Hybrid Machine Learning Model of Extreme Learning Machine Radial basis function for Breast Cancer Detection and Diagnosis; a Multilayer Fuzzy Expert System

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Abstract— Mammography is often used as the most common laboratory method for the detection of breast cancer, yet associated with the high cost and many side effects. Machine learning prediction as an alternative method has shown promising results. This paper presents a method based on a multilayer fuzzy expert system for the detection of breast cancer using an extreme learning machine (ELM) classification model integrated with radial basis function (RBF) kernel called ELM-RBF, considering the Wisconsin dataset. The performance of the proposed model is further compared with a linear-SVM model. The proposed model outperforms the linear-SVM model with RMSE, R^2, MAPE equal to 0.1719, 0.9374 and 0.0539, respectively. Furthermore, both models are studied in terms of criteria of accuracy, precision, sensitivity, specificity, validation, true positive rate (TPR), and false-negative rate (FNR). The ELM-RBF model for these criteria presents better performance compared to the SVM model.

Keywords—hybrid machine learning, extreme learning machine (ELM), radial basis function (RBF), breast cancer, support vector machine (SVM).

I. INTRODUCTION

Breast cancer is among the most common disease of young women over the world [1–3]. Approximately 29.9% of mortality from cancer in women is due to breast cancer. The incidence of this disease is lower in developing countries than in developed countries, about 10% of women with breast cancer in Western countries. However, millions of people over the world are suffering from this life-threatening disease mortality [3,4]. But recently, mortality in developed countries has increased, with global data showing about one million and six hundred thousand new cases of breast cancer were reported in 2012. Seven hundred ninety-four thousand people in developed countries compared to 883,000 people in developing countries, though 198,000 mortalities in developed countries compared to 324,000 people in less developed countries [5]. The increasing global prevalence of the disease and the resulting death rate can be attributed to the significant and growing threat in the developing world. Breast cancer caused by growing out the rule is abnormal cells in the breast. Cancer can be a common phenomenon in developing countries, that is, unfortunately, due to changes in lifestyle as well as hormonal therapies. Early detection of the disease has a crucial role in reducing mortality. However, the early treatment also requires early detection of breast cancer at an initial stage. Most methods for detection of this disease are performed through surgery or mammography screening and are costly; countries with good health systems use screening techniques that will result in high financial costs [6].

Several studies use data mining and artificial intelligence techniques for diagnosis and detection [7-13]. In 1995, data mining and machine learning were used in decision-making to detect breast cancer [14]. Data mining and machine learning techniques had been in use to enhance the speed and accuracy of diagnosis [3,15]. However, increasing accuracy to reduce the RMSE error rate is considered to be a challenge, and this subject to research is being discussed. Therefore, in this study, we introduce the multilayer model and investigate the performance of two important and well-known models. We first label the dataset using fuzzy logic and then use the proposed ELM and SVM-based models to classify the best performance between the two models to detect benign and malignant breast cancer with the lowest error rate. To evaluate the performance of the proposed models, we used the confusion matrix. We also applied

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