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Robot Apprentice in Supervision of Diabetes using Raspberry-Pi

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Abstract*: This work presents an innovative health proposal that includes a robot support system to emerge multifaceted concern move towards for the healing of diabetes. The structural design of the platform enlarges the internet of things to a web centric concept in the course of utilizing active web standards to contact and manage objects of the physical layer. This work presents a set of facilities for patients. The platform's software architecture prototype allows the growth of different applications without deliberating low-level information of the platform. A completely efficient prototype is developed and its end-to-end working and acceptability are tested prosperously and providing support that patients and doctors are accessible to the beginning of the projected platform.

Index Terms: Raspberry Pi, Server, Health, Diabetes, Stepper motor, Insulin reservoir, IOT, ULN, and Keypad.

I. INTRODUCTION

Now a days the rate of diabetes in humans increasing worldwide. Diabetes means increase in blood glucose level above the normal limit. Normal blood sugar level for fasting is 80 to 110mg/dl. Normal blood sugar level for post prandial is 100 to 150mg/dl and the criteria to diagnose diabetes mellitus are mentioned below according sugar level. If F.B.S., (fasting blood sugar-patients should not have anything for about 8 hours) is more than 125mg/dl or P.P.B.S., (post prandial blood sugar) is more than 149mg/dl or random blood sugar level more than 149mg/dl with Hba1c (Glycosylated hemoglobin) is more than 6.5. There are two types of diabetes they are, Type 1 diabetes and Type 2 diabetes [1].

A. Type 1 diabetes:

Type 1 diabetes is due to absence of secretion of insulin from beta cells (It is the type of cells which is present in the pancreas which secret insulin) of pancreas. It is seen in children. Main treatment of type 1 diabetes is insulin to diagnose diabetes mellitus [2].

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B. Type 2 diabetes:

Type 2 diabetes is because of either decreased secretion of insulin or resistance of receptor to insulin (receptor are the proteins which is on activation by some substance which are particular to its results in response).In this beta cells of the

Pancreas may be normal in function, treatment for type 2 diabetes (oral hypoglycemic dregs) example: metfarmine, glimiperide. If type 2 diabetes is not controlled by oral hypoglycemic drugs then patient will be treated with insulin and Gestational diabetes mellitus is a type of diabetes is seen only during the time of pregnancy. In this case diabetes will be completely reserved after delivery, in some cases around 1-2 percent patient might continue have diabetes [3], [4].

Use of new technology and advancements with wireless networks and web technologies, the several applications like mobile health/electronic applications have been noticed in literature [5], [6]. Initially finding the blood sugar level in clinics, hospitals showed a remarkable improvement in the blood sugar control in those who engaged in these type of care approaches [7], [8]. This work shows that, robot is used as a special assistant device to examine diabetic patients; this robot follows the patient activities and suggests certain advices to the patient [9]. This model has the views about the ideas of storing the data and transferring of data and this model is safeguard in various proposals towards advanced patient profile monitoring system [10]. This method of transferring of data and communication can be done through server application using internet of things [11]. This model can be implemented in the health care centers like government hospitals to keep away from waiting for doctor consultation and standing in the queues and this model can be used in home. Health intensive care system based on IOT has been in recent times introduced to progress the excellence [12].

II. BLOCK DIAGRAM

Firstly, all the circuit connections are made as per the figure 1 and all the circuits will get initialized, then LCD(Liquid crystal display) will be displaying on LCD the project title and then it will be display as please enter the sugar level through the LCD, so when it shows to enter the sugar level the patient should enter the checked blood glucose level using keypad and it will be displaying on the LCD, after the patient enters the blood sugar level, this information will be sent to the doctor application through the server using IOT(Internet of things).

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After receiving the information in the form of message to doctor.

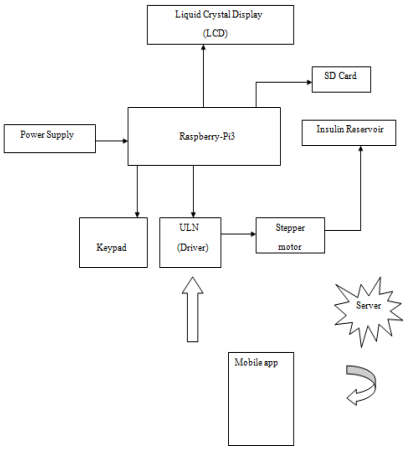

Fig 1: Diabetes monitoring system using Raspberry-pi

The doctor will check and calculate the insulin level and doctor will send the message that how much amount of insulin level is required for the patient using web application through server, this information will be transferred to the patient using IOT. After that patient will receives the message from the web application and this message will be transferred through Raspberry-pi to stepper motor, then stepper motor will intake the insulin with the help of ULN(ULN is a driver which is used to drive the stepper motor) . The insulin will intake to the insulin syringe from the insulin reservoir and this procedure is automated so the patient can intake the insulin at the end.

For example if the sugar level is 150mg/dl, doctor will s The end the data as 2 units of insulin is required for the patient, so accordingly the data will be received to the patient through sever to Raspberry-pi and Raspberry –pi will give the instructions to the stepper motor to intake 2units of insulin to the syringe from the insulin reservoir, so the syringe will intake 2units of insulin, then patient will take that syringe and he will inject up to his/her body. The major components used in block diagram are explained below.

A. Raspberry Pi*:* It is the main part of the system where other components will be controlled by it.The raspberry pi hardware has evolved through several versions that feature variation in memory capacity and peripheral-device support. The processor of the raspberry pi 3 uses a Broadcom BCM2837B0 SOC with a 1.4GHz 64-bit. The raspberry pi 3 is described as having ten times the performance of a raspberry pi, benchmark showed the raspberry pi 3 to be approximately 80% faster than the raspberry pi 2 in parallelized tasks.

B. LCD display: The main function of the LCD display is to show the amount of insulin required for the present blood sugar level. An LCD is an electronuc display module which uses liquid crystal to produce a visible image. The 16*2 LCD display is a very basic module commonly used in DIYs and circuits. The 16*2 translates o a displays 16 chaarcters per line in 2 such lines. In this LCD each character is displayed in a 5*7 pixel matrix.

***C. Keypad*:** With the help of keypad the patient can enter the present blood sugar level.In keypad typically one port pin is required to read a digital input to the Raspberry-pi. When there are a lot of digital inputs that have to be read it is not feasible to allocate one pin for each of them, this is when a matrix keypad arrangement is used to reduce the pin count. Therefore the number of pins that are required to interface a given number of inputs decreases with increase in the order of the matrix.

D. Insulin Reservoir*:* It mainly stores the insulin and disperse the insulin.

E. Stepper Motor: It mainly helps insulin reservoir to dispence the amount of insulin required and stepper motor is an electromechanical device it converts electrical power into mechanical power. Also it is brushless, synchronous electric motor that can divide a full rotation into an expansive number of steps, stepper motor use magnets to make motor shaft turn precise distance when pulse of electricity is provided. Rotor will require 24 pulse of electricity to move the 24 step make one complete rotation. The rotor will take to move precisely 15 degree each pulse of electricity that motor receives.

F. ULN: It is a driver, which is used to drive the stepper motor. It is cheap and small in size and 5 volt geared stepping motors. The stepping motors are evidently widely used to control things like automated blinds, A/C units and are mass produced.

III. METHODOLOGY

Methodology of the work is represented as shown in the below figure 2.

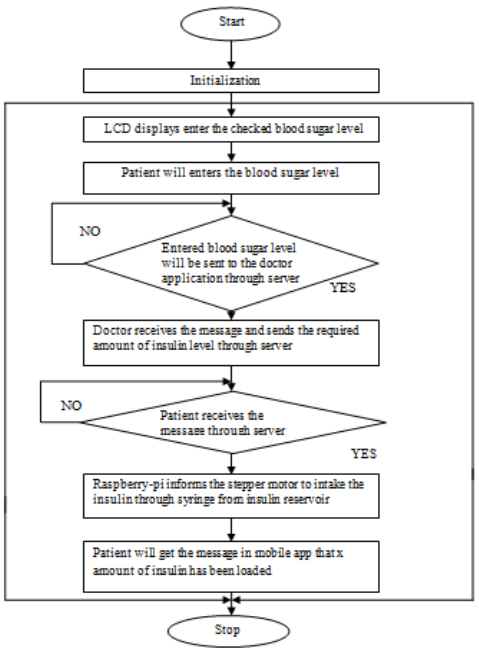

Figure 2: Flow chart of diabetes monitoring system.

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Initially, all the circuits will get initialized then LCD will be displaying to enter the sugar level, so once the user enters the sugar level, it will send that sugar level to doctor Application using the server, so doctor will receive the sugar level then doctor calculates what is the insulin level to be send to the patient, then doctor will enter the insulin level, what are the insulin level doctor enters that will be received to patient and intakes insulin.

IV. IMPLEMENTATION

The figure3 shows the internal circuit diagram of diabetes supervision system, in figure3 Raspberry-pi is centralized and it is connected to LCD, keypad, ULN, LCD. ULN and LCD are connected, 7805IC and stepper motor is connected to ULN. Here, LCD is the liquid crystal display. The LCD is connected to raspberry-pi; the pins D4, D5, D6 and D7 are the 8bit data pins which are connected to Raspberry-pi .GPIO pins of raspberry-pi 3 are connected to ULN Driver, keypad, LCD.

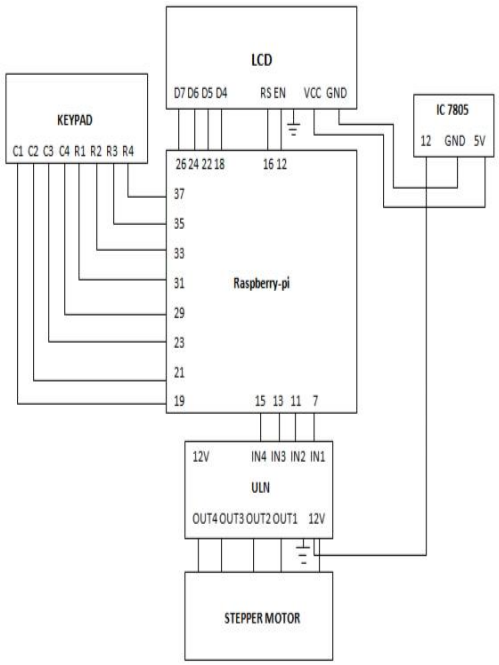

Figure 3: Internal circuit diagram of diabetes monitoring system.

GPIO pins(GPIO pins are the general purpose input and output pins) 18(GPIO24), 22(GPIO25), 24(GPIO8), 26(GPIO7) respectively, the pin RS is the register select pin in lcd which is connected pin16(GPIO23) in Raspberry-pi, the pin EN is the Enable pin in LCD which is connected to pin 12(GPIO18), in Raspberry-pi, and there are two ground pins present in LCD, the VCC in LCD has supply voltage 5v(4.7v-5.3v) which is connected to 5v of IC7805 and one ground pin(GND) from LCD is connected to IC7805 GND(Ground) pin , and keypad is connected to raspberry-pi , the input pins C1, C2, C3, C4 and R1, R2 ,R3, R4 are connected to GPIO pins of Raspberry-pi 19(GPIO10), 21(GPIO9), 23(GPIO11), 29(GPIO5), 31(GPIO6), 33(GPIO13), 35(GPIO19), 37(GPIO26), here we are using a matrix keypad, because typically one port pin is required to read a digital input into the Raspberry-pi. When there are lot of digital input that have to be read and it is not feasible to allocate one pin for each of them. This is when a matrix keypad arrangement is used to reduce the pin count from ULN the input pins IN1, IN2, IN3, IN4 are connected to GPIO pins of Raspberry-pi pins 7(GPIO4) ,11(GPIO17) ,13(GPIO27) ,15(GPIO22) and here ULN is used to drive the stepper motor, the stepper motor is connected to ULN output pins they are OUT1, OUT2, OUT3, OUT4 and for 12v of ULN stepper motor is connected from ULN, the 12v is connected to IC 7805 12v pin and another pin from ULN is grounded, the sd card is connected to raspberry model to the store the information that has been transferred to patient and doctor through the communication from server, this process is completely automated.

V. RESULT

As shown in below figure 4 it is indicated that how much amount of insulin has been intake for the patient blood sugar level, and insulin has been intake in units. Here patients cannot be able to draw more or less insulin so it will not cause any negative reaction to patient, it is completely automatic, there is no human interaction needed in the above graph 0 to 14 represents insulin level in units and the blood sugar level is mentioned in mg/dl.

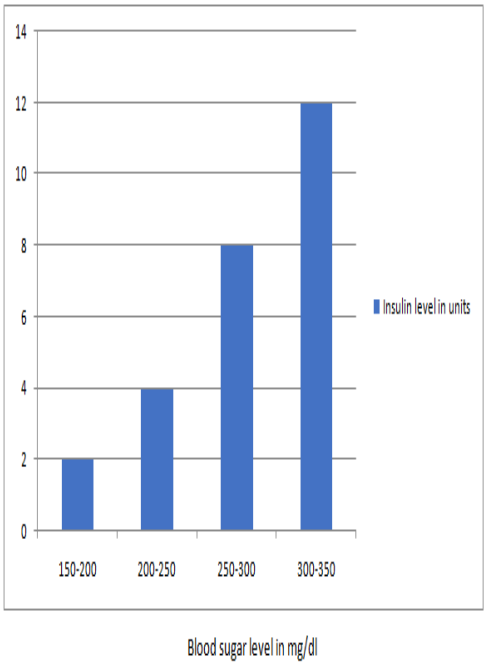

Figure 4: Outcome of insulin with respect to the blood sugar level.

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VI. CONCLUSION

A completely efficient IOT based eHealth stand that includes humanoid robot supports in diabetes managing in patients has been planned and developed effectively. This is accomplished through an intelligent, adjustable and reconfigurable practice of participatory design in which patients are closely implicated in innovative there modified health summary, follow up and treatment plans. This proposal is consequently leftovers for additional technical appliance and clinical study. This advance can be implementing to understand a more flexible patients robot conversation. Additional clinical knowledge are required to measure the impact of the recommend technology on the value of diabetics patients. The implement device can also be further enhanced by using progress of patient profile identical through reasonable conclusion as required.

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