

Predicting And Simulating Level Of Diabetes Over The Region Using Complex Networks

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Abstract:

In the industrialized world, diabetes is most common disease affecting 193 million people in 2003. Current research shows that current number of people affected with diabetes is 347 million. Scientists have researched many methods to replace the necessary hormone in blood glucose that is called insulin. As a result of advanced technology, new methods have opened up to develop advanced treatment methods. In this paper, I am going to relate diabetes with complex networks by creating a virtual system for the patients suffering from diabetes. I have taken a data set of patients suffering from diabetes and analyze the various factors by implementing on Matlab. The aim of this paper is to create a user-friendly virtual system that takes blood glucose values as input and analyzes them according to the graphs which are created using the data set. If the blood glucose value is under risk, the system will provide nearby hospital using a graphical user interface. The graphical user interface uses Google navigation to provide nearby locations.

Keyword: Insulin, blood, glucose, GUI, glucose biosensor

1. Introduction:

Diabetes is becoming a major health problem in today's life. The main cause of this problem is increasing obesity, sedentary life style etc. Energy source in human body is glucose. Two hormones, insulin and glucagon, are necessary to regulate the blood glucose level. When blood glucose level increases, alpha cells try to maintain the glucose level. When blood glucose level decreases, beta cells try to maintain the blood glucose level. Blood glucose is taken as input for the virtual system. We analyzed the various factors of diabetes using a data set. The data set helps us to design all the factors which will be responsible for diabetes. Blood glucose is the main energy source in human body.

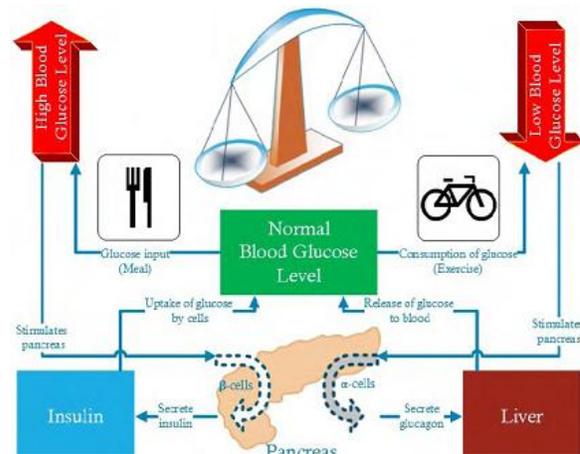


Fig: Glucose system

Diabetes is the syndrome in which carbohydrates, fat, protein metabolism is disturbed. We created a virtual system for the patients suffering from diabetes which analyzes all the factors of blood glucose. If the value of blood glucose is under risk, this system declares the patient under risk and provides nearby hospital according to geographical location. Blood glucose value is taken as virtual input. It is considered that blood glucose value is measured by a glucose biosensor. That value is given to the virtual system and it gives results according to the graphs generated using the data set. A graphical user interface is also created to provide Google navigation to patients. Different criteria are defined by WHO for measuring the value of blood glucose for type 1 and type 2. This criteria is considered to measure the value of blood glucose. Simulation process is used to analyze the blood glucose value. If the value is not suitable, the patient will be declared as in risk. Various risk factors are analyzed to declare the output of this system.

2 .Related Work:

First Step toward this research to analyze the risk factor from dataset. Dataset is taken from internet and analyzing various values of risk by implantation on the matlab.Glucose biosensor is used to take value of blood glucose.

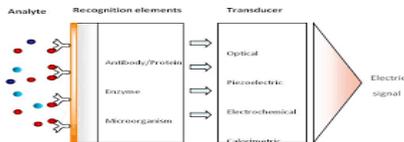


Fig:Glucose Biosensors

2.1 Analyzing values from dataset:

Codes used in data set representing various events:

- 33=Regular insulin dose
- 34=NPH insulin dose
- 35=Ultra-Lente insulin dose
- 48="Unspecified blood glucose measurement "
- 57="Unspecified blood glucose measurement "
- 58=Pre-breakfast blood glucose measurement
- 59=Post-breakfast blood glucose measurement
- 60=Pre-lunch blood glucose measurement
- 61=Post-lunch blood glucose measurement
- 62 = Pre-supper blood glucose measurement
- 63 = Post-supper blood glucose measurement
- 64 = Pre-snack blood glucose measurement
- 65=Hypoglycaemic symptoms
- 66 = Typical meal ingestion
- 67 = More-than-usual meal ingestion
- 68 = Less-than-usual meal ingestion
- 69 = Typical exercise activity
- 70 = More-than-usual exercise activity
- 71 = Less-than-usual exercise activity
- 72 = Unspecified special event

2.2 Designing Graphs InMatlab Between Blood Glucose And Code Values:

Graph is designed to analyze risk factors from dataset. First graph is between blood glucose and code. Code 33 means patient take regular insulin dose. That's why value of blood glucose is low. Between 45 to 50 unspecified measurement of blood glucose is taken. That's why value of glucose is high in this area.At 59 post breakfast glucose

measurement is taken. In this area value of blood glucose is high. At 60 pre lunch blood glucose measurement is taken Value of blood glucose is low than the post breakfast measurement. At 61 post lunch measurement of blood glucose taken. At 65 patient is suffering from hypoglycaemic.

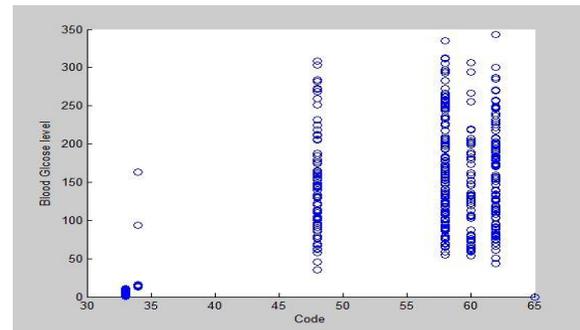


Fig:Graph Between Code and Blood Glucose

2.3 Designing Graphs InMatlab Between Blood Glucose And Age:

Graph is designed to analyse various risk factor between age and blood glucose. This graph is analysed from women dataset. Dark blue bubbles show the higher intensity of blood glucose. Light bubbles show less intensity of blood glucose. This graph is used to declare that person is in risk or not.After age 70 the value of blood glucose remain constant.

2.4 Various factors which can be studied:

- Number of times blood sugar increase
- Plasma glucose concentration a 2 hours in an oral glucose tolerance test
- Diastolic blood pressure (mm Hg)
- Hour serum insulin (mu U/ml)
- Body mass index (weight in kg/(height in m)^2)
- Diabetes pedigree function
- Age (years)

The following graph shows relationship between women age and blood glucose value. Between age 20 to 30 there is no consistency in value of blood glucose. Between age 30

to 40 there is some low intensity of blood glucose as compare to age 20 to 30. Between age 50 to 60 and 60 to 70 there is less intensity.

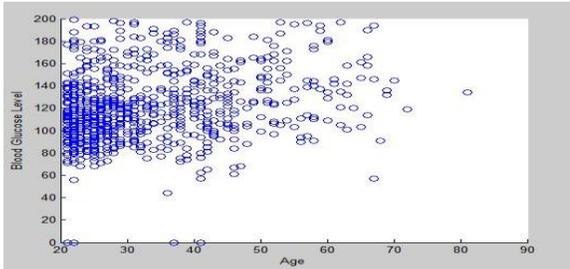


Fig:Graph Between Age and Blood Glucose Level

3. Designing Simulator:

Simulator provides the virtual environment to patient. It is assumed that blood glucose value is already we have. Simulator calculate the output by observing graphs and give output to patient according to value of blood glucose.

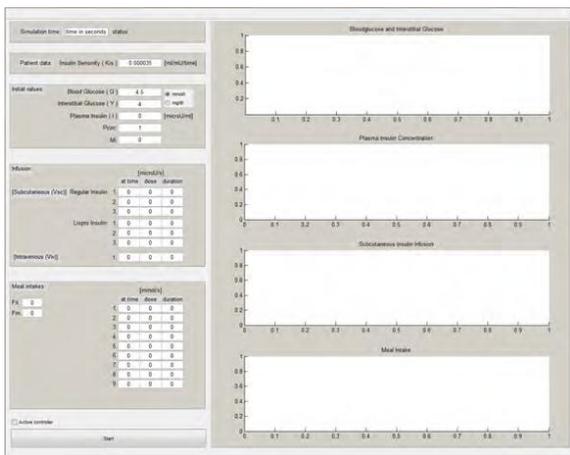


Fig:Design of Simulator

3.1 Differential Equations Which is solved in Matlab:

There are two types of insulin considered in this research:

Regular Insulin

Lispro Insulin

T1 and T2 are two constants which describe the time delay between insulin. Vs1 and Vs2 are the rate of administration. -S1 and -S2 are the release rates to plasma compartment. Following model is used in this research. This model consist of three compartment. The subcutaneous compartment describes the insulin flow I with a time delay to the plasma compartment after an insulin injection[1]. The time delay depends on the type of insulin[1]. The plasma compartment was modeled to describe the plasma insulin concentration I and the remote compartment shows the insulin concentration in the periphery X[1].



Fig:Flow Diagram

$$ds/dt=1/ti(-s+vi)$$

$$ds1/dt=1/t1(-s1+v1)$$

$$ds2/dt=1/t2(-s2+v2)$$

$$dI/dt=1/Txi(-I+Ki(V4+s1+s2))$$

$$dx/dt=1/Tm(-X+I)$$

The plasma compartment represents the plasma insulin concentration I (equation 4)[1], whereby S1,S2 , and V4 are subcutaneous intravenous insulin inputs andTxi is the time constant of diffusion in the plasma compartment[1]t. The Ki parameter is a gain constant, which determines how much insulin in plasma arrives in dependence of the distribution volume[1].

3.2 Glucose Subsystem:

It modeled into two non linear compartment. First compartment represents blood glucose G and second represents Subcutaneous glucose compartment y . Blood glucose compartment have three inputs. E_g in blood glucose compartment represents intestinal glucose absorption. E_b represents hepatic glucose. G_4 represents glucose infusion.

E_r describes the renal glucose clearance in hyperglycemic conditions [1]. To manage the glucose uptake in blood from ingestion of food as well as consumption of glucose by the glucose metabolism a liver was inserted, which is represented as a non- linear block [1].

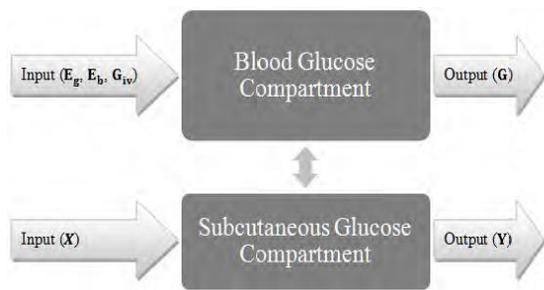
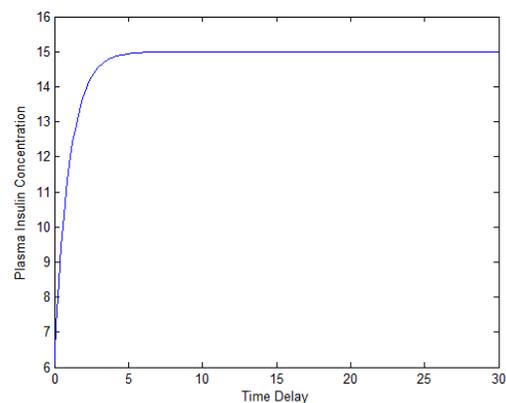
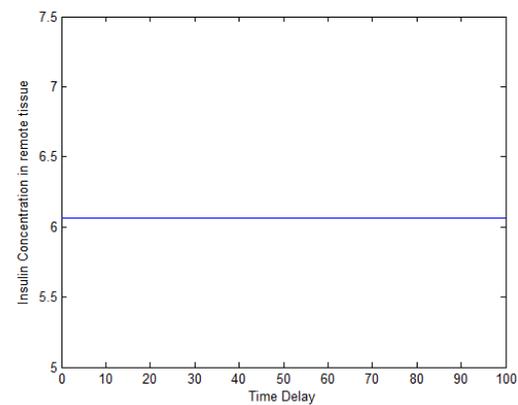
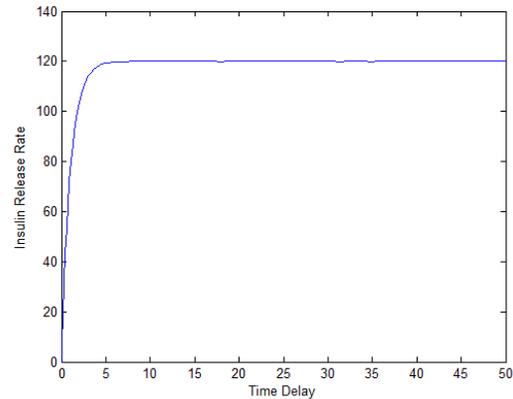
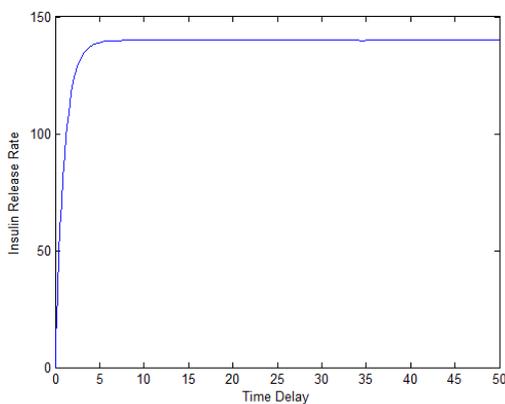


Fig:Input Output Diagram

4. Results:



5. Conclulsion:

This simulator system will provides information to the patient about insulin release rate ,plasma concentration .When value of blood glucose put by the user in simulator than graphs are generated automatically which provides

information to the patient about health. If the patients are under risk than this simulator provides information to the patient. Verification and validation are the problems with this virtual system.

The written software and associated implementations of components of the mathematical model, as well as the controller, were also successfully carried out by using MATLAB[1]

Finally, the developed graphical user interface (GUI) was completed for the operation of the simulator and is fully functional[1]. A user-friendly and correct application of the simulator is therefore secured[1].

6. References:

[1]. A virtual Type 1 Diabetes Patient by Tim Wasmuth.

[2]. **Tattersall, Robert B.** The history of diabetes mellitus. [book auth.] John C. Pickup & Gareth Williams. *Textbook of Diabetes 1.3*. Massachusetts : Blackwell Science Ltd, 2003, Vol. 1, 1.

[3]. **L. Duke, David.** *Intelligent Diabetes Assistant*. 2009. Chapter 1.2.1 Physiology of Diabetes.

[4] **International Diabetes Federation.** Types of Diabetes. [Online] [Cited: November 6, 2013.] <http://www.idf.org/types-diabetes>.

[5]. **World Health Organization (WHO).** Types of Diabetes. [Online] [Cited: November 9, 2013.] http://www.who.int/diabetes/action_online/basics/en/in dex1.html.