Prescription Updater for Diabetes

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Abstract: - Diabetes and its complications are a major cause of morbidity and mortality in India and the prevalence of type 2 diabetes. It can't be cured but treatment may help and the regular medical diagnosis is required and our project takes a part in this treatment. Normally glucometer checks the glucose level and shows the results. But our project focuses on providing apt prescription for that result.This product comes along with a glucometer. With the help of the glucometer patient measures the glucose level in their blood. As a result they would get the message containing the prescription for that condition. Prescription insists the diet they should take to maintain the glucose level normal and refers medicines in some cases. All the results obtained after every checkup will be stored in the cloud which could be viewed by the doctor and the patient at anytime. In some cases patient's condition would be abnormal and it would be indicated to the doctor automatically to avoid dangerous situations.

I. INTRODUCTION

As the world population is aging and chronic diseases are on the rise , the health care industry is rapidly delivering high-tech solutions. The proliferation of advanced medical electronic devices and wearable electronics is greatly improving patient outcomes and reducing health care costs. Connected patient modelling will be a critical factor in the continuing success of this field. The exponentially growing demand for connected medical devices is expected to reach 20 billion by 2020. Current technology generally involves a trip to the doctor's office to download data from a patient's device for review. But this is not enough. We need a Medical Internet of Things (Medical IoT) that will extend the connectivity and transmission of health data from the patient to the physician on a regular basis, or immediately and continuously in an emergency. The Medical IoT will make medicine participatory, personalized, predictive and preventive (P4 medicine). Successful medical devices and pharmaceutical companies are using engineering simulation and connected patient modelling to develop systems that ensure high reliability, provide data privacy and speed regulatory compliance. To make a real impact on healthcare, connected medical devices should capture and interpret relevant and reliable parameters without compromising patient safety and comfort, and deliver insights to physicians with full integrity, reliability and security The project mainly focuses on providing prescription for type II diabetes. Type II diabetes is caused when the insulin produced is not efficiently used by the body. This type of diabetes is also called as insulin resistance. It can be controlled only through food and exercise. The project generates a prescription (diet) that the patient should eat at the particular time to maintain the blood sugar at the correct level. The prescription mainly consists of the diet that the patient can afford easily at his/her location. For generating the prescription we are using IoT. IoT (Internet of Things) is a trending technology in the recent years. Iot allows vehicles and physical devices to connect with sensors, softwares, and actuators for exchanging data. IoT is now used for several medical applications. It is termed as M-IoT. The Internet of Medical Things (IoMT) is the collection of medical devices and applications that connect to health care IT systems through online computer networks. Medical devices equipped with WI-FI allow the machine-to-machine communication that is the basis of IoMT. IoMT devices link to cloud platforms such as Amazon, Thingspeak Web Services on which captured data can be stored and analysed. IoMT is also known as Healthcare IoT. Examples of IoMT include remote patient monitoring of people with chronic or long term conditions, tracking patient's medication order and the location of patients admitted to hospitals and patient's wearable end health devices which can send information to care givers. The practice of using IoMT devices to remotely monitor patients in their homes is also known as tele medicine. This kind of treatment spares patients from travelling to a hospital or physician's office whenever they have a medical question or change in their condition. Healthcare IoT can also boost patient engagement and satisfaction by allowing patients to spend more time by interacting with their doctors.

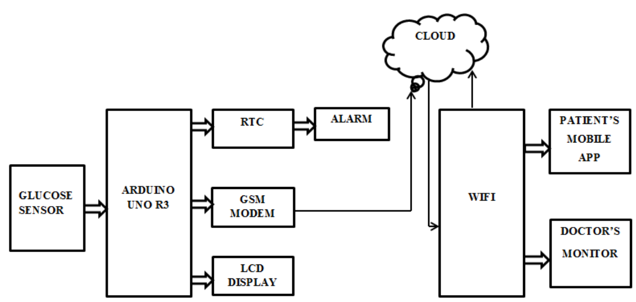

Fig.1. Block diagram, of the Prescription Updater for Diabetes

II. DESIGN COMPONENTS

A. Arduino UNO R3

From the figure.2, Each of the 14 digital pins on the Arduino Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor.The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function. Additionally, some pins have specialized functionality. From the figure.2, Pins 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip. From the figure.2, Pins 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt() function for details. Pins 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function. Pins 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

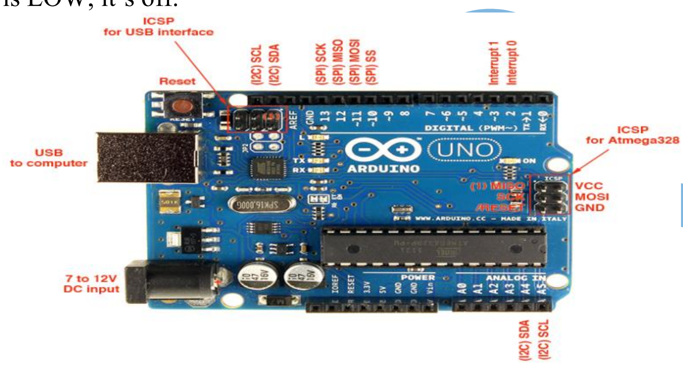

Fig.2. Arduino UNO R3

B. Glucose Sensor

Micro needles and strip arrays have also garnered a lot of interest over recent years for interstitial fluid sensing, since this approach can offer minimally invasive methods for bio-sensing. This concept was used in the development of a glucose-sensing patch. The device was designed in two compartments; the first containing the micro needle array and glucose biosensor with these conditions containing the electronics. This miniature device spans a total area of 6× 6 mm in which it contains 200 hollow micro needles(300 µm in length with a 50×50 µm lumen). Three screen-printed electrodes were used for quantifying glucose concentrations in the interstitial fluid, including a Pt-C working electrode covered with a layer of cross-linked bovine albumin serum and glucose oxidase. The sensing device was attached to the skin by an adhesive layer contouring the perimeter of the sensing pod. Detection was performed upon glucose diffusion into the micro needle array, wherein GOx could react to produce hydrogen peroxide. The production of hydrogen peroxide detected by the working electrode was proportional to the glucose concentration. The electronics module of this device required the use of an external potentiostat, a microprocessor and a battery to power the device.

C. GSM Module (SIM800)

SIM800 is a quad-band GSM/GPRS module that works on frequencies GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz. SIM800 features GPRS multi-slot class 12/ class 10 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. With a tiny configuration of 24*24*3mm, SIM800 can meet almost all the space requirements in users' applications, such as M2M, smart phone, PDA and other mobile devices. SIM800 has 68 SMT pads, and provides all hardware interfaces between the module and customers' boards. SIM800 is designed with power saving technique so that the current consumption is as low as 1.2mA in sleep mode. SIM800 integrates TCP/IP protocol and extended TCP/IP AT commands which are very useful for data transfer applications that are represented in the figure.3

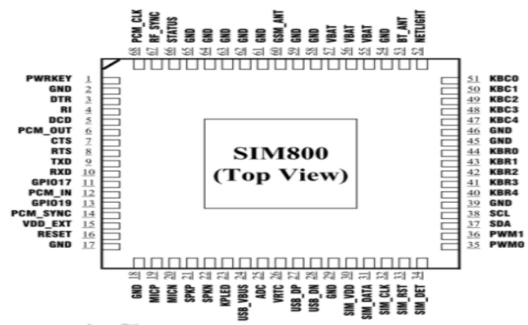

Fig.3. Pin configuration of SIM 800

D. Transformer(0-12V)

The ac voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.

E. LCD Display

The LCDs used exclusively in watches, calculators and measuring instruments are the simple seven-segment displays, having a limited amount of numeric data. The recent advances in technology have resulted in better legibility, more information displaying capability and a wider temperature range. These have resulted in the LCDs being extensively used in telecommunications and entertainment electronics. The LCDs have even started replacing the cathode ray tubes (CRTs) used for the display of text and graphics, and also in small TV applications. The pin configuration of 16*2 LCD is displayed in figure.

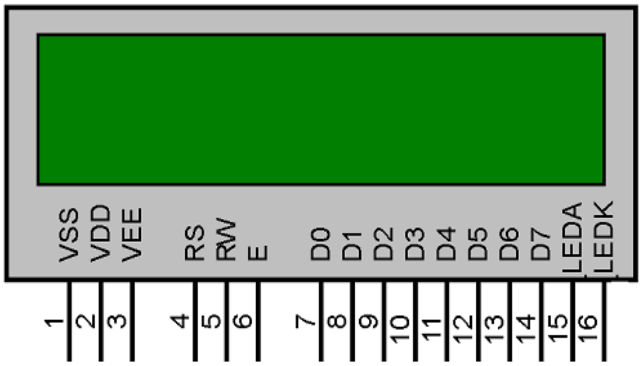

Fig.4. Pin configuration of LCD

F. Real Time Clock

The DS1307 Serial Real-Time Clock is a low-power; full binary-coded decimal (BCD) clock/calendar plus 56 bytes of NV SRAM. Address and data are transferred serially via a 2-wire, bi-directional bus. The clock/calendar provides seconds, minutes, hours, day, date, month, and year information. The end of the month date is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The clock operates in either the 24-hour or 12-hour format with AM/PM indicator. The DS1307 has a built-in power sense circuit that detects power failures and automatically switches to the battery supply. The pin configuration of RTC DS1307 is represented in figure.

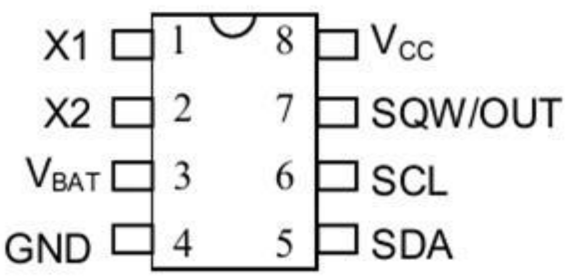

Fig.5. Pin configuration of RTC

G. Alarm

An alarm is a signalling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows. It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound.

III. WORKING PRINCIPLE OF THE PRESCRIPTION UPDATER FOR DIABETES

The step down transformer is used to convert AC current of 220V to DC current of 12V. It converts high voltage to low voltage so that current can be utilised by all the modules in the setup. This conversion is done with the help of a bridge rectifier. The rectifier consists of four diodes for converting an alternating current into a direct current output. The supply from the rectifier is given to the LCD and is used only in the write mode. The pins of the LCD are connected to the digital pins of the arduino and are defined in the program. The glucose sensor is used to detect the glucose level in the blood sample of the patient. The finger is pricked and the blood sample of the patient is taken. The blood sample is then placed in the strip and is inserted in the glucose sensor. This sensor is used for a single patient and a keypad is provided to mention the blood glucose levels for the remaining patients. The keys in the keypad represent different range of blood glucose. RTC is used to know the real time. The alarm is connected with the RTC to remind the patient regarding the next checkup timing. The sensor is connected with arduino and these values are made to communicate with the cloud with the help of a GSM module. The transmitter pin of the controller is connected with the receiver of the GSM module. The GSM module consists of a miniature model antenna that works with a help of a sim. A sim slot is provided in the GSM module and with the help of the network the values from the sensor are sent to the cloud by using arduino. An ID is created in the cloud called Thingspeak and it is already mentioned in the arduino program and so the values are automatically tracked by the cloud and the graph is displayed accordingly. Similarly, each patient has a different ID and so he/she can check for their glucose level periodically and also the history of values are also available all the time. The diet and the medicine that is to be taken by the patient is provided through message. The message is sent by using SIM 800.The diet and the medicines are already dumped in the cloud. A rule engine is developed according to availability of food in their locality, glucose level, other health issues and various factors. The glucose level is matched with the data which are already dumped and the diet is prescribed accordingly. The login ID is provided individually for each patient and it is maintained regularly. Caregivers and doctors can also view it by using the ID given to the patient so that the continuous monitoring of the patient is achieved.

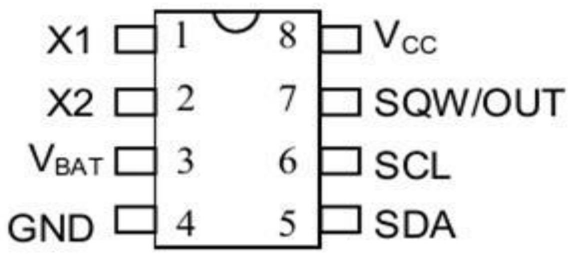

Fig.6. Sample graph

IV. CONCLUSION

The blood sample of the patient is collected and the glucose level in the blood is detected by the glucose sensor. This value is sent to the cloud and the processed output is obtained as the prescription. This prescription is sent as a message to the patient and it is also updated in the cloud everytime. These values are tracked and the graph is plotted. This graph is generated by using the history of values so that patient can easily recognise their level. Figure.6 represents the graph. Our product is an affordable healthcare system solution that utilizes existing devices with a GSM module and a smartphone. Users need to pay only a modest Internet connection fee to access the system. We utilized IoT to implement proactive notification of their health status for patients and their caregivers.

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