



DESIGN ARDUINO UNO BASE BLOOD GLUCOSE SENSOR FOR GESTATIONAL DIABETES

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Abstract

Blood glucose checking has been built up as a significant apparatus in the control of diabetes. On the grounds that maintaining regular blood glucose degrees is recommended, a collection of appropriate glucose biosensors were evolved over the last 10 years, glucose biosensor technology inclusive of factor-of-care devices, continuous glucose tracking structures and noninvasive glucose monitoring systems has been drastically improved but, there continues to be numerous demanding situations related to the achievement of accurate and reliable glucose monitoring. Similarly technical upgrades in glucose biosensors, standardization of the analytical goals for their performance, and constantly assessing and education lay customers are required. In the proposed system work glucose sensor it is mainly used to measure the glucose (sugar) levels of the pregnant women. The sensors are connected with the sensor interfacing equipment prototyping board which is named as Arduino UNO.

1. Introduction

The problem of maternal death during pregnancy is increase due to physical changes. Pregnancy is a delicate phase and requires serious medical care and treatment. The medical system is not centralized for information exchange (block chain). Most of pregnant women cannot be able to do their customary checkup in the beginning of pregnancy and this indicates high mortality in the case of infant and maternal in rural areas. Due to these

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issues, society is facing heavy medical problems. There is a need for technology that helps them to take care of them. In rural areas people do not know about proper medicines and technical progress during pregnancy. For example, pregnant women should scan at least the ultrasound during the pregnancy period to know more about the fetal growth. In addition, proper and timely check can ensure safe delivery. There is a lack of knowledge about the importance of proper medicine to women in rural areas. Medical expenses are also indispensable for them, therefore in this system, some fundamental parameters like glucose level is measured. Sensors are attached in this system thus it helps to take reading and display on the mobile. Pregnancy sometimes causes abnormal changes in the physical health of pregnant women, which lead to clinical problems. Complications arise when abnormal changes happen are driven by physical parameters when light changes in health are neglected, the result is serious; complications sometimes lead to maternal and fetal mortality.

1.1. Glucose-Insulin Control System

Glucose concentration is strictly managed by a composite of neuro-hormonal command framework [3] [4]. The glucose-insulin manage device have sizable effect in diabetes research and therapy .A ordinary nation plan of this framework is seemed in Figure 1. Insulin is a hormone. Its substance message advises the phone to open and get glucose secreted by means of beta cells, which are located inside corporations of cells inside the body. Chemical substance that controls the amount of sugar in the level is an organ, located among the stomach and backbone that assists with processing it discharges a hormone it makes referred to as insulin. The normal human chemical substance that controls the amount of sugar in level carries around 1,000,000 islets. The islets contain of 4 particular cell composes, of which three (α , β and λ cells) supply important hormones; the fourth section (C cells) has no acknowledged potential. The beta cellular, produces insulin, the sizable hormone inside the path of starch, fat, and protein digestion. Insulin is pressing in a few metabolic processes: It promotes the absorption and digestion of glucose by the cells of the body. Prevents the arrival of glucose for the liver; it reasons muscle cells to soak up amino acids, the fundamental segments of protein; and it hinders the breakdown and arrival of fat. The arrival of insulin from the beta cells may be activated via development

hormone (somatotropin) or by using glucagon, the most vital trigger of insulin discharge is glucose; whilst the blood glucose stage increments as it does after a dinner insulin is discharged to counter it. The lack of ability of the islet cells to make insulin or the failure to supply amounts enough to manipulate blood glucose degree is the reasons of diabetes [5].

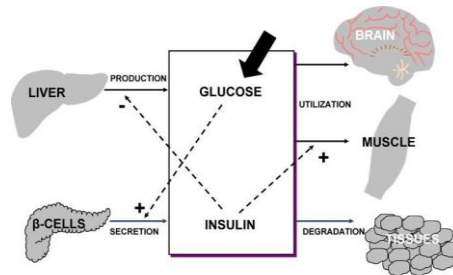


Figure 1. Scheme of the glucose-insulin system.

2. Methodology

2.1. Data Collection

Data collection was carried out from Sumaira maternity and nursing home at Aurangabad district of Maharashtra State. The required permissions were obtained from doctor and hospital to monitor the pregnant women visiting the hospital for monthly consultation constituted.

2.2. The System Design

The structural function of the system is the arrangement of blood glucose sensor for checking glucose level, and to support the reliable Monitoring of pregnant ladies and choose inactive glucose level for the indistinguishable, this proposed structure is inaccessible in two undeniable parts. Beginning one is sensor based unit and second is organization based unit. Sensor based unit accumulate the precedent from the watching body and the organization unit store the data and show the consistent data of the checking body. The arrangement of sensor based unit is according to the accompanying: it be supposed to be conservative, less requesting to pass on. It should have simple to utilize interface and moreover easy to use. It should accumulate the blood trial of the watching body and ought to send to the database. The arranged of organization unit is according to the accompanying: it must demonstrate the

blood glucose dimension of the body after that stores the sensor data and a modest point. Later demonstrate the chart of the glucose level. It is like a manner recuperate and manage the information of the checking body.

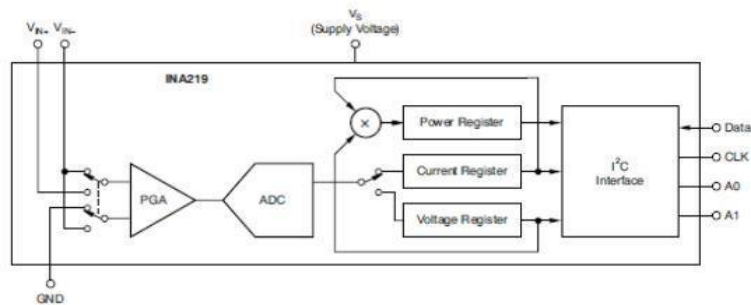
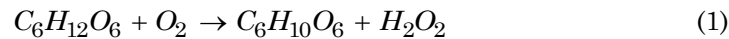


Figure 2. Electrical circuit diagram for blood glucose sensor.

The initial step is to quantify glucose in the blood. Convert the glucose focus into a voltage or current flag, this is conceivable with amperometry. As shown in figure no 2 Amperometry estimates electric current between a couples of terminals. The sensor utilizes a platinum and silver anode to frame some portion of an electric circuit where Oxydol Perhydrolysis electrolyzed. The hydrogen peroxide is delivered oxidation on a glucose oxide layer. The present moving through the circuit gives an estimation of the convergence of Oxydol Perhydrolygiving the glucose fixation. The compound reaction is given equation no 1.



Glucose Gluconic Acid

Three anode models utilize a working terminal (WE), reference cathode (RE), and a 'counter terminal (CE)'. After this current is created, it must be changed to voltage for preparing by the microcontroller (MCU). This activity is performed by the transimpedance enhancer. At last, the MCU distinguishes and forms this flag with the ADC module. A voltage is connected in the WE and RE terminals with a scope of - 200 mill volts to 8 volts. This is utilize to describe the voltage at which the sensor can perform at the largest part acute current. This esteem is around 4 volts with a current of 18 small scale amperes in the wake of choosing the 4 volts as a working quality, an adjustment time somewhere in the range of 2 and 4 seconds.

2.1. Hardware and Software Requirement

2.1.1. Hardware

Fundamental segment of the framework is the estimation motor which is a gathering of simple and advanced IP modules which connect with the sensors to convey a voltage to the microcontroller and process the estimation. The proposed estimation motor comprises of the accompanying segments:

A microcontroller is required as the fundamental organizer of the framework

Digital to Analog Converter (DAC): Gives the flag biasing. The DAC yields particular voltages to predisposition sensors (strips). A basic parameter in the DAC is the setting time, which must be equal to 1 second on a smaller scale for the high power mode and 5 μ s for low power mode. Monotonicity must be ensured, this will permit the best possible wave structures to inclination the biosensor.

Transimpedance Amplifier: Used to change over the current contributions to voltages that can be perused by the ADC, it performs flag molding. A basic parameter is predisposition current which must be underneath 500 microamperes to quantify little changes delivered in the biosensor amid the compound response.

Operational Amplifiers: Compare mode set for "more prominent than range" that starts the estimation calculation. The think about mode set for "inside range" effectively distinguishes the pinnacle of the synthetic response. A basic parameter for universally useful enhancer is the inclination current which must be beneath or equivalent to 2 μ A (normal at 25°C) to sanction the best likely plan of solidarity gain cushions, low pass channel, gain speakers, inverter and non-inverter programmable gain intensifier (PGA)

Analog to Digital Converter (ADC): The basic parameter on ADC is exactness which have to be above or equivalent to 13.5 piece compelling number of bits (ENOB), this permits the estimation of little flags in the biosensor. Standard quality and regard depend upon creator conclusions and advancement. Estimation frameworks impacts the exactness levels.

2.1.1. Software and USB Connectivity

Software components and algorithm are used for the growth of glucose

sensor. Extreme utilization for the explicit microcontroller lessens advancement time. These drivers would be utilized to control the LCD, the simple peripherals and the system interfaces. Application is used for automation of experiments, data visualization.

3. Effect of Gestation Diabetes on Mother and Its Fetus

Diabetes in pregnancy can have genuine ramifications for the mother and the mounting baby. The seriousness of issues regularly relies upon the level of the mother's diabetic infection, particularly in the event that she has vascular (vein) confusions and poor blood glucose control. Diabetes that happens in pregnancy is frequently recorded by White's characterization:

Gestational diabetes: At the point when a mother who does not have diabetes builds up a protection from insulin in light of the hormones of pregnancy.

- (a) Non -insulin dependent-Class A1, which can be controlled by changes in diet.
- (b) Insulin dependent-Class A2

It is essential for a mother to nearly deal with her diabetes amid pregnancy. For the largest part, the poorer the managed of glucose and the more extreme the illness and intricacies, the more prominent the dangers for the pregnancy. Babies of moms with diabetes are at more serious hazard for a few issues, particularly if glucose levels are not precisely controlled, including the accompanying:

3.1. Birth defect. Birth abandons are more probable in newborn children of diabetic moms, insulin-subordinate ladies who may have two to six times more noteworthy the danger of significant birth surrenders. Some birth abandons are not kidding enough to cause fetal passing. Birth absconds for the most part start amid the primary trimester of pregnancy. They are more probable in ladies with pre-gestational diabetes, who may have changes in blood glucose amid that time. In general, real birth deformities may happen in around 5 to 10 percent of newborn children destined to insulin-subordinate ladies.

3.2. Still-birth (fetal death). Still-birth is extra probable in pregnant ladies amid diabetes. The child may build up slowly in uterus because of poor

course or different conditions, for example, hypertension or microvascular sickness, which can confuse diabetic pregnancy. The accurate basis stillbirths occur amid diabetes is obscure. The danger of stillbirth increments in ladies with poor glucose managed and with vein changes.

3.3. Macrosomia. Alludes to an infant that is extensively bigger than ordinary. The common of the supplements the origin gets come specifically from the mother's blood. In the event that the maternal blood has excessively glucose, the pancreas of the hatchling detects the high glucose levels and delivers more insulin trying to utilize this glucose. The embryo changes over the additional glucose to fat. Notwithstanding when the mother has gestational diabetes, the embryo can make all the insulin it requirements. The mix of elevated blood glucose levels from the mother and elevated insulin levels in the baby results in substantial stores of fat that makes the hatchling become exorbitantly expansive.

4. Results and Discussion

Sensor: The sensor glucose INA219 used in this system .INA219 series glucose sensor belong to precision integrate circuit the output of proportional to the sensor is mg/dL sensor is used for glucose measured of mother and send it to Arduino is of microcontroller which is take this signal as input and is using Arduino software and get designed output. The kit analog output from glucose is connected to ADC TO DAC this kit used for various purpose. Arduino is a microcontroller the circle set up on the AT mega 328 has 14 digital input/output pin, 6 analog input, 16 MHz electronic oscillator circuit, a USB, dc plug, an ICSP pass made with the head and retune button. Since the value of the sensor is in analog format, it related to something to the analog input pin. In this semi-microcontroller, ADC will be change into digital signals before further processing. Arduino will process the signal and the result will be digital signal voltage form.

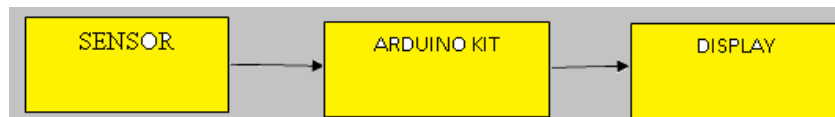


Figure 3. Block Diagram of Sensor Measurement.

The table no 1 is represents the 9 months count of average glucose level of pregnant woman and will be observed, Fasting average blood glucose levels were value in 3 time categories between one months prior to nine months postpartum in women. This paper represented that mobile health uses embedded sensors and microcontroller application. An android smart phone with glucose sensor is used to notice a go down of the carrier, and this android device is known as healthcare device. The android phone is then connected to the monitoring system. This document describes Android as a mobile application that interacts with sensors and allows simulation. This also helped to visualize signal processing. In this system, in the first place, there is the creation of an interface between the external sensors and the on-board device sensors to monitor the physiological limit of the human being. This document also explored the trend of mobile detection and adapted it to the improvement of digital signal processing (DSP), the creation of interfaces for medical sensors and external sensors.

Table 1. Average of glucose level.

Duration (Month/Date)	Fasting (100mgdl) (Avg)	Post Meal morning (<140)mgdl (Avg)	Post Meal Afternoon (<140)mgdl (Avg)	Post Meal Night (<140)mgdl (Avg)
21/04/2018	106	170	221	137
22/04/2018	116	154	226	143
23/04/2018	122	237	226	320
24/04/2018	113	135	188	130
25/04/2018	109	149	250	200
26/04/2018	120	260	222	119
27/04/2018	103	200	250	190
28/04/2018	128	250	320	180
29/04/2018	127	200	215	232
30/04/2018	108	200	220	190
01/05/2018	119	170	216	270
02/05/2018	109	197	259	200
03/05/2018	100	161	185	188
04/05/2018	180	230	250	196
05/05/2018	105	152	200	219
06/05/2018	124	252	223	151
07/05/2018	199	185	140	156
08/05/2018	166	248	200	249
09/05/2018	104	170	232	380
10/05/2018	121	174	177	111
11/05/2018	100	170	205	198
12/05/2018	106	128	226	174
13/05/2018	131	96	251	100
14/05/2018	101	279	208	118
15/05/2018	104	296	256	174
16/05/2018	116	158	241	173
17/05/2018	109	257	231	116
18/05/2018	108	188	121	157
19/05/2018	101	210	161	224

5. Conclusion

Nonstop glucose observing has a promising job in pregnancy. This device is light and very sensitive, therefore it is preferred as a domestic and regular monitoring. In rural areas, pregnancy reduces child mortality in women. It gives the quality and convenient health support for both fetal and pregnant

ladies. Changes in blood sugar ranges leads to birth defects in fetus. By giving continuous information and patterns in glucose levels, this sensor can be utilized in a clinical setting to advance guiding and administration of diabetes patients. On the off chance this sensors innovation turns out to be more available and advantageous, plausible future uses may reach out to nondiabetic pregnancies too. The result is seen in mobile phones. As a mobile application interacts with sensors and allows simulation. This also helped to visualize signal.

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