Research Article / Review Article FUPRE JOURNAL 8(1): 69-78 (2024)

FUPRE Journal

of

Scientific and Industrial Research

ISSN: 2579-1184(Print) ISSN: 2578-1129 (Online)

http://fupre.edu.ng/journal

Application of Supervised Machine Learning Algorithm with an Intrusion Detection System for Grazing Animals' Detection

AKAZUE, M.[1] *ONYEACHOLEM, I. J.* [2], *OMEDE, E*[3]

[1]*Department of Computer Science, Delta State University, Abraka*
[2]*Information and Communication Technology, Delta State University, Abraka*
[3]*Department of Computer Science, Delta State University, Abraka*

ARTICLE INFO

Received: 22/09/2023

Accepted: 22/12/2023

Keywords

Classification model, Detection, Grazing Animal, Intrusion, Supervised Machine learning Algorithm

ABSTRACT

Over the years, computer technology has contributed in the area of innovation and creativities through ideas put together in the areas of programming, machine learning, artificial intelligence, data science, and big data analytics, to unveil hidden pattern and make meaningful insight to data analysis result for better decision making. Considering the peculiarities and device techniques for farming, there is a need for more technological approaches to be inculcated into farming. Farmers today are faced with the challenge posed by grazing animals which has been the major issue surrounding farmers, this occurred in an environment like Nigeria where open grazing is allowed. In this paper, we developed an algorithm for grazing animals', detection system using a supervised machine learning algorithm with an intrusion detection system and classification model. The algorithm uses the signature-based intrusion technique to report a situation that matches a pattern corresponding to a known attack type. The result of the trained dataset and model classification was able to detect grazing animals (cows) with non-grazing animals (dogs). And we got (1.000 =100%) accuracy level of the trained and fitted model.

1. INTRODUCTION

The application of technological techniques to proffer solutions, and predict the future occurrence of events, has been in several literatures ranging from medical diagnostic devices (Ajenaghughrure et al. 2017; Akazue et al. 2023a; Chiemeke & Omede, 2014; Akazue et al. 2023b; Omede, 2022; Ojie et al. 2023a; Ojie et al. 2023b; Ojugo et al. 2023; okofu et al. 2018), IoT devices (Ihama et al. 2023; Akazue et al. 2017; Okofu et al. 2023; Okofu 2018;akazue & onyekweli, 2019; Akazue & Ajenaghughrure, 2016; Akazue and Ajenaghughrure, 2017; Akpoyibo et al. 2022), securing data (Akazue & Ojeme, 2014; Okpeki & Omede, 2019; Akazue et al, 2010; Akazue & Efozia 2010; Edje & Obeten, 2015), and detection, preventive and prediction devices (Okpeki et al, 2022; Akazue & Aghaulor 2015; Ojugo and Ekurume, 2021; Akazue 2015; Ojugo and Eboka, 2021; Akazue et al, 2015; Ojugo & Otakore, 2020; Ojugo and Eboka, 2020; Efozia et al. 2019). Several organizations, businesses, and farming have applied technological techniques to bridge the

*Corresponding author, e-mail:author@fupre.edu.ng
DIO

digital divide, enhance profile, and increase productivity.
Farmers today are faced with the challenges posed by grazing animals due to Nigerian open grazing policy. Hence, considering the device techniques for farming, there is a need for more technological approaches to be inculcated into farming. This work is hinged on machine learning classification model. We developed an algorithm that detects grazing animals using the Convolutional neural network (CNN) based on Tensor Flow layers which is embedded into intrusion and detection system device to examine when the proximity of grazing animals is under or out of control with respect to closeness.

Banupriya and Saranya (2019), stated that animals' images are classified using an algorithm so as to monitor them efficiently. They further stated that detecting animals and classifying them can help to prevent animal-vehicle accidents, trace and recognize animals and prevent vandalizing plant crops, by applying effective deep-learning algorithms.

Banupriya and Saranya (2019), in their research, used animals' images and classified them using an algorithm so as to monitor them more efficiently to prevent animal-vehicle accidents using deep learning algorithms **"but"** they did not inculcate the use of IDS for image detection so that the trained images can be used to detect and predict future occurrence hence this necessitated this research.

Suad et al. (2018), affirmed that in recent times, intrusion detection system techniques make the system more complex and less efficient when dealing with big data, this is due to its analysis properties process being so intricate and taking longer time in processing. This time consumption in analyzing the data has become one of the lapses which make the system prone to harm for a period of time before it triggers an alert. Therefore, using supervised learning algorithm techniques to analyze and store data in intrusion detection systems can reduce computation and training time.

Hemant et al. (2021), Object segmentation and detection from the background based on the motion of an object are necessary steps for automated analysis from image sequences. Several studies are based on background and foreground modeling for object detection; however, challenges are involved with complex dynamic scene modeling. The image sequences captured by camera traps consist of natural and dynamic scenes that are challenging to analyze using existing techniques, the natural camouflage of animals poses another difficulty for analyzing natural scenes. The prime challenge for wildlife detection is to design models that can handle complex backgrounds and efficiently detect animals from dynamic scenes.

Moradeyo (2019), The inadaptability of the frightening devices to the behavioral change exhibited by grazing animals has been a great challenge in developing an animal detection and recognition system that can prevent animal intrusion to a prohibited area. Animal distribution is something that is challenging and that does not have an immediate answer to. In fact, literature shows that just in the last few years, more than 68 different strategies have been used trying to affect animal distribution.

Liang et al. (2019), In recent years, deep convolutional neural networks have been used widely for computer vision tasks, including image classification, object recognition, and semantic segmentation. They surpass traditional methods for many visual recognition tasks. However, the application of deep neural networks to visual recognition tasks cannot be separated from supporting datasets. The release of publicly available datasets is a factor driving the advance of deep convolutional neural networks in the field of computer vision, allowing researchers to

develop, evaluate, and compare new algorithms.

John-Fredy, (2022), Monitoring livestock behavior can be a useful tool to improve farm animal management and to detect individual health events (Riaboff *et al*., 2019). The use of automated systems that predict daily behaviors from accelerometer data is widely used in cattle. Feeding time (Reynolds *et al*., 2019), rumination (Benaissa *et al*., 2019a; Rodrigues *et al*., 2019), lying time, predict calving (Krieger *et al*., 2019), welfare assessment traits (e.g. body condition score, udder/leg hygiene score) temperament traits (e.g. aggressiveness) (Jaeger *et al*., 2019, Chapa *et al*., 2020) or lameness detection (O'Leary *et al*., 2020) can be recorded with accelerometers in collars, pedometers o ear tags.

Eliéder et al, (2022), Recognizing these types of animal behavior is important, given that animals' performance is directly influenced, in addition to other factors, by their frequency of food intake. Performance can thus be determined with regard to nutritional and non-nutritional factors.

Nicola et al. (2018) stated that Grazing and ruminating are the most important behaviours for ruminants, as they spend most of their daily time budget performing these. Continuous surveillance of eating behavior is an important means for monitoring ruminant health, productivity and welfare. However, surveillance performed by human operators is prone to human variance, time-consuming and costly, especially on animals kept at pasture or free-ranging. The use of sensors to automatically acquire data, and software to classify and identify behaviors, offers significant potential in addressing such issues.

Natasa et al. (2018) stated that animal activity recognition is in the interest of agricultural community, animal behaviorists, and conservationists since it acts as an indicator of the animal's health in addition to their nutrition intake when the observation is performed during the circadian circle. Machine learning techniques and tools are used to help identify the activities of livestock. These techniques are helpful to discriminate between complex patterns for classifying animal behaviors during the day; human observation alone is labor intensive and time consuming. This proposes a robust machine learning method to classify five activities of livestock. To prove the concept, a dataset was utilized based on the observation of two sheep and four goats. A feature selection technique, namely Boruta, was tested with multilayer perceptron, random forests, extreme gradient boosting, and k-Nearest neighbors' algorithms.

Ihar et al. (2022), affirmed that before you can directly recognize moving objects, you must extract them from static background. For this, there are a number of deterministic foreground extraction methods: background subtraction methods, time difference methods, optical flow methods, etc. The choice of method greatly affects the efficiency of the entire recognition system and the more efficient the method is, the more complex it is, and requires more resources. The general structure of the impulse neural network used to isolate moving objects and used in the detector being developed. The input layer of neurons is an analog of the retinal photoreceptor layer, so what we're going to call the first layer neurons receptors.

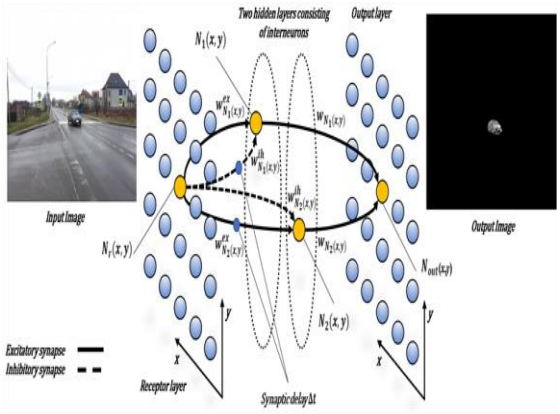


Fig 1.0: Layer neurons receptors. https://www.scirp.org/journal/researchnformation.aspx?reserach id=116971.

Ibrahim et al. (2021) noted that the classification technique is one of the most implemented data mining techniques in a variety of applications. The classification process needs two types of data: training data and testing data. Training data are the data used by a data mining algorithm to learn the classification metrics to classify the other data i.e., testing data. (Chiemeke and Omede, 2014). Two data sets of text articles are used and classified into training data and testing data. Various classification algorithms are revised in terms of accuracy in different areas of data mining applications.

Rotimi and Oluwatomilola (2019) stated that Effective management and control of activities in agricultural fields are vital to reduce the negative impact of farmers-herdsmen conflicts. They further affirmed that cloud-based management system gives herdsmen a complete view of their herds in real time. Advanced technology monitors the well-being of animals by collecting and analyzing behavioral data and sending alerts when anomalies occur. Information is tracked and aggregated over time, helping herdsmen make informed, long-term decisions about the well-being of both their herds and the agricultural fields around the grazing land. The innovative GPS and VF solution help herdsmen to minimize operating costs, reduce animal losses, destruction of farm land, and increase the safety of both animals and agricultural crops.

Santosh et al. (2018) stated that animal biometrics-based recognition system is a pattern recognition system. The recognition system extracts the prominent animal biometric features from the morphological image, biometric characteristics and phenotypic appearances of different species or individual animal. In animal biometrics, identification of cattle based on biometric features has been one of the current and future frontiers in the modern livestock for registration, tracking and breed associations of cattle. They also affirmed that animal identification methodologies can be categorized into following groups: (1) permanent recognition method, (2) semi-permanent recognition method, and (3) sketch pattern-based marking recognition approach. The sketch-based patterning techniques perform the design and different patterning of different color on the body of livestock. Sketch patterning and design-based techniques depend on individual drawing skills. The major problem with patterning technique is that it lacks standards Due to the enormous amount of human resource requirements.

Santosh et al. (2016), noted that the system performs image pre-processing on the muzzle point image of cattle to mitigate and filter the noise. The system uses support vector machine to classify the extracted feature of the muzzle images of cattle. We use a similarity score measurement for matching the muzzle points with the database. We also developed a prototype for evaluating the accuracy of the system.

2. Analysis of the Existing System

The existing system used what is known as 'template matching", the template matching is a technique in digital image processing for finding small parts of an image which match a template image. To perform the template matching, they used the concept of normalized cross correlation. So, the matching pattern in the existing system were based on template matching techniques.

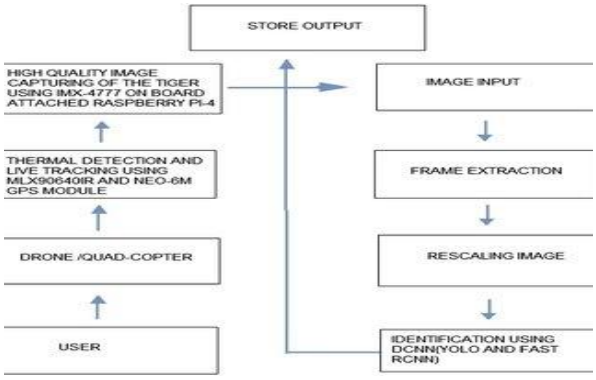


Fig 2.0: The Existing System: https://www.researchgate.net/publication/357862597_A_deep_neural_network_framework_for_detection_and_identification_of_bengal_tigers

Training Process.

2.1. Study Motivation

The weakness in the existing system is that using the template matching may likely result to false output because the template matching only display small part(image) of the trained animals' images, which it uses to compare the whole body of an animal type and report the result that matches that small part. In a situation where the small part captured the leg of an animal, said for instance black color it will be difficult to determine the animal because it is not only animal that has the color black what then happen. This leaves the existing with no choice than to trigger an alarm reporting that it is an animal whereas it a human.

2.2. Analysis of the Propose System

This paper focused on grazing animals' detection system using a supervised machine learning algorithm with intrusion detection system. It is a robust system in terms of analysis and design.

The system takes input as raw data and create temporary memory area known as programming data vector (PDV) which takes place at the backend, and compares it with the trained datasets, also known as "compilation phase". This dataset comprises of images of cows of different species, we trained these images and after training the dataset we validated them using the validated dataset which is the second layer, known as "execution phase" at this phase, two process takes place which are:

i. Data initialization (input processing)
ii. Data displayer (output processing)

This processing starts from the source data ==> input buffer ==> PDV ==> output.

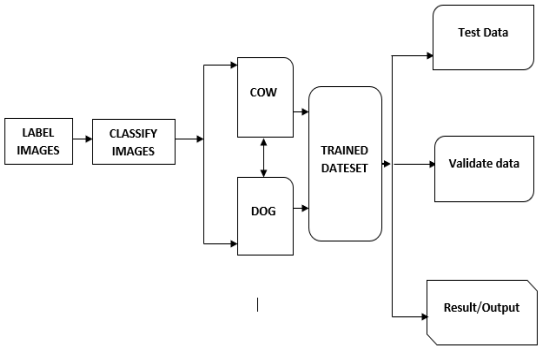


Fig 3.0: The Proposed System

2.3. High Level Model of the Proposed System

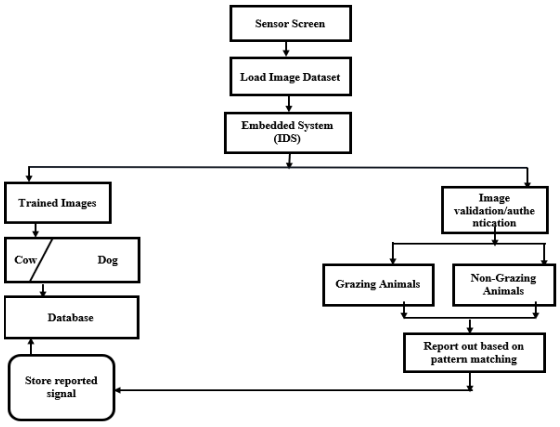


Fig 4.0: Model summary

2.4. Program Module Specification

In the cause of the development and training process, the program was segmented to run in the following modules:

Train data: The training dataset comprises of both grazing and non-grazing animals was trained together.
based on classification method using the CNN.
Test data: The test data were grouped to test the result concerning the list of trained datasets.
Validation data: The validation dataset is like a hypothesis, which will validate the test data whether the test data matches with the trained data and then report based on pattern matching.

Input/output Format

The system takes images as input, trained them, and stored those trainable data in the database, and then outputs the expected result based on the trained dataset.

Output of the above algorithm:

Found 32 images belonging to 2 classes.

Found 13 images belonging to 2 classes.

2.5. Output Summary of this Model

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 198, 198, 16)      448
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 99, 99, 16)        0
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 97, 97, 32)        4640
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 48, 48, 32)        0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 46, 46, 32)        9248
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 23, 23, 32)        0
_________________________________________________________________
flatten (Flatten)            (None, 16928)             0
_________________________________________________________________
dense (Dense)                (None, 512)               8667648
_________________________________________________________________
dense_1 (Dense)              (None, 1)                 513
=================================================================
Total params: 8,682,497
Trainable params: 8,682,497
Non-trainable params: 0
_________________________________________________________________
```

Fig 5.0: Trained Model Summary

3.0. OUTPUT OF THE FITTED MOD EL AND THE ACCURACY LEVEL

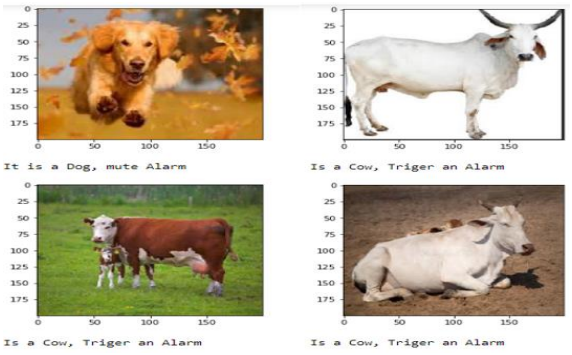
```
ω
['...']
Train for 10 steps, validate for 200 steps
Epoch 1/3
 9/10 [==========================>...] - ETA: 0s - loss: 0.5074 - accuracy: 0.7308WARNING:tensorflow:Your input ran out of data; interrupting training. Make sure that your dataset or generator can generate at least `steps_per_epoch * epochs` batches (in this case, 200 batches). You may need to use the repeat() function when building your dataset.
10/10 [==============================] - 2s 210ms/step - loss: 0.4876 - accuracy: 0.7586 - val_loss: 0.0070 - val_accuracy: 1.0000
```

Fig 6.0: Output of the fitted model and the accuracy level.

From the fitted model, we got (1.000 = 100%) level of accuracy, which is a very good fit.

3.1. Test Results Output (1)

Test Result 1: The test result below shows the predicted out of the grazing animals and non-grazing animals' detection.



3.2 Test Results Output (2)

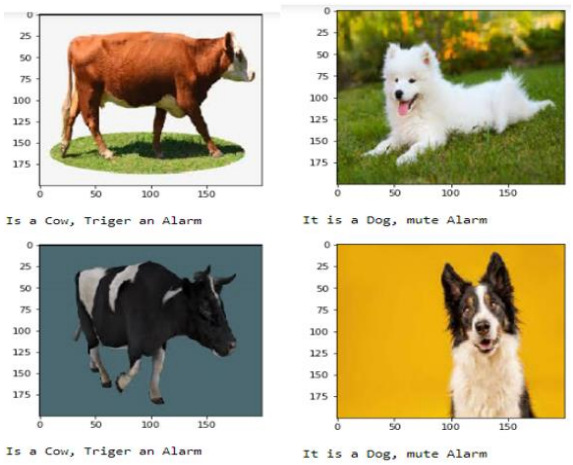


Fig 7.0: Test Result 2 output

3.3. Performance Evaluation

The performance level of the algorithm was accurate, since it attained a 100% level of accuracy.

3.4. Discussion

The existing system solved their expected problem and desire output result were accurate based on their area of focus, but the weakness in the existing system in using the template matching will leave the existing system with no choice than to trigger an alarm reporting that it is an animal whereas it is a human or any other creature. In this work, we were able to trained these grazing animal images and with the help of IDS system to not only capture small part of the animals' body, rather the full body parts and return the pattern that corresponds to the known attack type.

This is one of the best approaches in dealing with the challenges posed by grazing animals since the system will be acting as watchman to crop plants on any farmland. We recommend therefore, that the developed system should be deployed to serve as a long-lasting contrivance that if inculcated by farmers in every locality, there would be safer places for crop plants to grow without been disrupted by grazing animals such as cows.

References

Abel, E. E., & Obeten, E. (2015). Funding e-health in Nigeria by NGOS/multinational organization: Overview and perspectives. International Journal of Computer Applications, 111(11), 37–41.

Abel, E. E. An Overview and Perspective of Desktop Grid Middleware to Speed up Smul8 Process by Predicting Child Mortality Birth and Death Rate in West African Countries, Communications on Applied Electronics 2 (3), 37-43

Ajenaghughrure, I., Sujatha, P., Akazue, M. (2017). Fuzzy based multi-fever symptom classifier diagnosis model. International Journal of Information Technology and Computer Science, Vol. 9, No. 10, pp. 13–28. DOI: 10.5815/ijitcs.2017.10.02.

Akazue M., Ovoh O., Edje A.E., Ogeh C. Hampo J. A.C. (2023a) An Enhanced Model for the Prediction of Cataract Using Bagging Techniques. International Journal of Innovative Science and Research Technology, Vol 8, Issue 2, pages 220-227. https://www.ijisrt.com/assets/upload/files/IJISRT23FEB316.pdf

Akazue, M. I. (2015) "A Survey of Ecommerce Transaction Fraud Prevention Models." In The Proceedings of the International Conference on Digital Information Processing, Data Mining, and Wireless Communications, Dubai, UAE. 2015.

Akazue, M., & Aghaulor, A. (2015). Identification of Cloned Payment Page in Ecommerce Transaction. International Management Review, 11(2), 70-76.

Akazue, M. & Ojeme B. (2014) "Building

Data Mining For Phone Business", Oriental journal of computer science and technology: An international open access peer reviewed research journal*, vol. 7, no. 03, pp. 316-322.*

Akazue, M. I., Aghaulor, A., and Ajenaghughrure, B. I. (2015). Customer's Protection in Ecommerce Transaction Through Identifying Fake Online Stores. In International Conference e-Learning, e-Bus., EIS, and e-Gov. | EEE'15 (pp. 52–54).

Akazue M. and Efozia, N. F. (2010) "A Review Of Biometric Technique For Securing Corporate Stored Data," Software Engineering and Intelligent Systems, vol.1, pp. 329-342.

Akazue M., Ojeme B, and Ogini, N.O. (2010). User interface adaptability for all users. International Journal of Natural and Applied Sciences, vol 6, issue 1

Akazue, M. (2016). "Enhanced Hotel Management Information System for Multiple Reservation Booking", *Int. Manag. Rev.*, vol. 12, no. 1, pp. 52, 2016.

Akazue M.I. and Onyekweli, C.O. (2019). Awareness of the Knowledge, Perception, Impact and Usability of CAPTCHA Security Technology. Nigerian Journal of Science and Environment, Vol 17, page 9-25.

Akazue, M., Agwi, C.U., and Ajenaghughrure, I. B (2017). The interlink between rfid of things and internet of domestic things. sau Science-Tech Journal, 2(1) 92-101.

Akazue I. M. and Ajenaghughrure I. B., (2017). "Fuzzy based enhanced smart rest room automated faucet system", I.J. Engineering and Manufacturing., Vol.3., pp 20-30

Akazue M. I. and Ajenaghughrure I.B. (2016). "Virtual Examination Supervision System for Nigerian Universities", International Journal of Modern Education and Computer Science (IJMECS), vol. 8, no. 9, pp. 43-50

Akazue M.I., Nwokolo G. A. , Okpako A. E., Ogeh C.O., and Ufiofio E. (April, 2023b), Machine Learning Survival Analysis Model for Diabetes Mellitus. International Journal of Innovative Science and Research Technology, Volume 8, Issue 4, page 754 -760

Akpoyibo T. P., Akazue M. I., Ukadike I. D. (Nov 2022). Development Of A Floating Surface Water Robotic Oil Spillage Surveillance (Swross) System.. Gsj: Volume 10, Issue 11 (P7), November 2022, Pg. 2214 – 2230. Online: ISSN 2320-9186.

Banupriya, P. and Saranya, S. (2019): Animal detection using deep learning algorithm.

Chiemeke, S.C and Omede, E.U (2014): Mal-Typho Diagnosis Intelligent system(MATDIS):The Autodiagnostic rule generation algorithm.Computing Information Systems, Development Informatics & Allied Research Journal 5(4):83-92 www.cisdjournal.

Eliéder P. R., Rafeal N. W., Natalia V. B. F., Daniso P.B., Thais R. B., Bernardes P. A., Danisio P. M. and Racardo A. R. (2022). Modern livestock farming under tropical condition using sensor in grazing systems.

Efozia, N.F., Anigbogu, S.O. and Anigbogu, K. S. (July 2019). Development of a hybrid model for enhancing data integration process of business intelligence system. Journal of Basic Physical Research Vol. 9., No. 2., Pp 1-16

Ibrahim B., Thamer A., Abdulmoshen A., Khalid A., Saim R.: A short Review of classification

algorithm accuracy for data prediction in data mining application.

Ihar Y., Ihar M. , and Ihar Y. (2022). Detection and selection of moving objects in video images based on impulse and recurrent neural networks.

Ihama E.I., Akazue M.I. , Omede E., Ojie D. (May, 2023). A Framework for Smart City Model Enabled by Internet of Things (IoT). International Journal of Computer Applications (0975 – 8887) Vol 185, No. 6

John.Fredy,Ramirez.A,Sbastian,Bedoya.M ,Sandra.L,Posada.O,Jaime.R,Roser. N (2002): Automatic cattle activity recognition on grazing system.

Liang Han, Pin.T and Ralph.R.(2019): Livestock detection in aerial images using a fully convolutional network.

Maureen A. and Blessing O. (2011). "Design of an automated library management system for state universities in Nigeria", Asian Journal of Information Technology, vol. 10, no. 8, pp. 335-340.

Moradeyo Oluwatomilola Motunrayo (2019): Monitoring catle grazing behavior and intrusion using global positioning system and virtual fencing.

Nicola Mansbridge, Jurgen.M, Nicola.B, Keith.E, Giuliana G. Miguel.P, Tania. D, Jasmeet. K: Feature Selection and Comparison of Machine Learning Algorithms in Classification of Grazing and Rumination Behavior in Sheep (*Sensors* 2018, *18*(10), 532; https://doi.org/10.3390/s18103532).

Natasa K., Haussain A. M., Sneddon A., ShawA., Fergus P., Chalmers D., and AL-jumpily (2018). Machine learning Techniques for classification of livestock behavior, international conference on 13 Dec 2018.

Ojie, D.V, Akazue M, Omede E.U, Oboh E.O, Imianvan A (May 2023a) Survival Prediction of Cervical Cancer Patients using Genetic Algorithm-Based Data Value Metric and Recurrent Neural Network, International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Vol 13 Issue-2

Ojie, D.V, Akazue M, and Imianvan A. (2023b). A Framework for Feature Selection using Data Value Metric and Genetic Algorithm, International Journal of Computer Applications,Vol 184, Issue43, p14-21, doi:10.5120/ijca2023922533

Ojugo, A.A., Akazue, M.I., Ejeh, P.O., Odiakaose, C.C., Emordi, F.U. (May, 2023). DeGATraMoNN: Deep Learning Memetic Ensemble to Detect Spam Threats via a Content-Based Processing. Kongzhi yu Juece/Control and Decision, Volume 38, Issue 01, April, 2023, ISSN: 1001-0920

Ojugo A. A. and Ekurume E. (2021). "Deep learning network anomaly-based intrusion detection ensemble for predictive intelligence to curb malicious connections: An empirical evidence," International Journal of Advanced Trends in Computer Science and Engineering, vol. 10, no. 3, pp. 2090–2102, Jun. 2021, doi: 10.30534/ijatcse/2021/851032021.

Ojugo. A. A. and Otakore. D. O., (2020). Intelligent cluster connectionist recommender system using implicit graph friendship algorithm for social networks, Int. Journal of Artificial Intelligence, 9(3): pp497~506, doi: 10.11591/ijai.v9.i3.pp497~506

Ojugo A. A. and Eboka A. O. (2020), "Memetic algorithm for short messaging service spam filter using text normalization and semantic

approach," International Journal of Informatics and Communication Technology (IJ-ICT), vol. 9, no.1, pp. 9–18, doi:10.11591/ijict.

Ojugo A. A. and A. O. Eboka A. O. (Jun 2021), "Empirical evidence of socially-engineered attack menace among undergraduate smartphone users in selected Universities in Nigeria," International Journal of Advanced Trends in Computer Science and Engineering, vol. 10, no. 3, pp. 2103–2108, Jun. 2021, doi: 10.30534/ijatcse/2021/861032021.

Okofu, S. N. (2018). Users Service Quality Trust Perception of Online Hotel Room Reservation. SAU Journal of Management and Social Sciences,Vol 3, No.1 & 2, pp 1-14

Okofu, S., Anazia E. K., Akazue M., Ogeh C., Ajenaghughrure, I. B. (April, 2023), The Interplay Between Trust In Human-Like Technologies And Integral Emotions: Google Assistant. Kongzhi yu Juece/Control and Decision, ISSN: 1001-0920. Vol 38, Issue 01

Okofu, S. N., Akazue, M. I., Ajenaghughrure B. I., and Efozia F. N. (2018). An Enhanced Speech Based Airline Ticket Reservation Data Confirmation Module. Journal of Social and Management Sciences. Vol 13, issue 1, pg. 11-21.

Okpeki U. K., Adegoke S. A., and Omede E.U. (2022). Application of Artificial Intelligence for Facial Accreditation of Officials and Students for Examinations. FUPRE Journal of Scientific and Industrial Research. Vol 6 (3) 01 – 11.

Okpeki U.K and Omede, E.U. (2019). Design and implementation of auto tech resource sharing system for secondary schools in delta state. Journal of the Nigerian Association of Mathematical Physics, Vol 51, page 325 - 332

Omede E.U. (2022). Optimization of Determinant Diagnostic Symptoms for Febrile Diseases using Genetic Algorithm. Communication in Physical Sciences, 2022, Vol 8 (4), 556-572

Rotimi-Williams B., Oluwatomilola M. M. Monitoring cattle grazing behavior and intrusion using GPS and virtual fencing.

Santosh Kumar, Amit.P, Sai.K.S, Sunil. K, Sanjay.K, Amit.K, Anand.M (2018). Deep learning framework for recognition of cattle using muzzle point image pattern.

Santosh K., Sanjay K. and Tanima. D. (2016): A real-time cattle recognition system using wireless multimedia

Suad .M.O, Fadl .M.B, Nabeel .T. A & Amal. Y. A: Intrusion detection model using machine learning algorithm on Big Data environment 2018.

Yoro, R. E., Aghware, F. O., Akazue, M. I., Ibor, A. E., & Ojugo, A. A. (2023). Evidence of personality traits on phishing attack menace among selected university undergraduates in Nigerian. *International Journal of Electrical and Computer Engineering*, *13*(2), 194