CHAPTER 5
CONCLUSION

Uncertainty is inherent in medicine as it contains the complex behavior and the outcome is non-linear. Despite the exponential growth of medical information, the effect of health care interventions is often very uncertain or controversial. India leads the world with largest number of diabetic subjects earning the title “diabetes capital of the world”. According to the Diabetes Atlas 2006 published by the International Diabetes Federation, the number of people with diabetes in India currently around 40.9 million is expected to rise to 69.9 million by 2025 unless urgent preventive steps are taken.

Even though there are many devices available to diagnose the Diabetes Mellitus, there is no particular controlling device to control the major complications of Diabetes Mellitus which affects cardiac and renal. These two complications are very severe and increase the mortality rate day by day. As the medical domain has full of uncertain, vague, ambiguous and incomplete information, fuzzy control methods are used in this work for the prediction, diagnosis and treatment.

Fuzzy control is a control method based on fuzzy logic. Fuzzy logic can make human-like interpretations and is a very useful tool in artificial intelligence, machine learning and automation It can be described simply as “computing with words rather than numbers”, “control with sentences rather than equations”. Generally Fuzzy control are used to control consumer products such as washing machine, video cameras, rice cooker, industrial processes such as cement kilns, underground trains and robots. In health care system, Fuzzy controllers are used to control the existence of uncertainty in various medical sub domains.

There is no specific design procedure for fuzzy controllers because the rules are non linear in medical domain. Therefore, the basic components and functions of fuzzy controller can be described in order to recognize and understand the various options available in medical domain already designed. This forms the base for the design methodology of proposed controller to predict the cardiac and renal complications of diabetic patients.

The main contribution of this research work is to design a controller to control the controllable risk factors and to predict the severity of cardiac and renal problem of Diabetic subjects. In spite of many advanced equipments and devices available in health care system to control the disease, the proposed controller simultaneously control and maintain all the seven controllable risk factors at normal condition to avoid the unexpected failure of cardiac and renal system.

The most flexible feature of this controller is that the number of input and output parameters can be increased or decreased according to the disease, while constructing the fuzzy inference system. The insulin and ketones risk factors are interpreted for both cardiac and renal samples in order to reach an accurate assessment even though it is not often done in practice. Suggestions are given to the patients affected by contributing factors like cigarette smoking and alcohol on observation. The other significant improvement of this thesis is the reduction of the complexity of uncertain explanation of the disease by the patients with the help of the range defined as fuzzy sets.

The controller is proved as an effective tool to capture expert's knowledge and modeled the results. The rule base is constructed based on the number of terms, their shape and their overlap. It is also flexible to add or delete the rules. It consists of 16384 fuzzy If-Then rules based on seven input parameters and two output parameters. So, by using this controller any variation of any risk factors can be captured, thereby determine the seriousness of the disease.

The validation of the controller is experimented and is used to determine the stages of cardiac based on Heart Beat Rate and the stages of Renal based on Glomeruler Filtration Rate. This versatile approach has been implemented and tested using MATLAB successfully.

Another important factor that highlights the performance of the controller is the classification of patients with high risk and low risk using fuzzy c means clustering technique, so that the patients with high risk are treated immediately. The efficiency of the controller is tested with the four controller components to find the correction error while measuring the risk factors value by giving error and change of error as input parameters.

The most excellent feature of the controller is the simulation of the rule view which shows the results of fuzzification and defuzzification. The simulated model of the proposed

controller is used to monitor the Heart Beat Rate and Glomeruler Filtration Rate value by controlling the risk factors always at normal level. The structure of fuzzy inference system is automatically developed while training and testing the data and the output value is viewed diagrammatically in order to assist the medical experts. It is observed that by controlling the risk factors the heart beat rate and the glomeruler filtration rate are maintained at normal condition automatically. This simulated model may be treated as a strong base for determining other major diseases and hence the design of the controller in one sector leads to a successful application in the related sectors. Another important highlight of this work is the design of the basic logic circuit which implements the rule base.

Data analysis has been done on the basis of risk factors, age, sex and occupation. The results are interpreted and various inferences are inferred from the analysis. These inferences will be very much helpful for the experts to determine the seriousness of the disease, and in turn to treat the patients with proper treatment. This system can be taken as a sample to develop new fuzzy inference system for treatment of other diseases too.

The controller may be used as an intelligent system for the medical experts to take immediate decisions and to react accordingly. This will be helpful for the research students both in medical and computer, to study and analyze the construction of the controller and may be applied to various such diseases. It is also useful for the patients to know their disease status and to take proper treatment and diet controls at the right time.

The achievement of this work can be summarized as having successfully modeled the clinical expert knowledge necessary for the assessment of Diabetes Mellitus information. The development of the controller incorporating explicit uncertainty handling has increased the embedded intelligence within the inference system to a level which is indistinguishable from the best clinical experts. The main aim is to reduce the rate of mortality due to the uncertain fluctuation of Blood Sugar which accelerates the cardiac and P/C ratio which affects the renal complication especially in type 2 diabetes around the age of 40 to 50 years.

In this work, the controller is designed with seven input parameters and two output parameters to find the complication of cardiac and renal of Diabetes Mellitus patients. The further scope of the work can be carried out for other complications of Diabetes Mellitus

with more input and output parameters. Advanced intelligent hybrid structures like neuro-fuzzy and fuzzy genetic algorithm can also be applied depending upon the problem objective. In this work, the basic logic circuit has been designed to implement the rule base but in future the Micro Electro Mechanical System (MEMS) can be employed based on the logic circuit designed which integrates a large number of systems to be built on a single chip.