# Fuzzy multi-criteria decision-making using machine learning approach on diabetic disease

## 4.1 Introduction

Diabetes detection is a major technical challenge in medical diagnosis system. Medical information systems in modern hospitals and medical institutions become larger and larger causing a great difficulty in extracting useful information for decision support. A challenge of working with traditional database system with larger amounts of data is that decision making requires numerous comparisons. Health related database systems are the examples of such database which may contain millions of data entries and requires fast data processing to examine related information to make complex decisions [73]. Numerous computational techniques have been developed for classifying occurrence of diabetes in human being. Introduction of machine learning in the medical information system has proved to be beneficial as it increases the diagnostic accuracy, reduces cost and increases the number of successful treatments. Most of the patients describe their symptoms using superlative degree such as "never, very, rarely, often, sometimes, always, most of the times" [53] and each of the specific symptom can be graded using linguistic variables like "mild", "moderate", "high", "low". Fuzzy logic has the capability of merging the human analytics and computer based decision making to provide the best solution to a problem.

The recent World Health Organization report suggests that over 19% of the world diabetic population currently resides in India [59]. Diabetes in India is a growing area of research as statistically the number has increased significantly in last 5 years [78] . Diabetes Mellitus is a disease in which the body cannot properly store and use glucose for energy. Glucose comes from food and to use glucose, the body needs insulin. Insulin is made by glandular organ called pancreas. When the body doesn't produce enough insulin, it causes an excess of blood glucose (sugar).When the body's glucose is high, that becomes the chronic condition known as diabetes.

## 4.2    Research Background

Diabetes is a chronic disease that occurs when the human pancreas does not produce enough insulin, or when the body cannot effectively use the insulin it produces, which leads to an increase in blood glucose levels [53]. Normally, after a meal, the body breaks the food down into glucose, which his carried by the blood to cell throughout the body. The cells use insulin, a hormone made in the pancreas, to convert the blood glucose into energy [54]. People with diabetes have problems in doing such a conversion leading to fatigue and many other serious complications.

Late diagnosis and/or improper control of diabetes can lead to many serious complications: damage to the eye (leading to blindness), kidney (leading to renal failure), and nerves (leading to impotence and foot disorders with possible amputation) as well as, it increase the risk of heart disease, stroke, and reduces life expectancy [55]. Therefore, finding an effective management process for this disease is the need of the day. There is no cure for diabetes as of yet, never the less, an early diagnosis of this disease, followed by a suitable medication, a balanced diet, and regular physical activity go a long way in controlling blood glucose levels and decreasing the risk of  developing complications [83] . Controlling the blood glucose level of diabetic patients and keeping it within the normal range (70 mg/dL -120 mg/dL) is therefore the main goal of physicians[79].

## 4.3    Motivation

Diabetes is fast gaining the status of potential epidemic in India with more than 62 million diabetic individual currently diagnosed with the disease. The prevalence of diabetes is predicted to double globally from 171 million in 2000 to 366 million in 2030 with maximum increase in India [75]. India currently faces an uncertain future in relation to the potential burden that diabetes may impose upon the country. Many factors affect the prevalence of the disease like genetic factors, obesity and change in life style. The chronic disease imposes a large economic burden on health care systems and currently there is no evident cure for this disease [75]. Due to its importance, a design of classifier for the detection of diabetes with optimal cost and better performance is the need of the age. Machine learning approache shave increased the efficiency to numerous problems in various domains and has therefore gained

popularity. Adaptive Neuro-Fuzzy Inference System (ANFIS), a hybrid intelligent system is a combination of Artificial Neural Network (ANN) and fuzzy systems and serves as a strong predictor. ANN and Support Vector Machine (SVM) forms a good means of learning from the past data and generalizing the learnt trends in to the unknown inputs. The proposed method uses ANFIS, ANN and SVM as classifier for diagnosis of diabetes.

## 4.4   Objectives

Classification is one of the most important decision making technique in real world problem. The main objective of this study is to classify the data as diabetic or non-diabetic and improve predictive performance of various machine learning approaches. In this study we have considered various machine learning approaches and ensemble them to find the best results in terms of accuracy, specificity and sensitivity.

## 4.5   Problem Statement

Early detection of diabetes has attracted significant research interest. Detection and diagnosis of diabetes at an early stage is the need of the day. A classifier is required and needed to be designed that is cost effective, continent and accurate. So we have concluded to examine "Machine Learning Approach for Classification of Diabetes disease" .This problem is chosen because Diabetes has now become a major public health concern associated with increase morbidity, mortality and cost of health services. Therefore machine learning techniques have been considered to design automatic diagnosis system for diabetes. Supervised learning techniques like ANFIS, ANN with Leven berg-Marquardt (LM) back propagation approach, Scaled Conjugate Gradient(SCG) back propagation approach hand SVM are used.