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Fruit Quality Analysis using NIR Spectroscopy

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***Abstract:** In agriculture science, automation will increase the standard, economy and productivity of the country. The fruits and vegetable qualities plays an important role in the market. Classification of the fruits based on the color, size, shape were impact on the outside characteristics only, the inner characteristics is untold. When it reaches the end consumer will get disappointed with the quality of the fruit. Hence to measure the inner characteristics of the fruit can be done by passing signals into the fruit. For these prototype used NIR spectroscopy, which deals with irradiating the product with NIR light (750 nm to 2500 nm) and collecting and analyzing the spectrum using sigview analyzer and MATLAB. In this work, NIR based reflectometry sensing is to measure the moisture content of the fruits for determinant quality*
***Keywords:** Nir Spectrometry, Signal Acquisition, MATLAB, Histogram Analysis, Sigview, Cross Spline Transformation*

I. INTRODUCTION

India is an agriculture country. India is at second number after china in production of fruits. In India all the pre-harvesting and post-harvest are done manually.

Manual method is extremely time intense, less economical therefore to get accurate result automation in agriculture industry is needed.

The classification of the fruits includes sorting and grading. various quality factors are considered for sorting and grading of fruits. Automation is playing important role in day today life. In India more than half population depends upon agriculture. Their main source of income is agriculture.

Exporting of fresh fruit is increased day to day from India. increased expectations for food product of top quality and their characteristics of products continues to grow. NIR spectroscopy method will provides an alternative method for an automatic, non-destructive and cost effective technique to grading the quality of the fruit.

This inspection approach based on acquisition of reflected signal from the fruit and processing that by sigview and MATLAB.3d Classy Digital Amplifier helps to reduce the noise of the received signal, the noise free received signal is processed using MATLAB and histogram analysis is performed on it which acquires the required intensity values and feature extraction and cross spline transformation is done for measuring the fruit quality. This article examines the fruit quality by comparing with the pre defined values of the signal.

II. EXISTING SYSTEM

An fruit image is taken, that is in RGB color model, which is converted to the HSI color model, and is classified by hue value to separate the fruits from its background.

After that, the simplified histograms value of the fruit surface color are calculated,the histogram values are considered for the input and which is processed and The output is having the values which when fall between the pre defined reference value, it's considered good else not ripen.

III. PROPOSED SYSTEM

NIR Spectroscopy is used to measure the quality of the fruit in non destructive manner. NIR signals are passed to the fruit and reflected back based on the biological property of the fruit and the change in quality of fruit affects the reflection index of the NIR signal.

The signal is noiseless by 3d classy digital amplifier and histogram analysis is used to examine the required intensity values, Feature extraction a type of dimensionality reduction that efficiently represents attention-grabbing components of a picture as a compact feature vector and Cross spline transformation propose to generalize these spline constructions to obtain new wavelet bases with a continuous order parameter is used to analyse the collected input NIR signal to grade the quality of the fruits

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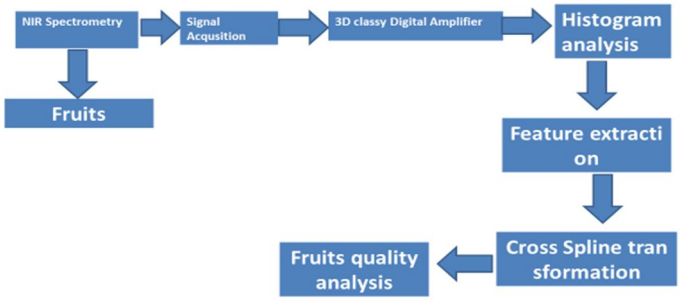
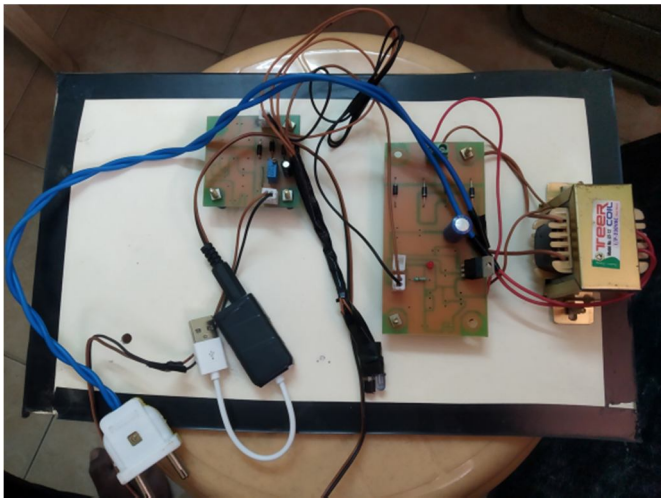
BLOCK DIAGRAM



IV. IMPLEMENTATION

A. Hardware

Acoustical NIR sensor can be used to detect the internal characteristics of the fruit. NIR sensor contains source and detector. Light Emitting Diode(LED) is selected as it is very cheap and works at very low power input than Laser diode. Acoustic sensor is selected as detector to observe the reflected or scattered signal from the surface of the fruit. In this prototype, an NIR sensor working at 750-1200nm spaced at the surface layer of the fruit. Signals can penetrate to a depth of approximately 3cm below the surface of the fruit. The sensor radiates the fruit with Infrared radiation. The signal reflected from the fruit is passed to3d Glassy digital amplifier is used to reduce the noise from the received signal and is recorded and visualized by software Sigview.



B. Signal Processing

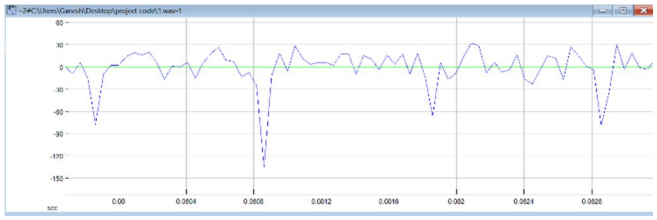
Raw signal captured using Sigview software and the noise, low frequency signals are removed using filter and

The NIR sensor consists of the sensor and the detector is interfaced through the sound card to the computer. NIR LED emits light into the fruit and the emitted signal is detected. The sensor is interfaced through the sound card to the system. Sigview software is used to acquire the raw signal and it is processed using MATLAB. Low frequency signals are filtered through the class c amplifier, quality measures, cross spline, statistical analysis is done for the resulting signal.

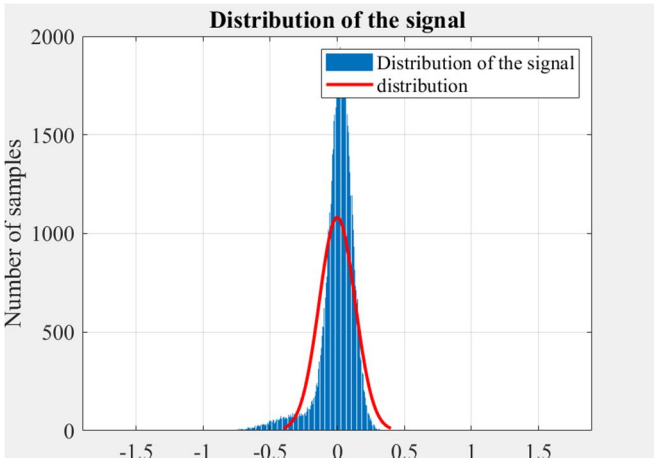
The acoustic signal is recorded for 3-5secs with a sampling rate of 2205Hz. Signals can also be recorded for any length of time and processing cabe done. Raw signals were processed using sigview and after filtering. Histogram analysis were performed and the statistical parameters like Standard deviation, σ (sigma), Mean,μ (mu), peak range and the dynamic range were noted down. Using the statistical parameters, various spectral analysis were done. Parametric and Non-parametric method were applied to get the spectral waveform and the best method was identified and compared for quality of the fruit. Table below clearly shows the statistical parameters for various subjects for processing.

condition	Subject	Sigma	Mu	Peak(db)	Dynamic Range(db)
Bad	1	0.13353	-0.00012383	Q=17.4888	D=44.4543
	2	0.13340	-0.00013352	Q=17.3523	D=44.3645
	3	0.13250	-0.00012390	Q=17.2540	D=44.4632
Good	1	0.13840	0.00012411	Q=17.1773	D=44.1903
	2	0.13852	0.00012421	Q=17.1762	D=44.1852
	3	0.13760	0.00012141	Q=17.1771	D=44.1901
Moderate	1	0.13562	0.00001345	Q=17.2346	D=44.2654
	2	0.13545	0.00001364	Q=17.2564	D=44.2623
	3	0.13492	0.00001390	Q=17.2453	D=44.2641

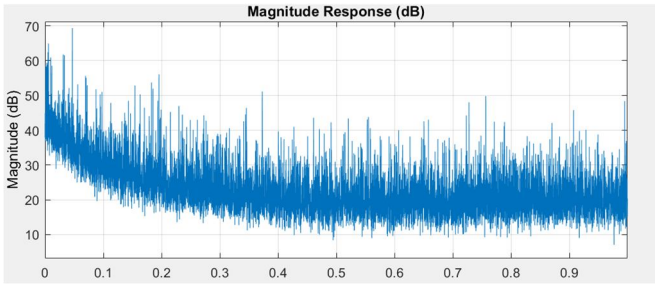
Parametric methods like quality measures, cross spline, statistical analysis were applied for the table above.



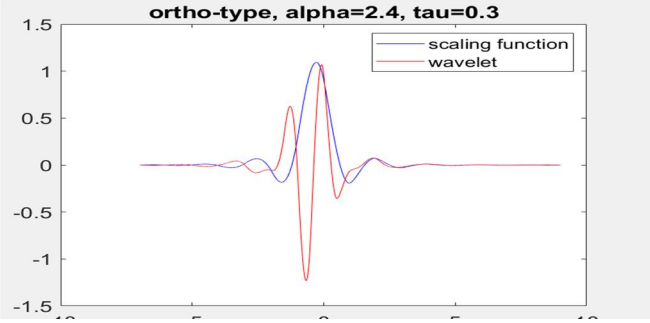
The recorded signal from sigview consists of unique peek and trough waves. Which will used for classifying the characteristics of the fruit



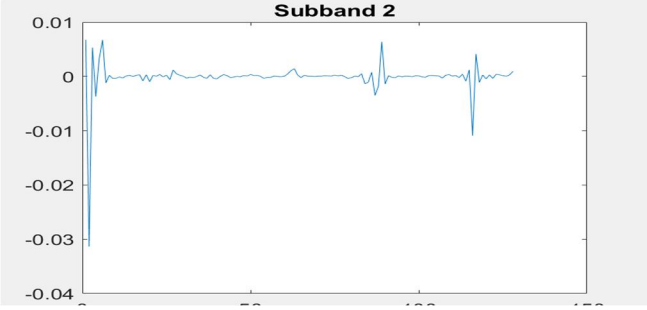
The .wav signal is processed by MATLAB software. First histogram analysis is performed for distribution of the signal which classify the intensity level and we can get the quality measure of the fruit



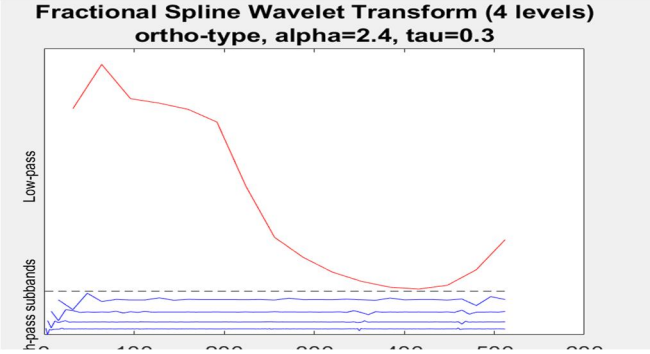
The cross-spline is performed for the filter visualization tool of the Magnitude response of the signal



The wavelet can be performed by ortho-type and the corresponding analog to the digital can be obtained



Sub band is used for the correlation, mean, standard deviation of the signal



The lpf and hpf were classified and they were used to compare reference value to get characteristic of the fruit.

V. CONCLUSION

In this paper, the fruit quality is discussed using signal processing of Near Infrared Spectroscopy. The test is performed on the fruit for moisture content measurement. This test is performed for fruit varieties having thin peel. The signal is analyzed with various parameters including statistical data like Standard deviation, σ (sigma), Mean,μ (mu), peak range and the dynamic range.

VI. FUTURE SCOPE

Future design can be modified by increased number of samples which will reflect in the high accuracy of the quality inspection. Moisture analyzer along with this for high precision result, we can improve this prototype into handheld device for portable, instant results.

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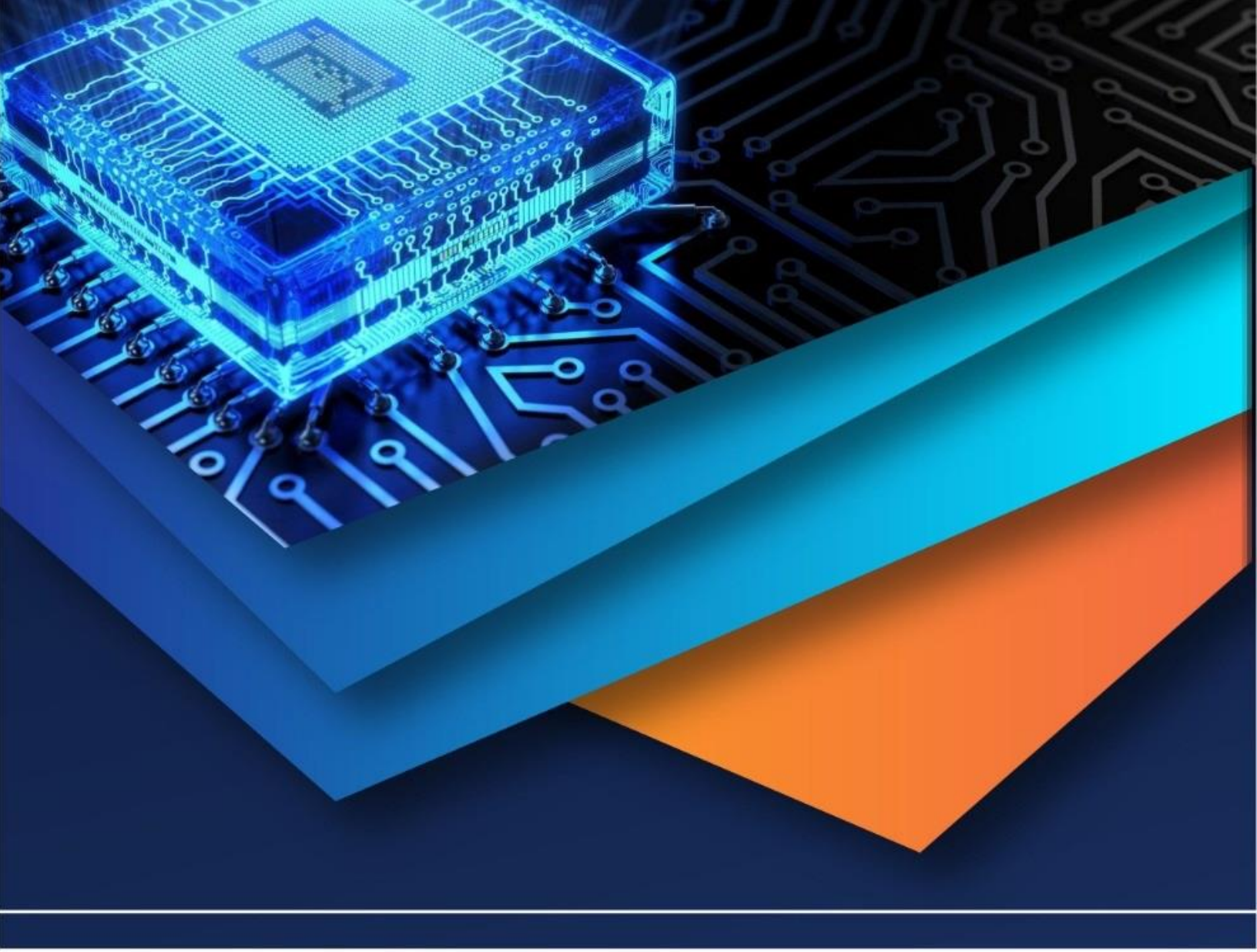

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