INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN 2278 – 0211 (Online)

A Model to Predict Diabetes Based on Chromosomes Using Genetic Algorithm

K. Vijaya Lakshmi
Department of Computer Science, S.V. University, Tirupati, India
M. Padmavathamma
Professor, Department of Computer Science, S.V. University, Tirupati, India

Abstract:
Expert systems are interactive decision support system that are intended to support patients, physicians and other health professionals in decision making tasks with accuracy. Diabetes is a chronic illness which requires continuous medical care and patient self-management education to prevent acute complications and to decrease the risk of long-term complications. Our proposed model is for recognition of the disease based on gene variants and chromosomal regions that may have diabetes susceptibility genes by genome-wide analysis. Genetic Algorithms are considered which are based on simplified evolutionary processes using directed selection to achieve optimal decision results.

Keywords*: Chromosomes, Diabetes, Diagnosis, Genetic Algorithm, Intelligence*

1. Introduction

Diabetes mellitus (DM) also known as simply Diabetes, is a collection of metabolic diseases in which there are high blood sugar levels over a prolonged period. Diabetes treatment focuses on controlling blood sugar levels to prevent various symptoms and complications through medicine, diet, and exercise. It requires continuous medical care and patient self-management education to prevent acute complications and to decrease the risk of long-term complications.

Diabetes treatment focuses on controlling blood sugar levels to prevent various symptoms and complications through medicine, diet, and exercise. The American Diabetes Association [1] categorizes diabetes into type-1 diabetes, which is normally diagnosed in children and young adults, and type-2 diabetes, i.e., the most common form of diabetes that originates from a progressive insulin secretary defect so that the body does not produce adequate insulin or the insulin does not affect the cells. Either the fasting plasma glucose (FPG) or the 75-g oral glucose tolerance test (OGTT) is generally appropriate to screen diabetes or pre-diabetes. Both genetics and environmental factors, e.g., obesity, race, gender, age, and lack of exercise, apparently play important roles in the diagnosis of diabetes.

Now along with above general factors genes are considered for compatibility analysis that will effect on the performance and more impact on the exactness of the proposing diagnosis system in prediction. The growing number of diabetic patients over worldwide has drawn the attention of a diverse array of fields, including artificial intelligence and biomedical engineering, explaining why related technologies such as fuzzy inference mechanisms and fuzzy expert systems have been adopted for diabetes research.

2. Literature Survey

Dr. A Tamilarasi, Sapna, M.Praveen Kumar developed system to predict Diabetes using Genetic Algorithm[2]. Aishwarya and Ano used genetic algorithm and Extreme Learning Machine (ELM) for diabetes disease diagnosis[3]. Fayssal et al[4] has designed a diagnosis system for diabetes using fuzzy classifier and modified Artificial Bee Colony algotithm. Polat et al. [5] also developed a cascade learning system to diagnose the diabetes. Chang and Lilly [6] developed an evolutionary approach to derive a compact fuzzy classification system.. Kahramanli and Allahverdi [7] designed a hybrid neural network system for classification of the diabetes database. For instance, Campos-Delgado et al. [8] developed a fuzzy-based controller that incorporates expert knowledge to regulate the blood glucose level. P.Magni and R.Bellazzi [9] devised a stochastic model to extract variability from a self-monitoring blood sugar level time series. Polat and Gunes [10] designed an expert system to diagnose the diabetes disease based on principal component analysis. Yuan ren [13] have proposed two SVM parameter optimization approaches, i.e. GA-SVM and PSO-SVM, adopt an objective function which is based on the leave-one-out cross-validation, and the SVM parameters are optimized by using GA (genetic algorithm) and PSO (particle swarm optimization) respectively. N.M.Lavanya and M.Pravin Kumar [14] developed expert system based on PSO and Fuzzy Technique for Medical Diagnosis.

3. Existing Genetic Algorithm

Genetic algorithm (GA) refers [2] to a model introduced and investigated by John Holland in 1975 for adaptation processes of nature. Generally stated, a GA is any population based model that uses selection and recombination operators to generate new sample points in a search space. Genetic algorithms were inspired by the processes observed in natural evolution described by Charles Darwin in his "The Origin of Species". GA is a global search procedure that searches from one population of points to another. It is a probabilistic search procedure, which is being frequently applied to difficult optimization and learning problems. There are two versions of the GA, namely the natural GA and the computational GA.

The advantage of genetic algorithms is, it go through an iterative process to create an optimal solution. Consecutively to use a genetic algorithm, there must be many components like multiple drugs, symptoms, treatment therapy and so on available in order to solve a problem. Genetic algorithms have proved to be useful in the diagnosis of various human diseases.

Genetic algorithm which is iterative, consists of the following steps

- Select an initial population, P(k), of a given size m, where k=1. This selection is made randomly from the set Gn. The choice of value m is important. If it is too large, the algorithm does not differ much from an exhaustive search; it is too small, the algorithm may not reach the optimal solution.
- Evaluate each chromosome in population P(k) in terms if its fitness. This is done by determining for each chromosome x in the population the value of the fitness function, f(x).
- Generate a new population Pn (k), from the given population P(k) by some procedure of natural selection. We describe only one possible procedure of natural selection, which is referred to as deterministic sampling. According to this procedure, we calculate the value e(x) = mg(x) for each x in P(k), where g(x) is a relative fitness defined by the formula.

$$g(k)=\frac{f(x)}{\sum_{n\in p^{(k)}} f(x)}$$

  Then the number of copies of each chromosome x in P(k), that is chosen for Pn(k), is given by the integer part of e(x). If the total number of chromosomes chosen in this way is smaller than m (the usual case), then we select the remaining chromosomes for Pn(k) by the fractional parts of e(x), from the highest values down. In general, the purpose of this procedure is to eliminate chromosomes with low fitness and duplicate those with high fitness.
- If stopping criteria are not met, go to step5, otherwise stop.
- Produce a population of new chromosomes P(k+1), by operating on chromosomes in population Pn(k). Operations that are involved in this step attempt to mimic genetic operations observed in biological systems.

These Genetic Algorithms are based on simplified evolutionary processes to achieve optimal results. It works based on the components of random sets of solutions to a problem, recombined with top solutions that come out then and mutated run through the process again. This happens over and over until the proper solution is discovered.

4. Proposed Model to Predic Diabetes

By literature survey, we observed that various fuzzy classification systems, stochastic models are developed to diagnose the Diabetes based on general symptoms i.e. mainly, the food taken by us converted into glucose. The pancreas secretes insulin which carries glucose into the cells of our bodies, which in turn produces energy for the perfect functioning of the body. Due to lack of it we may suffer with Diabetes with general symptoms like Increased thirst, Increased urination, Weight loss, Increased appetite, Fatigue, Nausea and/or vomiting , Blurred vision, Slow-healing infections , Impotence in men etc. Usually, the chronic suffering leads to complications like heart disease, stroke, and neuropathy, poor circulation leading to loss of limbs, blindness, kidney failure, nerve damage, and death.

Our proposing model focuses that besides general symptoms we can also diagnose Diabetes by analyzing genes and chromosomes. The common forms of diabetes in type 1 diabetes (T1DM) and type2 diabetes (T2DM) are diseases with important genetic underpinnings, by without any clear pattern of inheritance. The disease phenotypes result from the interaction of multiple gene variants, each exerting only a modest effect, and the environment.

Recent research has suggested that the number of gene variants that contribute to these disease phenotypes may be much larger than previously understood, and the precise genes that are involved have been difficult to identify. However, when grouped with other variants and acting either contemporaneously or over time, relatively insignificant changes created by individual gene variants may work additively or synergistically to cause disease.

The proposing model predicts the disease based on the family history of person who suffered with chronic Diabetes. Here diagnosis done based on personal observation data through Assessment Module as well as evaluates chromosomes through Compatibility Module. This is done by set of character strings that are analogous to the base-4 chromosomes that we see in our own DNA. It focused on fixed length character strings.

The Proposed model will work based on the following steps of modified GA:

- Step 1. Initialize the population of individuals of family members.
- Step 2.Test for termination criteria
- Step 2.1 Evaluate the fitness of all of the individuals in the family.

- Step 2.2 Create a new population by performing operations such as CROSSOVER and MUTATION on the individuals whose fitness has just been measured.
- Step 3. Discard the old population and iterate using the new population.
- Step 4. Repeat step 2, 3 until stopping criteria met, otherwise stop.

Where one iteration is referred as a Generation. Crossover is a genetic operator used to differ the programming of a chromosomes from one generation to the next using various selection methods. Mutation is a genetic operator used to keep genetic diversity from one generation to the next.

For evaluation it consider random sets of input and the solutions that come out on top are then recombined and mutated and run through the process again. This happens over and over until the proper solution is discovered. The contextual diagram for proposed system is as follows.

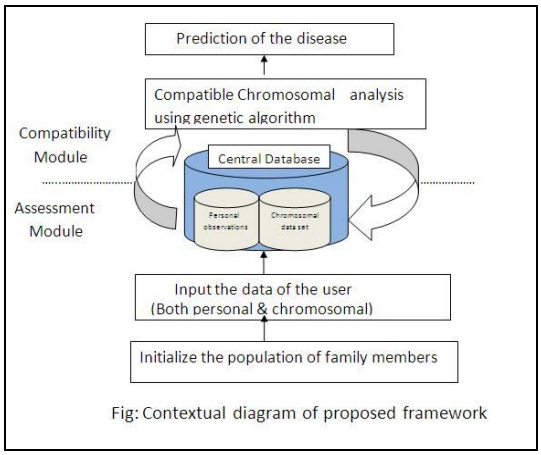

Figure 1

5. Conclusion

Based on the family history we proposed a model to predict the future scope in the generation of a particular family. So a person in family who is having suspension of diabetic symptoms, they can use our proposed system to predict the disease based on personal observation (general symptoms) along with chromosomal compatibility study in particular family. The combined reasoning approach will help to diagnose the disease with accuracy and exactness both by persons and clinicians. With this, a good intelligent system will be proposed to get enormous outcome for managing Diabetes.

6. References

1. American Diabetes Association, "Standards of medical care in Diabetes—2007," Diabetes Care, vol. 30, no. 1, pp. S4–S41, 2007.
2. S.Sapna, Dr.A.Tamilarasi and M.Pravin Kumar," Implementation of Genetic Algorithm in Predicting Diabetes", IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 1, No 3, January 2012
3. Aishwarya S and Anto S " A Medical Expert System based on Genetic Algorithm and Extreme Learning Machine for Diabetes Disease Diagnosis" International Journal of Science, Engineering and Technology Research (IJSETR), Volume 3, Issue 5, May 2014
4. B.Fayssal, M.A.Chikh, "Design of fuzzy classifier for diabetes disease using Modified Artificial Bee Colony algorithm", Computer methods and programs in biomedicine, No.1, pp.92-103, 2013.
5. K. Polat, S. Gunes, and A. Arslan, "A cascade learning system for classification of diabetes disease: Generalized discriminant analysis and least square support vector machine," Expert Syst. Appl., vol. 34, no. 1,pp. 482–487, Jan. 2008.
6. X. Chang and J. H. Lilly, "Evolutionary design of a fuzzy classifier from data," IEEE Trans. Syst., Man, Cybern. B, Cybern., vol. 34, no. 4,pp. 1894–1906, Aug. 2004.
7. H. Kahramanli and N. Allahverdi, "Design of a hybrid system for the diabetes and heart diseases," Expert Syst. Appl., vol. 35, no. 1/2,pp. 82–89, Jul./Aug. 2008.
8. D. U. Campos-Delgado, M. Hernandez-Ordonez, R. Femat, and A. Gordillo-Moscoso, "Fuzzy-based controller for glucose regulation in type-1 diabetic patients by subcutaneous route," IEEE Trans. Biomed. Eng., vol. 53, no. 11, pp. 2201–2210, Nov. 2006.
9. P. Magni and R. Bellazzi, "A stochastic model to assess the variability of blood glucose time series in diabetic patients self-monitoring," IEEE Trans. Biomed. Eng., vol. 53, no. 6, pp. 977–985, Jun. 2006.
10. K. Polat and S. Gunes, "An expert system approach based on principal component analysis and adaptive neuro-fuzzy inference system to diagnosis of diabetes disease," Dig. Signal Process. vol. 17, no. 4, pp. 702–710, Jul. 2007.
11. http://en.wikipedia.org/wiki/Clinical_decision_support_system#Features_of_a_Knowledge -Based_CDSS

12. Genetics of Diabetes by Richard B. Horenstein and Alan R. ShuldinerUniversity of Maryland School of Medicine, Division of Endocrinology, Diabetes and Nutrition, 660 West Redwood Street,Room 494, Baltimore, MD 21201, USA.
13. R.Yuan, B.Guangchen,"Determination of Optimal SVM Parameters by Using Genetic Algorithm/Particle Swarm Optimization", Journal of Computers, No.5, pp.1160-116, 2010.
14. N.MLavanya,M.Praveen Kumar"Expert system based on PSO And Fuzzy Technique for Medical Diagnosis" IJART,Vol.2,Isuue 4,2012,66-71