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Automatic Insulin Analyzer as an Important Part of Modern Health Care System

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C A R A S

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A B S T R A C T

Medicines are an important part of modern health care system. The market for pharmaceutical medicines runs in billions of dollars a year. But recently a new problematic phenomenon has risen which is termed as "Poor Medication Adherence". In simple terms it refers to improper intake of medicines as prescribed by doctor. Study shows that the reason for it is forgetfulness. So, the instrument devised here is to address the problem by building a wearable noninvasive device which can alert the patient in time. Since the device is in its initial stage so it was built for only glucose detection to control insulin intake by diabetic patients. Near Infra-Red light when passes through a tissue its absorbance is changed due to interaction with glucose molecules present. By detecting the level of glucose one can determine the insulin requirement of the patient. Glucose is one of the important biochemical produced in the process of metabolism in human body. But also, a proper level of glucose amount will ensure the health of a human. Insulin regulates the amount of glucose level to be maintained in the human body.

Key words: Poor medication adherence, Glucose, Insulin, Near infra-red

According to a publication in 2011 in National Center for Biotechnology Information the benefit of medication for chronic diseases is 50% of the time not realized due to improper intake. Medically it is termed as 'Poor Medication Adherence'. It renders a huge loss not only in the part of the patient also it creates looses for the entire health system of the country. In US alone the loss is estimated to be $100 billion annually. Also it is cited that 90% of the reason for poor medication adherence is due to personal negligence or forgetfulness due to lack of proper reminding system on a personal level [1].

There are wide ranges of medicines available on the market for each of known illness. Most of the time patients suffering from chronic disorder where they are required to take medicines for a very long period of time are usually a problematic. People who cannot afford a full time care taker would sometimes might skip the medication due to negligence. This results in the loss of the patient in the form of money as well as health. The current project will try to address this problem by devising a non invasive wearable device which can be used to monitor the level of medicine used. Since it's in initial stages only one medicine will be considered for this- Insulin. Future work will be extended to all the medicines available. Insulin is a very important biochemical produced in human body

which helps to keep the glucose level in check. But when a person is not able to produce the required amount of insulin by itself than it has to be supplied from the outside. Based on the type of diabetes a person is suffering from different doses of insulin is administered. A non invasive glucose meter is non painful and easy to carry and use, so it is much preferable than any other conventional method of insulin and glucose monitoring [2-5]. The basic principle involves the use of Near Infra Red light source as it has much penetrating power and is non lethal to humans. The light rays will penetrate through the tissue and will be detected by a detector on the other side. It is known that the absorbance and the intensity of Infra Red reduce after interaction with glucose molecule. By measuring the amount of infra red absorbed one can find the glucose level and can determine the need of insulin. The device was made to be worn in the wrist but a more effective way will be to make it use in the ear lobe as it has no bones for hindrance. Presence of bones effects the infra red on emergence. Future scope includes extending the device capacity to detect most of medicines available on the market and customize it according to the patient's prescribed medication.

MATERIALS AND METHODS

It is a noninvasive wearable device solely made for the easy use by patients. The simple construction of the device is the use of NIR emitter at one side of the device and a NIR detector/sensor is placed, which is connected to the microcontroller, which is further connected to seven segment display unit. Seven segment displays the output ration of the subject. Also, the buzzer trigger the alarm.

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Use of near infra red emitter and sensor

Near infra red is that portion of IR radiation spectrum with wavelength 700nm to 950nm used for medical diagnostics like detection of blood sugar and oxygen saturation [Fig. 1]. This application is carried out by employing a IR source and a IR detector based on radiation fluctuations when it passes through a medium [6-9].
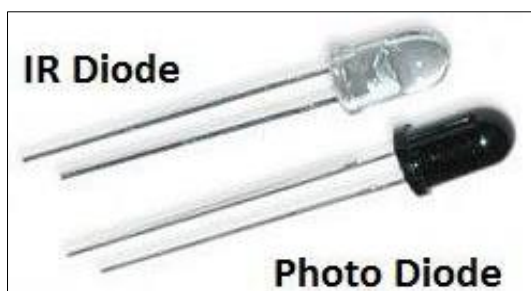

Fig 1 Near infra-red sensor

Use of seven segment display

This is electronic display which shows less complex physiological computations in easy understanding digits rather than the complex decimal ones [10-11].

RESULTS AND DISCUSSION

Use of sensor

The source and detector of IR are placed on either sides of the ear lobe. The NIR LED emits the radiation which passes through the earlobe and reaches the IR detector. The detector detects the intensity, scattering and absorption of the NIR according to Beer Lambert's Law. The light intensity increases with the cardiac diastole that means when heart relaxes and the intensity of light decreases when the heart contracts (cardiac systole) [12].

Application of microcontroller

A microcontroller is a simple integrated circuit which is used for various applications ranging from gaming to rocket science (Fig 2). Here we are using pre-programmed microcontroller to assess the variation of normal glucose values

like 120mg/dl [9]. This microcontroller also aids in activating the alarm system (buzzer) to produce sound for blind persons.
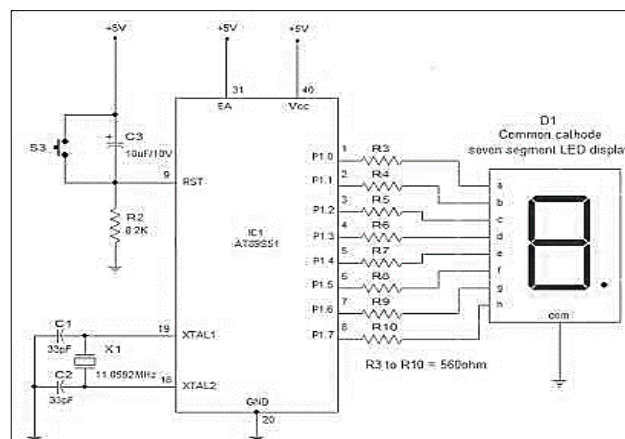

Fig 2 Microcontroller sensor

Use of crystal oscillator

A crystal oscillator is an electronic device which uses the resonance of a piezoelectric material. This oscillator aids in vibrating the component buzzer and amplifies the kilohertz frequency for better performances (Fig 3).

Fig 3 A miniature 4 MHz crystal

CONCLUSION

The purpose of glucose monitoring system is to analyze, monitor and offer some indications when the glucose level exceeds or decreases then the normal limit. This system is also aimed to analyze the concentration of natural insulin which is secreted by Inlets of Langerhan's of pancreas.

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