An Innovative Approach to Diabetes Diagnosis

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Abstract—According to the IDF report, diabetes kills one person every 6 seconds. The IDF estimates there are currently some 175 million cases of diabetes that have gone undiagnosed. The key objective behind the development of this project is to make people aware of diabetes. Diabetes is one of the deadly diseases that throw people to the condition of death .This project consists of mainly a program called "Diabetes Prevention Program"(DPP) where we classify people depending on the tests and the drugs available to them.
By using this program many people are let to know about the symptoms of diabetes and its causes ,risks involved and the diagnostic criteria.
This program was built by using the Archimedes Model ,LOWA algorithm and Glycemic Control Algorithm.

Keywords—Archimedies model, LOWA algorithm, DPP, Glycemic control algorithm, diagnosis.

I. INTRODUCTION

Diabetes is a disease of development. The misconception that diabetes is "a disease of the wealth'" is still held, to the detriment of desperately needed funding to combat the pandemic. In coming years we have much to do in making the case for those who have diabetes now and will have in the future[1].

Diabetes, often referred to by doctors as diabetes mellitus, describes a group of metabolic diseases in which the person has high blood glucose (blood sugar), either because insulin production is inadequate, or because the body's cells do not respond properly to insulin, or both. Patients with high blood sugar will typically experience polyuria (frequent urination), they will become increasingly thirsty (polydipsia) and hungry (polyphagia)[2].

Types of Diabetes
1. Type 1 Diabetes
The body does not produce insulin. Some people may refer to this type as insulin-dependent diabetes, juvenile diabetes, or early-onset diabetes. People usually develop type 1 diabetes before their 40th year, often in early adulthood or teenage years. Type 1 diabetes is nowhere near as common as type 2 diabetes. Approximately 10% of all diabetes cases are type 1.Patients with type 1 diabetes will need to take insulin injections for the rest of their life. They must also ensure proper blood-glucose levels by carrying out regular blood tests and following a special diet.
2. Type 2 Diabetes
The body does not produce enough insulin for proper function, or the cells in the body do not react to insulin (insulin resistance).

3. Gestational Diabetes
This type affects females during pregnancy. Some women have very high levels of glucose in their blood, and their bodies are unable to produce enough insulin to transport all of the glucose into their cells, resulting in progressively rising levels of glucose. Diagnosis of gestational diabetes is made during pregnancy. The majority of gestational diabetes patients can control their diabetes with exercise and diet. Between 10% to 20% of them will need to take some kind of blood-glucose-controlling medications. Undiagnosed or uncontrolled gestational diabetes can raise the risk of complications during childbirth.

4. Surgically induced diabetes
When surgery is performed on the pancreas for any reason, there's a risk that its ability to produce insulin will change. This condition may be temporary or permanent. If you have this type of surgery, frequent testing of blood sugar is needed to monitor whether or when medications or insulin injections may be necessary[4].

5. Chemically induced diabetes
Some types of medication can cause your blood sugar level to be higher than normal. Steroids, specifically cortisone or prednisone, are the most common cause of such high blood sugar. Treatment may include prescription oral diabetes medication or insulin.

Diabetes Is A Metabolism Disorder
Diabetes (diabetes mellitus) is classed as a metabolism disorder. Metabolism refers to the way our bodies use digested food for energy and growth. Most of what we eat is broken down into glucose. Glucose is a form of sugar in the blood - it is the principal source of fuel for our bodies.
When our food is digested, the glucose makes its way into our bloodstream. Our cells use the glucose for energy and growth. However, glucose cannot enter our cells without insulin being present - insulin makes it possible for our cells to take in the glucose. Insulin is a hormone that is produced by the pancreas. After eating, the pancreas automatically releases an adequate quantity of insulin to move the glucose present in our blood into the cells, as soon as glucose enters the cells blood-glucose levels drop. A person with diabetes has a condition in which the quantity of glucose in the blood is too elevated (hyperglycemia). This is because the body either does not produce enough insulin, produces no insulin, or has cells that do not respond properly to the insulin the pancreas produces. This results in too much glucose building up in the blood. This excess blood glucose eventually passes out of the body in urine. So, even though the blood has plenty of glucose, the cells are not getting it for their essential energy and growth requirements.

II. METHODOLOGY

The major methods used in the development of Diabetes Prevention Program are

1.Archimedies Model 1st equation
2.Lowa Algorithm for Prediabetes and Type 2 Diabetes
3.Glycemic Control Algorithm

1.Archimedies Model 1st equation

The main motive behind the Archimedies model is the generation of simulated data. The requirements to generate the simulated data are:

1. It is very difficult to gather patients in large numbers.
2. Most of the patients show unwillingness for the tests
3. Equipment and laboratory costs will become more

This model mainly defines the "Physiology" and "Care Processes" of the people. The model is mainly based on the object oriented programming where the number of people are considered to be the classes of objects.

Every object in the program can be represented as a variable and this model shows the relationship between variables. The physiology of an individual is characterized by features. Example of the feature includes blood sugar levels like FPG and PPBS.

From the set of features in a trajectory we shall calculate their health interventions with respect to the rate of change of that feature in a trajectory which is defined by the equation

$$\frac{dF^k(t)}{dt} = R^k(t)$$

Where $F^k(t)$ is the value of the feature at time t for the kth agent. $R^k(t)$ is the rate at which the value of feature changing at time t. The progressive or the change of the feature with respect to time is taken in a trajectory[3].

2.LOWA Algorithm

This is the algorithm that is mainly used to determine the precondition stage of diabetes by using the various tests like FPG.If the patient is supposed to have diabetes and in the prediabetes condition, he/she needs to go through the insulin therapy and the patient needs to be screened for the tests for every 3 months if the results are not achieved by the patient. The following are the various conditions if a patient does not have diabetes.

Initiate lifestyle interventions for treatment of Prediabetes; establish achievable targets/goals with patient; examples include:

Weight loss: 5-7% total body weight
Physical activity: 150 minutes/week
(examples include walking, biking, dancing, swimming, pilates, yoga)

Structured programs such as the Chronic Disease Self Management Program, YMCA, and Local Public Health Programs should be considered

Follow-up: Every 3 months.

If the patient does not achieve his/her targets then
 Consider starting metformin if no contradictions and if and if the following:

BMI>35kg/m2, age<55 years; FPG 100-125mg/dL
Starting Dose: 500mg QD with food

Increase dose every 1-2 weeks, to achieve clinically effective dose of 1500-2000 mg/day, based on tolerability
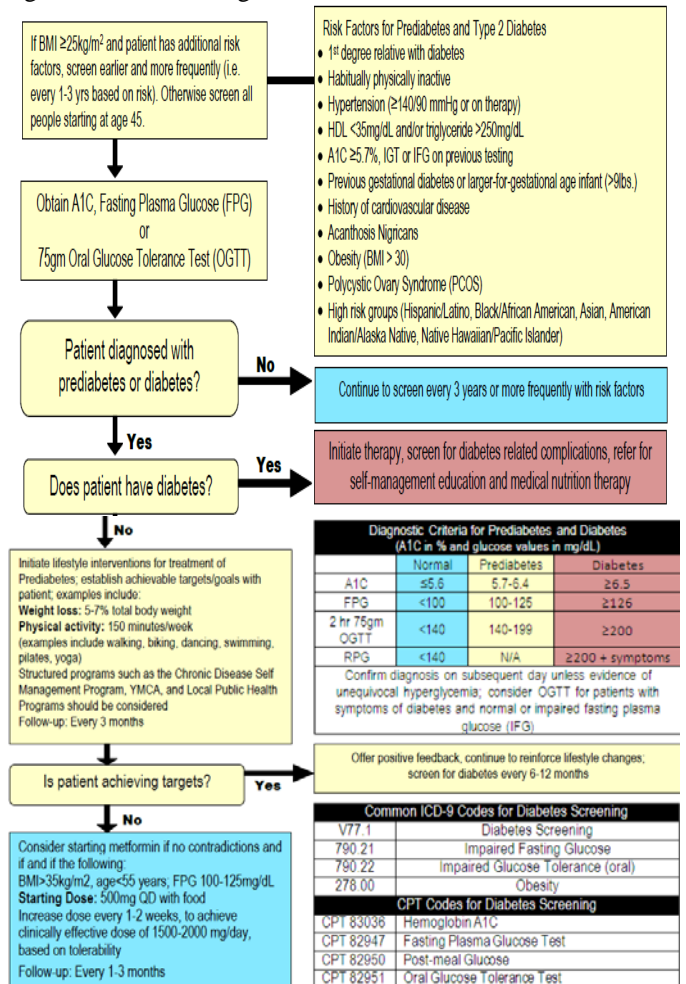Follow-up: Every 1-3 months as shown in fig 1.

The diagnostic criteria of various tests are represented as below

Fig1: Diagnostic criteria of tests

The LOWA Algorithm can be represented in the following figure as follows in fig 2

Fig 2:LOWA Algorithm

3.Glycemic Control Algorithm

This is the algorithm that is mainly used to tell about the usage of various medications available based on tests.
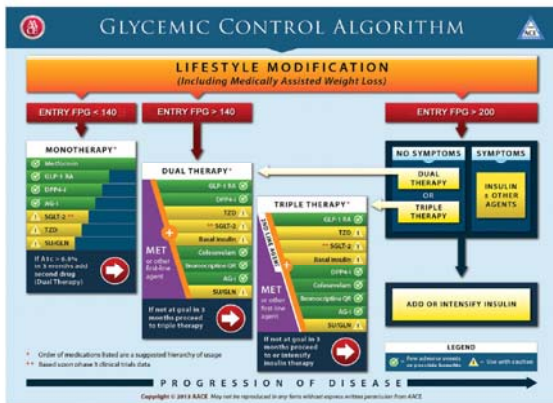
The algorithm can be represented as follows:

Fig 3: Glycemic Control Algorithm

This algorithm represents the medications in monotheraphy, dual therapy and triple therapy based on the results that are generated in FPG in fig 3.

If the FPG results are <140 we go for monotheraphy that consists of mainly drugs related to metaformin with a combination of any other drug.

In dual theraphy we use drugs if the FPG level>140 and mainly medications of the group GLP1-RA,DPP-4 inhibitors etc.

If The FPG level increases still without controlling then it denotes that it is a dangerous situation and we need to go for triple therapy where we uses combinations of more than two drugs and we also use some drugs in the form of injections. This is the most dangerous level that might transfer the disease into a cardiovascular disease, Kidney disease etc[5].

3. RESULTS AND DISCUSSION

The results generated in this project consist of the simulated values that vary over a time period depending upon the age.

Here age is considered as a trajectory and the values can be generated on this trajectory depending on the change of their test results. Thus we indicate that a patient in a normal situation today might get the diabetes over a change of period.
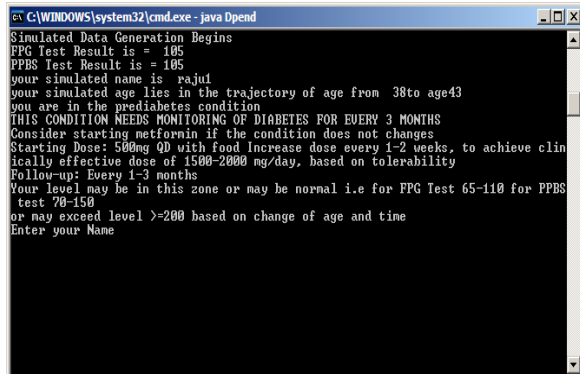
The results are as follows:

Fig 4: Result of FPG and PPBS Test

This shows that the person results are in the prediabetes condition. In fig 4.
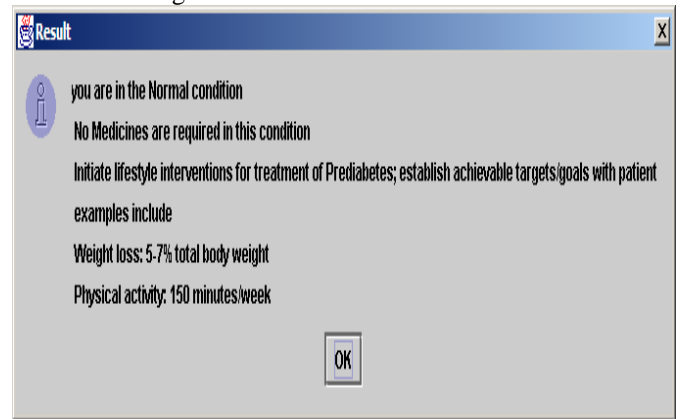

Fig 5: Result of normal test condition

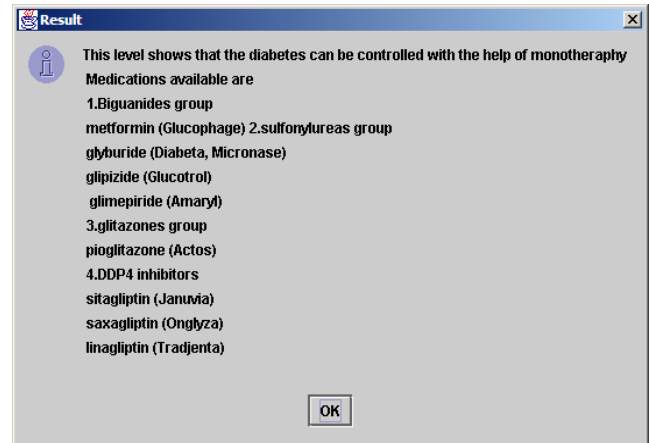This figure 5 shows that the same person if he is in the normal condition
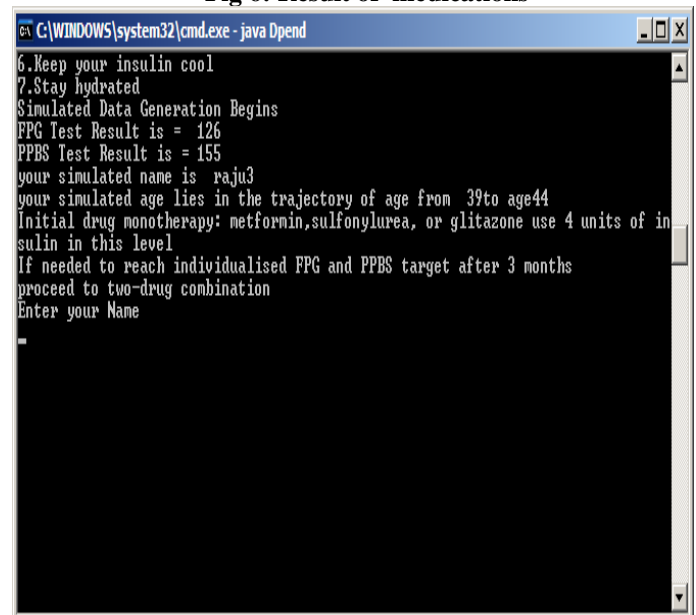

Fig 6: Result of medications

Fig 7: Result of FPG and PPBS Test in monotheraphy

This condition shows that if a person is suffering from diabetes and if he is in the monotherapy condition the drugs available in this therapy shown in fig 7

Fig 8: Result of FPG and PPBS Test in dualtheraphy

This condition shows that if the persons diabetes level increases with respect to the age, he will be in the diabetes condition and requires the dual therapy shown in fig 8..

Thus we are going to classify the various patients based on the test results and the age factors.

The data thus generated can be classified by using the ID and levels of tests and can be stored automatically into another file as follows in fig 9.

Fig 9: data extraction result

This can be obtained by merely entering the name and age group an Id will be automatically generated and by entering that Id then the results are loaded automatically into another file. This is the subpart of the program. This can also be classified by using the data mining technique [6].

CONCLUSION AND FUTURE SCOPE

We would like to conclude that this project aims at and labours all the efforts to take a kind of awareness of diabetes in the doorsteps of the layman. it brings the knowledge of different levels of diabetes to the doorsteps of the common man. Further the project enables the common man to avoid perils he will be exposed to because of diabetes. The project also helps him while suggesting the patient the medications and precautionary steps towards the disease.

Future Scope

The further enhancement of the project will help in the use of an online diabetes program that is available to a common man in the form of a web site. Even though today we have many programs that are available in the online for the diabetes, none can reach to any individual because of the cost of running of the program.

This further enhancement of the program helps in developing a web site that is openly accessing to an individual with the help of an ID without any charges. This enhancement may help the common man to know about the symptoms, risk factors and also the precautionary steps regarding the diabetes with the help of doctors may open a clinic that gives information regarding the diabetes and its complications [7].

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