Development of A Resistance Colour Codes Interpreter and Finder Application

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Abstract- ***This paper presents the design and development of a resistor colour code calculator and interpreter application, with Graphical User Interface (GUI) for easy identification of resistors by their colour codes, and also for finding colour codes of various resistances. A resistor is an electronics component that opposes the flow of current in a circuit. Resistors are one of the most common electronics components in use today. They are found in virtually all electronic devices and gadgets. Overtime, colour codes have been used to indicate resistances of resistors, and charts have been designed to help in the interpretation of these colour codes. In the electronic age, it has become necessary to have a way of easily identifying resistors by their colour codes, without necessarily having an exposure to the theory of resistor colour codes. This will make resistor identification easy and accessible to everyone. To this end, there is a need to develop an application (for desktop and smartphone) that will make this process a stress-free one, even to the layman. The design of the application presented in this paper was archived using Python programming language, and its Tkinter GUI library. Results of this application were accurate when compared to the conventional resistor colour codin techniques. This offline application will go a long way in saving the time lost in searching for solution on websites or from textbooks, and assure accuracy of results.***

Indexed Terms- ***Colour codes, Graphical User Interface (GUI), Python, Resistor, Tkinter***

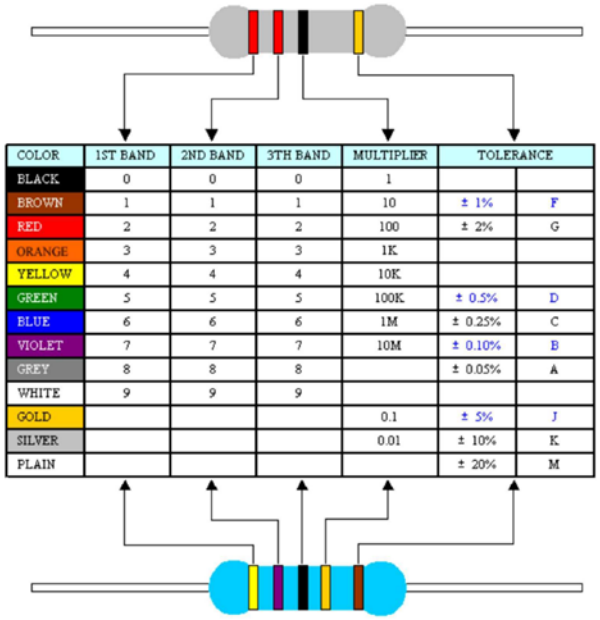
I. INTRODUCTION

A resistor is an electronic device that opposes (or resists) the flow of electric current in a circuit. Resistance is the opposition to current flow offered by a resistor in a circuit, measured in Ohms (Ω).

Resistors are commonly found in all electronic gadgets today, from televisions, radio sets, to music players, computer systems and even our phones. In virtually every electronic gadget today, one will find resistors of different specifications. Resistors are used to control current flow in electronics circuits by posing an opposition, called resistance, to the flow of electric current in a circuit, thereby regulating the flow of current in that circuit. A circuit is a path provided for the flow of electricity.

Colour codes have been used to indicate resistances of resistors, and charts have been designed to help in the interpretation of these colour codes. Resistor color coding system applies to carbon film resistors, metal oxide film resistors, fusible resistors, precision metal film resistors, and wire wound resistors (cylindrical with enlarged ends) of the axial lead type, and the power ratings of a colour coded resistor depend on the size of the resistor. This system was employed for resistors when the surface area was not sufficient to print the resistance value for the past time [1][2]. Practically, all leaded resistors with a power rating up to 1 watt are marked with colour bands. Together, they specify the resistance value, the tolerance, and sometimes the temperature coefficient and reliability of the resistor. Table 1 shows resistance colour-code chart for 4 and 5 band resistors.

Table 1: Resistance colour-code chart



COLOR	1ST BAND	2ND BAND	3TH BAND	MULTIPLIER	TOLERANCE	
BLACK	0	0	0	1		
BROWN	1	1	1	10	± 1%	F
RED	2	2	2	100	± 2%	G
ORANGE	3	3	3	1K		
YELLOW	4	4	4	10K		
GREEN	5	5	5	100K	± 0.5%	D
BLUE	6	6	6	1M	± 0.25%	C
VIOLET	7	7	7	10M	± 0.10%	B
GREY	8	8	8		± 0.05%	A
WHITE	9	9	9			
GOLD				0.1	± 5%	J
SILVER				0.01	± 10%	K
PLAIN					± 20%	M

According to a study carried out by Hassan [3], students find it difficult to memorize colour codes and determine the exact values of resistors as each colour has its own code interpretation. Mahizan et al. [4] also stated that students can not apply what they learn in practical work.

There is a need to have a resistance colour code calculator that will help to determine the value of resistors based on their colour codes, and to provide colour codes for different resistance values. In this research, a software application is developed to find the colour codes of resistors by clicking on buttons corresponding to the colours on the resistor, whether 3, 4, or 5 colour banded resistors. The application calculates and returns to the user the resistance value for the selected colour codes. The user can also enter a resistance value, and the application will calculate and return the colour codes for that resistance.

II. THEORETICAL FRAMEWORK

Table 2 shows the colour codes chart for the three and four colour-coded resistors, and table 3 shows the colour codes chart for the five colour-coded resistors.

Table 2: Colour codes chart for the three and four colour-coded resistors [5]

Colour	First Band	Second Band	Multiplier (Exponent)	Tolerance (for 4-colour code) (in %)
Black	0	0	1	-
Brown	1	1	10	-
Red	2	2	100	-
Orange	3	3	1000	-
Yellow	4	4	10000	-
Green	5	5	100000	-
Blue	6	6	1000000	-
Violet	7	7	10000000	-
Grey	8	8	100000000	-
White	9	9	1000000000	-
Gold			0.1	5
Silver			0.01	10
No colour (3-colour based)				20

Table 3: Colour codes chart for the five colour-coded resistors.

Colour	First Band (Digit)	Second Band (Digit)	Third Band (Digit)	Multiplier (Exponent)	Tolerance (in %)
Black	0	0	0	1	-
Brown	1	1	1	10	1
Red	2	2	2	100	2
Orange	3	3	3	1000	-
Yellow	4	4	4	10000	-
Green	5	5	5	100000	0.5
Blue	6	6	6	1000000	0.25

Violet	7	7	7	10000000	0.1
Grey	8	8	8	100000000	-
White	9	9	9	1000000000	-
Gold				0.1	5
Silver				0.01	10

III. SYSTEM DESIGN AND OPERATION

The application is designed to give users, whether technocrats or laymen, easy, convenient and stress-free access to resistor colour codes interpretation at their fingertips. The design has a graphical user interface (GUI) where users interact with the application by button-clicks. The GUI consists of various buttons, signifying the different colours used in the resistor colour coding. Users use the application to calculate resistance values by clicking on the respective colours that correspond to the colour codes on the resistor. The design covers resistors with three, four and five colour bands, giving it a very wide area of coverage.

The application consists of two major parts: resistor colour codes interpreter and the resistance colour codes calculator. With the colour codes interpreter, users can identify the resistance of resistors based on their colour codes, making the process a stress-free one, as users don't need to memorize the resistor colour codes chart. Just by button-clicks, users can get the resistance of resistors in no time. The second functionality of the application is the resistor colour codes calculator which accepts resistance values and converts it to the appropriate colour codes in three, four or five colour bands (as the case may be).

- Resistor Colour Codes Interpreter

This part of the application operates by accepting resistor colours from the user, interpreting these colour codes into resistance values, and displaying the results (selected colour codes and corresponding resistance value, including the tolerance) to the user's screen. The operations have been simplified to allow people from all works of life to use it with ease, without trading off precision and accuracy.

As stated earlier, this application interprets three, four and five colour bands, covering all of these colour codes specifications. Thus, there are five columns of colours for users to input (by simply clicking respective buttons) the colour codes. For five colour bands, users choose colours for the respective colours, and for four colou bands, users select "NC" (no colour) for the fifth column, and for three colour band, both fourth and fifth columns are to be "NC".

- Resistance Colour Codes Calculator

This part of the application accepts resistance values (in ohms) from the user, and evaluates the correct colour codes for that resistance value, taking into consideration the tolerance value.

With this application, resistors identification, calculation and sorting are made easy and stress-free, thus eliminating wrong replacement of resistors, which has led to severe damages on electronic gadgets and humans.

The application is designed using Python programming language, with the Tkinter Graphical User Interface (GUI). A screen capture of the application is shown in figure 1 below:

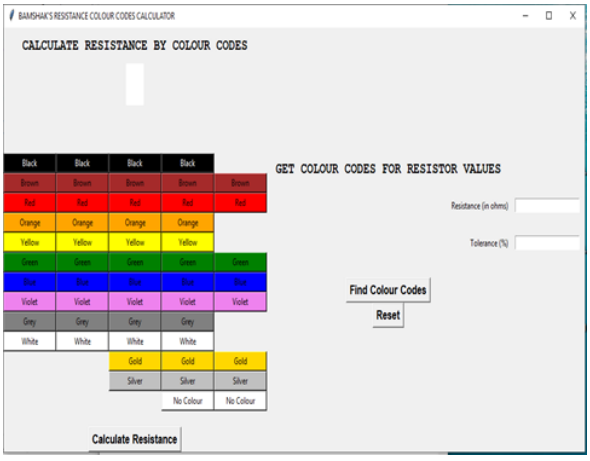


Figure 1: Screen capture of the application

IV. RESULTS

The application produced excellent results when tested. Screenshots of the results obtained are shown below:

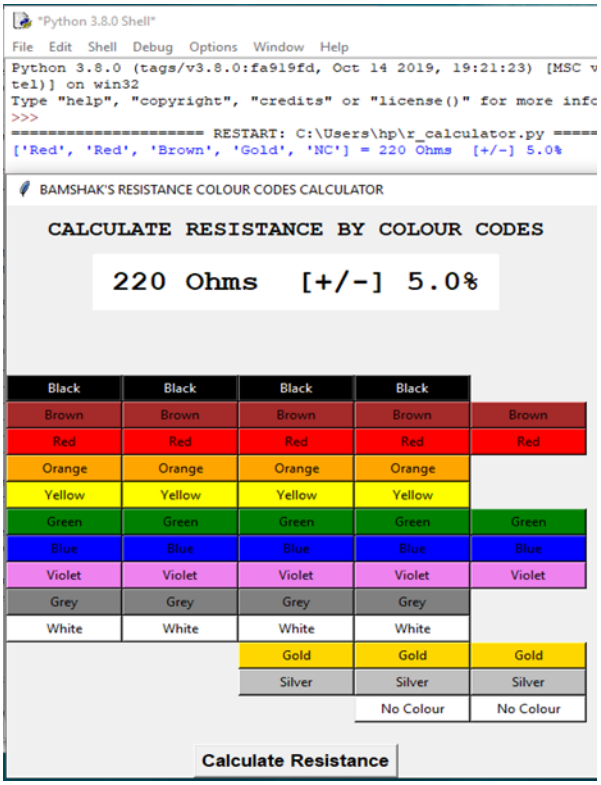


Figure 2: screen capture of results with four colours [Red, Red, Brown, Gold, NC]

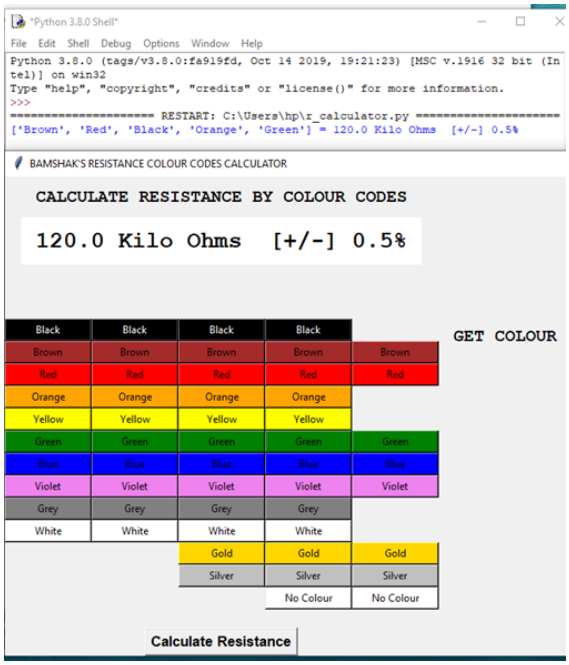


Figure 3: screen capture of results with five colours [Brown, Red, Black, Orange, Green]

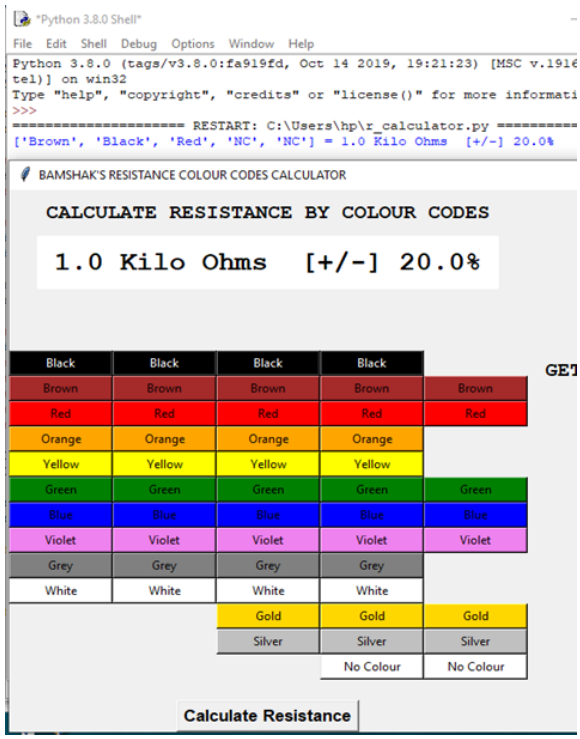


Figure 4: screen capture of results with three colours [Brown, Black, Red, NC, NC]

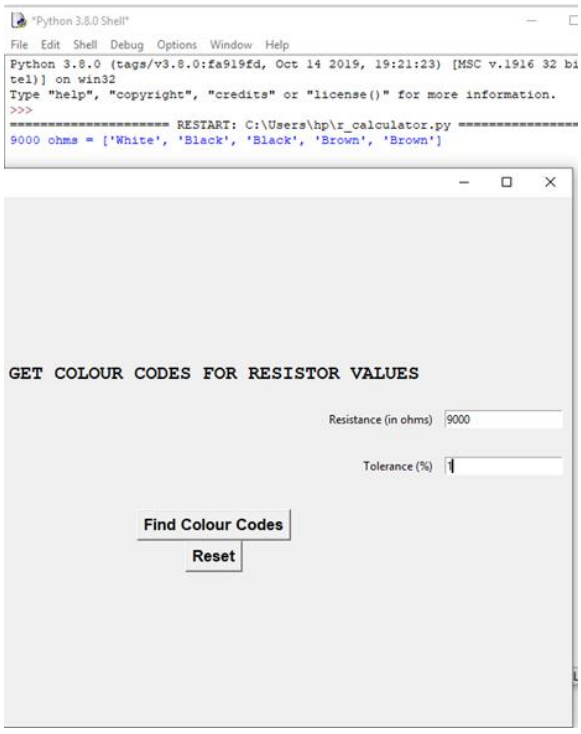


Figure 5: screen capture of colour codes calculator [9000 ohms resistor with 1% tolerance]

- Note – "NC" means 'no colour' – blank colour band

Figure 2 shows a screen capture of results for a resistor with colours [Red, Red, Brown, Gold] (four colour band), whose resistance the application analyzes (evaluates or calculates) to be 220 ohms with 5% tolerance. Figure 3 shows a screen capture of results for a resistor with colours [Brown, Red, Black, Orange, Green] (five colour band), whose resistance the application analyzes (evaluates or calculates) to be 120 kilo ohms with 0.5% tolerance. Figure 4 shows a screen capture of results for a resistor with colours [Brown, Black, Red] (three colour band), whose resistance the application analyzes (evaluates or calculates) to be 1 kilo ohms with 20% tolerance. conclusion. Figure 5 is the screen capture of the colour codes calculation operation (finding the colour codes of a 9000 ohms resistor with 1% tolerance).

CONCLUSION

Resistors are a key component of electronics today as they are found in every device. Being able to interpret resistor colour codes is key to working with resistors. This application has made the process of resistor identification (by colour codes and by values) an easy and a stress-free one. With this application, engineers, technicians and even the layman can easily identify resistors without needing to memorize resistor colour codes charts.

RECOMMENDATION

Owing to the accuracy of this application, it is recommended for use by engineers, technicians, craftsmen and the common street man for correctly identifying resistor values from colour codes, and also resistor colour codes for specified resistor values. Improvement should be made on this initial design to make it more user-friendly. Such improvements include: implementing computer vision (CV) and audio processing functionalities to enable users use pictures of resistors and/or voice prompts to get their resistances. A hardware implementation should also be developed for educational and personal uses.

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