Microcontroller Based Automatic Switching Types Multi-frequency Electrical Impedance Spectroscopy(EIS) System For Early Detection of Breast Cancer

Shekh Md Mahmudul Islam and Md Adnan Kiber

Abstract

Breast Cancer is among the top five causes of cancer death and topmost cause among women worldwide. The early diagnosis through simple, non-invasive and inexpensive screening can provide great deal of aid especially for the poor people of Bangladesh. Making diagnostics measurement available to the widely geographically spread population in developing countries is a challenge which is unlikely to be met by the technology used in the west. Multi-frequency Electrical Impedance Spectroscopy is quite attractive in this context as the instrumentation is relatively simple and there is no known health hazard. Electrical Impedance Spectroscopy has been the subject of quite intensive research in breast cancer screening for about 10 years. EIS is a medical imaging technique in which image of the conductivity or permittivity of part of the object is inferred from the surface of the electrical measurement through a set of electrodes. Tissue impedance spectroscopy involves injection of constant current into tissues at different frequencies and measurement of voltage gradients. Automatic switching system is needed for the reliability of the EIS system and automatic switching between electrodes are implemented using digitally controlled analogue switch (MC14551B) and the sequence of switching is controlled by locally available microcontroller ATmega8.This paper focuses on the instrumentation of microcontroller based automatic switching type EIS system for early detection of breast cancer. In this research work EIS system has been designed using function generator,Howland V/I converter, automatic switching system using digitally controlled analogue switch(Mc14551B) and the sequence of switching is controlled by microcontroller ATmega8,instrumentation amplifier and Butterworth bandpass filter. In our previous research work the automatic switching between electrodes has not been done but in this research work automatic switching has been implemented using Arduino board microcontroller and Arduino board has been designed. The performance of designed EIS system each section is found to be satisfactory and measurement on resistive components gave an error of 2.2% which indicates that proposed system can be used for breast cancer screening trials.

Keywords: Electrical Impedance Spectroscopy, Multi-frequency, Microcontroller, Instrumentation

I. INTRODUCTION

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BREAST CANCER is one of the most common cancers and leading cause of cancer death among women worldwide [1][2].Breast cancer incidence is increasing over the year with more than 1 million reported each year[3].In addition to that an average 37,300 women died globally in conjunction to the disease[2][4].As there is no cancer registry system in Bangladesh so we do not have accurate data on this. Like other developed countries the number of patients is increasing day by day in Bangladesh too. The most common form of screening system available to

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