



Application of Fuzzy Logic and Neural Network Algorithm as an Input to Decision Support System Prescribing Medicine for Diabetes

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Abstract

Decision support system (DSS) is a commonly used strategy to come up with a better solution. In the field of medicine, ideas from other doctors would be an effective way to determine the successful result of medicating a patient's disease. In this paper, fuzzy logic and neural network is used as a tool to determine the right input of medicines to the DSS of doctors. Fuzzy logic would be used to filter medicines that are applicable to the patient's capability. Through this, neural network would take the role of determining the most recommended medicine of the doctors from their previous patients. The output would serve as an input for the DSS which will be used by the doctors.

Keywords: decision support system; fuzzy logic; neural network; diabetes

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1. Introduction

Based on the statistics of the Department of Health, Philippines there has been 19, 805 deaths due to diabetes from the year 2004 to 2008. The number of cases increased to 22, 345 a year after. Diabetes is one of the major causes of death. This disease is not just a problem in the Philippines but also in other continents like Asia and Europe [7,9]. It is a disease that makes the body cells malfunction. Diabetes could also affect the other systems of the body including the heart [10]. It can be categorized into two: Type 1 and Type 2. Diabetes Type 1 can be cured by injecting insulin. This type of diabetes mostly affects children. [11]. Diabetes Type 2 could affect children and adults, any age or weight [7, 10]. Handling the possible sickness or diseases that the patient might have is one of the concerns in the stage of diabetes. Understanding the current body state of the patient is one way to determine the possible diseases because of diabetes [2,5]. Medication of Diabetes Type 2 might be through medicine or through insulin. Such treatment cost big amounts of money for some patients. Identifying the most effective medicine for the patient is a challenge for the doctors[3]. The worst case while under medication is that the patient might become weak due of the medicines or to come up with another disease. In this case, asking the support of other doctors is needed.

Prescribing the most effective medicine for diabetes can be done by collaborating with the different ideas of doctors. Controlling the future risk of the patient will be solved through this strategy [3-5]. In case of complicated disease of patient, decision support of different doctors would be effective. Application of fuzzy logic could be used to eliminate medicines that have contraindications to the patient's conditions. Fuzzy Logic analyzes the contraindication of the medicine and the patient's body state. Prescribing the right medicines for the patient would be the result of this algorithm [5,8,9]. These results would be numbers of medicines that are applicable to the patient. Identifying the most effective and commonly prescribed medicine by different doctors could be used as decision support [1]. Neural network would be an effective tool to connect prescribed medicine and the details of the patient. Prescribed medicines might differ to the result of patient's medication. It will always depends on the condition of the patient. In this case, studying the result of the previous patient and comparing this data would be an effective way to come up with a better medicine [1,2].

The result of the Fuzzy Logic and Neural Network algorithm will be the candidate medicines that are possible to prescribe. It will be the input to the decision support system of the doctors in prescribing medicines for diabetes. These medicines are the support of the different doctors based on their previous patient's case. It includes the results, findings, information, and medicines prescribed. Deciding the right medicine for the patient will be from the doctor.

2. Review of related literature

According to M. Shi and C. Zhou, Traditional Chinese Medicine (TCM) is commonly used for medication. The basis of medication would be the patient's symptoms and based on the previous case [3]. Application of neural network would be an effective way to connect uncertainty data in producing

the procedure to apply medication to the patient. Through this method, producing desired result would be accurate by validating the incoming data.

A research paper was published about determining the length of stay of the patient based on the disease and different symptoms. Fuzzy logic was used to relate the previous result of patient and their length of stay [6]. Using the same algorithm, X. Lei and X. Zheng used Fuzzy Logic to track the possible diseases of the patient based on their current disease and immune system[5]. Fuzzy Logic is an effective tool to manipulate data and produce useful result in medicating patient. Through this, it could be used as a tool to enhance the decision making of doctors in prescribing medicine to their patients. Neural Network could be used to determine the possible disease of the patient. It connects nodes or data of the patient to come up with possible results of diseases [2].

As diabetes increases the number of target victims, data mining could be used to prevent the continuous increasing of patient. One way of preventing the patient from diabetes is to monitor the current body state including the age, total cholesterol, body size, or gender [9]. Neural network would be an effective tool to connect these data at produce the result on how to handle the patient’s medication. In case that the patient already have the diabetes and must undergo with the medication, prescribing the best medicine for the patient would be done by applying Fuzzy Logic and Neural Network. Through this, decision support system would be useful for the doctors in case that there might be rare patient with different disease complication.

3. Filtering medicines using fuzzy logic algorithm

Application of fuzzy logic algorithm to the decision support system requires data coming from the doctor. These data would be the medicine to be prescribe and the details of the patient. Let’s say that M will be the medicine to be prescribe and P for the patient’s details that includes the contraindication to the medicines. 1 will indicate that the contraindication is true and 0 will indicate that the contraindication is false. Here are some medicines for diabetes based from MIMS Philippines.

Table 1. Medicines and Contraindications

Medicines	Contraindications
Actos	Cardiac Failure DM Type 1 Hypatic Dysfunction Hypersensitivity Pregnancy Renal Dysfunction Sever Infection Sever Ketosis

	Trauma
Actosmet	Cardiac Failure Hypersensitivity Impaired Renal Function Ketoacidosis
Byetta	DM Type 1 Gastrointestinal Disease Impaired Renal Function Ketoacidosis Renal Dysfunction
Januvia	Hypersensitivity
Janumet	Hypersensitivity Impaired Renal Function Cardiac Failure Renal Dysfunction Coma
RiteMED Metformin	Impaired Renal Function

Let's say that:

Actos {1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0}

Actosmet {1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0}

Byetta {0, 1, 0, 0, 0, 1, 0, 0, 1, 1, 1, 0}

Januvia {0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0}

Janamet {1, 0, 0, 1, 0, 1, 0, 0, 0, 1, 1, 1}

RiteMED Metformin {0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0}

Patient has Hypatic Dysfunction and Coma

P {0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1}

Prescribed Medicine is Byetta

M {0, 1, 0, 0, 0, 1, 0, 0, 1, 1, 1, 0}

Once the Fuzzy Logic encounters a medicine that contradicts with condition of the patient, it will be filter out. Through this, strengthening the decision of the doctors on their prescribed medicine would be done.

Result:

Actosmet {1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0}

Byetta {0, 1, 0, 0, 0, 1, 0, 0, 1, 1, 1, 0}

Januvia {0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0}

RiteMED Metformin {0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0}

From this result, application of the Neural Network will be used to identify the most recommended medicine coming from the data of the doctors. Identifying the most recommended medicine would give the doctors knowledge on the right and best medicine to be prescribed [1]. These data would be the inputs to the decision support system of the doctors in finalizing the prescribed medicine for the patient.

4. Application of Neural Network

The result of the Fuzzy Logic will be used to produce the target output of Neural Network. Filtered medicine will be connected into different hidden nodes to determine the best medicine based on the inputs of the doctors. Medicating the diabetes needs to consider the body immune system of the patient [9]. Decision support system would be effective if the patient was cured due to small period of time and cost. Through this, Neural Network would be an effective tool to use in identifying the appropriate medicine to prescribe.

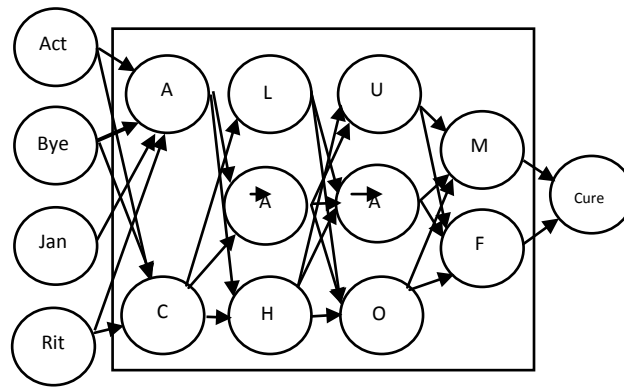


Fig. 1. Neural Network Analysis

Medication of patient will be based on its own body immune system. It includes the age bracket, cholesterol level, weight, and gender [9]. Each medicine has contraindications and effectiveness. Through the application of Neural Network, identifying the most recommended medicine would be produce. Reducing the risk of time and cost medication, an effective medicine is needed to cure the patient.

The figure shown the hidden nodes where medication will depends on the patient's capability.

Age: Adult or Child

Level of Cholesterol: Low, Average, High

Weight: Under, Average, Over

Gender: Male or Female

Determining the most recommended medicine will be based on the inputs of the doctors from their previous patient. It will be consolidated and turn into usable information for the decision support system. Application of Neural Network would be an advantage to the doctors to determine the medicine that would also help the patient to save time and cost of medicating diabetes.

5. Conclusion

Decision support system would be an effective tool to identify the possible medicines for curing different diseases. As the Fuzzy Logic used as the filtering of medicines from its contraindications and patient's capability, right medicines would be the output of this process. Neural Network would be the bridge to determine the most recommended medicine based on the inputs of the doctors. The output of the said algorithms will serve as a support for the decision of the doctors. Prescribing medicine will be still on the doctor's decision. The information produced by the decision support system will be the guide of the doctors to cure patient's disease.

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