

## Development of a Control Device for Monitoring Fruit Dimensions for the Practical Case of Orange Analysis

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### ABSTRACT

Every days in our daily activities are functions that need regulation laws of normativity specially in the food industries, where is necessary have specific regulations to the customers, being relevant to the commercial treatments between regions of the world or some countries. This scientific study was made to develop an electronic system with a low cost and basic electronic components to supports in the measurement operations to obtain orange with specific dimensions, because the customer of this agricultural industry evaluated, being interesting to reduce the orange that were taken off of the production for not have the specific dimensions of the law regulations of the customers. This investigation was made in 2022 in this agricultural industry that is installed in the Mexicali Valley, which is a zone of the northwest of Mexico that is neighbor with the California State of the United States of America (USA), which have a great commercial treatments with this state and the orange of this agricultural industry evaluated, presented strict specifications of the dimensions, and was to increase the productivity and quality indices.

**Keywords:** Electronic system; Agricultural industry; Productivity and quality induces.

### Introduction

The agricultural industry is an important type of industry in the worldwide, because in base of its activities in the ground and in the industrial operations of this type of industry, are necessarily make the continuous improvement for increase the productivity and quality indices (Miranda et al, 2019).

In this scientific study, the continuous improvement was made in accord to law regulations, which were controlled in base of the specifications of the customers and of the marketing process in the region of the northwest where is located the Mexicali Valley where was made this scientific study, and was installed this agricultural industry evaluated (Abbasi et al, 2021).

### Agricultural industry

This type of industry is considered that very important in the worldwide because is necessary to generates the food and beverages products, which are consumed by the vast majority of people, being fruits and vegetables the most common of the food products, as was evaluated the orange in this scientific study. The oranges that were stored in boxes, were strict specifications because were sending to the California State to were consumed by people of this region of the USA.

If these strict regulations not are good, the oranges are returned to the agricultural industry where was made the scientific study, representing economic losses to this industry, being considered as defective food product (Bhakta et al, 2019). Other relevant aspect in the agricultural industry is the variation of food products, or variation of dimensions of a same food product, where is necessarily have a methodology adequate or equipments of measure to have the food product correctly, as is illustrated in figure 1 (Lezoche et al, 2020).



**Figure 1.** Analysis of appearance of fruits and vegetables that are consumed in the California State

SOURCE: Analysis of investigation

### **Evaluation of nutritive factor in fruits and vegetables**

This aspect is necessary to the human health, where is evaluated constantly by experts in the nutrition thematic and is frequently recommended by health programs of the Mexican government health institutions, to avoid the occurrence as diseases as diabetes or cardiovascular symptoms as the most common health symptoms in the Mexican Republic (Mok et al, 2020). Also, other health aspects, are the nutritive compounds of fruits and vegetables to supports in the regulation of arterial pressure, senses as view and hear, especially, and also to reduce brain strokes and some type of cancer, and may be eye and digestive problems. By other way, some fruits and vegetables can be eaten raw and others must be cooked over low heat, or be used to salads and desserts, to have a rich diet in vitamins, proteins and antioxidants to conserve the good health of persons (Aceto et al, 2019).

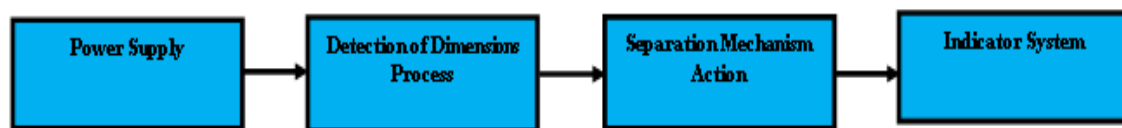
### **The nutritive properties of orange**

This rich fruit is very consumed in the world to reinforce the immunologic system and can avoid some health symptoms as respiratory diseases about the most occurrence of health symptoms in children's and old people, especially. The principal nutritive property is the C vitamin, which supports the immunologic system to avoid acute respiratory infections (ARI), being relevant also, the presence of minerals in the orange, with the average weight of 100 to 150 grams. The oranges are divided in two type of food products, as sweet and bitter flavor, where the most common is the sweet, called Valencian orange from Valencia, Spain and the other from the Persian region in the Middle East. On the other hand, a fruit from the group of oranges are mandarins, which are very consumed by people in the California State, and is very related with other fruits; being distinguished to be soft, loose, easy to peel and with sweet juicy flesh. Oranges, belonging to the citrus group, are described as an original structure (Valin et al, 2014).

### **Electronics systems used in the agricultural industry**

There are many electronic devices and systems utilized in the agricultural industry, being applied to count, control the process flow, detection of bad or inadequate agricultural products as fruit and vegetables and to reach the

productivity and quality indices, which all agricultural industries have in its programming plan of the production factor (Abbasi et al, 2021). In this investigation was utilized basic electronic devices to develop a small electronic system at low cost around 10 dollars, to be detected with a mechanism developed of wood, the dimensions of the oranges sold to markets of some cities of the California State of USA and detected the adequate or inadequate depending the dimensions (Idoje et al, 2021). This was made because before of this scientific study was sending orange with different dimensions and were returned to this agricultural industry where was made this investigation and was generated rework and with these originates economic losses. The electronic system elaboration by steps is showed in figures 2, 3 and 4, where was observed the forms to develop this automatized and small electronic device. Figure 2 shows the electronic system in a step diagram as is illustrated now (Schierhorn et al, 2017; Gacar et al, 2017).



**Figure 2.** Electronic detector of dimensions of oranges

SOURCE: Analysis of investigation

The assembly process of the mechanism consisted of several stages as shown below:

**Step 1:** The process of manufacturing the mechanism with wood begins and achieves the objective of having a base with an inclined slope of approximately  $60^\circ$  so that it circulates through three holes (Figure 4) where one of them indicates the appropriate dimensions and falls to a container. Before the oranges fall, a system with electrical cables detects the dimensions and, according to these, a signal is sent to a power supply indicator light (Figure 3).



**Figure 3.** Initial step of assembly of the mechanism and electronic systems

SOURCE: Analysis of investigation

**Step 2:** The manufacturing process of the three holes is developed to have the three types of levels where each orange will be detected to be sent to the containers according to each (Figure 4).



**Figure 4.** Manufacturing process of the three holes for detecting the dimensions of the oranges

SOURCE: Analysis of investigation

**Step 3:** Some evaluation tests were carried out to verify the operation of the mechanism in conjunction with the electronic system, as shown in figures 5 and 6.



**Figure 5.** Beginning of the tests causing the oranges to circulate through the mechanism

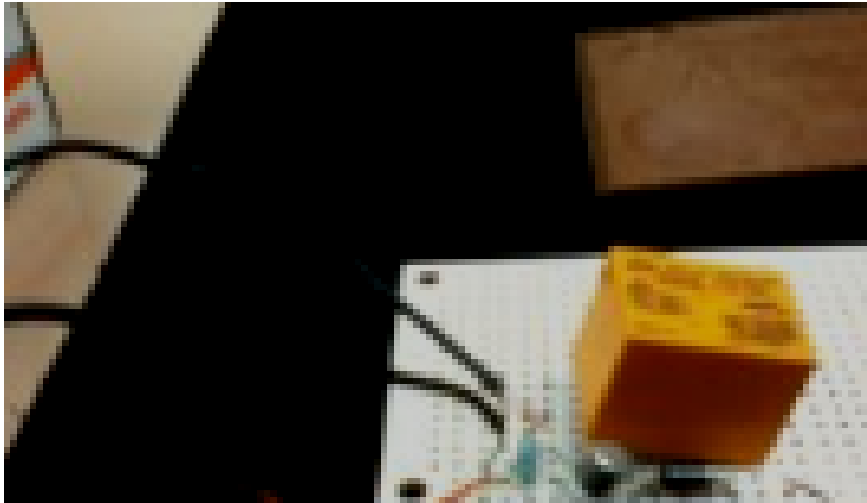
SOURCE: Analysis of investigation



**Figure 6.** Evaluation of the route of the oranges by the mechanism to know in which of the holes it will be located

SOURCE: Analysis of investigation

**Step 4:** The electronic detection system shows when the oranges contain the appropriate dimensions, being low cost and simple as shown in figure 7.



**Figure 7.** Electronic detection system and indicator of adequate dimensions of oranges

SOURCE: Analysis of investigation

### **Productivity and quality indices**

These relevant parameters are monitored in each industry because are the guide to determine if the production of any industry is good and go to good way (Liu et al, 2017). These factors are measured by directive and managers of the production and quality departments, being obtained by the programming and planning of the production based on the workers and industrial equipment and machinery efficiency, where is utilized as optimal functions to reach the goals proposed daily, and the efficiency of operative technicians as expert engineers and operative workers of the manufacturing areas (Da Silveira et al, 2021). Also, sometimes is necessary use the internal marketing to convince to operative workers of industrial process to make his industrial activities as an optimal function (Kyaw et al, 2017).

### **Methodology**

This investigation was made because, in the agricultural industry where was made this scientific study, was presented the productivity and quality indices, with low levels, because a lot oranges for the bad specifications as dimensions of the diameter and the buyers in the California State of the USA, not was in according with this. For this reason, was made this investigation in two steps as is mentioned now:

- (a) Evaluation of dimensions with the strict specifications of oranges and design and develop an electronic system to control this factor, evaluating its operative yielding.
- (b) Correlation analysis of the productivity and quality indices with the operative yielding of the electronic system to control the dimensions of oranges.

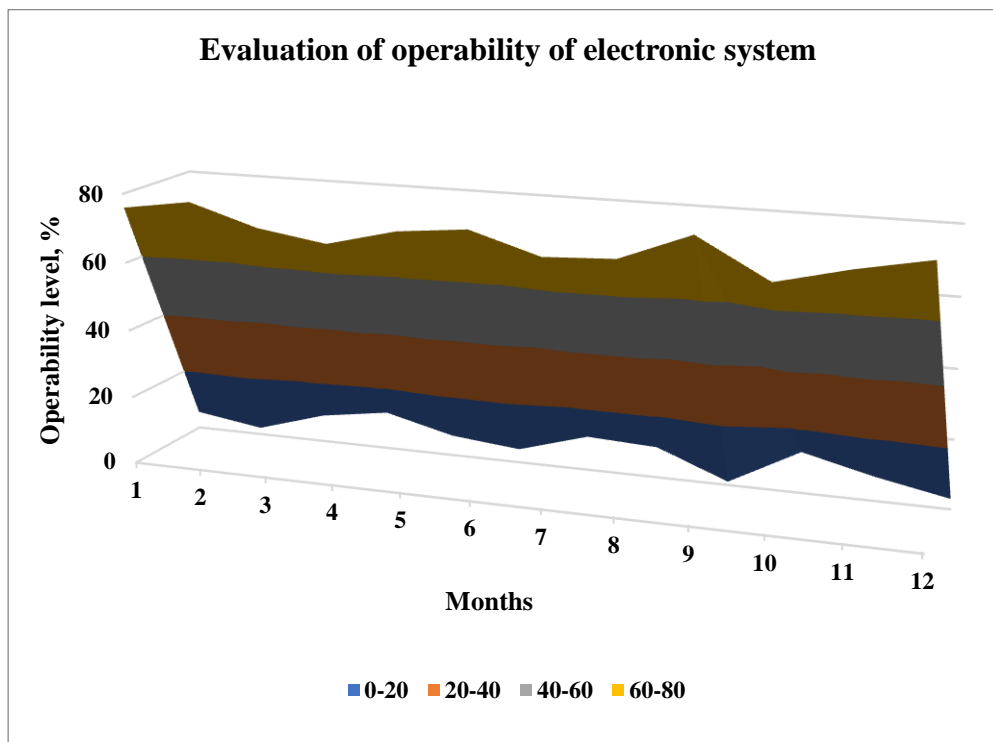
### **Results**

This scientific study was made to control the strict specifications of the buyers of oranges cropped and stored in the agricultural industry evaluated, and is located in the Mexicali Valley.

### Evaluation of operability of automatized system

This step of the scientific study was made to evaluate the form of was operating the electronic system designed and developed to this investigation, and was observed in figure 8, and where is presented by colors, being the light blue as the less percentage (0% to 20%) of the operation when was begin the operation in the first minutes when begin the application of this electronic system, because need adjust the mechanism and electronic systems to the dimensions of oranges.

Then adjusted, was better the function better, showing in figure 8 the ranges of 21% to 40% with the orange color, and followed by the gray color with 41% to 60% of the operative yielding and finally with 61% to 80%, and was illustrating the yellow color, being the best percentage of the operative yielding. Nothing electronic systems function to 100%.



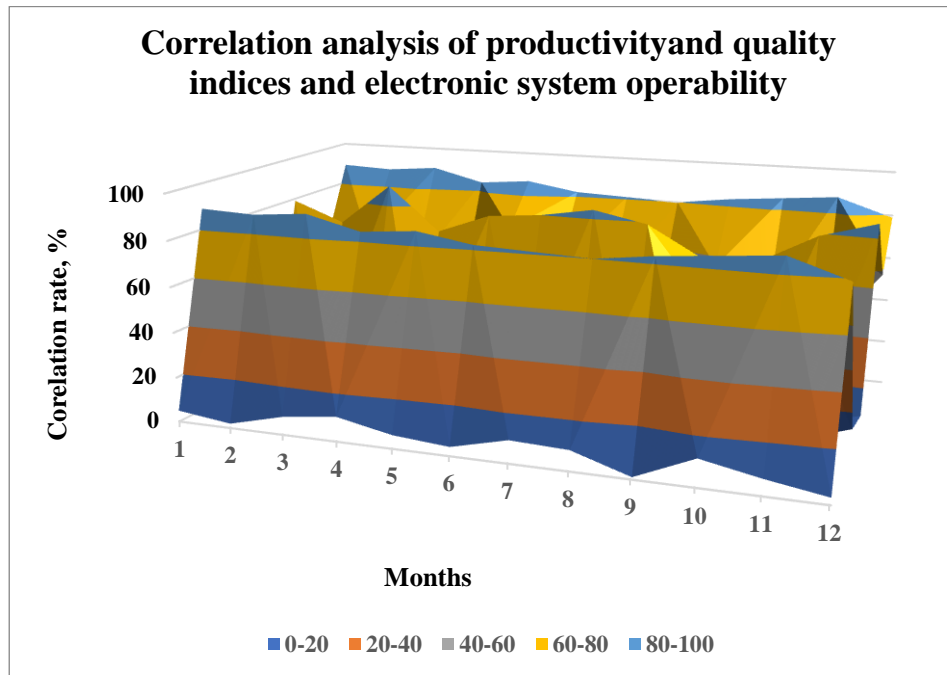
**Figure 8.** Evaluation of the operation yielding of the electronic detection system

### Correlation analysis of Productivity and quality levels and automatized systems

This step of the investigation was relevant to determine if the electronic system was operating as an adequate detector of the strict dimensions, where is showing in figure 9 the correlation rate of the productivity and quality indices with the operative yielding of the electronic system developed to this scientific study.

The first correlation rate percentage is the 0% to 205% with the light blue color, following with the orange color with 21% to 40%, indicating the process of the good relation between of the productivity and quality levels, and trying to reach the optimal correlation rate between both relevant factors.

Then was illustrated the gray color with the 41% to 60%, following of the yellow color with 61% to 80% and finally the dark blue color indicating the 81% to 100% of the correlation rate, as is showing in figure 9.



**Figure 9.** Correlation analysis of the productivity and quality indices with the operation yielding of the electronic detection system

### Conclusions

This scientific study was relevant because it solved a complicated situation that was presented in the agricultural industry where this investigation was made. The design and development of the new electronic systems to detect the strict dimensions of the oranges that were dropped and stored by the agricultural industry was made in this scientific study, being relevant to increase the productivity and quality indices. This is important because this mechanism adapted with the electronic systems can be applied in other agricultural products and agricultural industries or in other types of industry to control the dimensions of any manufactured product.

### Declarations

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#### Competing Interests Statement

The authors declare no competing financial, professional, or personal interests.

#### Consent for publication

The authors declare that they consented to the publication of this research work.

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