Notification No.: COE/Ph.D./(notification)/536/2023

Date of Notification:18-04-2023

Name of Scholar: Md Qaiser Reza

Name of Supervisor: Prof. Munna Khan

Name of Department/Center: Electrical Engineering

Topic of Research: Design and Development of a portable Device for Pharmaceutical inspection

Summary of Abstract

The objective of the thesis is to develop a pharmaceutical inspection device based on Acoustic Resonance Spectroscopy (ARS) is to achieve significant accuracy at minimal cost with maximal speed. With this aim, first a prototype model had been developed using V-shaped glass strip and two similar piezoelectric discs, attached at the two ends of strip. The experiments were performed three samples and acoustic signals were acquired and power spectral analysis was performed to record resonance pattern. It has been observed that different sample form distinguishing signature but the spectral was not good. So, a quartz V- tube were used in place of glass strip because it has very low acoustic impedance. The data acquisition part is the main physical part of the device which is designed with a hollow V-shaped quartz tube and two piezoelectric transducers and is known as resonator assembly. The two designs of resonator assembly have been developed which are named as Design 1 and Design 2. Design 1 contains a V-shaped tube and two piezoelectric discs. The discs are interchangeably acting as a transmitter and a receiver and attached at two ends of the tube. Whereas Design 2 contains a V-shaped quartz tube, a piezoelectric disc, and a piezoelectric film. The piezoelectric disc used as a transmitter, and a piezoelectric film used as a receiver. These transducers are attached at two ends of the tube. Design 2 is an improved version of design 1 and provides better accuracy than design 1. Because, the piezoelectric film used as a receiver in design 2 has better sensitivity than piezoelectric disc used as receiver in design 1. The data acquisition part of the device also has a signal generator, charge amplifier, amplifier, filter, and a means to store the received data. Using this device. the experiments were performed on distilled water, distilled Water+salt solution, distilled water +sugar solution, edible oils (Mustard, Olive, and Almond), and nonedible oils (Castor, Petrol, and Tarpin). The parametric and non-parametric spectral analysis were carried out on recorded acoustic signals in order to extract resonance frequencies. These datasets were fed to different machine learning classifiers after performing dimensionality reduction and results were very good. This conclude that the developed system has shown significant capability in forming a unique signature of samples and effective to be used in pharmaceutical inspections.