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An Automated Non-Invasive Blood Glucose Estimator and Infiltrator

M. Florence Silvia[1] , K. Saran[2], G. Venkata Prasad[3], John Fermin[4]
[1]Asst. Prof, [2, 3, 4] Student , Department of Electronics and Communication Engineering,
JEPPIAAR SRR Engineering College Padur, Ch-603 103.

Abstract- This paper presents design and working of a microcontroller based non-invasive blood glucose estimator and an automated insulin injector for worst-case automatically. The emergence of this concept is to overcome the invasive methodologies for estimating and also provides a database regarding patient's heath reports. The overall process is carried out by microcontroller. The blood glucose level is displayed over a LCD display. At worst case i.e. above 200mg/dl the insulin is automatically injected to the patient body ith the help of servo motor. Those data added to the database can be recovered or viewed at any time from any corner of the world with the help of IOT.
Keywords- microcontroller AT89s52, NIR spectroscopy IC, ADC, 16X2 LCD display, ZigBee transmitter and receiver, buzzer , servo motor, UART, S-MAC.

I. INTRODUCTION

A microcontroller based electronic Non- invasive blood glucose estimator and insulin injector is to provide the patient with enough health support to avoided cardiac attacks due to increase in blood glucose level. The control unit of this system is AT89S52 microcontroller through which the other units are connected and controlled. The system is divided into different units and all work to ensure its accuracy and efficiency. Each sub-units of the system namely NIR spectroscopy IC, ADC, LCD display, S-MAC, UART, servomotor units are controlled by the AT89S52 microcontroller with sequence of instructions that direct its performance. Every blood glucose level reading is been recorded in this database over the server using IOT. The main aim of work is to design and work on a prototype model of a blood glucose estimator and automated insulin insulator. The user can check blood glucose level by placing the finger between the IR LED and photo transistor which is considered as input. The 16x2 LCD display unit is used to display the level which is processed by the microcontroller. After every 2000ms (milliseconds) the data is transmitted to a sever to maintain the database of the user using IOT with the S-MAC.

II. ARCHITECTURE OF AT89S52

The AT89S52 is a low-power, high-performance, 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high density, on-volatile memory technology.

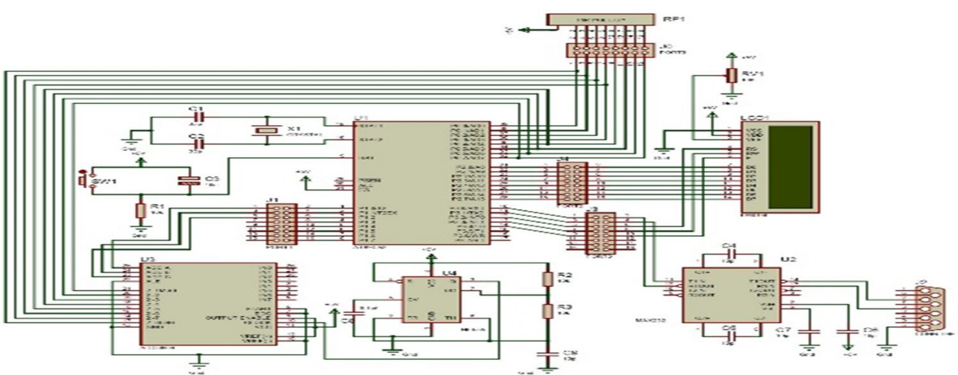

Fig.1 Architecture of AT89S52

A. Features

1) 4.0V to 5.5V Operating Range.
2) Operation: 0 Hz to 33 MHz.

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3) Three-level Program Memory Lock.
4) 256 x 8-bit Internal RAM.
5) 32 Programmable I/O Lines.

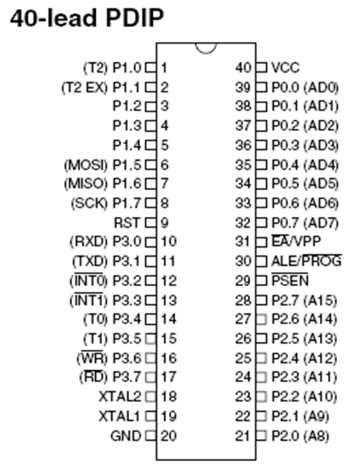

Fig.2 AT89S52 microcontroller pin configuration

This microcontroller contains 40 pins, and accepts only digital values, here have to combine it with ADC-Analog to Digital converter. There are four ports namely P1, P2, P3, P4. The ODD ports (P1,P3) on the left side of the controller and the EVEN ports (P2,P4) are on the right side. 32 pins for general purpose and 8 pins for special purposes.

III. BLOCK DIAGRAM

The block diagram of the module is shown as per fig.3

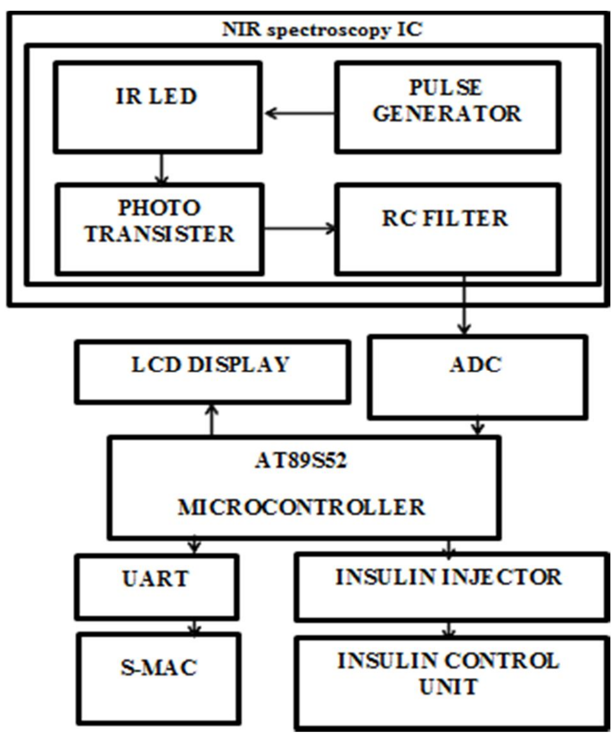

Fig.3 block diagram of automated blood glucose estimator and infiltrator

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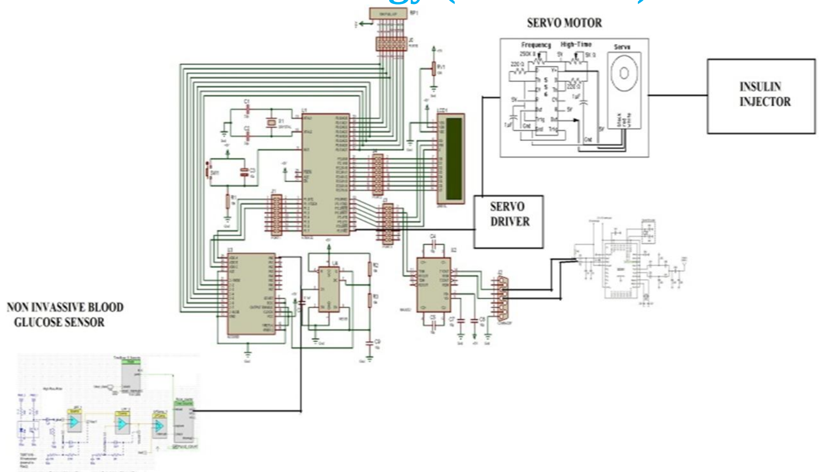

Fig.4 The estimator part and the transmitter part of the system

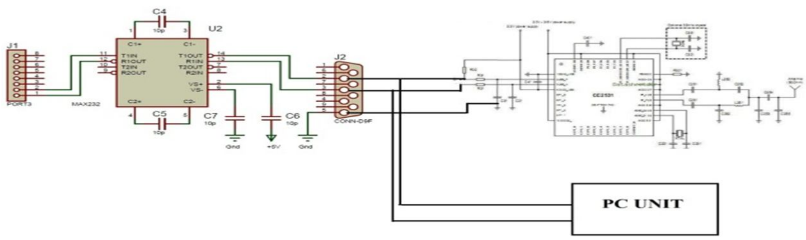

Fig.5 The receiver part (PC unit)

A. NIR Spectroscopy IC

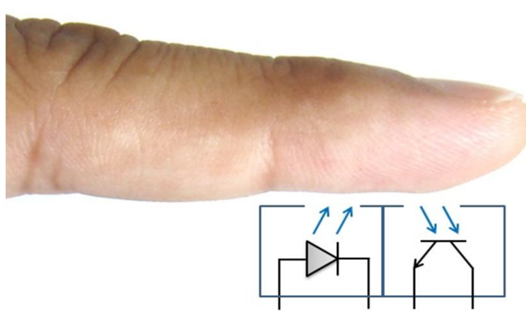

Fig.4 working model of NIR spectroscopy IC

The NIR spectroscopy IC has a pulse generator which generates the necessary pulse to the IR LED. The IR LED emits the light which is allowed to pass over the finger placed between the IR LED and photo transistor. The photo transistor receives the light passed through the finger. The RC filter is used to reduce the unwanted noise.

B. Voltage Regulator

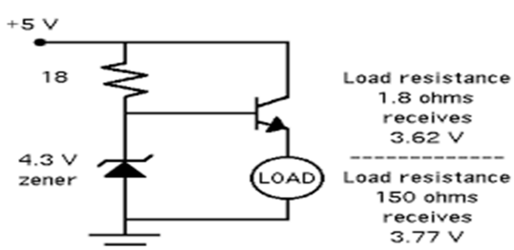

Fig.10 voltage regulator circuit

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Voltage regulator reduces the high power and converts it to the voltage capable for mobile charging. The charging voltage of mobile phones is 3.7V. if voltage regulator is not used the mobile phones cannot able to charge it may able to blast or do some malfunctions.

C. ADC

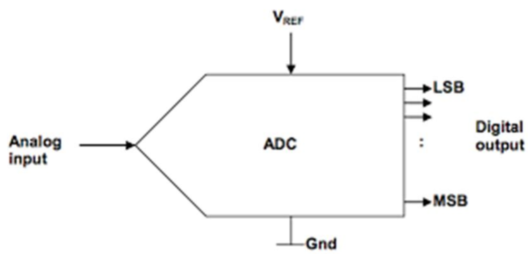

Fig.7 ADC circuit

The need for ADC is the microcontroller only accepts the digital values its does not accepts the analog information’s, ADC program coding is debugged into the ADC processor this converts the analog values to the digital .

D. Relay Unit

Fig.8 relay

Relay is a electrically operated switch. Many relays use an electromagnet to mechanically. Such relays are mostly used in TRANSRECEIVERS which combine transmitter and receiver in a single unit. The relay unit that used here is able to switch the module ON and OFF.

E. LCD

Fig.9 16X2 LCD display

The LCD used here is a 16x2 LCD display. The need for LCD is to show the amount of power that has received by the antenna and how much of power has stored in the battery. In the LCD here can see how much RF signal is collected and how much is stored to the battery. Every power conversion is seen through the display.

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F. UART

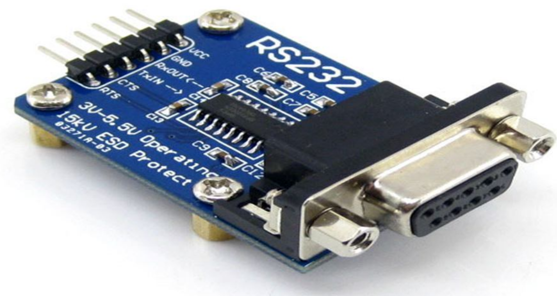

Fig.10 UART

An UART, universal asynchronous receiver / transmitter is responsible for performing the main task in serial communications with computers. The device changes incoming parallel information to serial data which can be sent on a communication line. A second UART can be used to receive the information. The UART performs all the tasks, timing, parity checking, etc. needed for the communication. The only extra devices attached are line driver chips capable of transforming the TTL level signals to line voltages and vice versa.

G. S-MAC

The S-MAC (Sensor-MAC) protocol provides mechanisms to circumvent idle listening, collisions, and overhearing. As opposed to STEM, it does not require two different channels. S-MAC adopts a periodic wakeup scheme, that is, each node alternates between a fixed-length listen period and a fixed-length sleep period according to its schedule, compare Figure 1 How- ever, as opposed to STEM, the listen period of S-MAC can be used to receive and transmit packets. S-MAC attempts to coordinate the schedules of neighboring nodes such that their listen periods start at the same time.

H. Insulin Injector Unit

1) *Servomotor:* A servomechanism may or may not use a servomotor. For example, a household furnace controlled by a thermostat is a servomechanism, yet there is no motor being controlled directly by the servomechanism. A common type of servo provides position control. Servos are commonly electrical or partially electronic in nature, using an electric motor as the primary means of creating mechanical force. Other types of servos use hydraulics, pneumatics, or magnetic principles. Servos operate on the principle of negative feedback, where the control input is compared to the actual position of the mechanical system as measured by some sort of transducer at the output. Any difference between the actual and wanted values (an "error signal") is amplified and used to drive the system in the direction necessary to reduce or eliminate the error. This procedure is one widely used application of control theory. Hence it is used for injecting the insulin

IV. WORKING CONCEPT

The power supply is provided (230v AC supply) to the power supply unit (A.). The power supply unit then step downs the power using step down transformer. The step down AC supply is sent to the bridge rectifier. The bridge rectifier converts the AC supply to DC supply. This DC supply is then sent to the voltage regulator to regulate a +5V supply to the NIR spectroscopy IC. The NIR spectroscopy IC consists of a clip which contains an IR LED and a photo transistor, where finger is placed. The pulse generator generates the necessary pulse to the IR LED. The LED emits light through the placed finger and the resultant passes the photo transistor. Then RC filters are used to negotiate unwanted noise. .Now the analog data is converted into digital data by ADC. This digital data is then moved to the microcontroller. The 16X2 LCD display unit displays the blood glucose level received from the microcontroller. After every 2000ms (milliseconds) the data is collected in a database through UART by the SMAC module. At worst case i.e. when the glucose level is more than 200 mg/dl the servomotor unit goes to ON state and the servomotor rotates to inject the insulin to the user. The PC unit has a UART provided with a S-MAC module for receiving purpose. The blood glucose level can be viewed even in the PC unit, those readings are stored in a server using IOT.

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V. RESULT

The design and execution of an automated non-invasive blood glucose estimator and infiltrator was carried out successfully. Firstly the hardware output can be viewed as show in figure Fig 11.

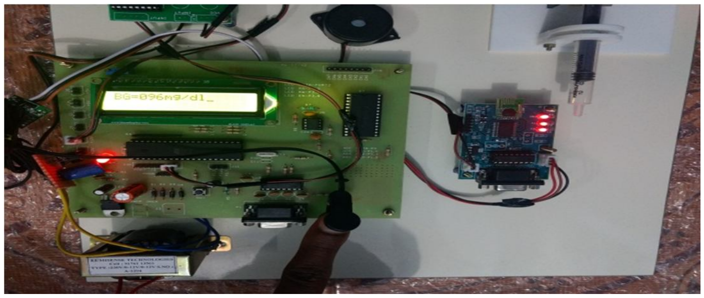

Fig 11pictorial hardware output representation

Secondly the software output can be viewed simultaneously on the PC unit using logger software as show in figure Fig 12.

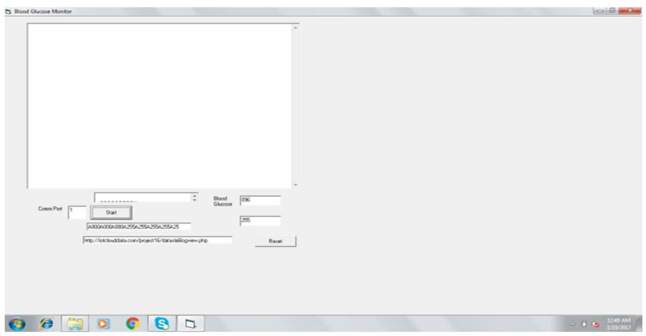

Fig 12 software output from logger software

Thirdly the database of the user health report can be viewed as shown in figure Fig 13 over the server from the link "http://iotclouddata.com/project16/datasla6logview.php ".

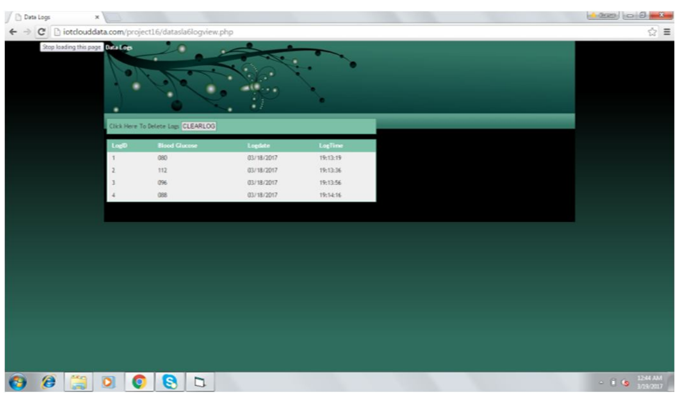

Fig 13 heath report of the user is been updated in cloud using IOT

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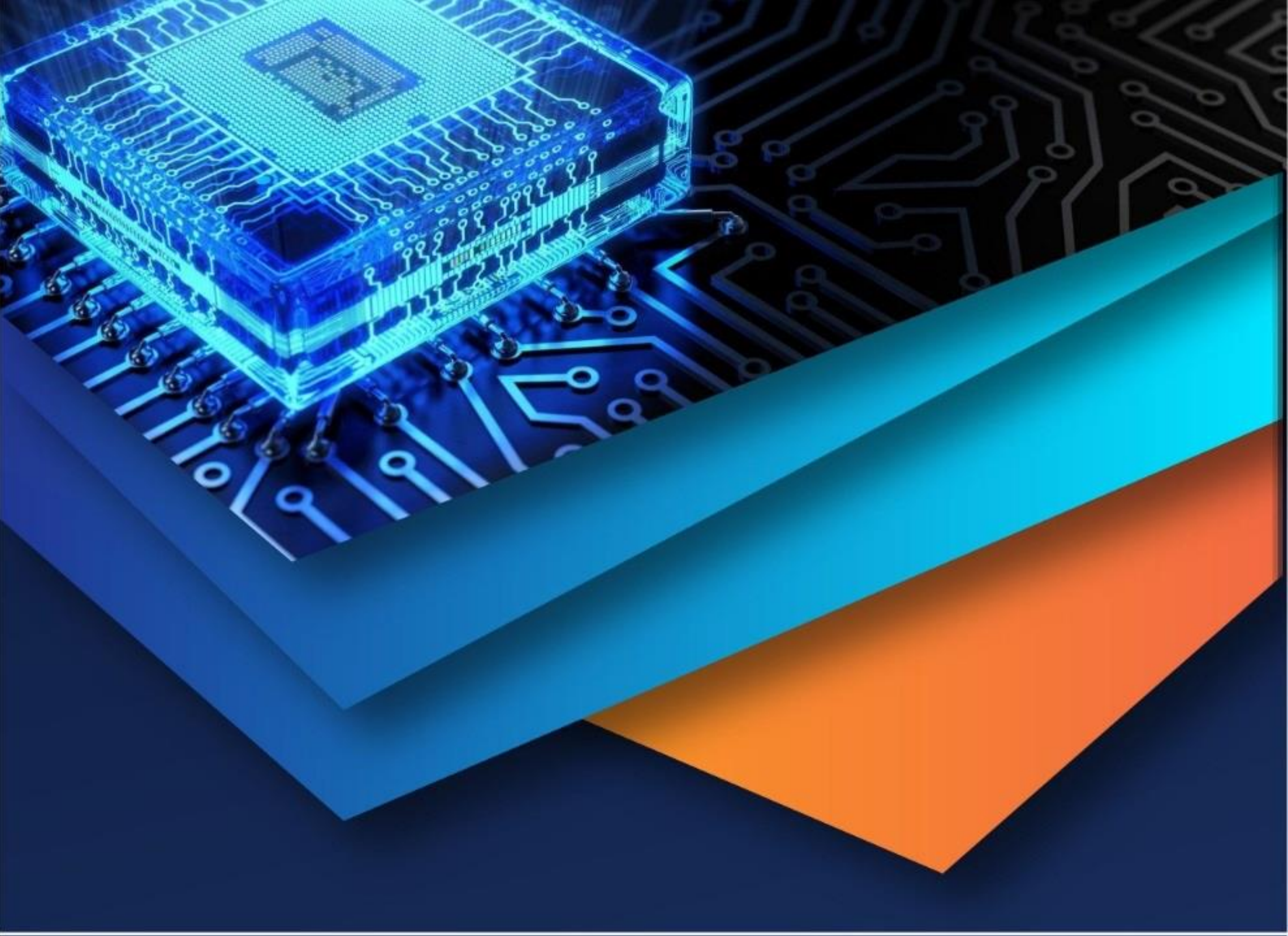

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