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Analysis of Volatile Organic Compounds in Exhaled Breath for Detection of Diabetes Mellitus and Cholesterol

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Abstract:- In this modern era, lifestyle-related illnesses have become increasingly common and the need for technology that makes diagnosing them easier and faster is growing. Respiratory analysis is the most promising field for research that has the potential to diagnose volatile organic compounds (VOCs) and its focus on the respiratory tract and has the potential to detect and monitor disease progression. Regarding the diagnosis of diabetes mellitus, glucose levels are calculated in the most painful, time-consuming, and aggressive manner which is why there has always been an urgent need for the development of a non-invasive, sensitive sensory system. Acetone is one of the effective biomarkers of glucose level but also appears to be a fast, flexible alternative to normal blood sugar levels. In response, we have developed a model of a portable non-invasive tool that explores the ability to analyze the respiratory signal as a means of monitoring glucose saturation with the help of a sensor for Acetone through which the effects will be realistic.

About 11% of Body cholesterol was present in the skin and evenly to the percentage found in the blood. This study focuses on simplicity and uncommon ways to measure cholesterol. Near Infrared (NIR) is a long light when the wavelength of the wave passes 700nm-1400nm from visible light in the electromagnetic spectrum. Non-invasive blood analysis methods were presented when the blood was lit in several different waves selected in the NIR spectrum, based on information obtained from analysis of skin parts using a simple test. The intensity of light reflected or transmitted at such wavelengths was measured.

Keywords:- *Diabetes Mellitus, Breath Analysis, Volatile Organic Compounds, Blood Cholesterol, Non Invasive, Near Infrared*

I. INTRODUCTION

An estimated 346 million people worldwide are said to have diabetes. Diabetes mellitus is a different group.

Regular testing of Glucose levels in Blood is necessary throughout our lives. Currently one of the most widely used diagnostic methods for diagnosing diabetes is Blood Glucose Meters (BGM's) that measure blood glucose levels. However taking blood samples from people is disruptive, painful, and not easy. Especially in Juvenile Diabetics which is usually Diabetes Type 1, they rely entirely on insulin injections to control diabetes, and insulin dose adjustment; therefore their blood should be drawn multiple times a day. As a result, after some time they may suffer pain physically. The human respiration pattern provides a handful of information. Respiratory methods of analysis, an upcoming process built on the development of modern measurement technology, is a type of non-invasive method used to diagnose a number of diseases. Many VOCs are found in both man-made and natural components. They are derived from normal metabolic functions and a few pathogenic diseases, which flow into the bloodstream and excrete through respiration, urine, sweat or saliva from the human body. From ppmv (parts per million volume) to pptv (parts per trillion volume), more than 1000 VOCs have been discovered that imitate the human spirit. Other respiratory VOC gases are signs of a wide range of illnesses, including diabetes, asthma, lung disorders, and many more. Apart from all gases, a number of studies have proven that acetone is a biomarker of diabetes. One of the VOCs in the sub-ppm range is acetone gas. Ancient physicians were able to identify an apple's rotting state in a diabetic patient's air. It was identified as the acetone scent after an extensive investigation over a number of years. Respiratory acetone intake varies from 0.22 to 0.80 ppm in healthy individuals and can reach 1.8 ppm two hours after a meal. It ranges from 1.76 to 3.73 ppm in those

with Type 2 diabetes and can reach -21 ppm in those with Type 1 diabetes. As a result, it is possible to create a non-invasive device that has an instantaneous, painless impact.

Each of the cholesterol-containing bodily cells serves critical environmental roles. It can also be released with meals and is created by the body. It seems waxy and is greasy. Since cholesterol is based on fat rather than water, it does not mix with blood. As a result, it is transported throughout the body via lipoproteins in the blood.

Low-density lipoproteins (LDL) and high-density lipoproteins (HDL) are the two types of lipoproteins that may transport cholesterol throughout your body, and both are crucial for optimal health.

Category	**Total (mg/dl)**
Desirable range	< 200 **(mg/dl)**
Borderline range	200 – 239 **(mg/dl)**
High range	>240 **(mg/dl)**

Table 1:- Total cholesterol reference value.

II. METHODOLOGY

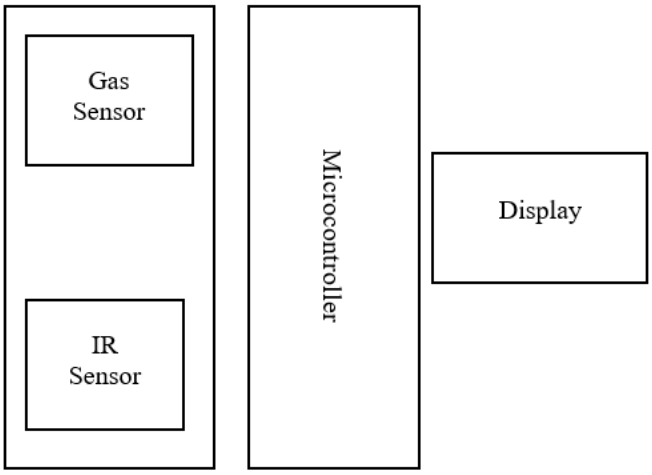

Fig 1:- Block diagram

By considering the specification requirements such as unit size, sensors, connection, control, power prototype expected to be achieved as shown in Figure 1. To calculate the glucose levels, we breathe air into the gas sensor and for cholesterol we keep our finger on the IR sensor.

All the sensory data provided by the Arduino control board is sent to the microcontroller to compute the values of the analog values and is put into the normal units of representing the glucose and cholesterol levels in the blood.

The photodiode supplies voltage to the ADC controller, which calculates the total quantity of cholesterol using the logarithmic equation and displays the results on the LCD panel. Then, changes in the measured reflectance or transmittance ratios are linked to certain material characteristics.

III. HARDWARE IMPLEMENTATION

To translate associated electrical characteristics into acceptable values that may be provided from a biological point of view, some sensors need to be encoded. For the purpose of preventing exposing mistakes brought on by other alterations, the code should be as exact and precise as feasible. For the device to be able to control operation, a microcontroller is required. Due to its simplicity and adaptability, we have decided to use the Arduino UNO. The TGS822 acetone sensor, which has the wonderful benefit of being a wide range of detectors and aiding us in obtaining precise acetone levels, continues to be the device's major structural component. A microcontroller's analog input is used by the sensor to operate. We're using an I2C optical connection to connect to the LCD display.

IV. DESIGN FLOW

Working of the device is shown in the flowchart.

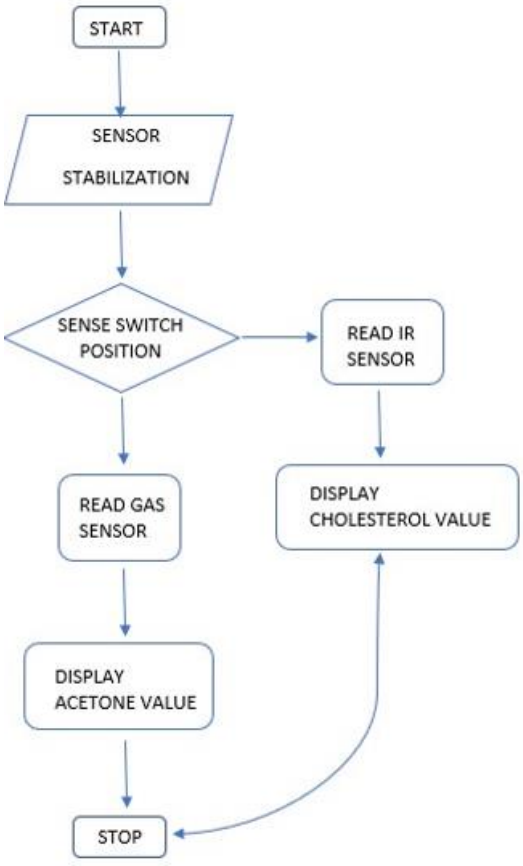

Fig 2:- Flowchart

V. RESULTS

The created device is a minimally invasive model. It has both qualitative and quantitative components. The gadget measures the acetone content in the person's breath and then proportionally shows the blood glucose level, indicating whether or not the individual has diabetes and simulating an intrusive technique reading. The subject samples were

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obtained using our device and verified using readings from the intrusive procedure. One can determine the accuracy of the gas sensor by carefully examining the generated findings. Numerous variables affect the likelihood that breath acetone will be present. Whether the user is tested before or after lunch is one of the variables to be considered.

The device measures the IR light reflected back when the subject's finger is placed on the sensor. It gives the corresponding values of cholesterol.

Fig 3:- Output of Glucose level

Fig 4:- Output of Cholesterol level

VI. CONCLUSION

It is a non-invasive model of the gadget that has been created. Equal parts are qualitative and quantitative. The gadget measures how much acetone is present in the person's breath and then proportionately shows the blood glucose level, indicating whether or not the individual has diabetes and simulating an intrusive method reading. The subject samples were taken using our technology, and they were verified using readings from the intrusive procedure. A determination on the accuracy of the Figaro sensor can be made after thorough study of the acquired findings. Numerous variables affect how likely it is that acetone will be found in the breath. It is important to take into account whether the user is tested before or after lunch.

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