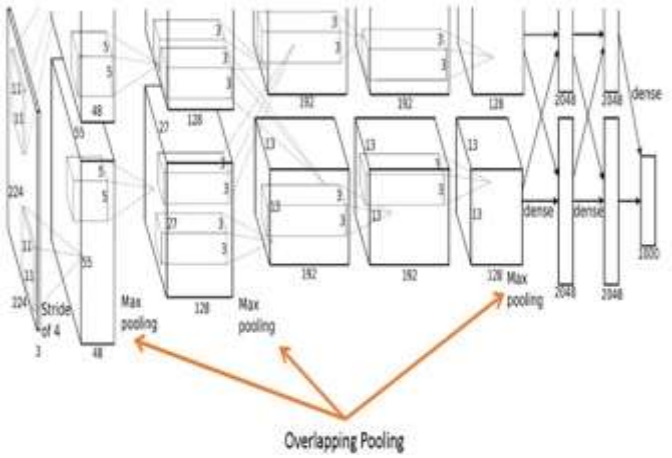

Fig 5: Overlapping pooling

➢ **Reducing over fitting - Data Augmentation**

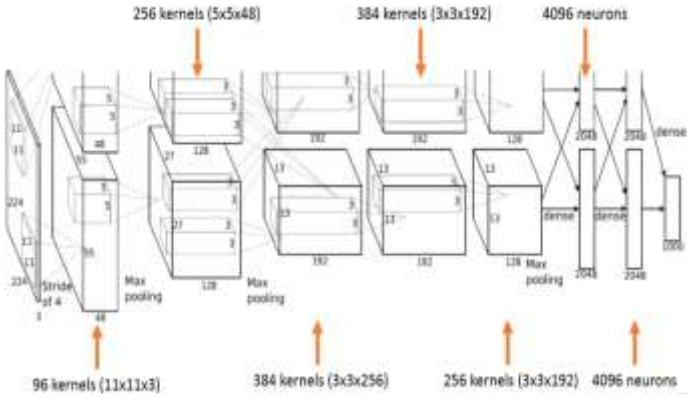

Fig 6: Overall architecture of data augmentation

1st: image translations and horizontal reflections

- 224x224 random patches + 256x256 horizontal reflections
- Testing: five 224x224 patches + horizontal reflections- predictions over ten patches on average[27].

2nd : it can be changed the intensity of RGB channels

- PCA for the collection of RGB pixel values in the entire Image-Net training package.
- If each RGB image pixel is Ixy =[IxyR ,$IxyG$,IxyB] following is added.

➢ **Reducing overfitting – Dropout**

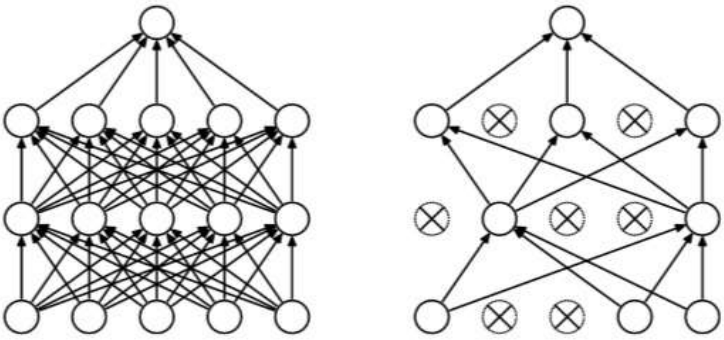

Fig 7: Dropout: A Simple Way to Prevent Neural Networks from Overfitting, 2014

- The output of each secret neuron is set to a probability zero of 0.5.
- Learning more robust features [13].
- Increases the number of iterations possible to converge.
- The first two fully attached layers can be added.

IX. CONCLUSION

The best experimental results on animal identification were obtained using the new CNN. The evaluation on the creation of an animal database with the CNN method should be suggested. Overall results can be identified in this method as being separate counts of test images and training images. So we interpret this paper review of machine learning to boost the accuracy of the classification of scene images.

References

[1] Alexander Loos, Christian Weigel, Mona Koehler, "Towards Automatic Detection of Animals in Camera-Trap Images," European Signal Processing Conference (EUSIPCO), 2018.
[2] Ashvini V. Sayagavi, Sudarshan Tsb, Prasthanth C Ravoor, "Deep Learning Methods for Animal Recognition and Tracking to Detect Intrusions," ResearchGate, 2019.
[3] Mauro dos Santos de Arruda, Gabriel Spadon, Wesley Nunes Goncalves, & Bruno Brandoli Machado, "Recognition of Endangered Pantanal Animal Species using Deep Learning Methods," IJCNN, 2018.
[4] Hung Nguyen, Sarah J. Maclagan, Tu Dinh Nguyen, Thin Nguyen, Paul Flemons, Kylie Andrews, Euan G. Ritchie, and Dinh Phung, "Animal Recognition and Identification with Deep Convolutional Neural Networks for Automated Wildlife Monitoring," Deakin University, Geelong, Australia, 2017.
[5] N. Banupriya, S. Saraya, Rashi Swaminathan, Sachinthaa Harikumar, Sukhita Palanisamya, "Animal Detection using Deep Learning Algorithm," Journal of Critical Reviews, 2019.
[6] Sazida B. Islam, Damian Valles, "Identification of Wild Species in Texas from Camera-trap Images using Deep Neural Network for Conservation Monitoring," CCWC, 2020.

[7] Naveen Sai Bommina, Nandipati Sai Akash, Uppu Lokesh, Dr. Hussain Syed, Dr. Syed Umar, "A Hybrid Optimization Framework for Enhancing IoT Security via AI-based Anomaly Detection", International Journal on Recent and Innovation Trends in Computing and Communication, ISSN: 2321-8169 Volume: 11 Issue: 3.

[8] Nandipati Sai Akash, Uppu Lokesh, Naveen Sai Bommina, Hussain Syed, Syed Umar, "Swarm Intelligence-Based Hyperparameter Optimization for AI-Powered IoT Threat Detection", International Journal of Intelligent Systems and Applications in Engineering, (2024), 12(17s), 941.

[9] Habeeb, M. S., & Babu, T. R. (2022). Network intrusion detection system: a survey on artificial intelligence-based techniques. Expert Systems, 39(9), e13066.

[10]Naveen Sai Bommina , Nandipati Sai Akash, Uppu Lokesh , Dr. Hussain Syed , Dr. Syed Umar, "Multi-Objective Genetic Algorithms for Secure Routing and Data Privacy in IoT Networks", International Journal of Communication Networks and Information Security (IJCNIS), (2020), 12(3), 632–643.

[11]Naveen Sai Bommina , Nandipati Sai Akash, Uppu Lokesh , Dr. Hussain Syed , Dr. Syed Umar, "Privacy-Preserving Federated Learning for IoT Devices with Secure Model Optimization", International Journal of Communication Networks and Information Security (IJCNIS), (2021), 13(2), 396–405.

[12]K Sankar, Divya Rohatgi, S Balakrishna Reddy, "COX Regressive Winsorized Correlated Convolutional Deep Belief Boltzmann Network for Covid-19 Prediction with Big Data", Grenze International Journal of Engineering & Technology (GIJET), Grenze ID: 01.GIJET.9.1.547, © Grenze Scientific Society, 2023.

[13]Singh, A., Gupta, M., Raj, A., Gupta, S. K., & Habeeb, M. S. (2020, December). TWDM-PON: The Enhanced PON for Triple Play Services. In 2020 5th IEEE International Conference on Recent Advances and Innovations in Engineering (ICRAIE) (pp. 1-5). IEEE.

[14]Naveen Sai Bommina, Uppu Lokesh, Nandipati Sai Akash, Dr. Hussain Syed, Dr. Syed Umar, "Optimizing AI-Driven Security Protocols in IoT Networks Using Metaheuristic Algorithms", International Journal of Intelligent Systems and Applications in Engineering, IJISAE, 2024, 12(23s), 3339–3347.

[15]Naveen Sai Bommina, Uppu Lokesh, Nandipati Sai Akash, Dr. Hussain Syed, Dr. Syed Umar, "Optimizing AI-Driven Security Protocols in IoT Networks Using Metaheuristic Algorithms", International Journal of Intelligent Systems and Applications in Engineering, IJISAE, 2024, 12(23s), 3339–3347.

[16]K. Kartheeban, K. Kalyani, S. K. Bommavaram, D. Rohatgi, M. N. Kathiravan, and S. Saravanan, “Intelligent Deep Residual Network based Brain Tumor Detection and Classification,” in 2022 International Conference on Automation, Computing and Renewable Systems (ICACRS), Dec. 2022, pp. 785–790. doi:10.1109/ICACRS55517.2022.10029146.

[17]Uppu Lokesh, Naveen Sai Bommina, Nandipati Sai Akash, Dr. Hussain Syed, Dr. Syed Umar, "Designing Energy-Efficient and Secure IoT Architectures Using Evolutionary Optimization Algorithms", International Journal of Applied Engineering & Technology, Vol. 4 No.2, September, 2022.

[18]M. Mukhedkar, D. Rohatgi, V.A. Vuyyuru, K.V.S.S. Ramakrishna, Y.A. Baker El-Ebiary, V.A. Asir Daniel, "Feline wolf net: A hybrid lion-grey wolf optimization deep learning model for ovarian cancer detection", Int. J. Adv. Comput. Sci. Appl., 14 (9) (2023).

[19]Habeeb, M. S. (2024). Predictive analytics and cybersecurity. Intelligent Techniques for Predictive Data Analytics, 151-169.

[20]Beibei Xu, Wensheng Wang, Greg Falzon, Paul Kwan, Leifeng Guo, Guipeng Chen, Amy Tait, Derek Schneider, “Automated cattle counting using Mask R-CNN in quadcopter vision system,” Computers and Electronics in Agriculture, 2020.