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Lyco-Frequency: A Development of Lycopersicon Esculentum Fruit Classification for Tomato Catsup Production Using Frequency Sensing Effect

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ABSTRACT

This study deals with the construction of a device that uses Arduino to assist in the classification of tomatoes for catsup production. The method intends to identify the tomato that is ideally adapted for Ketchup production, for improved product consistency. Using Arduino, the device can sense tomato resistance and check whether the frequency resistance for Catsup tomato is below the threshold. The device should be able to determine from this method whether or not its better suited for Catsup production.

Key words : frequency sensing effect, fruit quality, tomato catsup, tomato classification.

1. INTRODUCTION

Tomatoes are among the most widely produced crops in the world [1]. To meet regulatory requirements and customer demands, many industries depend on color consistency and quality [2]. The systemic integration of color within our global industrial culture is more critical than ever [3]. The correct communication of color between manufacturing plants ensures consistency of the commodity, eliminates waste materials, and guarantees output from batch to batch [4]. Tomatoes produce two photosynthesis pigments-green chlorophyll and red lycopene [5]. Once tomatoes begin to mature, they produce much fewer lycopene than chlorophyll, giving them a green color [6]. Yet as harvest season begins, the days shorten and temperatures decrease, dissolving chlorophyll, and taking over the fruit shade by lycopene. At this process, sugar levels are increasing, acid levels are dropping and the tomato is softening. This is good to eat [7].

People with children will believe that catsup is the hidden ingredient for boosting young children's diets [8]. You can convince almost any picky little kid to try new foods with it. But this passion isn't confined to the teenage palate — just look at meals, bars, and quick food outlets around the nation [9]. Ketchup has rooted itself in American food, from uniquely developed packaged goods to commercially manufactured foil-lined packages [10].

Yet with high demand for condiment comes a production volume that demands strict quality control [11]. The dynamic existence of the industry has made it important for farmers to choose the right color management systems to guarantee that their fresh tomatoes are converted into good quality ketchup items [12]. With advanced image recognition spectrophotometry and tomato color processing, you can build a highly effective condiment production method, maintaining both quality and consistency [13].

Fruit processing industries manufacture a variety of fruit items such as Jam, Jelly, Water, Syrup, Sauce, and Starch [14]. In certain instances, the range of good fruit content depends on its maturing percentage or maturation index [15]. Simultaneously, the collection of high-quality fruits is rendered by a few expert employees [16]. Clearly, this manual operation is never 100% error-free. This, however, is usually overlooked. To overcome this issue, this paper shows the process of selecting tomato voltage values ranging from 4800 mV to 4929 mV which is classified as accepted for ketchup output, otherwise it is rejected. The whole procedure is connected with a completely automatic device powered by a microcontroller board based in Arduino.

This analysis is intended to determine whether the tomato is a better fit for producing Ketchup utilizing a device. It is built to help farmers have good tomato quality. The producers should ensure the Ketchup they make is of good quality. This research aims to determine whether the tomato is ideal for Ketchup production or not. The researchers have set a standard that will decide whether or not the color is inside the spectrum for good Ketchup. The analysis is restricted to Ketchup only, certain tomato applications, such as tomato paste or other sauces are not considered.

2. RELATED LITERATURE

Texture, color, and scale are essential criteria for the identification of the fruit product. The color recognition mechanism in ripeness detection is very necessary. Detection of ripeness is an external consideration of consistency. But the texture is quite essential as well. Defected fruit may be recognized because of the texture. Analysis of texture detects the non-uniformity of the outside fruit surface. Even size is an essential parameter. This feature is easily shown by all customers picking fruit depending on size [17].

Based on Y. Wang et al, developed a system [18] for Fruit quality inspection centered on the color of the fruit surface. This is non-destructive. Fruit image captured with phone, RGB picture transferred to HSI color standard. Image segmentation is based on the meaning of the color, the different fruit, and the context. Histogram of Hue and Fruit surface color intensity is determined. Input is given as histogram, the output of Hue earlier, and surface color saturation of fruit from the network of backpropagation. Output as a summary of the consistency of the specified fruit checked. They performed a banana experiment and the result obtained is correct.

As [19] has suggested, they have established a fruit size measurement device. Both tests are determined depending on the analysis of the images. Measurement of edges, the measurement of fruit size, and the classification of fruit size. OSTU (maximum square error classes) is used for binary image processing. 8-connected boundary method is used for the edge sequence detection. Symmetry is considered for the detection of the diameter. Symmetry gives coordination of the center. The diameter of the line is determined dependent on the central point and main axis. Two edge points are scanned for the correct outcome. If the fruit is rotated so the diameter displayed is the same, then the actual fruit size showed the diameter. Then it is done based on the correct rating of the size.

According to the analysis of [20], the time required to examine growing fruit is a significant downside to manual fruit management, for both the farmer and the industry. Furthermore, based on research on human fatigue or error, diseased or unripe fruits/vegetables could reach the end of production. Also, this will result in low performing goods causing massive losses for the production business. [21]-[25] used the power of Arduino as microcontroller as their control system.

3. METHODOLOGY

The materials and methods used in this analysis are discussed in this section.

3.1 Dataset and Materials

Table 1: Dataset and Materials

Materials / Components	Description
Arduino	The Arduino Uno is a Board based on the ATmega328 (datasheet) microcontroller. It has 14 digital input / output pins (including 6 for PWM outputs) , 6 analog inputs, 16 MHz ceramic resonator, USB connection, power jack, ICSP header, and reset button.
Variable Resistor	It is a passive electrical element that is used as a current limiter in the Tomato under test in this experiment. For this study, a standard ceramic resistor based on 10 K ohm was utilized.
Tomato	Of the local vegetable market, 100 tomatoes are procured.
Dupoint Wires	In this study, a pair of copper wires (open head) are used as probes, and as a resistance medium.
16x2 LCD	This will be used to show whether the tomato is accepted or discarded for the production of ketchup.

The appropriate materials are (1) Arduino, (2) Resistor, (3) Tomatoes, (4) Potentiometer, and (5) LCD 16x2. Table I mentions the study's dataset and resources used.

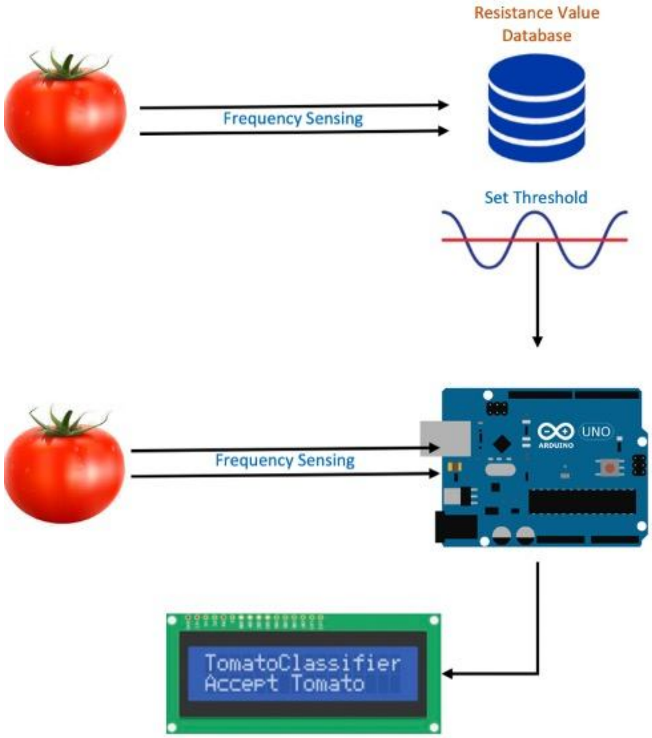

Figure 1: Methodology of Lyco-Frequency

As shown in Figure 1 the system input is the tomato resistance. The resistance value was obtained by pricking the tomato gently using Dupoint wire. The read value is interpreted via the Arduino to decide if the tomatoes are approved or rejected for Ketchup production. Through this method, the voltage value of the tomatoes was the output. The researchers were able to establish the threshold value of the tomatoes to be accepted or rejected from the compilation of multiple data on tomatoes. The accepted values ranged from 4800mV to 4920mV for the Tomato Ketchup production. Otherwise, Tomato Ketchup Production is declined.

3.2 Schematic and Prototype

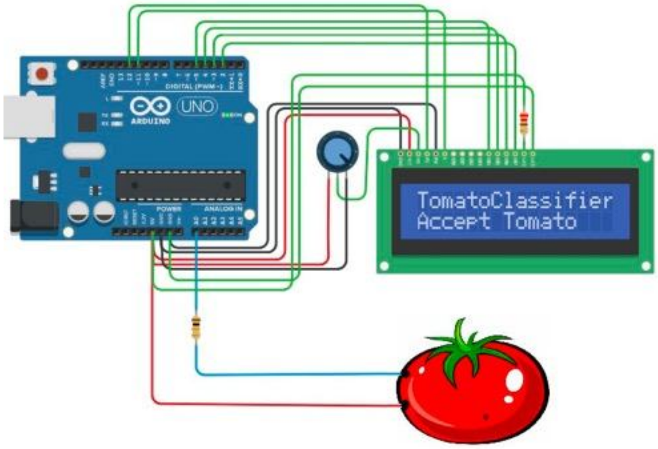

Figure 2: Lyco-Frequency Schematic Diagram

The actual prototype consists of an LCD to show tomato results if the tomato is perfect for ketchup, two 10 K resistors to measure tomato voltage, and Arduino Uno to process the data obtained from the resistors. Figures 2 and 3 display the corresponding schematics and prototypes.

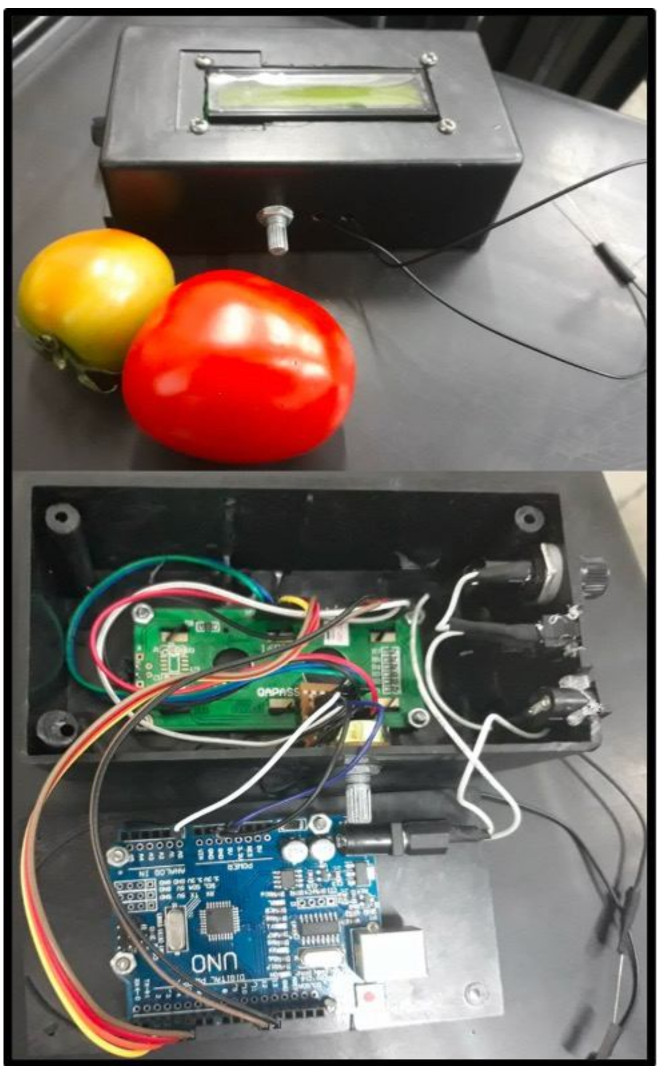

Figure 3: Lyco-Frequency Prototype

4. RESULTS AND DISCUSSIONS

Figure 4: Tomatoes

The result of accepted and refused tomatoes is set out in Table 2. From the table, it can be shown that only 18 were admitted out of the 100 tomatoes checked in Figures 4 and 5.

Table 2: Test Results

Test Case	Voltage (mV)	Classification	Test Case	Voltage (mV)	Classification
1	5000	Rejected	51	5000	Rejected
2	4821	Rejected	52	4885	Rejected
3	4993	Rejected	53	5000	Rejected
4	5000	Rejected	54	5000	Rejected
5	4888	Rejected	55	4963	Rejected
6	4875	Rejected	56	5000	Rejected
7	4910	Rejected	57	4992	Rejected
8	5000	Rejected	58	5000	Rejected
9	5000	Rejected	59	4880	Rejected
10	5000	Rejected	60	4980	Rejected
11	5000	Rejected	61	4920	Rejected
12	4966	Rejected	62	4880	Rejected
13	4887	Rejected	63	4800	Rejected
14	4932	Rejected	64	4990	Rejected
15	4909	Rejected	65	4999	Rejected
16	5000	Rejected	66	4963	Rejected
17	4820	Rejected	67	4988	Rejected
18	4933	Rejected	68	4977	Rejected
19	4946	Rejected	69	4962	Rejected
20	4940	Rejected	70	4964	Rejected
21	5000	Rejected	71	4931	Rejected
22	4946	Rejected	72	4933	Rejected
23	4960	Rejected	73	4930	Rejected
24	4990	Rejected	74	4988	Rejected
25	4887	Rejected	75	4987	Rejected
26	5000	Rejected	76	4856	Rejected
27	4946	Rejected	77	4939	Rejected
28	4950	Rejected	78	4930	Rejected
29	4980	Rejected	79	5000	Rejected
30	4946	Rejected	80	5000	Rejected
31	5000	Rejected	81	4965	Rejected
32	5000	Rejected	82	4994	Rejected

33	4800	Rejected	83	4957	Rejected
34	4924	Rejected	84	4994	Rejected
35	4854	Rejected	85	4974	Rejected
36	4968	Rejected	86	4936	Rejected
37	4989	Rejected	87	4978	Rejected
38	4978	Rejected	88	4999	Rejected
39	5000	Rejected	89	4923	Rejected
40	4999	Rejected	90	4929	Rejected
41	4852	Rejected	91	5000	Rejected
42	4960	Rejected	92	4924	Rejected
43	4896	Rejected	93	4987	Rejected
44	4892	Rejected	94	5000	Rejected
45	4953	Rejected	95	5000	Rejected
46	4991	Rejected	96	5000	Rejected
47	4886	Rejected	97	4954	Rejected
48	5000	Rejected	98	4990	Rejected
49	5000	Rejected	99	4956	Rejected
50	5000	Rejected	100	5000	Rejected

Figure 5: Sorted Tomatoes

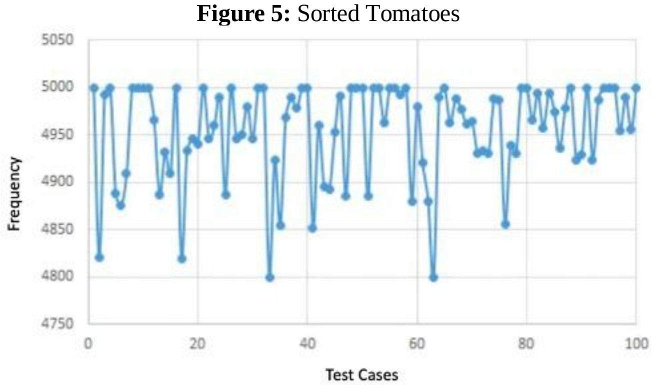

Figure 6: Tomatoes Frequency Values

This displays the various voltage values of the tomatoes in Figure 6 and indicates that out of 100 tests, most of their resistance varies from 4930 mV to 5000 mV.

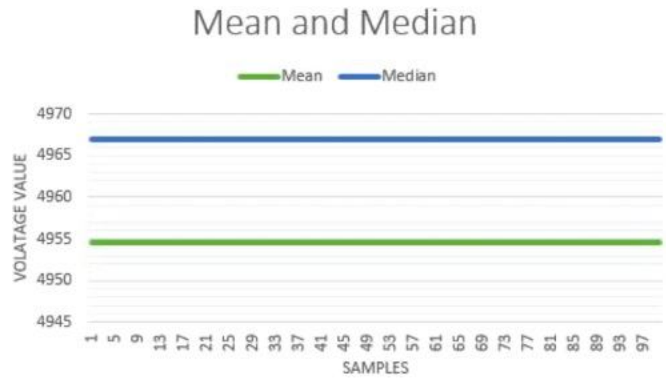

Figure 7: Tomatoes Frequency Mean - Median

The mean or average condensed the measured data into a single amount and the median is used to provide the data collection base. This appears in Figure 7 that the mean and the median are unequal, indicating the data is not symmetrical and is distorted.

Table 3: Statistics Results

Descriptive Statistics	
Mean	4954.64
Standard Error	5.098831714
Median	4967
Mode	5000
Standard Deviation	50.98831714
Sample Variance	2599.808485
Range	200
Minimum	4800
Maximum	5000
Count	100

Table 3 Descriptive Statistics contains the brief descriptive coefficients that summarize a specific collection of results, which may either represent the whole population or be a subset of it.

5. CONCLUSION

The paper identified a system for grading tomatoes in farms and markets, that is, better than manually sorting them with the naked eye. This method can have greater consistency in scoring or classifying whether the tomato is better for Ketchup production. From the data in Figure 6, green tomatoes have higher voltage while red tomatoes have low voltage at their highest intensity. The voltage value of a tomato ranges from 4800 mV to 5000 mV, as indicated in Figure 7. The study estimated the standard error of 5.0988 which implies the sample range is comparatively less distributed. The mean and median values are both 4954.64 and 4967, respectively. To conclude, the ones with the maximum strength of red that have low voltage values are the better fit for tomato ketchup.

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