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Design and implementation of a colorimeter for the classification of fabric by tonality in its final manufacturing process

Diseño e implementación de colorímetro para la clasificación de tela por tonalidad en su proceso final de fabricación

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Abstract

The color tones in textile fabrics vary slightly affecting makers of clothing, since they can cause clothing with slight color variations. The proposal of this project is to design and build a portable device able to estimate the color of the tones of the fabric colors, with the aim of reducing waste, minimizing costs and increasing quantity. The device is made in Arduino environment and processed in Matlab, it is able to take readings of different elements forming groups "clusters" with consistent patterns. In the phase of implementation textile fabrics were used. The device developed identifies compatibility margins of the elements by his color, Finding the Right Features for the correct garment manufacturing process.

Colimeter, Textile Industry, Functions Grouping (Clustering)

Resumen

Las tonalidades de los colores de los tejidos varían ligeramente afectando a los fabricantes de ropa, ya que pueden provocar prendas con ligeras variaciones de color. La propuesta de este proyecto es diseñar y construir un dispositivo portátil capaz de estimar el color de los tonos de los colores de la tela, con el objetivo de reducir los residuos, minimizar los costos y aumentar la cantidad. El dispositivo está realizado en entorno Arduino y procesado en Matlab, es capaz de tomar lecturas de diferentes elementos formando grupos "clusters" con patrones consistentes. En la fase de implementación se utilizaron tejidos textiles. El dispositivo desarrollado identifica los márgenes de compatibilidad de los elementos por su color, encontrando las características adecuadas para el correcto proceso de fabricación de la prenda.

Colímetro, Industria Textil, Agrupación de Funciones (Clustering)

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Introduction

As Dr. Patlán (2010) mentions, since clothing is a high consumption product, the textile industry occupies an important place in the economy, because it is a dynamic and relevant activity, which generates jobs and activates the economy.

However, the textile industry is one of the most controversial sectors since the formation of national and international trade agreements due to breaches of labor and salary conditions. In addition, it is a trade that is mainly integrated by micro and small manufacturing companies from private homes, workshops, manufacturing facilities to large companies.

Dr. Patalán also mentions that despite having a significant demand for its products, this industry competes with imports of goods from other countries. Although the garments do not meet customer specifications, sometimes unfair competition occurs. for the low prices.

Rhys (2012) discusses the environment and industry in Mexico, trends and business regulation, and in particular how Mexican industries have generated great progress in recent years, thanks to the implementation of technologies that favor the production process.

Rhys presents the main problems that can be eliminated to improve product quality, generating higher income for the sector, minimizing the amount of imported merchandise and facilitating industrial processes. It is a fact of the need to modernize technology in the textile industry, generating jobs, income, and increasing customer satisfaction.

Throughout history, color has acquired a very important role in people's taste, comfort, and mood. Begoña (2016) affirms the importance of color appropriation in the emotional sphere in order to generate brand value. that is why the fashion industry has evolved significantly in obtaining the desired colors with respect to the required color.

This condition is no different for the textile industry where it is continually required to obtain versatile shades for seasons of the year, short periods of time or occasional. Generating a latent problem since it is not always possible to obtain the requested tonality.

For this reason, various methods have emerged to dye fabrics, which are used according to the components of each type of fabric, cost of the process and demand. A bad dyeing can be perceived in the aspects that Lockuán (2012) states "The textile industry and its quality control".

One of the main characteristics that is required when subjecting a fabric to a dyeing process is that it does not lose its natural properties in the face of complex agents, as described by Sánchez (2013), which can cause important problems in the dyeing process, such as the formation of of soluble compounds and stable complexes, causing an uneven coloration.

This type of color inequality is often not noticeable during the process of monitoring compliance with the required quality standards, and they are packaged and shipped with these defects.

J. Díaz (2013) argues aboutthe main problem faced by the garment maquila industry is having a diversity of shades with which they are supplied by the suppliers of textile rolls.

The need for industries to make their industrial processes more efficient has led them to improve their production processes, which is why the need in the textile industries to have a portable device with the qualities of identifying similar color patterns in the rolls for the realization of uniform clothing.

The main objective of the work is to design and build a device that classifies the shades of fabrics in their final manufacturing process, to eliminate waste and rework in the production of garments, and the specific objectives are basically two:

– Reduce fabric waste, as well as time lost in the garment manufacturing process.

– Increase customer satisfaction in quality, time, cost and presentation of the product.

This work addresses the problem generated by the variety of shades obtained in the manufacture of fabrics, this situation hinders the production processes of garments, as shown in figure 1.

Figure 1 Difference in shades of the same batch of fabric manufacturing pants, courtesy of Bonpros SA de CV

Autonomous color selection system.

The development of an autonomous system of color selection will help to classify the tonality in the fabrics, for the packaging and delivery of rolls according to the specifications of the client.

Given the growth and scientific and technological development as mentionedA. Garcia Higuera(2005) in recent decades there have been important advances in the field of automation of production processes due in large part to the implementation of controls that systematize the work, so today it is not usual to omit automation in industry to increase product quality, reduce production times, perform complex tasks, reduce scrap or defective parts, and especially increase profitability.

In the same way, automatic systems are widely used thanks to the great benefit they provide for problem solving, in addition to being implemented in the automation of small and large-scale engineering.

Color, as stated by A. Valero (2013), is the result of an interaction with the reflection of light between an object and the human eye, predominantly red, green and blue known as primary colors and are the basis of space. of the RGB color.

Next, we explain the operation of the components that make up the circuit of the autonomous color selection system, as well as the programming contained in the Arduino board that helps monitor the tests on the different test fabrics.

The diagram that makes up the connections of the Autonomous Color Selection System.

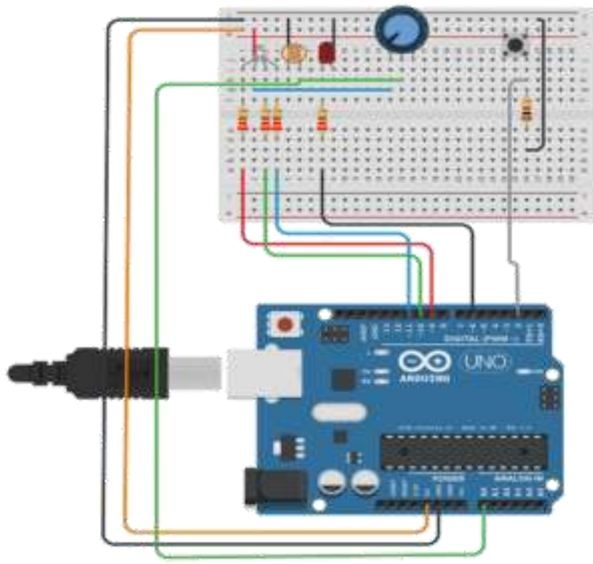

Figure 2 Arduino board interface connected to circuit components

The diagram in figure 1 consists of an RGB LED which emits Red, Green and Blue light at intervals of half a second and the photoresistor absorbs the saturation of each reflected color to identify the RGB pattern of the fabric.

Figure 3 System controlled with a potentiometer.

Figure 3 shows the potentiometer which has the purpose of adjusting the intensity of the RGB LED according to the light absorption of each fabric.

For the final design, it was decided to place the card and the electronic components inside a portable package, exposing the elements that help carry out its application, such as the sample collection section, the push-button that sends the signal , the input of the Arduino card and the sensitivity graduation of the potentiometer (see figure 4).

Figure 4 Final structure of the autonomous color selection system.

After several tests, it was identified that the correct way to carry out the test is through a dark surface with the least amount of reflecting light, with a little softness to adapt to the pressure of the device and thus avoid the entry of light, such as is shown in figure 5.

Figure 5 Correct way to make a sample of tonality in a fabric

Results

The fabric used to carry out the samples is composed of 65% polyester and 35% cotton, made with the corresponding weaving, dyeing, ironing and finishing processes. This type of fabric was selected because, due to its cross weave, this fabric is very resistant, has a soft, light, thin and versatile texture, which makes it one of the most used for the manufacture of clothing such as pants and trousers skirts.

To test the system, four colors of fabric were used that were taken from different rolls and thus be able to check the tonality of the fabrics.

Figure 5 Color samples to analyze

The colors selected to analyze the compatibility of the shades are Beige, Navy Blue, Bottle Green and Wine Color, the cases are shown in figure 5.

It is important to mention that all the samples come from different rolls from the same supplier and that the identification of the color tone before the cutting process allows identifying compatible fabrics for the manufacture of garments with the most uniform color tones possible. Using the device described, the measurements of the different shades of each color were taken, which are shown in table 1.

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Tone	Red	Green	Blue
Beige			
T1	110.9	127.75	160.4
T2	110.75	127.32	160.3
T3	111.25	126.9	159.25
Navy colour			
T1	147.75	170.75	198.5
T2	148.65	173.5	200.5
T3	148.65	173.5	200.9
T4	149.5	172.9	200,825
T5	149.75	174.57	202
bottle green color			
T1	147	164	197
T2	145.9	162.5	196.07
T3	144.75	159.32	193.65
T4	145.15	161	194.4
T5	144.75	160	193.4
Wine color			
T1	139.25	172.25	202.5
T2	136.5	170.75	202
T3	138.25	172	202.07
T4	138.5	172.75	203.15

Table 1 Result of RGB Hues of the color samples.

Table 1 shows the RGB colors of each fabric where it can be seen that despite coming from the same batch of fabric there are small differences between each of the rolls, which is why it is very important to identify the compatible rolls beforehand. of the cutting process.

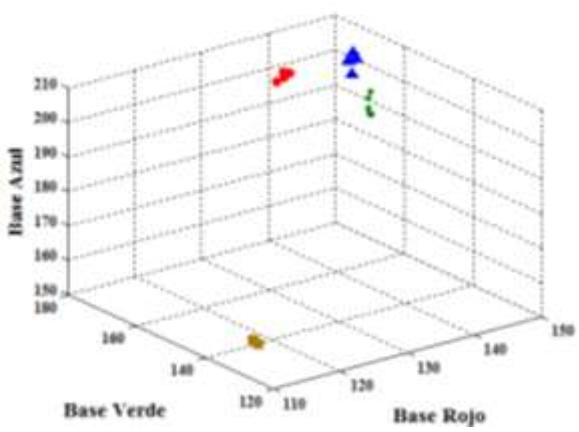
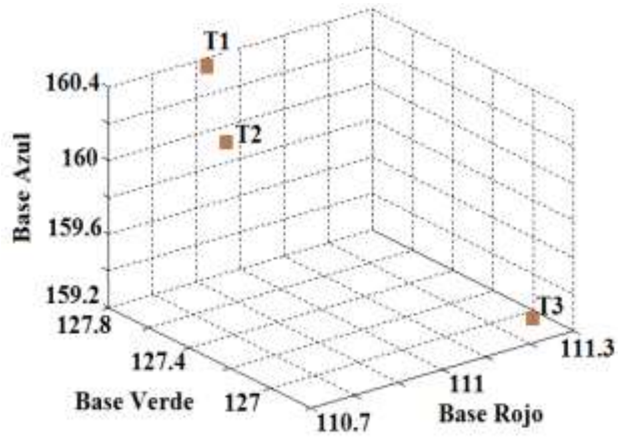


Figure 1 Samples in RGB space defined for all samples identified by their color

To facilitate the interpretation of table 1, the three-dimensional RGB representation was used, as shown in graph 1, where we can see that each color is grouped into well-defined regions, with Beige being the furthest away from the others. To carry out a better study, each batch of color is analyzed separately.



Graph 2 Samples in RGB space for the color Beige

Graph 2 indicates that shades 1 and 2 show greater similarity, while shade 3 is further away and the variation between the equivalent shades is mainly in the green color. Therefore, to ensure correct quality, only combinations between the fabrics of rolls 1 and 2 are allowed.

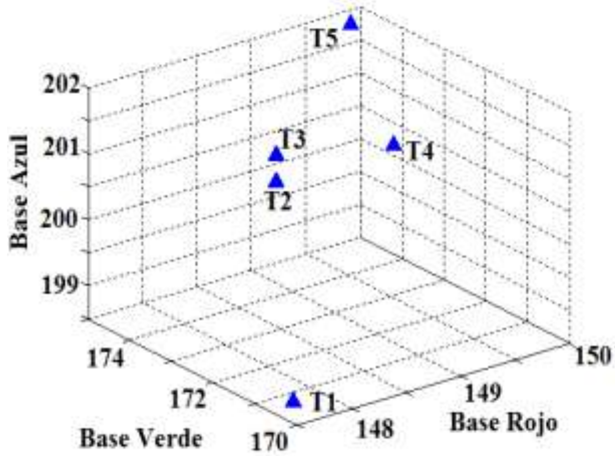
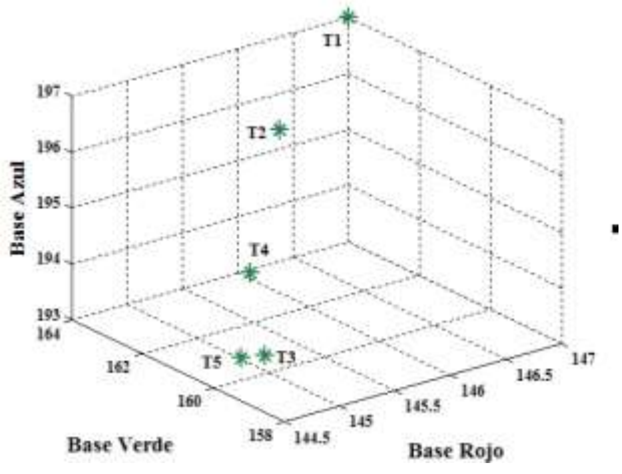


Chart 3 Samples in RGB space for the color Navy Blue.

For the Navy Blue color, it is observed that tones 2 and 3 are very similar, tone 4 is close to them, and tones 1 and 5 are the ones that present the most differences, the same effect occurs when observing table 1. Under this study we can conclude that it is possible to mix fabrics from rolls 2, 3 and 4 and 5 and roll 1 should not be mixed (see graph 3).



Graph 4 Swatches in RGB space for the color Bottle Green

According to graph 4, it can be seen that shades 3 and 5 show greater similarity, while shades 1, 2 and 4 are more different. We can conclude that the only possible combinations to ensure adequate quality are between rolls 3, 4 and 5 and between rolls 1 and 2.

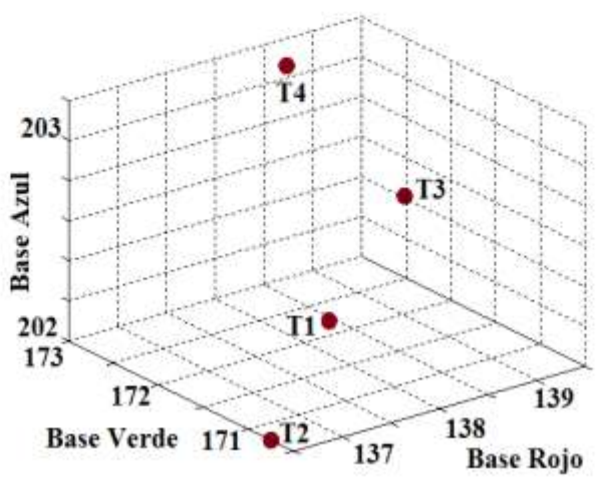


Chart 5 Samples in RGB space for the color wine

For the last case, it indicates that none of the samples show similarity between them. In the table of values it is observed that the numbers are very different from each other. Therefore, combinations between fabrics are not allowed.

After several studies, it was possible to conclude that to preserve the quality of the manufactured garments, the fabrics to be combined should not vary in a color between plus-minus between 1 value in any of the RGB primary colors.

Conclusions

It was possible to develop a prototype that reliably indicates the RGB colors of fabrics for the manufacture of clothing.

It was found that, in order to achieve color homogeneity in the manufacture of the fabric, in the RGB spectrum it must comply with The base color should not vary more than 1 With the application of the device, sales will be increased with quality products and processes will be streamlined for maquiladoras.

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