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Non-Invasive Health Monitoring System For Diabetes Patients

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Abstract: The growth of the digital era has paved the way for the development of numerous applications. Increasing the number of the population has also seen an increase in the number of people suffering from numerous diseases. Diabetes is one of the prominent diseases which is likely to occur commonly to most of the people in the world. It is necessary to check the level of glucose in the body for them by making use of many invasive methods. These methods bring a lot of pain to the patients using it. In order to get rid of these methods. The paper aims to study non-invasive detection methods for diabetes patients. Glucometry and pulse oximetry are two methods that are based on the absorption of light in tissues. Pulse oximetry-detecting blood glucose we will use the same method. Glucose can also be found in haemoglobin, according to the latest studies. It is especially useful when there is a suspicion of diabetes or prediabetes or to monitor long-term, in the case of diabetics. So we also measure other parameters which are basic for diabetes patients. The reading from Arduino is shared to the database via Wi-Fi Module and can be accessed by the patients or registered doctors. This research is significant where patients can independently monitor their diabetic health and the IoT system can be alerted directly to medial officers in the hospitals.

Index Terms - Health monitoring, Non-invasive, Arduino, Diabetic, Glucose

I. INTRODUCTION

Diabetes is one of the most challenging disease in 21st century healthy field due to number of patients increasing complication is very important in nowadays. Early detection of diabetes complication is very important in nowadays. The non-invasive glucose sensor is employed to detect the quantity of sugar levels in the body. Also presents the microcontroller to pre-process the sensor data and pre-processed data is updated to IOT. The creation of a non- invasive and reliable system for diabetic patients who are required to use this invasive procedure are going to be sigh of relief. The Internet of Things (IoT) is a paradigm in which different devices used on a day-to-day basis have the ability to communicate with other devices, whether or not they are of the same type, with the aim of providing services through the internet. These devices can be household objects (lamps or appliances), street objects, or embedded devices especially created for particular applications; they are all called “things”. Things not only acquire information from the environment and interact with the physical world, but also they can be equipped with identification, measurement, and process capabilities to provide context-aware services for achieving specific goals for information analytics, communications and final applications. Hyperglycemia and Hypoglycemia refer to medical conditions that exhibit abnormally high or low blood glucose/sugar levels. Diabetes is a condition in which the pancreas of the body ceases to produce insulin, which controls blood glucose levels. The causes of diabetes in humans are not yet fully understood, but the widely accepted hypothesis is that it may be genetic and may be caused by high sugar intake as part of a daily meal serving. Once diabetes is diagnosed, the blood sugar level needs to be continuously monitored in order to facilitate medicinal insulin intake. Patients with hyperglycemia, in which continuously high blood glucose levels are exhibited, may require Continuous blood glucose monitoring.

II. LITERATURE SURVEY

Blood Glucose Monitoring (BGM) is much necessary to be aware of complex situations due to variations in glucose levels in diabetic patients. To develop a portable and creative Non-Invasive monitoring device of blood glucose level for diabetics to measure the blood glucose concentration as and when needed [1]. Laser light-based sensors have demonstrated a superior potential for BGM. Existing Near-infrared (NIR) based BGM techniques have shortcomings such as the absorption of light in human tissue, higher signal to noise ratio (SNR) and lower accuracy, these disadvantages have prevented NIR techniques from being employee for commercial BGM applications. A simple, compact and cost-effective non-invasive device using visible red laser light of wavelength 650 nm for BGM (RL-BGM) is implemented in this paper [2].

Photoacoustic technique is employed to determinate the concentration of blood glucose non-invasively due to its advantage of avoiding the disturbance of optical scattering. But until now there is still no breakthrough on non-invasive blood glucose determination. The problem is that there is not only glucose in human blood but also a lot of other interference elements such as protein, fat and so on [3].

Monitoring blood glucose using a smartphone application that simply uses equipment already available on smartphones will improve the lives of diabetic patients who can continuously check their blood glucose levels while avoiding the current inconvenient, unhygienic, and costly invasive glucose meters [4].

In order to obtain accurate values of the synaptic weights of the ANN, inverse delayed (ID) function model of neuron has been used. The ANN model has been implemented on field programmable gate array (FPGA). Error in estimating glucose levels using ANN based on ID function model of neuron implemented on FPGA, came out to be 1.02mg/dl using 15 hidden neurons in the hidden layer as against 5.48mg/dl using ANN based on conventional neuron model [5].

III. BLOCK DIAGRAM

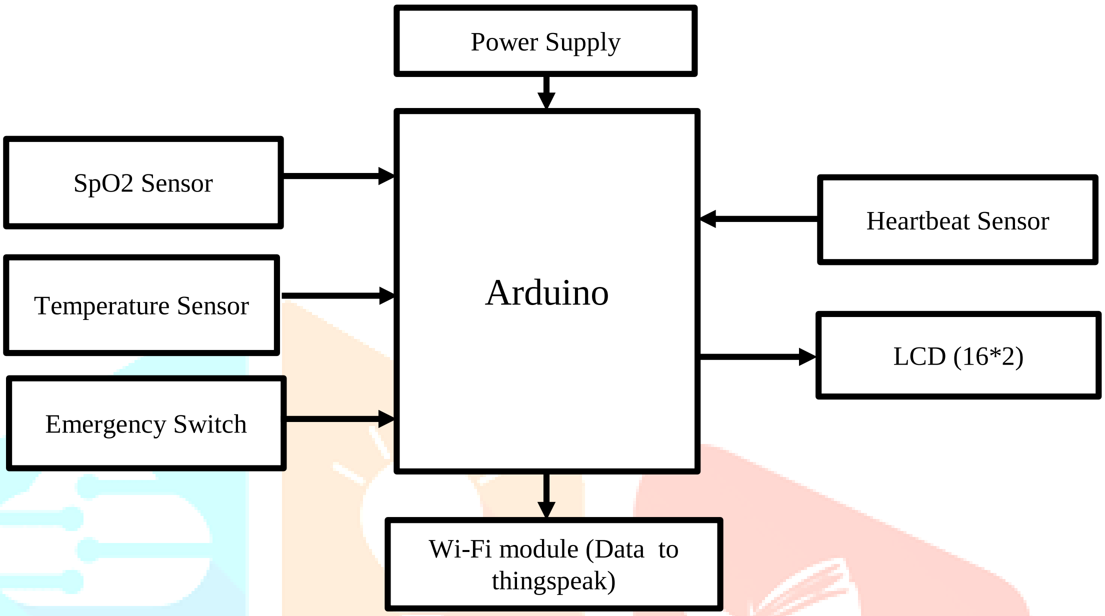

Figure: Block Diagram of proposed model

IV. HARDWARE DESIGN

A. ARDUINO UNO

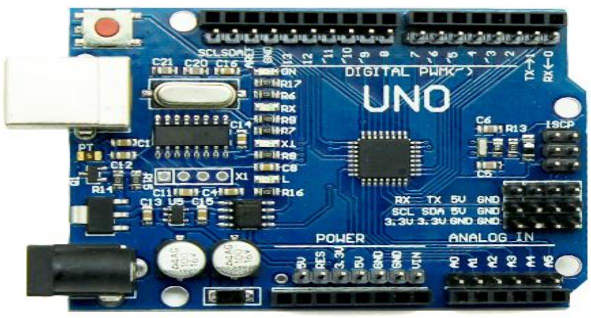

Figure: Arduino UNO

Arduino Uno is a microcontroller board developed by Arduino.cc which is an opensource electronics platform mainly based on AVR microcontroller Atmega328. The current version of Arduino Uno comes with a USB interface, 6 analog input pins, 14 I/O digital ports that are used to connect with external electronic circuits. Out of 14 I/O ports, 6 pins can be used for PWM output. It allows the designers to control and sense the external electronic devices in the real world.

B. SpO_2 SENSOR

Figure: SpO_2 Sensor

The SpO2 sensor is an integrated pulse oximetry and heart rate monitor sensor solution. It combines two LEDs, one emitting a red light, another emitting infrared light. Both the red light and infrared light is used to measure oxygen levels in the blood, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals.

C. TEMPERATURE SENSOR

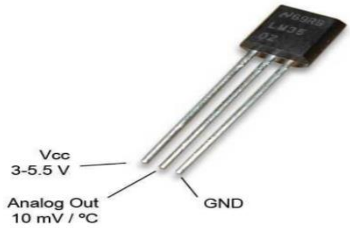

Figure: Temperature Sensor

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The device is to measure temperature readings through electrical signals.

D. HEART BEAT SENSOR

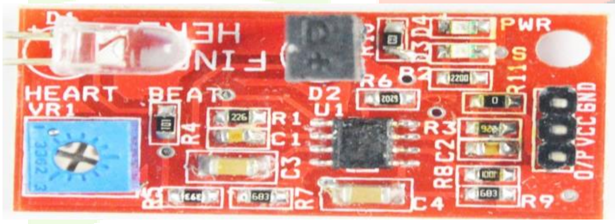

Figure: Heartbeat sensor

The heart rate sensor measures your heart rate in Beats per Minute using an optical LED light source and an LED light sensor. The light shines through your skin, and the sensor measures the amount of light that reflects back. The light reflections will vary as blood pulses under your skin past the light.

E. LCD

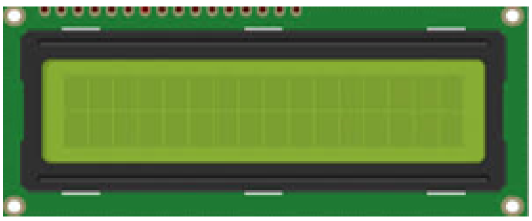

Figure: LCD

This is an LCD Display designed for E-blocks. It is a 16 character, 2-line alphanumeric LCD display connected to a single 9-way D-type connector. This allows the device to be connected to most E-Block I/O ports. The LCD display requires data in a serial format, which is detailed in the user guide below. The display also requires a 5V power supply.

V. FLOW CHART

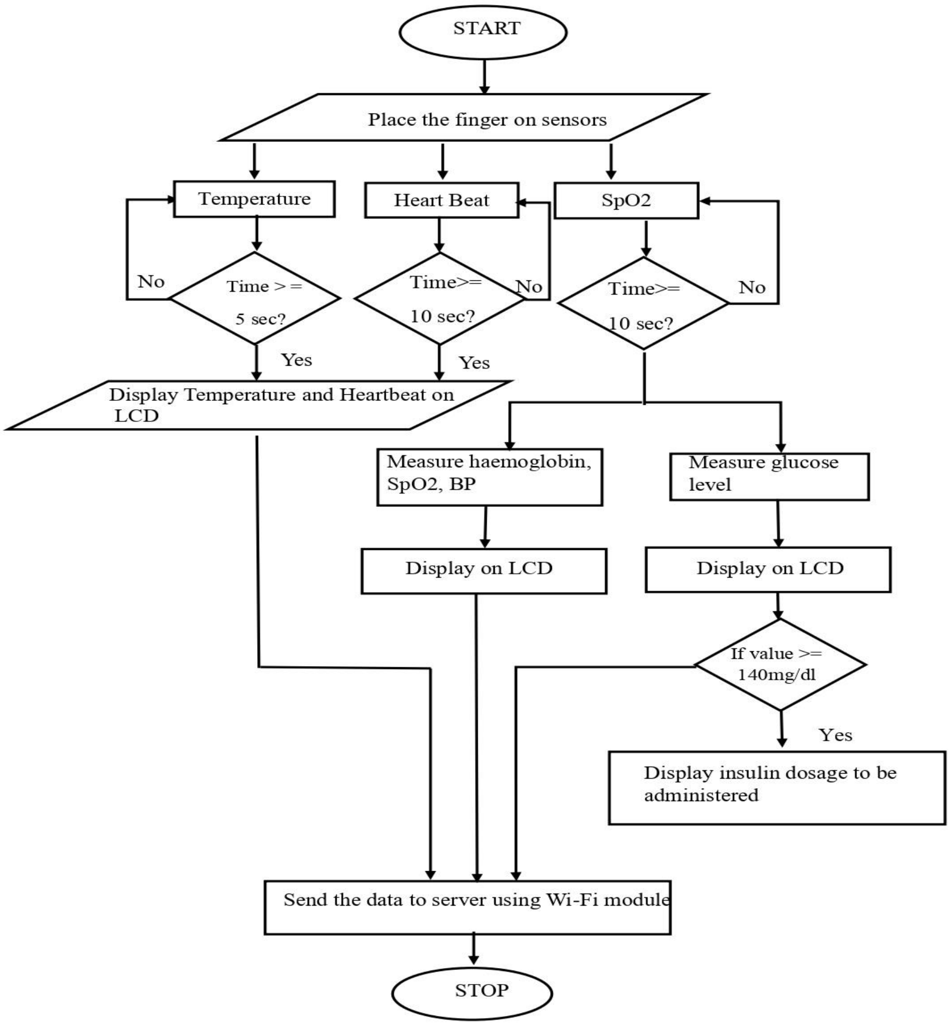

Figure: Flow chart of proposed model

VI. EXPERIMENTAL RESULTS

The glucose values obtained from the proposed system is near to the actual glucose values obtained from the commercially available glucometer. Volunteer were subjected to both the methods and the glucose values, SpO2 value, BP value, temperature and pulse value were compared. The range obtained using the proposed system showed glucose levels between 90 mg/dl and 140 mg/dl is within the normal range, the testing has been successful and the results seems to be promising.

Figure: BP, Heamoglobin and SpO2 values displayed

Figure: Glucose level displayed

Figure: Insulin level displayed

Figure: Patient's condition displayed

Figure: Body Temperature displayed

VII. REFERENCES

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