Glucose and Haemoglobin Monitoring with IoT and Non-Invasive methods
Portable and Handy prototype for making better possible health

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Abstract: Many people in India are going through various type of diseases. These diseases are maximum related to our basic health parameters which are day by day proving as more chronic and incurable. Those particular diseases when tried to be cured end up with financial problems after entering into chronic stage. The root cause of all these diseases are mainly low pulse rate, haemoglobin levels and improper pressure levels of blood as well as improper glucose levels. In order to come out from those crucial situations a prototype is being devised which is capable and portable to measure pulse, glucose as well as haemoglobin levels using non-invasive techniques and linked with IoT. This device is embedded with Oxi-Pulse Sensor that will record the ratio of Red light vs Infra-red light(R/IR) based upon the Oxygenated and De-oxygenated haemoglobin. The Ultrasonic sensor will be dealing with the echo response based on glucose levels that will be determined by the skin permeability varied from glycolysis. Both these sensors are connected to Raspberry and can be monitored using mobile or tablet with help of IOT technology which can be enhanced from the prototype devised. This device is expected to alert and provide caution for abnormal levels and helpful in identifying various diseases like Diabetes, Anemia etc.,

Index Terms **-Chronic, Non-invasive, Permeability, IoT.**

Introduction

In day to day life our current world's scenario we are getting outbound for limitations and all the aspects are getting simplified including ways of living, with that it gives rise to much complications in health conditions. Due to climatic, environmental and technological changes so much of mutations and toxins are entering and all over blood causing damage to our immune system giving rise to many diseases and more specifically related to blood. In that scenario blood glucose and haemoglobin plays key role, although they don't relate or doesn't depend or correlate but individual factor estimation plays critical role in enhancing the health conditions of entire human body and those are key factors for various diseases during acute stages. Chronic stages are worse part and even cause more economical and socio mental damage. So, discovering the abnormalities primarily in Glucose and Haemoglobin in earlier stages can prevent worst cases or diseases in acute level itself. Mostly hospitals or diagnostic centers blood will be collected by venipuncture or pricking a finger with a needle and it is noted that the hygiene conditions along with sterile environment is not maintained properly all-time in processing that. So, a prototype in being designed using two type of sensors one is Oxi-Pulse Meter and the other one is Ultrasound sensor. Both the sensors will be connected to Raspberry pi controller can be monitored using Mobile or tablet applications taking the help of IoT technology to monitor the parameters. This type of devise will help to detect and identify various type of blood related diseases like Diabetes, Anemia, etc., by giving levels based on timeline.

II CLASSIFICATION AND METHODOLOGY:

1. Introduction to Non-Invasive Methodology:

Recent methodologies are now leading us to modern and novel methodologies of accessing technology and using its resources to gain healthier and structured cum organized life.

Non-invasive is one of the novel methods in giving that possibility where the process is carried out with zero impact and has more advanced techniques to process information and tasks for enhancing the lives of people with care and simplicity.

Here this method involves carrying out of light and ultrasound signal to get the readings of glucose and haemoglobin of a person and this involves portable and non-invasive method of monitoring health parameters of person.

2. Introduction to Ultrasonic Skin Permeability Response

Human Skin starts accepting the ultrasonic waves starting from 10KHz and from 30KHz it can give the response triggered from echo and if it is more than 40KHZ further analysis can be processed on tissues and helps out to get the response as per the input trigger provided to the soft matter.

This method involves trigger of 100KHz by providing 10uS as pulse width input to the trigger terminal and it carries continuous pulses that can be transmitted via transducer and penetrated through the skin and by the response received from the echo terminal

that are being refracted and repelled by the skin tissues it gives the extent of glycolysis and glucose absorbed by the skin cells and permeability caused by keratin protein over the skin.

Whenever the response is continuous and periodic in sort of deterministic response then the permeability is more that means glycolysis is driven out and skin contains very high or very less amount of glucose and when the response is aperiodic or non-deterministic then the glucose levels are normal stating that permeability is strict and low for getting in of ultrasonic waves and also echo obtained for that input.

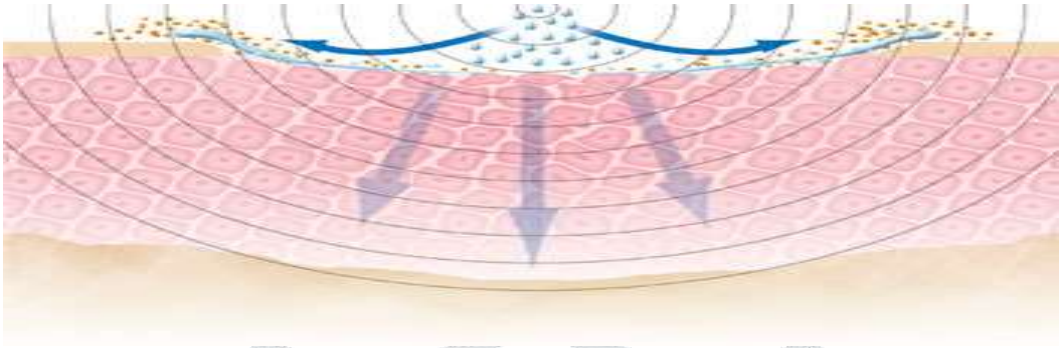

Fig: Ultrasound schematic of skin

3. Introduction to Infrared and LDR based Pulse Oxi Response:

Pulse Oxi response is the more abstract way of getting pulse and ratio of oxy-deoxy blood response, new modern methods involve measuring of Pulse and Haemoglobin using Light driven sensors consisting Red LED along with two parallel receivers having LDR and IR Receiver for getting the intensity of red color present in the blood and pulse by determining the ratio of oxygenated to deoxygenated blood ratio obtained by R/IR ratio from the sensor. In general pulse oximeters, red light emitted by light-emitting diodes ranging over 0.6 um of red spectrum in VIBGYOR and 0.94 um of infrared spectrum is incident over subject's finger and the spectrum emitted is estimated and determined factoring means and ratio from LDR and IR array. The changing material properties over the tissue absorbance is then divided and factorized electronically inconsistent data points are eliminated, the ratio (R, IR) is gained from the response of the sensor and processed using the digital comparator feedback IC inbuilt on the MAX30100 board that is being clarifying the methodology.

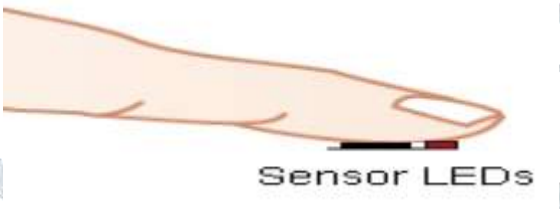

Fig: Placing of finger over pulse-Oxi sensor

averaged and mean values are randomly shuffled and finally factorizing all the mean values by determining ratio of R-IR is calculated and output is sent to controller.

I. DESIGN AND MODEL ANALYSIS:

II.

In the model of prototype, the 10uS pulse TTL digital OUT is provided to the trigger pin of the Ultra Sonic Transducer and the same transducers ECHO response is determined from the ECHO terminal that is being connected to the graspIO and also for more detailed view, we have also used MyDAQ to study the output response.

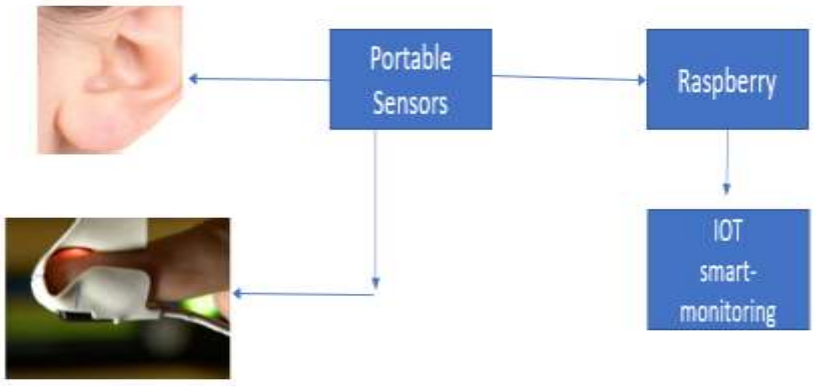

Fig: Schematic of devised prototype

Ultrasound sensor placed on the Ear Lobe

MAX30100 PO sensor placed on the index Finger

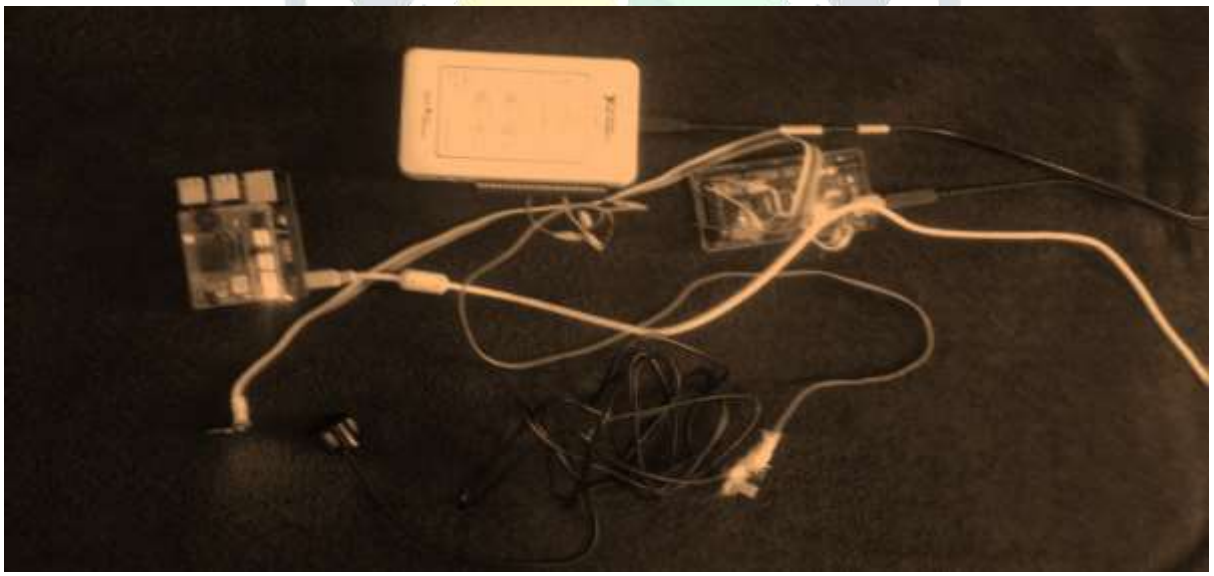

Fig: Final Prototype with MyDAQ & Arduino

IV. RESULTS OBTAINED:

The ultrasonic responses from the Fasting and post cardinal are taken and carried out for different subjects and the pulse, haemoglobin responses from the LDR and IR sensors are estimated and alerts have been triggered via notifications and email whenever any sort of abnormality conditions prevailing for the subjects.

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Sensor connectivity check......| Success....!
BEAT(1)
BPM: 74.63 | SPO2: 92.34%
BEAT(2)
BPM: 70.48 | SPO2: 91.07%
BEAT(3)
BPM: 87.25 | SPO2: 94.12%
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Fig: Pulse Oxi readings of subjects

Along with the raspberry pi the sensor data is connected to MyDAQ, hence the readings of the echo pin are displayed as below when taken for the subject during fasting and postprandial stages and difference can be easily identified.

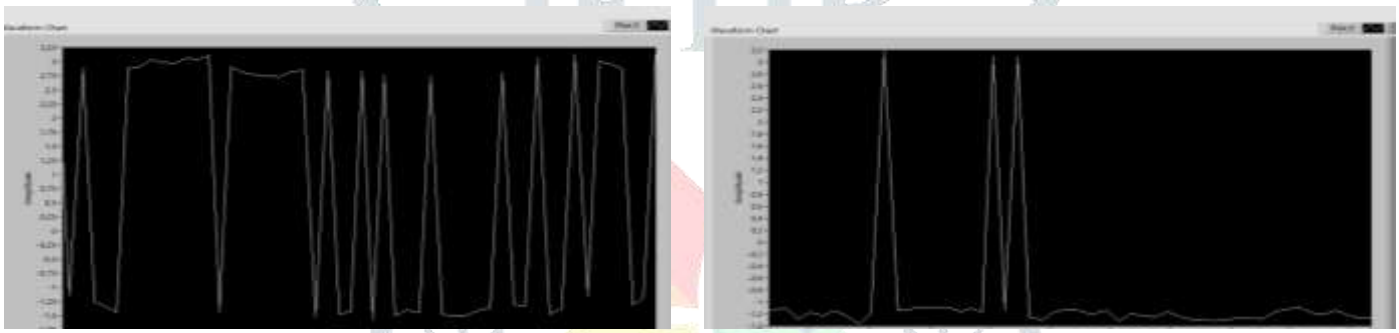
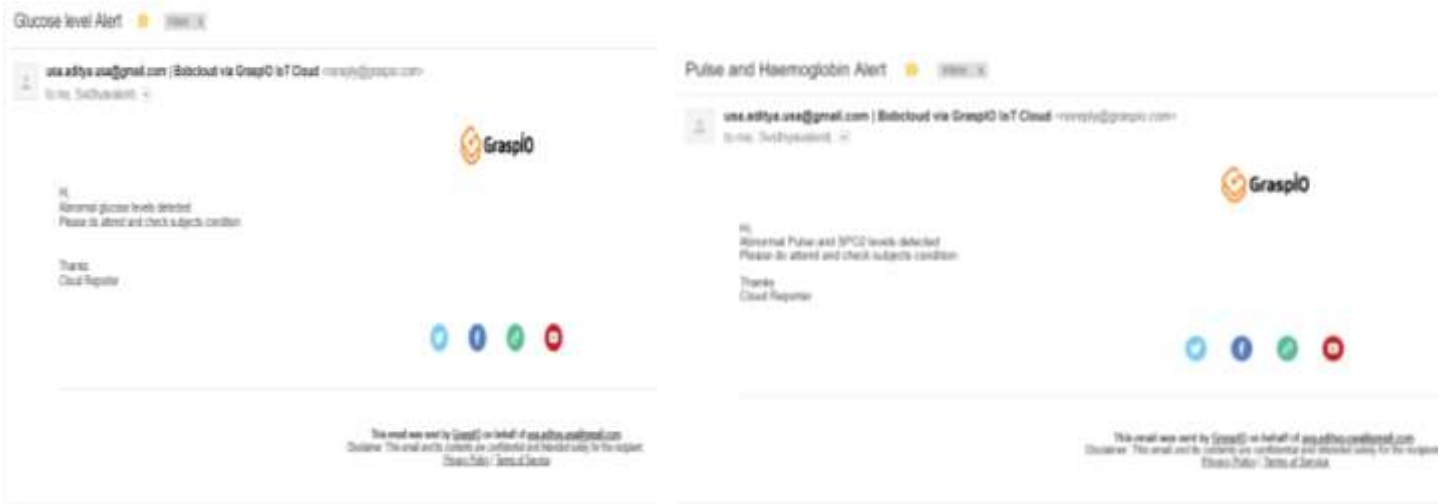


Fig: Fasting Response from ECHO pin Postprandial response

Whenever the response from the echo terminal is periodic and the wave pattern gives around 3.8 to 4.1 V Peak Amplitude with respective to time response then that implies permeability is more and glucose levels can be high or very low in manner and if the response is non-deterministic with aperiodic pattern of 3.2 to 3.7 V peak amplitude with trough symmetric patterns then the permeability of the sonic waves is less causing less response than fasting or glycaemia during post cardinal stage.

Here are the alert mails we get when any abnormal levels are detected and will be sent by graspIO cloud mailbox by configuring the threshold values in the raspberry pi system.



V CONCLUSION:

By the analysis done parameterizing the properties of Echo response carried out for various subjects and the result obtained by analysis done while fasting and post cardinal periods it states that the sonic response will be feeble when the permeability is high and vice versa. When the red to infrared ratio is more that implies peak magnitude of haemoglobin vs pulse is low. When the infrared absorption ratio is more that clearly states that more amount of oxygenated blood is present in our circulatory flow resulting good amount of haemoglobin. Thus, this novel and non- invasive of monitoring glucose and haemoglobin by portable means clearly helps us in enriching the lives of the people with zero damage along with the substantial periodic analysis of the data being monitored for weeks, months for the respective person, with the courtesy of IoT technology we can even more enhance and expand the monitoring elements and can help in maintain the safe and better living by early identification of conditions.

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