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Matrix Depiction Based Cyst Detection in Pediatric Aged MRI/ ULTRASONIC and Ultrasonic Images

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Abstract

Human brain is one of the most important organs in human body and it plays a vital role in the functioning of almost all parts of a body. The successful functioning of the human brain always leads to the human beings performing well in almost all types of works being performed by the human being. If the brain problems in children are a big problem not only to the children but also to the parents too. It may affect the actual growth of the children too. The good condition of this part is always a good sign of good health and good attitude of any human being. Colloid cyst are some of the problems that may occur at various locations of the human brain and if the cyst was identified earlier in the human brain, it can be removed through surgery and the life of a human being can be saved. If the cyst had not identified earlier, it may leads to the death of the human being in some special cases. Hence, identification of colloid cyst in human brain is one of the most important task and consideration for the doctors and lab technicians to identify it in the early stages of its growth. Hence, in the current article an attempt has been made to identify the cyst in pediatric aged children brain in the early stages also. In the current model, a new technique known as the identification was done from a monochrome image with matrix depiction method. The cyst was identified by using non-dependent threshold method from the matrix depicted method. The identification process was carried out by an algorithm and the proposed method was verified with various set of input images and the outputs are analyzed. The results are displayed in the results and discussions section in detail.

Keywords: *Pediatric, Fixed threshold method, Neuroepithelial cyst, Magnetic resonance images (MRI/ULTRASONIC), Matrix depiction, Ultrasonic images, Monochrome images, Cyst*

1. Introduction

Image processing technique is widely used in all fields [1][2][3]. The term image processing is used to perform some operations on the image. The operations performed on the image are enhancing the quality of image, extracting the information from the image and more [5][6]. To perform all these operations first we need to acquire the image [7][8]. Therefore, the Basic steps involved in image processing are:

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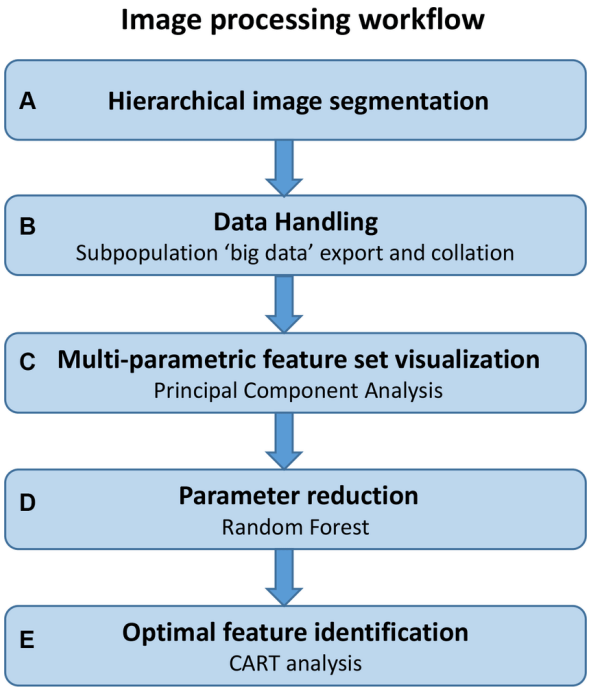

Figure 1. Stages involved in processing of an image

Image Acquisition: This is acquired from soft copies produced from MRI/ULTRASONIC/Ultrasonic scan that are stored in computer [9][10][11].

Filtering: Filtering is often used in image processing to remove noise, and to improve the quality of an image [12][13][14].

Feature Extraction: Feature extraction is used to extract image features for identifying meaningful objects from images.

Segmentation: Segmentation is a process where the image is segmented into its constituent parts or objects.

2. Types of Image Processing

Image processing is of two types. They are:

Analog Image Processing: In analog image processing the images are manipulated by electric signals. The time of processing signals is slow and it is costlier. The signals are processed on only 2-dimensional images [15][16].

Digital Image Processing: The raw data which we get from satellite contains deficiency. To overcome such defects and to improve the originality of the image the digital image processing techniques are used. Every image undergo into three phases of digital image processing are pre-processing which is used to remove noise from the image; enhancement is used to improve the quality of the image. Feature Extraction is used to extract useful information from the image [17][18].

The image processing is widely used in many fields to improve the quality of an image, and to extract useful information from the image [19][20]. Some of the applications where image processing used are:

- Medical Field

- Remote Sensing
- Color Processing
- Video Processing
- Robot Vision
- Image Sharpening

Brain is the foremost organ of the central nervous system that coordinates and controls the activities of other organs in our body [21]. Cysts in the brain are the group of cells, clustered collectively to form a sac that contains fluid or semi-solid material, such as cerebrospinal fluid, blood, tissue or tumor cells [1]. Cysts are generally benign, but are destructive when it is found in parts of the brain where it restricts the crucial performance of the brain.

In this paper, the focus is on the automatic detection of Colloid Cyst in Brain of pediatrics aged or the children brain from MRI/ULTRASONIC and Ultrasonic scanned images. Colloid cysts are known to be formed during the embryonic formation of the Central Nervous System. It contains a thick, gelatinous substance called colloid which came from the Greek word Kollodes (Kolla meaning glue and eidos meaning appearance). Apart from the colloid filling, the cyst may contain blood, minerals or cholesterol crystals [3]. Colloid Cysts are found in the center of the brain that holds spinal fluid, or, in the lining of the third ventricle. Cysts in this location block the foramina of Monro causing obstructive hydrocephalus that increases pressure in the brain. Familiar symptoms are severe headache, nausea, vomiting, seizures, vertigo, memory loss, insomnia, gait disorder, drop attack, and many more. The mortality rate due to Colloid cyst has been between 58% and 77% [5]. Its size may vary from 3 to 40 mm. Since, even small Colloid cyst can cause sudden death, it is vital to identify or detect the cyst at an early stage.

2. Literature review

In the past, various algorithms have been developed to automate the system of detecting Cysts and Tumors in the Brain by using Image Processing techniques like Threshold Segmentation, Edge Detection, Clustering based segmentation, Watershed Segmentation and many more.

Karishma Sheikh, VidyaSutar and SilkeshaThigale in their paper proposed a system that used a pixel to pixel comparison, the gray scale and K-means segmentation algorithm to detect tumor from MRI/ULTRASONIC images [4]. They used clustering to differentiate between affected and unaffected cells.

Lal A, Tejero H and Charif S discussed about the Colloid cysts are rare benign tumors that can cause acute obstructive hydrocephalus and sudden death. The literature indicates that many of these tumors are likely to be asymptomatic and that some may spontaneously regress in adults. However, the majority of colloid cysts in young patients are more clinically and radiologically covert. Conservative management is recommended in asymptomatic adults. While early diagnosis followed by surgical resection is recommended for the pediatric age group. Given that there have been few reported cases of spontaneous regression of colloid cysts in pediatric patients not requiring surgical intervention, management guidelines for pediatric patients are unclear. We present a case of a pediatric patient with a colloid cyst that underwent spontaneous decrease in cyst size along with changes in signal characteristics prior to surgery.

G. Lavanya et. al., had discussed about the identification of colloid cyst in human brain using the monochrome method [16].

Vrushali D. Dharmale and P.A. Tijare used Canny Edge detection and segmentation method for Cyst detection from MRI/ULTRASONIC brain images and mentioned the accuracy rate to be 100% [6].

Mashal Tariq, Attaullah Khawajah and Munawer-Hussain presented a system that focused on the early detection of the tumor [8]. In this paper Noise Reduction was done by the use of Median Filter, information about the object boundaries in an image was obtained through Sobel Edge Detector. The algorithm proposed that several morphological operations along with morphological reconstruction could accurately segment out Solid cum Cystic Tumor from T1 and T2 images.

On a different note Alexander C. Mamourian, Laurence D. Cromwell and Robert E. Harbaugh presented different cases and tried to prove that Colloid Cyst are sometimes more perceptible or noticeable on Computed Tomography Images than Magnetic Resonance Images. They stated cases where Colloid Cyst were found without any association with hydrocephalus and 55 cases where the cause of sudden death was due to Colloid Cyst in Brain ranging from 1 to 8cm. They concluded that "Ventricular size is not a reliable predictor of the outcome" [9].

Debapriya Hazra et al. [11] had considered the MRI/ULTRASONIC/Ct scan images and by using the MATLAB programming and image processing models, they tried to identify the presence of colloid cyst in brain images.

From the several works mentioned above, it is observed that no authors had implemented the matrix depiction method with the combination of monochrome images for identifying the cyst presence in the pediatric aged children brain with MRI/ULTRASONIC and Ultrasonic scan images. Also, the threshold value for identifying the cyst in the images also almost all the authors made fixed. Hence, we tried to consider this observation and a new matrix depiction method with monochrome image was used with varied threshold value of the images to identify the presence of cyst in the pediatric aged children's brain by using MRI/ULTRASONIC and Ultrasonic scan images.

3. Proposed work

In the current work, in order to identify the cyst in the pediatric brain with the help of MRI/ULTRASONIC/Ultrasonic scan images, an algorithm with that detects the colloid cyst of child brain images was considered and the algorithm can be observed as follows,

Step 1: Start.
Step 2: Read input image.
Step 3: Conversion of input image to Grayscale image.
Step 4: Resizing the input image to matrix orientation.
Step 5: Conversion of Grayscale image to Monochrome image.
Step 6: The threshold values are kept independent.
Step 7: Based on the threshold values, the monochrome images are converted to Matrix Model.
Step 8: The location of cyst is represented with 1's and non location of cyst are represented with 0's.
Step 9: To identify the colloid cyst in matrix model images from monochrome images.

4. Architecture

The architecture model of the current entire process of identification of the cyst in brain images was represented as follows,

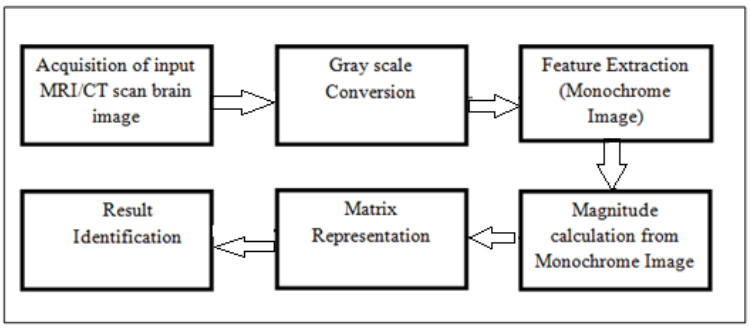

Figure 2. Architecture for detection of the colloid cyst

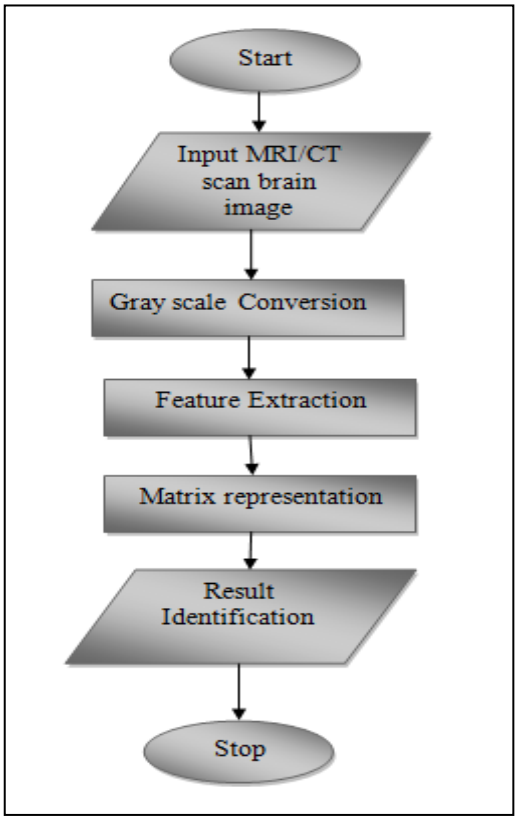

Figure 3. Execution Flow of the Considered Model

The components present in the architecture model of the entire process are, Acquisition of input images, preprocessing of the images, segmentation of the converted images, matrix representation of monochrome images, identification of the final cyst in the input images. At first, the input images were acquired.

The preprocessing of the image received was done and the input image was converted to the grayscale image. After that the same image was converted to the monochrome image. The segmentation was then applied to the monochrome image by using the threshold method. Here, the threshold value was changing based on the images from time to time. The values are adjusted due to the brightness of the images and clarity of the images. This process is done such that the pixel clarity on the images should be good. After that, the magnitude of each pixel was calculated and stored the values in the array model. Then the entire pixel values were analyzed and the results were displayed in the form of a matrix model by using arrays. From the matrix model, the cyst can be displayed on the matrix model in the form of number of 1's as the cyst observed in the original image. Similarly, the absence of cyst can be represented by 0's in the matrix model as in the original image.

5. Result analysis

In the current section of results, different scan images are considered and verified for the processing of the considered model and the results obtained are presented in the same places. Some of them are as follows,

Case 1: Testing the MRI/ULTRASONIC/Ultrasonic Pediatric aged brain image for identifying the cyst in normal 6 Weeks aged baby.

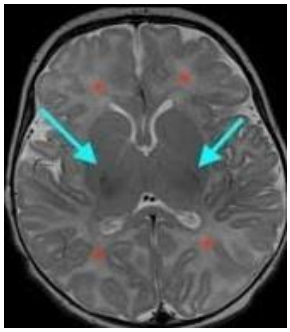

Figure 4. Input MRI/ULTRASONIC brain image

The input image is considered for checking the current model was represented in [Figure 4].

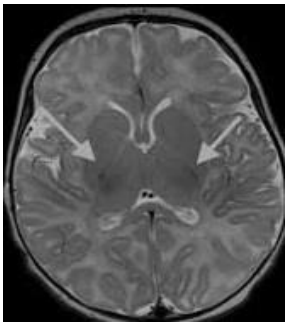

Figure 5. Grayscale Image

The converted grayscale image from the actual input image was observed in [Figure 5].

Figure 6. Monochrome Image

The above grayscale image was given as input to the model for converting the grayscale image to monochrome image. The converted monochrome image was observed in [Figure 6].

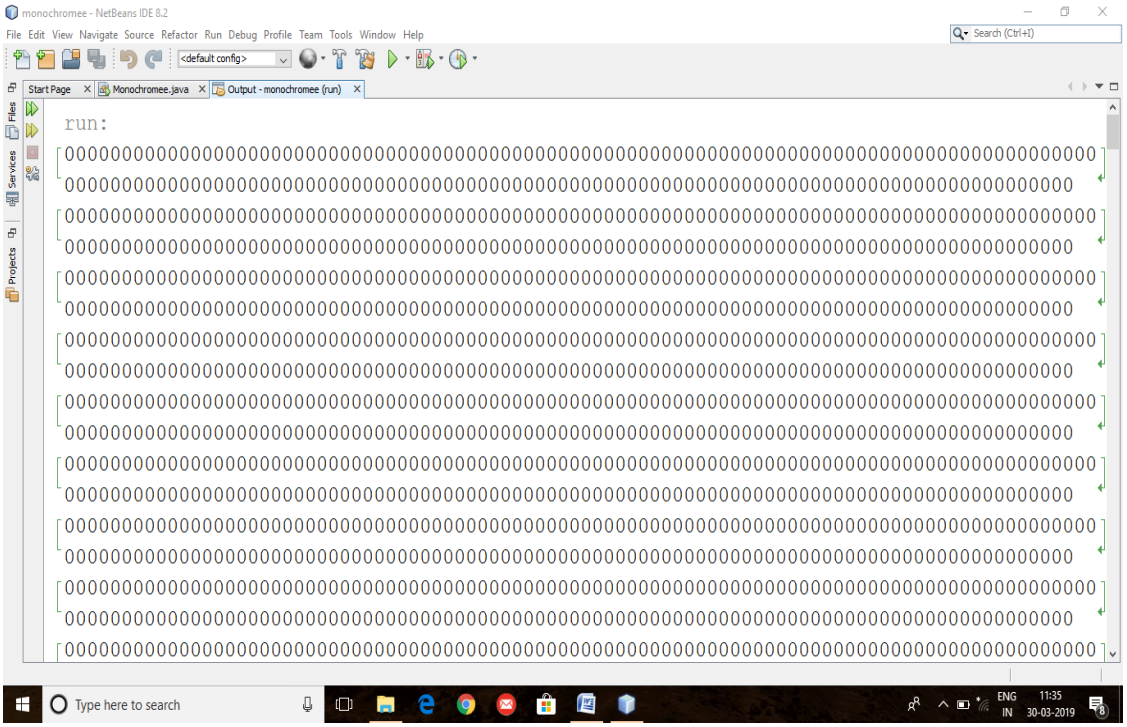

Figure 7. Matrix Depiction

From the above output image, the result we thereby declared the cyst was not present and it is shown in matrix format.

Case 2: Testing the MRI/ULTRASONIC/Ultrasonic Pediatric aged brain image for identifying the cyst in normal 6 Weeks aged baby.

The performance of the method considered can be observed as follows,

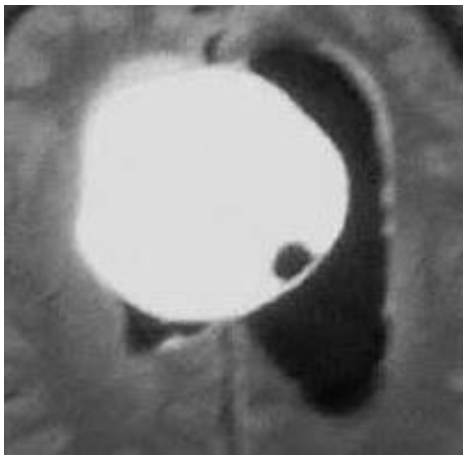

Figure 8. Input MRI/ULTRASONIC/Ultrasonic image

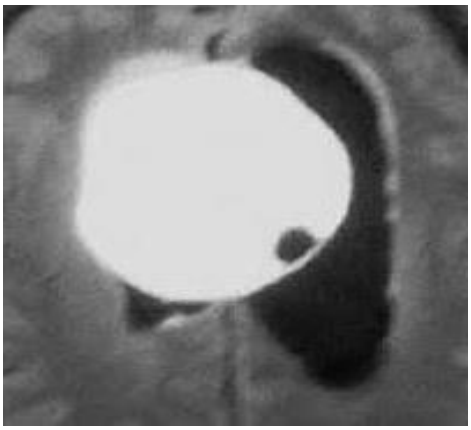

Figure 9. Grayscale Image

The converted grayscale image from the input image can be observed in [Figure 9].

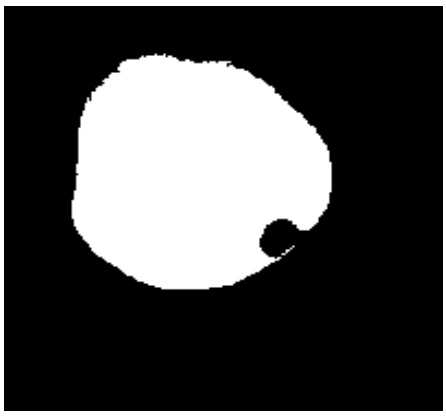

Figure 10. Monochrome Image

The grayscale image was converted further to the monochrome image and the converted image was displayed in [Figure 10].

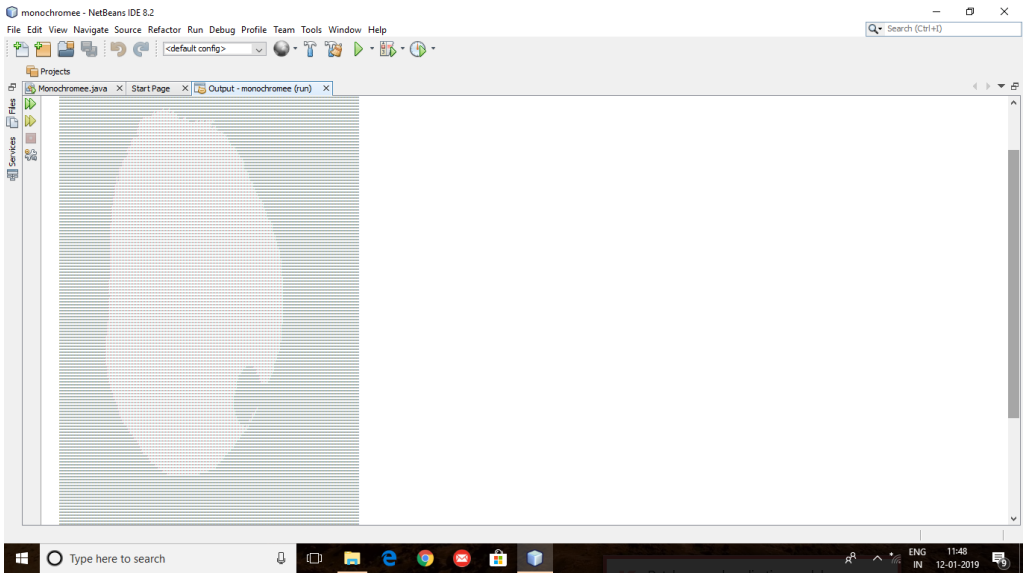

Figure 11. Matrix Depiction

Case 3: Testing the MRI/ULTRASONIC Pediatric aged brain image for identifying the cyst in normal 6 Weeks aged baby.

The performance of the method considered can be observed as follows,

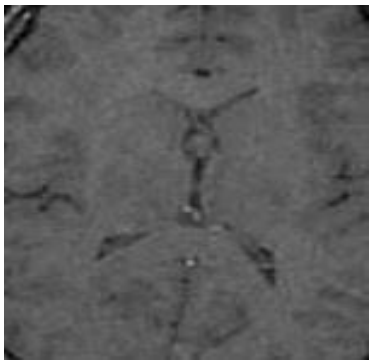

Figure 12. Input MRI/ULTRASONIC image

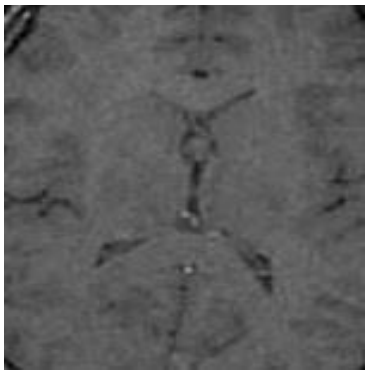

Figure 13. Grayscale Image

The converted grayscale image from the input image can be observed in [Figure 13].

Figure 14. Monochrome Image

The grayscale image was converted further to the monochrome image and the converted image was displayed in [Figure 14].

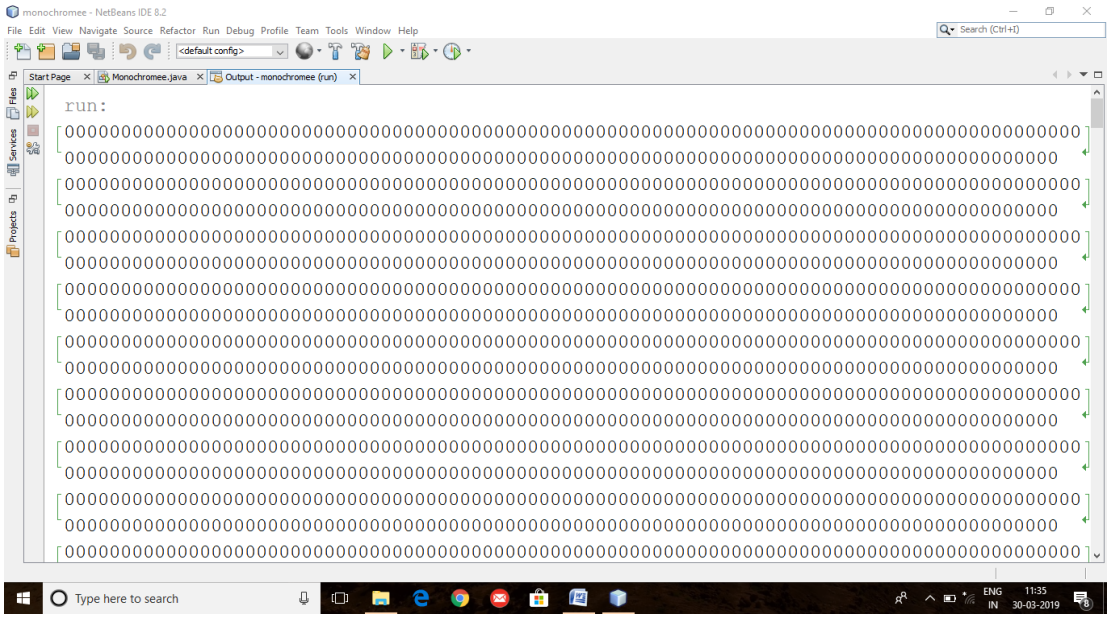

Figure 15. Matrix depiction

After completing the conversion of the grayscale image to the monochrome image, the threshold process, segmentation and other methods were implemented on the converted image and the final matrix representation of the data in the form of the matrix model with the help of the array model was displayed. In the above image, all zeroes are represented in the image which gives us the confirmation that no cyst was present in the input images which was given as input to the current model.

6. Conclusion

The proposed methodology detects presence or absence of colloid cyst easily by using image processing techniques through java programming. The methods used here are grayscale conversion, then conversion from grayscale to monochrome and then representing the converted images in to the matrix model by using the array concept well excellent. The results observed from the current considered model are excellent. The colloid cyst in the pediatric aged brain is detected by matrix depiction and the results are discussed in the results section.

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