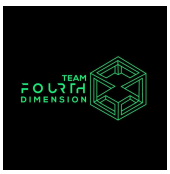

DiabeaTiT

Non-Invasive approach
powered by AI and IoT

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Defining the Problem:

Diabetes is a chronic condition that is caused by c high blood sugar levels. Treatment requires:

1. Tracking and monitoring of blood sugar level at uniform and frequent intervals.

2. Doing appropriate physical exercise, undertaking appropriate diet, controlling stress levels.

3. Taking insulin doses regularly.

Inconveniences faced by Patients and Doctors in the treatment procedure:

1. Blood Sugar tracking is an invasive process, it requires a person's blood to calculate glucose level.

   There is a need for changing the blood sample collecting plate for every test which makes the system even more expensive.

2. The discomfort of pain and risk of infection can sometimes be a source of great stress and concern.
3. No facility to check glucose level in remote areas without a proper setup.
4. Requires the patient to pay visits frequently at the doctor’s place.
5. Diets and Exercise are suggested to patients once in a while. This needs to updated in smaller intervals.

6. Some factors which aren't recognised but affect diabetes need to be addressed.
7. Irregularities in checkup and doses of medicines which results in bigger problems because of negligence of both patients and doctors.

Approach to solve the Problem:

1. Non Invasive Blood Glucose level Calculation:

The possible sources of data from human body which can be accessed non-invasively are:

a. Blood, by using parts of body with greater blood concentration and lesser bone and muscle as a container of blood (**Pseudo-invasive** method).
b. Saliva and urine (**External** method).
c. Eyesight condition based on retina **(Retinopathy)**.

Possible Methods of Acquiring Data are described below:

a. Blood through skin, pseudo-invasive method:

Consider blood to be the desired fluid sample and skin can be considered to be the container. Features that can be extracted can be optical and electrical.

With either of them, these steps need to be followed:

Step 1:

Analyse blood samples to calculate how blood glucose level is correlated to the parameters of **electrical and optical signals** which are:

Voltage, Current and Phase and frequency of the electrical signals (**bio-impedance matching**)
Transmission coefficients of light for different frequencies and phase of optical signals
(**spectroscopy**)

Step 2:

Take input from subject (preferably earlobe due to low bone density) and generate data-set containing values of the signal and blood sugar level of the subject.

Step 3:

Compare the data obtained in Step 1 and Step 2 and try to eliminate the parameters of the container as noise.

Machine Learning Techniques of Supervised Learning will be required to make correlation models for individual steps and Unsupervised Learning will be used to calculate Noise.

Comparison of both the datasets using data science can give us a model to accurately predict the blood glucose level.

b. Saliva and Urine: External method

Step 1:

Establish theoretically, the effect of variation of blood glucose level on parameters of chemical, electrical or optical parameters of saliva and urine.

Step 2:

Generate the data set of the variations in selected parameters from Step 1 and blood glucose level.

Step 3:
Analyse the data of Step 2 to find correlation. As done for 'a', unsupervised machine learning needs to be used to eliminate possible noise in the data and make an accurate predictor of blood glucose.

c. Eyesight condition based on pupils, Retinopathic methods:

Particularly for the age group with inability to produce urine (kidney failure cases) or the younger age group

It has been well established that high blood sugar causes the lens of the eye to swell, which changes patient's vision.

As of now dilated exams have are scheduled for patients when the patient feels discomfort in vision.

Current testing methods of testing of retinopathy include taking images of blood vessels of retina.

By making a wearable device and mounting high quality cameras in a VR headset, images of retina can be captured.

This data of **images of retina can be mapped to blood glucose level of the subject.**
Hence using **Artificial Neural Networks** and **Deep Learning**, a model can be created by which the blood sugar level can be predicted.

2. Reducing gap between Doctors and Patients:

Patients are often reluctant to pay frequent visits to their doctors. They blame their busy schedules for it which in fact might even be true.

Once the blood glucose level and other parameters like blood pressure, pulse rate, calories burnt and diet are monitored in real time by our wearables or instruments, the data will be directly pushed to a cloud for every hour. This facilities better understanding of the past trends according to the daily activities of patients.

A website will be used which will have a login portal for both doctors and patients. Patients can easily have access to their data and by the use of prediction techniques of machine learning when irregularities occurs it can directly send the data to the doctor, then from the doctor's login they can able to access their patient's data both present and past and can be able to monitor the past trends with the help of graph based on past data of patients and in return are able to comment or suggest the necessary steps.

An app will be installed on the user's mobile which will be used to frequently take the data from our device(s) and update the cloud database, it will be also used to remind the patient of their daily intake of medicines and help them follow their medication and steps in treatment as prescribed by the doctor.

The app monitors the patient’s glucose level in regular intervals and suggests the patient to have a dose if the amount of glucose is less than the intervals required as per the body conditions. lf there is a feeling of dizziness , the app sends an sms to the patient’s emergency contacts and doctors and also suggests measures for first aid.

Using tools of Data Analytics which will be made available on the website, the doctor can know better about his/her patients with the help of past records.

This can also help in directly sending them the prescription and maintaining a proper record of everything.

In remote areas like small villages, there is a bizarre ratio of doctors and patients. This makes it difficult for both of them to keep up with the schedule. Enabling such easy exchange of information by use of IoT can bridge the gap between doctors and patients.

Using tools of Data Analytics, the
doctor can know better about his/her patients.
This can also help in directly messaging them the prescription.

This doesn't eliminate the need of patients to meet the doctor but it does make the work of doctors easier and reduces the number of visits significantly.

3. Prescriptive Analysis for patients:

Looking at the data of patients and prescribing medicine, lifestyle and diet for each person has been a tedious task for the doctors.

Once the time-series data of blood glucose level of patients is available on the cloud, CART based models can be used to suggest ideal parameters.

Once the ideal parameters for patient and current parameters of the patient are known, data analysis algorithm can be used to map the difference between the two set of parameters and possible prescriptions of doctor like Diet, Physical Exercise and Stress Level. Algorithms can also be made to suggest the doctors about the quantity of insulin required in exact intervals of time where in the patient needs to consume insulin to make the task easy.

To complete the solution, a chatbot will be made for the patients such that chatbot represents an omnipresent nurse who is helping them take care of their diabetic conditions. The chatbot will have access to all the data on our cloud. Doctors will also have access to the chatbot. This way, with the help of **NLP,** the best user experience is also ensured.