CHAPTER 3

SYSTEM ARCHITECTURE

The architecture of the proposed Intelligent Food Recommendation System is shown in Figure 3.1. It consists of various modules such as User Interface, Decision Manager, Interface Engine, Rule Base, Fuzzy Rule Manager, Agent Subsystem, Image Data Manager, Diabetic Analyzer, Image Database, Lookup Table, Disease Database, Food Database and Food Recommendation.

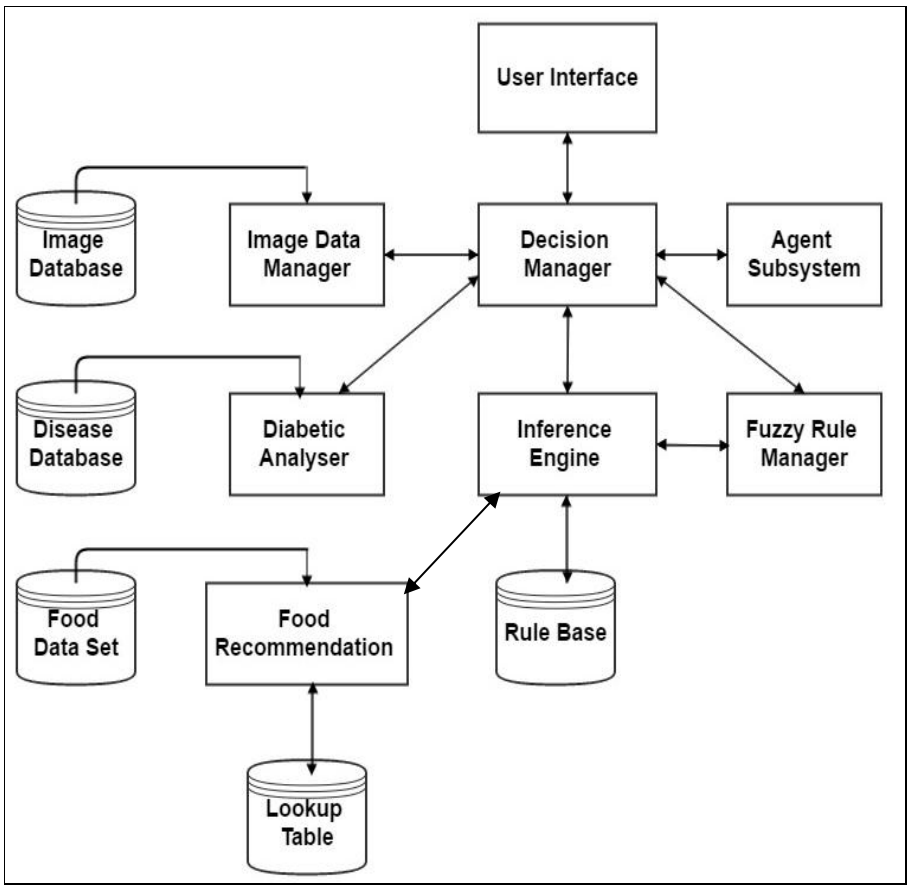

Figure 3.1 Overall System Architecture

The decision manager has the overall control of the entire system and also monitors the functionality of the system. Therefore, it performs many functions including the selection of a suitable classification technique using rules present in the rule base. This subsystem aims to build an appropriate decision support system in medical diagnosis. The preprocessing subsystem consists of four components namely input dataset, preprocessing module, outlier detection module and feature selection module. This subsystem aims to reduce attribute set and to choose appropriate subset of attributes, which may be treated as an input to the decision support system.

3.1 USER INTERFACE

The user interface module allows the user to interact with the system and hence it is considered as the most important parts of this architecture. This interface is helpful for the users which allows them to effectively perceive and express required information. And also, the design of User Interface provides computer means for effective communications with the user. In particular, this interface provides relevant formats and languages that can be used to present information to users with more accurate and a high level of control.

3.2 PREPROCESSING MODULE

A smart phone or a built in camera can be used to capture the image of food item and stored in the database or the food images can be downloaded from the web and stored in the food image database. The preprocessing of the images of food image includes resizing and feature extraction. The resizing process performs resizing based on width and height of the image so that their greatest side is assigned as 64*64 pixels. For disease prediction, the clinical dataset used contains irrelevant, redundant and similar attributes and hence it is necessary to eliminate or cluster it for building a more efficient model. The

UCI Machine Learning database is considered as sample which consists of hundreds of patient records which has a set of attributes of type numeric, categorical and other types of data. The first step of pre-processing is data cleaning, which is done by converting the data of text files into a relational database format and eliminating all the redundant records, and also fill up the missing and incomplete data if necessary. Then feature selection is performed to reduce to a generalized data set for the fuzzy neural network training.

3.3 FEATURE SELECTION MODULE

In feature selection stage, image features are extracted using the algorithms namely SIFT, Gabor filter and Color Histogram method for extracting local key points, texture feature and color features respectively. In this module, SIFT feature selection algorithm is used for attribute subset selection. This enables to build effective classification models. Moreover, the selection process is helpful to determine a minimal feature subset by eliminating useless features. It also uses an enhanced version of filter approach for feature selection for better accuracy. This step is necessary to enhance the accuracy of the intelligent decision support system and to increase the computational speed

3.4 FUZZY RULE MANAGER

The fuzzy rule manager is capable of retrieving, matching and firing rules. For this purpose, it uses either forward chaining or backward chaining interface mechanism as selected by the expert. It uses rule matching algorithms and builds discriminant networks for effective decision making. The main advantage of using a fuzzy rule manager is that it handles uncertainty more effectively under incomplete information which is present in the food dataset.

3.5 RULE BASE

This part of the architecture describes the construction of a knowledge representation model from which the rule mining is performed from the rule base. All the newly generated rules by different proposed algorithms are saved in the rule base. The fuzzy rule manager with user request will add or delete some rules and rule manager takes the final decision by interacting with the rule base. The rules from the rule base can be used to process the queries of individual patient records. The queries can be processed as singleton quires which specify the severity of the particular disease in each patient.

3.6 DECISION MANAGER

The overall activities of the proposed system is monitored by the module known as decision manager. This manager makes required decisions about the food type recognition, disease prediction and food recommendation for the users. The decision manager also makes a decision in feature selection and classification modules to provide accuracy for the proposed food recommendation system. It uses the services from the inference engine and fuzzy rule base for making decisions. It controls all the other modules of the proposed system.

3.7 AGENT SUBSYSTEM

The Agent Subsystem module facilitates the Decision Manager in making decisions in the process of food type identification, disease prediction and food recommendation. In order to make intelligent decisions, the decision manager uses agent subsystem. This sub system consists of specialized agents for fuzzy reasoning, temporal reasoning with prediction and diabetic analysis. Each agent has rules for sensing and additional rules for taking actions. The

agent subsystem is also responsible for providing a facility for communication among all the other sub systems. The agents are normally static in nature but can move from one module to another module of the proposed system by the advice of the decision manager for data collection, inference and effective communication.

3.8 INFERENCE ENGINE

The Inference Engine module is used to perform detective inference by fixing the rules from the rule base and to provide the inferred knowledge to the decision manager in order to make decisions. It also uses the fuzzy rule set for making decision for the overall process of food recommendation.

3.9 IMAGE DATA MANAGER

The Image Data Manager module is responsible for managing the images present in image database. Either a smart phone or built in camera is used to capture the image or it can be downloaded from web and then stored in the image database. This module retrieves the food image from the image database and also facilitates the decision manager for making decision for identifying the type of the food. The image data manager identifies the data structure and algorithms used for indexed storage of images and tree based manipulation for query optimization and to reduce the cost of searching the database.

3.10 DIABETIC ANALYSER

The Diabetic Analyzer module uses the diabetic disease database for predicting the patients have diabetes or not. For predicting the disease, the algorithm used generates transparent rules. Those rules are stored in the rule base. The rules from the rule base can be used to process the queries of

individual patient records. The queries are processed to specify severity of the particular disease in each patient. For making decisions, the decision manager uses these predicted results. The diabetic analyzer uses past history of the patients based on the food habits, sugar level and blood analysis. It also performs the prediction of the future by applying rules on past and present data. It also classifies the diabetic patients into different categories so that it is possible to provide suitable prevention tips.

3.11 FOOD RECOMMENDATION MODULE

The food recommendation module uses the food dataset and look up table for recommending the food depending upon the disease prediction results from the decision manager. Depending upon the disease severity, this module performs food recommendation for patients by considering the calorie content of the food item. The food recommendation module takes care of the suggestions provided by the domain expert while recommending the food. It considers the advice from doctors and specialists in diet recommendation. For every age this module finds the suitable type of food items either from the list of available food items or from commonly available food items.

3.12 IMAGE DATABASE

The image database contains the various images of food items captured using a smartphone, a built in camera or web download. The proposed image database supplies the image for the identification of its food type and for estimating the calorie value of the identified food type in the input image. These food images are obtained from the World Wide Web. In this work, six classes of food items has been considered.

3.13 FOOD DATASET

The Food Dataset contains various food items with its nutrient values and are divided into three classes namely allowed, limited and avoidable based on the calorie values of the food item. Based on the disease prediction results the user is recommended for the food type that falls under the above mentioned three classes.

3.14 DISEASE DATABASE

The Pima Indian Disease Database is used as the dataset for disease diagnosis. It consists of a set of medical diagnostic reports taken from 768 records of female patients, where the best features are selected from the overall given attributes. The algorithms namely information gain and chi-square are used for selecting the best features. Some of the selected features are HB1AC, UA, TG, Age, Cholestrol(CHOL), Waist, HDL, LDL.

3.15 CONCLUSION

In this thesis work, an architecture for the proposed Intelligent Food Recommendation System has been designed and explained. This architecture provides the various components of the food recommendation system and explains the function of each module. All the modules present in the architecture cooperate and provide an environment for recommending food. This architecture considers three types of data sets namely food image dataset, disease dataset and food dataset for food recognition, disease prediction and food recommendation respectively.