Artificial Neural Network algorithm for image Compression and Edge Detection

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Abstract— *In recent years, detection of things measured in the PASCAL VOC dataset has stabilized. Low-level image features and high-level context. There are many ways to perform complex grouping systems that combine image features in this work. An algorithm has been proposed to reveal the edge of the image in the proposed way Fully Connected Network (FC) by Convolution Neural Network (CNN) in short time using CNN method to reduce the space occupied by the original information of the image. To highlight the role of Artificial Neural Network (ANN) in the field of images to detect the edges using modern techniques in many areas of science, engineering and medicine, where the images of the cancerous cells algorithm that was created in this paper are revealed showing the importance of Artificial Neural Network (ANN) and Fully Connected Network (FC) by Convolution Neural Network (CNN) to detect cancer cells and tumors.*

Keywords— ***Artificial Neural Network (ANN), Fully Connected Network (FC), Convolution Neural Network (CNN).***

I. INTRODUCTION

Challenges faced by image analysis such as object discovery, identification, classification, description, etc. For example, creating a photo workbook with differences must work with high accuracy from viewing angles and lighting changes, etc [1-5]. To classify images inappropriate for work in rich environments with his main step in engineering The features cannot reach high-resolution with experts, they will not be able to classify images that are difficult to reach high-resolution to work with automatic images because of the artificial neural network (ANNs) [6-9], which is one of the methods that is characterized by its strength in the field of image analysis where it is based on an algorithm such as landing Shake (GD). ANN learns the image features automatically. The initial image is applied to ANN and ANN is responsible for creating the features that describe it.

Image Analysis using FC Network and compression

In this section ANN will work with images and how CNN is effective in the area of requirements at with respect to a simple example of (3×3) gray image in a smaller number of neurons will be used to simplify the process Fig 1 represent small size (3×3) gray image.

$$\begin{bmatrix} \mathbf{15} & \mathbf{8} & \mathbf{9} \\ \mathbf{100} & \mathbf{17} & \mathbf{22} \\ \mathbf{200} & \mathbf{150} & \mathbf{20} \end{bmatrix}$$

Figure 1: matrix size (3×3) gray image.

The simplification process is through the inputs, which is the image pixel ANN. The array will be converted to a vector in figure 2 represent converting of 2D image into 1D vector.

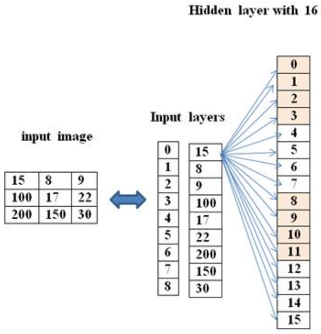
$$\begin{bmatrix} 15 \\ 8 \\ 9 \\ 100 \\ 17 \\ 22 \\ 200 \\ 150 \\ 30 \end{bmatrix}$$

Figure 2: represent converting of 2D image into 1D vector.

For each component of the vector in ANN, a neuron is required, so that the input layer has 9 neurons the size of the matrix inserted, as usual, due to the extension ANN as the vector to prepare it.

1- Preparing of the ANN.

2- Add the hidden layer (s) that learns how to convert the image pixels in to representative features.
3- Assume that there is a single hidden layer with 16 neurons as in figure3



Figuer 3: represent how to connect each input pixel to hidden neurons.

For each input there are 16 connections, which leads to each pixel connected to all neurons. The total number of the nine inputs are $9 \times 16 = 144$ parameters see figure 4

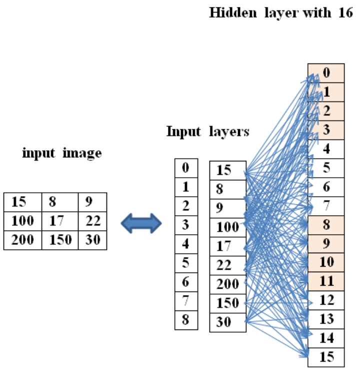


Figure 4 : represent full connected of input 1D vector to the input neurons.

II. The problem of parameters with a large number

It is noted in FC is acceptable. Because the number of image pixels and hidden layers increases, the number increases, meaning that if the neurons are 90 and 50, there is a network that contains two hidden layers, which leads to 9 x 90 = 810 between the input layer and the first hidden layer, which is the number of parameters, and the second is 90 x 50 = 4500. The total number will be 810 + 4500 = 5310. It will be a large number that takes a large size from the grid.

To avoid this problem, the image size should be reduced to 32 x 32 (1024 pixels). This is done by converting the network into a single hidden layer of 500 neurons. The number of parameters will be the weight that does not match the size of the hidden layer, which leads to a solution to avoid this problem. Here a role appears CNN With fewer parameters with a large grid for FC

III Gathering of neurons

By assigning a single parameter for a group of neurons rather than individual neurons, number of parameters are visual. If groups of 4 neurons are created then number of parameters will be visual by a factor of 4. Hence, each input will have just 4 parameters rather than 16. Total of parameters are visual for 144 to just 36 parameters see figures 5 and 6

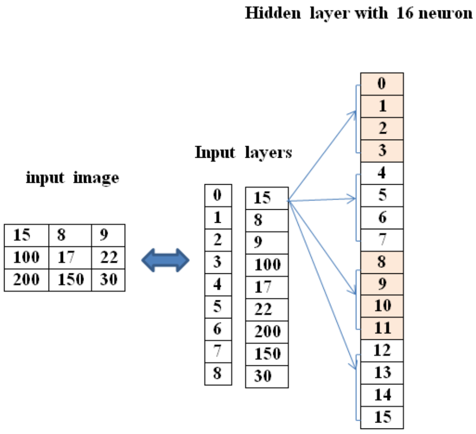


Figure 5: represent the process of neurons grouping.

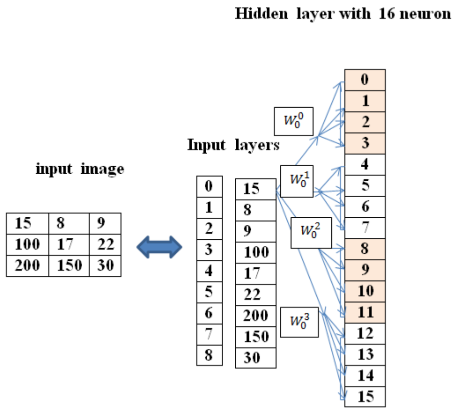


Figure 6: represent how to grouping multi neurons with same weights

Each pixel is connected to similar groups so Figure 7 shows that each group has a parameter to be the result $9 \times 4 = 36$.

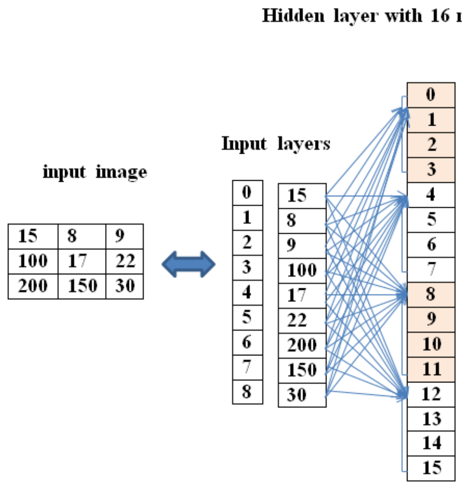


Figure 7: shows the unique connections from each pixel to the neuron of each group.

In each group, the work of every neuron for all pixels is to communicate between all pixels of the image. Some pixels have. In fact, the pixels are spaced spatially, working with some pixels instead of all of them, each neuron is sent in figure 8.

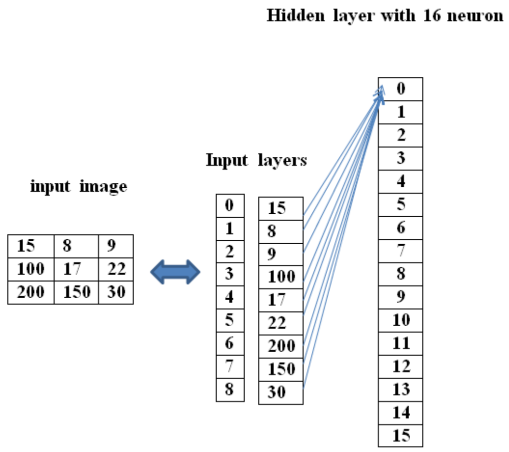


Figure 8: represent the works of each neuron in each group with all pixels.

IV Pixels locative attachment

From the image in Figure 9, the example that illustrates the process of the previous shapes is where the image is analyzed inside the face. Each pixel is bound to the surrounding pixel units, but the distant pixel is less like the earth and the sky.

Meaning that pixels are accepted by each neuron if $f(x_1, x_2, x_3, x_4)$ is a function of four inputs, meaning the process is designed on the basis of the four inputs. From the above forms, the inputs can be reduced to 2

Figure 9: the example that illustrates the process of the previous shapes

From above example, not all nine pixels units are used for a neuron, but only 4 can be used, as in Figure 10 the pixel in the picture is the first neuron is (0,0) has 3 units either. The following group is related to the cell (0,1) , (1,0) and (1,1) as for the fourth neuron It is instead of 9, so these four neurons are matched by only 4 parameters. The total number will be 4 x 4 = 16. This leads to a decrease of 144-16 = 128 parameters, meaning the percentage is decreased 88.89% , then each neuron in each group work with just a 4 pixels rather than figure8 in figure 10.

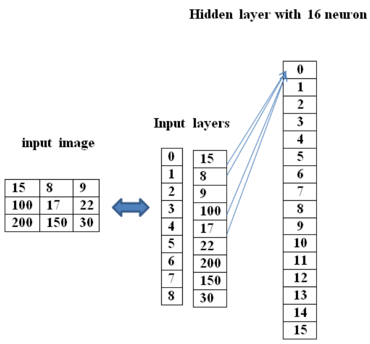


Figure 10 : shows that each neuron in each group work with just a 4 pixels rather than fig8.

Result The number of pixels is reduced from 4 pixels to 9 pixels in each group for each neuron. This reduces the parameters $9 \times 4 = 36$ to just $4 \times 4 = 16$.

V Convolution Neural Network (CNN)

Convolution Neural Network (CNN) for time and memory from FC network. At this stage more efficiently with layers and neurons with a greater number and that is not possible then the idea of circumvention is implemented in CNN.

In this work there are 4 weights of neurons that cannot cover 9 pixels

Communication is made to Figure 11 after adding the weights inside the neuron so that the product of each pixel of the input units will have a corresponding weight of the equation in Figure 11 shows the previous network in figure10 but after adding the weights labels to the connections.
Each pixel is visualized as an array so that it is instead of a wrap size from 3×3 to 2×2

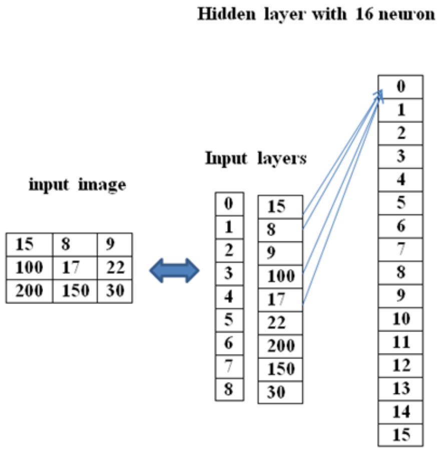


Figure 11 : shows the previous network in figure10 but after adding the weights labels to the connections.

This can be visualized as follows

15	8	9
100	17	22
200	150	30

×

w_0	w_1
w_2	w_3

This can be visualized as follows

The process of wrapping between pixels and block.

$$15 \times w_0 + 8 \times w_1 + 100 \times w_2 + 17 \times w_3$$

The process is carried out by transferring the process to the following neurons, i.e. the process is repeated to other groups, which are from indicator 1 to indicator 0, which are related to the same weights and also 2 and 3 the same process is repeated. This is illustrated in Figure 12. It is clear that the first neuron starts from the left upper pixel to choose A number of pixels surrounding it. As for the last neuron, it starts from the right side. This process is called a warp between the image and the weight that characterizes CNN.

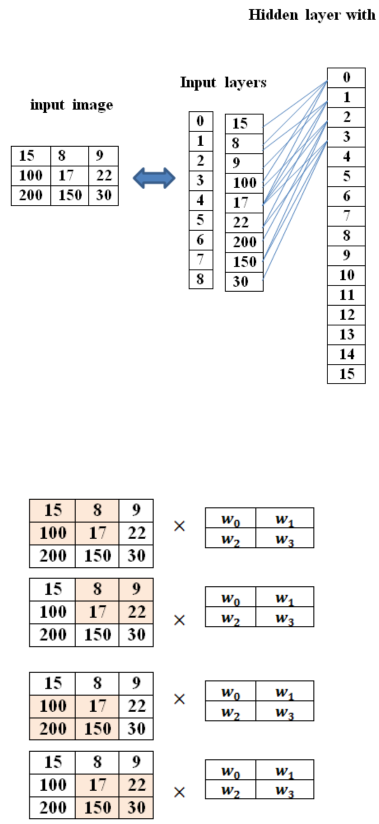


Figure 12: represent how convolution process work for connect input pixel to hidden neurons.

The remaining neurons repeat the same process, where the guardian from each group is also from the left corner and the last from the right corner for each pixel around it.

V. Edge Detection

In image density, the edge is a curve that follows the path of rapid change in the image
the edges of the boundaries of the objects in the scene. The method used to determine the edges in the images is the edge detection.
The edge function can be used to find edges and this function searches for places where the intensity changes rapidly in the image from criteria in which the first is greater than the size of some of the threshold

The intensity of the zero crossing is the second criterion where edge detection is with many capabilities. The process can be determined if it is a binary image where the edges contain 1 and if not then it is 0.

In this work we use the strongest method to detect the edge is Canny because it uses two different thresholds in order to reveal the strong and weak edges if the strong edges are connected to it the weak edge this last does not include in the output the method is strong because it is less affected by the noise than any other method and the other reason is The probability of discovering the true weak edge is certain, The example shows the edge detection process using the above method.

Algorithm.1: Detect Cell Using Edge Detection

In this example, the cell in the image is detected if it is a contrast of the background.

the Steps Edge discovery of a cancerous cell is completed

Step 1: Read Image

The example used is an image of a prostate cancer cell, where the image contains two cells, but it turns out to be one

Step 2: Detect Entire Cell

The object that differs from the background image is segmented when calculating the gradient of the image. Changes can be detected by applying the threshold and gradient calculation in order to create the binary mask containing the divided cell.
To calculate the threshold value, an edge and a factor sobel are used to obtain a binary mask containing the divided cell. The edge is used again
Step 3: Dilate the Image

In the image, the contrast lines showing the double gradient mask are high. Which leads to that the outlines of the object are not important if compared with the original image, a note in the gradient mask are gaps in the lines surrounding the object so that it leads to masking the linear gaps due to a way to expand the image and by using the Strel function that helps in forming two elements of orthogonal linear structure which leads to The double-stretch gradient mask also by vertical and horizontal restructuring elements, respectively, all of this leads to expansion to expand the image.

Step 4: plug Interior Gaps

The outline of the cell will appear well shown by the expanded gradient mask, the imFill function is used to fill holes inside the cell

Step 5: Clean the boundaries of the connected objects

Using a function imclearborder the cell fragmentation task completed successfully, but there are other objects that were found for this reason that will clean up the boundaries of the image

Step 6: Smooth the Object

Using a diamond structural element by eroding the image twice Smoothing the object A diamond structuring element is created using the strel function due to making the segmented object look natural

Step 7: the Segmentation

On the original image the mask is displayed by using the label stickers function. Figure 13 shows the stages of the algorithm to determine the edge of the cell

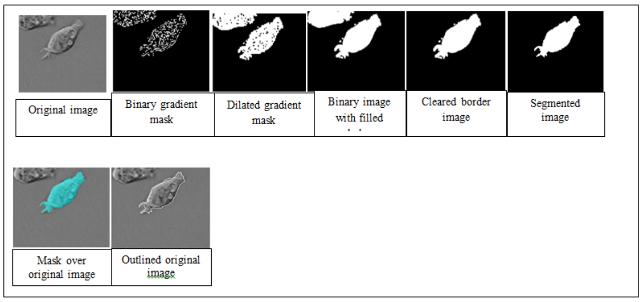


Figure 13 shows the stages of the algorithm to determine the edge of the cell

VI.Conclusion

detection of things measured in the PASCAL VOC dataset has stabilized. Low-level image features and high-level context There are many ways to perform complex grouping systems that combine image features in this work. An algorithm has been proposed to reveal the edge of the image in the proposed way Fully Connected Network (FC) by Convolution Neural Network (CNN) in short time using CNN method to reduce the space occupied by the original information of the image To highlight the role of Artificial Neural Network (ANN) in the field of images to detect the edge using modern techniques in many areas of science, engineering and medicine, where the images of the cancerous cells algorithm that was created in this paper are revealed showing the importance of Artificial Neural Network (ANN) and Fully Connected Network (FC) by Convolution Neural Network (CNN) to detect cancer cells and tumors.

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