1.1 GENERAL INTRODUCTION

Present chapter introduces the problem of Asthma diagnosis and its long term serious effects along with the content of research reported in the various chapter of this thesis. The chapter is divided into three main sections. The first section informs the motivation behind present study and a brief outline regarding the Asthma disease and problems of its diagnosis. Second section briefly encompasses the development of Inference Systems. The Inference System is modeled on the basis of Fuzzy Logic (FL), Artificial Neural Network (ANN) and Artificial Neuro Fuzzy Inference System (ANFIS). The performance of modeled Inference Systems has been presented in the subsequent section. The basic objectives and contribution of the present work has been categorically mentioned at the end.

1.2 BACKGROUND OF ASTHMA

Asthma is a major public health issue in the world [2]. In the United States alone, it affects 6.2 million children and 13.8 million adults. Globally, it affects an estimated 300 million people, and is responsible for approximately 1 out of every 250 deaths [3, 4]. A survey based study estimated the percentage of Asthma patients in Western Europe and North America with “severe” symptoms to be approximately 40% [5]. Especially troubling is that it has increased significantly in the past 2–3 decades in the U.S. and worldwide [6]. Hospital based study on 20,000 children under the age of 18 years in 1979,1984,1989,1994 and 1999 in the city of Bangalore showed
a prevalence of Asthma is 9%, 10.5%, 18.5%, 24.5%, and 29.5% respectively. Reasons for this increase are not clear; however it may reflect increased exposure to environmental risk factors [7].

The episodes of Asthma severity cause coughing, wheezing, chest tightness and difficulty in breathing. An Asthma attack can be life threatening. There are many diseases with almost same symptoms and normally misdiagnosed with Asthma. Although the occurrence of Asthma is not known exactly and its diagnosis is unclear but in some populations Asthma is under-diagnosed. Some sources claim Asthma is under-diagnosed in children, with episodes of wheezing not considered possible cases of and thus not seeking diagnosis and treatment for Asthma.

### 1.3 MOTIVATION

Asthma is common chronic illness that may result in significant burden for patients and their families. This may cost the life of patients in its advance stage. The morbidity and mortality due to Asthma is prevented by providing early and correct diagnosis [1]. The correct diagnosis is a matter of long experience and deep knowledge of the doctors. The availability of such recognized and renowned doctors are few in numbers. The benefit of such experts is also limited as compared with the number of patients. This situation has been the motivating force to take-up present study. In the present study it is aimed to make available the expertise of renowned doctors for the diagnosis of Asthma, to the other junior medical practitioners and even to the suspected patients for self diagnosis. The three Inference Systems based on Fuzzy Logic (FL), Artificial Neural Network (ANN) and Artificial Neuro Fuzzy Inference System (ANFIS) has been developed through this study. The modeled/developed Inference Systems are capable to encompass and incorporate the
experience and knowledge of experts. The basic questions/query and corresponding
diagnosis of experts is the prime feature of these Inference Systems. These Inference
Systems can be used by other doctors as well as by the patients for the diagnosis of
the stages/ severity of Asthma. Based on the correct and early diagnosis [10] of the
disease proper and suitable, preventive and curative measures may be taken up by
patients.

1.4 **INFERENCE SYSTEM**

The inference system developed is based on the experience and knowledge of
experts and this system essentially encompasses a Decision Support System (DSS).
Decision Support System (DSS) based on the combination of Fuzzy Logic (FL) and
Artificial Neural Network (ANN) is termed as Artificial Neuro Fuzzy Inference
System (ANFIS). During designing of this system uncertainty part in the diagnosis
have been used as principle component in the fuzzy and artificial neural network. The
Fuzzy Logic Controller (FLC) is a potential tool for dealing with uncertainty and
imprecision. The FLC is a successful application of Zadeh’s fuzzy set theory [8]. The
knowledge and experience of a doctor can be modeled using an FLC. The
performance of an FLC depends on its knowledge base which consists of a data base
and a rule base. It is observed that the performance of an FLC mainly depends on its
rule base, and optimizing the membership function distributions stored in the data
base is a fine tuning process [9]. The major limitation of the FLC is that it requires an
extensive knowledge of the system to be controlled. Such an extensive knowledge
may be difficult to obtain beforehand. Based on the user’s knowledge, one can design
the rule base of an FLC. Thus, tuning is required of the manually constructed rule
base of an FLC so that it can perform well. In this work, ANN has been developed
and employed to optimize the designed rule base of an FLC, which is used to
diagnose the disease. After using the Fuzzy and ANN tools, their hybrid tool ANFIS
has been derived for the development of Decision Support System (DSS). Further
Inference System has been modeled using DSS outcomes.

The Neuro Fuzzy System or ANFIS is employed for the purposes of detection
of Asthma severity. Decision making are performed in two stages: feature extraction
using the Principal Component Analysis (PCA) and the ANFIS trained with the back
propagation gradient descent method in combination with the least squares method.
The performance of the ANFIS classifier is evaluated in terms of training
performance and classification accuracies. The results confirm that the proposed
ANFIS has potential in detecting the Asthma severity.

1.5 OBJECTIVE OF PRESENT STUDY

The present work concerned with the intelligent diagnosis of the severity of
the Asthma disease. Three automated decision support system has been developed by
using a self-organizing fuzzy, Neural Network (NN) and Neuro-Fuzzy (NF) systems
with following major objectives:

- Collection of guidelines for Asthma diagnosis.
- Identification of risk factors that worsen Asthma.
- Implementation of artificial neuro-fuzzy inference system (ANFIS) to develop
  Asthma diagnosis modules.
- Validation of tool based on Asthma cases available in public domain.
- Suggestion of Asthma management plan to control Asthma episode in
  patients.
With the fulfillment of these broad objectives, the present thesis makes several major contributions of the current knowledge of mechanism of different intelligent systems such as Fuzzy Logic, ANN and Artificial Neuro Fuzzy for correct diagnosis of Asthma.

1.6 ORGANIZATION OF THESIS

This thesis has been organized in five chapters. In Chapter 1, some overview including the motivation, objectives, aim & research contributions are presented. Some literature reviews, related works and also theories regarding this project are included in Chapter 2. Chapter 3 contains a research methodology of the proposed methods, algorithm involved in Matlab, designing of Inference Systems with the help of the Fuzzy Logic, Artificial Neural Network and Artificial Neuro Fuzzy Inference System for diagnosis of Asthma. Chapter 4 presents the result from the Inference Systems and discussion on the performance analysis. Lastly, the conclusion of this project and some recommendations for future work are discussed in Chapter 5.

The basic knowledge and information regarding Asthma and various tools available has been presented through ‘Literature Review’ in the chapter to follow.