Chapter 42
ANN Based Expert System to Predict Disease in Cardiac Patients at Initial Stages

Umer Rashid
Quaid-i-Azam University, Pakistan

ABSTRACT

Objective of this research is to develop an expert system for the preliminary investigation of cardiac abnormality in human beings. Artificial Neural Network (ANN) is judged best for the prediction of heart abnormalities in cardiac patients at initial stages. Our research is intended to employ an Artificial Intelligence (AI) technique in an automated solution, having minimum error bounds. An ANN based expert system is designed and developed, which identifies presence or absence of cardiac disease in patients by considering best practiced disease symptoms. The proposed expert system may help the clinicians in the preliminary investigation of cardiac abnormality in human beings.

1. INTRODUCTION

Artificial Intelligence (AI) techniques have been extensively utilized in the design and development of expert systems (Mitchell, 1997; Cowan, 2005; Jackson, 1990). They have applications in the mining of large datasets (Phyu, 2009). Patterns and trends can be learned and may be utilized in the decision making process (Dashti et al., 2010). Expert systems have applications in domains like remote sensing, simulations, and disease predictions (Pal, 2007; Ivezic & Garrett, 1998; Veropoulos, 2001; Oh et al., 2009).

Most common and widely used AI techniques include but not limited to Artificial Neural Network's (ANN's), Decision Tree's (DT's) and Naïve Bayes' Classifier's (NBC's) (Mitchell, 1997). AI techniques have been widely explored for medical domain in the disease prediction. They are employed in the prediction of orthopedic problems (Mantzaris et al., 2008), lung cancer (Mughal & Ikram, 2004), diabetes (Huang et al, 2004; Sopharak et al., 2010), and cardiac abnormalities (Tantimongcolwat et al., 2008; Qazi et al, 2007; Yaghouby et al., 2009; Parthiban & Subramanian, 2008; Patil & Kumaraswamy, 2009; Adams & Choi, 2012; Srinivas et al., 2010).

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Several disease symptoms have been observed by the clinicians in the Preliminary investigation of cardiac abnormality in human beings (Beers et al., 2003). Thirteen attributes are identified by the clinicians; these attributes are considered sufficient in cardiac abnormality prediction (Parthiban & Subramania, 2008). Each attributes has several possible values. Hypothesis of disease prediction includes combination of disease attributes. Manual or automatic consideration of hypothesis using these attributes with their collective possible values is difficult for clinicians. Problem is obdurate for the clinicians and the accuracy of the predication is not guaranteed in advance. The abnormality prediction procedure is biased by the clinician's observations; experiences and perceptions. It may have unspecified high error bounds. An automated expert system for cardiac abnormality prediction having known error bound is required.

Through experimentation ANN's are jugged best for the development of an expert system for cardiac abnormality prediction. Architecture of the expert system is proposed. An expert system, based on the proposed architecture is implemented. The implemented cardiac abnormality prediction application is easy to use and deploy. The Proposed system can help clinicians in the preliminary investigation of cardiac abnormality.

In section 2, we provide brief overview of existing cardiac abnormality prediction by machine learning techniques. Section 3 and 4 demonstrates classifier selection mechanism and development of cardiac abnormality prediction application respectively. In section 5, we conclude our discussion and in section 6, we discuss possible future enhancements.

2. EMPLOYMENT OF MACHINE LEARNING IN CARDIAC ABNORMALITY PREDICTION

In recent years research has been conducted to predict cardiac abnormality in patients. Existing research mainly focused towards the identification of optimal set of attributes and machines learning techniques with minimum error bounds. Now the research is focusing to investigate an automated procedure that predicts cardiac abnormality in patients. Now we give brief overview of the research in this area.

Research has been conducted to predict heart abnormality accurately with fewer numbers of attributes. Fewer numbers of attributes may reduce human cognitive burden by reducing the number of possible options. Patel et al. (2013) and Anbarasi et al. (2010) in their work reduced the number of attributes to predict heart abnormalities in cardiac patients using data mining and genetic algorithms respectively. Heart abnormality prediction attributes are reduced from thirteen to six. According to their research six attributes are sufficient to predict cardiac disease in patients. Considering six attributes with their all possible values to predict heart abnormality is also tedious for cardiac clinicians. A diagnostic process to predict heart abnormality in cardiac patient with reduced number of attributes still needs:

1. Identification of best classification techniques; and
2. An automated process to predict heart abnormalities in cardiac patients with fewer error rates.

Fenici et al. (2005) in their research validate predictive value of machine learning techniques in comparison with interactive, computer-aided, MCG analysis. In their research they measured sensitivity, productivity, and specificity values of important machine learning techniques.

Kangwanariyakul et al. (2010) in their work explored that Ischemic Heart Disease (IHD) is major factor that increases death rates in human beings. Prediction of disease by Magnetocardiogram (MCG)