

Bone Crack Detector based on X-Ray using Fuzzy Logic and Neural Network

K.A.W.P. Abesinghe and S.D.H.S. Wickramaratna
Uva Wellassa University, Badulla, Sri Lanka

Introduction

An x-ray (radiograph) is a noninvasive medical test (Tian Tai Pengn, 2002) that helps physicians diagnose and treat medical conditions. X-Ray images are used by doctors to detect the crack and abnormal conditions of the bones. Doctors are analyzing thousands of X-Ray images at hospital day by day. That activity is monotonous and also consuming lot of time.

Bones contain much calcium, which due to its relatively high atomic number absorbs X-Rays efficiently. This reduces the amount of X-rays reaching the detector in the shadow of the bones, making them clearly visible on the radiograph.

A recognition system has three parts; Image Processing and feature extraction, Fuzzy Logic based identification and Neural Network based verification. The main objective of this study is Computer-assisted decision-making system to detect the crack of the bone in X-Ray image.

Methodology

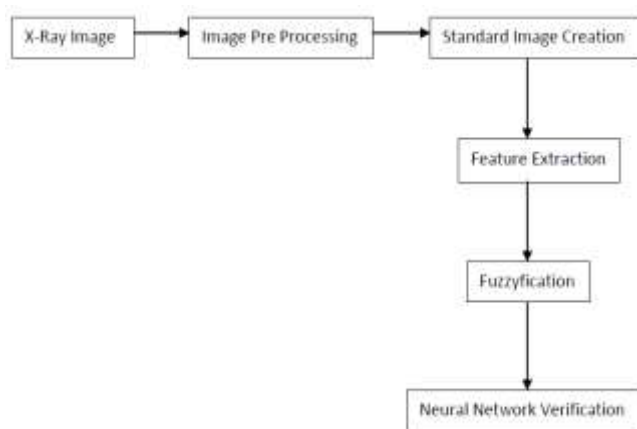


Figure 1. Basic system architecture.

Above Figure 1 shows the basic system architecture. C#.net, Emgu CV image processing library and Aforge.net framework used to develop the system.

Image Preprocessing is applying for enhance the features of the image. Edges based filters apply for enhance the edges because edges perform the vital role for detecting the crack of the bone image. Then system detects the edges of the image using canny edge detector.

Background of the image is eliminated as the next step. System is finally detecting the edges that could be a crack or not. System could detect the actual crack and also some specific features of the bone. Those specific features of the bone are smooth lines and cracks are rough line. Using that specific characteristics system separate crack lines form some features of the bone. Finally abstract the features information for Fuzzyfication.

Fuzzy Classifier contains fuzzy inference engine, input output variables. Input variables are information about the edges. Output variables are the detected crack. System is using two fuzzy sets and three fuzzy functions for each fuzzy set. One fuzzy set is Fuzzy Multiplication and other is Fuzzy Ratio. The fuzzy rules calculate the output and those outputs send to Neural Network for verification.

Neural Network (Davis et al., 1999) takes the input from the Fuzzyfication and specific some parameters taken from image. Eight neurons for input layers, ten neurons for hidden layer and three neurons for output layer use for Neural Network. Supervise training uses for trains the Neural Network. Output obtains as pattern. Finally Neural Network verifies the fuzzy output and correctly says crack or not a crack.

Results and Discussion

System is able to detect the crack in the long bone X-ray image as well as in single figure. Femur bone uses for simple bone structure and single figure uses for complex bone structure. Bones are not in same size and same shapes but the fuzzy module detects the crack in long bone as well as single figure. Neural Network further clarify that bone contains crack or not. Long bone and single figure are also not in same shape and not in same sizes. Single figure contains complex structure rather than long bone.

Some characteristics of bone also sometimes display as the crack of the bone. But fuzzy classifier is eliminating those characteristics. Neural Network verifies that X-Ray contains crack or not. Output of the system displays in the User Interface and marked the crack of the bone.

Conclusions

System contains of three modules as image processing, Fuzzyfication and Neural Network verification. Those three modules are interconnected. The system is accurately detecting that X-Ray image of the bone contains crack or not.

References

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