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ALTERED TEMPERATURE THRESHOLD ASSESSMENT IN DIABETIC PATIENTS SUFFERING FROM PERIPHERAL NEUROPATHY

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Abstract - This project describes the assessment of the altered temperature sensation in the type 2 diabetic patients suffering from peripheral neuropathy. Peltier crystal is used as a temperature threshold determining tool. Its temperature is altered and this is introduced on the site of examination of the body like palm, foot etc. Tests are conducted for both hot and cold cases. The thermograph (temp v/s time plot) is plotted using digital values obtained by the electric circuitry in any of the software platforms. Average values of 3 or more tests yield a better distinctive value of the altered temperature threshold. [1]

Keywords— *Temperature, Peltier, Thermograph, Neuropathy, Threshold.*

I. INTRODUCTION

Diabetes is a group of metabolic diseases in which a person has high blood sugar, either because the body does not produce enough insulin, or because cells do not respond to the insulin that is produced. There are, currently, approximately 33 million patients with diabetes in India and this number is expected to rise to about 57 million by the year 2025. Diabetes is associated with long term complications due to peripheral neuropathy and microangiopathy. Diabetic foot is one such complication which leads to frequent hospitalization and amputation of lower limbs, adding to disability, reduced quality of life and economic burden to the country. [2]

Peripheral neuropathy is the term for damage to nerves of the peripheral nervous system, which may be caused either by diseases of or trauma to the nerve or the side-effects of systemic illness. Diabetes and post herpetic neuralgia are the most common causes of peripheral neuropathy. The numbness and the inefficiency in sensing the temperature variations of any hot or cold substance is a qualitative process. The main aim of the project is to convert this qualitative process to a quantitative analysis. The various stages of the numbness and variation in the temperature threshold are experimented to express in the terms of values. [3]

II. METHODOLOGY

The project is a combination of Hardware and Software. The Hardware includes the following working modules.

a. PWM Circuit for Peltier Crystal

b. Bio-Sensor

c. Analog-to-Digital Converter

d. Micro-Controller

The Peltier crystal is the thermoelectric module of around 5cmx5cm sandwich formed by two ceramic plates with an array of small Bismuth Telluride cubes in between. When a DC current is applied heat is moved from one side of the device to the other. PWM circuit using 555 timer IC is used to provide regulated power supply to the crystal according to the necessary controlled heating. This crystal is introduced on the site of examination and tests for cold and hot conditions are carried out. The cold and hot temperatures which are been sensed by the subject are marked. [4] [5] [6]
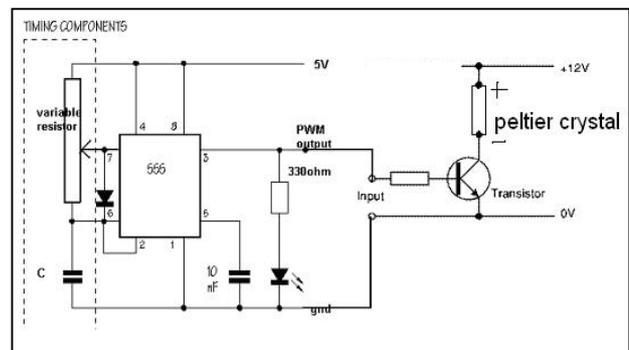

Fig1. PWM circuit for Peltier Crystal using 555 Timer IC.

LM35 is a bio-sensor used in this project. It is pre-calibrated in ^{o}C. It is sensitive to the external temperature variations. Corresponding to the external temperature
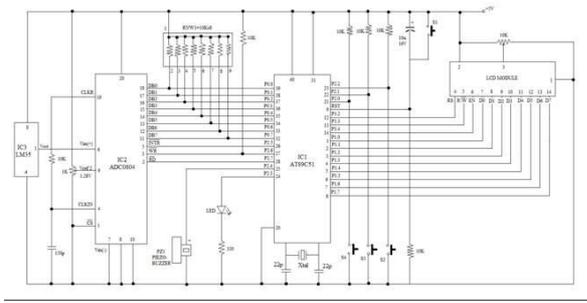
Fig2. Circuit Diagram of the Project

variations, it produces voltage variations, which is in analog form. It gives 10mV/$^{\circ}$C. [7]

The A-to-D converter digitizes the output of the LM35. ADC0804 is an 8-bit analog to digital convertor which is used here. The digital outputs vary from 0 to a maximum of 255. The voltage reference input provides a means of encoding small analog voltages to the full 8 bits of resolution. [8]

The AT89C51 is a micro-controller controls the major parts of the project like, LCD display, Serial Communication etc. The Micro-Controller is coded so that, it performs the following tasks serially. [9]

- Temperature of the Peltier crystal is sensed by the Bio-Sensor,

- Conversion of Analog data to Digital data

- Digital temperature reading is displayed in the LCD display module.

- This data is fed to the computer through serial communication.

The fig 2. Shows the major circuitry of the project.

III. OBSERVATIONS

The LCD shows the digital reading of the temperature of any object which is sensed at that instinct.

The corresponding changes in the readings for every change in the temperature of the Peltier Crystal is shown in the LCD

IV. INFERENCE

The above circuitry in addition with the serial communication and front end programming can be used for the assessment of the altered Temperature Threshold in Diabetic patients suffering from Peripheral Neuropathy.

V. FUTURE DEVELOPMENTS

In this project, the temperature of the Peltier Crystal is acquired, and the corresponding digital temperature is displayed on the LCD display. The main aim of the project is to obtain a "Thermograph"

in the computer. To obtain the Thermograph, the digital temperature data has to be fed to the computer. Serial communication is necessary to feed the digital data to the computer system. The values hence obtained have to be plotted as a Thermograph with the help of MATLAB. MATLAB software is used for Front End Programming.

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