CHAPTER 1

INTRODUCTION

1.1 Background

For food and agricultural commodities production, banana is ranked one of the top twenty in the world trade with more than 97.4 million metric tons and a total international price of 27 billion dollars in 2009. Appropriate banana ripeness level is typically estimated by naked eyes and demonstrated including destructive analysis of mechanical hardness, total solid soluble content, ethylene content, and aromatic composition via gas chromatography.

To maintain the quality of bananas, non-destructive methods are highly desirable. This can be performed in a close chamber by using an array of electronic odour sensors incorporated with a complex neural network-based algorithm. Acoustic and capacitive properties of the banana can also be used to evaluate the banana ripeness. However, a variation of banana shape and size has tremendous effect in the acoustic resonant frequency and electric permittivity. Nuclear magnetic resonance (NMR) and proton magnetic resonance techniques were demonstrated for measuring the sugar content with key concerns on cost and radiation leakage. Other promising approaches through gloss analysis as well as two-wave length and visible near infrared spectral analysis was demonstrated. Because these techniques can evaluate the banana ripeness level in a very limited small area, imaging-based technique can be employed as it has been recently used for identification of genuine credit cards and Thai jasmine rice.

Previously, a hyper spectral-imaging concept, and a machine vision embedded with a colour feature extraction algorithm and artificial neural network were proposed and demonstrated for classifying maturity levels of the banana. The rapid growth of today smart mobile phones also stimulates mobile phone applications such as Fruit Checker, Colorimeter, Catch Colour, and Colour Detector that can be used to roughly evaluate the quality of fruits under illumination of the ambient white light or a light emitting diode (LED)-based flash light embedded on the smart mobile phone. As the chlorophyll in completely yellow banana is mostly degraded and the banana colour is unchanged, these techniques cannot correctly

estimate the banana ripeness level until undesired brown spots appear. In this scenario, the banana is already in the unwanted over ripe stage. Although observation of the increase in blue luminescence from bananas under an ultraviolet light at either 350 or 366 nm wavelength can evaluate the banana ripeness level during ripening, it fails in distinguishing bananas between immature and over ripe stages. However, it cannot efficiently excite the chlorophyll in plants because the fluorescent catabolite of the chlorophyll has absorbance spectra near 358 nm. As different areas of the whole banana are not in the same ripeness level at the same time, the above methods totally fail in dividing the whole banana into different ripeness zones as well. To clearly pinpoint the ripeness level of the whole banana from its beginning immature to over ripe stages, this project proposes and experimentally demonstrates for the first time a 2-D banana ripeness level indication concept. Our key idea is to simultaneously analyze two broad-spectral images under white light and ultraviolet illuminations. Particularly, specific colour ratios from these two broad-spectral images are used for specifically classifying the whole banana into immature, ripe and overripe zones. In addition, we show how MATLAB can be implemented with our proposed spectral analysis and can be used as a banana ripeness sensor.

1.2 Aim of the Project

We propose an effective analysis concept for banana ripeness estimation. Our key idea is based on the simultaneous analysis of images of the banana taken under white light and ultraviolet illuminations. The calculated red and green color ratio and the computed blue and green color ratio of image are used to spatially and specifically classify the whole banana into immature, ripe, and over ripe zones.

The secondary aim includes developing a MATLAB based Graphic User Interface (GUI) tool to be used.