Fusion of CT and MRI Scanned Medical Images Using Image Processing

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Abstract -- In the field of medicine to evaluate or to examine the inner body parts different radiometric scanning techniques can be used. Some most commonly used scanning techniques include the computerized tomography scan (CT scan) and magnetic resonance imaging scan (MRI scan) but the images of various body parts taken by using these scanning techniques are having their own merits and demerits. MRI scans can show the images of soft tissues very clearly but it cannot show the images of bones and hard tissues clearly. The CT scan can show the images of the hard tissues like bones clearly but it cannot show the images of the soft tissues clearly such as the membranes covering the brain. If the images of both the CT scan and MRI scan are combined then the resultant image will have the merits of both CT scan and MRI scan images. This paper will describe an image fusion technique to combine both CT scan and MRI scan images.

Keywords: Image fusion, fusion of CT scan and MRI scan images, enhancement of medical imagery, CT scan, MRI scan.

I. INTRODUCTION OF CT SCAN AND MRI SCAN IMAGES

A. CT scanning

CT scan is the acronym for computerized tomography. It is a type of X-ray machine. In a normal x-ray exam, a small amount of radiation is aimed at and passes through the body, recording an image on photographic film. In CT scan instead of sending a single X-ray beam through our body many X-ray beams are sent through our body in different angles at the same time. In a human body different parts absorb the X-ray beams in different directions. The X-rays beams which are passed through less dense tissue such as the lungs will be stronger, whereas beams that have passed through denser tissue such as bone will be weaker. This technique was developed by the British inventor Sir Godfrey Hounsfield, who was awarded the Nobel Prize for his work.

CT scan of internal organs, bones provide greater clarity and can give more details than regular X-ray exams. CT scan provides information on head injuries, stroke, brain tumors and other brain diseases than regular radiographs.

CT scanning is painless and accurate. Major advantage of the CT is its ability to image bone and blood vessels all at the same time. Unlike normal X-rays, CT scan provides detailed images of many types of tissue, lungs, bones, and blood vessels. CT scanning is faster and simple. In emergency cases, they can provide vital information of internal injuries and bleeding quickly enough to help save lives.

CT scan is a cost-effective imaging tool for a wide range of clinical problems. It is less sensitive to movement of the patient when compared to the MRI scanning. CT scanning can be done even if we have an implanted medical device of any kind, unlike MRI scanning.

A diagnosis determined by CT scanning may avoid the need for exploratory surgery and surgical biopsy. No radiation will be present in patient’s body after a CT examination. X-rays which are used in CT scans will not have immediate side effects. Compared to MRI imaging, the precise details of soft tissue (particularly the brain, including the disease processes) are less visible on CT scans and it is not sensitive in detecting inflammation of the membranes covering the brain.

B. MRI scanning:

MRI is the acronym for magnetic resonance imaging. The MRI scanning uses both magnetic and radio waves that means there is no exposure to the X-rays or any other hazardous forms of radiation. In MRI scanning the patient lies inside a large, cylinder-shaped magnet. Radio waves of 10,000 to 30,000 times stronger than the magnetic field of the earth are sent through the body. This affects the body’s atomic structure and can cause the nuclei into a different position as they move back into place they send out radio waves of their own. The scanner picks up these signals that are reflected by the atoms and nuclei; then a computer turns them into a picture; these pictures are based on the location and strength of the incoming reflected signals.

Our body consists mainly of water, and water contains hydrogen atoms because of this reason, the nucleus of the
hydrogen atom is often used to create an MRI scan in the manner described above.

MRI is the most sensitive scanning exam for brain tumors. A variant called MR angiography (MRA) provides detailed images of blood vessels in the brain without the need for contrast material. New MRI systems can detect a stroke at a very early stage. The MRI scan images can give detailed information of soft tissues. The main drawback of the MRI scanning is that it cannot provide clear information of hard tissues such as bones and skull. If the images of both the CT scan and MRI scan are combined then the resultant image will have the merits of both CT scan and MRI scanned images.

II. IMAGE FUSION USING IMAGE PROCESSING TECHNIQUES

Image fusion is the process of combining two images which are having same sizes. There are many tools in image processing to perform image fusion. The basic image processing function used for image fusion is the image addition. Here Mat lab software is used for programming. The image addition function along with its implementation using Mat lab can also be explained as follows

A. Image addition

In image processing, image addition is used for adding two different or same images with same sizes. Image addition is also used to increase the intensity of an image by adding a constant value to each and every pixel value of the image. Image addition can be implemented by using mat lab command it is given as follows

\[ H = \text{imadd}(L,M) \]

Above mat lab command adds each element in the array \( L \) with the corresponding element in array \( M \) and returns the sum in the corresponding element of the output array \( H \). \( L \) and \( M \) are the real, non sparse numeric arrays with the same size and class, or \( M \) is a scalar double. \( H \) has the same size and class as \( L \), unless \( L \) is logical, in which case \( H \) is double. If \( L \) and \( M \) are integer arrays, elements in the output that exceed the range of the integer type are truncated, and fractional values are rounded.

III. PRACTICAL RESULTS

Let us consider the CT and MRI scanned images of human brain. The CT scanned image of the brain is given in figure 1.

In the figure 1 hard tissue like the skull bone is clearly seen but the soft tissue like the membranes covering the brain are less visible. The MRI scanned image of the same brain is given below by figure 2.

In the above figure, we observe the soft tissue like the membranes covering the brain can be clearly seen but the hard tissue like the skull bones cannot be clearly seen. These are the disadvantages of the CT and MRI scans. If we combine both the CT and MRI scanned images of the brain then we will get a resultant image in which both hard tissue like skull bones and the soft tissue like the membranes covering the brain can be clearly visible. Here the image addition can be used to combine both the CT and MRI scanned images. The resultant image after performing the image fusion of both CT and MRI scanned images is given below in the figure 3.

In the above resultant figure both hard tissue like skull bones and the soft tissue like the membranes covering the brain are clearly visible. In this way the resultant image of image fusion will have the merits of both CT and MRI scanned images. Now a constant value can be added to each and every pixel of the resultant image to improve the clarity of the image by increasing the intensity of the image, this enhanced image is given in figure 4.
The above figure is produced by adding a value of 20 to each and every pixel of the image in fig. 3. Hence fig. 4 is an enhanced image of fig 3. In this way, we can perform the image fusion of CT and MRI scanned images to get an enhanced medical image.

IV. REFERENCES
