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Design of Smart Health Monitoring and Alert System Using IOT

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Abstract*: The advent of technology in the medical sector is tremendous as of today. Yet there are no any basic instruments which detect the temperature, blood pressure and pulse rate. This paper describes an electronic sensor network system which detects and monitors the above quantities. IoT technology is upgrading the environments at a faster rate and this technology can have a higher impact in the medical sector if used efficiently. The paper also describes the addition of blood sugar level detection using non-invasive method.

Keywords: Temperature, Blood pressure, Pulse rate, Sensor, Diabetes, Blood sugar/glucose, Near-Infrared spectroscopy, IoT, Raspberry Pi.

I. INTRODUCTION

Many of the developed and developing countries have very poor healthcare infrastructure where the number of hospitals is less compared to the massive population. These few hospitals are less equipped with basic diagnostic machines which are used by very few doctors.

Diabetes has become the most common disease all over the world. The disease is monitored by measuring the blood glucose levels regularly. This monitoring is done by injecting the human body to get the blood sample and then chemically testing it.

A device which monitors the basic quantities such as temperature, blood pressure and pulse rate are being developed day to day. Also there have been new devices to measure the blood glucose levels which again is pricked onto finger to get the blood sample. But there have been no approaches to make a device which performs all the above mentioned operations.

Recently, many devices have been launched all over which use Internet to store the data. And the devices monitor only the blood glucose levels but not the other quantities. Many ideas are coming forth but none are being implemented.

IoT, Internet of Things is an environment where all the electronic devices are connected to Internet. It is the latest technology which is developing at a faster rate in implementation of big ideas. A device using this latest technology would revolutionize the healthcare world.

Also, the existing invasive technique of blood sugar measurement has disadvantages of loss of blood and physical pain. But the non-invasive technique using near-infrared spectroscopy overcomes the above disadvantages easily giving light to a newer technology in the medical sector.

A. Internet of Things

Internet of Things, IoT is an environment where objects are connected to Internet. These objects may be electronic or non-electronic. These objects are given unique identities over a network allowing data sharing over the Internet. IoT is considered as the future of Internet. IoT enables machine to machine (M2M) communication where in all the machines are controlled through Internet or one Internet machine controls other machines. The basic applications of IoT is in every sector we imagine such as at home, industry, hospitals, etc.

IoT in medical sector can help achieve a greater height in technology, which is now being referred as IoMT, Internet of Medical Things. All the medical devices and equipment are connected through Internet which enables M2M communication. A device which uses IoT can control all the devices or equipment at a faster rate compared to humans. The continuous monitoring of a patient is difficult by humans which enables IoT to achieve this easily. A few sensors on a patient are required to achieve continuous monitoring of a patient at emergency times.

B. Near-infrared spectroscopy

Diabetes is one of the biggest challenge of our century. As of 2016 report, it was found that 422 million adults across the world have diabetes and around 1.5 million deaths were caused due to diabetes. It is said that 1 in 11 people have diabetes.

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The diabetes is the measurement of blood sugar or blood glucose levels in a human body. The measurement is done by sampling a small amount of blood and then performing chemical tests giving the sugar levels of the body. The blood samples are obtained by pricking the human finger giving an acute pain and blood loss as well.

Non-invasive spectroscopy is one of the technique where in blood samples need not be obtained. This technology using near-infrared light measures the light intensity levels at the reception and the transmission and then doing an analysis we get the blood sugar levels.

II. DESIGN OF SMART HEALTH MONITORING AND ALERT SYSTEM USING IOT

The smart health monitoring system comprises of a temperature sensor, a pulse rate sensor, a blood pressure sensor and the non-invasive blood sugar measurement system as the inputs. The output is seen on LCD and a user device such as cellphone/PC on a webpage, comprising of an IP address.

The patient or the doctor can access the data sitting at any place of the world through Internet. The alert system is the usage of mail service. Any alerts of patient are sent over mail using Internet.

A. Near Infrared Spectroscopy

An NIR (near-infrared) LED is used as a transmitter and a NIR photodiode as a receiver. The light is passed through a finger. The received light is processed and then the output is displayed on an LCD as shown in the below diagram.

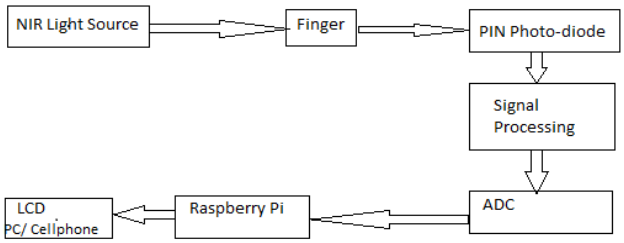

Fig. 1: Block diagram of Non-invasive blood sugar measurement system.

The signal processing consists of four stages. The current through the NIR photo-diode is proportional to the light incident on the photo-diode. The signal is first sent through a trans-impedance amplifier which converts small current changes into voltage. The output of photo-diode consists of some unwanted noise and also DC signals. To get rid of this, a low pass and high pass filter is designed for a cut-off of 0.7Hz and 10Hz, respectively. Then the signal is amplified with an amplifier which has a gain between 0 and 100. Lastly the signal is sent to ADC through a buffer amplifier to match the impedance of the signal to that of ADC.

After the ADC buffer gets filled, the signal is analysed using linear regression model consisting of a dataset. The dataset is acquired after analysing individual patients using accu-check meter and the proposed hardware setup. Finally the signal is sent to Raspberry Pi, to which an LCD is connected.

B. Proposed IoT system

The sensors are attached to the body and the non-invasive system is subjected to a finger of the body. The output of the sensors and the non-invasive blood sugar measurement system is given to raspberry pi through an ADC for digital conversion.

The raspberry pi model 3 has been used. It is one of the latest models. It is called as a computer on a chip.

The raspberry pi processes the input data and displays it on an LCD. Also the raspberry pi acts as a server where the patient data has to be stored. Thus by entering the IP address of raspberry pi on a mobile device or PC the data is accessed. The raspberry pi is converted to a server using PHP scripts.

The webpage is enabled with one-step authentication where in the patient or the doctor need to enter the username and password to access the webpage.

The advantage of using raspberry pi is that it can be coded using any language such as C, C++, Python, Java, etc.

III.RESULTS

The below pictures depict the results of the system built.

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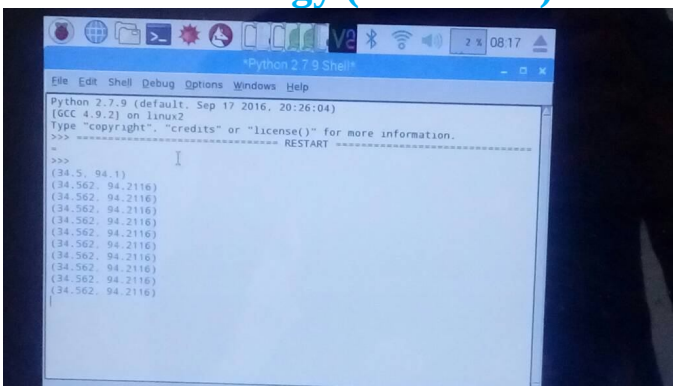

Fig. 3: Temperature sensor output on PC

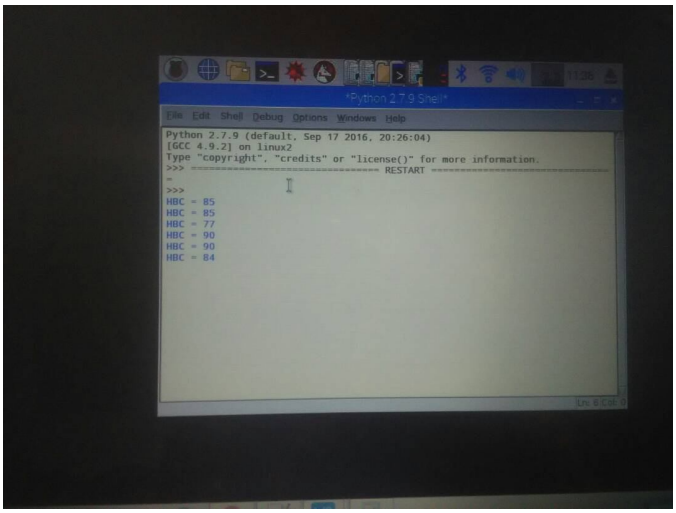

Fig. 4: Pulse rate output on PC

IV. CONCLUSION

As Diabetes is one of the threat to our century, it is highly recommended to be in regular check-ups before the disease takes a toll. We developed a system to check the blood sugar levels using non-infrared spectroscopy giving the accurate readings of blood sugar. With this, we developed a whole new system of measuring temperature, pulse rate and blood pressure using Raspberry Pi giving accurate readings of the medical quantities over the Internet. If we try for mass manufacturing of such a system, the medical sector could get a new higher level of technology.

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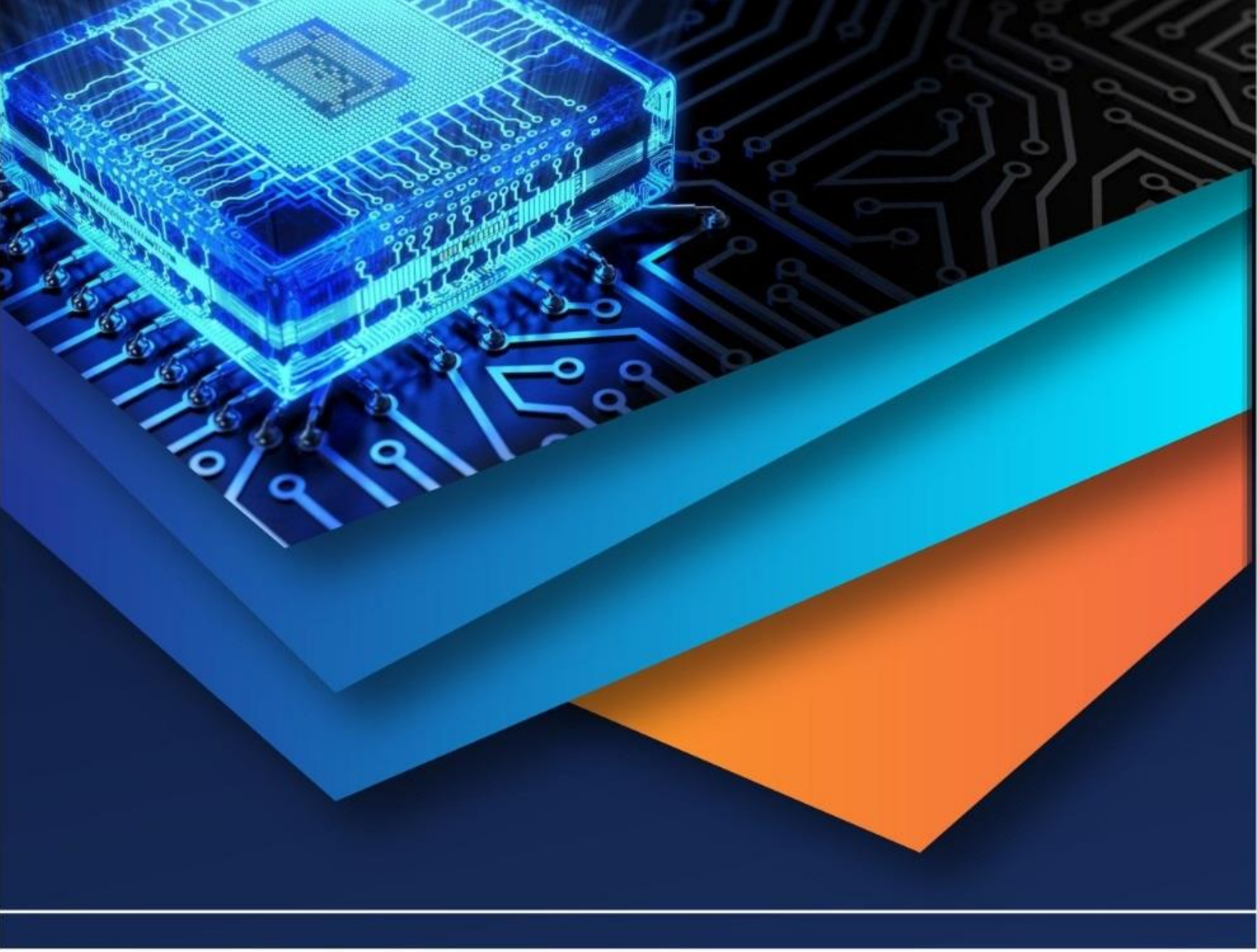

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