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Novel Automatic Blood Glucose level Sensor and Insulin Injector for Diabetic Care

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***Abstract*—**Diabetes is the most common metabolic disease in the world in which Blood Glucose levels in human body remains high due to the insufficient or ineffective insulin secretion. The Prolonged existence of high Blood Glucose levels in human body for a stipulated period may lead to death in absence of proper health care. In order to manage the diabetic patients Blood Glucose levels must be monitored and treated systematically. Diabetic patient check Blood Glucose levels by performing a capillary test at least three times per day. This Blood Glucose monitoring technique is an invasive procedure, where the blood samples are collected through finger prick and manual Insulin application, this process is painful with the risk of infection. To overcome this, an Automatic Blood Glucose Regulator is developed for the critical Diabetic patients. In this automatic regulator the Blood Glucose levels are continuously monitored with non invasive risk free procedure and in case of high Blood Glucose level the insulin will be automatically injected into the patient body by using insulin injector. In addition a SMS message about patient Blood Glucose level will also be sent to the corresponding caretaker and the same will be stored in the cloud for future reference.

Key words: Diabetes, Blood Glucose regulator, Insulin Injector.

I. INTRODUCTION

Diabetes disease is the third leading cause of death and estimated that there were 400 million people affected all over the world. diabetes is the common name for diabetes mellitus, it is a metabolic disorder that is characterized by high blood glucose level in human body, which may lead to blindness, renal failure, amputation, heart attacks and stroke when there is no proper health care. diabetes can be categorized into three. the type 1 diabetes appears during childhood or in adolescence. in this condition the pancreas will be unable to produce insulin, which may due to some genetic reason. the type 2 diabetes is commonly seen in adults. in this type the pancreas produces insulin, but the amount produced may not be sufficient or the body will become resistant to it. the main reason behind this is obesity. type 2 diabetes is usually referred as a lifestyle disease. the third type is gestational diabetes, which is triggered by pregnancy. this type of diabetes usually resolves itself after pregnancy. the most common type is type 2 diabetes. middle age and older adults are at the risk of developing this type. people at lower risk can manage their sugar level by diet and exercise. for a healthy individual the sugar level falls between 4 to 5.4milli mol/l when fasting and 7.8milli mol/l after having food. the diabetes can be treated with various medications. the medicines help the body to use insulin efficiently. if oral medication is not effectively reducing the sugar level, the patients eventually need to take insulin injections. diabetic patient should be followed by a doctor lifelong and testing of the blood glucose level at regular intervals is very important for managing the treatment and avoiding the complications. the diabetes patients takes blood by the finger prick method which does not monitor the levels continuously and it also causes pain and inconvenience. the frequency of testing depends upon the type and severity of diabetes. for critically ill diabetic patients blood glucose levels are much affected due to their medication effects and they require blood glucose test multiple times a day. so it is very difficult to take blood sample many times a day and continuous pricking the finger and taking the sample may lead to anemia. the introduction of non-invasive glucose monitoring can solve this problem because it does not require any finger pricking and reduce the difficulties related to diabetes allow the patient an alternative painless continuous monitoring and reliable treatment with automatic insulin injector.

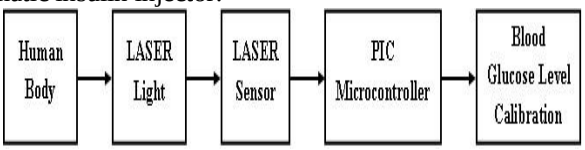

Fig 1: Block Diagram of Non Invasive Method

II. AUTOMATIC BLOOD GLUCOSE REGULATOR:

The Blood Glucose levels of critical ill diabetic patients can be controlled using Automatic Blood Glucose Regulator. This scheme contains a LASER sensor for Non invasive Blood Glucose measurement and an Automatic insulin injector

Non Invasive Procedure:

In the conventional method the Blood Glucose cannot be measured continuously and it has high risk of infection. So this method is not applicable for critically ill patient as they require continuous monitoring. To overcome these problems non invasive method emerged, here the blood glucose level is

continuously monitored and regulated.

In this work non invasive procedure adopted, the Red LASER (RL) is made to pass through the human finger for a few seconds. The LASER light is being absorbed by the glucose in dermis fluid, remaining light gets refracted and it is collected by LASER sensor. The refracted light captured by the LASER sensor is converted into corresponding voltage value. The analog voltage which is given as input to PIC microcontroller

1) PIC Microcontroller*:*

In this work PIC 16F877A is used. The main advantage of this microcontroller is it can be write-erase as much as possible because it uses FLASH memory technology. The operating voltage is between 4.2 volts to 5.5 volts. It has 8 channel of 10 bit A/D convertor. The analog voltage from LASER sensor is given as input to Microcontroller, which convert it to the corresponding digital value. The voltage processed by the PIC Microcontroller is calibrated to equivalent level of blood glucose level and it is displayed on the LCD screen.

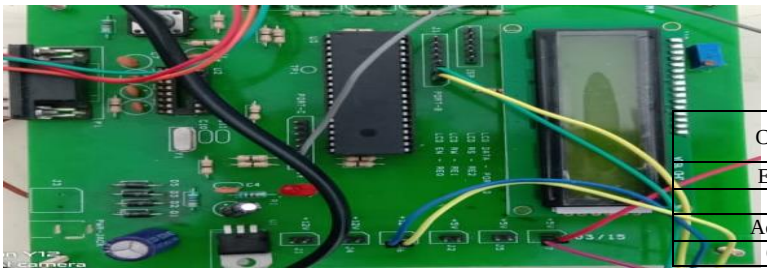

Fig 2: Photograph of PIC 16F877A

2) UART:

UART is used for transferring data serially to PC and Zigbee. Transmitting and Receiving UARTs must be set for the same bit speed, character length, parity and stop bits for proper operation. The data transmitted will be in binary form .The data transmitted is in two states, they are MARK and SPACE state. MARK state when the bit is 1 and the SPACE state when the bit is 0. The data transmission starts with the start bit (positive voltage) following it the data will be transmitted serially, it is followed by stop bit (negative voltage) this cycle continues till the data are completely transmitted.

3) Zigbee:

Fig 3 Photograph of Zigbee Module

zigbee module is used to create pan (personal account number). zigbee is a low data rate supporting wireless networking standard, which is basically used for two way communication between sensors and control system. it is a short range communication standard like wi-fi, covering range of 10 to 100 meters with low power consumption..

4) Insulin Injector

Insulin control unit consist of servo motor, pair of gears and injection when the glucose level in the critically ill patient gets high, insulin control unit injects the insulin automatically to the patient.

Fig 4 : Photograph of Insulin Injector unit

Table: Blood Glucose level

Condition	Blood Gucose Level (mg/dL)	
	Before Meal	After Meal
Excellent	72-109	90-126
Good	110-144	127-180
Acceptable	145-180	181-234
Critical	>180	>235

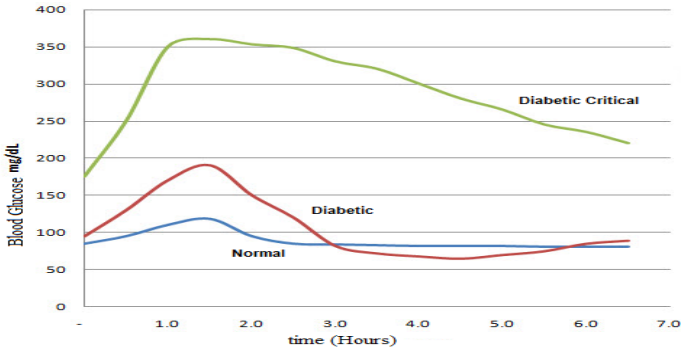

Fig 5 : Blood Glucose vs Time Graph

Table: Blood Glucose level vs Insulin

Blood Glucose Level (mg/dL)	Insulin (Units)		
	Low Dose	Medium Dose	High Dose
70-130	0	0	0
131-180	2	4	8
181-240	4	8	12
241-300	6	10	16
301-350	8	12	20
351-400	10	16	24
>400	12	20	28

5) CLOUD and GSM:

The blood glucose values will be continuously stored

in the cloud platform using Zigbee and SMS will be sent to the caretaker of the patient using GSM.

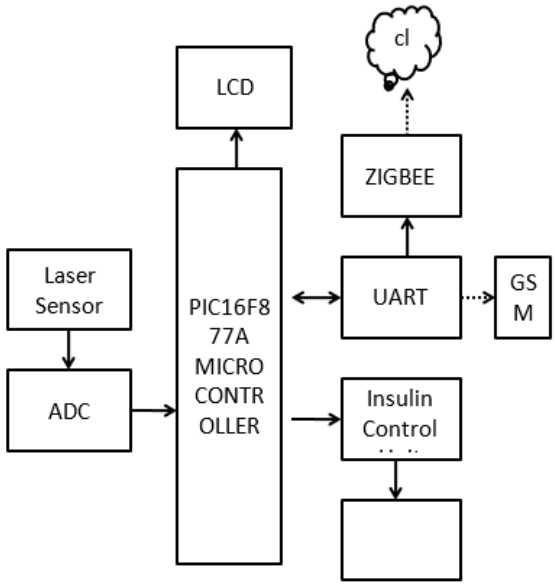

Fig 6: Block diagram of Automatic Blood Glucose Regulator

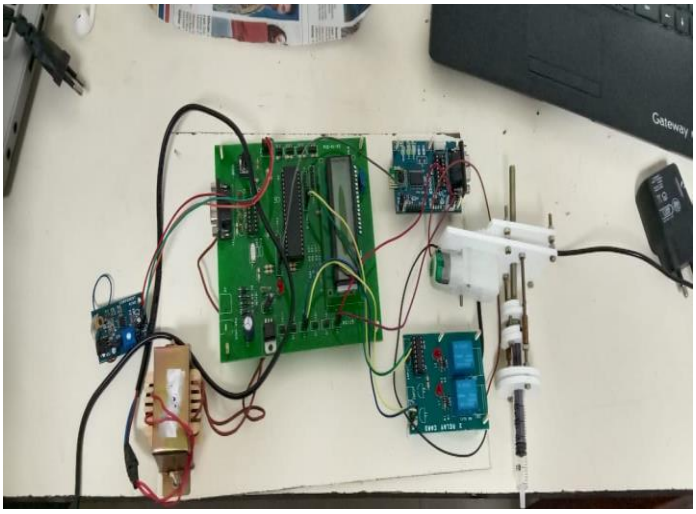

Fig 7: Photograph of Automatic Blood Glucose Regulator

III. CONCLUSION

The normal blood glucose level of a person is 70 to 130 mg/dl. but for the critically ill diabetic patients, the blood glucose level abruptly varies and metabolic activities slow down due to the intake of medicine effects. for such patients the blood glucose levels must be continuously monitored and regulated. this automatic blood glucose regulator contributes improving the quality of life of those critical ill patients by continuous blood glucose monitoring and regulation throughout the day. this existing system is can be made more reliable by adding some other parameters measurements like blood potassium level, hemoglobin level, respiratory rate etc.,

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