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Implementation of Oppositional Gravitational Search Algorithm on Arduino Through Simulink

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ABSTRACT

Ultrasound (US) imaging has been broadly utilized as part of kidney diagnosis because of its ability to show structural abnormalities like cysts, stones, and infections as well as information about kidney function. Here, the normal and abnormal kidney images are effectively classified through ultrasound imaging based on the selection of relevant features. In this study, abnormal kidney images were classified through gray-scale conversion, region-of-interest generation, multi-scale wavelet-based Gabor feature extraction, probabilistic principal component analysis-based feature selection and adaptive artificial neural network technique. The anticipated method is executed in the working platform of MAT LAB, and is implemented on an Arduino board through Simulink. Results show that the proposed approach had 94% accuracy and 100% specificity. In addition, its false-acceptance rate is 0%, whereas that of existing methods is not <27%. This shows the precise prediction level of the proposed approach, compared with that of existing methods.

KEYWORDS: Probabilistic Principal Component Analysis (PPCA), Oppositional Gravitational Search Algorithm (OGSA), Artificial Neural Network (ANN), K-Nearest Neighbors (KNN), Genetic Algorithm-based ANN (GA-ANN).

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INTRODUCTION

In medical imaging, any error can cause a threat to proper diagnosis; hence, accurate identification of medical image is a difficult task. To ensure the statistical significance of studies, sufficient amount of data from clinical trials and medical examinations has to be collected. Collection of clinical analyses and laboratory results from electronic databases is useful for research, medical investigations, epidemiological studies, quality control and so on [1,2]. To solve complex geometric problems arising in medical image processing, the classification method of segmentation, shape extraction, three-dimensional (3D) modeling and registration of medical data efficient algorithms are required.

Medical image segmentation is the basis of medical image analysis and understanding. It plays an important role in pathology analysis and treatment and clinical diagnosis. In the imaging process, the formation of medical image is susceptible to some factors such as noise and effect of bias field. These factors lead to intense homogeneity in the image. In image segmentation, the disadvantage of open-source software is that they do not support parallel image processing. Large-scale processing leads to long computational times and high computational power requirements.

LITERATURE REVIEW

Huang et al.[4] have explained the segmentation of US kidney images. Using trained prior shapes, they employ a parametric super-ellipse as a global prior shape for a human kidney. The Fisher–Tippett distribution was employed to describe the gray-level statistics. By combining the gray-level statistics with a global character of a kidney shape, they used an active contour model to segment the US kidney images. It involves two sub-problems: one was the optimization of the parameters of a super-ellipse and the other was the segmentation of a US kidney image. An alternating minimization scheme was used to simultaneously optimize the parameters of a super-ellipse and segment an image.

Gunasundari et al. [5] have explained the computer-aided diagnostic system, which plays an important role in the detection of cancer. Feature selection was an important preprocessing step in the classification phase of the diagnostic system. The feature selection was an NP-hard challenging problem that provides many applications in the area relevant to expert and intelligent system.

Odeh et al. [6] have proposed the use of early imaging markers to predict future renal deterioration in infants with posterior urethral valves. Using National Institutes of Health-sponsored image-processing software, they analyzed a series of initial postnatal US images of the serial posterior urethral valve of the cases seen at a single tertiary referral center. Estimates of renal parenchyma quantity and quality measured on initial postnatal US carry prognostic value by determining future risk of stage 5 chronic kidney disease in patients with posterior urethral valves.

Subramanya et al.[3] have explained a computer-aided classification system for three kidney classes, viz. normal, medical renal disease (MRD) and cyst using B-mode US images. Thirty-five B-mode kidney US images consisting of 11 normal, eight MRD and 16 cyst images have been used. A one-against-one multi-classM support vector machine classifier has been used, which was based on overall classification accuracy (OCA), and features from the ROIs of original images were concatenated with the features from the ROIs of preprocessed images. Based on OCA, few feature sets were considered for feature selection.

EXPERIMENTAL SECTION

The Oppositional Gravitational Search Algorithm (OGSA) is implemented on an Arduino board by interfacing it through Simulink. In this work, the simulink model of the OGSA algorithm is built by creating the target block. The output of the block gives the values of accuracy, sensitivity and specificity after simulation. Then the values are given to the serial transmit block of the Arduino (UNO). The output can be visualized in a digital oscilloscope.

RESULTS AND DISCUSSION

The waveforms for accuracy, sensitivity and specificity are presented below for Oppositional Gravitational Search Algorithm (OGSA).

i. ACCURACY:

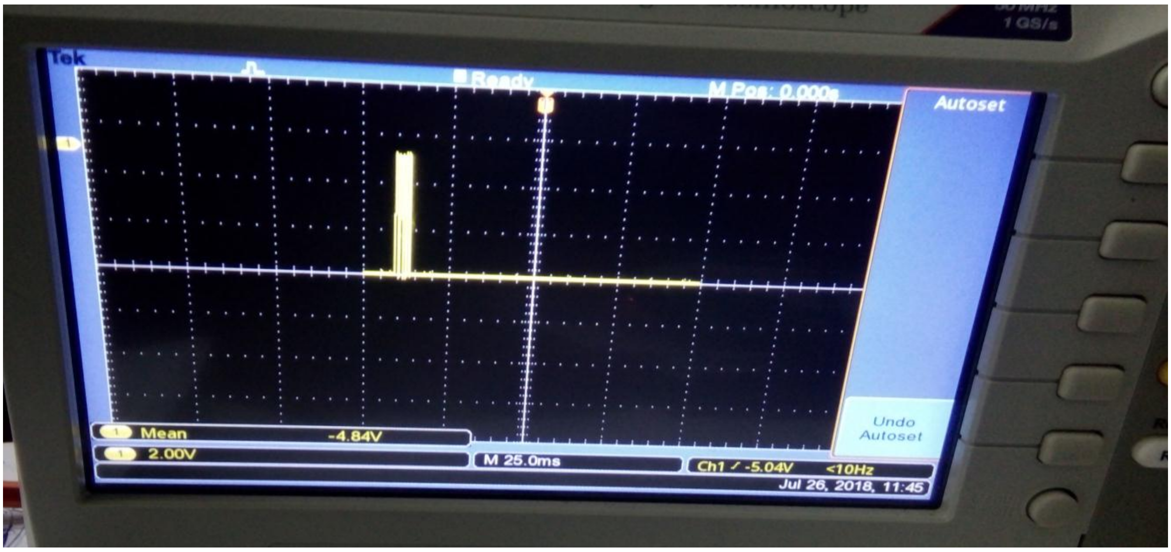

Figure1: Accuracy Waveform Of Ogsa

The value of Accuracy is 0.9375. This has to be converted into binary form whose value is $(1111)_2$. This value is shown in the figure1

ii. SENSITIVITY:

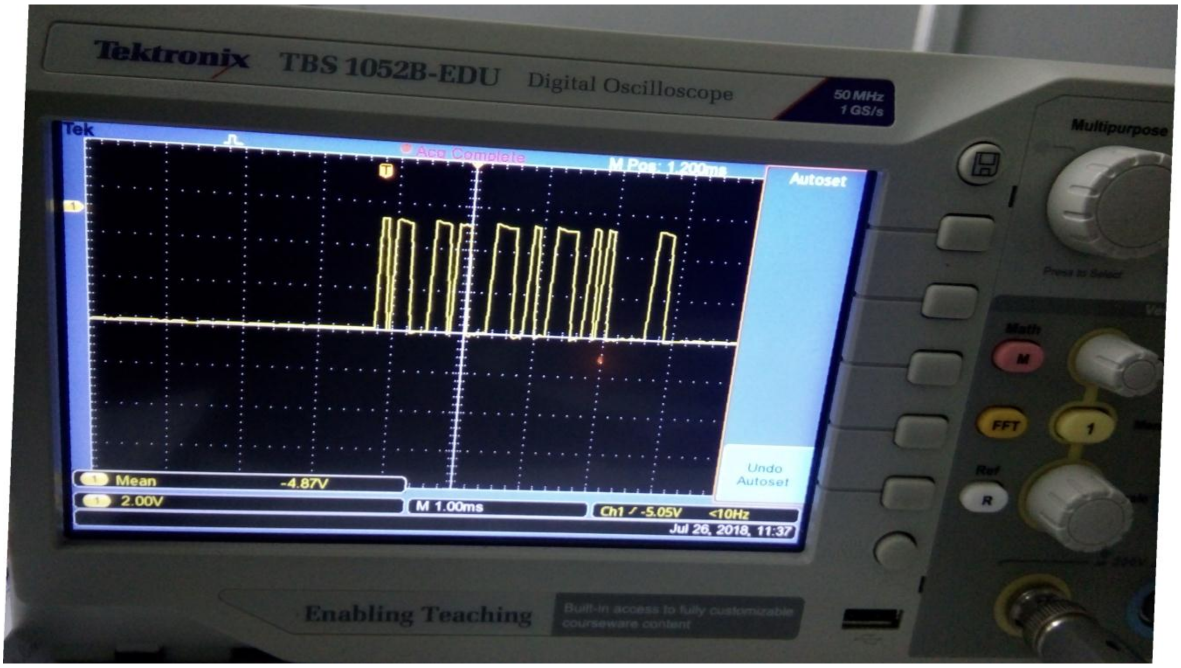

Figure2: Sensitivity Waveform Of Ogsa

The value of Sensitivity is 0.66667. This has to be converted into binary form whose value is $(1010101010101010)_2$. This value is shown in the figure2.

iii. SPECIFICITY:

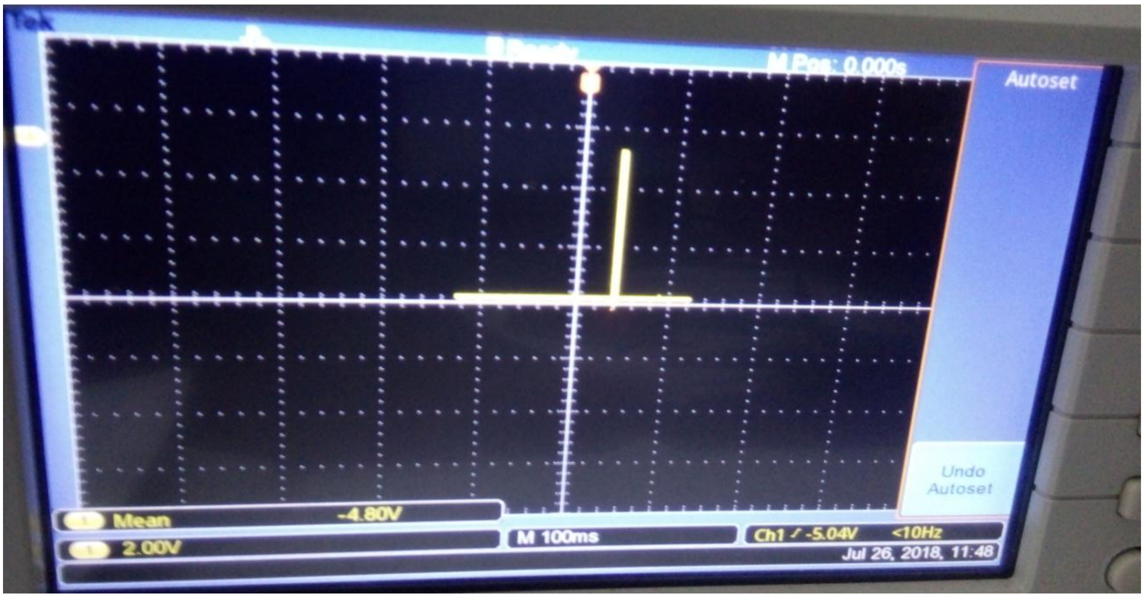

Figure3: Specificity Waveform Of Ogsa

The value of Specificity is 1. So, its binary value is also 1. This value is shown in the figure3.

The comparison table of theoretical (Simulated using MAT lab) and practical values is shown in below table.

Table No 1 : comparison table of theoretical (Simulated using MAT lab) and practical values

Parameter	Theoretical value	Practical value
Accuracy	0.9375	0.9375
Sensitivity	0.6667	0.6667
Specitivity	1	1

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