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Application of Artificial Intelligence in Modern Ecology for Detecting Plant Pests and Animal Diseases

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Abstract

Climate change could lead to an increase in diseases in plants and animals. Plant pathogens have caused devastating production losses, such as in tropical countries. The development of algorithms that match the accuracy of plant and animal disease detection in predicting the toxicity of substances has continued through a massive database. Data and information from 10,000 substances from more than 800,000 animal tests have been carried out to generate the algorithms. Plant and animal disease detection using artificial intelligent in the modern ecological era is important and needed. Diseases in animals are still found in several Ruminant-Slaughterhouses. The purpose of the study is to identify the leverage attributes for using of Artificial Intelligence (AI) in detecting plant pests and animal diseases. The use of Multidimensional Scaling (MDS) produces a leverage attribute for the use of AI in detecting plant pests and animal diseases. The results showed that leverage attributes found were: Prediction of the presence of proteins structures produced by pathogens with a Root Mean Square (RMS) value of 4.5123. Also, plant and animal disease data will be opened with an RMS value of 4.2555. The findings of this study in the real world are to produce the development of smart agricultural applications in detecting plant pests and animal diseases as an early warning system. In addition, the application is also useful for eco-tourism managers who have a natural close relationship with plants and animals, so that ecological security in the modern ecological era, can be better maintained.

Keywords: Artificial-Intelligent; sustainable environment; plant-animal-disease; modern-ecology

1. Introduction

Agriculture has an important role and is needed in today's world to deal with the Covid-19 pandemic which is heading towards endemic (Poudel et al., 2020; Gray, 2020). Therefore, Artificial Intelligence (AI) is needed to remotely operate and monitor agriculture and livestock business in the modern ecological era (Talaviya et al., 2020; Sukono et al., 2020). AI must provide ways of detecting plant pests and animal diseases as well as treatment solutions for infected plants and animals (Almadhor et al., 2021;

Patria and Sambas, 2020). This AI can be effectively designed using microcontrollers, water level sensors, ultrasonic sensors, gas sensors, temperature, humidity sensors, and Internet Protocol (IP) cameras along with Internet or Intranet connectivity with smartphones or computers (Madushanki et al., 2019; Kuncoro et al., 2020; Mujiarto et al., 2019).

Faster and more accurate predictions of diseases in plants can help develop early treatment techniques thus greatly reducing the economic losses of farmers (Hussain et al., 2011). Modern developments in deep learning have made it possible to improve the performance and accuracy of object detection and recognition systems. A Deep Learning-based approach to detecting leaf diseases in many different plants uses images of plant leaves, so that the development of Deep Learning methodologies can be more suitable (Akila and Deepan, 2018; Ferentinos, 2018). There are three main detectors: Faster Region-Based Convolutional Neural Network (Faster R-CNN), Region-Based Fully Convolutional Network (R-FCN), and Single-Shot Multi-Shot Box Detector (SSD). The system can effectively identify different types of diseases with the ability to handle complex scenarios from the plant's area (Hari et al., 2019; Chandana et al., 2020).

In 2019, a biotic component named *C. auris* has been classified as an urgent threat to public health. The increasing number of infections worldwide in these health care facilities has been attributed to the unique characteristics of this yeast in that it can survive in the hospital environment for long periods of time (Arora et al., 2021). The plant pests and diseases as biotic components in nature are important risks faced in agriculture. To detect the biotic components of plant pests and diseases in various parts of the world, techniques in the field of leaf-based image classification are needed. Identification between the created healthy and sick leaf data sets, creation of advanced data sets, and feature extraction are some of the important activities in the use of Artificial Intelligence (AI). Image feature extraction could use the Histogram of the Oriented Gradient (HOG) (Ramesh et al., 2018). On the other hand, the information technology process related to the use of AI for the detection of animal diseases also faces serious problems.

Information technology that provides access to worldwide data is likely to be able to abet the warping of truth and normalizing lies. Truth, untruth and information technology, including how social media has manipulated behavior, and technologies such as deepfakes have spread misinformation, including biases inherent in algorithms. That is why true digital leadership is needed from the Ruminant-Slaughterhouse Manager (Hartawan et al., 2020). Tropical countries are the countries that harbor the most 37 emerging zoonotic diseases. The main contribution of this paper is to formulate the leverage attributes of the use of artificial intelligence (AI) in detecting plant pests and animal diseases in the modern ecological era.

2. Methodology

The purpose of this study is to identify and formulate the leverage attributes of the use of Artificial Intelligent (AI) in detecting plant pests and animal diseases. The use of the Multidimensional Scaling (MDS) method produces leverage attributes for the use of AI in detecting plant pests and animal diseases. The flowchart of the MDS method can be seen in Figure 1.

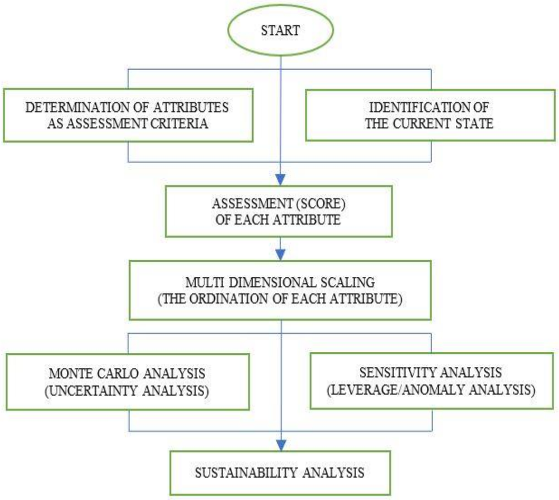

Figure 1. The Flowchart of the MDS Method

3. Results

Three components are essential for most infectious diseases, namely the agent (or pathogen), the host (or vector) and the environment of transmission. Some pathogens are carried by vectors or require an intermediate host to complete their life cycle. Appropriate climatic and weather conditions are necessary for the survival, reproduction, distribution and transmission of disease pathogens in plants, animals and even humans, vectors, and hosts (Wu et al., 2016).

Infectious diseases are caused by microorganisms belonging to the group of bacteria, viruses, fungi, or parasites. AI and its components have been widely publicized for their ability to detect better from imaging data to identify the potential of smart machines for HPT and animal disease detection. The key aspects of detection are: diagnosis, transmission, response to treatment, and resistance. Building a database of plant pest and disease detection, among other things, can be done by taking objects with certain procedures on plant leaves (See Figure 2).

Figure 2. Identification of Plant Pests and Diseases for databases

Detection in animals can be traced through the transmission model of Nipah virus infection to humans, as described in Figure 3.

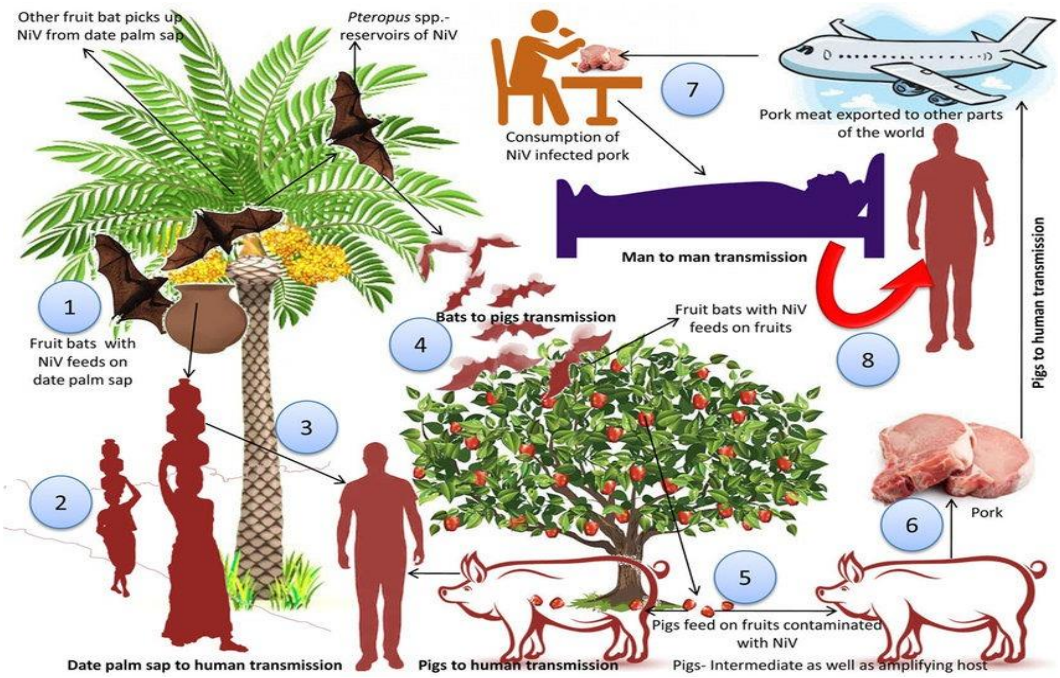

Figure 3. Model of transmission of Nipah virus infection to humans

3.1 Multidimensional Scaling (MDS) produces a leverage attribute for the use of AI in detecting plant pests and animal diseases

Multidimensional Scaling (MDS) method has been implemented for several studies (Maharani, 2021; Maharani and Pamungkas, 2021).

MDS method is the mapping of perception relying on Euclidian distance, with the formula:

$$d_{1,2} = \sqrt{(X_1 - X_2)^2 + (Y_1 - Y_2)^2 + (Z_1 - Z_2)^2 + \ldots}$$

Description:

$D_{1,2}$	= Euclidian distance
X, Y, Z	= Attributes
1,2	= Observation

Two-dimensional euclidian distance regression formula ($\dot{D}_{1,2}$):

$D_{1,2} = a + b\, D_{1,2} + c$

Description:

a = intercept
b = slope
c = error

Data is sourced from library studies, mitigation ecological attributes resulting from stage1. Output in the form of index and ecological sustainability status of mitigation, and leveraged attributes. The same two points or objects are mapped in one point adjacent to each other using the ALSCAL FORTRAN algorithm techniques available in statistical devices. Rap-Ecological-Mitigation software (modified Rap-Fish) in principle makes iteration, the regression process is such that it gets the smallest stress value and tries to force the intercept on the equation equals 0. For attributes as much as m, stress is formulated in the equation:

$$stress = \sqrt{\frac{1}{m}\sum_{k=1}^{m}\left(\frac{\sum_i\sum_j\left(D_{ijk}^2 - d_{ijk}^2\right)^2}{\sum_i\sum_j d_{ijk}^2}\right)}$$

The magnitude of the stress value is shown in Table 1.

Table 1. Stress values

Number	Stress value	Conformity
1	➢ 20.00%	Bad
2	(10.00-20.00)%	Enough
3	(5.00-10.00)%	Good
4	(2.500-5.00)%	Excellent

Source: (Kavanagh and Pitcher, 2004)

Through the rotation method, the position of the sustainability point can be described through the horizontal and vertical axes with the sustainability index values rated 0 percent (bad) and 100 percent (good). If the system studied has a sustainability index value of > or = 50 percent, then the system is said to be sustainable, and unsustainable if the index value < 50 percent.

Based on the calculation of the analysis, the value of S stress is 0.13 or < 0.25. This means that the accuracy of the configuration of the points (goodness of fit) model built for the sustainability.

3.1.1 Sustainability Analysis

The sustainability status of AI in the detection of plant pests and animal diseases is important to proceed the leverage analysis.

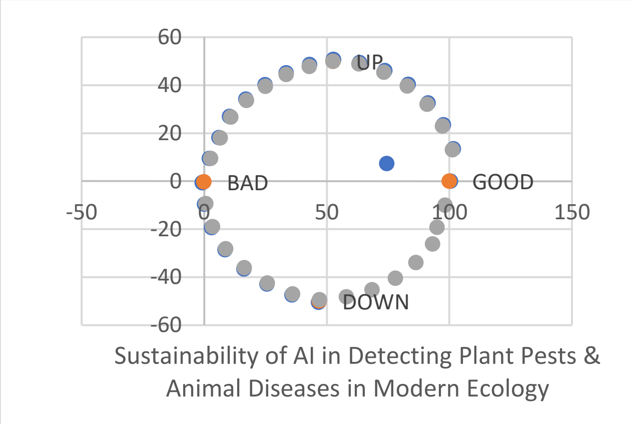

Figure 4. Result of sustainability AI in detecting plant pests & animal diseases

Based on the Figure 4, the AI sustainability index value in the detection of plant pests and animals diseases is 74.55 percent (quite sustainable) (Figure 3 and Table 2). However, the difference of MDS (74.55 %) calculation results with Monte Carlo analysis results (74.25 %) of 0.30 (< 1) indicates that the results of MDS calculations can reflect a high level of precision.

Table 2. Value of AI Sustainability Index in detecting Plant Pests and Animal Diseases

Number	Index value	Category
1	(0.00-24.99)%	Bad (unsustainable)
2	(24.99-49.99)%	Less (less sustainable)
3	(49.99-74.99)%	Enough (fairly sustainable)
4	(75.00-100.00)	Good (very sustainable)

3.1.2 Leverage Analysis

Leverage analysis is to determine the effect of stability if one of the attributes is removed during ordination. The results of the leverage analysis show the percentage change in the Root Mean Square (RMS) of each attribute (See Figure 5). Validation of AI in detecting plants pests and animal diseases in modern ecology simulation results shows that the coefficient of Squared Correlation (RSQ) has a high enough value of 0.96.

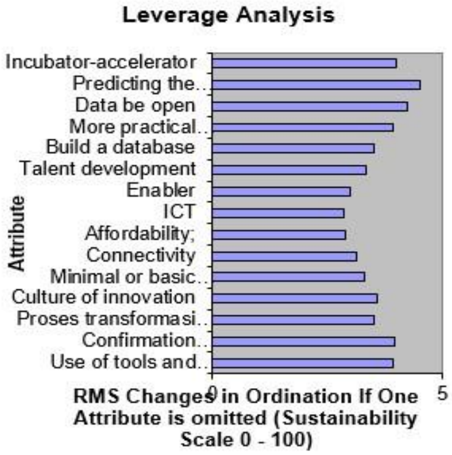

Figure 5. Leverage analysis

The attributes that have the highest percentage are the most sustainability sensitive attributes. From the leverage analysis, the RMS value of each attribute can be seen in the Table 3.

Table 3. Root Mean Square value from leverage analysis results

Number	Attributes	Root Mean Square
1	Use of tools and mechanisms for retrieving data and information in the field	3.9164
2	Confirmation matches the same symptoms, but the causes of pest diseases are different	3.9796
3	Proses transformasi digital	3.5086
4	Culture of innovation	3.5966
5	Minimal or basic conditions	3.2972
6	Connectivity	3.1341
7	Affordability	2.9017
8	Information and Communication Technology (ICT)	2.8438
9	Enabler	2.0006
10	Talent development	3.3375
11	Build a database	3.5219
12	More practical observations	3.9266
13	**Data be open**	**4.2555**
14	**Predicting the structure of proteins produced by pathogens**	**4.5123**
15	Incubator-accelerator	3.9999

4. Conclussion

The leverage attributes of the use of AI in detecting plant pests and animal diseases are predictions of the presence of protein structures produced by pathogens with an RMS value of 4.5123 and plant and animal disease data that will be disclosed through ICT with an RMS value of 4.2555. The power of the world's artificial intelligence laboratories has been able to produce protein structure predictions with the aim of detecting biotic components that cause plant pests and animal diseases. The EU Animal Disease

Information System (ADIS) is designed to register and document the evolution of important infectious plant-animal disease situations. This is a change that makes it possible to obtain more open data and information through ICT.

The findings of this study in the real world are to produce the development of smart agricultural applications in detecting plant pests and animal diseases as an early warning system (EWS). In addition, the application is also useful for eco-tourism managers who have a natural close relationship with plants and animals, so that ecological security in the modern ecological era, can be better maintained.

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References

Akila, M., & Deepan, P. (2018). Detection and classification of plant leaf diseases by using deep learning algorithm. *International Journal of Engineering Research & Technology*, *6*(7), 1-12.

Arora, P., Singh, P., Wang, Y., Yadav, A., Pawar, K., Singh, A., ... & Chowdhary, A. (2021). Environmental isolation of Candida auris from the coastal wetlands of Andaman Islands, India. *Mbio*, *12*(2), e03181-20.

Chandana, P., Ghantasala, G. P., Jeny, J. R. V., Sekaran, K., Deepika, N., Nam, Y., & Kadry, S. (2020). An effective identification of crop diseases using faster region based convolutional neural network and expert systems. *International Journal of Electrical and Computer Engineering (IJECE)*, *10*(6), 6531-6540.

Ferentinos, K. P. (2018). Deep learning models for plant disease detection and diagnosis. *Computers and Electronics in Agriculture*, *145*, 311-318.

Gray, R. S. (2020). Agriculture, transportation, and the COVID‐19 crisis. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie*, *68*(2), 239-243.

Hari, S. S., Sivakumar, M., Renuga, P., & Suriya, S. (2019, March). Detection of plant disease by leaf image using convolutional neural network. In *2019 International Conference on Vision Towards Emerging Trends in Communication and Networking (ViTECoN)* (pp. 1-5). IEEE.

Hartawan, M. S., Maharani, M. D. D., & System, E. K. I. (2020, November). Structural Model of System Information for Management Innovation Ruminant-Slaughterhouse. In *2020 International Conference on Informatics, Multimedia, Cyber and Information System (ICIMCIS)* (pp. 319-323). IEEE.

Hussain, M., Madl, P., & Khan, A. (2011). Lung deposition predictions of airborne particles and the emergence of contemporary diseases, Part-I. *Health*, *2*(2), 51-59.

Kavanagh, P., & Pitcher, T. J. (2004). Implementing Microsoft Excel software for Rapfish: a technique for the rapid appraisal of fisheries status, *Fisheries Centre research reports*, *12*(2), 1-12.

Kuncoro, A. H., Mellyanawaty, M., Sambas, A., Maulana, D. S., & Mamat, M. (2020). Air Quality Monitoring System in the City of Tasikmalaya based on the Internet of Things (IoT). *Jour of Adv Research in Dynamical & Control Systems*, *12*(2), 2473-2479.

Madushanki, R., Wirasagoda, H. & Halgamuge, M. (2019). Adoption of the Internet of Things (IoT) in Agriculture and Smart Farming towards Urban Greening: A Review. *International Journal of Advanced Computer Science and Applications, 10* (4), 11-28.

Maharani, M. D. D. (2021). Ecological Sustainability of Mitigation Deal with the Surge of the Covid-19 Pandemic and Other Pandemics. *Journal of Hunan University Natural Sciences*, *48*(4), 170-176.

Mujiarto, Djohar, A., Komaro, M., Mohamed, M. A., Rahayu, D. S., Sanjaya, W. S. M., Mamat, M., & Sambas, A. (2019). Colored object detection using 5 dof robot arm based adaptive neuro-fuzzy method. *Indonesian Journal of Electrical Engineering and Computer Science*, *13*(1), 293-299.

Patria, L., & Sambas, A. (2021, March). Image Processing Technology for Edge Detection Based on Vision and Raspberry Pi. In *IOP Conference Series: Materials Science and Engineering* (Vol. 1115, No. 1, p. 012044). IOP Publishing.

Poudel, P. B., Poudel, M. R., Gautam, A., Phuyal, S., Tiwari, C. K., Bashyal, N., & Bashyal, S. (2020). COVID-19 and its global impact on food and agriculture. *Journal of Biology and Today's World*, *9*(5), 221-225.

Ramesh, S., Hebbar, R., Niveditha, M., Pooja, R., Shashank, N., & Vinod, P. V. (2018, April). Plant disease detection using machine learning. In *2018 International conference on design innovations for 3Cs compute communicate control (ICDI3C)* (pp. 41-45). IEEE.

Sukono, Sambas, A., He, S., Liu, H., Vaidyanathan, S., Hidayat, Y., & Saputra, J. (2020). Dynamical analysis and adaptive fuzzy control for the fractional-order financial risk chaotic system. *Advances in Difference Equations*, *674*(1), 1-12.

Talaviya, T., Shah, D., Patel, N., Yagnik, H., & Shah, M. (2020). Implementation of artificial intelligence in agriculture for optimisation of irrigation and application of pesticides and herbicides. *Artificial Intelligence in Agriculture, 4*, 58-73.

Wu, X., Lu, Y., Zhou, S., Chen, L., & Xu, B. (2016). Impact of climate change on human infectious diseases: Empirical evidence and human adaptation. *Environment international*, *86*, 14-23.