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Designing and Prototyping of High-End Glucose Instrument for Diabetic Patients Using IoT

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ABSTRACT: Day by day the number of diabetic patients gets gradually increased. Patients need to check the glucose level regularly. For calculating the glucose level, Small amount of blood sample is taken from the patients. Centrifugation process is used to separate the serum from the blood sample. In a tube Enzyme reagent is added to serum, colour of the sample gets varied depending on the glucose level. An instrument has been designed, where the sample in the tube is placed between the LED and photodiode. 510nm LED is used to transmit the light through the Sample. The intensity varies due to the absorption of light by the sample and the remaining light is sensed by the photodiode, which converts the light into current. Ultimately the current produced is different for different intensities of light falling onto it. The output is fed to the ESP8266 Microcontroller which is a low cost WI-FI chip with integrated TCP/IP protocol stack which is connected with the webpage for updating the result of the patient and the corresponding values are calculated. Result is displayed in the LCD and automatically it gets updated in the webpage using IoT (Internet of Things). At the same time both lab technicians and the patients can view the result precisely. The data can be stored and accessed anytime by the technicians for future reference. These data can be further extended to plot the variation of number of diabetic patients present and their glucose level.

I. INTRODUCTION

The objective of this project is to measure the glucose level of diabetic patients and to updates the result in the webpage automatically using IoT. Blood glucose monitoring is the way of testing the concentration of glucose in blood. Glucose is a sugar that your body uses as a source of energy. Unless you have diabetes, your body regulates the amount of glucose in blood. People with diabetes may need special diets and medication to control blood glucose. People With diabetes should consult their doctor or healthcare provider to set appropriate Blood glucose goals.

The most challenging part for any analyst is to determine the type of chemical being used. If they are colored, then the concentration depends on the amount of light absorption the concentration of a chemical in a solution is directly proportional to the amount of light it absorbs; if you double the concentration of the chemical, the solution absorbs twice as much light. Glucose present in the blood can be determined by using Beer lamberts law. The law state that “The absorbance of light is directly proportional to the thickness of the media through which the light is being transmitted multiplied by the concentration of absorbing chromospheres”.

In Centrifugation process the serum is isolated from the blood sample. Enzyme reagent is added to serum, incubation time is taken about 15minutes. Depending on glucose level the colour get varied from luminous red to dark red. The wavelength of the LED used is 510nm. This is actually visible green’s wavelength. This light is achieved by making use of 510 nm LED. The light from the LED passes through the tube and the sample (red) before it hits the detector. It also passes through the sides of the vessels holding the liquids. As more light is absorbed, less light passes through the solution, so the number of photons striking the photodiode varies, ultimately the current produced is different for different intensities of light falling.

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ESP8266 controller is low cost WI-FI chip update the result in webpage. The value of the sugar level is send to the webpage by using IoT which plays a major role to know about our details from wherever we are. Its very useful to the patients for verifying their old result also.

II. METHODOLOGY

In this section, we can able to determine blood glucose level for both diabetic patient type I & II. Hear sensing element used as photo diode and corresponding value will be calculated in micro controller ESP8266 which is a WI-FI chip. Result can easily viewed in the webpage by using internet of things (IoT), ESP8266 plays a major role in connecting our hardware with the webpage created using IoT. It is very useful for knowing about previous information about the health conditions of the diabetic patients. So that the patients can able to know about their details wherever they are Medicine prescriptions can also be updated in the same webpage for the welfare of the patients.

EXPERIMENTAL SETUP:

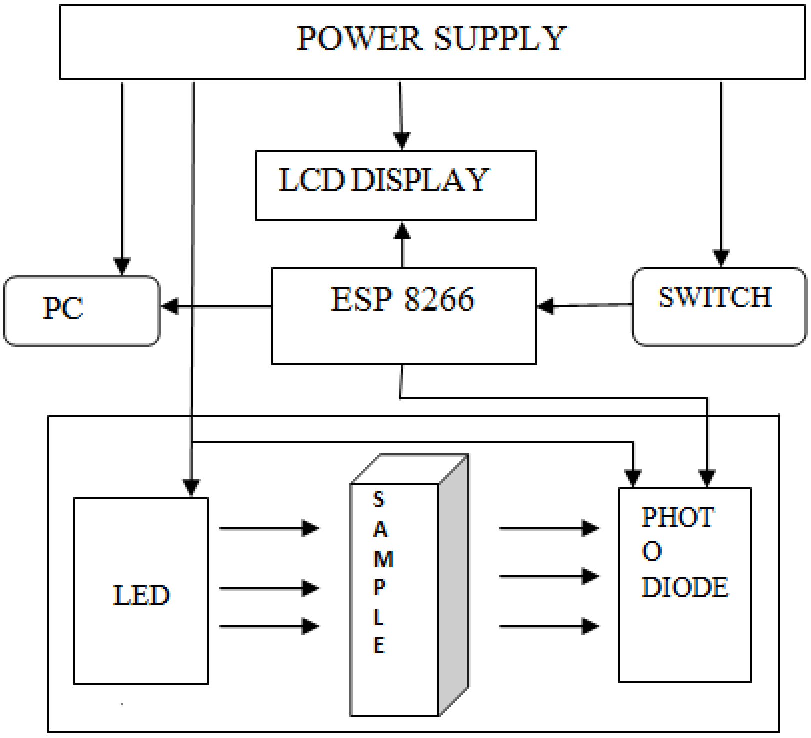

Fig 1: System Architecture

This setup consists of power supply, LCD display, microcontroller, LED, Photo diode and sample. The functioning voltage required for controller is 5V. Transmitter consists of LED (of 510 nm wavelength), this constantly passes the light rays in the fixed path and direction where the solutions need to be kept. And on the other end is the receiver. Receiver consists of photodiode. Once the light rays passes through the solution. The light is absorbed by the solution. The amount of absorption of light depends on the concentration of glucose present in it. The remaining light rays falls on the photodiode which produces current. Ultimately the current produced is different for different intensities of light falling onto it. And the output of sensor is fed to the controller. Control unit used here is ESP8266 where the programs are installed in it for the calculations of the glucose level. Display unit consists of LCD. Once the concentration of glucose present in blood is determined by the controller, the values are further sent to the LCD. LCD acts as output device for displaying the result.

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III. CLOUD DATA STORAGE AND PROCESSING

Data aggregated by the concentrator needs to be transferred to the cloud for long term storage. Offloading data storage to the cloud offers benefits of scalability and accessibility on demand, both by patients and clinical institutions. Also, utilized with analytics and visualization (described in subsequent sections), cloud hosting and processing can reduce costs at HCOs and provide better diagnostic information. In this section, we outline such could architectures and discuss issues that impact long term medical data storage on the cloud.

a) Hybrid Cloud/Cloudlet Architecture: Cloudlet is a limited resource computing and storage platform that eliminates the need to outsource resource intensive tasks to the enterprise cloud. Cloudlet computing has been introduced as a potential solution to deliver low latency to time critical tasks for health monitoring applications via body area networks. Communication between concentrator and cloudlet is realized through WiFi interface. Direct connection between these two entities reduces data transfer latency for time critical tasks on aggregated data. LTE access provided in concentrator can in turn be used for direct data transfer from the concentrator to the cloud bypassing the cloudlet, while exposing the data to the latency imposed by mobile network.

b) *Context-Aware Concentration via Smart Devices:* As previously indicated, smart phones can at as concentrators in IoT infrastructure as today's smart phones can use both LTE and Wi-Fi as the backhaul network. Data aggregation can be carried on either in cloudlet (thorough the Wi-Fi connection between concentrator and the cloudlet) or the cloud (LTE). In studies, the former compared with the latter, has been shown to provide ten times the throughput and to require only a tenth of the access time, and half the power. Aggregated data, however, needs to be finally being stored in the cloud to allow distributed access and reliable storage. To effectively partition data aggregation tasks between cloud and cloudlet, context aware concentration may be utilized. Context can account for the current and expected status of the patient. For example, when the patient is in a critical condition requiring time critical monitoring of biosensor data, data concentration may be the preferred choice.

c) Privacy of the Data Concentrator: Although person-ally identifiable information can be removed before transmitting sensed data information, still the system is prone to aggregate disclosure attacks information via pattern recognition.

The **ESP8266** is a low-cost Wi-Fi chip with full TCP/IP stack and MCU (Micro Controller Unit) capability produced by Shanghai-based Chinese manufacturer, Express. The chip first came to the attention of western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer, AI-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at the time there was almost no English-language documentation on the chip and the commands it accepted. The very low price and the fact that there were very few external components on the module which suggests that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation. The **ESP8285** is an ESP8266 with 1 MB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi. The successor to these module(s) is ESP32.

The ESP8266 is a low cost serial-to-Wi-Fi module that interfaces nicely to any microcontroller. However a word of caution—it is highly undocumented (primary reason for writing this document), and more importantly, it is frequently updated and not backward capability. A good example is how newer versions use 9600 baud rate, while older versions used 57600-115200 baud rates. First, it is important to understand how the board works. The ESP8266 has a full TCP/UDP stack support. It can also be easily configured as a web server. The module accepts comments via a simple serial interface. It then responds back with the operation's outcome (assuming everything is running correctly). Also, once the device is connected and is set to accept connection, it will send unsoiled messages whenever a new connection or a new request is issued.

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IV. RESULT

The result of this model has been discussed below:
This model helps in determining the blood sugar value using the most known method known as spectroscopy. The prototype helps a IoT in storing the data in the cloud for future reference by the technicians. The estimated value is more accurate when compared with other instruments as it completely deals it microcontroller action and more precise calculations. Moreover the data stored in cloud has maximum space which helps in storing huge numbers of data all at once in the server.

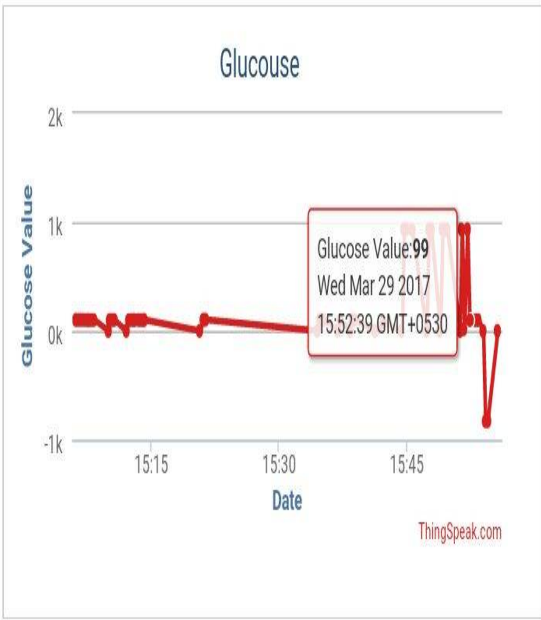

Fig 2: Glucose value of the diabetic patients based on date and time

V. CONCLUSION

This paper presents about the designing of an instrument for diabetic patients and to calculate the result automatically in the webpage using IoT. The blood sample is collected from the diabetic patients and is kept between the LED and the Photodiode, where the glucose level is analyzed by the microcontroller by calculating the absorption values of light by samples in the tube. The output is displayed in the webpage created using IoT which is connected with the controller. LCD acts as a display unit where it is also connected with the controller for displaying the result.

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