International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 02 | Feb 2020 www.irjet.net p-ISSN: 2395-0072

Symmetric Image Registration based on Intensity and Spatial Information-CSAA

J. Menaka Gandhi[1], R. Agalya[2], M. Anandeeswari[3], S. Beryl Selin[4]

[1]*Assistant Professor, Dept. of Information Technology, Meenakshi College of Engineering, Tamil Nadu, India*
[2,3,4]*Student, Dept. of Information Technology, Meenakshi College of Engineering, Tamil Nadu, India*

Abstract - *Image registration is the process of establishing correspondences between images and a reference space, such that the contents of the images have a high degree of affinity in the reference space. There are two main categories of approaches for image registration: feature-based method extracts a set of feature points for which a correspondence is found, whereas intensity based methods use voxel-values directly, and evaluate candidate mappings based on similarity measure (affinity). Intensity-based distance measures which are most commonly used for image registration are Sum of Squared Differences (SSD), Pearson Correlation Coefficient (PCC) and Mutual Information (MI).This can be applied efficiently in Bio-Medical registration task. The existing system used only grey scale images for Bio-Medical registration task with the help of Simple Algebraic Algorithm. We proposed a system that makes use of an algorithm called "Coloured Simple Algebraic Algorithm (CSAA)" to analyze multilevel coloured images. These measures are point based in which the functions are based on the intensities of points belonging to the overlapping regions of the two compared sets. The enhanced values are used to compare the feature extracted images. By using the deep neural network it displayed that the image is symmetric or asymmetric. Thus proposed system provides outstanding performance for intensity based affine registration in terms of robustness, accuracy and symmetry.*

Key Words: **Image registration, affine registration, intensity-based distance measures, candidate mapping, deep neural network, voxel-value, reference space**.

1. INTRODUCTION

Image registration [2] is the process in which different sets of data is transformed into one coordinate system. Data include different photographs, data from different sensors, times, depths, viewpoints. In order to compare and integrate the data obtained from these different measurements we ought to register the images. This technique is used in medical imaging. Image registration algorithms are classified into intensity-based and feature-based. Intensity-based images are referred to as the moving or source and the other are referred to as the target, fixed or sensed images. It involves spatial transformation of moving image in order to align them with the target image. Intensity-based methods compare intensity patterns in images with respect to correlation metrics [3] and register the entire image. Feature-based methods find correspondence between image features to establish a correspondence between the number of distinct points in images. Now a geometrical transformation is determined to map the target image to the reference images to establish point-by-point correspondence between the reference and target images. Geometrical transformations are classified into two categories. The first broad category of transformation models is linear transformation. It includes rotation, scaling, translation and cannot model local geometric differences between images. The second category of transformation is non-linear transformation. It allows elastic transformations and capable of locally warping the target image to align with the reference image.

An important branch of image registration is Medical and Biomedical image registration [4]-[5]. As a result of recent research, non-linear image registration technique is used in the medical industry but the prevailing image registration method is linear registration because deformations allowed by non-linear registration[4] can be difficult to evaluate which affect reliability of diagnosis.

During this study a registration framework is developed based on family of symmetric distance measures [6] combining intensity and spatial information as a single measure to characterize smooth distance surfaces minimum local minima in order to demonstrate the slightly modified versions of the distance measures can be successfully used for affine image registration. To achieve this we use efficient gradient based optimization. The proposed method measures similarities in both synthetic and real scenarios of medical and biomedical registration tasks, which confirmed by (i) evaluation on transmission electron microscopy (TEM) images [7] with the aim of improving multi-image super-resolution reconstruction and (ii) evaluation on the task of atlas-based segmentation of magnetic resonance (MR) images [8]. The tool required for intensity-based registration is intensity interpolation which map points to regions. The empirical test confirms the system is highly symmetric in practice. The proposed measure is fast to compute with comparison with existing system. The proposed registration framework is implemented in ITK [9] and the source code is available.

2. PRELIMINARIES AND PREVIOUS WORK

2.1 Symmetric Image Registration

An intensity based image registration [1] approach is used to find the similarity measures to guide the search for geometric correspondence. In this paper, a framework is proposed which is symmetric, interpolation free and affine registration framework-based on combination of intensity and spatial information.

The performance of the framework is demonstrated by undertaken synthetic tests and recovering known transformation in the presence of noise.

This method provides higher accuracy and greater robustness. This framework exhibits excellent performance in biomedical and medical image registration for both 2D and 3D images. This method is shown to have a low computational cost and making it practical for real time applications.

2.2 Images as JPEG Compression

Low level image processing mainly deals with extracting description from images. Many deep learning methods used for low- level image processing tasks [13] have shown outstanding performance. In this paper, an unified deep learning based approach is used for low- level image processing specifically, it makes use of image de-noising, image de-blurring and compressed image restoration.

This method makes use of deep convolution neural and conditional generative adversarial network. For the different adversarial networks, here present an new network architecture, which includes bi-skip connections to address hard training and losing details issues.

Extensive experiments carried out on three low level image processing tasks on both qualitative and quantitative factors.Hence this method works against all current state of the art approach and provide best results.

2.3 Acuity of Colour Images

Digital image plays an significant role in our day to day life, but an automatic evaluation of the quality of digital colour image is an important aspect. In this paper, a new model called Ycbcr model is used to calculate the ratio of its highest gradient magnitude to the difference in intensity at the boundary in an image. This method is said to be a post-hoc method .which finds the quality of the colour image.

An acuity of the colour image[14] can be calculate based on some factors such as image acquisition, reconstruction etc. And then it provides a result as visually poor image or visually good image.

This method works for normal and out of focus images. No other colour model will give the appropriate result than ycbCr model. Hence this process of measuring the acuity of the colour image is easy to execute and simple. It can be used in various applications.

3. PROPOSED SYSTEM

In our proposed work, there are 3 main modules namely, **Preprocessing**, **Feature Extraction** and **Classification.** Here, the distances and gradients [10] can be computed efficiently for the special case of digital images on rectangular grids. The enhanced values are used to compare the feature extracted images. By using the deep neural network it will exhibit whether they are symmetric or asymmetric images.

3.1. ARCHITECTURE

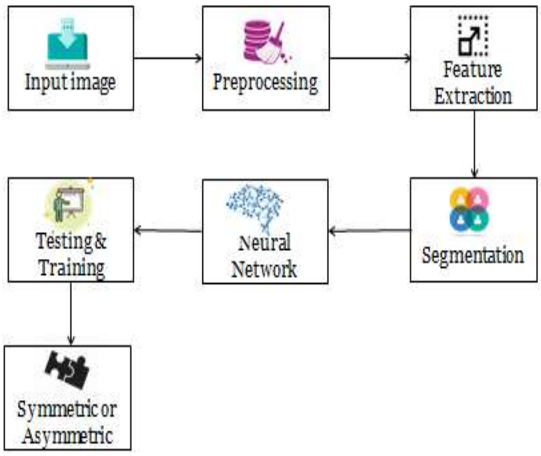

Chart -1: IMAGE CLASSIFICATION

To start with the architecture (Chart-1), we store the input image to a variable and displayed the image. The image may contain outliers including discrepancies in data which are highly susceptible to error. So Data preprocessing is performed which is a data mining technique involving transformation of raw data.

The next step is Feature extraction which makes a remarkable impact on the system performance. Its main task is to find applicable features of the subset in order to increase classification accuracy which is quite challenging. Classification is complex and it is easily affected by huge number of factors. It is the process of assigning different levels of information to pixels.

The next step is Segmentation which splits up the image into pixel set for simple transformation that is easy to retrieve. The deep neural network is a multi-level structure representing features and segmented image in a sequential manner that forms a network and can accommodate huge set of information.

Now the data is tested against some set of trained pre-computed rules and constraints for pattern matching and pixel evaluation. As a result we can conclude whether the input image is symmetric or asymmetric image in correspondence with the test data.

Input: Data vectors $\{x_n\}_{n=1}^{N}$, number of clusters K.
for n ← 1 . . . N do ◅ Initialize all of the responsibilities.
  $r_n \leftarrow [0, 0, ..., 0]$ ◅ Zero out the responsibilities.
  k' ← Random Integer (1, K) ◅ Make one of them randomly one to initialize.
  $r_{nK'} = 1$
end for
repeat
  for k ← 1 . . . K do ◅ Loop over the clusters.
  $N_K \leftarrow \sum_{n=1}^{N} r_{nK} x_n$ ◅ Compute the number assigned to cluster k.
    $\mu_k \leftarrow \frac{1}{N_k}\sum_{n=1}^{N} r_{nK}$ ◅ Compute the mean of the kth cluster.
  end for
  for n ← 1 . . . N do ◅ Loop over the data.
    $r_n \leftarrow [0, 0, \cdots, 0]$ ◅ Zero out the responsibilities.
    $k' \leftarrow argmin_K \|x_n - \mu_K\|^2$ ◅ Find the closest mean.
    $r_{nK'} = 1$
  end for
until none of the r_n change
Return assignments $\{r_n\}_{n=1}^{N}$ for each datum, and cluster means $\{\mu_K\}_{k=1}^{K}$.

Chart -2: Coloured Simple Algebraic Algorithm

3.2.MODULE DESCRIPTION

3.2.1: Preprocessing

The RGB panel [14] is used to view the red, green and blue components of the image separately. The overlap of three two 2-D matrix forms an RGB image Fig - 1(a). So the RGB image is converted into Gray-scale image [11], where the pixel size can be set as 0 to 255. The median filter is used in order to remove the noise from the image [13]. There are three types of filters namely Gaussian filter, weimer filter, and median filter. Here we make use of median filter to filter out the noise from the image. An image can be further enhanced by increasing the brightness by sharping, histogram equalization (Histeq), and adaptive histogram equalization (ADAPT Histeq).

3.2.2: Feature Extraction

In this section we extract the features [1], like shape based features Spatial Binding Ratio, Radial Features all features are extracted. To make the extraction process easier we can increase the intensity to that matching the image with the data set can be mode easier. In first stage, an input image can be resized to build an actual value so that it can fit into a particular frame Fig - 1(e). In the second stage, splitting can be done to find the intensity and then it can be combined using discrete cosine Transform.

3.2.3: Classification

In this module the image data are being stored up in an array, and channel values of the images are being compared and stored in temporary arrays. The enhanced values are used to compare the feature extracted images. By using the neural network it will display matching or not matching. By using the neural network it will display whether an image is matching or not matching then we will conclude that, an image is symmetric or asymmetric[1].

4. IMPLEMENTATION

We implemented the proposed system by making use of CSAA – (**Chart -2)** symmetric image registration process and RGB panel. We use RGB panel as it displays the components of images separately. The input image is chosen and the execution process is carried out. After successful execution the result is displayed in a sequence as original image, resized image, binary image, boundary image, holes filled image, skin binary image and masked image. These images are stored in an array and the enhanced values are used to compare the feature extracted images. Finally we make use of neural network layers to display whether the image is symmetric or asymmetric Fig -2(f).

Fig - 1(a): Illustrative example of an image which makes use of RGB panel to view the red, green and blue components of an image separately.

Fig - 1(b): The image can be resized to build an actual value so that it can fit into a particular frame.

Fig - 1(c): The complement of a binary image, Zeros become ones and ones become zeros; black and white are reversed.

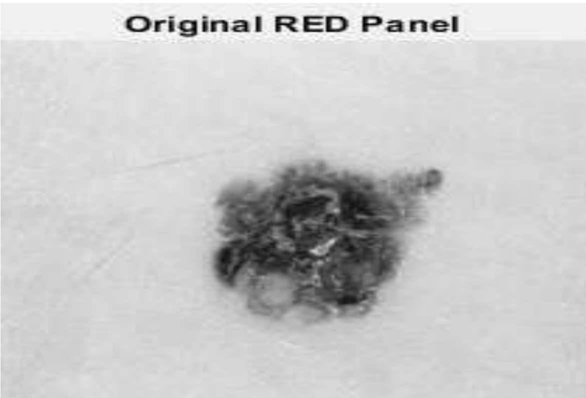

Fig - 1(d): The image is displayed in an original image RED panel which is a part of RGB panel.

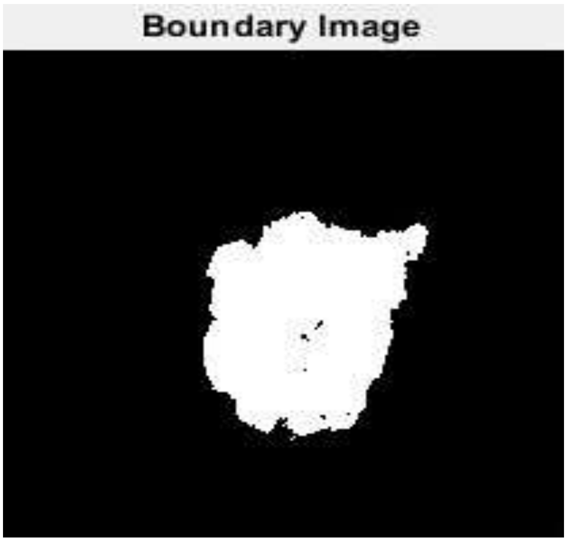

Fig - 1(e): For easy analysis, image segmentation is used to locate objects and boundaries in images.

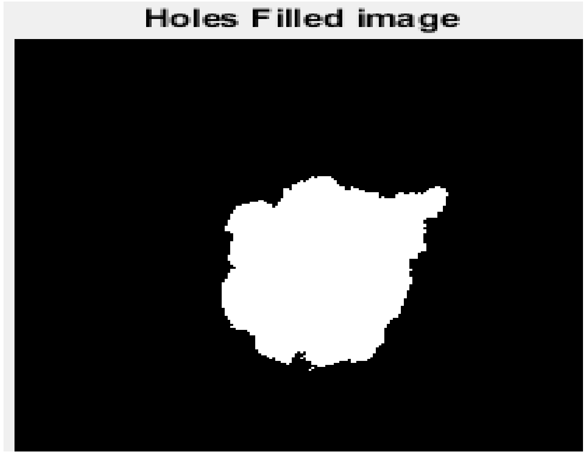

Fig - 1(f): Here the holes we are referring to are white dots on a black background that the whole edge are nicely connected.

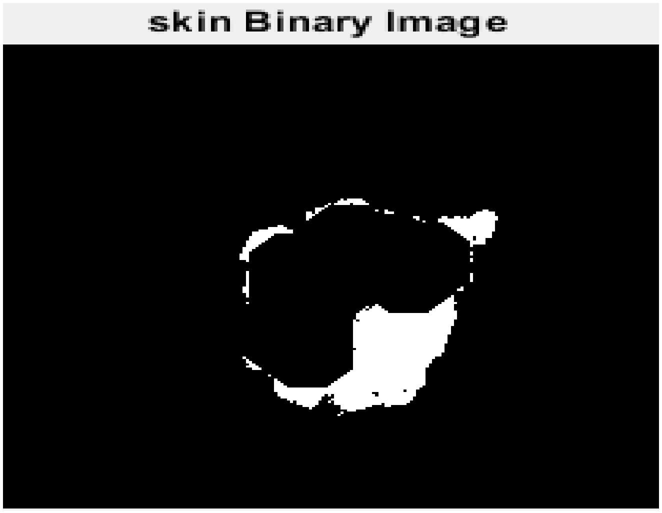

Fig - 1(g): This identifies true skin pixels using the probability threshold which is approximate to 1.

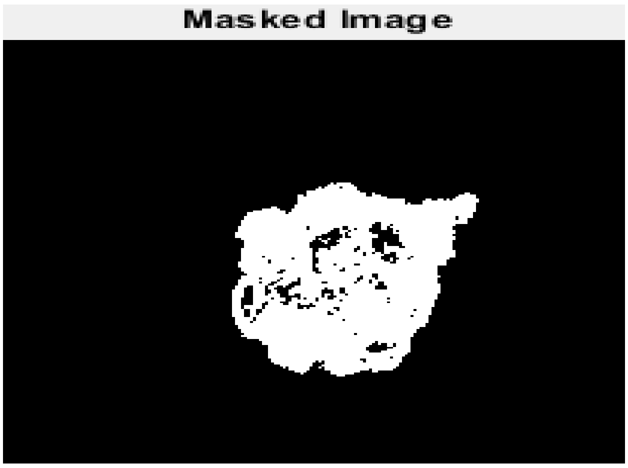

Fig - 1(h): This masking technique is used to remove the background of transulent object.

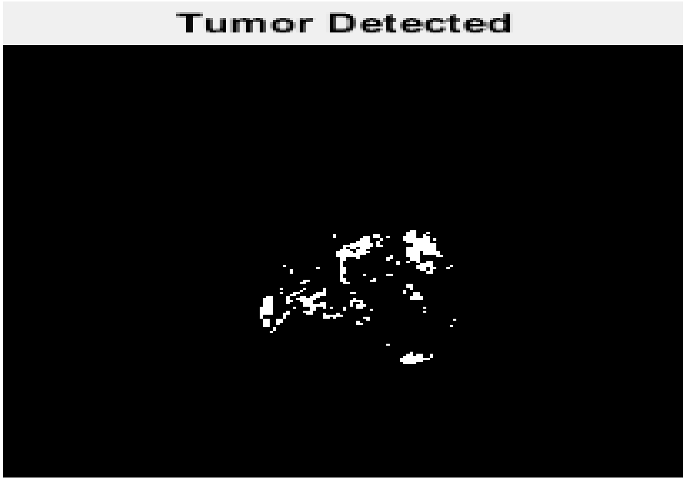

Fig - 1(i): Detection of tumor: For diagnosing various tissue abnormalities we make use of a medical technology called magnetic resonance imaging (MRI).

4.1 PERFORMANCE ANALYSIS:

We evaluate the performance of the proposed system by means of obtaining performance graph, training state and error histogram.

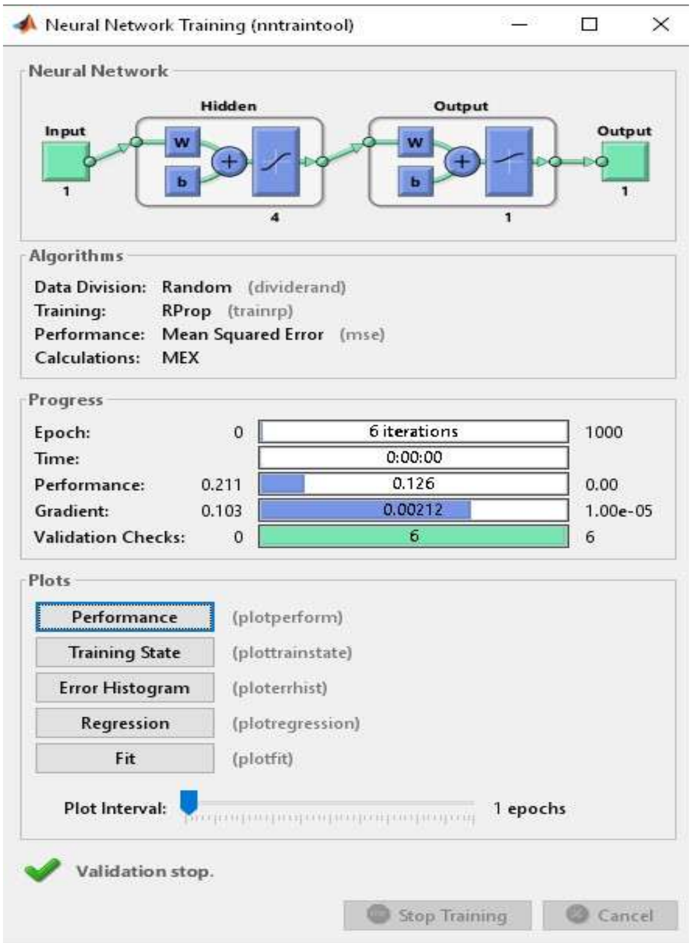

Figure 2(a): Illustration of the pattern recognition neural network

Here patterns are presented to the network via input layer which communicate with one or more hidden layers, then the hidden layers are linked to an output layers.

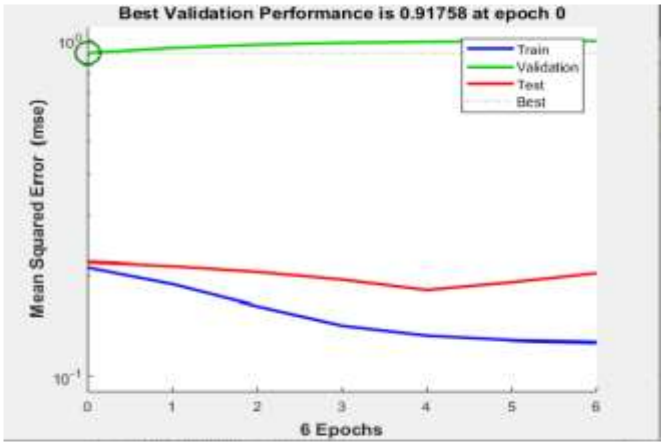

Figure 2(b): Neural network training performance using epochs and mean squared error: Performance of training and validation to test the performance at epoch 0

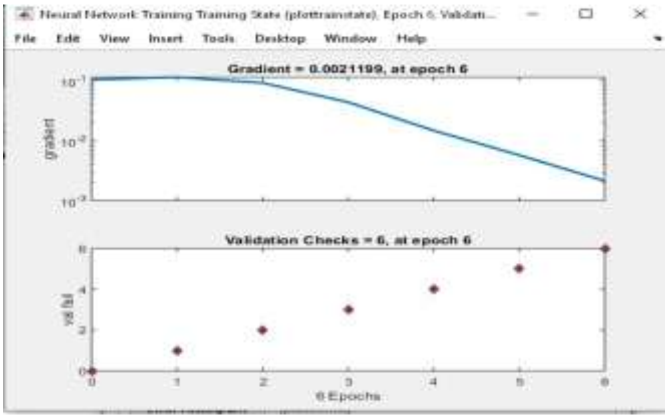

Figure 2(c): Neural Network training state for validating checks and gradient: From this graph gradient and validation checks with respect to epoch can be found.

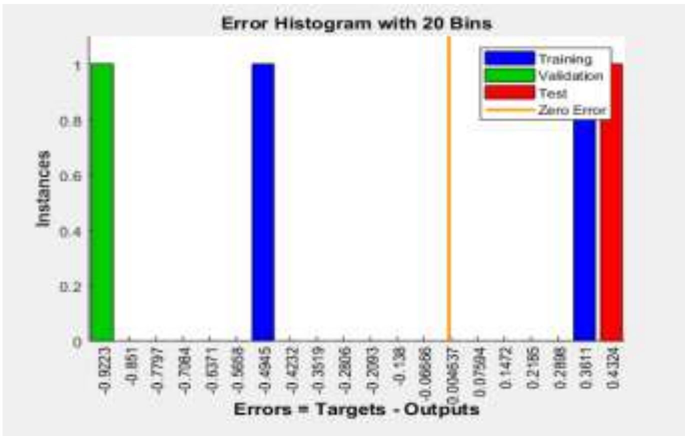

Figure 2(d): An error with 20 bins.Here errors can be subtracting targets from outputs with reference to instance to find out the zero error.

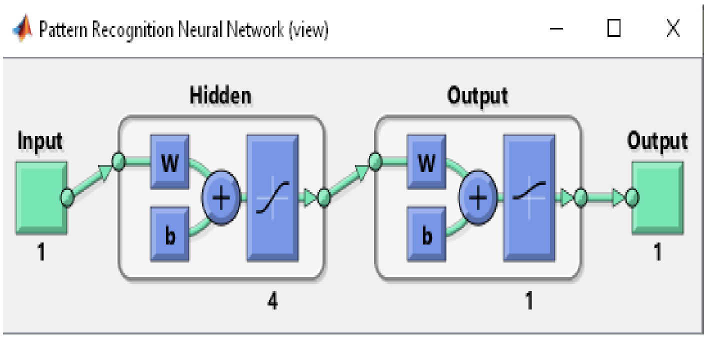

Figure 2(e): Neural network training:

we make use of an train tool to display the neural network training from this we can plot performance ,training state and error histogram.

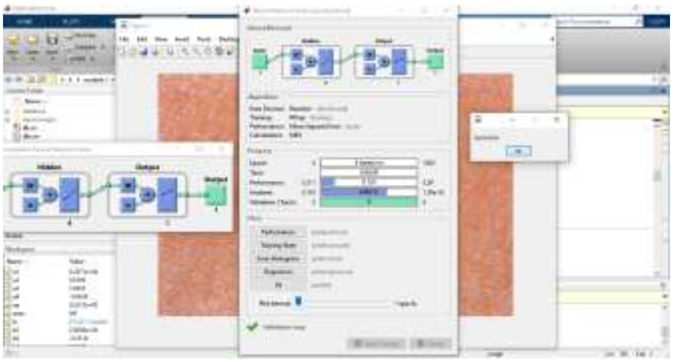

Figure 2(f):A Final outcome which predicts that an image is symmetric

5. CONCLUSION AND FUTURE WORK

In this study we have adapted symmetric image registration using neural network for colour images. We observe that the proposed method provides excellent performance for image registration and it is also robust, accurate, symmetric and efficient which allows it to be practically applicable. Future work includes extending the measures to deformable and multilevel 3-D image registration.

REFERENCES

[1] Johan �fverstedt, JoakimLindblad , Member, IEEE, and NatašaSladoje , Member, IEEE," Fast and robust symmetric image registration based on distance combining intensity and spatial information-", IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 28, NO. 7, JULY 2019.

[2] J. B. A. Maintz and M. A. Viergever, "A survey of medical image registration," Med. Image Anal., vol., no. 1, pp. 1–36, Mar. 1998.

[3] J. V. Hajnal, N. Saeed, E. J. Soar, A. Oatridge, I. R. Young, andG. M. Bydder, "A registration and interpolation procedure for subvoxelmatching of serially acquired MR images," J. Comput. Assist. Tomogr.,vol. 19, no. 2, pp. 289–296, 1995.

[4] M. A. Viergever, J. B. A. Maintz, S. Klein, K. Murphy, M. Staring, and J. P. W. Pluim, "A survey of medical image registration—Under review," Med. Image Anal., vol. 33, pp. 140–144, Oct. 2016.

[5] S. Matl, R. Brosig, M. Baust, N. Navab, and S. Demirci, "Vascular image registration techniques: A living review," Med. Image Anal., vol. 35, pp. 1–17, Jan. 2017.

[6] J. Lindblad and N. Sladoje, "Linear time distances between fuzzy sets with applications to pattern matching and classification," IEEE Trans. Image Process., vol. 23, no. 1, pp. 126–136, Jan. 2014.

[7] A. Suveer, N. Sladoje, J. Lindblad, A. Dragomir, and I.-M.Sintorn, "Enhancement of cilia sub-structures by multiple instance registration and super-resolution reconstruction," in Proc. Scand. Conf. Image Anal. Cham, Switzerland: Springer, 2017, pp. 362–374.

[8] D. W. Shattuck et al., "Construction of a 3D probabilistic atlas of human cortical structures," NeuroImage, vol. 39, no. 3, pp. 1064–1080, Feb. 2008.

[9] B. B. Avants, N. J. Tustison, M. Stauffer, G. Song, B. Wu, and J. C. Gee, "The insight toolkit image registration framework," Frontiers Neuroinformatics, vol. 8, p. 44, Apr. 2014.

[10] S. Ruder. (2016). "An overview of gradient descent optimization algorithms."[Online]. Available: https://arxiv.org/abs/1609.04747

[11] L. A. Zadeh, "Information and control," Fuzzy sets, vol. 8, no. 3,pp. 338–353, 1965.

[12] D. G. Lowe, "Object recognition from local scale-invariant features," in Proc. 7th IEEE Int. Conf. Comput. Vis., vol. 2. Sep. 1999, pp. 1150–1157.

[13] Chunbiao Zhu, Yuanqi Chen, Yiwei Zhang, Ge Li Peking University, Shan LiuTencent America ," ResGAN: A low level image processing network to restore original quality of JPEG compressed image-2019" Data Compression Conference (DCC) IEEE10.1109/DCC.2019.00128.

[14] Santosh S. Saraf, PoojaBhati ,Dept. of Electronics and Communication, Gogte Institute Of Technology, Belgaum, India, "Measure for acuity of colour images",2018 International Conference on Computational Techniques, Electronics and Mechanical Systems (CTEMS) IEEE, 10.1109/CTEMS.2018.8769312.