

# Experimental study on the automatic selection of olives

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**Abstract.** In this paper, we made an experimental stand designed to recognize and sort all three types of olives taking into consideration color (black and green), regardless of their dimensions. The stand is intended for small businesses, as it is well-known that in Greece most olive orchards are in the range of hundreds of square meters, or maximum in the 1-2-hectare range, and of the modern traditional type, as shown in other papers written by Babanatsas and Glavan [1-2]. Therefore, an inexpensive and efficient piece of equipment designed for this type of orchards is welcome.

## 1 Theoretical considerations

The olives are the fruit of the olive tree and are of several varieties, the most common being European Olea. Olives cannot be consumed directly from the tree because they are bitter but must be processed. The olives can be black, brown or green depending on the degree of maturity. So, the green ones are not ripe, the brown ones are at the beginning of the maturation period, and the black ones are ripe (mature) [2- 4].

Automated olive sorting systems are essential in today's economy that is based on quality and productivity. Automatic harvesting systems are increasingly used for olive harvesting. After harvesting it is good to make their selection (green and black) as soon as possible [3]. This must be done because olives continue to mature even after they have been harvested [5, 6]. To make the selection as soon as possible after harvesting we use an automatic sorting system. Modern sorting systems are based on the principle of image scanning, systems that are very expensive [7]. We propose color recognition systems because they are cheaper than the image scanning systems. This is how we develop an experimental prototype to help small entrepreneurs (such as most olive groves in Greece), namely to be as efficient and as cheap as possible.

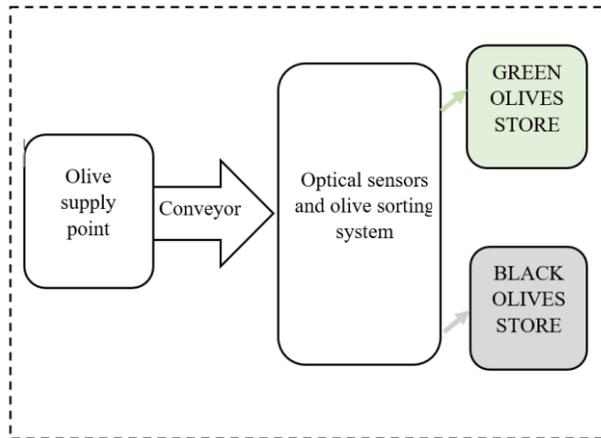
## 2 Methodology

To achieve this prototype, we have taken the hypothesis that we must sorting the olives, namely the black ones from the green ones.

That is why we create a prototype device that will automatically sorting olives. It is based on color recognition system and the schematic structure is presented in figure 1.

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**Fig. 1.** Schematic structure of automatic sorting olive system

The olives are transported from supply point to the pick-up device with a conveyor belt that are driven from electromagnetic brake motor. The optical sensor detecting the green and the black olives on the belt, then we use a pick system (push up hydraulic system).

We create this prototype system based on color sensors. One black sensor, by Keyence manufacturing, (figure 2) and one RGB digital fiber optic sensor, by Keyence manufacturing, (figure 3).



**Fig. 2.** Black sensor



**Fig. 3.** RGB sensor

We use a hydraulic pick up system (figure 4) and electro-magnetic motor (figure 5) with adjustable rotation speed up to 1500 rpm, because are very efficiency pick up objects and in transportations belt [8].



**Fig. 4.** Pick up dispositive



**Fig. 5.** Electrical motor

Other important parts are the control panel (figure 6) and the main board, (figure 7). With these parts we programming the reaction speed of pick up system and the rotation speed of transportation belt

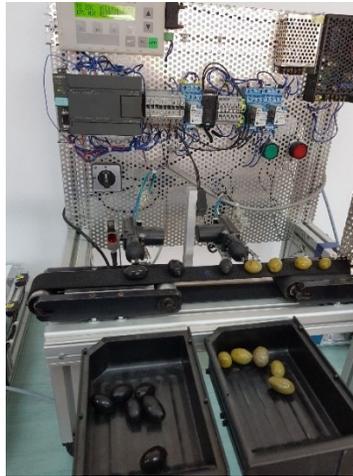


**Fig. 6.** Control panel



**Fig. 7** Main board

We assembled all the components on the panel, figure 8. Then we adjusted the work parameters, and we tested the accuracy of these parameters on green and black olives.



**Fig. 8.** The prototype olive selection dispositive

### 3 Results and discussions

To determine the accuracy of the olive recognition device, we tested a total of 100 black and green olives, the position on the conveyor belt was random and the displacement speed varied from 0.5 to 4 cm/sec.

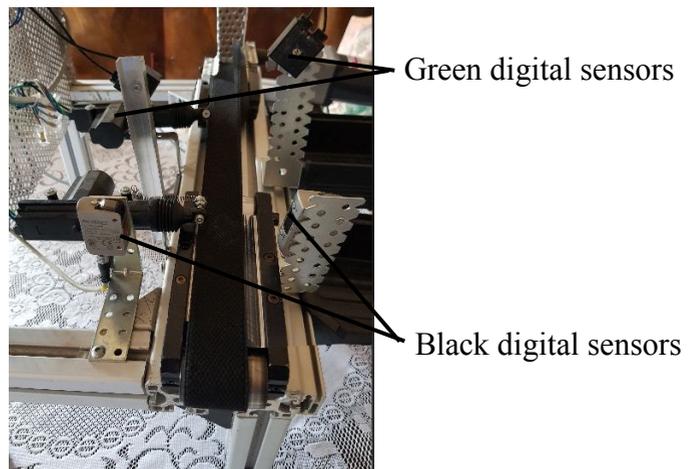
The experimental data, which shows the exactness of each condition, were centralized in Table 1.

We also need to keep track of the delay time between the time when the digital color sensor detects the olives and the moment when the pickup system pushes the olive into the collection box of the collected olives that is 0.2 seconds. At this point, we created the length between the point where the digital optical sensor detects the olive and the point where the lifting system is operating.

**Table 1.** Accuracy of olive recognition.

| Speed of displacement [cm/sec] | Accuracy on green olives [%] | Accuracy on black olives [%] |
|--------------------------------|------------------------------|------------------------------|
| 0.5                            | 100                          | 99                           |
| 1                              | 98                           | 97                           |
| 1.5                            | 93                           | 92                           |
| 2                              | 86                           | 87                           |
| 3                              | 83                           | 83                           |
| 4                              | 80                           | 79                           |

Because the results of this experiment were not satisfactory at high speed. Then we mounted, on the opposite side, another set of sensors (two green optical sensor and two black sensor), figure 9.



**Fig. 9.** The prototype olive selection dispositive with dual sensors

We repeat the experiment and now we have increased the accuracy of olive recognition, table 2.

**Table 2.** Accuracy of olive recognition with dual sensors.

| Speed of displacement [cm/sec] | Accuracy on green olives [%] | Accuracy on black olives [%] |
|--------------------------------|------------------------------|------------------------------|
| 0.5                            | 100                          | 100                          |
| 1                              | 100                          | 100                          |
| 1.5                            | 100                          | 100                          |
| 2                              | 99                           | 100                          |
| 3                              | 100                          | 99                           |
| 4                              | 100                          | 99                           |

We proved when we using a dual sensors we have increased the accuracy of olive recognition.

## 4 Conclusions

Creating an automatic sorting system for olives is essential. With this system, we can increase the productivity and quality of finished products, mainly olive oil [8]. It is known that the aromatic characteristics of olive oil depend mainly on the maturity status of the olives, depending on their color. Green olives contain a large number of aromatic ingredients with a strong fruit taste, just like the Koroneiki and Athinolia varieties [9, 10]. On the contrary, as the olives mature, the number of flavoring elements decreases. Olive oil derived from violets and black olives has a softer flavor and a finer smell [11].

With this system, we can make an automatic selection between black and green olives. The device did not perform well when we installed a green color sensor and one for the black color of the olives. To increase accuracy, we mounted on the opposite side at each sensor, another pair of sensors, as we show in figure 8, in this case our test indicates the highest accuracy of our test.

By doing this, we have achieved two important things. One increased the accuracy of healthy lives. Also, we raised the color reading surface to the olives, fixing the sensors on opposite sides. The result indicates that when the transport speed is slow, there are no detection errors, no matter the number of sensors. Also, if the speed is high, the use of a more significant number of sensors increases the accuracy of the selection of the olives.

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