International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075, Volume-8 Issue-12, October, 2019

# Enhanced Protocols for CT Slice Thickness on Clinical Target Volume for 3d Radiation Therapy

**BudidaAnjaneyulu, A. BhavaniSankar**

***Abstract—Radiation Therapy is used to treat the cancer diseases by ionization of radiations. From the beginning the aim of radiation therapy is to cure the cancer without any side effects. Tumour location and type, geometric accuracy and involvement in anatomic area affect the output of radiation therapy in which the amount of radiation dose is given. The tumour is controlled by production of high dosage of radiation. The amount of dosage is limited by possibility of damage of normal tissue. To control the amount of dose, for three dimensional radiation therapy computed tomography (CT) slice thickness is proposed in this paper. This paper defines the changes of CTV (clinical target volume) using various computed tomography slice thickness on three dimensional radiation therapy. For all computed tomography datasets, planning of three dimensional treatments is achieved.***

***KEY WORDS: Radiation Therapy, computed tomography (CT) slice CTV (clinical target volume)***

## I. INTRODUCTION

Radiation therapy is also known as radio therapy which is used for treatment of cancer. To minimize the size of tumour and to kill the cancer cells, high dose of radiation used in radiation therapy. To observe inside body x-rays are used in which the radiation is done at low dose. Radiation therapy kills the cells of cancer by using high doses and by damaging cancer cells DNA their growth will be slow down [1]. Cancer cells are burst and separated from the body by damaging of cancer cells. Cancer cells are not killed by radiation therapy immediately. The treatment goes on few days or weeks before the damaging of DNA for pass on cancer cells. After end of radiation therapy, cancer cells takes weeks or months to die.

Today various types of radiation therapy are used to treat the cancer. Based on the radiation waves or particles, classification of radiation therapy is done to provide the treatment. Different radiation therapy techniques are protons, electrons and photons. Among these electrons and photons are widely used in the United States and other countries. Also proton therapy facilities are in beginning stage. Usually radiation therapy contains three most important subtypes, these maintains same biological effects on tumour tissue [2]. That means to eliminate the tumours these three subtypes contains same potential. Though each type maintains different advantages and disadvantages.

The radiation applied to propagation and emission of energy over the space or medium of material. Generally particulate radiation and electromagnetic radiation are types of radiation.

Oscillating electrical and magnetic fields is used for characterization of electromagnetic radiation in which both fields contains dual characters. In the radiation therapy electromagnetic radiation has two forms they are gamma rays and x-rays. Tungsten-Molybdenum is the high atomic number material. In the anode of x-ray tube, high speed electrons run into high atomic number material to produce x-rays where as intra nuclear disintegration provides gamma rays. Travelling corpuscles propagates the energy is known as particulate radiation and it has definite rest mass and momentum and position [3].

Even though in many researches, in radiation therapy therapeutic modality represented in the photon-beam because particulate radiation is used with different uncertain technical problems. Between the matter and photon interactions are occurred if $\gamma$-ray or x-ray passes over the medium and energy is feeded to medium. Absorption, transmission, scattering and attenuation are done by the photon beam. Pair production, Photo electric effect and Compton Effect are the main types of radiation to interact with matter and those types are important in radiation therapy. Now a day's radiation therapy of mega voltage, Compton Effect is mostly used. In diagnostic radiology photo electric has the importance and now days radiation therapy has historical importance of photoelectric effect. The energy is provided by the interaction of protons with free electrons in Compton Effect. The photon is spread by angle, electron handles the energy and photon lost the energy which is interconnected [4]. The change of wavelength not depends on irradiated material and energy of radiation. The change of wavelength depends on angle in which the radiation is spreads.

Although EMET therapy contains the capabilities of energy modulated electron which is used to obtain high dose distribution in superficial targets and due to the problems of inherent in electron beam radio therapy, EMET is not implemented. Before works new technique was proposed by using automated few leaf electron collimators (FLEC) to provide EMET. This technique contains four motor driven leaves which are fixed in clinical electron beam applicator. This technique combined with optimization algorithm based on Monte Carlo, kernels of patient specific dose used in this

**Revised Manuscript Received on August 05, 2019.**

**BudidaAnjaneyulu**, Research Scholar, Dept. of E.C.E, Sri SatyaSai University of Technology & Medical Sciences, Sehore, Bhopal-Indore Road, Madhya Pradesh, India

**Dr. A. BhavaniSankar,** Associate professor, Dept. of E.C.E, Sri SatyaSai University of Technology & Medical Sciences, Sehore, Bhopal-Indore Road, Madhya Pradesh, India.

algorithm and operation of linear accelerator combined with treatment delivery. Clinical accelerator added with accessory tool which is provided by FLEC. The construction and design of FLEC is provided and presented goals are matched.

In-house developed EMET controller controlled the FLEC prototype. Here described the EMET controller software structure and characteristics of hardware. For different sizes and various fields, Monte Carlo calculations are authorized by getting measurements of output by the use of parallel plate ionization chamber. By using energy independent radio chromic films, 1-D and 2-D dose distributions are compared, for this purpose performs the further verifications.

For the correct dose reports and planning of 3D treatment, volume definition is required. Several targets and volumes of critical structure are described by 50 and 62 of ICRU reports those are provided in the process of treatment planning and basis is provided for the treatment outcomes comparison. To avoid tumour remission in planning of radio therapy treatment tumour volume is estimated correctly. In complete eradication of disease tumour volume estimation is important task. The indirect measure of clonogen number is the tumour volume and it has direct impact on local disease control by using radiotherapy. Tumour bulk is measured by correct volume definition and analysis of treatment response are also provided.

In the treatment planning, different imaging techniques are available such as CT (magnetic resonance imaging) and CT in which CT is used to decrease variation of inter observer and Ct is used to process of dose calculation. Each phase of treatment is impacted by interslice spacing and slice thickness between CT sections. Definition of structures is affected by it and reconstructed image quality represented in arbitrary planes, coronal and sagittal. For the dose display and localization, DRR (digitally reconstructed radiographs) is utilized. In ICTT (intensity modulated radiation therapy) definition of volume has a crucial role, it is more sensitive to uncertainties of geometric because organs at risk and sharper dose gradients at the target volume. Different authors describe the target definition importance. For the localization the treatment volume superior and inferior boarders are defined by PTPCWG (photon Treatment Planning Collaborative work group) in 1991.

To get cooperation between throughput and resolution, for the head take the close space between sections, maintain the CT slices with the thickness of 3 to 5 mm and for the body CT slice thickness as 5 to 10 mm should be required. In the radiation therapy additional studies are necessary for CT slice thickness optimization and it is recommended by PTPCWG. The aim of this technique is to determine target volume variation with various thicknesses of CT slices. In the planning of 3D radiation therapy the impact of variation is studied in this paper. For the 3DRTrequired CT slice thickness determination and centre of mass of tumour changes with various CT slice thickness are focused in this paper.

## II. TWO DIMENSIONAL PHOTON BEAM DISTRIBUTION USING FIBRE OPTIC RADIATION SENSOR

To treat the tumour, the position of radiation beam is determined by X-ray films if conventional radiation therapy or 2D is utilized. Generally for the radiation treatment planning machine is used that is called fluoroscopic simulator. To find the position of tumour bones on x-ray is used as landmarks and for the treatment of tumour the radiation beams position in the patient is also identified. There should be leave normal organs. Planning should be done quickly and the treatment can be started fastly by patients and other techniques has more time consuming and high in-depth in the planning. For urgent treatment this type of techniques are used.

In radiation therapy, to measure high energy photon beam fiber optic sensor is used with organic scintillator. For small field radiation therapy to determine real time dose distributions and high resolution, 2-D fiber- optic sensor was utilised. Organic sensor probe provides scintillating lights which are combined and arranged into water phantom. These are guided by 10m plastic optical fibers. For the photon beam with different field sizes and various energies, measure the distribution of 2-D (2-dimentional) photon beam in water phantom.

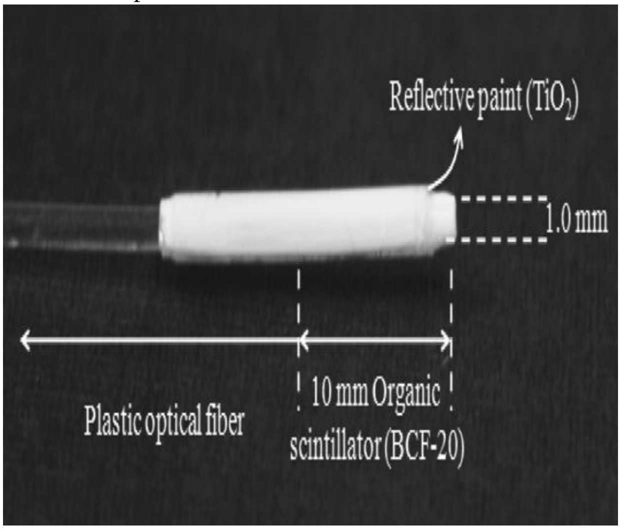


**Fig. 1: OPTICAL FIBRE RADIATION SENSOR**.

The designing of Fiber optic radiation sensor is displayed in above figure and it is designed by using POF and organic scintillator probe. This sensor contains 2-D organic scintillator probes in water phantom and irradiation fields are 6 and 15 MV photon beams. In this study the organic scintillator is used which is available designed with PVT (polyvinyltouene) base with wavelength shifting. The emission colour of this organic scintillator i green and peak wavelength is specified as 492 nm. In this scintillator, number of emitted photos per1MeV of energy are dropped which are 8000. This scintillator is in the form of cylinder and its measurements are diameter is 1mm and length is 10mm. polished the surfaces of ends of cylinder with different optical grade polishing pods and powders. By using optical cement the organic scintillator is sticked into POF. By using powders and polishing pods the surfaces of POF's are polished. The titanium dioxide is used to make the reflective paint which is used in sensor probe outside to improve the efficiency of scintillating light collection and to capture the light noise from outside. Another name for this scintillator is typical organic scintillator, these are depends on PVT.

## III. CT SLICE THICKNESS ON CLINICAL TARGET VOLUME FOR 3D RADIATION THERAPY

For the definition of target volume, brain tumours are selected, due to obtaining of various CT slice thicknesses there is no impact on organ motion. There are two steps in three dimensional radiation therapy treatments: one is phantom study and another one is clinical study. For planning of 3D treatment, the determination of minimum CT slice thickness is used by the study of phantom study. After completion of determination of minimum slice thickness, clinical study is carried out by the comparison of calculated tumour volume with minimum and larger slice thickness. In the planning of 3D treatment, the impact on CT slice thickness was also proposed, for the slice thickness iso-center values are shifted with tumour values.

For the treatment of tumours three dimensional radiation therapy is mostly used. It is used when the tumour closed to important organs such as neck, lung, and carcinomas of prostrate, bladder, spine, head and pancreas. Most of 3-DRT cases begin with 'virtual simulation' session that lasts in between 30 and 90 minutes. In the treatment position, CT scans are taken from patients and that images are send to the treatment planning computer. The Ct slices are marked to the required volume for the treatment by clinician. The volume of 3D image produced by computer and highlighted the critical structures at the risk. Due to this best beam arrangements are defined and minimum dose distribution is calculated by computer. To provide image digitally beam's-eye view could be generated to see the simulation film which is utilised in verification of treatment. Beam shaping covers the critical structures and these are obtained with use of lead box or use of multi-leaf collimators. Multi leaf collimators are computer controlled movable leaves within treatment machine which is used to block the part of radiation field. A conformity index, defined in Equation 1, was used to measure the target dose conformity.

$$CI = \frac{TV_{RI}}{TV} \cdot \frac{TV_{RI}}{V_{RI}} \quad (1)$$

where, TVRI was the target volume covered by the reference isodose (95%), VRI was the volume covered by the reference iso dose (95%), and TV was the target volume. The target dose homogeneity was measured with a homogeneity index (HI) defined in Equation 2.

$$HI = \frac{D_{5\%} - D_{95\%}}{D_{mean}} \quad (2)$$

where, D5%, D95% indicated that at least 5%, 95% of the target volume received this dose, and Dmean was the mean dose to target. The HI value was between 0 and 1, with 0 representing the ideal homogeneity, whereas the CI value was between 0 and 1, with one representing the ideal conformity. In OAR, the minimum and maximum dose of spinal cord, V30 and V40 of heart, and V20 and V30 of lung were analyzed and compared.

First scanning was done in sequential mode for all patients and before CT scanning for every patient non-ionic contrast was organized. The results of phantom study are, for the planning minimum slice thickness is 2.5 mm, accuracy is 3%. For all patients three scans are performed with different slice thickness such as 2.5, 5 and 10mm in sequential mode. By using DICOM network CT data sheets are send to the Eclipse treatment planning system. In the 3D treatment planning system based on 3D CT datasets (2.5, 5 and 10 mm), external body contour and volume of tumour are defined.

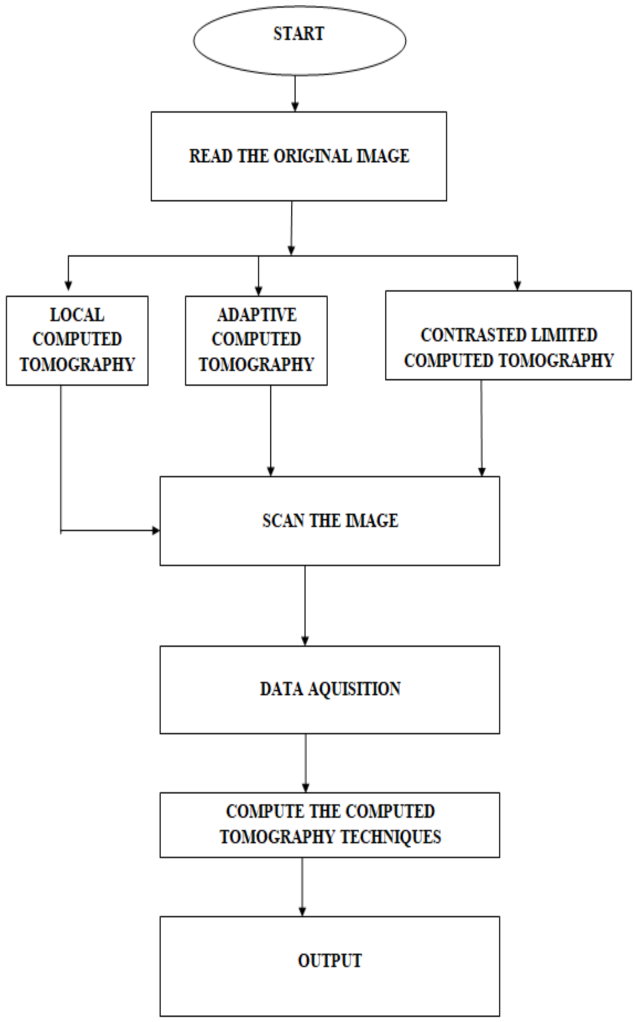


**Fig. 2: PROPOSED SYSTEM**

Clustering pixels into prominent picture region is the goal of image acquisition. In order to provide data such as anatomical structure and identify the region of interest, i.e. locating the tumor, lesion and other abnormalities, the acquisition of gray level data is used. The suggestion method depends on the anatomical structure data of the healthy components and compares it with the infected components. This starts by assigning a reference picture of a standard candidate brain scan picture to the anatomical structure of the healthy components.

The aim of radiation therapy (RT) is to cure the cancer disease without any side effects. In the planning of radiation therapy treatment, imaging has an important position; there is an impact on volume of tumour definition and outcomes of final treatment. Three dimensional radiation therapy computed tomography (CT) slice thickness is proposed in this paper. It is observed that the accuracy of definition of tumour volume depends on Ct slice thickness. From the study of proposed system it is concluded that for three dimensional treatment planning of brain tumours, the thickness of CT slice should be the 2.5 mm for tumour volume<25cc and for volume of tumour>25 the slice thickness is 5mm. Proper planning is achieved for three dimensional radiotherapy treatment for tumour.

CT scan enhanced to detecting the suspicious region by the using of the Pre-processing techniques. The first step of pre-processing is tracking features involves those activities that are usually crucial prior to major information review and detail extraction, and are frequently grouped as radiometric or geometric improvements. for example, film artifacts or labels, names, age and marks of the patient. Through the tracking algorithm, film artifacts are eliminated. At this point, the intensity value of the pixels starting from the primary row and the initial column is analyzed and the threshold value of the film artifacts is found. The threshold value should be noted to exceed the threshold values removing from CT. CT eliminates the film artifacts ' high intensity value. At some point in eliminating film artifacts, the image includes salt and pepper noise.

## IV. RESULTS

**Fig 3: INPUT IMAGE-1**

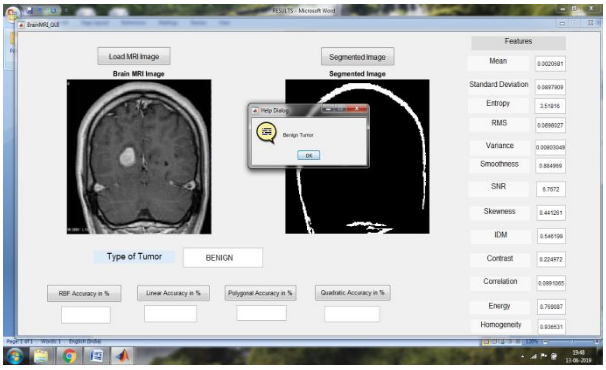

**Fig. 4: BENIGN TUMOR IMAGE-1**

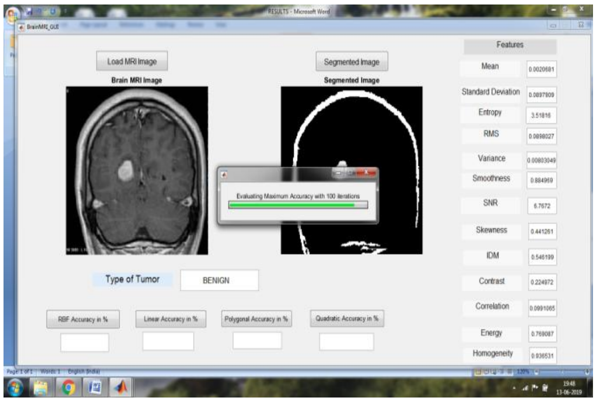

**Fig. 5: EVALUATION OF MAXIMUM ACCURACY WITH 100 ITERATIONS OF FIG 2**

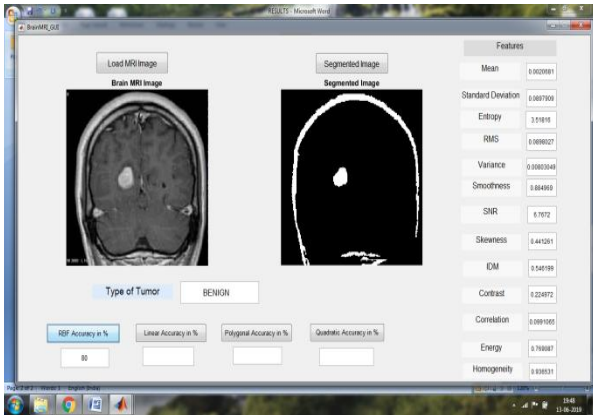

**Fig. 6: RBF ACCURACY IN PERCENTAGE OF FIG 2**

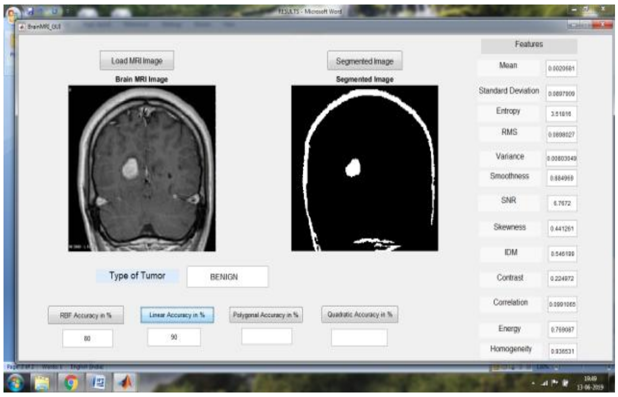

**Fig. 7: LINEAR ACCURACY IN PERCENTAGE OF FIG 2**

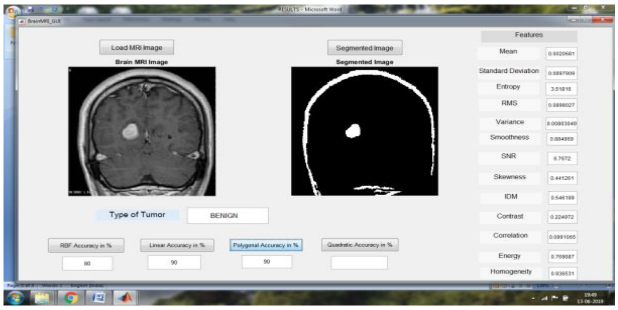

**Fig. 8: POLYGON ACCURACY IN PERCENTAGE-1**

*Retrieval Number L39281081219/2019©BEIESP*
*DOI: 10.35940/ijitee.L3928.1081219*



*Published By:*
*Blue Eyes Intelligence Engineering*
*& Sciences Publication*

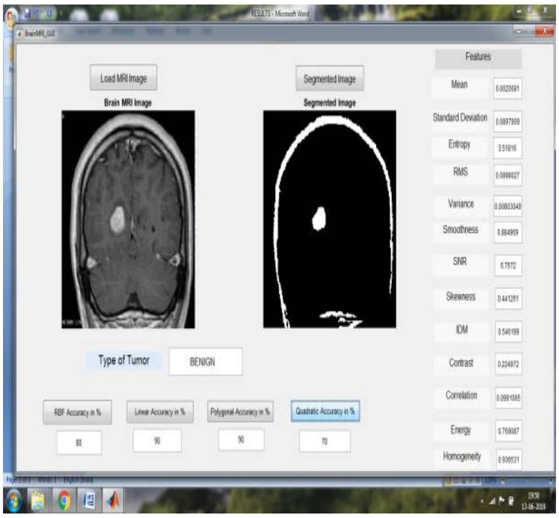

**Fig. 9: QUADRATIC ACCURACY IN PERCENTAGE-1**

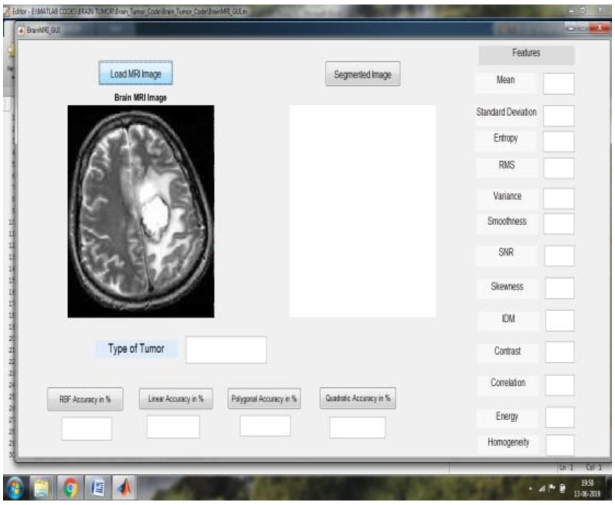

**Fig. 10: INPUT IMAGE-2**

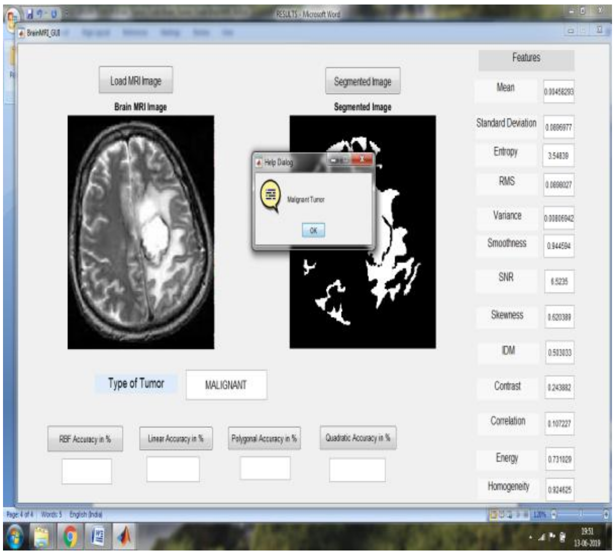

**Fig. 11: MALIGNANT TUMOR IMAGE**

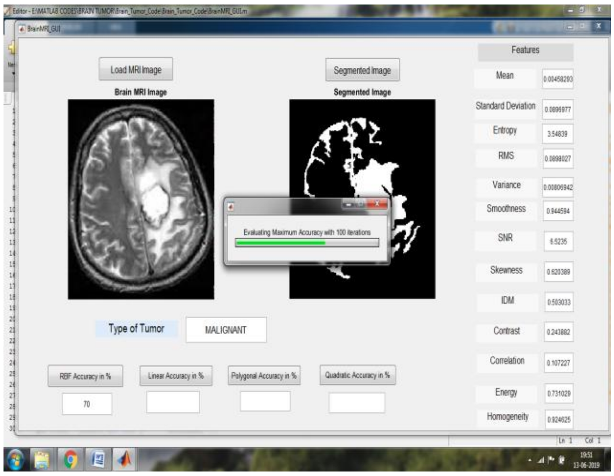

**Fig. 12: RBF ACCURACY IN PERCENTAGE-2**

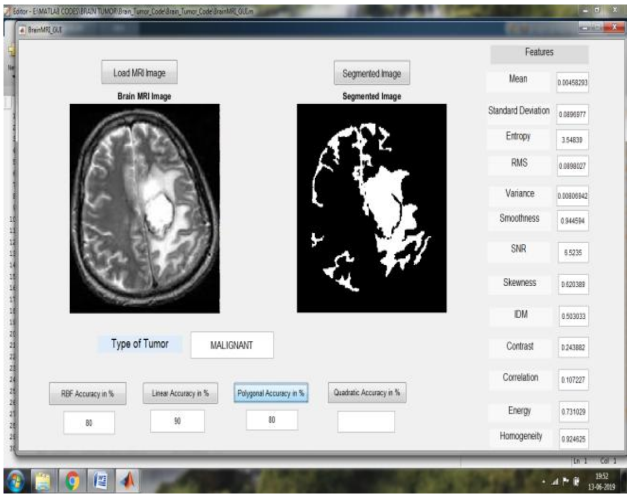

**Fig. 13: POLYGON AND LINEAR ACCURACY IN PERCENTAGE-2**

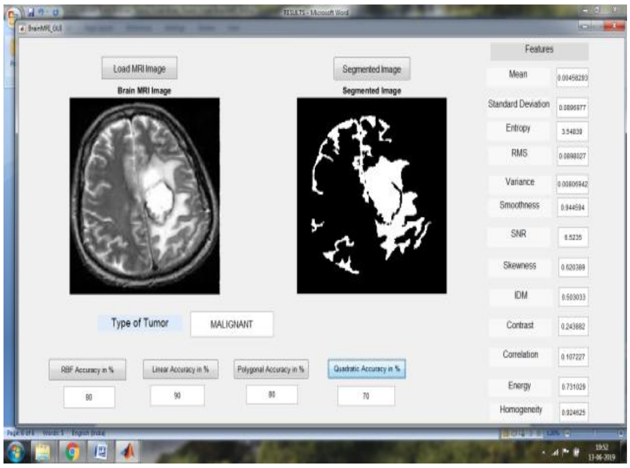

**Fig. 14: QUADRATIC ACCURACY IN PERCENTAGE-2**

## V. CONCLUSION

In this paper, the robust and simple classifications of CT scans are proposed. This system detects the motion-corrupted images in large-scale data bases. Proposed algorithm produces the best enhancement of image contrast producing good enhancement of image contrast. In the initial stage of the work pre-processing is done to remove noises. The experimental result shows that the suggested methods offer greater precision in classification than other volumetric methods. From the view of this work, other classification techniques are scheduled, but also various CT modalities in the classification structure developed.

## REFERENCES


1 AnatoliArodzero , Salime Boucher , Paul Burstein, "ACTM: Adaptive Computed Tomography with Modulated-Energy X-ray Pulses", 978-1-5386-2282-7/17/$31.00 ©2017 IEEE.

2 KusworoAdi, Catur Edi Widodo, ArisSugiharto, QidirMaulana B. S., AdiPamungkas, "Calculation of Phantom Volume for Computed Tomography (CT) Scan Images", 978-1-5090-0890-2/16/$31.00 c 2016 IEEE.

3 Abinashi Dhungel1,2 , Zhen Qian1 , Gustavo Vazquez1 , Sarah Rinehart1 , Michael Weeks2 , Szilard Voro, "Optimal Cutoff Threshold for Calcium Quantification in Isotropic CT Calcium Scans by Validating Against Registered Intravascular Ultrasound with Radiofrequency Backscatter", 978-1-4577-1787-1/12/$26.00 ©2012 IEEE.

4 P. Chatterjee, S. Mukherjee, S. Chaudhuri, G. Seetharaman.: Application of Papoulis-Gerchberg Method in Image Super resolution and Inpainting, The Computer Journal, Vol.52 No.1. Oxford University Press, Oxford (2009) 80-89.

5 R. Grosjean, B. Sauer, R. M. Guerra, A. Blum, J. Felblinger, and J. Hubert, "Degradation of the z-resolution due to a longitudinal motion with a 64-channel CT scanner.," ConfProc IEEE Eng Med BiolSoc, vol. 2007, p. 4429-32, 2007-01-20 2007.

6 J. A. Kennedy, O. Israel, A. Frenkel, R. Bar-Shalom, and H. Azhari, "Super-resolution in PET imaging," Medical Imaging, IEEE Transactions on, vol. 25, p. 137-147, 2006.

7 G. Schwarzband and N. Kiryati, "The point spread function of spiral CT," Phsics in Medicine and Biology, vol. 50, p. 5307-5322, 2005

8 R. R. Peeters, P. Kornprobst, M. Nikolova, S. Sunaert, T. Vieville, G. Malandain, R. Deriche, O. Faugeras, M. Ng, and P. van Hecke, "The use of super-resolution techniques to reduce slice thickness in functional MRI," International Journal of Imaging Systems and Technology , vol. 14, p. 131-138, 2004.

9 S. C. Park, M. K. Park, and M. G. Kang, "Super-resolution image reconstruction: a technical overview," Signal Processing Magazine, IEEE, vol. 20, p. 21-36, 2003.

10 J. Hsieh, Computed tomography: principles, design, artifacts, and recent advances. Bellingham, WA: SPIE Optical Engineering Press, 2003.

11 H. Greenspan, G. Oz, N. Kiryati, and S. Peled, "MRI interslice reconstruction using super-resolution.," Magnetic Resonance Imaging, vol. 20, p. 437-446, 2002-06-01 2002.

12 S. Peled and Y. Yeshurun, "Superresolution in MRI: Application to Human White Matter Fiber Tract Visualization by Diffusion Tensor Imaging," Magnetic Resonance in Medicine, vol. 45, p. 29-35, 2001.


*Retrieval Number L39281081219/2019©BEIESP*
*DOI: 10.35940/ijitee.L3928.1081219*



*Published By:*
*Blue Eyes Intelligence Engineering*
*& Sciences Publication*