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ELECTRONIC TONGUE FOR TEA QUALITY DETERMINATION

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***Abstract* — Taste sensation is the effect of physio-chemical interactions of food molecules with the interconnection of thousands of cell buds sited by chance all over the pores in the tongue. However, sensory test results of are usually affected by several subjective factors such as sensation, exhaustion, habits and by physiological and psychological conditions. In India tea industry places an important role cultivator and producers have always relied on skilled and experienced tea tasters to give out quality scores to tea which determines the prices at which tea manufactured is sold and bought. In this paper different tea powders are examined by components present in tea and pH value is determined. Bitterness taste can be found using pH value**

Index Terms – Sensory array, Tea samples, pH value, Tannin Component

I. INTRODUCTION

Tea is the most economic level in India. Tea is composed of many components like caffeine, tannin, theaflavin, flavanoid, fluoride, theobromine, theanine and catechin. While exporting, the quality of tea must it is important for the exporter to fulfill the needs of the customer. So the tea taster must be prompt while classifying the tea. There are different processes involved for preparing tea from tea leaves. During the process, if there is any minute change like temperature, moisture or through any environmental changes also may cause changes to the composition [10]. This cannot be easily identified by professional tea tasters. The main drawback by this process is time consuming, imprecise and mainly an experienced human resource is needed. By psychological and physiological factors such as body temperature, mood of the particular person, temperature changes etc tea variety cannot be identified perfectly. Both factors underscore the role of taste while manufacturing [4].

E-Tongue compresses timelines and lets researchers gather taste and dissolution data simultaneously. Researchers believe that electronic tongue can be used by industry to quantify and qualify the products. They also planned to go further than the four tastes of the human tongue and use the e-tongue for analyzing urine or blood substances, or to check for water contaminated. Someday, the tongue might speed up blood investigation by testing everything from cholesterol to medications in a person's bloodstream. The electronic tongue provides a fast, inexpensive and objective method to judge the quality of tea.

Neural network used to refer to a network or circuit of biological neurons which are composed of artificial neurons or nodes. The contemporary usage of the term often refers to artificial neural networks (ANN). There are two types of neural networks:

- Biological neural networks are made up series interconnection of neurons which can regulate its own activity related to nervous system.
- Artificial neural networks are made up of interconnecting artificial neurons which can compute values from input. It has three parameters: interconnection pattern, learning process and the activation function. The types of ANN also mimic the behavior of neurons.

E-tongue comprises array of chemical sensors, data acquisition system and the processing tools [5]. It is widely used for the data processing stage.

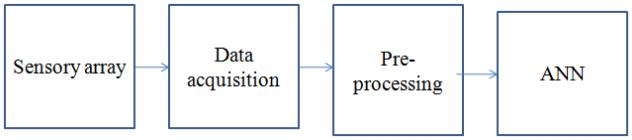

Fig: Schematic Diagram of E-Tongue

The main elements used are the number of different sensing element for the samples which imitates the taste buds in human tongue [12]. Neural Networks are information processing structures imitating behavior of human brain. The main advantages of neural networks are adaptive structure, interaction between input and output data when many data's are fed, fault tolerance, process data in parallel manner and adapting to the circumstances and gives better performance result. An artificial neural network is composed of many artificial neurons that are linked together according to specific network architecture. The main aim of the neural network is to determine the meaningful outputs. ANNs have a broad field of applications such as classifications, clustering, prediction etc. The ANNs are quite flexible for adaption to different type of problems and can be custom-designed to almost any type of data representations. It can be used in many applications like medicine, food industry, chemical industry, tea industry etc. Based on the application the sensing element gets varied.

The main objective of this work is to analyse the complicated component of tea samples and to find the tannin component by using the pH sensor. The tastiness can be determined by pH value.

II. LITERATURE SURVEY

J.K. Lorenz et.al [2009], stated that E-Tongue data was compared to existing data from a human taste panel. They have compared active pharmaceutical ingredient against placebo. Effective clustering is obtained [8]. K.Beullans [2007], stated that HPLC and GC shows serious drawback and ASTREE E-Tongue by Alpha MOS was used to determine the different tastiness parameters which is expensive [11].

Attribute	**Reference components**
Sweetness	Fructose
Sourness	Citric acid
Saltiness	Na-Cl
Umami	Mono-na-glutamate

Nirmala Halligudi et.al [2012], stated that the components of tea are composed and Ph sensor was used to measure the caffeine content in tea. Tea powder mixed with distilled water [2].

TEA SAMPLES	**CAFFEINE CONTENT/10g of tea**
Tata	.34g
Twinning	.27g
Lipton	.47g
Red label	.39g
Mumtaz	.41g
Kanan devan	.57g

III. MATERIALS AND METHODS

A. *Materials collected*

There are different tea samples in India and 10 tea samples are collected from commercial market they are Akbar tea, lemon tea, tulsi tea, 3Roses, AVT, Chakra gold, Tetley tea, Himalaya, Nestea and Red Label. The sample is to be prepared in equal concentration of solute and solvent. A measuring cup with reading scale with the measurement of 2.5ml, 5 ml and 10 ml is taken. The tea sample is taken upto 5 ml and poured into test tube. The distilled water of 30 ml is added with the measured tea samples to dilute it. Now the sample is prepared by mixing the tea sample and distilled water. For data acquisition process the LABVIEW software with DAQ card is needed.

pH sensor is used to determine the pH values of tannin component which is present in tea. The pH of a solution indicates how acidic or basic (alkaline) it is. Any one sensor can be used to determine the tannin content.

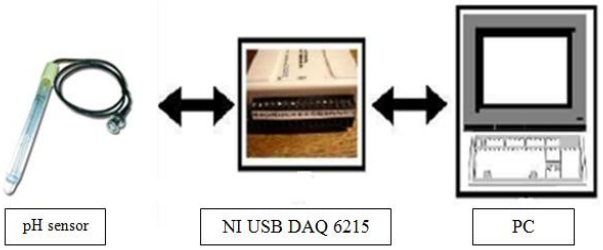

Fig: Measurement setup

B. *Instruments and software*

1. *USB DAQ-6215*

Fig: USB DAQ 6215(Adapted from NI)

The NI USB 6215 is a bus powered isolated USB M Series multi function DAQ module optimized for better-quality accuracy at fast sampling rate. It offers 16 analog inputs; 250kS/s single channel sampling rate; 2 analog output; 4 digital input lines; 4 digital output lines;4 programmable input ranges per channel; digital triggering and two counter/ timers. For improved accuracy and safety 60V CAT 1 isolation is provided.

The features of NI signal streaming technology gives high streaming of data. The DAQ provides basic functions and can take measurements in minutes. Plug and play installation is used for quick setup time.

2. *Software*

The final component of a complete Data Acquisition System is the software. The different levels of DAQ software that are used to program the DAQ device is available. The three levels are NI-DAQ, Measurement & Automation Explorer (MAX), and LabVIEW.

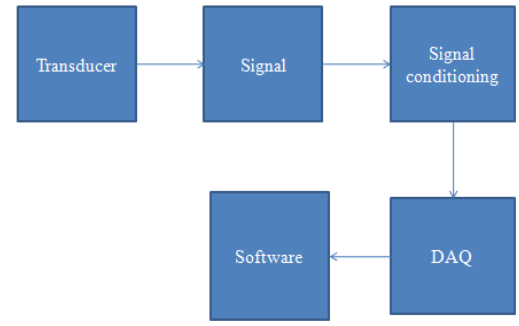

Fig: Block Diagram of DAQ

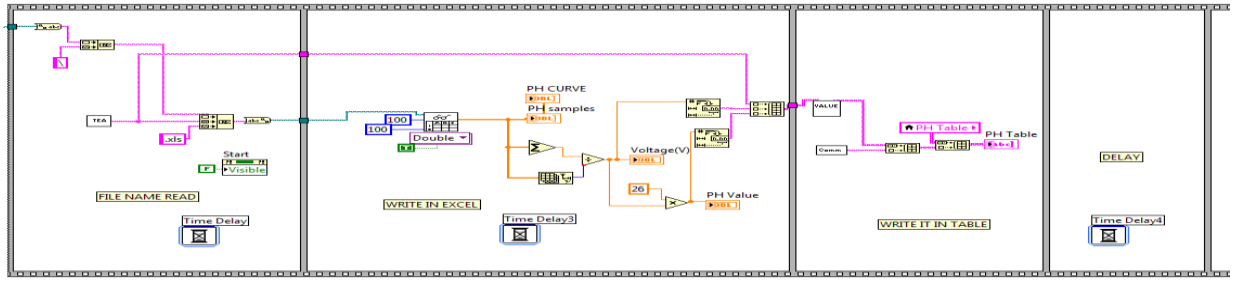

Fig: Block Diagram of LABVIEW

B. Procedure to analysis tannin content

1. The pH sensor is immersed into the solution prepared by diluting tea with distilled water.

2. The output of pH sensor is voltage fed through the physical channel of DAQ-USB card

3.The DAQ card comprises of amplifier and low pass filter to eliminate noise in physical measurement.

4.The physical channel in DAQ card should be chosen (ai0-ai1) to provide interface between the transducer(sensor) and the software(LABVIEW).

Fig: Analysis of tannin content

IV. RESULT AND DISCUSSION

For ten different samples the average value was determined and converted to pH value to measure the quality. The different tea sample voltage and pH value is found for the tannin component present in tea samples.

Highest pH value has mildly bitter taste in comparison with lowest pH values. The pH value and tannin content is plotted in the form of bar chart. The output of pH sensor is converted to pH value which is the plot between samples and pH value.

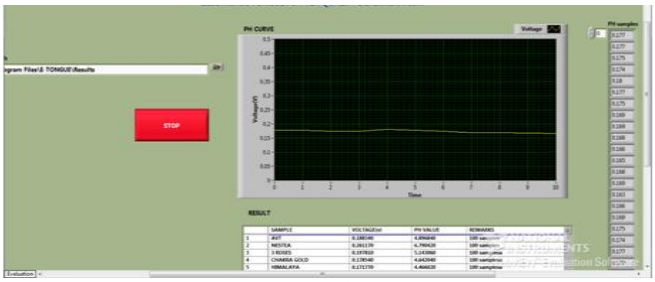

Fig: Front Panel of LABVIEW

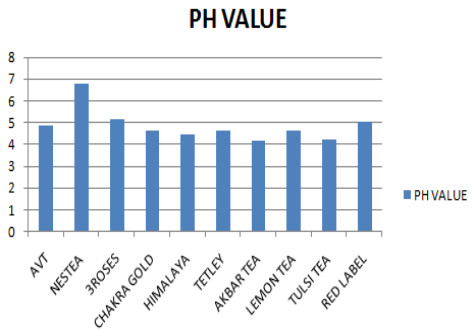

Fig: pH value of ten different samples

The result showed that Nestea has the highest pH values and tulsi tea has the lowest pH value. All other tea values fall between pH value of 4.4 to 5.1.

With regard to the taste of the product Tulsi tea has the very bitter taste and Nestea has the mildly bitter taste. By the values of pH the taste can be clustered.

Table: Tannin content present in tea samples

	SAMPLE	VOLTAGE(v)	PH VALUE
1	AVT	0.188340	4.896840
2	NESTEA	0.261170	6.790420
3	3 ROSES	0.197810	5.143060
4	CHAKRA GOLD	0.178540	4.642040
5	HIMALAYA	0.171770	4.466020
6	TETLEY	0.177290	4.609540
7	AKBAR TEA	0.189130	4.917380
8	LEMON TEA	0.178950	4.652700
9	TULSI TEA	0.162040	4.213040
10	RED LABEL	0.193740	5.037240

CONCLUSION

The tastiness of Tea can be assessed by many chemical analytical tools which is processed along with pattern recognition. However, all of these methods mentioned above takes lot to time to compute. Tea appearances, including color and texture, are not only the influential attributes of visual information from consumers but also important references in tea quality evaluation. It would be useful to rapidly identify tea grade using computer vision. In this work, the determination of tastiness provides the easiest and inexpensive method to assess the quality of tea. By analysing for every component in Tea the exact calculations can be determined using LABVIEW.

In future, preprocessing and pattern recognition process can be undergone. The sensors are constructed into sensory array for each component so that the resolution and gain can be improved. While correlating the result of individual sensor output, the perfect quality of tea can be determined. Using Electronic Tongue, the thought of human being can be analysed. It mimics the human brain. Problems associated with human beings such as physiological or psychological factors can overcome. The variety of tea can be classified using pattern recognition like ANN, PCA etc.

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