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Artificial Neural Network for Classification Task in Tabular Datasets and Image Processing: A Systematic Literature Review

Adi Zaenul Mustaqim, Nurdana Ahmad Fadil, Dyah Aruming Tyas*
Department of Computer Science and Electronics, Faculty of Mathematics and Natural Sciences
Universitas Gadjah Mada, Indonesia

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ABSTRACT

Artificial Neural Network (ANN) is one of the machine learning algorithms that is widely used for classification cases. Some examples of classification cases that can be handled with ANN include classifications in the health sector, banking, and classification in image processing. This study presents a systematic literature review (SLR) of the ANN algorithm to find a research gap that can be used in future research. There are 3 phases used in preparing the SLR. Those are planning, conducting, and reporting. Formulation of research questions and establishing a review protocol is carried out in the planning phase. The second phase is conducted. In this phase, searching for relevant articles is carried out, determining the quality of the literature found and selecting particles according to what has been formulated in the planning phase. The selected literature is then carried out by the process of extracting data and information and then synthesizing the data. Writing SLR articles based on existing findings is carried out in the last phase, namely reporting. The results of data and information extraction from the 13 reviewed articles show that the ANN algorithm is powerful enough with satisfactory results to handle classification cases that use tabular datasets or image datasets. The challenges faced are the need for extensive training data so that ANN performance can be better, the use of appropriate evaluation measures based on the cases studied does not only rely on accuracy scores, and the determination of the correct hyperparameters to get better performance in the case of image processing.

Corresponding Author: Dyah Aruming Tyas
Department of Computer Science and Electronics, Faculty of Mathematics and Natural Sciences, Universitas Gadjah Mada, Yogyakarta, Indonesia.
Jl. Sekip Utara, Sendowo, Sinduadi, Kec. Mlati, Kabupaten Sleman, Daerah Istimewa Yogyakarta 55281 Email: dyah.aruming.t@ugm.ac.id

1. INTRODUCTION

Classification is one of the techniques in machine learning that can process unknown information from a dataset [1]. Classification uses a supervised learning method in which the algorithm trains using data already known to the target class [2]. This technique is essential and helpful for handling large amounts of data. According to [3] this technique can handle data with attributes of both numeric and categorical types and will then be classified into categorical type classes by the classification model.

One of the widely used classification algorithms is the ANN. ANN is one of the shallow learning algorithms in machine learning that is widely used for clustering and prediction, such as classification and regression [4]. This algorithm works by mimics the working concept of human brain nerve cells [5]. Even now, ANN is developed as deep learning, and it is popularly in image processing. The use of ANN is

already widely used for various fields, such as material science [6], health [7], banking [8], and others. With the development of the times, the ANN algorithm is constantly undergoing changes to deal with more complex cases, giving rise to many types of ANN. There are about 40 types of neural networks which have been proposed, such as backpropagation, perceptron, Boltzmann machine, self-organizing maps, and others [6].

Researches related to the ANN algorithm have been carried out by several researchers, include researches which are related to classification issues. This article analyzes the use of ANN algorithms in classification tasks using tabular datasets and image classification in several studies carried out over the past five years and obtained from 3 primary database sources, namely ScienceDirect, IEEE Xplore, and Sinta Journal. Seeing the rapid development of ANN, this article was created to conduct a systematic literature review on several cases that can be resolved by ANN which aims to find gaps regarding the application of ANN in classification cases using both tabular datasets and for image processing. We analyzed the strategy of applying ANN to tabular and image datasets to find out the advantages and disadvantages of each method used in the study, giving rise to opportunities to conduct further research from the gaps we found.

2. METHOD

This study uses three primary stages to make a Systematic Literature Review (SLR). These stages are planning, conducting, and reporting. The following figure shows details of the stages and processes of each stage.

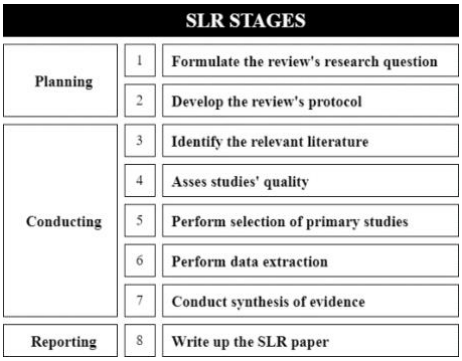

Figure 1. Systematic literature review (SLR) stages

The first thing to do is plan. In this section, two stages will be carried out by compiling a research question (RQ) and determining the protocol for conducting a review. The first stage is the preparation of the RQ. This stage is essential because RQ is used to guide searching and extracting literature. The RQ formulated in this study is presented in Table 1.

Table 1. Research questions

Research Questions
RQ1: What is an artificial neural network and how does it work?
RQ2: What cases can ANN solve when using tabular datasets?
RQ3: Can ANN be used for image processing and what are some examples of its application?

There are two research questions presented in this study, those are ANN concepts, and case studies. RQ1 is used to explain the concept of the ANN algorithm, starting from the definition, architecture, and types of ANN. At the same time, RQ2 and RQ3 will discuss case study examples of applying the ANN algorithm to tabular datasets and image processing. The second stage is to determine the review protocol. One of the ways to determine the protocol here is to formulate the scope of the research to determine the boundaries of the problem. Problem limitation of the research here is done by selecting the keywords used to search for articles. The keywords are presented in Table 2.

Table 2. Keywords searching

Code	Keywords
Key1	"Artificial Neural Network" OR "ANN"
Key2	"Binary Classification" AND "Artificial Neural Network"
Key3	"Image Processing" AND "Artificial Neural Network"

These keywords are used in the reference search process in 3 primary databases, namely ScienceDirect, IEEE Xplore, and Sinta Journal. There are several eligibility criteria used in the reference search process, including (1) articles published between 2018 and 2022, (2) articles published in accredited national and international journals and proceedings, (3) articles discussing the implementation of the ANN algorithm in case of tabular dataset classification and image processing.

The third stage is the process of searching for articles. This research uses the help of a tool called Mendeley to make it easier to manage the literature obtained. The fourth stage is to look at the quality of the articles found. The fifth stage is the process of selecting articles according to the protocol that has been defined at the planning stage. After the articles have been selected, enter the sixth stage namely data extraction. At this stage the process of collecting data and information needed to answer the previously defined RQ will be carried out. The final stage, the seventh stage, is preparation for writing the SLR report.

3. RESULT AND DISCUSSION

Based on the SLR process, there were at least 13 suitable articles obtained in this study. The articles were obtained from 3 primary database sources, those are ScienceDirect, IEEE Xplore, and Sinta Journal. These articles discuss the implementation of the ANN algorithm in several cases, both using tabular datasets and image processing. The articles used in this study consist of Q1 accredited journals (5 articles), Q2 journals (2 articles), Q3 journals (1 article), third rating of Sinta journal (1 article), and proceedings (4 articles). The results of data extraction from selected articles based on the RQ that have been compiled are as follows:

3.1. Introduction to ANN

The idea of the Artificial Neural Network (ANN) was introduced in 1943 by McCulloch and Pitts. However, ANN became famous when a backpropagation algorithm was invented and initiated by Rumelhart et al. in 1986 [9]. The backpropagation algorithm is one of the learning algorithms in ANN in the data training process [10]. This algorithm will continuously adjust the weight of each neuron connection to minimize errors.

ANN is one of the most widely used techniques in the field of AI, where this algorithm can learn independently for the data training process [11]. ANN is a computational model inspired by complex, non-linear, and parallel information processing within human brain cells [12]. Nerve cells in the human brain have several components, such as dendrites, cell body or soma, and synapses. The signal will be captured by dendrites to be processed in the cell body. The processing results will be passed on to other nerve cells through the axon, and this is a non-linear operation [13]. Likewise, in ANN, data will be entered through an input layer and then processed in a hidden layer then forwarded to the output layer. ANN can be applied to prediction problems such as classification and regression [14]. However, this paper will discuss the application of ANN to classification cases.

ANN is one of the powerful supervised learning algorithms. ANN is one of the most popular techniques in machine learning due to its ability to model complex non-linear functions [15]. The advantages of ANN compared to other supervised learning algorithms include [16]:

1. ANN is practical for handling high-dimensional datasets.
2. It can handle complex and non-linear cases between input and target variables.
3. It can be used for various cases of complex classifications and functions involving input and output.
4. It can reduce overfitting and underfitting problems during the training process by conducting a hyperparameter tuning process before the training process starts.

In the same article [16] mentions that ANN has some drawbacks. The complex structure of the ANN network, in theory, because it has several layers and a few processing neurons in each layer, ANN requires high computing power. To solve this problem, we adopted a hybrid ANN model and applied feature selection techniques. In addition, the hyperparameter tuning process can also be used to optimize the performance of the resulting model [17].

To improve ANN performance, we can carry out a hyperparameter tuning process before the training process. This process will determine the configuration of the ANN architecture, such as the number of layers used, the number of neurons, regularization, and others. This process can be done manually by the researchers or by using a method [18]. The principle of ANN is to pass data to non-linear

functions, where ANN can transform data and find non-linear decision boundaries with non-linear functions [19].

3.1.1. ANN Architecture

The ANN architecture consists of several different layers. The input layer is the first layer where data is entered into the model. The middle layer, known as the hidden layer, is a place to process data inputted through the input layer. Then, the output layer, is the last layer where the classification results, will be passed through this layer [20].

The primary process of ANN starts with the input layer, hidden layer, and output layer where each layer has a different number of neurons. Neurons are units in the ANN network that are tasked with processing data [6]. Each neuron on one layer is connected to the neuron on another layer with a transfer function. In some articles, the transfer function is known as the activation function or the output function [21].

The ANN architecture is simply shown in Figure 2. In some ANN architecture models, the number of hidden layers can be more than 1. The depth of a neural network model refers to the number of layers. In comparison, the width of a neural network model refers to the number of units/neurons in the layer [22].

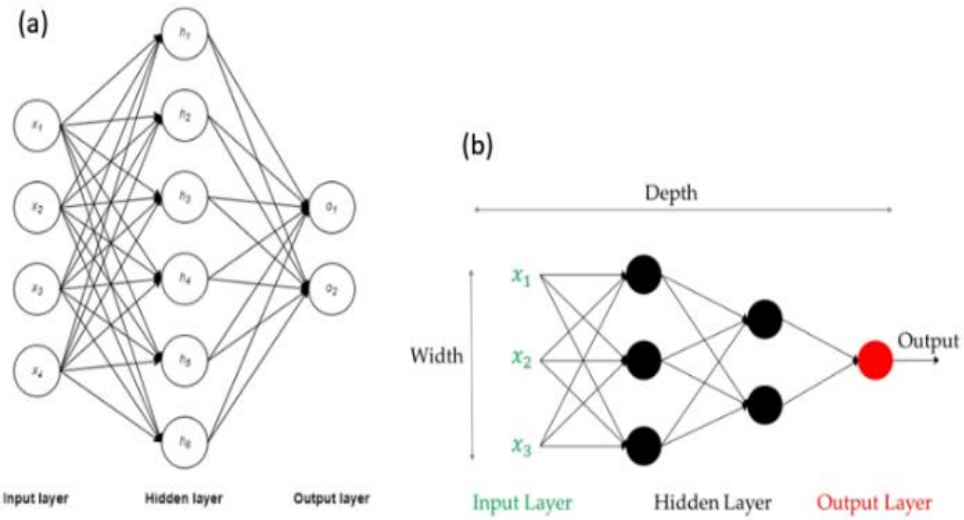

Figure 2. (a) Network architecture, (b) ANN Network Width and Depth

3.1.2 Types of ANN

The ANN architecture consists of several layers, and each layer consists of several neurons. Neurons on one layer can be connected to neurons on another layer, known as fully connected layers. The activation function [20] is used to do this. The activation function will limit the value that comes out of a neuron. The activation function is also referred to as the squashing function that will limit the output of the range of values produced by a neuron [23]. There are several activation functions used in ANN.

The activation function can be used on hidden layers and output layers. In hidden layers, the activation function is responsible in transforming the input attribute into a value relevant to the target [15]. This activation function will determine the output produced by a neuron [8]. Some of the activation functions that can be used on an ANN for classification are shown in Table 3.

In general, the ANN model architecture has three forms, namely feed-forward, recurrent, and hybrid [13]. In the feed-forward model, it can be passed one way from the input layer to the output layer. The MLP algorithm is one of the algorithms that use this model [24]. Meanwhile, the recurrent neural network passes data from the input layer to the output layer, and then returns to the input layer through a loop. There are many neural network models used for data prediction including radial basis function (RBF), multi-layer perceptron (MLP), recurrent neural network (RNN), generalized regression neural network (GRNN), and others [25].

Table 3. Activation function

Activation function	Formula	Use
Rectified Linear Activation (ReLU)	$f(x) = \begin{cases} 0 \text{ for } x < 0 \\ x \text{ for } x \geq 0 \end{cases}$	Hidden layer, Output layer
Logistic (Sigmoid)	$f(x) = \frac{1}{1 + e^{-x}}$	Hidden layer, Output layer. Score Range [0,1]
Hyperbolic Tangent (Tanh)	$f(x) = \frac{e^{x} - e^{-x}}{e^{x} + e^{-x}}$	Hidden layer. Score Range [-1,1]
Softmax	$S(x_i) = \frac{e^{x_i}}{\sum_{j=1}^{n} e^{x_j}}$	Output layer

Classification using tabular datasets in general uses a Multi-Layer Feed Forward Neural Network (MLFFNN) model. Some algorithms that use this model are Generalized Regression Neural Network (GRNN), Radial Basis Function (RBF), Multi-Layer Perceptron (MLP), Surface Volume Method (SVM), and others. The MLFNN model has three primary layers, just like layers in ANN in general, namely input layers, hidden layers, and output layers. Each layer has a processing unit called a neuron. In the learning phase, the ANN network will store knowledge on an interconnected link known as weights [13]. Each data will enter the neuron by calculating each weight on the neuron plus bias and will be calculated again with an activation function that will determine the output value of a neuron [6]. There are some learning algorithms that can be used to connect inputs and outputs,. The most common and most widely used is the Feed Forward Backpropagation (BPL) learning algorithm [13].

3.2. ANN Classification using Tabular Dataset

ANN is one of the classification algorithms that has excellent performance and is widely used by researchers with various datasets. One of them is classification research using tabular datasets. A tabular dataset is a dataset consisting of columns and rows. These columns contain attributes and targets. ANN with tabular datasets is widely applied to various fields such as health, banking, etc.

3.2.1. Health Sector

In the health sector, several researchers conduct research to detect diseases or abnormalities in the human body. As was done by [7][26], who conducted research on the detection of heart disease, research [27][28] on the detection of diabetic disease, and research [5], which conducted research on the early detection of autism spectrum disorder (ASD).

Research [7] identified three types of patients, namely patients with psoriasis, patients with coronary heart disease, and patients with psoriasis and coronary heart disease for early anticipatory steps. This study identified that patients with psoriasis have poor symptoms or are prone to coronary heart disease. This study used a tabular dataset with 4,360 patient data of 12 attributes. The neural network (NN) model is a Multi-Layer Perceptron (MLP) with an architecture of one input layer, one hidden layer, and one output layer. The data was first standardized using StandardScaler and then divided into training data and testing data with a composition of 80:20. The evaluation measures used are accuracy and the ROC curve. The results showed that ANN with the MLP model could identify three types of patients with an accuracy score of 86%. However, this study has several shortcomings, namely the absence of hyperparameter tuning to determine the ANN network configuration before the training process. Hyperparameter tuning is performed to select the optimal configuration for the ANN network, such as the number of hidden layers, number of neurons, learning rate, optimization algorithms, and stopping conditions. For further research, it can be done to improve the accuracy score by using more data, modifying the architecture of the MLP by performing hyperparameter tuning, and applying several stopping condition techniques, such as early stopping to stop the iteration process when it does not experience improved model performance, dropouts, and regularization to prevent overfitting.

Similar studies on heart disease were also conducted by [29]. This study made an automatic diagnosis to detect of heart disease early with the ANN algorithm. The dataset used has 303 data consisting of 13 attributes. Research begins with pre-processing data, training data, and evaluation. In the data pre-processing process, the statistical method X2 is used to select features. This study used a deep neural network (DNN) with an architecture of one input layer, two hidden layers, and one output layer. Unlike study [7], this study used more evaluation measures. The evaluation measures used are accuracy, sensitivity, specificity, and Matthew's Correlation Coefficient (MCC), AUC curve, and ROC. The results showed that the statistical method X2 for feature selection and DNN for classification were able

to produce an accuracy value of 93.33%. However, this study did not consider the time complexity in creating a diagnosis system, and still used grid search techniques in performing hyperparameter tuning to determine network configuration. Further research that can be done is by configuring the network with other faster techniques, such as genetic algorithms.

Still in the health sector, in addition to the detection of heart disease, several studies have detected diabetes. Research [27] classifies whether a person has diabetes or not based on attribute data in the dataset. This study made modifications to the ANN algorithm. The algorithm is an artificial backpropagation scaled conjugate gradient neural network (ABP-SCGNN) algorithm. To make a comparison, this study used other neural network algorithms as a comparison, namely multi-layer perceptron (MLP) and Bayesian regularized. The dataset used is a Pima Indian dataset containing 768 data with eight attributes. The dataset is divided by a composition of 70:30 for training data and testing data. This study combined the number of neurons on the hidden layer with 5 to 50 neurons. To evaluate the model, accuracy values, and mean square error (MSE) values are used. The results showed the highest accuracy score obtained, namely 93%, with neurons on the hidden layer totaling 20 when using the ABP-SCGNN algorithm. The ABP-SCGNN algorithm also has a lower time complexity than MLP and Bayesian regularized algorithms. The weakness of this study is that the amount of data used is only 768. For further research, you can use datasets with more significant amount of data.

Diabetic disease detection research was also conducted by [28]. This study conducted the detection of diabetic disease by comparing several algorithms. These algorithms are the decision tree algorithm, ANN, naïve bayes, and SVM. The dataset used has 768 data consisting of 9 attributes. For the model creation process, the dataset is divided by a composition of 75:25 for training data and testing data. The evaluation measures used are accuracy, precision, recall, and f1 score. The results showed that ANN and SVM had an accuracy score of 82%. Higher than decision tree algorithms and naïve bayes. Accuracy values that are not high enough can be increased in future studies by using datasets with a greater amount of power.

Research [5] conducted early detection of autism spectrum disorder (ASD). This study is an improvement of previous studies with low sensitivity and specificity scores. This study used three types of datasets. Those datasets are AQ-child datasets (8 features), AQ-adolescent (8 features), and AQ-adult (6 features). The study was conducted by comparing three algorithms, namely SVM, RF, and ANN. The evaluation measures used are sensitivity and specificity. The results showed that the SVM algorithm was able to increase the specificity value and RF was able to increase sensitivity compared to previous studies. The following research that can be done is to use a dataset with more features to be able to increase the sensitivity and specificity score to above 90%.

3.2.2. Banking

In the banking sector, ANN is widely used to detect credit card transaction fraud. Credit cards are one of the characteristics of the lifestyle of modern people. Credit cards are one of the payment methods that are often used by the public. However, it does not guarantee that the transaction is safe from fraud cases. Several studies have been conducted to detect fraud in credit card transactions. One of them is research [30].

In the banking sector, ANN is widely used to detect credit card transaction fraud. Several studies have been conducted to detect cases of fraud on credit card transactions. One of them is research [30]. This research conducted fraud detection on credit card transactions. The dataset used has 31 attributes consisting of 30 attributes and one target. This study used three different classification algorithms, namely SVM, KNN, and ANN. This study used a 1:15:1 network architecture. Fifteen hidden layers are used. The evaluation measures used are accuracy, precision, and recall values. The results showed that ANN had an almost perfect accuracy score of 99.92%. However, the recall value is still at 76%, and precision is 81%. Many hidden layers also cause the training time to become long. For further research, you can use hyperparameter tuning to determine the ANN network configuration so that there are not too many hidden layers but still produce good performance. The application of sampling techniques is also needed so that the dataset is balanced between positive (fraud) and negative (non-fraud) classes. A summary of the review of some of the papers above, is shown in Table 4. The advantages and disadvantages of each study are shown in Table 5.

Table 4. Tabular Dataset Research Network Architecture

Author	NN Type	Architecture	Performance Evaluation	Split Data
An-Hai Li et. al. (2022)	MLP	1:1:1	Accuracy, ROC Curve	80:20
Liaqat Ali et. al (2019)	MLP	1:2:1	accuracy, sensitivity, specificity, MCC, AUC, and ROC	70:30
Mazhar B. et al (2021)	ABP-SCGNN	1:1:1	Accuracy and MSE	70:30
Sonar, Priyanka (2019)	MLP	-	Accuracy, precision, recall, and F1	75:25
Taftazani G. Primary (2019)	MLP	1:1:1	Sensitivity and specificity	90:10
Asha RB (2021)	MLP	1:15:1	Accuracy, recall, precision	-

Table 5. Advantages and Disadvantages of Tabular Dataset Research

Author	Strength	Weakness
An-Hai Li et. al. (2022)	The accuracy score is quite high at 86%	Stopping condition uses the maximum iteration value. Can be an earlystopper implementation.
Liaqat Ali et. al (2019)	High accuracy score of 93.33%	Tuning hyperparameters using grid search which takes a lot of time
Muhammad Mazhar Bukhari et. al (2021)	High accuracy score of 93%	Too little data used
Sonar, Priyanka (2019)	Accuracy score of 82%	Accuracy score can be improved higher and data used too little
Taftazani Ghazi Primary (2019)	Sensitivity and specificity score of more than 90%	Too little data used
Asha RB (2021)	Very high accuracy score of 99.92%	Low recall score of just 76% and precision 81%

3.3. ANN for Image Classification

In research [31] discusses the analysis of colorectal cancer diagnosis based on digital imagery taken from a CT scan. Colorectal cancer is the uncontrolled growth of a cell in the lower part of the colon or in the colon. This study used a data set of 140 images of which 59 images were used for training, 41 images for testing and the reprimarying 40 images for validation. The neural network (NN) model used is a Multi-Layer Perceptron (MLP) trained with Back Propagation Algorithms (BPA) and tuned with the Genetic Algorithm and Feed Forward Algorithm (FFA) with an architecture of one input layer, one hidden layer and one output layer. The evaluation measures used are accuracy and the ROC curve. The results of this study showed that benign polyps had an accuracy of 85%, adenomatous polyps 85%, polyps relatively malignant 75%, and finally very malignant polyps 75%. In this study, the parameters used for ANN have not been tuned in depth, so readers do not know in what kind of conditions the parameters that are good enough can work. For further research, tuning parameters can be done to find the best so that accuracy can be maximized.

Research [32] discusses modeling electricity consumption on digital images. Digital imagery in the study included nighttime light developed and presented by the Earth Observations group at the National Centers for Environmental Information (NOE) of the National Oceanic and Atmospheric Administration (NOAA). Publicly available data from the U.S. Air Force Defense Meteorological Satellite Program (DMSP) Operational Linescan System (OLS) covers the period between 1992 and 2013. The Neural Network model used is Multi-Layer Perception (MLP) with an architecture of one input layer one hidden layer and one output layer. The evaluation measure in this study used MAPE with Polish region results achieved for the two types of output variables surveyed by MAPE of 11.95% and 7.92%, respectively. In this study, the number of data sets in detail was not explained, which one for the training data was not mentioned, and the parameter tuning was carried out directly without choice, and the best was taken. Further research should be more detailed in explaining the data set used and consider tuning parameters more so that the results are maximized.

Research [33] addresses the precise detection of defective wood to help optimize sawmill operations and find effective wood processing solutions. The image capture process uses a CT scan consisting of an X-ray source, a detector that measures the number of photons passing through the sample, a system to control the movement of the source, and a signal-changing unit that allows the display of CT images on the monitor. The data set in this study used 500 two-dimensional CT images for

different tree species, such as cherry, pine and poplar trees and the size were 200x200 pixels. The Neural Network model used is Multi-Layer Perception (MLP). The measure of evaluation in this study was accuracy with a result of 94%. In this study, the architecture of ANN was not explained in detail and the tuning parameters were also not explained at all. Although the accuracy of this study is quite high, it should be necessary to explain in detail the ANN architecture and the selection of parameters so that subsequent studies can improve its performance.

This study [34] adopts research methods to be able to extract useful information from MRI medical images, so it is necessary to perform effective image segmentation based on the characteristics of horizontal, vertical and diagonal differences, and then perform a comparative analysis on different MRI medical images and use the appropriate operators to detect the edges of the image. The effect is that, the edges of the MRI medical picture are not precise, and it is difficult for the human eye to accurately to judge the subtle differences. The total data set in this study amounted to 40 MRI images of which, 24 MRI images were used for training, and 16 were used for testing. The Neural Network model used is Multi-Layer Perception (MLP), with architecture using one input layer, three hidden layers and one output layer. The evaluation measure in this study used Peak Signal to Noise Ratio (PSNR), and MSE with results of 10.22 PSNR and 78.12 MSE. The results of edge detection in this study are relatively good compared to using an algorithm without ANN as in general but the drawback in this study is that it takes longer than an algorithm without ANN.

The next research should consider the time and explain in detail about tuning parameters. Research [35] aims to recognize and classify Falcaria vulgaris, Pelargonium sidoides, Trigonella foenum-graecum, Origanum vulgare, Rumex asetose as the most famous Iranian medicinal plants. The image of the plant is obtained with the smartphone vision system. An algorithm is implemented to extract texture, color, and shape features from the obtained image. ANN are applied to classify different groups of medicinal plants studied and efficient classifiers are selected based on error, correlation, and accuracy. In this study, 40 sites were selected, and 4 plant specimens were collected at each site. Generally, 6 groups of medicinal plants are collected and labeled from A1 to A6. The ANN architecture in this study uses three input layers, three hidden layers and three output layers. The accuracy obtained reaches 100%. The results can be said to be perfect because experiments were carried out for tuning ANN parameters and the extraction of features that were carried out pretty a lot at the time of the classification process was quite long, but here the author did not describe the time needed to do a classification. In this study, it should not only be a matter of accuracy results displayed but also other evaluation results so that they are more diverse and travel time.

The study [36] aims to design an automatic disease diagnosis system using image processing techniques. This study presents a method of diagnosing apple disease at a low cost using neural tissue and classification of fruits into four classes, namely scab, bitter rot, black rot, and healthy fruit. This method uses color and texture features. This study used a multi-layer perceptron neural network whose input is a feature extracted from the image and whose output is a defined class. The data set in this study was taken with a digital camera as many as 110 images were successfully taken, 42 pictures were taken from apples with scabs, 27 pictures with bitter rot, and 21 pictures with black rot. Also, 20 pictures were taken of healthy fruits. The Neural Network model used is Multi-Layer Perception (MLP) with an architecture using 13 input layers, two hidden layers and four output layers. The evaluation measure in this study used accuracy with a result of 73.7%. The results of this study are quite low because it only uses one feature extraction, namely color. For the following research, the feature extraction process should be more varied so that accuracy can be maximized.

In research [37] conducted a simulation of pattern recognition of hijaiyah khat kufi letters using sobel edge detection and backpropagation artificial neural networks using learning rate and epoch test parameters. The simulation was carried out 28 targets of hijaiyah letters. The Neural Network model used is Multi-Layer Perception (MLP) with an architecture using 900 input layers, two hidden layers and one output layer. The evaluation measure in this study used accuracy with a result of 94%. In this study it is not explained. In detail about tuning parameters and the architecture so that for the next research it is difficult to continue this research. A summary of the review paper above on image processing is shown in Table 6. The advantages and disadvantages of the study are shown in Table 7.

Table 6. Image Processing Research Network Architecture

Author	Architecture	NN Type	Performance Evaluation	Training & testing
Sujatha. K et. al. (2020)	1:1:1	MLP	Accuracy, MSE	70:30
Tomasz Jasinski (2019)	1:1:1	MLP	MAP	75:25
Ligong Pan et. al. (2021)	-	MLP	Accuracy	80:20
Shao Yunhong et. al. (2022)	1:3:1	MLP	PSNR, MSE	60:40
Rahim Azadnia et. al. (2021)	-	MLP	Accuracy	80:20
Hossein Azgomi et al. (202-2)	-	MLP	Accuracy	60:40
Irvan Faturrahman et. al. (2018)	1:2:1	RBF	Accuracy	-

Table 7. Advantages and Disadvantages of Image Processing Research

Author	Method	Strength	Weakness
Sujatha. K et. al. (2020)	Firefly algorithm	Many algorithms are carried out so that the training process is maximized	Not explained in detail for parameter determination on ANN
Tomasz Jasinski (2019)	-	The results are already pretty good with the real data	The determination of the data set is not spelled out in detail and for tuning its parameters is not explained in more detail
Ligong Pan et. al. (2021)	PCA	The accuracy evaluation is good enough	The ANN architecture and the parameter selection is not explained
Shao Yunhong et. al. (2022)	-	PSNR and MSE are small	It takes longer than other algorithms
Rahim Azadnia et. al. (2021)	-	Perfect accuracy results	Travel time not explained
Hossein Azgomi et. al. (2022)	SVM	Described in detail on parameter tuning	Accuracy is still not optimal
Irvan Faturrahman et. al. (2018)	Canny edge	Accuracy is quite maximum	Not explained in detail for parameter tuning

4. CONCLUSION

ANN algorithm is a powerful algorithm for dealing with classification problems both when using tabular datasets and for image classification. The primary purpose of this article is to explain the theory of ANN including definitions, working concepts, architecture, types of ANNs and to present a systematic literature review of the use of ANNs in several cases so that the gaps we found can be used for further research. The results of data and information extraction from 13 articles reveal that ANN is a classification algorithm whose working concept is like the working concept of the nerves of the human brain. Some examples of classification cases that can be handled with ANN while using tabular datasets include classifications in the health sector such as detection of coronary heart disease, detection of diabetes, detection of autism spectrum disorder (ASD), classifications in the banking sector such as fraud detection in credit card transactions. In addition, recently ANN has been popularly used for image processing. ANN is used to study important features of images and perform tasks such as object recognition, segmentation, reconstruction, and others. The challenge that arises from using ANN is about data. The more data used the better the resulting performance. In addition, it is important to use the right evaluation measure to measure the performance of the resulting model.

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