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REVIEW ON AN AUTOMATIC DETECTION OF SKIN CANCER USING CNN

[1]Shabnam Ara Chowdhary, [2]Er.Mandeep Kaur

[1]M.Tech Student, [2]Assistant Professor,

[1]Computer Science Engineering,

[1]Desh Bhagat University, Mandi Gobindgarh, Fatehgarh Sahib, Punjab- 147301, India

Abstract: Skin cancer is one of the deadly types of cancer. The way detecting melanoma is to use the biopsy method. To do this method requires the performance of a trained doctor. The biopsy Process painful and requires considerable time long. Therefore, this review has been conducted Image classification of melanoma skin cancer using the convolutional neural network technique. However, the stages of the cancer image classification process melanoma skin in this study include the pre-processing process, segmentation, feature extraction with ABCD namely Asymmetry, Border Irregularity, Color Variation and Diameter. Subsequently, it's quantified that both the convolutional neural network can be used for skin cancer diagnostics effectively and promptly.

Index Terms **–Skin Cancer, Deep Learning, Artificial Neural Networks, Convolutional Neural Networks.**

I. INTRODUCTION

Skin cancer is cancer of the skin layer whose main cause is radiation ultraviolet light, certain toxins and genetic factors, which result in the constituent cells skin experiences uncontrolled growth and makes the cells that make up the skin these grow into cells that are very dangerous[1,2] . The cancer will continue to grow into abnormal cells and can also spread to the tissues normal. This disease can cause death in sufferers, depending on the type skin cancer and the level of malignancy of the cancer. This type of disease is increasingly affecting the world community, including India, due to substances in food that can be toxic to the human body and its effects global warming. Ultraviolet rays from the sun are increasingly free to radiate and continue to damage human skin [2]. Skin cancer is one of the cancer triad malignant often found in India, in addition to cervical cancer and breast cancer. In United States, more than 5.4 million cases of skin cancer are found each year making skin cancer the most common type of cancer in the country [3-5].

One in five Americans is diagnosed with a malignant skin disease in his life. Among the types of skin cancer that exist, Melanoma is a type of cancer most ferocious. Although melanoma is only 5% of all skin cancer cases that occur in the United States, but melanoma has been the cause of death in 75% of cases deaths due to skin cancer that occurred in these countries [3]. This matter indicates that melanoma is a type of skin cancer that is very dangerous to have can be overcome appropriately and quickly. Apart from the high level of malignancy, melanoma also has a shape similar to a mole so its existence often not realized. In the medical field, the diagnosis of skin cancer is carried out in the biopsy process invasive and microscopy. Parts of the cancer cells are taken to be checked in detail whether these cells are cancer cells or not.

This testing technique requires long enough for even an expert dermatologist to have risks alone for accidents during the biopsy process. In previous research, deep neural network has been implemented training 129,450 clinical images, and its performance is tested by 21 certified dermatologist's clinical biopsy images. This proves the role of computer systems in helping the process of detecting skin cancer. Deep Learning technology is an algorithm that is being very developed in solve various problems of human life. Supported by progress computations and enormous datasets, deep learning proved to be beyond humans in visual tasks and object recognition. This algorithm improves the performance of Convolutional Neural Network (CNN) which is used for object recognition on image (Image Processing) [6].

II. LITERATURE REVIEW

2.1 SKIN

The skin is the outermost organ of the human body that covers its layers and organs other. This organ is the part of the human body that is in direct contact with the environment and natural phenomena around it [1]. Human skin consists of the hypodermis, dermis and epidermis (outermost). The epidermis is composed of 3 cells main, namely squamous cells (inner layer of skin), basal cells (producing new skin cells), and cells melanocytes.

2.2 MELANOCYTES

Melanocytes are the producers of melanin, the pigment that gives skin its normal color. In an effort to protect the inner layers of the skin, melanocytes produce more lots of melanin when exposed to sunlight.

2.3 MELANIN

Melanin: Melanin is a skin color giving enzyme that absorbs some of the ultraviolet radiation (UV) harmful rays from the sun, and can reduce the damaging effects of skin cells caused by UV rays, so a deficiency or absence of this enzyme results someone has a high potential for skin cancer [2-4].

2.4 SKIN CANCER

This disease is the most common type of cancer in people, in the form of skin which grows abnormally due to genetic factors, toxins, and especially due to ultraviolet (UV) rays from sunlight [7]. Sunlight is the most common cause of this disease because the average human being is exposed to light sun directly every day, but skin cancer can also appear in those areas skin that is not exposed to direct sunlight. Skin cancer grows in the lining the outermost skin (epidermis) so that it can be seen from the outside and easily symptoms are found at an early stage.

2.4.1 Types of Skin Cancer

In general, skin cancer is divided into melanoma skin cancer and skin cancer nonmelanoma. Nonmelanoma skin cancer is divided into basal cell carcinoma and carcinoma scuasoma cells. The following are types of skin cancer based on the cells involved:

2.4.2 Basal Cell Carcinoma (KSB)

This type of cancer is the most common skin cancer in humans especially in the elderly [8]. KSB is often referred to as basalioma, basal cell epithelioma, rodent ulcer, Jacob's ulcer, or Komprecher tumor. KSB is a malignant neoplasm of cells that are not keratinized lapisal basal epidermis, locally invasive, aggressive, destructive, and rare metatasis [1,2].

2.4.3 Squamous Cell Carcinoma (KSS)

This type of skin cancer is the second most common type humans, after KSB, which is about 20% of all skin cancer cases [1,2]. KSS is often referred to as epidermoid carcinoma, cell epithelioma squamous, planocellular carcinoma, prickle cell carcinoma, and spinalioma.

Fig 1: Examples of Skin Cancer in Melanocytes

The nevus has a shape similar to melanoma, so sufferers often ignore the presence of a nevus or melanoma, which looks like an ordinary mole. Based on the level of malignancy, melanoma can be classified into two types, namely:

2.4.4 Melanoma in Situ (MIS)

This type of melanoma is often called stage 0 melanoma and is not the type of melanoma that is directly related to death [9]. MIS is a type of melanoma that has not metastasized, so it is not too dangerous. However, MIS has the potential to develop into Malignant Melanoma so that leading dermatologists advise patients with pigmented lesions to undergo routine screening [9].

Fig 2: Melanoma in Situ

2.4.5 Invasive Melanoma / Malignant Melanoma (MM)

MM is a type of melanoma that has metastasized. MM has spread and grow/penetrate into deeper skin layers. According to [10], adjuvant chemotherapy is an alternative for sufferers of this type of disease. Malignant Melanoma has asymmetrical shape and can have color more than one.

Fig 3: Malignant Melanoma

Table 1: Characteristics of Benign and Malignant Lesions

Characteristics	Benign Lesions (Nevus)	Malignant lesions
Growth	Not growing	Grow
Bloody	Not	Yes
Location	Many places	Sun-exposed areas of the body
Shape	Regular shape with smooth and symmetrical lines	Not symmetric
Color	Color	Color may vary
Incident	Many years	New lesions

2.5 SKIN CANCER DETECTION

According to [11], the differences in the image of skin lesions can be taken with using ABCD parameters, namely:

1. Asymmetry: One part is not the same as the other
2. Border: Irregular, toothed, or unclear boundaries
3. Color: Varies from one area to another. Has a black, brown or color sometimes white, red or blue.
4. Diameter: Melanoma is usually larger than 6mm when diagnosed, but it can also smaller.

2.6 MACHINE LEARNING

Machine Learning is a branch of artificial intelligence that includes designing and developing algorithms on computer systems that allow computers to perform and develop behaviors based on empirical data such as from sensor data from databases [12]. Machine Learning's main focus is on how computers can automatically recognize complex patterns and make intelligent decisions based on data. Data are used to describe the relationships between the observed variables and capture the necessary features of the probabilities underlying the relationships between variables. According to [13], such as the case of bait shyness, where mice learn to avoid poisonous bait food. When rats find a food with a strange smell and / or shape, they will eat the food in very small amounts and then depend on the taste and the psychological effects of the food on them. If the food eaten by the mice causes disease effects on their bodies, then they will assume the subsequent bite will cause poison as well so they will not continue to eat the bait. In this case, mice use their experience in eating poisonous bait food to detect other poisonous bait foods so they can avoid familiar toxins, likewise in Machine Learning computer systems learn to avoid mistakes or perform certain skills based on data which is an added experience. to the computer. The main tasks of machine learning are classification (grouping) and regression (prediction of numerical values). For example in an expert system, when you want to determine something you have to do something, including weighing it with a scale to get a result about weight and using computer vision to recognize a shape. Classification in Machine Learning is done by training the algorithm used by providing the algorithm with quality data (training set). The following are categories of algorithms in Machine Learning based on their objectives:

Supervised Learning: The computer is given a modelling of the relationships and dependencies between input and target predictions the desired output so that the computer can understand the underlying pattern the given output. Experts act as teachers of computers, where they are provide labelled training data to be studied by computer systems.

Unsupervised Learning: Computer systems are not given training data labelled as in supervised learning, however through this label less training data the computer system learns patterns or other things can be seen from these data. The main types of this Unsupervised Learning algorithm are a clustering algorithm.

Semi-supervised Learning: Very useful for use in training data that still does not have a label complete due to the difficulty of obtaining complete data. Although in this method there is still a lot of unlabeled data, training data is used carries a lot of important information about pattern parameters.

Reinforcement Learning: This method aims to use observations gathered from interactions with environment to take actions that will maximize expertise or minimize risk. The Reinforcement Learning algorithm (also called the agent) continues learn from the environment repeatedly. In the process, the agent learns from experience about the environment to explore various possibilities circumstances.

2.7 ARTIFICIAL NEURAL NETWORK

An artificial neural network is a thinking model that uses a model of billions of connected nerves. The collection of neurons is made into a network that has a function as a computational tool, where the number of neurons and the network structure used will differ depending on the problem to be solved. The structure of the artificial neural network is inspired by the structure of the human body tissue, especially the human brain network, which is composed of no less than 1013 neurons, each connected to about 1015 dendrites. Neurons are the smallest processing units in the brain which are simplified in the following illustration:

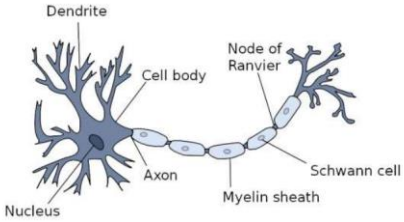

Fig 4: Illustration of neurons and their components

Figure 4 shows one in 10^{13} neurons modeled in the network artificial nerve. The function of dendrites is to convey signals from these neurons to neurons connected to it [13].

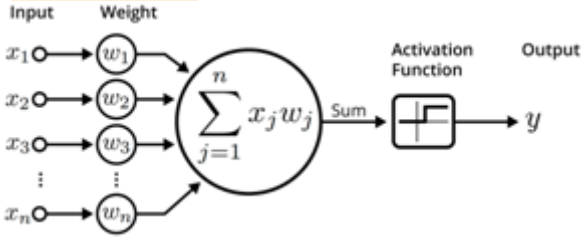

Fig 5: Imitation Model of a Neuron

Figure 5 show a mock model of a neuron where a number of signals input is multiplied by each corresponding weight w. Then all of these products and the resulting output are added to the function activity to get the degree level of the output signal y [14].

2.8 CONVOLUTIONAL NEURAL NETWORK

Convolutional Neural Network is a feed-forward type neural network (not repeating) which is used to analyze visual images, detect and recognize object in the image, which is a high-dimensional vector that will involve a lot parameters for characterizing the network. A bionic convolutional neural network is proposed for reduce the number of parameters and adapt the specific network architecture to the task vision [15]. Convolutional neural networks are usually composed of a single set layers that can be grouped by their function. Broadly speaking, CNN is not too different from the usual neural networks. CNN is composed of neurons that have weight, bias and activation functions, however The architecture of the Convolutional Neural Network is divided into two major parts, namely Feature Extraction Layer and Fully-Connected Layer (Multilayer Perceptron).

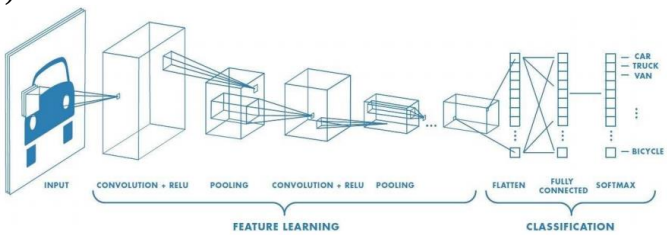

Fig 6: Convolutional Neural Network Architecture

Figure 6 shows the Convolutional Neural Network architecture, where the Feature Extraction Layer is the process of encoding an image into features in the form of numbers that represent the image. This layer consists of a Convolutional Layer and a Pooling Layer which have the following functions.

This Convolutional Layer layer consists of neurons arranged in such a way as to form a two-dimensional filer with length and height (pixels). For example, the first layer in the feature extraction layer is a convolutional layer with a size of 7x7x3, which is 7 pixels long, 7 pixels wide, and 3 pixels thick according to the channel of the image. This filter process is carried out by shifting the dot operation between the input and the filter value to produce an output activation map or feature map. The filter shift is determined by a parameter called stride, which determines the number of pixels shifted horizontally and vertically. The smaller the stride used, the more detailed results it will get, but also requires better computation [15]. In Figure 7 the stride used is 2.

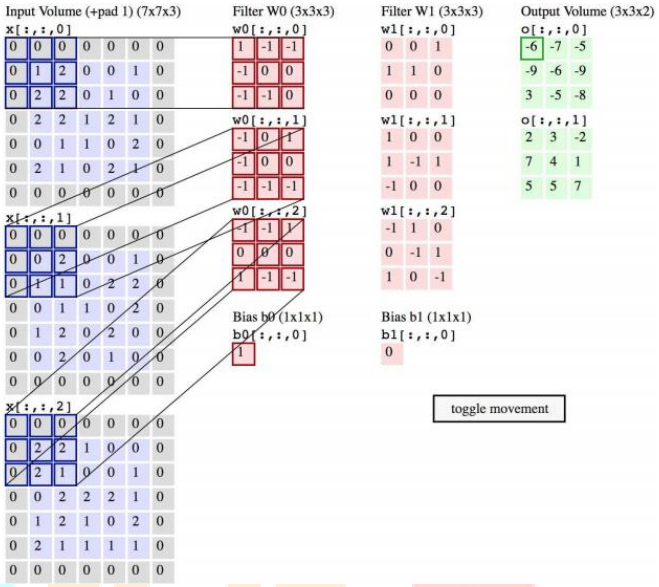

Fig 7: Filter 1 process to generate a Feature Map

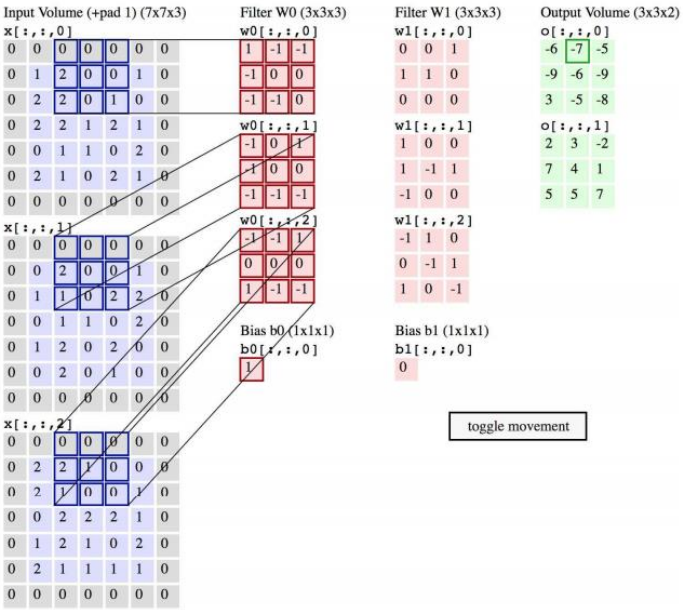

Fig 8: Filter 2 process to generate a Feature Map

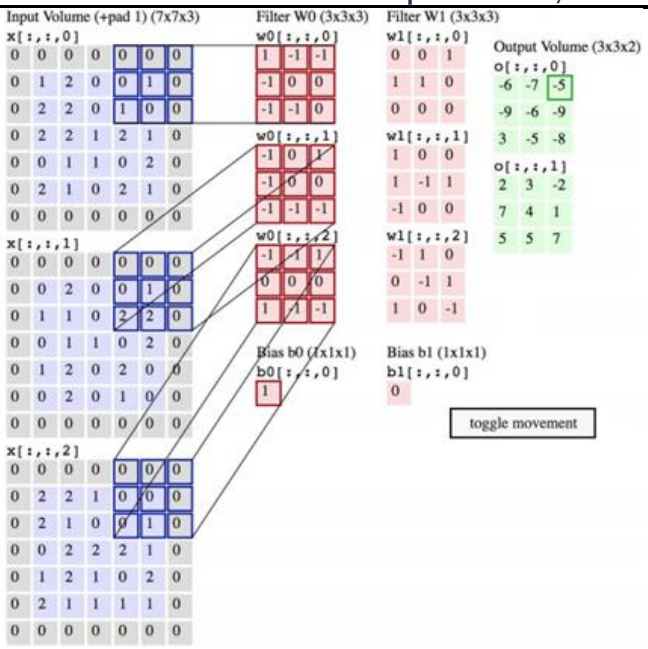

Fig 9: Filter 3 process to produce a Feature Map.

Figure 7 uses zero padding so that we can adjust output dimensions in order to stay the same or at least not drastically decrease from input dimensions, so we can use a deeper convolutional layer to extract more features. This padding is also a limit in order convolutional filter is more focus and the performance of the model will increase. In the Convolutional Layer, the accepted input images size is W1 x H1 x D1 and produce an output with the size W2 x H2 x D2 with a formula like in equations 1, 2 and 3.

$$\boldsymbol{W_2 = (W_1 - F + 2P) / S + 1 \ (eq.1)}$$
$$\boldsymbol{H_2 = (H_1 - F + 2P) / S + 1 \ (eq.2)}$$
$$\boldsymbol{D_2 = k \ (eq.3)}$$

2.8.1 Pooling Layer

This layer is located after the convolutional layer, consisting of a filter and a stride of a certain size. Pooling that is commonly used is Max Pooling and Average Pooling. As in Figure 11, in Max Pooling, the maximum value in the filter area to be selected at the time of shift, while in Average Pooling, the average value of the filter will be selected. The pooling layer is used to reduce the dimensions of the feature map (downsampling), so that fewer parameters need to be updated and speed up computation, as shown in Figure 10 [15].

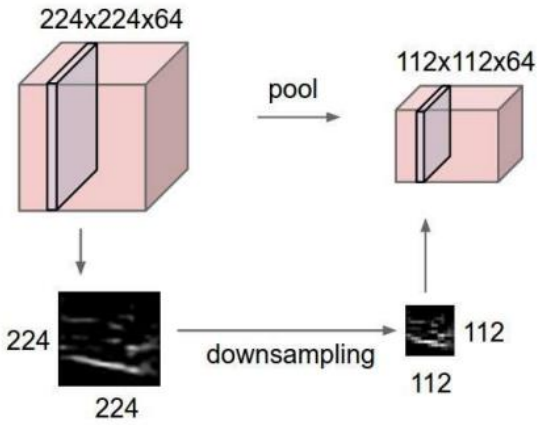

Fig 10: Down-sampling Process on the Pooling Layer

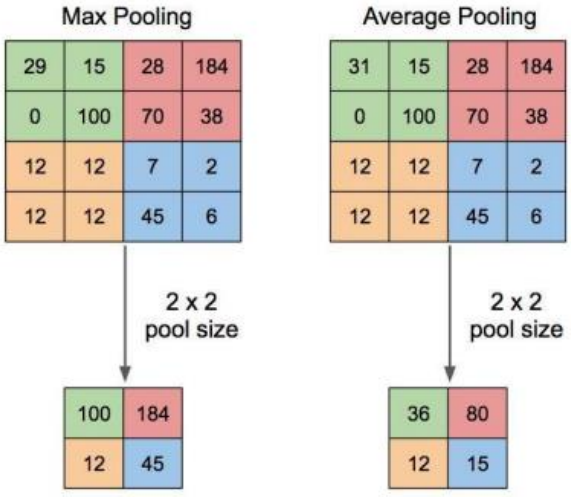

Fig 11: Down-sampling Process with Max Pooling and Average Pooling.

In the Pooling Layer, the input size received is in W1 x H1 x D1 and produces an output with the size of W2 x H2 x D2 with the formula as in equations 4, 5 and 6.

$$\boldsymbol{W_2 = (W_1 - F) / S + 1 \ (eq.4)}$$

$$\boldsymbol{H_2 = (H_1 - F) / S + 1 \ (eq.5)}$$

$$\boldsymbol{D_2 = D_1 \ (eq.6)}$$

F: Spatial extent

S: The number of Strides used

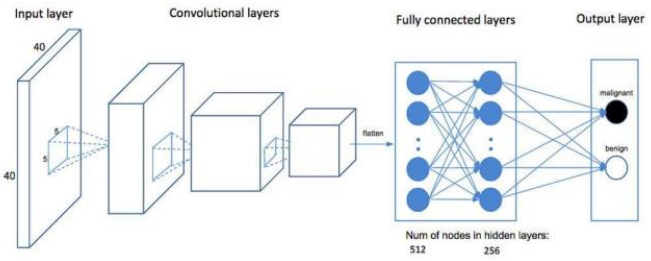

Fig 12: Fully Connected Layer using ordinary Neural Network

In Figure 12 there is a layer that looks like using an ordinary neural network with a hidden layer, output layer, activation function, and loss function, namely the Fully Connected Layer (FC Layer). The FC Layer is the end of the learning phase in a Convolutional Neural Network, where the output is a vector that has been extracted and produces the expected output. In this layer, flatten or reshape the feature map into a vector so that it can be used as input to this layer, because the feature map generated in the previous layer is still in the form of a multidimensional array.

2.8.2 Deep Convolutional Neural Network

The term "deep learning" is intended to add accuracy to the training process by adding a hidden layer to the neural network so that the resulting output is more detailed. In the Convolutional Neural Network, the layer added to improve the accuracy of the training model is a convolutional layer.

3. Related Study

In 2014, [17] Combined digital image processing and artificial intelligence for skin cancer detection. The data used are images dermoscopy. The feature extraction technique used here is GLCM (Gray Level Cooccurrence Matrix) and RGB color features to get differences in ordinary skin textures. with the texture of the skin affected by cancer. To improve the ANN classification accuracy optimized with genetic algorithms. This study managed to achieve an accuracy of 88.0%.

In [18], used the geometric features of the ABCD rule melanoma to train SVM machine learning algorithms. Experiments were carried out with the use of color space and lighting to enhance visualization for GrabCut segmentation accuracy. This study managed to achieve an accuracy of 80.0%.

In [19], used the Deep Neural Network method for skin cancer classification based on skin lesion images. This research also makes research from Alex, et al., (2012) as a research reference. Testing is done with compared system performance with 21 certified dermatologists from clinical images with two use cases

classification namely kerationocyte carcinoma versus benign seborrheic keratosis and malignant melanoma versus benign nevi. Research this too compared the results of a study of three skin cancer classes with nine skin cancer class based on a certified dermatologist. This research was successful in achieving accuracy of 93.3%.

In [20], used the Deep Residual Neural Network method to analyze the Basal Cell Carcinoma (KSB) dermoscopy images. Modeling divided into two parts, namely segmentation and classification. The segmentation model uses The FCRN is capable of identifying lesions on images and removing information foreign. The classification model takes this segment and uses Deep Residual Neural Network 152 layer. This model works smoothly from input to output without conditions manual labor. This research succeeded in achieving an accuracy of 93% in detection of KSB.

In [21], Alex, et al., Used a Deep Convolutional Neural Network to classify ImageNet, which is more than 15 million labeled high-resolution images, comprising approximately 22,000 categories. The images used in this study are various, ranging from cars, ships, airplanes, bicycles, dogs, cats, tigers, lions, and others. The best model learning accuracy obtained in this study is 78.1%. This study is a large study which is the benchmark for further research in the field of image recognition using a Deep Convolutional Neural Network.

Research conducted by [22] determination of benign or malignant skin lesions using the Support Vector Machine (SVM) classification method based on color features, ABCD rules (axis length, border irregularity, color, and depth), and geometric features. Evaluation results obtained from research This results in an accuracy value ranging from 90.00% to 97.00%. The classification method used by researcher in detecting skin cancer is a form of application of artificial methods intelligence.

Research by [23] classifies the image of skin cancer using the VGGNet deep learning method. The parameters that used, namely the initialization of the dropout probability of 0.5 and the number of batchsize equal to 16. Classification is carried out based on image data that has been augmentation with rescaling, rotation, transformation, dilation, and reflection. Level the best accuracy obtained is 95.9% with the number of epoch as much as 20.

Patients with skin cancer experience abnormal cell growth on the skin [24] Abnormal cell growth generally occurs in parts of the skin that are often exposed to the sun, but can also occur on the skin of any part of the body. Skin cancer attacks the outermost layer of the skin Squamous CellsCarcinoma (SCC), second layer Basal Cell Carcinoma (BCC), and melanocytes cells in the third or deepest layer. Squamous cells and basal cells are commonly referred to as non-melanoma, while melanocytes cells called melanoma cancer [25]. Melanoma begins of malignant transformation of melanocytes cells. Melanocytes cells located in The deepest part of the epidermis is responsible for the formation of pigment melamine skin, so that melanoma type skin cancer attacks the pigment cells on the skin [26]. Damage to skin tissue due to cancer cells can prevented by detecting skin cancer at an early stage in order to get appropriate treatment [24].

CNN is a deep learning method that studies the features of a data using the learning feature. CNN hasbeen implemented in various computing applications such as pattern recognition, object detection, data classification image, and so on. CNN is commonly used in identification and image data classification [27]. CNN has multiple architectures different channels, such as AlexNet, ResNet, LeNet, GoogleNet, and others [28]. GoogleNet is thearchitecture of the CNN method which introduced in 2014 and won the ImageNet Large-Scale . competition Visual Recognition Challenge 2014 (ILSVRC14) for image data classification [29]. The GoogleNet architecture has been used in previous research. Research conducted by [30] using GoogleNet architecture on the CNN algorithm for face detection. Level the accuracy resulting from the facial recognition system is better than the technique Conventional Machine Learning (ML) is 91.43% [30].

III. CONCLUSION

Neural networks are among the most innovative technologies to date from writing this text. The development of a skin lesion classification system using networks convolutional neurons is a task that requires, therefore, constant research and experimentation to achieve better and more useful results in the service of humanity After choosing a complex and flexible network architecture, the main improvements when it comes to train the neural network come from increasing the number of data in the training set as has been observed in the literature review. The techniques of convolutional neural network provide much benefit in tasks. The different regularization techniques applied such as "Dropout" and "Class balanced loss using ReLU" also provide slight improvements, especially in complex and flexible network architectures (the most popular at present) and in scenarios where the training data present a distribution of classes

(malignant and benign), where the data with a positive diagnosis while achieving the high accuracy of successfulness.

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